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EDITORIAL

An approach to dark circles under the eyes

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Keywords: Infraorbital darkening, periorbital darkening, dark circles, eyes, treatment, therapy

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Who does not loath looking in the mirror after a long and sleepless night? Periorbital melanosis, popularly known as “dark circles” (DC) under the eyes, is a common and frustrating cosmetic grievance in both men and women, although in most cases it is not a sign of a severe medical condition[1,2]. DC is inevitably a sign of exhaustion, but anxiety seems to deteriorate facial appearance through the development of DC[3].

There has been little research dedicated to investigating the cause of this common disorder. The fact that various treatment modalities carried out in the past resulted in inconsistent outcomes shows that pinpointing the cause of DC is not exactly a walk in the park. There are multiple factors that cause DC in a majority of patients. Possible reasons include excessive pigmentation, along with thin and luminous lower eyelid skin overlying the orbicularis oculi muscle. As people grow older, the skin gets thinner and collagen fibers are lost, at times augmenting the advent of tiny blood vessels beneath the eyes, thus making the area seems darker. While lack of sleep and aging certainly play a role in under-eye discoloration, so do genetics, allergies, hormonal abnormalities, and accumulated skin damage[4,5].

Certain conditions such as fluid disproportion or locally swollen eyelids can also cause shades that make the area under the eyes seem darker. Some researchers also speculated that DC has a tendency to run in families. Brown circles could also form as a result of hyperpigmentation triggered by chronic eye-rubbing, sun exposure, or genetics. When there is no apparent cause, it could be due to termed idiopathic cutaneous hyperchromia of the orbital region (ICHOR)[6]. Numerous treatments have been used for this complaint with various results, including topical lightening creams, chemical peelings, lasers, and even fat injections. None of the treatments have proven to be uniformly effective and thus there is a need for newer approaches[7-9].

In spite of its prevalence and cosmetic importance, there are only a few reported works in literature regarding DC. A virtuous description of this condition is unavailable and there is neither an overall understanding about the pathogenesis nor an agreement about the main factors responsible for it. Treatment modalities are chosen in empirical ways, frequently resulting in suboptimal outcomes. It is important to identify the probable cause and choose appropriate treatment methods.

DC is less responsive to standard treatments due to its multifactorial etiology and the presence of melanin in skin layers. Nevertheless, even a mild-to-moderate improvement in appearance can enhance the quality of life of patients; hence topical therapies and simple physical therapies can be used to treat patients seeking to improve the cosmetic appearance of their eyes[10]. Instead of fighting an uphill battle against the genes, one can also turn to corrective coloring makeup.

Conflict of interest

The author declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

References

1. West TB, Alister TS. Improvement of infraorbital hyperpigmentation following carbon dioxide laser resurfacing. Dermatol Surg 1998; 24(6): 615–616. doi: 10.1111/j.1524-4725.1998.tb04216.x.
2. Sheth PB, Shah HA, Dave JN. Periorbital hyperpigmentation: A study of its prevalence, common causative factors and its association with personal habits and other disorders. Indian J Dermatol 2014; 59(2): 151–157. doi: 10.4103/0019-5154.127675.
3. Roberts WE. Periorbital hyperpigmentation: Review of etiology, medical evaluation, and aesthetic treatment. J Drugs Dermatol 2014; 13(4): 472–482.
4. Freitag FM, Cestari TF. What causes dark circles under the eyes? J Cosmet Dermatol 2007; 6(3): 211–215. doi: 10.1111/j.1473-2165.2007.00324.x.
5. Verschoore M, Gupta S, Sharma VK, Ortonne JP. Determination of melanin and haemoglobin in the skin of idiopathic cutaneous hyperchromia of the orbital region (ICHOR): A study of Indian patients. J Cutan Aesthet Surg 2012; 5(3): 176–182. doi: 10.4103/0974-2077.101371.
6. Huang YL, Chang SL, Ma L, Lee MC, Hu S. Clinical analysis and classification of dark eye circle. Int J Dermatol 2014; 53(2): 164–170. doi: 10.1111/j.1365-4632.2012.05701.x.
7. Kontochristopoulos G, Kouris A, Platsidaki E, Markantoni V, Gerodimou M, *et al*. Combination of microneedling and 10% trichloroacetic acid peels in the management of infraorbital dark circles. J Cosmet Laser Ther 2016; 18(5):289–292. doi: 10.3109/14764172.2016.1157363.
8. Sahni K, Kassir M. Dermafrac™: An innovative new treatment for periorbital melanosis in a dark-skinned male patient. J Cutan Aesthet Surg 2013; 6(3): 158–160. doi: 10.4103/0974-2077.118420.
9. Hassan AM, Hassan GFR, Aldalies HY, El Maghraby GM. Treatment of periorbital dark circles: Comparative study of chemical peeling with a combination of trichloroacetic acid and lactic acid versus carboxytherapy. J Surg Dermatol 2016; 1(2): 108–115. doi: 10.18282/jsd.v1.i2.29.
10. Sarkar R, Ranjan R, Garg S, Garg VK, Sonthalia S *et al.* Periorbital hyperpigmentation: A comprehensive review. J Clin Aesthet Dermatol 2016; 9(1): 49–55.

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Electrodesiccation treatment for dermatosis papulosa nigra

An under-recognized tool is found to have less postoperative complications, and ideal for treating common superficial skin lesions

The use of electrodesiccation – an electrosurgical procedure for eliminating superficial skin growths by using a high-frequency electric current – proved to be particularly effective, well tolerated and economical for the treatment of skin lesion dermatosis papulosa nigra in dark-skinned individuals, according to a recent study published by the *Journal of Surgical Dermatology* (JSD).

Complications were few, and therapy was performed appropriately with effective postoperative measures," reported lead author Surajit Gorai and his colleagues from the Department of Dermatology, Venereology & Leprology, Burdwan Medical College and Hospital in Burdwan, India.

Dermatosis papulosa nigra (DPN) is a small, benign black or brown lesion that develops mainly in the face and neck of individuals with dark complexion. The skin condition is common, estimated to affect 35% of people of African and South Asian descents. Oscar-winning actor Morgan Freeman is one of the most recognized faces of celebrities with DPN.

Typical therapeutic modalities include some traditional surgical procedures such as curettage, electrosurgery and snip/shave excision, according to the research authors. In addition, different laser treatments such as pulse dye treatment, potassium titanyl phosphate and neodymium-doped yttrium aluminium garnet (Nd:YAG) have also been used to treat DPN, albeit with varying success.

On the other hand, electrodesiccation (ED) is a "very simple, efficacious, and low-cost procedure" in dermatosurgery, claimed the researchers. ED, performed under local anesthesia, involves destroying of lesions by desiccating (*i.e.* dehydrating) the tissue with electric sparks applied with a blunt needle-shaped electrode.

The procedure has already been used to treat various types of skin growth, according to the authors. "Many diseases such as verucca, molluscum, milia, epidermal nevi, skin tags, pyogenic granuloma, etc., can be treated effectively by ED," they noted.

Yet, their research noted that this modality is still

under-documented as a single effective therapy for the treatment of DPN. "Although electrodesiccation (ED) is a simple procedure, studies on ED use for DPN with a good number of cases are lacking," the authors said.

Their research paper hence presents an evaluation of ED for the treatment of DPN in different types of skin. "The aim of the present study was to examine the safety, efficacy and cost-effectiveness of this age-old ED procedure for the treatment of DPN," they said.

The study examined 40 patients with dermatosis papulosa nigra who were of skin types IV–VI on the Fitzpatrick scale, the field standard for dermatological research in human skin pigmentation. The examined skin types range from moderate brown skin that burns minimally under ultraviolet light and always tans well, to the deeply pigmented dark-to-darkest brown skin type, which neither burns nor tans.

The patients are then subjected to the electrodesiccation procedure. "Superficial ED (monopolar, low, 2.0–3.5 W) was done by just touching the lesion under topical anesthesia," according to the study.

All preoperative photographs of the patients, as well as photographs taken after 2, 4 and 8 weeks following the procedure, were examined by two independent dermatologists who rated the efficacy by counting completely cleared lesions as well as examining the side effects of hypo/hyperpigmentation and scarring.

Simple, cheap and affordable

The result showed great promise for ED. "85% of

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patients showed excellent improvement (>75% clearance), 7.5% good (51%–75% clearance), 5% fair (26%–50% clearance) and 2% poor (0–25% clearance)," the study reported.

"Our study revealed that ED is safe, well tolerated and efficacious in removing DPN painlessly by using topical anesthesia under occlusion for an adequate duration. Studies with quantitative assessment of the number of lesion clearances well established its efficacy," the authors reported.

The most distressing side effect of dermatosurgery for individuals with darker skin types, especially in the case of DPN patients seeking treatment for cosmetic concerns, is typically the post-inflammatory pigment alteration, *i.e.* the darkening and discoloration of the skin following thermal burn.

However, the authors reported, there was little evidence of post-inflammatory pigment alteration in the electrodesiccation procedure. "In our study, post-inflammatory hyperpigmentation was observed only in a small number of cases after two weeks, and it would disappear after 8–12 weeks with minimal therapy," their research noted.

"The procedure was judicious, and with appropriate postoperative measurement, complications were able to be reduced."

The better outcome of lesser pigmentary complications in their study was explained by "the accurate depth assessment and the dried residue being left as it was after reaching the end point without wiping it out," the researchers explained, in contrast to another cited research whose study protocol required the removal of each lesion by a gauge piece for depth assessment after ED, resulting in a high rate (50%) of post-inflammatory hyperpigmentation.

"Along with that, we prescribed post-procedural topical antibiotic and least potent steroid combination for a certain period of days with sunscreen applied," they added.

The researchers also reported no lesional recurrence after three months of follow-up sessions. While minor side effect profile was observed in the darker skin type, "[i]mmediate postoperative lesional mild erythema and edema disappeared within 3–5 days afterward," their study observed.

Although many expensive and high technology lasers are steadily dominating the market as the treatment of choice for various cosmetic and dermatosurgical conditions, "successful techniques with lasers were not as convincing compared to trusted age-old ED" despite certain lasers already being subjected to trials for the treatment dermatosis papulosa nigra, the research authors noted.

In addition, laser treatments have a higher cost and limited availability at only specific dermatology centers, said Gorai and his fellow researchers. In contrast, "ED machines are simple, cheap and affordable," they said.

Their study acknowledges that, compared to lasers, electrodesiccation involves more time because the procedure needs to target each lesion separately and extra care is often required to keep the lesion superficial in order to avoid post-inflammatory hyperpigmentation. Often, as in the case of multiple lesions, more than one sitting may be needed.

However, "we have shown that a simple ED is an effective method for treating a condition such as DPN. The procedure was judicious, and with appropriate postoperative measurement, complications were able to be reduced," the authors concluded. ■

The research team includes Surajit Gorai, Joly Seth, Ayush Bindal, Asit Baran Samanta, Subhas Nag and Bani Kumar Mondal. Their original research article is published in this issue of JSD (page 103–107) and can be downloaded at: http://www.jsurgdermatol.com/

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The Art of Aesthetic Medicine

A Libyan doctor's inspiring journey in the field of dermatology

By: R.N. Sugitha Nadarajah

Dr. Ebtisam Elghblawi

Ever since she was a young girl, it has always been Dr. Ebtisam Elghblawi's wish to become a medical doctor. Now, the Researcher in Spotlight for this issue is enjoying a thriving career as a private dermatologist at Saint James Hospital, Tripoli, Libya.

The dermatology expert is also a proud member of the American Academy of Family Physicians (AAFP), which is one of the largest national medical associations with highly skilled professionals from all over the world.

"Medicine was my humble dream since I was young," says Dr. Elghblawi, who felt that she was lucky to have attended the medical school in her hometown in Tripoli. She adds, "I attained a high score which helped me enter into medicine and, moreover, I was top-ranked in my medical study years. I never failed any year, thanks to God, and my goal was to reach the highest degree in my career."

According to her, the circumstances in her own country made the chances of obtaining a Libyan scholarship seem almost like an impossible feat. "However, that didn't refrain me from reaching my aspiration of doing postgraduate study in dermatology," she asserts.

Dr. Elghblawi's aim to further her studies took her to the United Kingdom. "I did a Master's degree in the UK, which helped broaden my insights on research work," she says. Her scholarship was granted by the Chevening award, a prestigious UK government's international awards scheme given to outstanding scholars from all over the world. "I was selected out of 700 applicants based on the merits value," says the dermatologist proudly.

Determined to acquire more knowledge, Dr. Elghblawi also went the extra mile in order to study clinical dermatology via distance learning at Australian Institute of Clinical Dermatology. "I developed more passion for dermatology due to my mentor Dr. Ian McColl who was very caring and helpful," she says.

"Dr. Ian is a consultant dermatologist in Australia. His ways were really fascinating and it made me love the subject by heart. It was a life-changing experience which brought out my true potential. It also made me a passionate individual and a far better dermatologist," says Dr. Elghblawi.

In addition to her qualifications in dermatology, Dr. Elghblawi received a Professional Diploma in Reproductive Health in Developing Countries at Liverpool School of Tropical Medicine, UK, and was also awarded with distinction.

While there, she wrote a thesis about genital warts and its lack of knowledge among women. "Only Australian women seem to have more knowledge about the issue compared to their counterparts all over the world," she says of her discovery, which was completely unexpected by her and her tutor. Her theses done during her postgraduate diploma "HPV Infection in Women" and Master's "Women and Critical Analysis of Pain" have since been published into books, as a result of her hard work. "I enjoyed this course a lot and it opened my mind to a lot of topics. As a matter of fact, it was here that I realised how much workplace diversity can ensure that there is a large pool of knowledge, skills, life experience, perspectives, and expertise to be shared and exchanged," says Dr. Elghblawi.

"The main reasons I enjoy clinical dermatology are the variety of medical presentations, the feeling of being


Slavery and ran away to freedom

Dr. Elghblawi's poem as featured in Middle East Journal of Business

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valued by the patients, and the occasional excitement of diagnosing something rare or exotic. Though the career is not paying too much money, doing the job properly is not boring at all to me," she explains.

Not many are aware that this skilled dermatologist is also a talented poet and a passionate artist. In fact, Dr. Elghblawi's artwork and poems have been featured in a number of journals, including the *Middle East Journal of Business*.

"The artworks that I do as a hobby are diverse, like drawing and writing poems. However some journals, based on their acquaintance with me, happened to know about my hobbies and requested me to send some artworks. I even wrote some poems and the last one published was about slavery," she says.

Dr. Elghblawi, who has almost 20 years of clinical experience shares with us, "The years of clinical experience at dermatology clinics are my only achievements and I am proud of it, really. Last year, I was among the researchers who were given recognition with the awarding of a trophy for the best clinical laser case that I had submitted to a conference in Paris."

Dr. Elghblawi: "Medicine is always evolving and what was applicable in the past is not so anymore. There is no limit to search further and get the new piece of knowledge to keep yourself scaled up."

On the same note, she points out the challenges she faces in this field. "The biggest challenge in dermatology is that it is a visual medicine diagnosis, and is not parallel to other branches of medicine whereby you treat symptoms. Sometimes you are not confident about it as you don't observe anything in reality and the main assumption can only be made by speculation, palpation, and by working out certain investigation and proposition," says the skin specialist.

In addition to this, the fact that there is no medical insurance for Libyan doctors simply adds to her frustration and, according to Dr. Elghblawi, "it feels as if medicine doesn't pay us back like other fields do, such as engineering which is fully insured by private companies." She also claims that sometimes patients lose their trust on doctors due to various factors, one of it being the lack of proper healthcare infrastructure system and basic facility.

As a clinician with an ardent desire to improve her skills, Dr. Elghblawi isn't discouraged and is never hesitant to put in extra efforts to achieve her goals. "I have lots of dream to hunt, but some are impossible due to many reasons including the high fiscal issues. However, nowadays as some courses are available online, I try my best to keep catching up and recently I also developed a passion for skin cancer study and the art of dermatoscopy," she says.

Dr. Elghblawi's artwork as featured in *Middle East Journal of Business*

One of the admirable qualities of the physician is that she strives to keep herself updated with the latest developments in her field of expertise. According to her, there is currently rapid advancement of targeted therapy, as well as the nanotechnology of creating the skin which can be used in serious cases where the skin had been destroyed. There is also focus on genetically-based drugs which could change ways in approaching and treating the patients.

"After all, medicine is always evolving and what was applicable in the past is not so any more. There is no limit to search further and get the new piece of knowledge to keep yourself scaled up," concludes Dr. Elghblawi.■

> **"Workplace diversity can ensure that there is a large pool of knowledge, skills, life experience, perspectives, and expertise to be shared and exchanged."**

Dr. Ebtisam Elghblawi publishes her work entitled "Frontier in hair loss and trichoscopy: A review" in this issue of JSD (page 80–96).

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SHORT COMMUNICATION

Hyaluronidase in the treatment of papular dermal mucinosis: First case reported in North America

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Abstract: Papular mucinosis is an uncommon, idiopathic disorder characterized by dermal mucin deposition and increased collagen in the skin and internal organs. Its clinical presentation is characterized by dome-shaped, flesh colored papules that are closely spaced or linearly arranged. Papular mucinosis has been individually associated with several entities that include discoid lupus erythematosus, systemic lupus erythematosus and monoclonal gammopathy of undetermined significance. We encountered a 60-year-old woman with papular mucinosis in the setting of three concurrent disorders: discoid lupus erythematous, systemic lupus erythematosus and IgG paraproteinemia. Furthermore, we have reported the first case in North America of papular mucinosis being successfully treated with intralesional hyaluronidase.

Keywords: Papular mucinosis; discoid lupus erythematosus; systemic lupus erythematosus; monoclonal gammopathy; paraproteinemia; hyaluronidase

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Introduction

Papular mucinosis is a relatively uncommon disease characterized by diffuse papular eruption due to mucin deposition in the skin[1–6]. This disease most commonly affects middle-aged adults and has been associated with monoclonal gammopathy, systemic lupus erythematosus and discoid lupus, independently[2–14]. The report presents the first case of papular mucinosis in the setting of three concurrent disorders: IgG paraproteinemia, systemic lupus erythematosus and discoid lupus erythematosus. Additionally, we also report the first case in North America of papular mucinosis being successfully treated with intralesional hyaluronidase.

Case presentation

A 60-year-old woman was evaluated in the clinic for a five-month history of pruritic, eruptive lesions on the chest, back, and legs. She also reported a several-year history of localized hair loss on the scalp, which had not been previously evaluated. Physical exam revealed multiple smooth, dome-shaped and flesh-colored 2–3 mm papules on the chest, back, upper arms, abdomen, bilateral lower extremities and feet (**Figures 1** and **2**). Additionally, a 4-cm pink, painful plaque with overlying crust was noted on the right parietal scalp (**Figure 3**). Differential diagnosis for these findings included lichen myxedematosus, eruptive seborrheic keratoses and discoid lupus of the scalp.

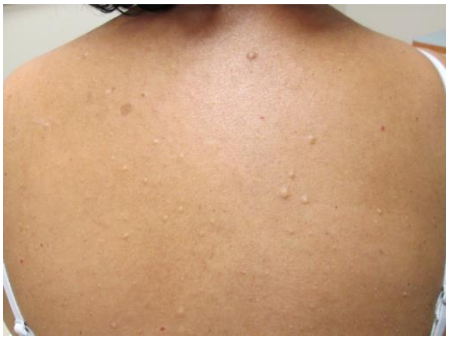

Figure 1. Multiple, smooth, flesh-colored papules on back

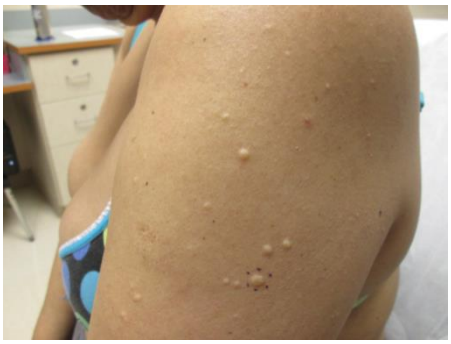

Figure 2. Multiple, smooth, flesh-colored papules on left arm

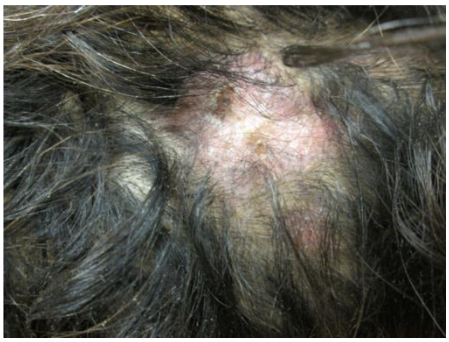

Figure 3. Erythematous plaque with overlying crust on right parietal scalp

Biopsy of a dome-shaped papule on the left forearm revealed focal deposition of mucin within the reticular dermis, consistent with focal cutaneous mucinosis. Biopsy of the plaque from right parietal scalp revealed vacuolar interface changes at the dermal-epidermal junction, with focal thickening of the basement membrane, as well as a superficial and deep perivascular infiltrate of lymphocytes with increased mucin within the dermis. Direct immunofluorescence revealed granular staining along the dermal-epidermal junction with the use of IgG, IgM, and complement 3 (C3). These findings were consistent with discoid lupus.

Routine laboratory investigations were noted for pancytopenia with white blood cell count of 4.5×10^9/L, hemoglobin of 11.9 gm/dL, and platelet count of 130×10^9/L. Urinalysis was unremarkable. Serum protein electrophoresis revealed a distinct M-band (1.5 g/dL) in the gamma region, and urine protein electrophoresis was unremarkable. Levels of serum immunoglobulins were elevated with IgG of 1746 mg/dL, IgA of 581 mg/dL, kappa light chain of 7.00 mg/dL, and lambda light chain of 4.26 mg/dL. Bone marrow biopsy was also performed and revealed 10% polyclonal plasma cells. These findings were interpreted as monoclonal gammopathy of undetermined significance (MGUS). In addition to the above, further follow-up confirmed the diagnosis of systemic lupus erythematosus. Positive anti-nuclear antibody titer was observed at 1:2560 in a speckled pattern, as well as positive anti-smooth muscle antibody, positive anti-ribonucleoprotein antibody and a slightly decreased complement/C3 level of 80 mg/dL.

Based on clinical examination, histopathology, serum protein electrophoresis, bone marrow biopsy findings and antibody titers, a final diagnosis of concomitant papular mucinosis associated with (MGUS), discoid lupus and systemic lupus erythematosus was performed. Hydroxychloroquine was initiated at a dose of 200 mg via oral administration twice daily, and topical clobetasol ointment was prescribed for the papular eruption and the affected scalp for management of both papular mucinosis and discoid lupus erythematosus. The patient reported no significant improvement of papular mucinosis lesions with this regimen. In the follow up session, selected lesions of papular mucinosis were treated with 0.35 mL of intralesional hyaluronidase (Hylenex®). The patient was observed to have visible improvement in papular lesions within 48 h after the injection. Unfortunately, she declined to do repeated biopsies and follow-up was not done.

Discussion

Papular mucinosis is an uncommon, idiopathic disorder characterized by dermal mucin deposition with increased collagen in the skin and internal organs[1–6]. Also known as discrete papular lichen myxedematosus, there are four subtypes of this entity that include discrete papular mucinosis, acral mucinosis, cutaneous mucinosis of infancy, and nodular mucinosis. Our patient presented with the discrete papular form of mucinosis. This rare condition predominantly affects middle-aged adults between 30–80 years old with no predilection for race or gender[1,2]. Significant morbidity and mortality may be seen with ex-

tracutaneous manifestations involving the cardiac, gastrointestinal, pulmonary and central nervous systems[1].

Clinical presentation is characterized by widespread dome-shaped, flesh colored papules that are closely spaced or linearly arranged. Classically, papules are small, waxy and symmetric in shape with lesions, most commonly affecting the face, neck, distal forearms and hands. Lichenification may be noted as well[1,2]. Although affected areas are not pruritic, koebnerization in areas of excoriation is widely reported[2]. In some cases, skin may appear shiny as in scleroderma; however, the lack of telangiectasia and cutaneous calcinosis preclude this diagnosis. Diffuse involvement of the face may also produce characteristic leonine facies[1]. Definitive diagnosis of papular mucinosis is largely based on histopathologic findings, as clinical presentation may be non-specific. Biopsy results show diffuse deposition of mucin in the upper and mid-reticular dermis, increased collagen deposition, and marked proliferation of irregularly arranged fibroblasts. A perivascular lymphoplasmacytic infiltrate may be noted, as well[1,10,13].

The etiology of papular mucinosis is unknown. It is theorized to be primarily due to immunologic dysregulation, in which cytokines and immunoglobulins lead to an increase in glycosaminoglycan synthesis by fibroblasts. In fact, it has been shown that dermal fibroblasts in patients with papular mucinosis produce a higher amount of hyaluronic acid, a glycosaminoglycan found in mucin, as compared with regular fibroblasts[1]. Serum from patients with papular mucinosis has been found to stimulate *in vitro* fibroblast proliferation. In contrast, purified immunoglobulin from paraprotein-containing serum does not contribute to fibroblast proliferation. Therefore, it is likely that non-paraprotein factors contribute to the pathogenesis of papular mucinosis, causing increased fibroblast production and subsequent hyaluronic acid production[1]. Furthermore, the association between papular mucinosis and other immunologic disorders such as rheumatoid arthritis, hashimoto thyroiditis, HIV and acquired immunodeficiency syndrome suggests that aberrancy in immune regulation may indeed play a key role in the pathogenesis[15-21].

Association with these immunologic conditions further highlights the relationship between papular mucinosis and immune dysregulation. There are several reports of papular mucinosis in the setting of monoclonal gammopathy with paraproteinemia, as in our patient, most commonly of IgG with lambda light chains[3,14]. Paraproteinemia is present in up to 83% of these patients. Our patient's MGUS was confirmed via serum protein electrophoresis and bone marrow biopsy. Other paraproteinemias include IgM or IgA levels and, occasionally, kappa light chains[2]. Interestingly, paraprotein levels do not correlate with disease severity and patients rarely progress to develop multiple myeloma[2,3]. However, Waldenstrom's Macroglobulinemia, Hodgkin's and non-Hodgkin's lymphomas have all been associated with the disease[1].

Papular mucinosis also has a well-known association with discoid lupus erythematosus (DLE) and systemic lupus erythematosus (SLE)[4–13]. Up to 80% of cases of papular mucinosis may be associated with SLE. Further, papular mucinosis has been reported as the first clinical clue in some cases of SLE[4,5]. Gold *et al.* was the first to describe two patients with an unusual papular eruption associated with lupus erythematosus. In this report, histopathologic evaluation of suspicious lesions showed diffuse deposits of dermal mucin with scant perivascular lymphocytic infiltrate, which is characteristic of papular mucinosis[10]. The epidermal changes that are seen in SLE or DLE were lacking[10]. Similarly, though our patient had SLE and DLE in association with papular mucinosis, histopathologic findings of papular lesions failed to show epidermal or inflammatory infiltrate suggestive of SLE or DLE.

Treatment options for papular mucinosis are varied and primarily anecdotal. Melphalan, antimalarials, systemic steroids, intravenous immunoglobulins and plasmapheresis have all been reported used. While this disease is chronic and slowly progressive, spontaneous resolution has been reported as well[1,2]. Perhaps most notable in the case presented here was our patient's rapid response to treatment with intralesional hyaluronidase. Hyaluronidase is a naturally occurring enzyme that hydrolyzes hyaluronic acid, a glycosaminoglycan present in mucin. It is most commonly used as an adjunct therapy to facilitate absorption of other injectable drugs by increasing tissue permeability[22]. Our patient was specifically treated with a purified preparation of hyaluronidase derived from recombinant human deoxyribonucleic acid (DNA) called Hylenex®. The method of action of intralesional hyaluronidase in these cases deserves further investigation, though it has been used as a successful adjuvant therapy in the treatment of various epithelial and mesenchymal cell-driven processes including dermatofibrosarcoma protuberans prior to excision, bladder cancer, breast cancer and Kaposi's sarcoma[23–26]. Our success in this case further suggests a role for hyaluronidase in the treatment of papular mucinosis.

Two other reports of successful treatment of papular mucinosis with intralesional hyaluronidase have been described[9]. While its use for papular mucinosis has

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not been reported since 1995, more recent success is well-documented in the treatment of scleroderma and pretibial myxedema. Adverse effects of intralesional hyaluronidase are uncommon, and intralesional injections can take effect immediately for up to 48 hours, as seen in our case[22]. Given the chronic nature of papular mucinosis, intralesional hyaluronidase may have a therapeutic role in the treatment and prevention of the progressive disease and deserves further investigation.

Conclusion

We presented a unique case of papular mucinosis diagnosed concomitantly with three other entities: monoclonal gammopathy, discoid lupus and systemic lupus erythematosus. The patient's condition proved refractory to conventional treatment methods, including oral hydroxychloroquine and topical clobetasol, but her lesions improved dramatically with the use of intralesional hyaluronidase. This may support the role of hyaluronidase in the treatment of papular mucinosis and should be investigated further.

Conflict of interest

The authors declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

References

1. Cokonis Georgakis CD, Falasca G, Georgakis A, Heymann WR. Scleromyxedema. Clin Dermatol 2006; 24(6): 493–497. doi: 10.1016/j.clindermatol.2006.07.011.
2. Cather C, Menter MA. Diffuse eruption of pigmented papules. Proc (Bayl Univ Med Cent) 2001; 14(2): 185–186.
3. Thatte SS, Dongre AM, Chikhalkar SB, Khopkar US. Papular mucinosis associated with monoclonal gammopathy of undetermined significance. Indian J Dermatol Venereol Leprol 2015; 81(2): 213–214. doi: 10.4103/0378- 6323.152308.
4. Shekari AM, Ghiasi M, Ghasemi E, Kani ZA. Papulonodular mucinosis indicating systemic lupus erythematosus. Clin Exp Dermatol 2009; 34(8): e558–e560. doi: 10.1111/j.1365-2230.2009.03235.x.
5. Rongioletti F, Parodi A, Rebora A. Papular and nodular mucinosis as a sign of lupus erythematosus. Dermatologica 1990; 180(4): 221–223. doi: 10.1159/000248034.
6. Pandya AG, Sontheimer RD, Cockerell CJ, Takashima A, Piepkorn M. Papulonodular mucinosis associated with systemic lupus erythematosus: Possible mechanisms of increased glycosaminoglycan accumulation. J Am Acad Dermatol 1995; 32(2 Pt 1): 199–205. doi: 10.1016/0190-9622(95) 90126-4.
7. Lamberts RJ, Lynch PJ. Nodular cutaneous mucinosis associated with lupus erythematosus. Cutis 1981; 28(3): 294–295, 297–299.
8. Jackson BA, Norum RA, Lowe L, Fivenson DP. Papulonodular dermal mucinosis in systemic lupus erythematosus. J Rheumatol 1994; 21(5): 940–941.
9. Maruyama M, Miyauchi S, Hashimoto K. Massive cutaneous mucinosis associated with systemic lupus erythematosus. Br J Dermatol 1997; 137(3): 450–453. doi: 10.1111/j.1365-2133.1997.tb03757.x.
10. Gold SC. An unusual papular eruption associated with lupus erythematosus. Br J Dermatol 1954; 66(12): 429–433. doi: 10.1111/j.1365-2133.1954.tb12574.x.
11. Lowe L, Rapini RP, Golitz LE, Johnson TM. Papulonodular dermal mucinosis in lupus erythematosus. J Am Acad Dermatol 1992; 27(2 Pt 2): 312–315. doi: 10.1016/0190- 9622(92)70188-L.
12. Weigand DA, Burgdorf WHC, Gregg LJ. Dermal mucinosis in discoid lupus erythematosus. Arch Dermatol 1981; 117(11): 735–738. doi: 10.1001/archderm.1981.01650110057022.
13. Ortiz VG, Krishnan RS, Chen LL, Hsu S. Papulonodular mucinosis in systemic lupus erythematosus. Dermatol Online J 2004; 10(2): 16.
14. Mandell JA, Glick JB, Kaur RR. Scleromyxedema: A rare disorder associated with monoclonal gammopathy. J Drugs Dermatol 2014; 13(5): 619–620.
15. Ertam I, Karaca N, Ceylan C, Kazandi A, Alper S. Discrete papular dermal mucinosis with hashimoto thyroiditis: A case report. Cutis 2011; 87(3): 143–145.
16. Abbott RA, Calonje E, Almaani N, Kulasegram R, McGibbon D. Widespread papules in a patient with human immunodeficiency virus. Clin Exp Dermatol 2010; 35(7): 801– 802. doi: 10.1111/j.1365-2230.2010.03830.x.
17. Azaña JM, De Misa RF, Casado J, Muñoz E, Ledo A. Papular mucinosis associated with human-immunodeficiency-virus infection. Int J Dermatol 1996; 35(9): 652–654. doi: 10.1111/j.1365-4362.1996.tb03693.x.
18. Biro DE, Lynfield YC, Heilman ER. Papular mucinosis and human immunodeficiency virus infection. Cutis 1995; 55(2): 113–114.
19. Ruiz-Rodriguez R, Maurer TA, Berger TG. Papular mucinosis and human immunodeficiency virus infection. Arch Dermatol 1992; 128(7): 995–996. doi: 10.1001/archderm. 128.7.995.
20. Gildersleeve RF, Krik JF, Cooper PH, Greer KE. Papular mucinosis associated with acquired immunodeficiency syndrome. Cutis 1995; 55(3): 174-176.
21. Yokoyama E, Muto M. Adult variant of self-healing

papular mucinosis in a patient with rheutmatoid arthritis: Predominant proliferation of dermal dendritic cells expressing CD3 or factor XIIIa in association with dermal deposition of mucin. J Dermatol 2006; 33(1): 30–35. doi: 10.1111/j. 1346-8138.2006.00005.x.

22. Lee A, Grummer SE, Kriegel D, Marmur E. Hyaluronidase. Dermatol Surg 2010; 36(7): 1071–1077. doi: 10.1111/j. 1524-4725.2010.01585.x.
23. Menon P, Smith KJ, Crittenden J, Skelton H. Adjuvant therapy with hyaluronidase prior to excision of dermatofibrosarcoma protuberans. Dermatol Surg 1999; 25(3): 205– 209. doi: 10.1046/j.1524-4725.1999.08148.x.
24. Höbarth K, Maier U, Marberger M. Topical chemoprophylaxis with mitromycin C and adjuvant hyaluronidase. Eur Urol 1992; 21(3): 206–210.
25. Beckenlehner K, Bannke S, Spruß T, Bernhardt G, Schönenberger H, *et al*. Hyaluronidases enhance the activity of adriamycin in breast cancer models *in vitro* and *in vivo*. J Cancer Res Clin Oncol 1992; 118(8): 591–596. doi: 10.1007/BF01211802.
26. Smith KJ, Skelton HG, Turiansky G, Wagner KF. Hyaluronidase enhances the therapeutic effect of vinblastine in intralesional treatment of Kaposi's sarcoma. J Am Acad Dermatol 1997; 36(2 Pt1): 239–242. doi: 10.1016/S0190-9622(97)70288-3.

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REVIEW

Evidence of incompatibility for topical anionic agents used in conjunction with chlorhexidine gluconate: A systematic review

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Abstract: Chlorhexidine gluconate (CHG) is a widely used antiseptic agent for skin and wound disinfection. The cationic properties of CHG may allow its inactivation and precipitation by anionic agents in commonly used topical agents. We conducted a systematic review by searching through PubMed, Cochrane Library, and Web of Science databases and selected original research articles reporting on CHG incompatibility, defined as inactivation or precipitation. The search yielded 22 publications that demonstrated CHG incompatibility via: (1) reduced antibacterial activity (carbomer, acrylates/C10-C30 alkyl acrylate crosspolymer, dentin, bovine serum albumin, copolymer M239144, sodium lauryl sulfate, heat-killed microbes, triethanolamine, and bark cork); and (2) visible precipitate formation (sodium hypochlorite, EDTA, saline, ethanol, andnystatin). Only three publications reported on CHG incompatibility in dermatology, specifically for carbomer, triethanolamine, and acrylates/C10-C30 alkyl acrylate crosspolymer. Although limited evidence linking CHG incompatibility and anionic agents exists, clinicians should carefully consider the nature of topical agents used if CHG is concurrently applied. Increased awareness of CHG incompatibility may result in better antibacterial activity thus ensuring optimal patient management.

Keywords: Chlorhexidine; incompatibility; inactivation; skin; reduced antibacterial activity; precipitation; systematic review

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Introduction

Chlorhexidine gluconate (CHG) is a widely used, broad-spectrum antiseptic agent for skin and wound disinfection[1]. The cationic bisbiguanide moiety is a characteristic feature of CHG that allows its binding to keratinocytes. This produces bacteriostatic and bactericidal effects from the interactions with anionic bacterial cell walls[2,3]. CHG has been shown to have cumulative antibacterial persistence on the skin[4]. Despite all these positive attributes, its cationic properties may allow inactivation or precipitation by anionic agents found in products commonly applied as emollients immediately after CHG application. We conducted a systematic review to evaluate the evidence of CHG incompatibility in a dermatological clinical setting.

Materials and methods

This study was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement, where applicable (the PRISMA checklist can be found in *Appendix 1*)[5]. We searched PubMed, Cochrane Library, and Web of Science databases from their inception up to October 2015 using the following key words: "chlorhexidine AND inactivation", "chlorhexidine AND incompatibility", "chlorhexidine AND precipitate", and "chlorhexidine AND anionic". Results were filtered for English language and human studies, if possible, within the databases. Original research articles were deemed eligible if there are reported chlorhexidine incompatibilities (i.e., reduced antibacterial activity by inactivation or by visible physical precipitation). Two independent reviewers (Tran G and Huynh TN) selected, screened, and reviewed the search results. Variance was reconciled by consensus or, if necessary, through a third reviewer (West DP). Data collection included the type of study (*in vivo* or *ex vivo*), incompatible agents, and significance of incompatibility reported as *p* values (**Table 1**).

Results

The search yielded 414 articles: 78 from PubMed, 15 from Cochrane Library, and 321 from Web of Science. 231 articles were found evaluable after removal of duplicates. After screening the titles and/or abstracts, we excluded 209 articles and hence 22 eligible articles remained. After the final screening, only three articles addressed the dermatologic usage of topical CHG and its incompatibility, specifically addressing the following compounds: carbomer[6], triethanolamine[7,8], and acrylates/C10-C30 alkyl acrylate crosspolymer[6,7]. **Figure 1** showed a flow diagram outlining the selection of articles. Of the 22 eligible articles, 10 articles reported reduced antibacterial activity from the following compounds: carbomer[6], acrylates/C10-C30 alkyl acrylate crosspolymer[6,7], dentin[9-12], bovine serum albumin[11], copolymer M239144[13], sodium lauryl sulfate[14], heat-killed microbes[9,12], triethanolamine[7,8], and bark cork[15]. The 12 remaining articles reported precipitation related to the following compounds: sodium hypochlorite[16-25], EDTA[16-18,26], saline[16], ethanol[16], and nystatin[27].The most commonly reported incompatibility was sodium hypochlorite (bleach, *N* = 10, 45%) and the most commonly reported indication for CHG and its incompatibility was oral mucosal applications (*N* = 19, 86%).

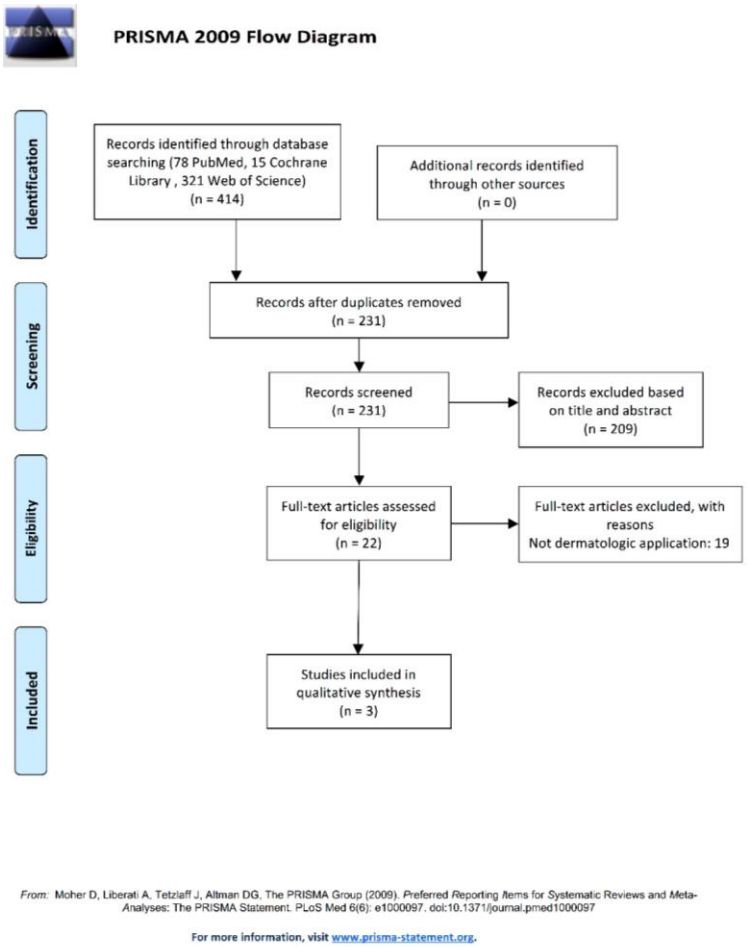

Figure 1. The PRISMA flow diagram for study selection

Discussion

A clinically advantageous feature of CHG compared to other antibacterial agents is its affinity to keratinocytes and persistence within skin tissue. To maintain this clinical feature, it is important to be aware that some concurrently applied topical products may have the potential to disrupt the persistent antibacterial activity. This systematic review identified three publications reporting CHG inactivation after concurrent application of topical agents[6-8]. Emulsifiers and thickeners found in these topical agents contributed to CHG inactivation. As revealed by our systematic review, there was a distinct lack of literature addressing topical CHG incompatibility.

In an *ex vivo* study by Benson *et al.*, anionic surfactant systems almost completely eliminated prolonged residual antibacterial effect of CHG, whereas minimal effect occurred with nonionic products over the same prolonged residual period[7].

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Table 1. Summary of articles exploring dermatologic chlorhexidine incompatibility

Study	Type of study	Bacteria	Inactivating agent	*p* value
Kaiser *et al*. (2009)[6]	*in vivo* + *ex vivo*	*Serratia marcescens*, *in vivo* *Staphylococcus aureus*, *ex vivo*	Carbomer, C10-C30 alkyl acrylate crosspolymer	<0.0001
Benson *et al*. (1990)[7]	*ex vivo*	*Serratia marcescens*	Triethanolamine, C10-C30 alkyl acrylate cross-polymer (Vaseline® Intensive Care)	<0.01
Walsh *et al*. (1987)[8]	*in vivo*	*Escherichia coli*	Triethanolamine	<0.001

Triethanolamine and C10-C30 alkyl acrylate cross-polymer were the implicated inactivating agents in the anionic surfactant system. Another *ex vivo* study also demonstrated statistically significant decreases in $\log_{10}$ reductions in alcohol hand sanitizing gels[6]. Of note, emulsifying and thickening agents, carbomer, and C10-C30 alkyl acrylate crosspolymer were associated with CHG inactivation rather than the alcohol itself. Moreover, these results paralleled *in vivo* testing involving 11 human subjects. Hand creams containing triethanolamine, an emulsifier and thickener, yielded similar *in vivo* CHG inactivation[8]. Based on the Cosmetic Ingredient Review (CIR) Expert Panel, triethanolamine, carbomer, and C10-C30 alkyl acrylate crosspolymer were found in 3756, 1610 and 1696 cosmetic formulations, respectively[28-30]. This demonstrated the prevalence of these compounds as well as the potential for inactivation if concurrently applied.

CHG is widely known for its antibacterial superiority over many antiseptics and its substantial residual activity on skin[31-34]. CHG typically has a very rapid action onset with high bacterial kill rate efficacy and additionally has been shown to reduce bacterial counts of drug-resistant *Acinetobacter baumannii* and methicillin-resistant *Staphylococcus aureus* strains by 99.9% within three minutes[35,36]. After several decades of clinical use with no clinically significant events reported concerning the interaction and/or inhibition of antibacterial effect with concurrent application of other topical products, the immediate kill by CHG might be its most important clinical property. One study suggested that the residual kill of CHG may be an artifact of testing protocols and was dependent on the skin being wet[37]. Generally, if avoidance of an incompatible agent is not possible, and because of the rapid and relatively complete kill rate by CHG, topical anionic agents may likely be applicable after a short period, with a low likelihood of impaired CHG efficacy. Despite this, clinicians should weigh the risks and benefits in deciding the appropriate amount of elapsed time subsequent to CHG application to ensure adequate efficacy.

A limitation of this study was that chemistry (non-biomedical) databases were not included – such databases may yield additional supporting evidence in regards to the incompatibility of anionic agents that may be utilized in biomedical products applied to skin or mucous membranes concurrent to CHG use. Despite the fact that we only reported three agents for CHG inactivation with concurrent application, there are other agents not yet investigated and reported for this potential interaction. Moreover, there is a clear gap in clinician knowledge of CHG incompatibility. According to a survey in Washington State, a cohort of only 48% health personnel was aware of CHG inactivation by some topical anionic moisturizers[38]. This survey illustrated a need for further education and research on CHG incompatibility with selected concurrently used topical agents. Future exploration of this issue should perhaps focus on health outcomes to delineate the clinical significance of CHG incompatibility.

Conclusion

Despite widespread use of anionic agents in topically applied products, this systematic review of CHG incompatibility, as measured by reduced antibacterial activity or physical precipitation, yielded very limited evidence of incompatibility and only with very few anionic agents. Given the several decades of clinical use without reports of reduced efficacy due to topical incompatibility, CHG's relatively immediate killing property may be its predominant function and therefore the potential for reduction in antibacterial efficacy may be minimal due to this ability. However, in light of the very limited but relatively high level of evidence for *ex vivo* incompatibility, clinicians should carefully consider the possibility of CHG incompatibility with concurrent use of topical anionic agents. Clinicians should be aware of the ingredients in topical emollient/skin regimens for patients who concurrently use CHG. Although further investigation to determine the ionic nature of topical agents may be somewhat tedious, this information affords the opportunity for optimizing antibacterial activity and, ultimately, health outcomes.

Author contributions

The study was conceived and designed by Ahmad N, Budris WA, Posligua A, Hammel JA, Nardone B, and

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West DP. Tran G, Huynh TN, and West DP reviewed the articles. The manuscript was prepared by Tran G, Huynh TN, and Bruins FM with revisions by Tran G, Huynh TN, Bruins FM, Ahmad N, Budris WA, Posligua A, Hammel JA, Nardone B, and West DP.

Conflict of interest

West DP is a consultant for Sage Products LLC but he did not receive any financial support to conduct the work reflected in this research. All the other authors declare no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

Supplementary information

Appendix 1: The PRISMA checklist of items to include when reporting a systematic review or meta-analysis. The supplementary information is available free of charge on JSD's website at doi: 10.18282/jsd.v1.i2.21.

References

1. McDonnell G, Russell AD. Antiseptics and disinfectants: Activity, action, and resistance. Clin Microbiol Rev 1999; 12(1): 147–79.
2. Abdallah C. Perioperative chlorhexidine allergy: Is it serious? J Anaesthesiol Clin Pharmacol 2015; 31(2): 152–154. doi: 10.4103/0970-9185.155140.
3. Jones CG. Chlorhexidine: Is it still the gold standard? Periodontol 2000 1997; 15(1): 55–62. doi: 10.1111/j.1600-0757.1997.tb00105.x.
4. Aly R, Maibach HI. Comparative study on the antimicrobial effect of 0.5% chlorhexidine gluconate and 70% isopropyl alcohol on the normal flora of hands. Appl Environ Microbiol 1979; 37(3): 610–613.
5. Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. Ann Intern Med 2009; 151(4): 264–269. doi: 10.7326/0003-4819-151-4-200908180-00135.
6. Kaiser N, Klein D, Karanja P, Greten Z, Newman J. Inactivation of chlorhexidine gluconate on skin by incompatible alcohol hand sanitizing gels. Am J Infect Control 2009; 37(7): 569–573. doi: 10.1016/j.ajic.2008.12.008.
7. Benson L, LeBlanc D, Bush L, White J. The effects of surfactant systems and moisturizing products on the residual activity of a chlorhexidine gluconate hand wash using a pigskin substrate. Infect Control Hosp Epidemiol 1990; 11(2): 67–70. doi: 10.2307/30144264.
8. Walsh B, Blakemore PH, Drabu YJ. The effect of hand cream on the antibacterial activity of chlorhexidine gluconate. J Hosp Infect 1987; 9(1): 30–33. doi: 10.1016/0195-6701(87)90091-0.
9. Portenier I, Haapasalo H, Ørstavik D, Yamauchi M, Haapasalo M. Inactivation of the antibacterial activity of iodine potassium iodide and chlorhexidine digluconate against *Enterococcus faecalis* by dentin, dentin matrix, type-I collagen, and heat-killed microbial whole cells. J Endod 2002; 28(9): 634–637. doi: 10.1097/00004770-200209000-00002.
10. Haapasalo HK, Sirén EK, Waltimo TMT, Ørstavik D, Haapasalo MPP. Inactivation of local root canal medicaments by dentine: An *in vitro* study. Int Endod J 2000; 33(2): 126–131. doi: 10.1046/j.1365-2591.2000.00291.x.
11. Portenier I, Haapasalo H, Rye A, Waltimo T, Ørstavik D, *et al*. Inactivation of root canal medicaments by dentine, hydroxylapatite and bovine serum albumin. Int Endod J 2001; 34(3): 184–188. doi: 10.1046/j.1365-2591.2001.00366.x.
12. Mohammadi Z, Shalavi S. The effect of heat-killed Candida albicans and dentin powder on the antibacterial activity of chlorhexidine solution. Iran Endod J 2012; 7(2): 63–67.
13. Claydon N, Addy M, Ridge D, Jackson R. An evaluation of an antiadhesive copolymer agent on plaque inhibition by chlorhexidine. J Clin Periodontol 1996; 23(10): 952–954. doi: 10.1111/j.1600-051X.1996.tb00517.x.
14. Barkvoll P, Rølla G, Svendsen K. Interaction between chlorhexidine digluconate and sodium lauryl sulfate *in vivo*. J Clin Periodontol 1989; 16(9): 593–595. doi: 10.1111/j.1600-051X.1989.tb02143.x.
15. Linton KB, George E. Inactivation of chlorhexidine ("hibitane") by bark corks. Lancet 1966; 1(7451): 1353–1355. doi: 10.1016/S0140-6736(66)92141-6.
16. Prado M, Santos Júnior HMS, Rezende CM, Pinto AC, Faria RB, *et al*. Interactions between irrigants commonly used in endodontic practice: A chemical analysis. J Endod 2013; 39(4): 505–510. doi: 10.1016/j.joen.2012.11.050.
17. Rossi-Fedele G, Doğramaci EJ, Guastalli AR, Steier L, de Figueiredo JAP. Antagonistic interactions between sodium hypochlorite, chlorhexidine, EDTA, and citric acid. J Endod 2012; 38(4): 426–431. doi: 10.1016/j.joen.2012.01.006.
18. Shenoy A, Bolla N, Sayish, Sarath RK, Ram CHS, *et al*. Assessment of precipitate formation on interaction of irrigants used in different combinations: An *in vitro* study. Indian J Dent Res 2013; 24(4): 451–455. doi: 10.4103/0970-9290.118392.
19. Gasic J, Popovic J, Živković S, Petrovic A, Barac R, *et al*. Ultrastructural analysis of the root canal walls after simultaneous irrigation of different sodium hypochlorite concentration and 0.2% chlorhexidine glu-

doi: 10.18282/jsd.v1.i2.21

conate. Microsc Res Tech 2012; 75(8): 1099–1103. doi: 10.1002/jemt.22036.
20. Krishnamurthy S, Sudhakaran S. Evaluation and prevention of the precipitate formed on interaction between sodium hypochlorite and chlorhexidine. J Endod 2010; 36(7): 1154–1157. doi: 10.1016/j.joen.2010.01.012.
21. Akisue E, Tomita VS, Gavini G, de Figueiredo JAP. Effect of the combination of sodium hypochlorite and chlorhexidine on dentinal permeability and scanning electron microscopy precipitate observation. J Endod 2010; 36(5): 847–850. doi: 10.1016/j.joen.2009.11.019.
22. Bui TB, Baumgartner JC, Mitchell JC. Evaluation of the interaction between sodium hypochlorite and chlorhexidine gluconate and its effect on root dentin. J Endod 2008; 34(2): 181–185. doi: 10.1016/j.joen.2007.11.006.
23. Cintra LTA, Watanabe S, Samuel RO, da Silva Facundo AC, de Azevedo Queiroz ÍO, *et al*. The use of NaOCl in combination with CHX produces cytotoxic product. Clin Oral Investig 2014; 18(3): 935–940. doi: 10.1007/s00784-013-1049-5.
24. Nowicki JB, Sem DS. An *in vitro* spectroscopic analysis to determine the chemical composition of the precipitate formed by mixing sodium hypochlorite and chlorhexidine. J Endod 2011; 37(7): 983–988. doi: 10.1016/j.joen.2011.03.033.
25. Basrani BR, Manek S, Sodhi RNS, Fillery E, Manzur A. Interaction between sodium hypochlorite and chlorhexidinegluconate. J Endod 2007; 33(8): 966–969. doi: 10.1016/j.joen.2007.04.001.
26. Rasimick BJ, Nekich M, Hladek MM, Musikant BL, Deutsch AS. Interaction between chlorhexidine digluconate and EDTA. J Endod 2008; 34(12): 1521–1523. doi: 10.1016/j.joen.2008.08.039.
27. Barkvoll P, Attramadal A. Effect of nystatin and chlorhexidine digluconate on *Candida albicans*. Oral Surg Oral Med Oral Pathol 1989; 67(3): 279–281. doi: 10.1016/0030-4220(89)90354-X.
28. Fiume MM, Heldreth B, Bergfeld WF, Belsito DV, Hill RA, *et al*. Safety assessment of triethanolamine and triethanolamine-containing ingredients as used in cosmetics. Int J Toxicol 2013; 32(3 Suppl): 59S–83S. doi: 10.1177/1091581813488804.
29. Cosmetic Ingredient Review Expert Panel. Annual review of cosmetic ingredient safety assessments – 2001/2002. Int J Toxicol 2003; 22(Suppl 1): 1–35.
30. Cosmetic Ingredient Review [Internet]. Final Safety Assessment: Crosslinked alkyl acrylates as used in cosmetics. [cited 2015 December 15]. Available from: http://online.personalcarecouncil.org/ctfa-static/online/lists/cir-pdfs/FR583.pdf.
31. Maki DG, Ringer M, Alvarado CJ, Ringer M. Prospective randomised trial of povidone-iodine, alcohol, and chlorhexidine for prevention of infection associated with central venous and arterial catheters. Lancet 1991; 338(8763): 339–343. doi: 10.1016/0140-6736(91)90479-9.
32. Darouiche RO, Wall MJ Jr, Itani KMF, Otterson MF, Webb AL, *et al*. Chlorhexidine-alcohol versus povidone-iodine for surgical-site antisepsis. N Engl J Med 2010; 362(1): 18–26. doi: 10.1056/NEJMoa0810988.
33. Macias JH, Arreguin V, Munoz JM, Alvarez JA, Mosqueda JL, *et al*. Chlorhexidine is a better antiseptic than povidone iodine and sodium hypochlorite because of its substantive effect. Am J Infect Control 2013; 41(7): 634– 637. doi: 10.1016/j.ajic.2012.10.002.
34. Popovich KJ, Lyles R, Hayes R, Hota B, Trick W, *et al*. Relationship between chlorhexidine gluconate skin concentration and microbial density on the skin of critically ill patients bathed daily with chlorhexidine gluconate. Infect Control Hosp Epidemiol 2012; 33(9): 889–896. doi: 10.1086/667371.
35. Adams D, Quayum M, Worthington T, Lambert P, Elliott T. Evaluation of a 2% chlorhexidine gluconate in 70% isopropyl alcohol skin disinfectant. J Hosp Infect 2005; 61(4): 287–290. doi: 10.1016/j.jhin.2005.05.015.
36. DeBaun B. Evaluation of the antimicrobial properties of an alcohol-free 2% chlorhexidine gluconate solution. AORN J 2008; 87(5): 925–933. doi: 10.1016/j.aorn.2008.02.001.
37. Rutter JD, Angiulo K, Macinga DR. Measuring residual activity of topical antimicrobials: Is the residual activity of chlorhexidine an artefact of laboratory methods? J Hosp Infect 2014; 88(2): 113–115. doi: 10.1016/j.jhin.2014.06.010.
38. Marino C, Cohen M. Washington State hospital survey 2000: Gloves, handwashing agents, and moisturizers. Am J Infect Control 2001; 29(6): 422–424. doi: 10.1067/mic.2001.117298.

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REVIEW

Treatment modalities for hyperpigmented skin lesions: A brief overview

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***Abstract*:** Skin hyperpigmentation involves a broad range of skin conditions, including epidermal pigmented lesions, dermal pigmented lesions, and mixed pigmented lesions. Treatment includes various modalities such as brightening cream, chemical peeling, and laser therapy. Responses to various treatment modalities can be quite varied depending on the type of treatment and the degree of pigmentation. Sometimes a lesion can lighten or even partially disappear, while other lesions may recur. This paper provides a brief overview of treatment modalities available for hyperpigmented skin lesions including the importance of photoprotection, various types of brightening creams, suitable types of chemical peels, specific laser therapies targeted for skin hyperpigmentation, and surgery.

***Keywords*:** Skin hyperpigmentation; photoprotection; brightening cream; laser

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Introduction

The management of skin pigmentation disorders poses a significant challenge to both patients and doctors. A doctor's goal to achieve successful elimination of pigmentary lesions rests on two basic principles: 1) minimising detrimental effects of sunlight radiation, and 2) optimising conditions of the pigmentary disorder with available treatment modalities. Although currently available sun protection skin care products are increasingly varied and sophisticated, its primary function remains to reduce the adverse effects of sun radiation.

Skin pigmentation disorders manifest as skin lesions arising from the melanocytic system of the skin. It can be classified as hyperpigmentation lesions (*i.e.*, extrinsic and intrinsic factors imposed on the body that cause excessive pigmentation) or hypopigmentation lesions (*i.e.*, underlying conditions that inhibit pigmentation resulting in decreased melanin production). Pigmentation is the result of melanin pigment production in the melanocytes of the epidermis. Melanin synthesis is stimulated by sunlight and is controlled by the pituitary gland via melanocyte-stimulating hormone (MSH). Melanin synthesis is also influenced by endocrine secretions, including oestrogen and androgen. The number of melanocytes is the same between races; however, the amount of melanin production varies upon stimulation. The melanin in the skin has protective effects from sunlight radiation. The rising trend is that epidermal pigmentation has a direct relationship with the degree of sun exposure. Skin pigmentation affects all ethnic and racial groups; however, skin pigmentation disorders primarily affect fair- skinned populations. The closer the light-skinned races are to the equator, the higher the incidence of skin pigmentation. However, increased pigmentation can be due to causes other than melanin. **Table 1** listed the factors that contribute to hyperpigmentation disorders. Treatment modalities of epidermal melanin-induced hyperpigmentation have

emphasised on not only curative therapy but also preventive measures from sun exposure. The new trend of treating pigmented epidermal lesions has improved exponentially with the advancement of research and development of skin care products and lasers.

Photosensitive pigmentation is commonly localised on areas of the body exposed to the sun, primarily on the face (forehead, cheeks, and upper lip), hands, and back. In darker Asian, and Mediterranean skin types, the appearance of solar lentigines, seborrheic keratosis, and melasma are particularly common. This paper will present a brief overview of the treatment modalities for acquired skin pigmentation.

Table 1. Causes of skin hyperpigmentation

Causes of increased melanin production		**Non-melanin causes**
Acquired	***Congenital/ Inherited***	
Melasma	Mongolian spots	Primary haemochromatosis
Post-inflammatory pigmentation	Naevus of Ota	Hepatic cirrhosis
Solar lentigines	Naevus of Ito	Chronic renal failure
Ephelides	Spindle cell naevus	Alkaptonuria
Lichen planus	Blue naevus	Lamellar ichthyosis
Fixed drug eruption	Halo naevus	Epidermolytic hyperkeratosis
Erythromelanosis follicularis faciei et colli	Café au lait	Drug and heavy metal toxicity
Pellagra	Peutz-Jegher's syndrome	Canthaxanthin
Poikiloderma of Civatte	Albright's syndrome	Pituitary tumours
Riehl's melanosis		

Photoprotection

Sun protection is of utmost importance in the treatment of skin hyperpigmentation. The use of full spectrum sunscreens should be emphasised before, during, and after procedures. Only sunscreen has a confirmed benefit in the treatment of skin hyperpigmentation. Daily use of sunscreen with a sun protection factor (SPF) of at least 15 is valuable for sun protection. Sunscreen must be applied to all exposed skin including the lips, scalp, and ears. Sunscreen should be applied 15–30 min before sun exposure and reapplied every 2 h. The reapplication of sunscreen is required after swimming or heavy sweating. Outdoor activity during peak tanning or burning hours, between 10 a.m. and 4 p.m., should be minimised or avoided. All patients who are active outdoors should wear additional sun-protective apparel to reduce sunlight radiation exposure. Tanning beds could aggravate skin hyperpigmentation.

Brightening agents

Topical brightening agents serve a crucial role in achieving the lightening of skin hyperpigmentation. These are composed of natural or synthetic bleaching components which mainly suppress melanocytic activity and help reduce hyperpigmentation. These agents are commonly used as topical products to achieve optimal results after prolonged application. Commonly used brightening agents include hydroquinone, kojic acid, licorice extract, arbutin, ascorbic acid, glycolic acid, niacinamide, azelaic acid, retinoids, and others.

Hydroquinone

Hydroquinone has the advantage of being well tolerated, easily available with prescription, and inexpensive. These agents are composed of extractions from plants such as tea and coffee, and have an inhibitory effect on tyrosinase which lead to the reduction of melanosomes. Melanocytes are present in the basal layer of the epidermis, producing melanosomes containing melanin which is synthesised from tyrosine with the action of tyrosinase. Hydroquinones are usually combined with tretinoin to achieve optimal depigmentation results. At a concentration of 4%–6%, hydroquinone is effective in treating skin hyperpigmentation, including post-inflammatory hyperpigmentation, melasma, freckles, age spots, and acne scars. However, prolonged use of hydroquinone (for more than three months) has been associated with exogenous ochronosis (persistent blue-black pigmentation) in Fitzpatrick groups V and VI[1].

Kojic acid

Kojic acid is a type of bleaching agent harvested from Japanese fungus, namely *Penicillium* and *Aspergillus*[2]. These bleaching agents are mild inhibitors of the formation of pigments in plant and animal tissues, and are used in cosmetics to brighten skin colour. These bleaching agents have a mild inhibitory action on tyrosinase. Kojic acid at a concentration of 4% or in combination with alpha hydroxy acid (AHA) can cause skin exfoliation to accelerate the lightening result. Kojic acid is used to treat skin disorders such as melasma[3].

Licorice extract

Licorice is the root of *Glycyrrhiza glabra*[4]. Most

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licorices are used as flavouring agents for tobacco, candies, sweeteners, and herbal medicines. The main component of licorice is glabridin which has been reported to prevent ultraviolet light B-induced skin pigmentation. Clinical trials have demonstrated that licorice has promising tyrosinase inhibition and that it has an influence on both melanogenesis and skin inflammation[5,6]. Licorice is very effective in treating post-inflammation hyperpigmentation but it is expensive. Skin hyperpigmentation could be optimised with licorice extract at concentrations ranging from 10%–40%[7]. The reduction of hyperpigmentation is also accelerated when licorice extract is combined with kojic acid and vitamin E in topical applications.

Arbutin

Arbutin is an extract from a bearberry plant of the genus *Arctostaphylos*. It is also found in wheat and *Bergenia crassifolia*[8]. Arbutin has a skin-lightening effect by decreasing both tyrosinase activity and melanin content. Hence, it is used in skin-lightening treatments at concentrations of 3%–7% and has been reported to be effective in treating liver spots and freckles[9]. Hydroquinone has been banned by the European Committee due to the risks of side effects. Arbutin is an alternative and gentler form of hydroquinone. Arbutin has advantages with long-term usage, and it can be used once or twice daily. *In vivo* experimental studies have demonstrated that arbutin is a safe and effective brightening treatment for hyperpigmented lesions[9,10].

Ascorbic acid

Ascorbic acid (vitamin C), derived from fruits and green leafy vegetables, is a type of water-soluble vitamin and is present as a potent antioxidant in human skin[3,11]. Ascorbic acid inhibits melanin synthesis by interfering with the action of tyrosinase. The disadvantages of ascorbic acid are that it is rapidly oxidised, highly unstable, and its hydrophilic property limits its skin penetration[3,12]. Hakozaki *et al.* have demonstrated an enhanced skin-lightening effect by increasing transepidermal penetration and vitamin C efficacy using ultrasound[13].

Glycolic acid

Skin-lightening treatments would have more effective results if preceded by thorough exfoliation. Glycolic acid is derived from sugar cane. It is a weak organic acid, and is reportedly effective in treating solar lentigines, melasma, and post-inflammatory hyperpigmentation[14]. At low concentrations, it promotes exfoliation of pigmented keratinocytes and facilitates brightening cream penetration. However, any brightening cream treatment must be stopped at least three days prior to chemical peeling treatment to prevent complications such as epidermolysis.

Niacinamide (vitamin B_3)

Niacinamide is an amide form of vitamin B_3 (niacin) and is a water-soluble vitamin. It can be found in trace amounts in fish, nuts, mushrooms, and root vegetables[15,16]. Niacinamide has various beneficial medical applications. It has anti-inflammatory actions and may be beneficial to patients with inflammatory skin conditions such as acne vulgaris[17]. Hakozaki *et al.* demonstrated *in vitro* that niacinamide exhibited effective skin-lightening activity by inhibiting the transfer of melanosomes to adjacent keratinocytes by 35%–68%[18,19]. In a clinical study, Navarrete-Solís *et al.* reported that 8 weeks of treatment with 4% niacinamide cream showed good to excellent improvement in 44% of patients with melasma, compared to 55% from a 4% hydroquinone cream treatment[20].

Azelaic acid

Azelaic acid is derived from wheat, rye, and barley. It has been used for treating melasma and post-inflammatory hyperpigmentation. It is an alternative to hydroquinone treatment for skin pigmentation. It works as a tyrosinase inhibitor. A clinical study conducted by Breathnach has shown that a topical application of 20% azelaic acid is superior to 2% hydroquinone in patients with melasma[1,21]. Another clinical trial conducted by Baliña *et al.* found no significant differences between treating melasma with 20% azelaic acid cream and 4% hydroquinone cream. 65% of patients treated with azelaic acid were reported to have achieved good to excellent results versus 73% of patients treated with hydroquinone that achieved similar results[22].

Retinoids

Retinoids are composed of chemical compounds related to vitamin A. It is widely used in medicine, and its beneficial effects are primarily attributed to the regulation of epithelial cell growth. Topical applications of these agents are indicated for dermatological conditions with increased cell turnover such as psoriasis[23] and inflammatory skin disorders such as acne[24]. Retinoids are also ideal for treating photoaging and skin wrinkles[25,26]. The inhibition of tyrosinase action provides an effective environment for reducing

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hyperpigmentation. Other mechanisms of action include a dispersion of pigmented granules in keratinocytes, a reduction in pigment transfer, and an acceleration of epidermal exfoliation[27]. Retinoids are suitable as long-term medications and have favourable safety profiles. When applying topical retinoids, a 0.025% concentration should be utilised initially as local adverse effects, including erythema, pruritus, and dryness, occur frequently during the early treatment phase[28]. Subsequently, treatment can be increased gradually every week up to a daily use of the cream at a concentration of 0.1%. Pathak *et al.* demonstrated that the treatment of melasma should include a topical formulation of cream containing 2% hydroquinone and 0.05% to 0.1% retinoic acid[29].

Other active ingredients

Other ingredients under *in vitro* investigation include linoleic acid which is an unsaturated fatty acid, extracts from a type of Chilean snail, *Helix aspersa*, and lumixyl which is a synthetic oligopeptide that exhibits inhibitory activity against human tyrosinase.

Chemical peels

Chemical peeling is a popular option for facial rejuvenation and treatment of superficial hyperpigmentation. A wide spectrum of chemical peels is available, producing variable effects on the skin. Fine and coarse facial rhytides and uneven skin pigmentations that are not effectively treated surgically can be treated with chemical peels. Chemical peeling affects the epidermis and superficial dermis by smoothing irregularities and altering skin pigmentation. Different solutions are used to target skin injury at specific depths, resulting in the removal of damaged skin with pigmentation. Superficial and medium-depth chemical peels are desirable due to their safety records, effectiveness, relatively low costs, and rapid recovery times. Major indications for chemical peel treatments are solar lentigines and other signs of photodamage including rhytides, scarring, actinic keratosis, melasma, and acne vulgaris. In the early phase of photodamage, skin which exhibits pigmentary changes without wrinkles will respond effectively to repetitive superficial peels[30]. Lesions arising from deeper layers of the skin, such as actinic keratosis and melasma, require treatment with one or more medium-depth peels.

All patients should be adequately prepared prior to chemical peeling. Gentle facial washing is required prior to a superficial chemical peel. For medium peels, residual oils, make-up, and debris must be removed thoroughly prior to applying chemical peel solutions. The following discussion will specifically provide an overview of chemical peeling solutions suitable for treating skin hyperpigmentation.

Glycolic acid at 20%–70%

Glycolic acid peels use materials derived from sugar-cane. Weekly or biweekly peels using 40%–70% unbuffered glycolic acid is a method of superficial peeling. Penetration depth is related to the concentration and duration of the treatment. A patient's skin will naturally develop tolerance to glycolic acid peels. Therefore, a regime should start with a low-strength glycolic peel of 20%–30% applied for 2 min. Patient's level of pain and erythema are the two main factors determining the endpoint of glycolic acid peels. A typical peel regime includes 6 peels with each peel one month apart. At subsequent visits, patient's tolerance to pain and their recovery time can be evaluated. If the patient tolerated the previous glycolic acid peel well, the subsequent peel can be escalated to 40%–50% glycolic acid, or maintained at the same concentration of the previous glycolic acid peel (*i.e.*, 20%–30%) and left on the skin longer, for approximately 5–6 min. Glycolic acid peels require dilution with water or neutralisation with 5% sodium bicarbonate[31]. Glycolic acid is found in many cosmetics at low concentrations. A low concentration of glycolic acid may be used as a primer for a chemical peel or for laser resurfacing.

Salicylic acid at 20%–30%

Salicylic acid is a type of beta-hydroxy acid. It has an anti-inflammatory effect and thus helps to diminish inflammation-induced hyperpigmentation. Joshi *et al.* demonstrated that salicylic acid peels at 20% to 30% are safe and clinically effective for patients with Fitzpatrick skin types IV to VI and post-inflammatory hyperpigmentation[32]. Salicylic acid peels can remove the stratum corneum and stratum granulosum with an exfoliation process. This will stimulate the generation of new epithelium. Kligman *et al.* demonstrated that single and multiple salicylic acid peels at 30% applied at 4-week intervals resulted in significant improvements of pigmentation in patients with moderately photodamaged skin[33].

Blue peel

Variable results often occur with various chemical peels due to lack of control over the depth of the peel. Trichloroacetic acid (TCA)-based blue peel facilitates the

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treatment of the papillary dermis and immediate reticular dermis. TCA-based blue peel is formed by mixing TCA at a fixed concentration (15%–20%) and volume with the blue peel base which contains glycerine, saponins, and a non-ionic blue colour base. This forms a homogenous TCA-oil-water solution for slow penetration and an even coating. An even blue colour demonstrates the uniformity of an application. Hence, the depth of the peel can be easily recognisable. Blue peel has no systemic side effects or toxicity[34].

Frosting occurs as a result of protein denaturation and coagulation. Pink frost develops as the papillary dermis is reached. This will become white frosting as the peel acts at the immediate reticular dermis. The time required for the blue peel solution to begin exerting its action due to initial acid neutralisation by dermal protein is approximately 2 min. Erythema will last for 3–7 days. The use of topical antibiotics and acyclovir should be considered as bacterial and viral infections are common. With increasing peel depth, scarring and pigment change become more likely. A typical regime includes two or three blue peels, and the peels are typically spaced 6–8 weeks apart for maximum effect.

Lasers

Lasers are based on Einstein's theory of stimulated emission of radiation. In 1960, Theodore Harold Maiman invented and developed light amplification by stimulated emission of radiation (LASER) using a synthetic ruby crystal[35]. Maiman's invention led to the subsequent development of various types of lasers. Laser resurfacing removes discolourations, age spots, and photodamaged skin. There are specific lasers for pigmented skin lesions such as lasers with blue, green, red, and near-infrared wavelengths. Various laser systems can be applied to treat skin hyperpigmentation (**Table 2**). However, lasers should be applied with caution as they will result in paradoxical effect of hyperpigmentation following treatment if no proper information was given to patients.

Continuous wave lasers

Continuous wave lasers supply an uninterrupted beam of laser light without pulses. Long exposures to these lasers can result in thermal damage to adjacent tissues.

Argon lasers

An argon laser at a wavelength of 514 nm produces blue-green light. Continuous wave argon lasers and argon lasers are pulsed using a mechanical shutter target melanin. Therefore, argon lasers have been used in the past to treat port-wine stains and superficial pigmentation[36]. However, scarring and depigmentation are commonly observed in argon laser-treated lesions. These unwanted side effects are due to the strong absorption of argon lasers by melanin and the diffusion to surrounding tissues.

Table 2. Various laser resurfacing systems for treating skin hyperpigmentation

Laser types	Wavelength (nm)	Clinical Applications
Continuous wave		
Argon	514	Birthmarks, port wine stains
Flashlight-pumped pulsed dye (green)	510	Benign epidermal pigmented lesions
Copper vapour	511	Lentigines
Krypton	520	Epidermal pigmented lesions
KTP:YAG	532	Benign pigmented lesions
CO_2 (pulsed)	10,600	Various epidermal and dermal lesions
Quality-switched (Q-switched)		
Ruby	694	Benign pigmented lesions, dark tattoos
Alexandrite	755	Benign pigmented lesions, dark tattoos
Nd:YAG	1,064	Pigmented dermal lesions, dark tattoos

Flashlight-pumped pulsed dye lasers (green)

Flashlight-pumped pulsed dye lasers (green) (FPPDLs) are delivered in short single pulses or a train of pulses at high peak powers. These green-dyed lasers contain fluorescent dyes which are absorbed in water and alcohol. Therefore, the 510 nm wavelength is absorbed well by melanin, making it suitable for treating benign pigmented skin lesions[36]. It penetrates to a depth of 0.75–1.0 mm. In Fitzpatrick V–VI skin, this treatment may damage melanocytes, leading to hypopigmentation.

Copper vapour lasers

Copper vapour lasers generate light at a wavelength of 511 nm, similar to that of FPPDLs, but the pulses are much shorter at 22 ns compared with 450 μs for FPPDLs. These continuous wave copper vapour lasers emit pulses at very high frequencies (5,000–15,000 Hz). Therefore, these lasers present a higher risk of hypertrophic scarring[37]. Copper vapour lasers at 511 nm have been effective in treating lentigines.

Krypton lasers

Krypton lasers are a type of continuous wave lasers.

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These lasers emit light at 520 nm (green) which is effective for treating pigmented epidermal lesions[36]. The common problem with krypton lasers is the heating of the skin surface due to strong scattering of light. Hence, skin cooling prior and during this procedure is of utmost importance.

KTP:YAG lasers

Potassium-titanyl-phosphate (KTP) lasers have a wavelength of 532 nm which targets melanin. These lasers are effective in treating benign skin hyperpigmentation such as melasma. In cases of melasma, KTP functions by generating gentle heat in melanosomes with long pulses (millisecond) rather than causing mechanical destruction of the target chromophores. KTP lasers greatly reduce redness and pigmentation compared to Nd:YAG lasers in patients requiring skin rejuvenation[38].

CO_2

The active laser medium is a mixture of carbon dioxide, nitrogen, and helium gases. This combination of gases generates a laser beam with a wavelength of 10,600 nm which is in the middle of the infrared spectrum and is therefore invisible. With a hand piece, the beam is aimed to transmit helium ion light. The target chromophore of the CO_2 laser is water. The laser spot is focused at a depth of 0.1–2.0 mm in the skin, and the specific amount of thermal build-up determines whether the treatment results in ablation, cutting or coagulation at the cellular level. The mainstay of CO_2 laser is ablative tissue resurfacing; therefore, it is effective for both benign epidermal and dermal hyperpigmentation such as various benign naevi[39].

Quality-switched (Q-switched) lasers

When one of the resonating mirrors is non-reflective for an interval of pumping, the stored energy is emitted at extremely high levels of laser energy in a nanosecond. These lasers allow thermal relaxation time; therefore, these lasers carry very little collateral damage to the adjacent tissue and subsequent scarring is rare[40,41]. Taylor *et al*. demonstrated the mechanism of pigment removal via laser application[42]. The short pulses of high energy cause rapid thermal expansion of the pigment granules and result in photoacoustic fragmentation of the pigments. These fragments are then removed by redistribution, transepidermal elimination, and phagocytosis[41]. The advantages of laser treatment include greater precision, higher efficacy, and lesser scarring than other treatment modalities. However, suspicious pre-malignant and malignant skin lesions are absolute contraindications for laser treatment. Multiple laser treatment sessions are required at 3–4 weeks intervals. Typically, 5 to 6 treatments are performed to achieve noticeable results. Minimal erythema and oedema are commonly noted immediately after laser treatment, and tend to resolve several hours thereafter.

Q-switched ruby lasers

The ruby laser was the first laser developed. It was initially a continuous wave and was then developed to be Q-switched. Q-switched ruby lasers emit light at a wavelength of 694 nm which is useful for treating epidermal and dermal pigmented lesions[43].

Q-switched alexandrite

Alexandrite laser uses a Q-switching system and emits light at a wavelength of 755 nm which is effective in treating benign pigmented lesions such as freckles[44].

Nd:YAG lasers

The neodymium: yttrium aluminium garnet (Nd:YAG) laser emits light in the near-infrared band at a wavelength of 1,064 nm. Q-switched Nd:YAG lasers function by a mechanism similar to that of Q-switched ruby lasers. However, it was developed to avoid melanin absorption and further reduce the resulting hypopigmentation that is common with Q-switched ruby laser treatments. It has multiple clinical applications including treating pigmented lesions and tattoos[45-49].

Frequency-doubled Nd:YAG lasers

When fitted with a K-diphosphate crystal which doubles the frequency and halves the wavelength to 532 nm, Q-switched Nd:YAG lasers are effective in treating epidermal hyperpigmented lesions[43] and red, orange, and yellow tattoos. It is uncommon to have complications with repeated treatments.

Skin preconditioning is an essential part of laser therapy for skin hyperpigmentation. Applications of retinoic acid (vitamin A) with glycolic acid preconditioning regimes are often used before laser resurfacing or chemical peels. These agents increase skin metabolism, accelerate cellular division, boost collagen synthesis, and reduce the thickness of stratum corneum. In doing so, subsequent therapies are more effective. Tretinoin 0.005% (Renova) is a topical agent that is effective for treating photodamaged skin and mottled pigmentation[50]. Pretreatment with retinoids may help to reduce post-treatment hyperpigmentation but it may contribute to

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postoperative erythema. It is also contraindicated during early pregnancy due to its teratogenic effect. Renova is an excellent treatment for solar-induced lentigines on the dorsum of the hands. Overall, laser therapy for skin hyperpigmentation is an expensive consumable.

Surgery

Surgery is indicated for dermatologic lesions such as large congenital naevus, dysplastic naevi syndrome, melanoma, pre-malignant skin lesions, and malignant skin lesions.

Discussion

With rapid development of cosmetic products, skin procedures, and medical devices, the desire to have beautiful skin is achievable. Skin rejuvenation can be achieved by improving external appearances without complications. However, there are several important factors that should be taken into consideration in patient evaluation of hyperpigmentation disorders. These include specific skin type, skin complexion based on the Fitzpatrick scale, skin texture, skin thickness, degree of photoaging, severity of facial rhytides, aesthetic outcome, relative cost of treatment, patient expectation, and time consumption.

The purpose of treating hyperpigmentation lesions is to control local factors that result in excessive melanin production. The ideal treatment for hyperpigmentation lesion would achieve this goal by applying the following effects:

1. Eliminate melanin-induced hyperpigmentation;
2. Protect skin against further injury from sun radiation and post-inflammation hyperpigmentation;
3. Reduce oedema and erythema;
4. Promote integrity of the surrounding tissue.

There are numerous medical-grade brightening agents and sun protection agents available. In addition, there are different types of laser therapies available to treat hyperpigmentation disorders. The purpose of treating hyperpigmentation is to develop an optimal treatment that eliminates pigmentary lesions. Non-surgical methods are the most desirable methods. Among non-surgical methods, non-invasive treatments are the most sought after. In contrast with invasive treatments, no downtime is required after non-invasive procedures. Generally, hyperpigmented lesion treatments can be categorised into five groups: 1) photoprotection, 2) topical brightening agents, 3) chemical peeling, 4) laser therapy, and 5) surgery.

Conclusion

Skin hyperpigmentation is a very common skin disorder in all Fitzpatrick skin types. Various treatment modalities have been studied and have shown improvements in reducing pigmentation. However, no single treatment is effective for all types of dermal hyperpigmentation. A brief overview of the treatment modalities for hyperpigmentation has been provided. Patients with long-standing hyperpigmentation will need to undergo continued treatment depending on the duration of treatment, cost, patients' compliance, and clinicians' experience. Laser treatments and chemical peels remain popular for the treatment of skin hyperpigmentation. These treatments can achieve good synergistic results in combination with brightening creams. Lastly, clinicians should educate patients about the importance of photoprotection to optimise treatment.

Conflict of interest

The authors declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

References

1. Draelos ZD. Skin lightening preparations and the hydroquinone controversy. Dermatol Ther 2007; 20(5): 308–313. doi:10.1111/j.1529-8019.2007.00144.x.
2. Bentley R. From miso, sake and shoyu to cosmetics: A century of science for kojic acid. Nat Prod Rep 2006; 23(23): 1046–1062. doi: 10.1039/B603758P.
3. Badreshia-Bansal S, Draelos ZD. Insight into skin lightening cosmeceuticals for women of color. J Drugs Dermatol 2007; 6(1): 32–39.
4. Licorice [Internet]. Merriam-Webster's Medical Dictionary: Merriam-Webster, Inc.; 2007 [cited 2015 Dec 1]. Available from: www.merriam-webster.com/dictionary/licorice.
5. Halder RM, Nordlund JJ. Topical treatment of pigmentary disorders. 2nd ed. In: Nordlund JJ, Boissy RE, Hearing VJ, Hearing RA, King WS, *et al*., (editors). The pigmentary system: physiology and pathophysiology. Oxford: Blackwell Publishing Ltd; 2006. p. 1165–1174. doi: 10.1002/9780470987100.ch59.
6. Picardo M, Carrera M. New and experimental treatments of cloasma and other hypermelanoses. Dermatol Clin 2007; 25(3): 353–362. doi: 10.1016/j.det.2007.04.012.
7. Yokota T, Nishio H, Kubota Y, Mizoguchi M. The inhibitory effect of glabridin from licorice extracts on melanogenesis and inflammation. Pigment Cell Res 1998;

doi: 10.18282/jsd.v1.i2.35

11(6): 355–361. doi: 10.1111/j.1600-0749.1998.tb0049 4.x.

8. Pop C, Vlase L, Tamas M. Natural resources containing arbutin. Determination of arbutin in the leaves of *Bergenia crassifolia* (L.) Fritsch acclimated in Romania. Not Bot Hort Agrobot Cluj Napoca 2009; 37(1): 129–132.
9. Boissy RE, Visscher M, DeLong MA. DeoxyArbutin: A novel reversible tyrosinase inhibitor with effective *in vivo* skin lightening potency. Exp Dermatol 2005; 14(8): 601–608. doi: 10.1111/j.0906-6705.2005.00337.x.
10. Hamed SH, Sriwiriyanont P, deLong MA, Visscher MO, Wickett RR, *et al*. Comparative efficacy and safety of deoxyarbutin, a new tyrosinase-inhibiting agent. J Cosmet Sci 2006; 57(4): 291–308.
11. Colby SI, Schwartzel EH, Huber FJ, Highton A, Altman DJ, *et al*. A promising new treatment for solar lentigines. J Drugs Dermatol 2003; 2(2): 147–152.
12. Briganti S, Camera E, Picardo M. Chemical and instrumental approaches to treat hyperpigmentation. Pigment Cell Res 2003; 16(2): 101–110. doi: 10.10 34/j.1 600-0749.2003.00029.x.
13. Hakozaki T, Takiwaki H, Miyamoto K, Sato Y, Arase S. Ultrasound enhanced skin-lightening effect of vitamin C and niacinamide. Skin Res Technol 2006; 12(2): 105–113. doi: 10.1111/j.0909-752X.2006.00186.x.
14. Zhu W, Zhang R. Skin lightening agents. In: Draelos ZD, Thaman LA, (editors). Cosmetic formulation of skin care products. New York: Taylor and Francis Group LLC; 2005. p. 205–218.
15. Zhu W, Gao J. The use of botanical extracts as topical skin-lightening agents for the improvement of skin pigmentation disorders. J Investig Dermatol Symp Proc 2008; 13(1): 20–24. doi: 10.1038/jidsymp.2008.8.
16. Rolfe HM. A review of nicotinamide: Treatment of skin diseases and potential side effects. J Cosmet Dermatol 2014; 13(4): 324–328. doi: 10.1111/jocd.12119.
17. Niren NM. Pharmacologic doses of nicotinamide in the treatment of inflammatory skin conditions: A review. Cutis 2006; 77(1 Suppl): 11–6.
18. Greatens A, Hakozaki T, Koshoffer A, Epstein H, Schwemberger S, *et al*. Effective inhibition of melanosome transfer to keratinocytes by lectins and niacinamide is reversible. Exp Dermatol 2005; 14(7): 498–508. doi: 10.1111/j.0906-6705.2005.00309.x.
19. Hakozaki T, Minwalla L, Zhuang J, Chhoa M, Matsubara A, *et al*. The effect of niacinamide on reducing cutaneous pigmentation and suppression of melanosome transfer. Br J Dermatol 2002; 147(1): 20–31. doi: 10.1046/j.1365-213 3.2002.04834.x.
20. Navarrete-Solís J, Castanedo-Cázares JP, Torres-Álvarez B, Oros-Ovalle C, Fuentes-Ahumada C, *et al*. A double-blind, randomized clinical trial of niacinamide 4% versus hydroquinone 4% in the treatment of melasma. Dermatol Res Pract 2011; 379173. doi: 10.1155/2011/ 379173.
21. Breathnach AS. Melanin hyperpigmentation of skin: Melasma, topical treatment with azelaic acid, and other therapies. Cutis 1996; 57(1 Suppl): 36–45.
22. Baliña LM, Graupe K. The treatment of melasma 20% azelaic acid versus 4% hydroquinone cream. Int J Dermatol 1991; 30(12): 893–895. doi: 10.1111/j.1365-43 62.1 991.tb04362.x.
23. Saurat JH. Retinoids and psoriasis: Novel issues in retinoid pharmacology and implications for psoriasis treatment. J Am Acad Dermatol 1999; 41(Suppl 3): S2–S6. doi: 10.1016/S0190-9622(99)70358-0.
24. Thielitz A, Gollnick H. Topical retinoids in acne vulgaris. Am J Clin Dermatol 2008; 9(6): 369–381. doi: 10.2165/01 28071-200809060-00003.
25. Stefanaki C, Stratigos A, Katsambas A. Topical retinoids in the treatment of photoaging. J Cosmet Dermatol 2005; 4(2): 130–134. doi: 10.1111/j.1473-2165.2005.40215.x.
26. Mukherjee S, Date A, Patravale V, Korting HC, Roeder A, *et al*. Retinoids in the treatment of skin aging: An overview of clinical efficacy and safety. Clin Interv Aging 2006; 1(4): 327–348.
27. Nair X, Parah P, Suhr L, Tramposch KM. Combination of 4-hydroxyanisole and all-trans retinoic acid produces synergistic skin depigmentation in swine. J Invest Dermatol 1993; 101(2): 145–149.
28. Solano F, Briganti S, Picardo M, Ghanem G. Hypopigmenting agents: An updated review on biological, chemical and clinical aspects. Pigment Cell Melanoma Res 2006; 19(6): 550–571. doi: 10.1111/j.1600-0749.200 6.00334.x.
29. Pathak MA, Fizpatrick TB, Kraus EW. Usefulness of retinoic acid in the treatment of melasma. J Am Acad Dermatol 1986; 15(4): 894–899. doi: 10.1016/S0190-962 2(86)70247-8.
30. Glogau RG. Chemical peeling and aging skin. J Geriatr Dermatol 1994; 2: 30–35.
31. Branham GH, Thomas JR. Rejuvenation of the skin surface: Chemical peel and dermabrasion. Facial Plast Surg 1996; 12(2): 125–133. doi: 10.1055/s-0028-1082404.
32. Joshi SS, Boone SL, Alam M, Yoo S, White L, *et al*. Effectiveness, safety, and effect on quality of life of topical salicylic acid peels for treatment of postinflammatory hyperpigmentation in dark skin. Dermatol Surg 2009; 35(4): 638–644. doi: 10.1111/j.1524-4725.2009.01103.x.
33. Kligman D, Kligman AM. Salicylic acid peels for the

doi: 10.18282/jsd.v1.i2.35

treatment of photoaging. Dermatol Surg 1998; 24(3): 325–328. doi: 10.1111/j.1524-4725.1998.tb04162.x.
34. Obagi ZE, Obagi S, Alaiti S, Stevens MB. TCA-based blue peel: A standardized procedure with depth control. Dermatol Surg 1999; 25(10): 773–780. doi: 10.1046/j.1524- 4725.1999.98178.x.
35. Low DW, Percec I. Lasers in plastic surgery. In: Thorne CH, Chung KC, Gosain AK, Gurtner GC, Mehrara BJ, *et al*. (editors). Grabb and Smith's plastic surgery. Philadelphia: Lippincott Williams & Wilkins; 2013. p.163–172
36. Goldberg DJ. Laser treatment of pigmented lesions. Dermatol Clin 1997; 15(3): 397–407. doi: 10.1046/j.1524-4725.1999.98178.x.
37. Chung JH, Koh WS, Lee DY, Lee YS, Eun HC, *et al*. Copper vapour laser treatment of port-wine stains in brown skin. Australas J Dermatol 1997; 38(1): 15–21. doi: 10.1111/j.1440-0960.1997.tb01092.x.
38. Lee MWC. Combination 532-nm and 1064-nm lasers for noninvasive skin rejuvenation and toning. Arch Dermatol 2003; 139(10): 1265–1276. doi: 10.1001/archderm.139.10.1265.
39. Fitzpatrick RE, Goldman MP, Satur NM, Tope WD. Pulsed carbon dioxide laser resurfacing of photoaged facial skin. Arch Dermatol 1996; 132(4): 395–402. doi: 10.1001/archderm.1996.03890280047007.
40. Reid WH, McLeod PJ, Ritchie A, Ferguson-Pell M. Q-switched ruby laser treatment of black tattoos. Br J Plast Surg 1980; 36(4): 455–459. doi: 10.1016/0007-1226(83)90128-5.
41. Laub DR, Yules RB, Arras M, Murray DE, Crowley L, *et al*. Preliminary histopathological observation of Q-switched ruby laser radiation on dermal tattoo pigment in man. J Surg Res 1968; 8(5): 220–224. doi: 10.1016/0022-4804(68)90090-5.
42. Taylor CR, Gange RW, Dover JS, Flotte TJ, Gonzalez E, *et al*. Treatment of tattoos by Q-switched ruby laser: A dose-response study. Arch Dermatol 1990; 126(7): 893–899. doi: 10.1001/archderm.1990.01670310055007.
43. Tse Y, Levine VJ, Mcclain SA, Ashinoff R. The removal of cutaneous pigmented lesions with the Q-switched ruby laser and the Q-switched neodymium: yttrium-aluminum-garnet laser. J Dermatol Surg Oncol 1994; 20(12): 795–800. doi: 10.1111/j.1524-4725.1994.tb03707.x.
44. Jang KA, Chung EC, Choi JH, Sung KJ, Moon KC, *et al*. Successful removal of freckles in Asian skin with a Q-switched alexandrite laser. Dermatol Surg 2000; 26(3): 231–234. doi: 10.1046/j.1524-4725.2000.09243.x.
45. Ross EV, Naseef G, Lin C, Kelly M, Michaud N, *et al*. Comparison of responses of tattoos to picosecond and nanosecond Q-switched neodymium: YAG lasers. Arch Dermatol 1998; 134(2): 167–171. doi: 10.1001/archderm.134.2.167.
46. Suzuki H. Treatment of traumatic tattoos with the Q-switched neodymium: YAG laser. Arch Dermatol 1996; 132(10): 1226–1229. doi: 10.1001/archderm.1996.03890340090014.
47. Stratigos AJ, Dover JS, Arndt KA. Laser treatment of pigmented lesions-2000: How far have we gone? Arch Dermatol 2000; 136(7): 915–921. doi: 10.1001/archderm.136.7.915.
48. Citron BS. Laser treatment of pigmented lesions. Clin Plast Surg 2000; 27(2): 193–198.
49. Kilmer SL. Laser eradication of pigmented lesions and tattoos. Dermatol Clin 2002; 20(1): 37–53. doi: 10.1016/S0733-8635(03)00057-3.
50. Griffiths CEM, Goldfarb MT, Finkel LJ, Roulia V, Bonawitz M, *et al*. Topical tretinoin (retinoid acid) treatment of hyperpigmented lesions associated with photoaging in Chinese and Japanese patients: A vehicle-controlled trial. J Am Acad Dermatol 1994; 30(1): 76–84. doi: 10.1016/S0190-9622(94)70011-7.

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REVIEW

Frontier in hair loss and trichoscopy: A review

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***Abstract*:** Skin surfaces have always been examined using dermoscopy, a familiar tool which is useful to magnify and examine skin especially in cases of pigmented skin lesions. However, to examine the hair and scalp, a practical tool called trichoscopy has surfaced recently and has proven to be handy and functional in diagnosing most hair-related diseases. It is also referred to as dermoscopy of the hair and the scalp. It can aid in assessing active diseases in the scalp and hair, such as yellow dots, dystrophic hairs, cadaverized black dots, white dots, and exclamation mark hairs – all of which denote specific criteria for hair diseases. Trichoscopy is a very newly developed non-invasive technique for hair image analysis. It permits non-invasive visualization of hair shafts at higher intensification (about ×70 and ×100) and enables measurement of hair shaft width without the need for removing hair for diagnostic reasons. Moreover, it helps *in vivo* visualization of the epidermal portion of hair follicles and perifollicular epidermis (orifices). Consequently, it is valuable as it permits the inspection of structures that are otherwise not seen by the naked eye. Trichoscopy is the new frontier for the diagnosis of hair and scalp disease. Nowadays, a trichoscope is considered a must for dermatologists and it is a hot topic in the treatment of hair diseases. There is pooled evidence that the utilization of trichoscopy in the clinical setting for evaluating hair disorders can improve its diagnostic capability beyond simple clinical scrutiny. Trichoscopy can identify both hair shaft and hair opening abnormalities without the need for hair sampling, as well as distinguish between different scalp and hair diseases. Furthermore, it can give easy and quick evaluation of the hair with a follow-up to determine progress and prognosis of the disease with photos. It can also aid in some genetic hair shaft dystrophies such as trichorrhexis nodosa, trichorrhexis invaginata, monilethrix, pili annulati, and pili torti. The limitation of trichoscopy is that it needs prior knowledge to apply it effectively in order to mandate an efficient use by correctly interpreting the findings and their significance. In cases where there are unsettled discrepancies, a histopathological investigation is needed. The interest in trichoscopy has vastly increased and has become an indispensable tool in evaluating patients with hair loss. The aim of this review is to supplement existing knowledge on trichoscopy with recent readings of different scalp and hair conditions that are commonly encountered in clinical settings.

***Keywords*:** Hair loss; alopecia; non-cicatricial hair loss; cicatricial hair loss; diagnosis; dermoscopy; scalp dermoscopy; hair; anisotrichosis; trichoscopy

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Introduction

Normal terminal hair is uniform in its thickness and color throughout the length (**Figure 1**). The width of normal hair is usually more than 55 mm. Terminal hairs may have medullae that are continuous, interrupted, fragmented or absent (**Figure 2**). Up to 10% of normal human scalp hair is made up of vellus hairs which lack the medulla[1]. Trichoscopy of normal scalp illustrates follicular units composing of 2–4 terminal hairs and 1–2 vellus hairs[1,2].

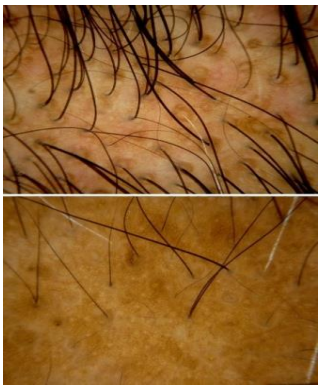

Figure 1. Normal scalp and hair

Figure 2. No diversity of hair shaft diameter[1,2]

There are many hair-related diseases of the scalp which reflect how they affect the hair. Most dermatological clinics are crowded with complaints related to hair loss, mostly from women. With the progress of hair loss over time, it may become cosmetically unacceptable and psychologically frustrating to patients. Losing hair is not usually a health-threatening condition. Nevertheless, it can affect a patient's self-esteem by inflicting enormous psychological and emotional distress. Trichoscopy aids in visualizing hair at working magnifications of 20-fold to 70-fold and up to 160-fold[2-7].

Trichoscopy has recently aid in rapid diagnosis of some genetic hair shaft dystrophies, namely trichorrhexis nodosa, trichorrhexis invaginata, monilethrix, pili annulati, and pili torti, in addition to pediatric patchy scalp hair loss conditions such as tenia capitis and aleopecia areata, as these show specific trichoscopic features[5-7] that necessitate immediate medication rather than awaiting cultures which would take days to reveal results (**Table 1**, **Diagram 1**). Trichoscopy is a rapid, simple, valuable, and non-invasive effective tool, saving time and money to reach a precise diagnosis and proposes immediate treatment[5,8-10].

Furthermore, trichoscopy is a novel, sensitive, and underutilized means which facilitates the visualization of the surface and constitutes color outlines of scalp and hair[9,10]. It provides rapid detection of scalp and hair disorders with advanced diagnostic accuracy, predicts the course of the disease, and decreases the unnecessary need for biopsies. It can generally alienate hair signs, vascular patterns, pigment patterns, and interfollicular patterns, all of which can denote specific diseases and aid in making proper diagnoses[6-8].

Recently, its tasks were stretched out to assist in diagnosing some inflammatory scalp conditions such as lichen planopilaris (LPP), scalp psoriasis, and discoid lupus erythematosus (DLE). Trichoscopy can help differentiate between different categories of hair loss, namely cicatricial and non-cicatricial alopecias and hair shaft disorders where trichoscopic examinations and findings are distinctive. In addition, trichoscopy will avoid unnecessary invasive scalp biopsies. However, if a biopsy is mandatory, trichoscopy can aid in assessing the active biopsy sites following hair and scalp disorders[1-6].

Chief applications of trischoscopy

The main clinical classifications, as well as trichoscopic findings and recognitions, were presented in **Tables 1** and **2**, **Diagram 2**, and **Chart 1**.

Non-cicatricial alopecias: Female pattern hair loss (FPHL), telogen effluvium (TE), androgenetic alopecia (AGA), alopecia areata (AA), alopecia areata incognita (AAI), scalp psoriasis and seborrheic dermatitis, tinea capitis (TC), trichotillomania (TTM), traction alopecia, temporal triangular alopecia (TTA), and syphilitic alopecia.

Cicatricial alopecias: LPP, DLE, frontal fibrosing alopecia (FFA), folliculitis decalvans (FD), tufted folliculitis (TF), dissecting cellulitis (DC), and Pseudopelade of Brocq (PPB).

The main genetic hair shafts disorders with their main trichosopic readings are as shown in **Diagram 1**: Trichorrhexis nodosa (brush fractures), trichorrhexis invaginata (shafts nodes), monilethrix (beaded shaft), pili annulati (ringed hair), and pili torti (twisted shafts).

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Table 1. Summary of trichoscopic findings and readings about Alopecia

Non-cicatricial alopecia	Cicatricial alopecia
Presence of empty follicular openings is a common trichoscopy finding.	Trichoscopy shows milky-red or ivory-white areas lacking follicular openings in all forms.
Female pattern hair loss (FPHL) The presence of hair with different caliber is typical of FPHL and reflects progressive hair miniaturization due to the disease.	**Lichen planopilaris (LPP)** Shows perifollicular inflammation (spare intervening follicles), tubular perifollicular scaling, elongated, concentric blood vessels, and "classic white dots (WD)", which merge to form white areas.
Telogen effluvium (TE) Presence of empty hair follicles over entire scalp, one follicular hair unit dominance and perifollicular discoloration (perpilar sign), and upright short hair regrowth.	**Discoid lupus erythematosus (DLE)** Atrophy, complete follicle paucity, scattered dark-brown discoloration of the skin, large hyperkeratotic folliculilar yellow dots (YD) and thick large arborizing vessels, and follicular red dots.
Androgenetic alopecia (AGA) Hair shaft thickness heterogeneity, multiple thin and vellus hairs, peripilar halo, YD, perifollicular discoloration, and predominance of follicular units with only one hair. These features predominate in the frontal area. Sebaceous gland hypertrophy.	**Frontal fibrosing alopecia (FFA)** Mild perifollicular scaling, absence of follicular opening, follicular hyperkeratosis, follicular plugs, and erythema.
Alopecia areata (AA) Uniform black dots (BD) and micro-exclamation mark hairs and tapered hairs correlate with disease activity, whereas YD and vellus hairs correlate with disease severity.	**Folliculitis decalvans (FD) and tufted folliculitis (TF)** Tufted hairs (polytrichia), perifollicular erythema, large follicular pustules with emerging hair shafts and perifollicular starburst pattern hyperplasia (doll hair).
Alopecia Areata Incognita (AAI) Numerous diffuse YD of different size and uniform colors within the follicular orifices of both empty and hair-bearing with a large number of re-growing of tapered terminal hairs in the entire scalp	**Dissecting cellulitis (DC)** "3D" YD imposed over dystrophic hairs, large, yellow amorphous areas, and pinpoint WD with a whitish halo.
Scalp psoriasis Regularly distributed twisted and lacelike blood vessels.	**Pseudopelade of Brocq** Nonspecific. It is as white areas with no follicular openings. Also some solitary dystrophic hairs can be seen at the periphery of the lesion.
Seborroic dermatitis Thin arborizing vessels may be observed.	
Tinea capitis (TC) Comma shaped, zigzag, corkscrew hairs, BD, and short broken hairs. Zigzag shaped hairs are the diagnostic trichoscopic features of tinea capitis.	
Trichotillomania (TTM) Trichoptilosis "longitudinal split ends" and irregular coiled hairs, hair shafts of variable length, coiled fractured hair shafts. Additionally some other findings, BD, flame hair, V-sign, follicular hemorrhages, tulip hair, and hair powder.	
Traction alopecia It shares some features of TMM with some hair casts, WD lacking follicular opening, hair thinning, and decreased hair density.	
Temporal triangular alopecia (TTA) Normal follicle orifices with vellus hair surrounded by terminal hair.	
Syphilitic alopecia BD, focal atrichia, hypopigmentation of hair shaft, empty ostia of hair follicle, and YD.	

Non-cicatricial alopecias

Female pattern hair loss

It is usually present with visible patterns of hair loss, thus making a bedside diagnosis likely doable[11-13].

Trichoscopic findings: According to Bhamla *et al*., the presence of hair at different statures is typical of FPHL and reflects progressive hair miniaturization due to the disease (about 75% anisotrichosis on trichoscopy)[12]. The presence of more than six vellus hairs in the frontal scalp at 20-fold magnification can be used as an additional criterion of FPHL (**Figure 3**)[5].

Telogen effluvium

It is a self-limiting, abrupt diffuse hair loss (on the entire scalp) and thinning process with premature development

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Diagram 1. Genetic hair shafts dystrophies and the main trichoscopic findings

Table 2. Summary of main different dots

Dots type	Indication	Implication	Marker
YD	Sensitive feature of AA, but are also seen in some cases of AGA and alopecia incognita (AAI). YD in AA are keratinous whereas they represent sebaceous debris in AGA.	Embody follicular infundibulum, distended with degenerating keratotic, keratinocytes and sebum vary in color, shape, and size.	Known to be the marker of AGA and AA.
BD *i.e.* Cadaverized dots	These are seen within the YD and represent stubs of hair that are fractured before emergence from the scalp in AA.	Broken pigmented hairs at scalp surface	
WD	Pale WD are seen in cicatricial alopecias that spare the interfollicular epidermis, like LPP or folliculitis decalvans.	Represent the destroyed follicles that are replaced by fibrous tracts	Can be fibrotic dot or pinpoint WD. The classic big, irregular perifollicular seen in LPP. Pinpoint WD are small, regular with peripheral pigmentation which means empty follicle or eccrine sweat gland opening that can be seen in sun exposed areas in dark skin.
Red dots and globules (RDG)	RDG are the key diagnostic criterion for psoriasis.	Dilated infundibula containing keratotic material and reduction in number and size of sebaceous glands with presence of dilated vessels and red blood cells extravasation in perifollicular distribution	Seen in DLE and vitiligo.
Pink/grey	Prognostic indicator for eyebrow regrowth		Seen on eyebrows of FFA.

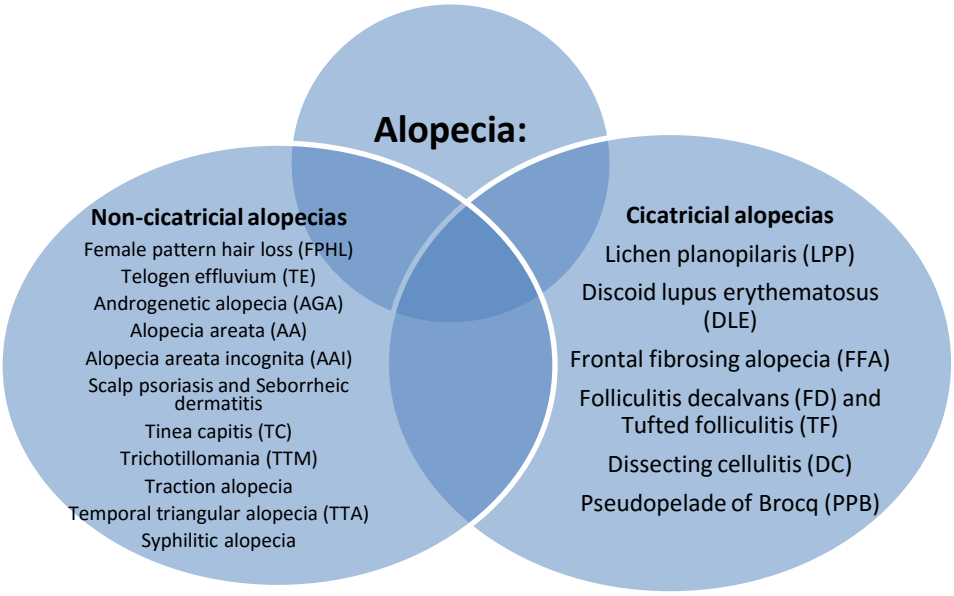

Diagram 2. Types of alopecia

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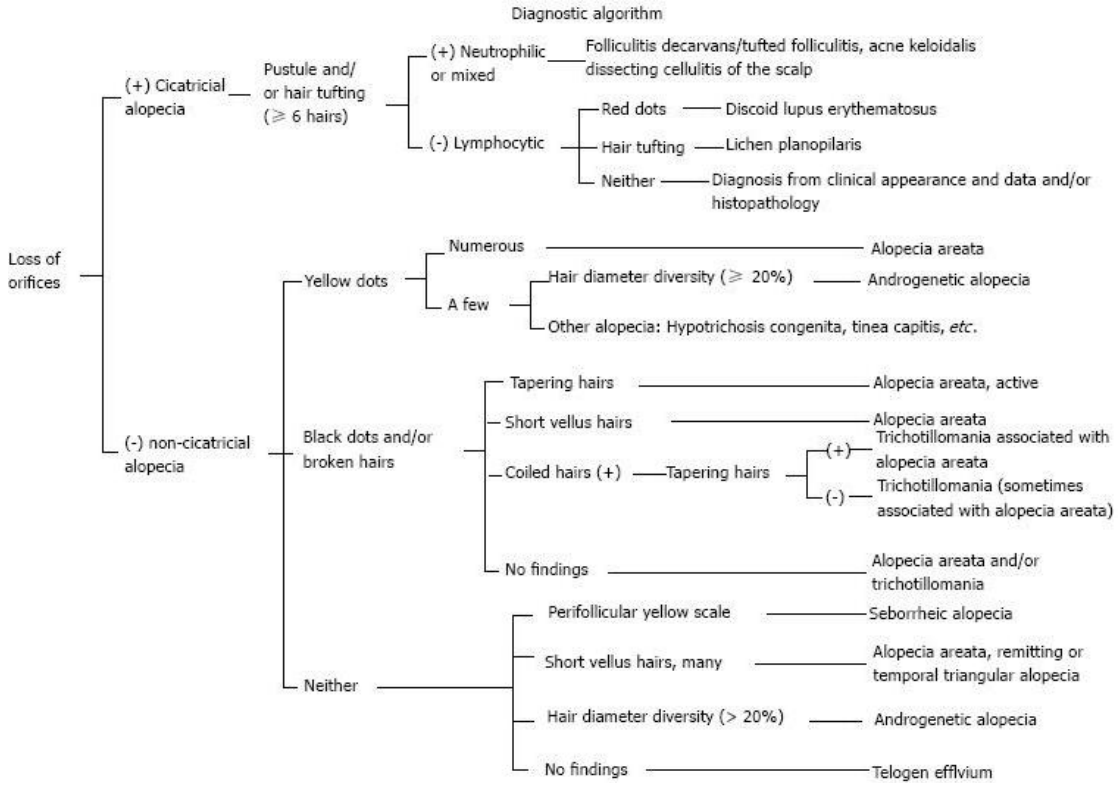

Chart 1. Diagnostic algorithm for trichoscopic findings of hair loss diseases[9]

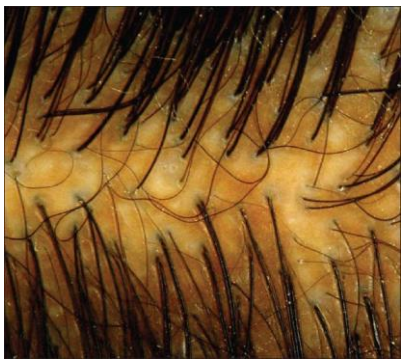

Figure 3. Anisotrichosis[8,19]

of catagen and telogen follicles, with premature termination of anagen follicles, while almost never causing obvious baldness. However, patients will panic and complain of the handful of hair shedding as it is severe during the earlier stages. Such patients are predominantly distressed by the ongoing hair loss and are afraid of total baldness.

TE is characterized by persistent excessive hair shedding, yet the loss of hair is replaced as rapidly as it sheds, so patients never become bald. It is due to the shedding of telogen hairs and it is the most frequent form of hair disorder seen in the clinical setting by dermatologists. It can be chronic and seen chiefly in women between the ages of 30–60 with full head of hair prior to the shedding incident. TE hair sampling will reveal telogen hairs in excess of 25% (normally 10%–15%).

Effluvium can be based on two types: TE and anagen effluvium (AE) or defluvium. TE can be followed by any stressful events such as diet, pregnancy or illness, while AE follows certain medications and occurs much faster than TE, usually within one month or less after the event.

Trichoscopic findings: The presence of empty hair follicles and decreased hair density, one follicular hair unit dominance (**Figure 4**) and perifollicular discoloration (perpilar sign) with upright short hair regrowth[10]. TE is a diagnosis of exclusion.

Figure 4. Upright hair in TE[13]

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Androgenetic alopecia

The most common form of hair loss in both men and women, it is featured by a progressive loss of hair diameter, length, and pigmentation. Over time, it may become cosmetically unacceptable and psychologically frustrating to patients[14-16]. It is an inherited androgen-dependent state and is presumed to occur in genetically predisposed hair follicles, causing hair follicle miniaturization and thus causing a gradual substitution of large, pigmented terminal hairs by hardly seen depigmented vellus hairs in affected areas[16].

In female androgenic alopecia (FAGA), focal areas of baldness (atrichia) are commonly seen. Male androgenetic alopecia is featured by its distinctive bi-temporal recession of hair and balding vertex, while FAGA, by its more disperse thinning of the crown area with an intact frontal hairline[8,16].

Generally speaking, FAGA is clinically suspected in cases of frontal accentuation (Christmas tree pattern), central diffusion, or vertex/frontal and temporal (male pattern) with the sparing of the occiput (occipital area) (**Figures 5–7**)[14,15].

FAGA is the outcome of a progressive reduction of the anagen phase with miniaturization of the hair bulb, yielding TE and terminal-to-vellus hair conversion in the affected scalp area[14,16].

Trichoscopic findings: Increased proportion of thin and vellus hairs, miniaturization, hair shaft thickness heterogeneity (anisotrichosis) (**Figure 8**), empty follicle[16], perifollicular discoloration (hyperpigmentation), the presence of a variable number of YD, and the decline in one follicular hair unit (**Figures 8–11**). Perifollicular discoloration of the skin is also known as “hyperpigmentation”, “peripilar sign”, or “peripilar halo” which denote the existence of perifollicular lymphocytic infiltration in early androgenic alopecia[2,14]. It has been suggested that 20% of women are diagnosed with FAGA[14,17]. WD have been seen and suggested to be related to severe disease stage. They are represented by empty follicular opening (ostia) which is replaced by fibrosis in the advanced phase of the disease (**Figure 12**). According to Rakowska *et al*., the diagnosis of FAGA depend on some criteria[14,16,17]:

Major criteria: 1) more than four empty follicles in four images (at 70-fold magnification) in the frontal area; 2) lower thickness in the frontal area compared to the occiput; 3) more than 10% of vellus (thin) hairs in the frontal area.

Minor criteria: 1) increased frontal to occipital ratio of single-hair pilosebaceous units; 2) vellus hairs; 3) perifollicular discoloration (peripilar signs).

Accomplishing two major criteria or one major and two minor criteria constitutes the diagnosis of FAGA with 98% specificity. According to Pedrosa *et al*., hair diameter diversity larger than 20% was confirmed to be the most consistent finding in AGA with perifollicular pigmentation (PFP)[18]. Moreover, in FAGA, the number of YD and pilosebaceous units with only one hair and with perifollicular hyperpigmentation is significantly increased in androgenic alopecia.

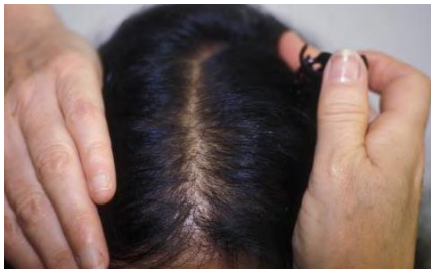

Figure 5. Christmas tree pattern, more parting. FAGA pattern of increased hair thinning, retention of the frontal hairline, and the presence of miniaturized hairs[2-4].

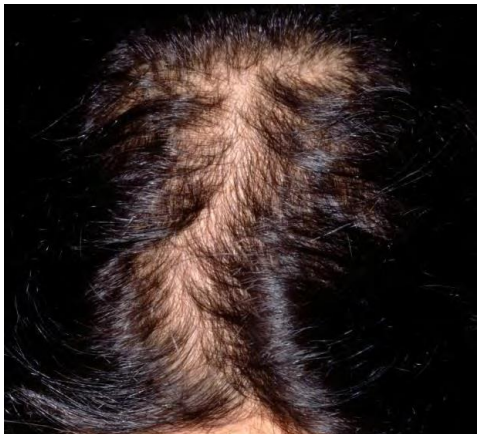

Figure 6. Frontal accentuations – Parting[5-6]

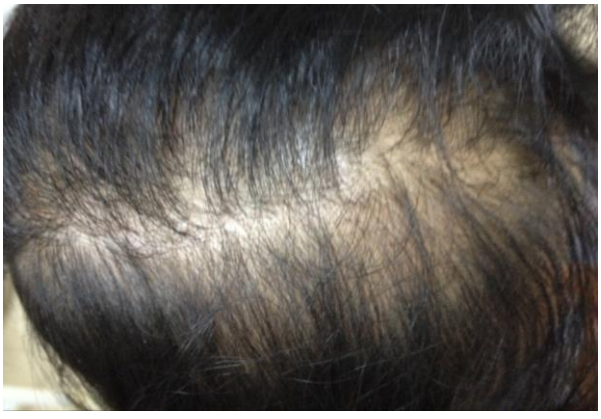

Figure 7. Distinctive parting with Christmas tree display

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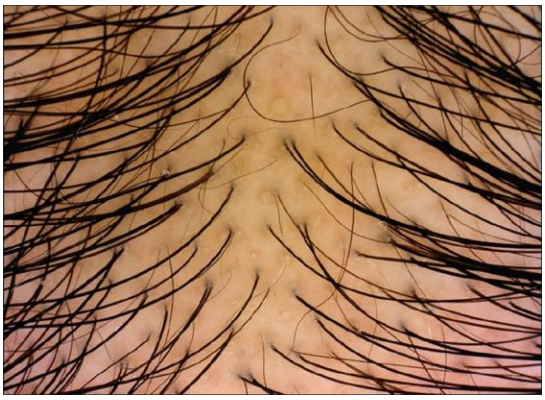

Figure 8. Anisotrichosis[5-7]

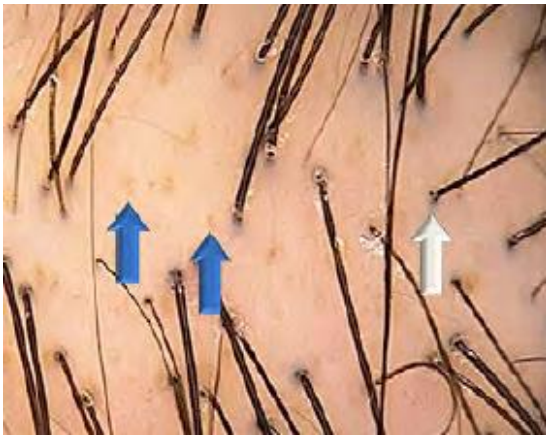

Figure 9. Yellow dots at blue arrow, and pigmentation at white arrow[14]

Figure 10. Yellow dots[5,6]

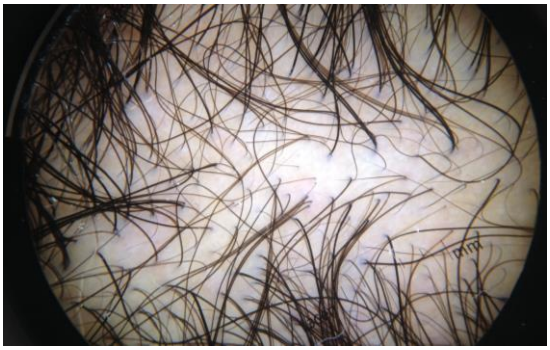

Figure 11. Anisotrichosis frontal

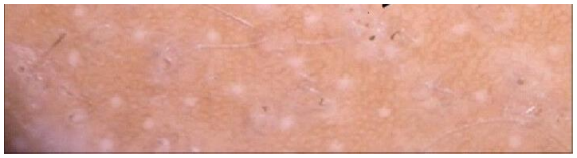

Figure 12. White dots[5,6]

Alopecia areata

AA is an autoimmune disease that disrupts anagen hair follicles[19]. It is manifested by an area on the head which is devoid of hair with smooth scalp. Hair starts to fall out suddenly, often in clumps. The amount of the hair loss varies, and it can be at a few round or oval localized areas or greater. It can be local to the scalp and can be generalized to all areas of the body. One form of AA is ophiasis which can mimic FFA, a cicatricial alopecia where hair follicles are lost[9].

Trichoscopic findings: In active AA patients, the hallmark trichoscopic specific features are upright hair regrowth (**Figures 13**–**18**), tapered hairs (mark of active disease) (**Figure 14**), dystrophic hairs (broken hairs) (**Figure 15**), YD (**Figure 16**), uniform cadaverized hairs *i.e.* BD, broken hairs (micro-exclamation mark hairs) (**Figures 13**–**17**), trichoptilosis, pig tails (**Figure 18**), and short vellus hairs. According to Rakowska *et al*., vellus hair was discovered to be a marker for long-lasting inactive disease process[14]. According to Pedrosa *et al*., uniform miniaturization of hair shafts is seen during remission[18]. Pig tails are hair regrowth coiled as a pigtail, as described by Rudnicka *et al*. (**Figure 18**)[6]. Previously, the exclamation mark was thought to be a sign for recovery and regrowth of hair. However, some studies had contradicted the concept of active disease findings. A Turkish study by Kibar *et al*. concluded that WD and BD were related to severe disease, while exclamation mark hairs were related to mild disease[20].

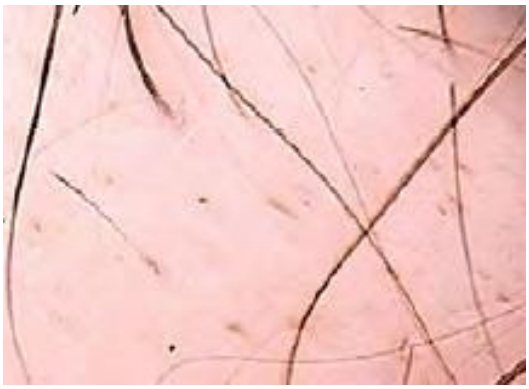

Figure 13. Black dots, micro exclamation hair mark[14-16]

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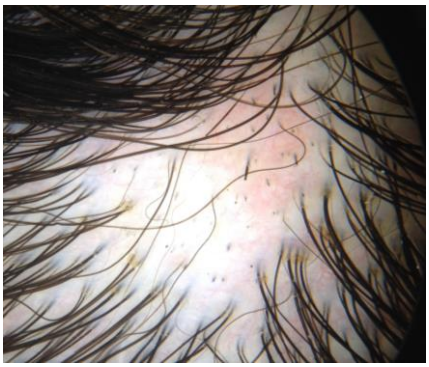

Figure 14. Black dots, cut hair, micro-exclamation hair mark, and tapered hair

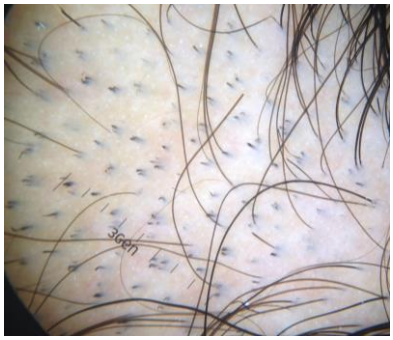

Figure 15. Multiple white dots and broken hair (dystrophic)

Figure 16. Yellow dots[14-16]

Figure 17. Exclamation mark hair[17]

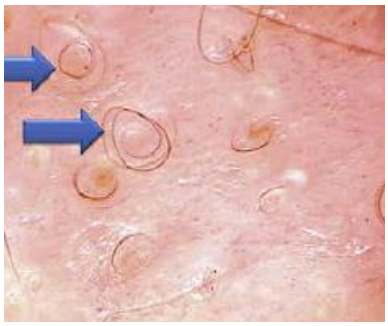

Figure 18. Pig tails[14]

Alopecia Areata Incognita

AAI is considered by some as a variety of alopecia areata (diffuse-type AA), characterized by acute diffuse shedding of telogen hairs, and trichodynia. It stimulates AGA and TE with the occurrence of disperse and severe hair thinning in a short time[9]. Molina *et al*. stated that AAI affects mostly women below age forty; however, there has been some disagreement[21].

Trichoscopic findings: According to Tosti and Duque-Estrada, there are numerous diffuse YD of different sizes and of uniform colors within both empty and hair-bearing follicular orifices, with a large number of regrowing of tapered terminal hairs in the entire scalp (**Figure 19**)[7].

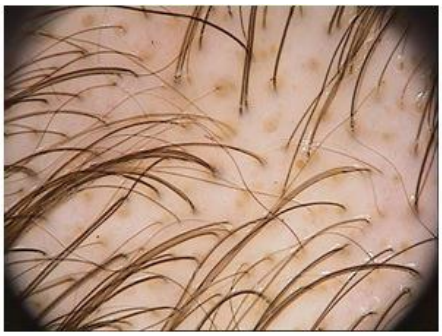

Figure 19. YD in whole scalp: Hairy and non-hairy areas and up-growth of hair[2-3].

Scalp psoriasis and seborrheic dermatitis

Psoriasis and seborrheic dermatitis are equally chronic erythemato-squamous dermatoses that can involve the scalp. It may be hard to clinically distinguish between both when it affects only the scalp, and thus it poses a diagnostic challenge[22,23]. However, the involvement of frontal hair lines is distinctive for scalp psoriais.

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Psoriasis is characterized by silvery-white scaling while seborrheic dermatitis is featured by red, flaking, and greasy areas.

Trichoscopic findings: Atypical red vessels (ARV), RDG (**Figure 20**), signet ring vessels (SRV) (**Figure 21**), structureless red areas (SRA), glomerular vessels (GV), twisted red loops (TRL), PFP, and hidden hairs (HH) were seen mostly in psoriasis while TRL and comma vessels (CV) (**Figure 22**) were specific for seborrheic dermatitis[22,23]. Additionally in seborrheic dermatitis, arborizing red lines (ARL), HH (**Figure 23**), perifollicular white scale, TRL, ARV, SRA, GV, yellow dots (YD), PP, SRV, CV, honeycomb pigment pattern, and brown dots can be seen. As a standard, RDG are considered as the characteristic for psoriasis while ARL and CV for seborrheic dermatitis[22].

RDG signify tortuous and dilated blood vessels within the elongated dermal papillae (**Figure 20**). While arborizing blood vessels and ARV depict marked dilated capillaries in slightly hypertrophic rete ridges, in seborrheic dermatitis, the blood vessels proliferate horizontally in the subpapillary plexus associated with perivascular inflammation[22].

SRV is formed due to vascular alteration in psoriasis and seborrheic dermatitis, and it depicts a slightly tortuous glomerular vessel. It is characterized by an elongated and dilated annular ring shaped vessel[22,23]. This vascular sign, however, was not observed in other alopecias and thus it is considered as a specific sign for these two dermatoses[22].

HH is due to perifollicular and epidermal proliferation and infiltration, together with an altered hair shaft with macropits (lips of follicular ostia infiltration), which would cause the proximal hair shaft to seem hidden under this thickened epidermis (**Figure 23**). As a result of these epidermal and perifollicular inflammations, the pilosebaceous unit with proximal hair shafts may be fairly hidden under the white-grey epidermal proliferations[22].

According to a study by Kim *et al*., the main trichoscopic figures typically seen in psoriasis were RDG, TRL, and GV; while ARV, ARL, and SRA were seen in seborrheic dermatitis with absence of RDG[23]. Kibar *et al*. observed that RDG, ARV, SRA, HH, and SRV were chiefly seen in psoriasis while TRL and CV were seen in seborrheic dermatitis[20]. Both cases showed scales.

In short, when comparing psoriasis and seborrheic dermatitis trichoscopy findings; ARV, RDG, SRV, SRA, and HH are significantly more common in psoriasis while TRL and CV are significantly more common in seborrheic dermatitis.

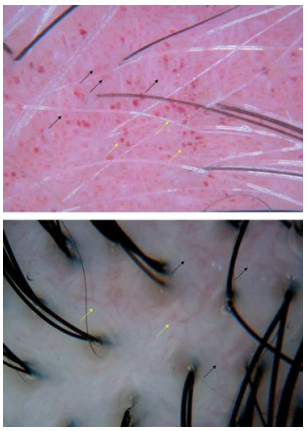

Figure 20. Red dots and globules (top) and arborsing vessels (bottom)[23-24]

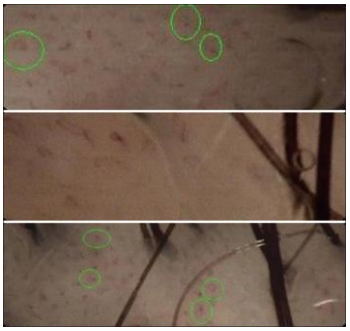

Figure 21. Singlet ring vessel[23]

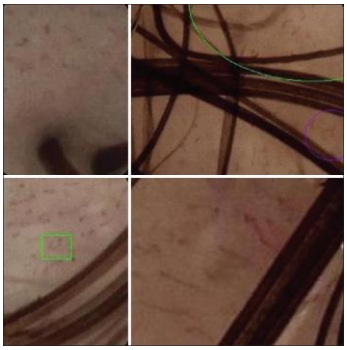

Figure 22. Comma vessels[24]

Figure 23. Hidden hairs with psoriasis (top) and with seborrheic dermatitis (bottom)[23]

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Tinea capitis

A frequent condition caused by superficial fungal infection of the scalp, it is mostly encountered in children. It is primarily inflicted by dermatophytes, explicitly *Trichophyton* and *Microsporum* that intrude hair shafts. The clinical picture is typically single or multiple patches of hair loss, occasionally with a "black dot" outline which might be accompanied by inflammation, scaling, pustules, oozing pus, and itching (kerion).

Trichoscopic findings: Comma-shaped hairs (**Figure 24**), corkscrew hairs, BD, short broken hairs, and zigzag-shaped hairs are the diagnostic trichoscopic features of TC (**Figures 25** and **26**)[24]. According to Rudnicka *et al*., the main trichoscopic features are comma hairs and the slightly curved and fractured hair shafts that are associated with ectothrix and endothrix type fungal invasions[3]. Comma hairs are probably shaped as a result of subsequent cracking and bending of hair shafts filled with hyphae. Zigzag-shaped hairs or corkscrew (twisting-coiled) hair is a variant of the comma hair, manifesting typically among patients of African ancestry. The term "tapering hair" is favored over "micro-exclamation mark hair" because the affected hair is not a typical exclamatory mark in shape. It is due to the tapering of hair shafts toward the follicles, which is captured by trichoscopy rather than the naked eye. Tapering hair is considered as a marker of disease activity and is known to reflect exacerbation of disease. BD are remnants of broken hairs or dystrophic hairs, such as the exclamation mark hairs, occurring when the hair shaft is fractured before emerging from the scalp. BD provide a sensitive marker for disease activity and severity of AA. According to a study by Rudnicka *et al*., white hairs were detected in 45% of AA cases; it was believed to be a diagnostic trichoscopic finding denoting spontaneous remission of AA[3].

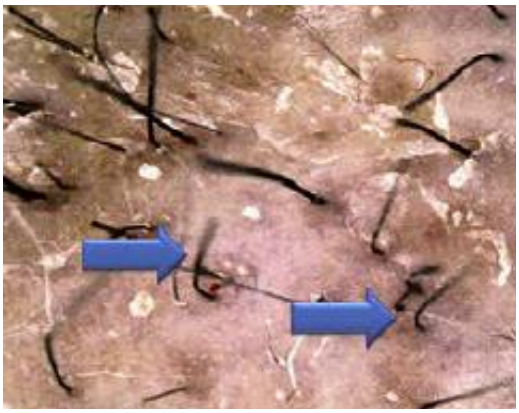

Figure 24. Comma hairs[2,14]

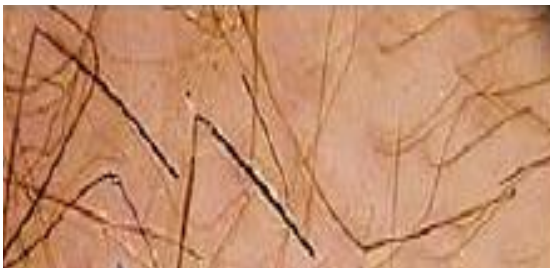

Figure 25. Zigzag hairs[2,14]

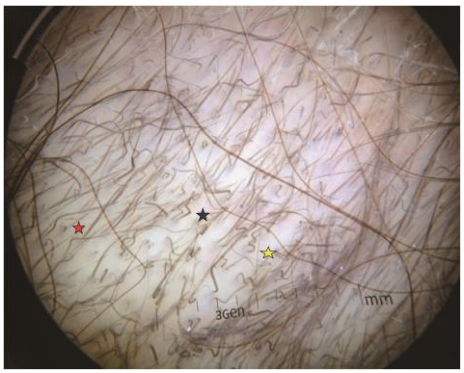

Figure 26. Comma (red asterisk), corkscrew (yellow asterisk), and zigzag hairs (blue asterisk)

Trichotillomania/trichotillosis

It is a self-inflicted injury and is characterized by punctuate alopecia of hair-bearing areas. Traction alopecia also falls under this category, which arises due to hair-styling procedures. It factually means a dismal urge and craving to repeatedly pull out hair, with a sense of pleasure, gratification or relief after the hair is plucked. The pulling behavior serves as a coping mechanism for anxiety, stress, and other difficult emotions. The favored location is the easily accessible fronto-parietal area of the scalp, followed by the eyelashes, eyebrows, pubic hair, body hair, and facial hair. TTM is derived from Greek – *thrix* meaning hair, *tillo* meaning to pull out and *mania* meaning madness – coined by Hallopeau in 1889[25]. The incidence is unknown but estimated to affect about 4% of the general population and is commonly encountered in children and adolescents. The usual pattern is called the tonsure pattern which is also referred to as the "Friar Tuck" sign. It is considered to be amongst the psycho-cutaneous diseases as it is associated with psychiatric comorbidity, social and functional hurt[26-30]. It can be easily diagnosed by an experienced dermatologist as, clinically, there is decreased hair density with broken hairs at different levels[30].

Trichoscopic findings: Short hair with trichoptilosis "split ends" and irregular coiled hairs, upright hair re-

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growth and BD; additional findings include flame hair, V-sign, follicular hemorrhages, decreased hair density, broken hairs at different levels, and absence of exclamation signs[29]. Recently, tulip hair and hair powder were observed as well in some cases[25,28,30]. Coiled hair is incurred due to hair shaft fracture caused by the persistent urge of pulling and coiling of residual proximal part which is attached to the scalp[28]. According to Mathew, there are regularly distributed YD (hyperkeratotic plugs in the hair follicles), cadaverized hairs *i.e.* BD, micro-exclamation mark hairs (visible at 1 mm or less in length), and dystrophic hair regrowth[27].

Recent trichoscopic findings revealed decreased hair density, vellus hairs, broken hairs, hair with trichoptilosis (split end), coiled hairs, flame hairs, tulip hairs, V-sign, BD, and broom fibers. Yorulmaz *et al*. not only demonstrated typical trichoscopic features of TTM such as broken hairs, vellus hairs, BD, coiled hairs, and trichoptilosis, but Yorulmaz's study also displayed newly defined findings like tulip hairs, flame hairs, and V-sign (**Figures 27**–**29**)[26]. The V-sign is created when two or more hairs originating from one follicular unit are broken at equal levels. It is believed that recently defined pathognomonic finding for TTM is flame hairs. Generally noticed in active TTM, flame hairs are observed after severe mechanical trauma. Rakowska *et al*. and Rudnicka *et al*.[30] noted that BD are uniform in size and shape in AA, whereas in TTM and tinea capitis, they were irregular in diameter and shape[14,31]. Follicular micro-hemorrhage is a diagnostic sign of TTM. It appears as a red dot corresponding to follicular ostia that is swollen with blood clot due to traumatic forceful hair plucking. It was recently proposed that flame hairs, V-sign, tulip hairs, and hair powder were emphasized explicitly for diagnosing TTM[26,30]. Flame hairs are semi-transparent, wavy, and cone-shaped hair remains that occur due to strict mechanical hair pulling and tear-ups. V-sign happens when two or more hairs come out from one follicular unit, which are pulled concomitantly and fractured at the same length above the scalp surface. Tulip hairs are short hairs with darker, tulip-flower-shaped ends. These develop when a hair shaft fractures obliquely. When a hair shaft is almost totally damaged by unconscious handling, only dotted hair residue is visible. This feature is called hair powder. Finally, histopathology plays a corroborative role in definitive diagnosis. It is hard to distinguish between TTM and AA; a histological reading is needed to specify the right diagnosis since empty hair follicle, incomplete disrupted follicular anatomy, trichomalacia and pigment casts without significant inflammation are only seen in TTM[27].

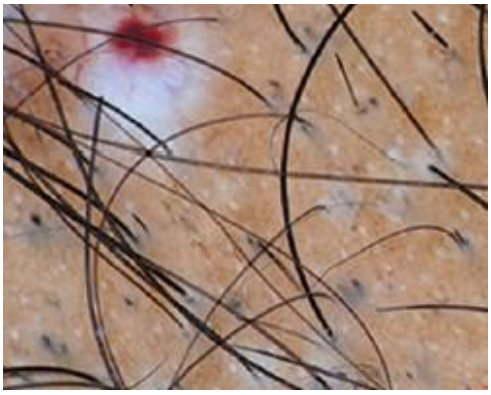

Figure 27. Follicular hemorrhage, black dots, V shape, and tulip hair[5,26]

Figure 28. Split ends (orange asterisk), broom (blue asterisk), powder (violet asterisk), flame (green asterisk), and V-sign hairs (yellow asterisk)

Figure 29. Tulip hairs[27-28]

Traction alopecia

Traction alopecia is caused by hair styling and shares some features of TTM trichoscopic readings along with some hair casts, WD lacking follicular opening, hair thinning, and decreased hair density [30].

Temporal triangular alopecia

TTA is also referred as congenital triangular alopecia, Brauer nevus or "*alopecia triangulaire congenitale de la*

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temp", and mostly seen between 2–9 year-olds and even in adulthood in the fronto-temporal section. It is not congenital, though. It is featured by rounded, triangular or oval non-scarring alopecia and the main confusion is AA. It is a rare, stable, and benign dermatosis of unknown cause[31,32].

Trichoscopic findings: Normal follicular openings with vellus hairs surrounded by the terminal hairs can be appreciated (**Figure 30**), with absence of YD and/or BD, brittle hair, and exclamation mark hairs.

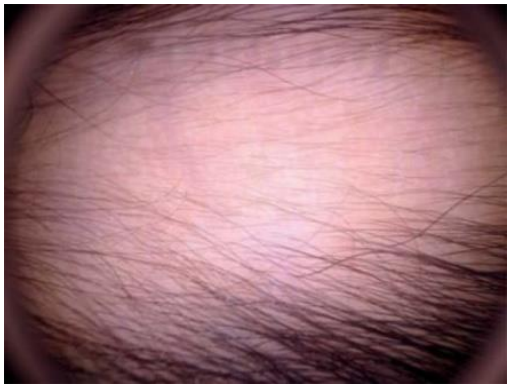

Figure 30. Normal follicle orifices and vellus hairs

Syphilitic alopecia

Syphilitic alopecia is not common in patients with secondary syphilis. However, it is known as moth-eaten alopecia (various small, scattered, and non-scarring hairless patches with incomplete hair loss, which is irregular in size and without defined borders).

Trichoscopy findings: Previous trichoscopic features of syphilitic alopecia have not been looked into. According to Ye *et al.*, BD, focal atrichia, hypopigmentation of hair shaft, empty ostia of hair follicle and YD (**Figure 31**) are symptoms of syphilitic alopecia[33].

Figure 31. Black and yellow dots[30]

Cicatricial alopecias

Recently, it has been revealed that scarring are incurred due to permanent abuse of the stem-cell-rich bulge area of the hair (**Figure 32**) which is obligatory for cyclic regeneration of the lower follicle[7]. Thus, in any trichoscopy, we can anticipate no hair follicle orifice and a fibrous white band.

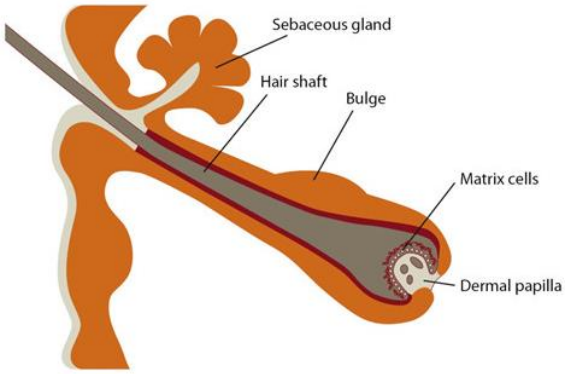

Figure 32. Hair bulge area[43]

Lichen planopilaris

Clinically, it appears to manifest as purplish plaques affecting the central aspect of the mid scalp, and finally with atrophy and irreversible alopecia of the scalp. The pull test is positive for anagen at the site of active disease. Atrophy and permanent alopecia of the scalp may result in time[34,35]. Lichen planus (LP) usually affects the interfollicular skin; however, LPP affects hair follicles with the sparing of interfollicular areas[10].

Trichoscopic findings: Tubular perifollicular scaling due to perifollicular inflammation (peripilar casts seen at the periphery of the patch) and perifollicular erythema (arborizing vessels around the follicular ostia) due to perifollicular inflammation, with elongated blood vessels observed in lichen planopilaris[34]. Hair tufting can be seen in some cases[18]. Peripilar casts can be seen as "blue-grey dots" which denote perifollicular pigment incontinence (**Figures 33** and **34**). Chronic inflammation leads to fibrosis which is seen as WD (**Figure 35**)[36].

Discoid lupus erythematosus

Clinically appearing as erythematous scaly plaques in the early stages, lesions would get thickened with adherent scales and follicular plugging[33]. In a later stage, the lesions would become depressed, depigmented, and telangiectasia. In DLE, there is complete loss of follicular

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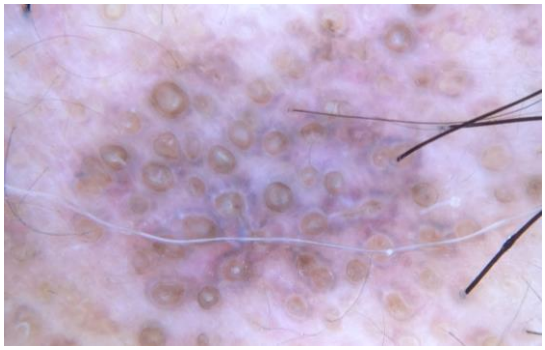

Figure 33. Perifollicular blue grey dots in circular manner sparing interfollicular area (DLE) (targetoid)

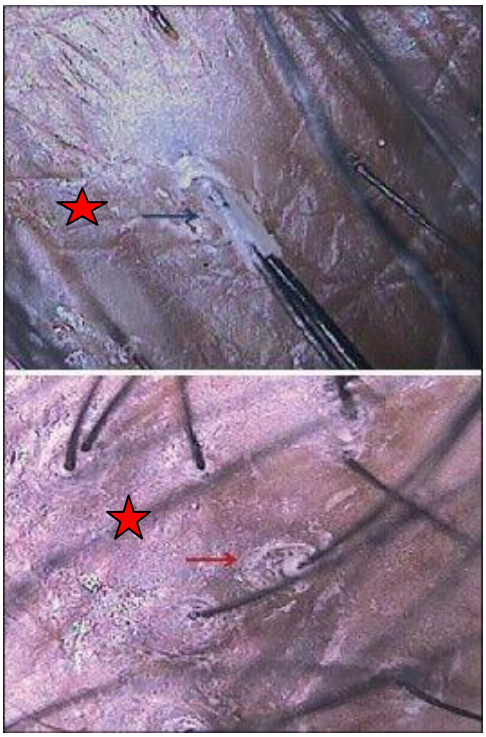

Figure 34. Intense perifollicular and tubular scales/casts[31,33,34]

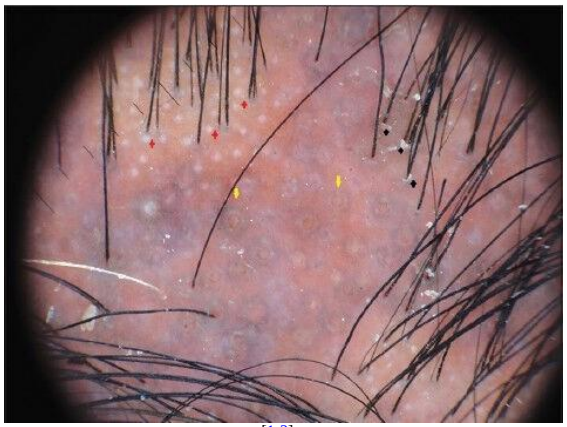

Figure 35. White dots of LPP[1-3]

openings. Arborizing telangiectasia can be visualized over the patch. Prominent hyperkeratotic follicular plugging is seen at the periphery of the plaque. DLE affects interfollicular area, contrasting with LPP which is concentrated around the follicles[10]. DLE may show hair regrowth if promptly treated and thus early treatment is important[36,37].

Trichoscopic findings: Scattered dark-brown discoloration of the skin, large YD and thick arborizing vessels in cutaneous (discoid) lupus erythematosus (**Figures 36** and **37**)[36,37]. Scalp atrophy is identified by a diffuse white color of the scalp[7]. Arborizing and tortuous vessels are visualized inside DLE plaques[8]. Red to pinkish-red, round, and polycyclic dots of uniform size are often scattered around follicular openings, which may be a peculiar finding as well. According to Pedrosa *et al*., follicular red dots seem to be a specific finding of scalp DLE, which denotes an active disease[18].

Follicular red dots with reduced follicular ostia, arborizing vessels, white patches, honeycomb pigmented network (**Figure 37**), blue-grey dots, and variable scaling are found in DLE. Keratotic plugs represent the clinical signs of carpet tack (**Figure 36**). Numerous yellow follicular keratotic pluggings (markers of early active DLE) are seen, which are a typical feature of DLE that can be easily identified[36,37].

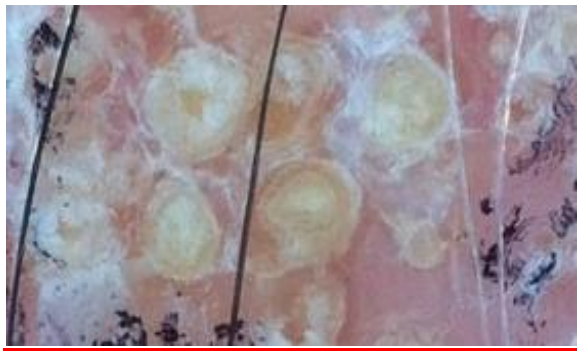

Figure 36. Numerous large yellow Follicular keratotic plugging[34]

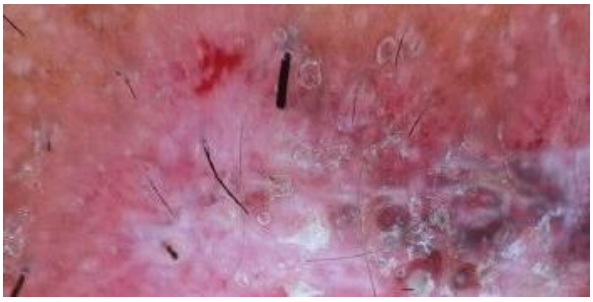

Figure 37. Thick arborizing blood vessels and red follicular dots interspersed with scar areas[34]

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Frontal fibrosing alopecia

FFA is distinguished by the recession of the fronto-temporal hairline (FTHL) with alopecic scarring change (such as hairband retraction, loss of eyebrows, and orphaned hairs). It is usually associated with alopecia in other non-scalp locations. FFA disease appears only in postmenopausal women, with no hormonal status association. However, other FFA clinical manifestations such as axillar or eyebrow alopecia, LPP or pruritus appear in variable frequency, except for the mentioned recession of the hairline present in all patients[38]. FFA is considered by some as a probable clinical variant of LPP, which exhibits similar histopathological readings. Usually FFA has been connected with the postmenopausal state in women even though not all patients with this diagnosis are postmenopausal.

Trichoscopic findings: The absence of follicular opening, with presence of follicular hyperkeratosis, follicular plugs, and erythema. According to Toledo *et al*., the presence of perifollicular erythema will be a direct marker of FFA activity (**Figure 38**)[38]. Minor perifollicular scaling is present in FFA[34].

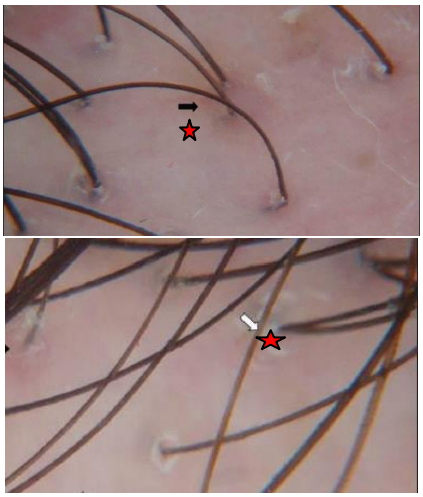

Figure 38. Absence of follicular openings, dominance of follicular units with only 1 hair, mild perifollicular scaling and perifollicular erythema, and hyperkeratosis, follicular plugs and erythema[35]

Folliculitis decalvans and tufted folliculitis

FD (baldness with scarring) is a category of alopecia that is connected with scarring involving the vertex and the occipital. In Latin, it means "to remove hair". It is characterized by redness, swelling, and pustules oozing pus around the hair follicle which leads to inflammation of the hair follicle (folliculitis) with damage to the hair follicle, and thus enduring hair loss with scarring and loss of follicular openings. It is also called TF, characterized by "polytrichia" which is multiple hairs emerging from a single dilated follicular orifice[39].

Trichoscopic findings: The hallmark is the emergence of multiple hairs from a single dilated follicular opening (5–20 or more) polytrichias with a band of yellow scales at the base of the hair, and perifollicular hyperplasia that is arranged in a starburst pattern (starburst sign) in FD[39,40]. According to Fabris *et al*., there are follicular tufts (**Figure 39**), perifollicular erythema (**Figure 40**), yellowish tubular scaling, crusts, and pustules[39]. Follicular scaling and pustules represent follicular inflammation and an active disease[10]. Multiple follicular pustules can be seen at the active border. Twisted capillary loops may be visualized in the interfollicular region. When the disease is inactive, the long- standing disease yields scarred areas which are seen as pinkish-white patches with absence of follicular openings[10].

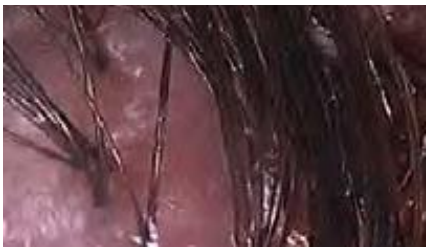

Figure 39. Tufted hair[13]

Figure 40. Polytrichia and redness[37]

Dissecting cellulitis (dissecting folliculitis)

It is a rare progressive chronic condition that affects the scalp vertex and posterior neck, commonly seen in young males of African ancestry (skin type 5 and 6) between ages 20–40, and is often called doll hair. It starts clinically as simple folliculitis or perifolliculitis, which then

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rapidly erupts as multiple painful nodules with purulent discharge that coalesce to form interconnecting abscesses and sinuses. Pus can be expressed by exerting pressure. The scalp is boggy and causes scarred hair loss, eventually prompting either hypertrophic or atrophic scarring of the scalp.

Trichoscopic findings: Yellow structureless areas, with "3D" YD (soap bubble) structure imposed over dystrophic hair shaft (**Figure 41**), which can sometimes be seen with some BD and pin-point vessels with white halo, and with no follicular opening and fibrosis[41]. Those bubbles are due to dense neutrophilic dermal infiltrate[41]

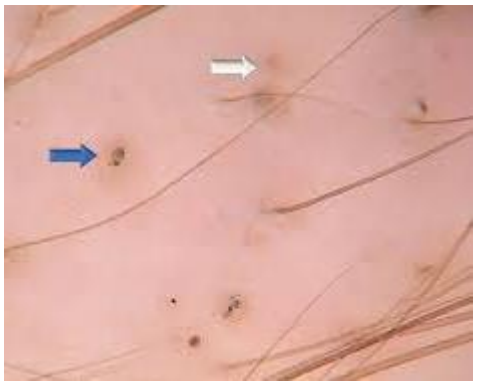

Figure 41. 3D yellow dots with or without black dots in their center (soap bubble)[30]

Pseudopelade of Brocq

PPB is a remarkable form of continuing aleopecia of the central scalp for at least two years without affecting the eyebrows, mostly affecting middle aged and older women, and is slowly progressive without noted inflammation. Its causes are unidentified, are diagnosed by excluding LPP and DLE, and are described as 'foot prints in the snow'. It can be distinguished from AA by irregular asymmetrical smooth patches without follicular orifices. PPB is not an inflammatory form of alopecia, and hair loss is due to atrophy of hair follicles by lymphocyte invasion rather than scarring. However, some authors argued that it is the end-stage of other inflammatory cicatricial alopecias such as LPP, but this is yet to be confirmed[42].

Trichoscopic findings: According to Olszewska *et al*., trichoscopic features of classic Pseudopelade of Brocq are nonspecific[40]. It can manifest as smooth porcelain white skin to slight red tint with no follicular openings (**Figure 42**). Some solitary dystrophic hairs can also be seen at the periphery of the lesion with no indicative features of other cicatricial alopecia. In short, when there are no tubular perifollicular scales of LPP, no starburst hyperplasia of FD, and no arborizing vessels of DLE, the diagnosis is PPB[42].

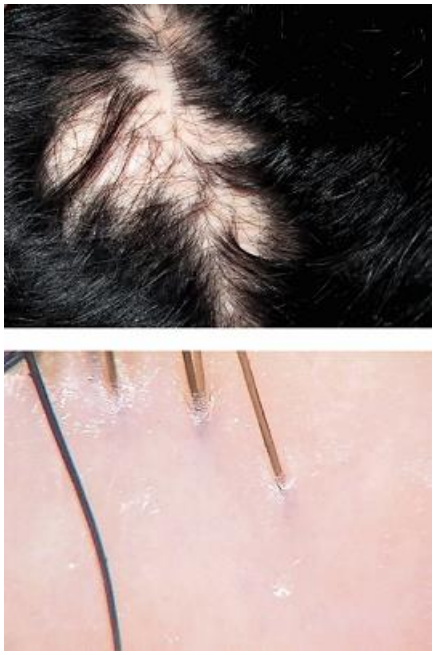

Figure 42. Smooth porcelain white skin to slight red tint with no follicular openings[39]

Conclusion

In conclusion, trichoscopy is a very useful, handy, and noninvasive tool in the armamentarium of dermatologist for diagnosis of hair and scalp disorders. Nonetheless, diagnosis cannot be made without a clinical case approach, available data and histological readings in some cases. All should complement each other.

Conflict of interest

The author declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

References

1. Rakowska A. Trichoscopy (hair and scalp videodermoscopy) in the healthy female. Method standardization and norms for measurable parameters. J Dermatol Case Rep 2009; 3(1): 14–19. doi: 10.3315/jdcr.2008.1021.
2. Rudnicka L, Olszewska M, Rakowska A, Kowalska-Oledzka E, Slowinska M. Trichoscopy: A new method for diagnosing hair loss. J Drugs Dermatol 2008; 7(7): 651–654.

doi: 10.18282/jsd.v1.i1.8

3. Rudnicka L, Rakowska A, Olszewska M. Trichoscopy. How it may help the clinician. Dermatol Clin 2013; 31: 29–41. doi:10.1016/j.det.2012.08.011.
4. Kowalska-Oledzka E, Slowinska M, Rakowska A. Sensitivity and specificity of the trichoscopy. Indian J Dermatol Venereol Leprol 2012; 78(5): 636–637. doi: 10.4103/0378-6323.100591.
5. Rudnicka L, Olszewska M, Rakowska A, Slowinska M. Trichoscopy update 2011. J Dermatol Case Rep 2011; 5(4): 82–88. doi: 10.3315/jdcr.2011.1083.
6. Rudnicka L, Rakowska A, Kurzeja M, Olszewska M. Hair shafts in trichoscopy: Clues for diagnosis of hair and scalp diseases. Dermatol Clin 2013; 31(4): 695–708. doi: 10.1016/j.det.2013.06.007.
7. Tosti A, Duque-Estrada B. Dermoscopy in hair disorders. J Egypt Women Dermatol Soc 2009; 7(1): 1–4.
8. Romero J, Grimalt R. Trichoscopy: Essentials for the dermatologist. World J Dermatol 2015; 4(2): 63–68. doi: 10.5314/wjd.v4.i2.63.
9. Inui S. Trichoscopy: A new frontier for the diagnosis of hair diseases. Expert Rev Dermatol 2012; 7(5): 1–9. doi: 10.1586/edm.12.40.
10. Jain N, Doshi B, Khopkar U. Trichoscopy in alopecias: Diagnosis simplified. Int J Trichology 2013; 5(4): 170–178. doi: 10.4103/0974-7753.130385.
11. Herskovitz I, de Sousa ICVD, Tosti A. Vellus hairs in the frontal scalp in early female pattern hair loss. Int J Trichology 2013; 5(3): 118–120. doi: 10.4103/0974-7753.125601.
12. Bhamla SA, Dhurat RS, Saraogi PP. Is trichoscopy a reliable tool to diagnose early female pattern hair loss? Int J Trichology 2013; 5(3): 121–125. doi: 10.4103/0974-7753.125603.
13. Zhang X, Caulloo S, Zhao Y, Zhang B, Cai Z, *et al*. Female pattern hair loss: Clinico-laboratory findings and trichoscopy depending on disease severity. Int J Trichology 2012; 4(1): 23–28. doi: 10.4103/0974-7753.96082.
14. Rakowska A, Slowinska M, Kowalska-Oledzka E, Olszewska M, Rudnicka L. Dermoscopy in female androgenic alopecia: Method standardization and diagnostic criteria. Int J Trichology 2009; 1(2): 123–130. doi: 10.4103/0974-7753.58555.
15. Kibar M, Aktan Ş, Bilgin M. Scalp dermatoscopic findings in androgenetic alopecia and their relations with disease severity. Ann Dermatol 2014; 26(4): 478–484. doi: 10.5021/ad.2014.26.4.478.
16. Galliker NA, Trüeb RM. Value of trichoscopy versus trichogram for diagnosis of female androgenetic alopecia. Int J Trichology 2012; 4(1): 19–22. doi: 10.4103/0974-7753.96080.
17. Blume-Peytavi U, Blumeyer A, Tosti A, Finner A, Marmol V, *et al*. S1 guideline for diagnostic evaluation in androgenetic alopecia in men, women and adolescents. Br J Dermatol 2011; 164(1): 5–15. doi: 10.1111/j.1365-2133.2010.10011.x.
18. Pedrosa AF, Morais P, Lisboa C, Azevedo F. The importance of trichoscopy in clinical practice. Dermatol Res Pract 2013; 2013: 986–970. doi: 10.1155/2013/986970.
19. de Moura LH, Duque-Estrada B, Abraham LS, Barcaui CB, Sodre CT. Dermoscopy findings of alopecia areata in an African-American patient. J Dermatol Case Rep 2008; 27; 2(4): 52–54. doi: 10.3315/jdcr.2008.1020.
20. Kibar M, Aktan Ş, Lebe B, Bilgin M. Trichoscopic findings in alopecia areata and their relation to disease activity, severity and clinical subtype in Turkish patients. Australas J Dermatol 2015; 56(1): e1–e6. doi: 10.1111/ajd.12102.
21. Molina L, Donati A, Valente NSY, Romiti R. Alopecia areata incognita. Clinics 2011; 66(3): 513–515. doi: 10.1590/S1807-59322011000300027.
22. Kibar M, Aktan Ş, Bilgin M. Dermoscopic findings in scalp psoriasis and seborrheic dermatitis; two new signs; signet ring vessel and hidden hair. Indian J Dermatol 2015; 60(1): 41–45. doi: 10.4103/0019-5154.147786.
23. Kim GW, Jung HJ, Ko HC, Kim MB, Lee WJ, *et al*. Dermoscopy can be useful in differentiating scalp psoriasis from seborrhoeic dermatitis. Br J Dermatol 2011; 164(3): 652–656. doi: 10.1111/j.1365-2133.2010.10180.x.
24. El-Taweel AE, El-Esawy F, Abdel-Salam O. Different trichoscopic features of tinea capitis and alopecia areata in pediatric patients. Dermatol Res Pract 2014; 2014: 848763. doi: 10.1155/2014/848763.
25. Ankad BS, Naidu MV, Beergouder SL, Sujana L. Trichoscopy in trichotillomania: A useful diagnostic tool. Int J Trichology 2014; 6(4): 160–163. doi: 10.4103/0974-7753.142856.
26. Yorulmaz A, Artuz F, Erden O. A case of trichotillomania with recently defined trichoscopic findings. Int J Trichology 2014; 6(2): 77–79. doi: 10.4103/0974-7753.138597.
27. Mathew J. Trichoscopy as an aid in the diagnosis of trichotillomania. Int J Trichology 2012; 4(2): 101–102. doi: 10.4103/0974-7753.96903.
28. Thakur BK, Verma S, Raphael V, Khonglah Y. Extensive tonsure pattern trichotillomania-trichoscopy and histopathology aid to the diagnosis. Int J Trichology 2013; 5(4): 196–198. doi: 10.4103/0974-7753.130400.
29. Peralta L, Morais P. Photoletter to the Editor: The Friar Tuck sign in trichotillomania. J Dermatol Case Rep 2012; 30; 6(2): 63–64. doi: 10.3315/jdcr.2012.1103.
30. Rudnicka L, Olszewska M, Rakowska A. Tricholillomania and traction alopecia. In: Rudnicka L, Olszewska M, Rakowska A (editors). Atlas of Trichoscopy. London: Springer-Verlag; 2012. p. 257–275. doi: 10.1007/978-1-4471-4486-1_20.
31. Gupta LK, Khare AK, Garg A, Mittal A. Congenital triangular alopecia: A close mimicker of alopecia areata. Int

doi: 10.18282/jsd.v1.i2.8

J Trichology 2011; 3(1): 40–41. doi: 10.4103/0974-7753.82135.

32. de Campos JG, Oliveira CMPB, Romero SAR, Klein AP, de Melo Akel PB, et al. Use of dermoscopy in the diagnosis of temporal triangular alopecia. An Bras Dermatol 2015; 90(1): 123–125. doi: 10.1590/abd1806-4841.20153639.
33. Ye Y, Zhang X, Zhao Y, Gong Y, Yang J, *et al*. The clinical and trichoscopic features of syphilitic alopecia. J Dermatol Case Rep 2014; 8(3): 78–80. doi: 10.3315/jdcr.2014.1176.
34. Rakowska A, Slowinska M, Kowalska-Oledzka E, Warszawik O, Czuwara J, *et al*. Trichoscopy of cicatricial alopecia. J Drugs Dermatol 2012; 11(6): 753–758.
35. Kang H, Azolibani AA, Otberg N, Shapiro J. Lichen planopilaris. Dermatol Ther 2008; 21: 249–256. doi: 10.1111/j.1529-8019.2008.00206.x.
36. Ankad BS, Beergouder SL, Moodalgiri VM. Lichen planopilaris versus discoid lupus erythematosus: A trichoscopic perspective. Int J Trichology 2013; 5(4): 204–207. doi: 10.4103/0974-7753.130409.
37. Lanuti E, Miteva M, Romanelli P, Tosti A. Trichoscopy and histopathology of follicular keratotic plugs in scalp discoid lupus erythematosus. Int J Trichology 2012; 4(1): 36–38. doi: 10.4103/0974-7753.96087.
38. Toledo-Pastrana T, García Hernández MJ, Camacho Martínez FM. Perifollicular erythema as a trichoscopy sign of progression in frontal fibrosing alopecia. Int J Trichology 2013; 5(3): 151–153. doi: 10.4103/0974-7753.125616.
39. Fabris MR, Melo CP, Melo DF. Folliculitis decalvans: The use of dermatoscopy as an auxiliary tool in clinical diagnosis. An Bras Dermatol 2013; 88(5): 814–816. doi: 10.1590/abd1806-4841.20132129.
40. Rakowska A, Stefanato C, Czuwara J, Olszewska M, Rudnicka L. Folliculitis decalvans. In: Rudnicka L, Olszewska M, Rakowska A (editors). Atlas of Trichoscopy. London: Springer-Verlag; 2012. p. 319–329. doi: 10.1007/978-1-4471-4486-1.
41. Rakowska A, Olszewska M, Czuwara J, Kowalska-Oledzka E, Rudnicka L. Dissecting cellulitis. In: Rudnicka L, Olszewska M, Rakowska A (editors). Atlas of Trichoscopy. London: Springer-Verlag; 2012. p. 331–337. doi: 10.1007/978-1-4471-4486-1_25.
42. Olszewska M, Radowska A, Rudnicka L. Pseudopelade of Brocq. In: Rudnicka L, Olszewska M, Rakowska A (editors). Atlas of Trichoscopy. London: Springer-Verlag; 2012. p. 339–340. doi: 10.1007/978-1-4471-4486-1_26.
43. BelleLASER [Internet]. 2015 [updated 2015; cited 2015 August 12]. Available from: http://www.bellelaser.com/en/clinic.htm

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CASE REPORT

Functional deltoid muscle reconstruction following an extensive squamous cell carcinoma resection

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Abstract: Squamous cell carcinoma frequently occurs in an individual with albinism. In this case, the growth of the squamous cell carcinoma was aggressive that it invaded the deltoid muscle. After an oncologic resection, there was a huge defect which required near total resection of the deltoid muscle. Loss of deltoid muscle will lead to the loss of abduction and anterior flexion at the shoulder. This could be debilitating in a person's normal daily life and activities. Restoration of the shoulder abduction and flexion function with a pedicle bipolar latissimus dorsi flap transfer was chosen in this case due to the versatility and reliability of the flap.

Keywords: Latissimus dorsi flap; squamous cell carcinoma; reconstruction of the shoulder

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Introduction

Albinism is a genodermatosis with a high risk for non-melanocytic skin cancer, such as cutaneous squamous cell carcinoma and basal cell carcinoma, in sun-exposed regions. Individuals with albinism lack the ability to synthesize melanin, a photo-protective pigment found in the basal layer of the epidermis which determines the skin colour.

Squamous cell carcinoma (SCC) displays more rapid growth, has a greater tendency to invade deep structures such as muscle and bone, and to metastasize, as compared to basal cell carcinoma (BCC)[1]. In this case, the squamous cell carcinoma had extended into the deltoid muscle. In order to completely remove the SCC, near total deltoid muscle resection was necessary. Absence of the deltoid muscle could be debilitating in a person's normal daily life as the normal arm will be hanging weakly at the shoulder joint with a complete loss of abduction and flexion. A functional muscle transfer using the trapezius, latissimus dorsi, pectoralis muscle, biceps or triceps is essential for the restoration of the shoulder function[2]. Restoration of the shoulder joint function may prevent the need for shoulder arthrodesis and therefore, the patient can still engage in his normal daily life and professional activity. A pedicle latissimus dorsi flap with a bipolar transfer was chosen in this case for the reconstruction of soft tissue at the shoulder.

Case report

A 45-year-old Malay male with albinism was constantly exposed to the sun due to his occupation as a fisherman. He underwent multiple excisions with or without a local flap and skin graft for numerous previous SCC and BCC. He noticed a rapidly growing, ulcerated and fungating lesion on his right shoulder measuring 10 x 10.5 cm^2 that had grown within a month. Magnetic resonance imaging was done, which demonstrated that the lesion had extended into the deltoid muscle while sparing the sur-

rounding muscles. He underwent wide local excision which included the affected deltoid muscle. Due to the loss of deltoid muscle and its large defect of 21 x 8 cm^2, a pedicle bipolar musculocutaneous latissimus dorsi flap transfer was chosen to reconstruct the shoulder.

The ipsilateral latissimus dorsi flap was designed according to the size of the defect and harvested as a pedicle musculocutaneous flap based on the thoracodorsal neurovascular bundle. A bipolar transfer was done where the origin and insertion of the latissimus dorsi was transected and raised as an island flap passing through the subcutaneous tunnel at the axilla. The flap was rotated 180° where its origin was attached to the clavicle and acromion, and its insertion was attached to the remnant of the deltoid muscle at the deltoid tubercle (**Figure 1**). Postoperatively, his right arm was placed in an abducted and internally rotated position. The arm was maintained in an abduction orthosis for six weeks. After six weeks, he was started on active and passive physiotherapy. He was able to attain 100° flexion and abduction after a year (**Figure 2**).

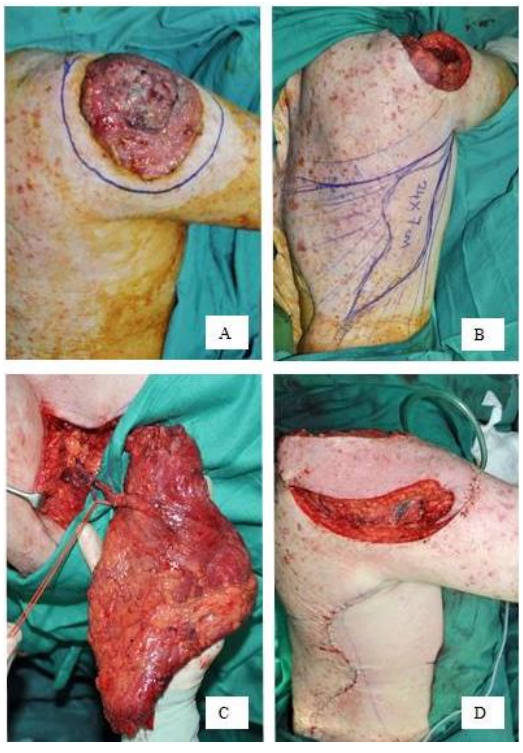

Figure 1. (A) Patient in lateral decubitus. Huge fungating lesion over the right shoulder 2cm margin taken. (B) Latissimus dorsi flap planning with a skin paddle of 24x7cm. (C) A Latissimus dorsi musculocutaneous flap harvested with both insertion and origin is transected based on the thoracodorsal neurovascular bundle. (D) Bipolar transfer of the latissimus dorsi flap with a rotation of 180°. Primary closure of the donor site.

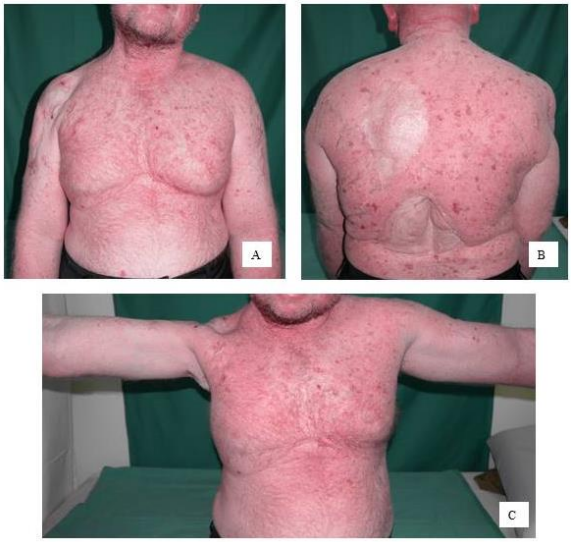

Figure 2. (A, B) Contour of the right shoulder is almost similar with the left shoulder. (C) Full abduction.

Discussion

Squamous cell carcinoma is the second most common non-melanocytic skin cancer which contributes to substantial morbidity and mortality due to its potential to metastasize. Early recognition and resection of the tumour may be curable. The incident rates of SCC in the Asian population is 1.3–2.6 per 100,000 persons annually. The risk quintuples in a person with albinism[1].

Oncologic wide resection of the lesion, together with the involved deltoid muscle, was indicated to attain a clear margin of cancer cells. A durable soft tissue reconstruction was necessary, especially at mobile joints, to maintain the shoulder function which plays a major role in daily life[3]. Placing a flap, in comparison to skin graft, as wound coverage in a large defect is not only cosmetically better, but is also able to exceptionally withstand the radiation complications as it is less delicate and heals faster, owing to its own functional vascular circulation.

Latissimus dorsi muscle flap is a workhorse flap which is highly versatile and reliable. The latissimus dorsi muscle is wide and expendable, with a long free-lying neurovascular bundle[4]. This will provide adequate coverage for a huge defect where a significant arc of rotation can be performed. In 1987, Itoh *et al.* reported the usage of latissimus dorsi innervated muscle flap as a replacement of the deltoid muscle[5]. In this case, the latissimus dorsi pedicle flap provided both functional muscle replacement and skin cover. Due to its close resemblance to the deltoid muscle in its cross-section and excursion, shoulder abduction and flexion can be maintained. Bipolar transfer is where the origin and insertion

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site of the latissimus dorsi muscle is transected while retaining its functional vascular circulation, which is the thoracodorsal vascular bundle[6]. The muscle is then rotated and attached to the remnant of the excised deltoid muscle at both ends. Torsion and tension of the pedicle were able to be avoided in a bipolar transfer.

Conclusion

Pedicle latissimus dorsi flap has advantages such as the ease of flap elevation, which is less time consuming, and a long calibre neurovascular bundle with a constant anatomy made it the preferable and reliable flap for extensive defect of the shoulder. It not only provides good function, but is also cosmetically acceptable.

Conflict of interest

The authors declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

References

1. Alam M, Ratner D. Cutaneous squamous-cell carcinoma. N Engl J Med 2001; 344(13): 975–983. doi: 10.1056/NEJM200103293441306.
2. Kim JS, Lee JS, Yoon JO, Park JB. Reconstruction of the shoulder region using a pedicled latissimus dorsi flap after resection of soft tissue due to sarcoma. J Plast Reconstr Aesthet Surg 2009; 62(9): 1215–1218. doi: 10.1016/j.bjps.2007.12.079.
3. Ferrier JA, Owens T, Singer DI. Functional reconstrution of the shoulder with a latissimus dorsi pedicle flap and a hemiarthroplasty: A case report. J Hand Surg Am 1995; 20(2): 284–287. doi: 10.1016/S0363-5023(05)80027-9.
4. Ma CH, Tu YK, Wu CH, Yen CY, Yu SW, *et al*. Reconstruction of upper extremity large soft-tissue defects using pedicled latissimus dorsi muscle flaps – Technique illustration and clinical outcomes. Injury 2008; 39(Suppl 4): 67–74. doi: 10.1016/j.injury.2008.08.033.
5. Itoh Y, Sasaki T, Ishiguro T, Uchinishi K, Yabe Y, *et al*. Transfer of latissimus dorsi to replace a paralysed anterior deltoid. A new technique using an inverted pedicled graft. J Bone Joint Surg Br 1987; 69-B(4): 647–651.
6. Chaudhry S, Hopyan S. Bipolar latissimus transfer for restoration of elbow flexion. J Orthop 2013; 10(3): 133–138. doi: 10.1016/j.jor.2013.06.004.

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CASE REPORT

Treatment of multiple scalp cylindroma

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Abstract: Cylindroma is a rare, benign adnexal tumor of the skin. The most frequent tumor location is the head, especially the scalp, and neck area. This type of tumor can occur as solitary or multiple tumors. Tumor diagnosis is relatively easy and is based on clinical findings and biopsy. The therapy of choice is surgical excision with parts or entire scalp excision depending on whether it is solitary or multiple tumor. We presented a 65-year-old male patient with multiple scalp tumors of 0.5–6 cm in diameter. An entire scalp excision was performed and the postoperative wounds (i.e., the periosteum of the skull and the fascia galea) were covered with free skin graft of partial thickness. In order to prevent profuse bleeding, we placed a tourniquet around his head and performed bilateral temporary ligature of temporal artery prior to surgery. During the nine-year follow-up, there were no new tumors or tumor recurrence reported.

Keywords: Skin tumors; cylindroma; turban tumor; scalp defects; scalp reconstruction

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Introduction

Dermal cylindroma is a benign tumor of the sweat glands differentiating toward either the eccrine or apocrine line[1-11]. The most frequent location is the head, especially the scalp, and neck area. It can occur as solitary or multiple lesions. The name cylindroma originated from the specific appearance of tumor cells with cylindrical pseudolumina. Cylindroma is a tumor of uncertain etiopathogenesis. There is a familial (i.e., genetic) base for the development of this tumor[1-5]. Due to its appearance on the scalp, multiple cylindromas are also called the 'turban tumor'. Malignant transformation of the tumor has been described in literature[3-8].

Cylindroma diagnosis is relatively easy and is based on clinical findings and biopsy. Cylindroma is characterized by circumscribed or poorly circumscribed dermal tumor without attachment to the epidermis, movable from the underlying surface, and with characteristic histological and immunohistological findings. The treatment of choice for cylindroma is surgical excision. Other treatments include electrodesiccation with curettage, cryotherapy, carbon dioxide laser treatment, and irradiation therapy. Multiple cylindromas usually require extensive plastic surgery in single or multiple procedures.

Materials and methods

Case Report

A 65-year-old male patient had a long-standing history of multiple scalp tumors of 0.5–6 cm in diameter, with progressive growth over the past two years (**Figure 1**). The skin over the tumors looked like normal skin. The tumors were painless, circumscribed, and movable from the underlying surface. There were no palpable lymph nodes in the head and neck area. Routine laboratory panel results were normal. One small tumor was removed via deep biopsy and submitted for histological examination. Histological findings confirmed clinical diagnosis of cylindroma. Since there were a number of tumors found on

the scalp, we decided to excise the entire scalp. In order to prevent profuse bleeding, a tourniquet was placed around the head (around the forehead and below the nape) and bilateral temporary transcutaneous ligature of superficial temporal artery was performed prior to surgery. The excision of the scalp was completed with minimal bleeding. Surgical wounds (*i.e.*, skull periosteum and fascia galea) were covered with free split-thickness skin graft (**Figure 2**). Upon completion of the operation, ligature of temporal arteries were removed.

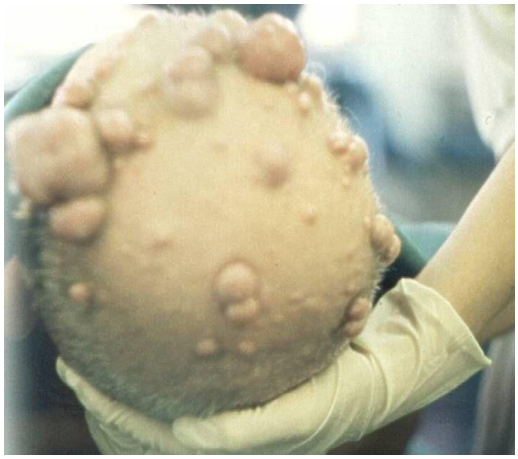

Figure 1. Before surgery

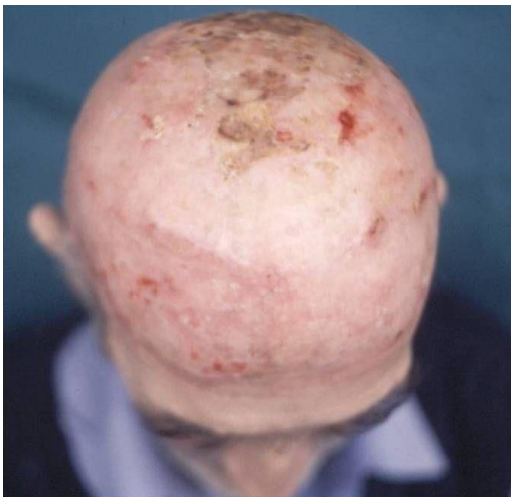

Figure 2. One month after surgery

Results

The entire scalp was excised via extensive surgical procedure with minimal bleeding. Numerous scalp tumors were removed (**Figures 1** and **2**). Good–even excellent–long lasting, therapeutic, functional, aesthetic, and hygienic results were achieved after six weeks of surgery. During the nine-year follow-up, there were neither new tumors in the region of the excised scalp nor tumor recurrence reported.

Discussion

There is already substantial consensus, both in literature and in practice, regarding the main characteristics of cylindroma–its clinical picture, diagnosis, prognosis, histological, and immunohistological image; thus, these will not be discussed. Tumor therapies discussed were usually within the scope of surgeons and dermatologists; hence, no full consensus was reached with respect to therapy.

Surgeons would advocate and implement surgical treatment almost exclusively. Dermatologists often implement non-surgical methods of treatment (cryotherapy, laser treatment, electrodesiccation with curettage, and irradiation therapy). Both surgical and nonsurgical methods have advantages and disadvantages.

The advantage of surgical therapy is that it achieves radical removal of the tumor, which implies minimal risk of recurrence and malignant tumor transformation. In addition, surgical therapy significantly reduces treatment time. However, surgical therapy is considered an aggressive and invasive method which requires anesthesia and special conditions. Nonsurgical methods for treating cylindroma in appropriate cases often achieve good, even excellent, results but there is a possibility of malignant transformation or recurrence, as well as the possibility of basal or squamous cell skin cancer occurrence due to the application of these nonsurgical methods. Moreover, nonsurgical methods would prolong tumor treatment.

In cases of numerous large cylindromas, the only real therapy is via surgery. In such cases, applying nonsurgical methods would be a professional error, a '*vitium artis*'. It is often emphasized that nonsurgical methods are applied when patients are in poor general health and thus are unsuitable for surgery. For contemporary surgery with modern anesthesia and resuscitation (preoperative, intraoperative, and postoperative), rarely are there contraindications for surgery due to patients' poor general health. Cylindroma, even multiple ones, do not require large surgical procedures that last a long time. An entire scalp excision is not a large and risky procedure if proper procedures are applied, such as methods to prevent profuse bleeding. By placing a tourniquet around the patient's head and performing temporary transcutaneous

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temporal artery ligation, an extensive operation–which is always accompanied by extensive bleeding–can be safely performed with minimal bleeding. It is often stated that nonsurgical methods are applied when a patient refuses surgical treatment. If a conscientious physician sufficiently explains the advantages and disadvantages of the treatments, a patient will usually accept the safest method.

Conclusion

In cases of scalp cylindromas, especially in cases of multiple scalp cylindromas, surgical therapy is the therapy of choice. It is possible to achieve good results by utilizing different nonsurgical methods of treatment but there is always a risk of tumor recurrence and malignant transformation.

Conflict of interest

The author declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

References

1. Stoll C, Alembik Y, Wilk A, Grosshans E. Familial cylindromatosis. Genet Couns 2004; 15(2): 175–182.
2. Burrows NP, Jones RR, Smith NP. The clinicopathological features of familial cylindromas and trichoepithliomas (Brooke-Spiegel syndrome): A report of two families. Clin Exp Dermatol 1992; 17(5): 332–336. doi: 10.1111/j.1365-2230.1992.tb00223.x.
3. Singh DD, Naujoks C, Depprich R, Schulte KW, Jankowiak F, *et al*. Cylindroma of head and neck: Review of the literature and report of two rare cases. J Craniomaxillofac Surg 2013; 41(6): 516–521. doi: 10.1016/j.jcms.2012.11.016.
4. O'Blenes CA, Lee JP, Walsh NM, Morris SF. An unusual case of turban tumor syndrome treated with total scalp excision and advancement flaps and skin graft reconstruction. Ann Plast Surg 2010; 65(1): 107–109. doi: 10.1097/SAP.0b013e3181b40532.
5. Denish SC, Yadavalli G. Dermal cylindroma of the scalp. Natl J Maxillofac Surg 2012; 3(1): 59–61. doi: 10.4103/0975-5950.102163.
6. Bansal C, Batra M, Lal N, Srivastava AN. Solitary cylindroma with malignant transformation. Indian J Dermatol 2012; 57(2): 141–143. doi: 10.4103/0019-5154.94289.
7. Kuklani RM, Glavin FL, Bhattacharyya I. Malignant cylindroma of the scalp arising in a setting of multiple cylindromatosis: A case report. Head Neck Pathol 2009; 3(4): 315–319. doi: 10.1007/s12105-009-0138-x.
8. De Francesco V, Frattasio A, Pillon B, Stinco G, Scott CA. Carcinosarcoma arising in patient with multiple cylindromas. Am J Dermatopatholog 2005; 27(1): 21–26. doi: 10.1097/01.dad.0000141548.69423.c7.
9. Freedman AM, Woods JE. Total scalp excision and auricular resurfacing for dermal cylindroma (turban tumor). Ann Plast Surg 1989; 22(1): 50–57. doi: 10.1097/00000637-198901000-00010.
10. Mackie RM. Tumors of the skin appendages. 5th ed. In: Champion RH, Burton JL, Ebling FJG, (editors). Textbook of Dermatology. Oxford: Blackwell Scientific; 1992. p. 1520.
11. Rončević R. Current notion of treatment and prognosis of malignant skin tumors. Srpski Arhiv 1994; 122: 358–363.

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ORIGINAL RESEARCH ARTICLE

Electrosurgery in dermatosis papulosa nigra: An effective, well-tolerated but less documented tool

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Abstract: Dermatosis papulosa nigra (DPN) is a superficial, black or brown benign papule that develops mainly in dark-skinned individuals over the face and neck. Clinically seborrheic keratosis shows a stuck-on appearance that differentiates it from DPN. Histopathological examination describes that both are identical. Many types of lasers are used as treatments for it. Traditional surgical procedures such as curettage, electrosurgery, and snip/shave excision are still considered as a therapeutic modality. Although electrodesiccation (ED) is a simple procedure, studies on ED use for DPN with a good number of cases are lacking. This paper presents the evaluation safety, efficacy and cost-effectiveness of ED for the treatment of DPN in Fitzpatrick's skin type IV to VI. A total of 40 patients (11 male and 29 female) with DPN over the face and neck with skin type IV–VI were included. Superficial ED (monopolar, low, 2–3.5 W) was done by just touching the lesion under topical anesthesia. All preoperative photographs as well as 2-, 4- and 8-week post-procedure photographs were examined by two independent dermatologists who had no prior information concerning the procedure, (both known hereafter as "blinded observer"): one for examining efficacy in terms of poor improvement (0%–25%), fair (26%–50%), good (51%–75%), or excellent (76%–100%), by counting completely cleared lesions; and the other for examining side effects in terms of hypo/hyperpigmentation and scarring. As a result, 85% of patients showed excellent improvement (>75% clearance), 7.5% good (51%–75% clearance), 5% fair (26%–50% clearance) and 2% poor (0–25% clearance) as measured by the "blinded" observer. Post-inflammatory hyperpigmentation was observed in 15% cases, whereas hypo-pigmentation was documented in 7.5% cases. Only in two cases (5%) was lesional scarring noted. Those complications were cleared after eight weeks. In this study, ED was observed to be an effective, well-tolerated and cost-effective method for treatment of DPN in colored skin. Complications were few, and therapy was performed appropriately with effective postoperative measures.

Keywords: Dermatosis papulosa nigra (DPN); electrodesiccation; colored skin

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Introduction

Dermatosis papulosa nigra (DPN) is a superficial, black or brown, smooth surfaced, benign papule that develops mainly in dark-skinned individuals. They grow in size and number, yet individual lesions remain small, mainly

affecting the face and neck region. Treatment is indicated mainly for aesthetics. Sometimes larger lesions may raise suspicions of untoward complications but proper counselling regarding a benign course will suffice in most of the cases. Spontaneous regression of lesion is rare. Clinically seborrheic keratosis shows a stuck-on appearance that differentiates it from DPN. However, histopathologically they are identical. Many experts consider DPN to be a variant of seborrheic keratoses[1].

A few studies have documented lasers as treatment for seborrheic keratoses[2]. So, different lasers such as pulse dye treatment (PDL), potassium titanyl phosphate (KTP), and neodymium-doped yttrium aluminium garnet (Nd:YAG) are used for the treatment of DPN with varying success[3]. Though lasers are the recent trend, traditional surgical procedures such as curettage, electrosurgery and snip/shave excision are still considered as therapeutic modalities. Post-inflammatory pigmentary complications are the primary concern in colored skin. Electrodesiccation (ED) is a very simple, efficacious, and low-cost modality used in dermatosurgery. Many diseases such as verucca, molluscum, milia, epidermal nevi, skin tags, pyogenic granuloma, etc., can be treated effectively by ED[4]. However, this modality is less documented for DPN treatment as a single effective therapy. ED also serves as a therapeutic modality for seborrheic keratoses even though studies in DPN lacked significant number of cases. The aim of the present study was to examine the safety, efficacy and cost-effectiveness of this age-old ED procedure for the treatment of DPN in Fitzpatrick's skin type IV to VI.

Materials and methods

A total of 40 patients with DPN on the face and neck with skin type IV–VI were recruited from the outpatient department for this prospective, non-randomized and double-blind study. It was carried out from Jan 2015 till June 2015. Willing patients of over 18 years old, with skin type IV–VI and clinically having more than four DPN lesions, were recruited after obtaining informed consent. Patients who received prior treatment for DPN, patients with cardiac pacemaker, and pregnant ladies were excluded from the study. After taking pre-procedure photograph, EMLA (2.5% lignocaine + 2.5% prilocaine) was applied under occlusion for 50–60 min. Then, with the angled fine tip probe, superficial ED (monopolar, low, 2–3.5 W) was performed by just touching the lesions momentarily, considering grayish white discoloration as the end point. The patients who volunteered were observed. After treatment, each of them was asked about the prevalence of pain and burning sensations. They were also examined for erythema and edema. In four cases (where lesions were extensively distributed over the whole face and neck), all the lesions were treated in a single sitting. Postoperatively, all the patients were prescribed with topical fusidic acid and hydrocortisone cream for a period of seven days. Additional chemical (30 SPF) sunscreen was prescribed for four weeks. After the second week, monthly follow-up sessions were done on the patients for three months. Photographs were taken in each follow-up session. All preoperative photographs as well as 2-week, 4-week and 8-week post-procedure photographs were examined by two independent dermatologists who had no prior information concerning the procedure or patient selection, (both known hereafter as "blinded observer") to rate the efficacy and side effects. Efficacy was analyzed as poor improvement (0–25%), fair (26%–50%), good (51%–75%), or excellent (76%–100%) by counting completely cleared lesions[5]. Side effects were examined in terms of hypo/hyperpigmentation and scarring.

Results

A total of 40 patients (11 male and 29 female) were included in the study. All of them are Indians who reside in West Bengal. The age distribution was 19–62 years old. Gender distribution according to skin types is stated in **Table 1**. Each patient was assessed for the total number of lesions, with photographs taken preoperation and two weeks postoperation. Rate of efficacy, as measured in terms of complete clearance of lesions, was expressed in percentage. Incomplete clearance of lesion was regarded as non-clearance. 85% of patients showed excellent improvement (> 75% clearance), 7.5% good (51%–75% clearance), 5% fair (26%–50% clearance) and 2% poor (0–25% clearance) as measured by the "blinded observer" (**Figure 1**). In the 'excellent' group, 58.8% demonstrated 100% clearance of lesion. In the immediate postoperative period, there was localized erythema (85%) and edema (70%) over the ED sites (**Figure 2**). **Figure 3** showed the left side of the face and neck of a patient preoperatively. **Figure 4** showed excellent result postoperatively. 3 patients (7.5%) complained of mild pain during the procedure and therefore reapplication of topical anesthetic agent for another 15 mins was required. 4 (10%) patients reported burning sensation instantly after the procedure.

Photographs at two weeks post-procedure and monthly for three months thereafter were evaluated by the "blinded observer" for documentation of complications. Post-inflammatory hyperpigmentation was observed in 15% cases and hypopigmentation was documented

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in 7.5% cases. In 2 cases (5%), lesional scarring was observed (**Figure 5**). One of the patients had an extensive lesion that required a second sitting for total removal. After eight weeks of pigmentary changes and scarring, the results were not perceptible.

Table 1. Skin types with sex distribution

SKIN TYPES	Male	Female
IV	3	11
V	6	14
VI	2	4
Total	11	29

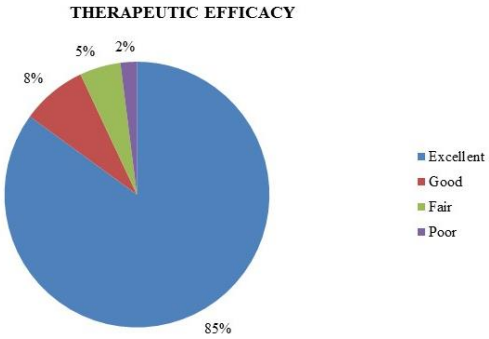

Figure 1. Therapeutic efficacy, two weeks after treatment

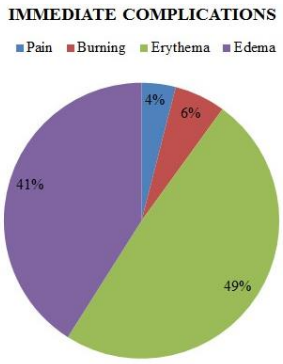

Figure 2. Immediate complications after treatment

Discussion

Our study revealed that ED is safe, well tolerated and efficacious in removing DPN painlessly by using topical anesthesia under occlusion for an adequate duration. Studies with quantitative assessment of the number of lesion clearances well established its efficacy. In a randomized control trial of ED, curettage and PDL by Garcia and colleagues showed that there was no significant difference in clinical efficacy among these three procedures. In their study, one "blinded observer" evaluated and recorded the findings from pre- and post-procedure photographs. "Blinded observers" performed a global assessment without quantification by lesional count. The assessment reported that patients favored ED over others, including PDL, due to lesser pain. In the same study, patients preferred ED with best cosmetic outcome followed by curettage and laser[6]. Niang and team carried out a prospective study on 30 DPN patients in Senegal. The analysis of results over a period of six months demonstrated ED as a perfect therapeutic modality[7].

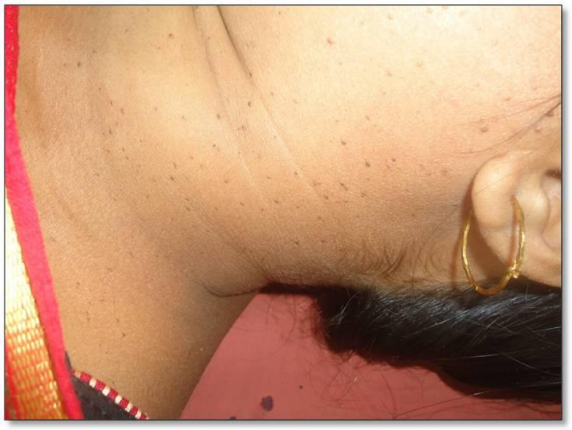

Figure 3. Pre-operative photograph showing extensive lesions

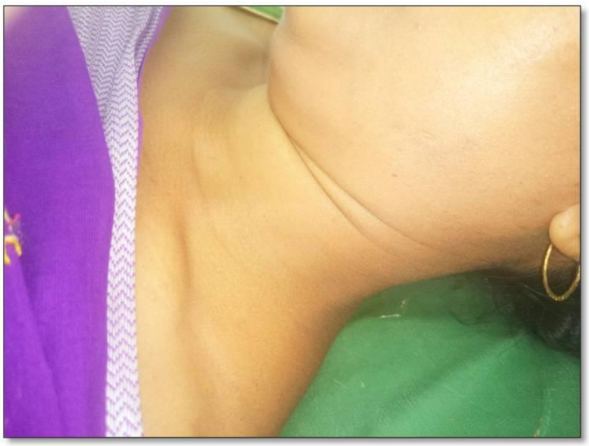

Figure 4. Postoperative photograph showing almost no lesion

Multiple expensive and high technology lasers were capturing the market gradually for different cosmetic and dermatosurgical conditions. Certain lasers other than PDL have been in trials in DPN; however, successful techniques with lasers were not as convincing compared to trusted age-old ED. Kundu *et al.* compared ED with

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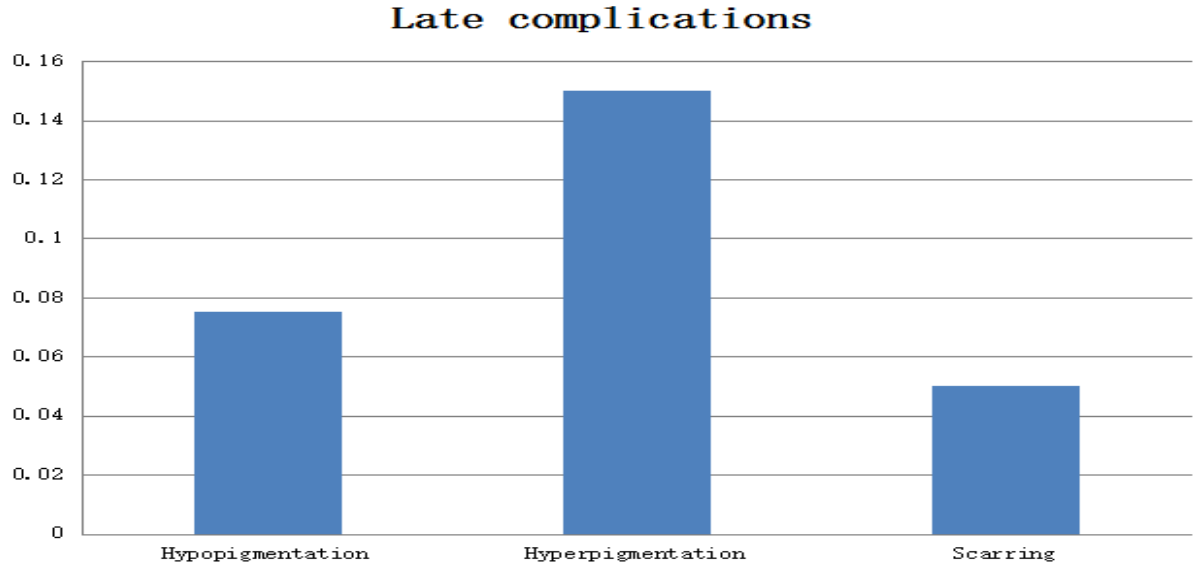

Figure 5. Late complications

KTP laser for DPN in 14 subjects (skin type IV to VI) with a split-face model and the study demonstrated that in terms of efficacy, the ED and KTP lasers had no significant difference. The analysis showed that a small number of patients experienced discomfort with KTP laser as compared to ED, in the event of both cases having no administration of anesthesia in the study protocol[5].

In darker skin types, the most detrimental side effect is post-inflammatory pigment alteration. In the case of DPN patients who seek it exclusively for cosmetic concerns, post-inflammatory pigment alteration usually affects patient satisfaction. In our study, post-inflammatory hyperpigmentation was observed only in a small number of cases after two weeks, and it would disappear after 8–12 weeks with minimal therapy. In contrast, a study by Gracia MS *et al.* reported a high rate (50%) of post-inflammatory hyperpigmentation[6]. These were due to the removal of each lesion after ED by a gauge piece for depth assessment, as per study protocol. The better outcome in terms of pigmentary complication in our study was explained by the accurate depth assessment and the dried residue being left as it was after reaching the end point without wiping it out. Along with that, we prescribed post-procedural topical antibiotic and least potent steroid combination for a certain period of days with sunscreen applied, which contributed to the result[5].

Minor side effect profile was observed in darker skin type. We encountered no recurrence after three months of follow-up sessions. Immediate postoperative lesional mild erythema and edema disappeared within 3–5 days afterward. A few cases of post-inflammatory hypopigmentation were also observed after a week, which thereafter healed within 4–6 weeks. Minimal scarring that was perceived in two cases disappeared within eight weeks. ED targets each lesion separately, and care should be taken for it to be kept superficial in order to avoid post-inflammatory hyperpigmentation. This method requires time compared to laser. In the case of multiple lesions, more than one sitting may be needed[8]. Katz *et al.* discussed erbium-doped 1550 nm fractionated laser as an effective tool for DPN though it was based on a single patient evaluated by a "blinded observer". The improvement rate of 75% was based on global assessment instead of lesion count[9]. Schweiger described an improvement of 70%–90% with long-pulsed Nd:YAG in two patients. However, the assessment method was not described[3].

The presented study was restricted due to requirement of long-term follow-up session and the process of juxtaposition with other modalities. Further research is suggested to distinguish this method for treatment modalities. Cost-effective measures optimized for Indian scenario should be evaluated. ED machines are simple, cheap and affordable. In contrast, lasers have higher cost and limited availability at specific centers. Treatment outcome of DPN with a laser is inadequate. Hereby, we have shown that a simple ED is an effective method for treating a condition such as DPN. The procedure was judicious, and with appropriate postoperative measurement, complications were able to be reduced.

Conclusion

The current study observed ED to be an effective,

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well-tolerated and cost-effective method for the treatment of DPN in colored skin. Complications are minimal if the therapy procedure is performed accurately with effective postoperative measurement.

Conflict of interest

The authors declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

References

1. James WD, Berger T, Elston D. Epidermal nevi, neoplasms and cysts. 11th ed. In: James W, Berger T, Elston D, (editors). Andrews's diseases of the skin: Clinical dermatology. Philadelphia: Elsevier; 2011. p. 626.
2. Pierson D, Bandel C, Ehrig T. Benign epidermal tumors and proliferations. 2nd ed. In: Bolognia J, Jorizzo JL, Rapini RP (editors). Dermatology. New York: Mosby; 2003. p. 1717.
3. Report of two cases. J Cosmet Laser Ther 2008; 10(2): 120–122. doi: 10.1080/14764170801950070.
4. Sebben JE. The hazards of electrosurgery. J Am Acad Dermatol 1987; 16: 869–872. doi: 10.1016/S0190- 96 22(87)80221-9.
5. Kundu RV, Joshi SS, Suh KY, Boone SL, Huggins RH, *et al.* Comparison of electrodesiccation and potassium-titanyl-phosphate laser for treatment of dermatosis papulosa nigra. Dermatol Surg 2009; 35: 1079–1083. doi: 10.1111/j.1524-4725.2009.01186.x.
6. Garcia MS, Azari R, Eisen DB. Treatment of dermatosis papulosa nigra in 10 patients: A comparison trial of electrodesiccation, pulsed dye laser, and curettage. Dermatol Surg 2010; 36: 1968–1972. doi: 10.1111/j.1524-4725.2010.01769.x.
7. Niang SO, Kane A, Diallo M, Choutah F, Dieng MT, *et al.* Dermatosispapulosanigra in Dakar, Senegal. Int J Dermatol 2007; 46(Suppl 1): 45–47.
8. Karadag AS, Ozkanli S, Mansuroglu C, Ozlu E, Zemheri E. Effectiveness of the pulse dye laser treatment in a Caucasian woman with dermatosis papulosa nigra. Indian J Dermatol 2015; 60: 321. doi: 10.4103/0019-5154.156447.
9. Katz TM, Goldberg LH, Friedman PM. Dermatosis papulosa nigra treatment with fractional photothermolysis. Dermatol Surg 2009; 35: 1840–1843. doi: 10.1111/j.1524-4725.2009.01302.x.

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ORIGINAL RESEARCH ARTICLE

Treatment of periorbital dark circles: Comparative study of chemical peeling with a combination of trichloroacetic acid and lactic acid versus carboxytherapy

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Abstract: Periorbital dark circles (PODC) are a common worldwide cosmetic problem. It is difficult to treat due to complications in its pathogenesis and aetiology. Available lines of treatment for PODC include whitening creams, topical retinoid acid, chemical peeling, laser therapy, carboxytherapy, autologous fat transplantation, injectable fillers and surgery (blepharoplasty).The aim of this study isto evaluate and compare the efficacy of chemical peels using trichloroacetic acid (3.75%) and lactic acid (15%) in a gel formula with that of carboxytherapy, in the treatment of periorbital hyperpigmentation.Two groups of patients with PODC were included in the study, named Group A and B in which each group consisted of 15 patients. Group A was assigned for patients who received treatment with chemical peeling with a combination of trichloroacetic acid (3.75%) and lactic acid (15%) in a gel formula, once a week for four weeks. Group B was assigned for patients who received carboxytherapy that was performed by subcutaneous and intradermal injection of CO_2 once a week for four weeks. All patients were assessed by digital photographs, before and after treatment, by observing the improvement in the grade of PODC. Reports of patient satisfaction and global tolerance were evaluated by three medical observers. There was a significant improvement in the grade of PODC in both groups. The degree of improvement of PODC in group A was excellent, with good grade in 93.4% of the treated patients while fair grade in 6.6% of them. There was a statistically significant improvement in the pigmented type. The degree of improvement of PODC in group B was excellent, with good grade in 86.7% of the treated patients while fair grade in 13.3% of them. However, no statistically significant difference between the two groups was observed. Minimal and transient side effects were noticed; however, it did not require further treatment. In conclusion, the two methods of treatment were effective in the treatment of PODC, with the improvement of PODC observed from the first treatment session with both chemical peeling and carboxytherapy.

Keywords: Chemical peeling; carboxytherapy; periorbital dark circles

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Introduction

Periorbital dark circles (PODC) are known as bilateral homogeneous pigmentation on the periorbital areas. The condition is a common cosmetic problem affecting individuals of any age. Both sexes and any race can be affected. It becomes worse with the aging process and it can cause complaints of major annoyance, especially for female patients. PODC interferes with the appearance of the face, giving the patient a tired, sad look and an aging appearance[1,2].

Hyperchromia of the periorbital area can be classified into primary (idiopathic) type and secondary type, which is associated with systemic or local diseases of known causes[3]. Secondary PODC may be caused by multiple etiologic factors such as familial or ethnic tendency, periorbital edema and post-inflammatory hyperpigmentation, resulting from atopic or allergic contact dermatitis, medications and systemic diseases. Other causes that can be considered are fatigue, smoking, excessive sun exposure, superficial location of vasculature of the eye lids, tear trough depression and shadowing due to laxity of the skin[1,2].

In fact, PODC can be a combination of the above - mentioned factors[4].On the other hand, it has been suggested that cutaneous hyperchromia of the orbital region is not associated with underlying diseases in many cases, as it can affect completely normal people[5]. Available treatments for PODC include topical bleaching agents, chemical peeling, carboxytherapy, laser therapy, injectable fillers, autologous fat transplantation and surgery (blepharoplasty)[6,7].

Chemical peeling is considered as a simple in-office technique. It is a medical procedure causing controlled damage to the skin, in which regeneration and rejuvenation of tissues occur after the healing process. It can be classified into three basic types according to the histologic depth of injury, i.e., superficial, medium and deep peeling. The first type affects only the epidermis down to the basal layer. The medium peel affects the papillary portion of the dermis, whereas the deep type can reach the reticular dermis. Chemical peels are widely used for depigmentation alone or in combination with other topical agents[8].

Carboxytherapy is the administration of carbon dioxide (CO_2) gas for therapeutic purposes. It is used for the treatment of many cosmetic problems such as PODC, striae alba, improvement of cellulite, lipolysis, and rejuvenation of the face. It works by increasing blood flow to the injected region. Carboxytherapy also increases the deposition of collagen in the skin, giving the patient a young and healthy appearance[9].

This study will evaluate the efficacy and safety of a novel superficial chemical peeling technique consisting of a combination of trichloroacetic acid (TCA) 3.75% and lactic acid (LA) 15% in a gel formula (this combination increases the depth of penetration without using high concentration of the agents used, and has no adverse effects such as scarring and permanent depigmentation), and comparing it with carboxytherapy.

Methods

Upon approval from the research ethics committee of Faculty of Medicine of Tanta University (approval code 2655/08/14), this study was conducted on 30 patients with PODC, recruited from the Out-Patient Clinic of Dermatology and Venereology Department of Tanta University Hospital from August 2014 to March 2015. The patient inclusion criteria were namely patients with newly diagnosed cases who were otherwise clinically free, and patients not receiving any PODC treatment in the last six months. Patients with history of keloid scarring, bleeding tendency, and photosensitivity or hypersensitivity to the treatment components were excluded from this study. An informed consent was taken from every patient after full explanation of the procedure, risks and purpose of the study.

All patients were subjected to detailed history taking, thorough general and dermatological examination, evaluation of patient's skin type and evaluation before and after the treatment based on the type of PODC, i.e., whether it is pigmented (brown color), vascular (blue/pink/purple color) or mixed type. Assessment of the grade of PODC was conducted in comparison to the surrounding skin, which is as follows[10]:

Grade 0: Skin color comparable to other facial skin areas.

Grade 1: Faint pigmentation of infraorbital fold (bilateral).

Grade 2: Pigmentation more pronounced.

Grade 3: Deep dark color, all 4 lids involved.

Grade 4: Grade 3 + pigmentation spreading beyond infraorbital fold.

The improvement was graded as 0% to 25% (poor), 26% to 50% (fair), 51% to 75% (good) and 76% to 100% (excellent), which was done by three medical observers. The patients were requested to estimate the clinical results and choose one out of the four categories: not satisfied, slightly satisfied, satisfied and very satisfied. Safety was assessed by evaluating global tolerance (poor, fair, good and excellent) and adverse effects. All patients were photographed before and after the treatment. The patients were divided into two groups named group A and B, with each group consisting of 15 patients.

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Group A

A combination of peeling agents consisting of TCA in the concentration of 3.75% and LA of 15% was prepared in a gel formula[11]. The patients were subjected to experience peeling every week for four weeks. Cleaning of the skin was carried out using a moistened wipe dampened with a combination of acidified hydroalcoholic solution with citric acid. For accurate application of the gel, a rigid device applicator covered with a thin spongy material was used. During every session, 4 layers of the peel were applied to periorbital area. The gel was applied for 1–2 min in the 1st, 2nd, and penultimate layer, and about 5 min in the last layer. The duration of each session was 8–11 min. Neutralization of the gel was done by a moistened wipe with 12% solution of arginine and the patients washed the treated area with pure water afterwards. All patients were advised to avoid rubbing the periorbital area, avoid sun exposure, use sunscreen and wear sunglasses.

Group B

Patients underwent a combination of intradermal and subcutaneous injections of CO_2 once a week for four weeks[12]. The instrument used was carboxytherapy device (Concerto SN: CO 501-0600. Italy). The injections were performed bilaterally in the lateral upper and lower eyelid. A 32G needle was used to perform the injections. A total amount of gas was administered at 1–2 mL at each side, with flow rate of 1 cc/sec. The average time for each session was between 5–7 min. External compression was avoided, as it may lead to leakage of the gas through the skin. Routine follow-ups and evaluation of improvement for every patient were conducted every week throughout the treatment course for at least one month after finishing the treatment.

Statistical analysis

The collected data were organized, tabulated and statistically analyzed using Statistical Package for the Social Sciences (SPSS) software version 20. For qualitative data, comparison between two groups or more was done using Chi-square test (χ^2). For comparison between means of the two groups, parametric analysis (*t*-test) and non-parametric analysis (*Z* value of Mann-Whitney *U* test) were used. For comparison between means of the same group before and after treatment, parametric analysis (paired *t*-test) and non-parametric analysis (*Z* value of Wilcoxon Signed Ranks test) were used. A comparison was done between two groups using the hypothesis test of proportions or *Z* test, by calculating the percentage of changes of pre- and post-treatment. Correlation between variables was evaluated using Pearson's correlation coefficient. The significance level was adopted at $p < 0.05$ for interpretation of the tested results[13,14].

Results

30 female patients were included in the current study. They were divided into 15 patients in each group. Their age ranged from 18–50 years (median: 24). The duration of the disease was 3–10 years (median: 5) with no statistically significant difference found between the two studied groups.

Results of group A

The patients' skin types were presented as follows: 1 patient (6.7%) with skin type II, 10 patients (66.7%) with skin type III while 4 patients (26.6%) experienced skin type IV. The patients were categorized into several skin types, i.e., 8 patients (53.3%) with pigmented type of PODC whereas 7 patients (46.7%) with mixed type. Improvement in skin color was observed in most patients from the first session of peeling until further improvement thereafter. There was a statistically significant improvement in the grade of PODC ($p < 0.001$) as shown in **Table 1**.

All patients were satisfied with the treatment. None of the patients reported that PODC worsened after the treatment. The evaluation of every patient's degree of improvement by three medical observers revealed an excellent improvement in 46.7% of the patients (**Figure 1**), with good and fair results in 46.7% and 6.6% of them, respectively (**Figures 2** and **3**). Patient satisfaction result was as follows: very satisfied (33.3%), satisfied (53.3%) and slightly satisfied (13.3%). The procedure was tolerated with excellent global tolerance in 33.3% of the patients, whereas 46.6% and 20% of them showed good and poor tolerance, respectively, as shown in **Table 2**.

Some participants (40%) tolerated the chemical peeling treatment's minimal side effects known as tingling. On the other hand, 20% of patients experienced itching, 46.6% had mild burning sensation, while the other 33.3% and 20% of them had erythema, and exfoliation and dryness, respectively. The occurrence of exfoliation was most relevant at 24–48 h after the peeling treatment. However, all these symptoms existed for a short duration of time and did not require further treatment.

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Table 1. Comparison between groups based on grade of PODC before and after treatment

		Chemical peeling (*N* = 15)		Carboxytherapy (*N* = 15)		*Z*	*p*
		No.	%	No.	%		
Grade of PODC before treatment	**0**	0	0	0	0	*Z* = 0.726	0.468
	1	2	13.3	2	13.3		
	2	6	40.0	3	20.0		
	3	5	33.3	8	53.3		
	4	2	13.3	2	13.3		
Grade of PODC after treatment	0	10	66.7	9	60.0	*Z* = 0.342	0.732
	1	4	26.7	5	33.3		
	2	1	6.7	1	6.7		
	3	0	0	0	0		
	4	0	0	0	0		
	Z	3.531*		3.482*			
	p	< 0.001*		< 0.001*			

Z: *Z* value for Mann Whitney test

Figure 1. Patient with PODC as seen before (A), and after (B), chemical peeling treatment, who was diagnosed as pigmented type grade 3 PODC and showed excellent improvement

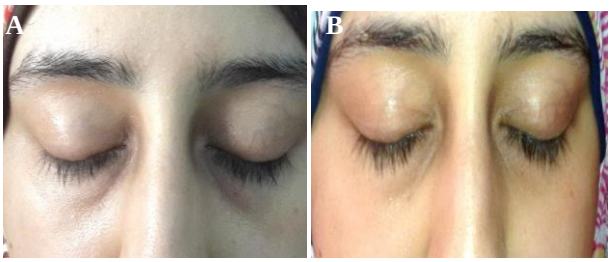

Figure 2. Patient with PODC as seen before (A), and after (B), chemical peeling treatment, who was diagnosed as pigmented type grade 3 PODC and showed good improvement

The relationship between type of PODC and its degree of improvement showed significant improvement in pigmented type of PODC ($p = 0.005$) as shown in **Table 3**.

Results of group B

The patients' skin types were presented as follows: 5 patients (33.3%) with skin type II, 7 patients (46.7%) with skin type III and 3 patients (20%) with skin type IV. The patients were divided into several skin types, i.e., 7 patients (46.7%) with pigmented type of PODC, 6 patients (40%) with mixed type, and 2 patients (13.3%) with vascular type. The patients reported improvement in both PODC and wrinkles. There was a statistically significant improvement in the grade of PODC ($p < 0.001$) as shown in **Table 1**.

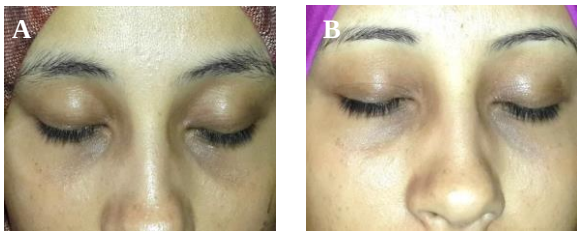

Figure 3. Patient with PODC as seen before (A), and after (B), chemical peeling treatment, who was diagnosed as pigmented type grade 3 PODC and showed fair improvement

The evaluation of every patient's degree of improvement by three medical observers reported an excellent result in 46.7% of the patients (**Figure 4**), with good and fair results in 40% and 13.3% of them, respectively (**Figures 5** and **6**). The patient satisfaction result was as follows: very satisfied (40%), satisfied (53.3%) and slightly satisfied (6.7%). The procedure was tolerated with excellent global tolerance in 33.3% of the patients, whereas 53.3% and 13.3% of them showed good and poor tolerance, respectively, as shown in **Table 2**.

Most participants (33.3%) tolerated carboxytherapy treatment with minimal side effects of minor pain at site of injection; however, the pain was temporary and limited to the site of injection. Edema was found in 26.6% of the patients (which totally disappeared 10 min after the

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session; however, it continued for 24 h in a few patients), 20% experienced burning sensation, whereas 6.6% reported mild ecchymosis. All of these side effects were only temporary and most of the patients tolerated it very well.

The relationship between type and degree of improvement of PODC was presented in **Table 3** and shows no significant difference in the improvement of different type of PODC.

Table 2. Comparison between groups according to degree of improvement, patient satisfaction and global tolerance

	Chemical peeling (*N* = 15)		Carboxytherapy (*N* = 15)		χ^2	^{MC}p
	No.	%	No.	%		
Degree of improvement						
Poor response (0%–25%)	0	0.0	0	0.0		
Fair response (26%–50%)	1	6.6	2	13.3		
Good response (51%–75%)	7	46.7	6	40.0	0.540	1.000
Excellent response (⩾76%)	7	46.7	7	46.7		
Patient satisfaction						
Not satisfied	0	0.0	0	0.0		
Slightly satisfied	2	13.3	1	6.7	0.555	1.000
Satisfied	8	53.3	8	53.3		
Very satisfied	5	33.3	6	40.0		
Global tolerance						
Poor	0	0.0	0	0.0		
Fair	3	20.0	2	13.3		
Good	7	46.6	8	53.3	0.394	1.000
Excellent	5	33.3	5	33.3		

χ^2: value for Chi square; MC: Monte Carlo test

Table 3. Relationship between degrees of improvement and type of PODC

	Type of PODC	Degree of improvement						χ^2	*p*
		Fair		Good		Excellent			
		No.	%	No.	%	No.	%		
Group A	Mixed	1	100.0	6	85.7	0	0.0		
	Pigmented	0	0.0	1	14.3	7	100.0	10.500*	0.005*
	Vascular	0	0.0	0	0.0	0	0.0		
Group B	Mixed	1	50.0	2	33.3	3	42.9		
	Pigmented	1	50.0	4	66.7	2	28.6	3.296	0.742
	Vascular	0	0.0	0	0.0	2	28.6		

χ^2: Chi square test; FE: Fisher Exact test; *Statistically significant at $p \leqslant 0.05$

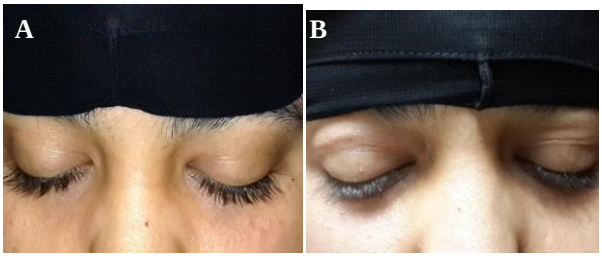

Figure 4. Patient with PODC as seen before (A), and after (B), the treatment of carboxytherapy, who was diagnosed as pigmented type grade 2 PODC and showed excellent improvement

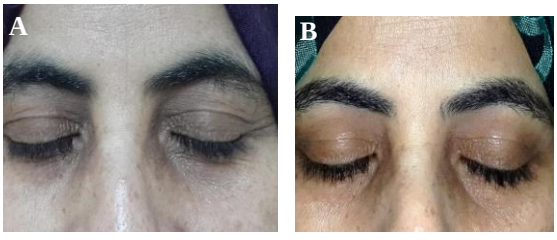

Figure 5. Patient with PODC as seen before (A), and after (B), the treatment of carboxytherapy, who was diagnosed as pigmented type grade 3 PODC and showed good improvement overall especially in the periorbital wrinkles area

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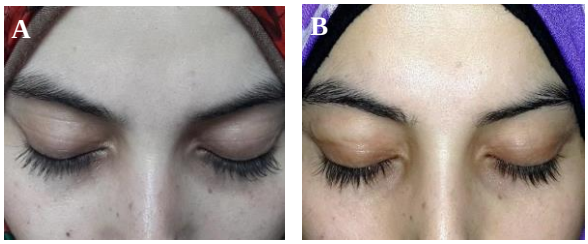

Figure 6. Patient with PODC as seen before (A), and after (B), the treatment of carboxytherapy, who was diagnosed as pigmented type grade 2 PODC and showed fair improvement

Comparison between group A and B

There was no statistically significant difference in the improvement of the PODC grade between the groups, as shown in **Table 1**. The degree of improvement of PODC, patient satisfaction and global tolerance also showed no statistically significant difference between the two studied groups (**Table 2**).In addition, there was no significant correlation between either age or duration of the PODC and degree of improvement in both groups.

Discussion

The etiology of PODC may be multifactorial with none of the etiologic agent predominating. That is why there is no treatment of choice for PODC; in truth, published research are still deficient with regard to this problem[15,16].

Chemical peeling is a simple in-office procedure that has evolved over the years. It is based on causing chemical injury to the skin that leads to the regeneration of new healthy layers. It is a simple and cheap technique which needs fewer instruments to rejuvenate the skin[17].

Although carboxytherapy is widely used in many fields, only a few researches concerning its application in aesthetic medicine were published. It was discovered that it improves skin elasticity, circulation, aids collagen repair and destroys localized fatty deposits[18].

In the current study, the degree of improvement of PODC treated with chemical peeling in group A was found to be excellent in 46.7% of the patients, while showing good and fair result in 46.7% and 6.6% of them, respectively. None of the patients' skin became worse or did not respond to the treatment. Statistically significant improvement in the grade of PODC was reported ($p < 0.001$). This result was even better than the results of a previous study by Vavouli *et al*. who performed chemical peeling with the same chemical combination for infraorbital dark circles. They reported an excellent response in 16.6% of the patients, while 40.0%, 36.7% and 6.6% of them showing good, fair and poor result, respectively[11].

In the present study, 33.3% of the studied patients were very satisfied with the results, 53.3% were satisfied and 13.3% were slightly satisfied. This was in agreement with the study by Vavouli *et al*., in which they reported that the patient satisfaction result was 63.3% responded to be very satisfied, with slightly satisfied in 23.3% of them, while the other 13.3% were dissatisfied[11].

In this study, the patient global tolerance was found to be 33.3% excellent, 46.6% good and 20% fair in the patients, respectively. This finding was in accordance with Vavouli *et al*., who reported 46.7% excellent tolerance in the patients, while 30.0% and 23.3% of them showed good and fair tolerance, respectively[11].

The side effects were minimal and listed as transient in the patients. 46.6% of patients experienced burning sensation, 40% had tingling, 33.3% presented with erythema, 20% manifested itching and the other 20% had skin dryness. At the same time, Vavouli *et al*. discovered the same side effects which were not considered as restrictive factor to the patients[11]. This was the first study to find out that this combination of chemical peeling was significantly much more effective for PODC of pigmented type as compared to other types.

This could be explained by the fact that TCA application on the skin produces injury to the epidermis and upper dermis, as well as coagulation of skin proteins and melanin dispersion. This is followed by regeneration of new cells with increased collagen formation, which leads to the increase in the volume of epidermis and dermis. Many factors affect the depth of skin necrosis such as the increase in the concentration of TCA, application of TCA on a more permeable skin, increase in the number of skin layers used in the same treatment session, prolongation of contact time with the skin, the number of previously performed sessions, the duration between sessions, and the patient's skin type[19].

Lactic acid is an alpha hydroxy acid (AHA) which facilitates desquamation of epidermal cells, melanin dispersion, and induces collagen and glycosaminoglycan deposition. Moreover, it has been reported to inhibit tyrosinase enzyme; therefore it was used in the treatment of melasma[20]. It induces the skin-lightening effect through three mechanisms, namely the induction of keratinocytes desquamation and the removal of melanosomes; the inhibition of tyrosinase; and the thickening of the epidermis and the dermis, so that the vasculatures become less visible[21,22].

There are several advantages of the combination of chemical peels: for instance, increasing the depth of skin penetration without increasing the concentration of chemical peels; lowering the treatment's adverse effects

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such as scarring and permanent depigmentation by using low concentration of the peeling agents; enhancing tissue regeneration; and reducing subsequent recovery time[11].

Additionally, this chemical peel is reliable and an effective method of treatment for PODC, especially the pigmented type. It is cheaper when compared to other methods. It has the advantage of well-homogenizing effect. It is also effective, safe, and well tolerated, which is satisfying for both patients and physicians[11]. However, the only limitation for this kind of treatment is that the patients should avoid sun exposure.

The degree of improvement of PODC for group B treated by carboxytherapy was excellent in 46.7% of the patients, while showing good and fair results in 40% and 13.3% of them, respectively. None of the patients' skin was worsening or not responding to the treatment. A statistically significant improvement in the PODC grade was reported ($p < 0.001$). The patient satisfaction result was as follows: 53.3% satisfied, 40% very satisfied and 6.7% slightly satisfied. On the other hand, the patient global tolerance was as follows: 33.3% excellent, 53.3% good and 13.3% fair. The side effects were minimal and listed as transient, with 33.3% of the patients having pain at the site of injection, 26.6% having edema, 20% experiencing burning sensation and 6.6% manifesting ecchymosis, while two patients did not report any complaints.

This was in accordance with the results of a previous study by Paolo *et al*. who performed carboxytherapy for PODC[12]. The compliance of the patients was good and they tolerate the procedure well. They reported a progressive improvement of periorbital wrinkles as well as periorbital pigmentation from the first treatment session with continuous improvement after that. In the present study, we found that the patients' wrinkles also improved and their skin textures became better. We also reported an excellent improvement in the vascular type of PODC, which occurred in two cases only.

Carboxytherapy is a new technique that consists of the subcutaneous and intradermal injection of CO_2. The injected CO_2 creates a relative state of hypercapnia which is compensated by vasodilatation and increment in the capillary blood flow to the injected area, reduces cutaneous oxygen consumption, as well as stimulates growth factors secretion such as vascular endothelial growth factor (VEGF), leading to new blood vessels formation. The state of hypercapnia is not harmful to the body because it can be simply eliminated via lungs[23].

Carboxytherapy is very beneficial in restoring the physiology of the lymphatic system in patients complaining of having lymphatic stasis as its vasodilation effect enhances tissue perfusion and improves local parameters of circulation resulting in the reduction of lymphedema[24,25]. It also increases collagen turnover as reported by Paolo *et al*., as their patients showed reduction in periorbital wrinkles and facial lines with improvement in skin texture as well[12].

This was the first study to compare between chemical peeling and carboxytherapy in the treatment of PODC. There was no significant difference between the groups regarding the grade of PODC before and after the treatment. The degrees of improvement of PODC showed no statistically significant difference between the two studied groups. There was no significant difference between the studied groups and both the patient satisfaction and global tolerance results.

Conclusion

We concluded that the two methods of treatment were equally effective in the treatment of PODC, with the improvement of PODC observed from the first treatment session for both chemical peeling and carboxytherapy. Chemical peeling was much better in the treatment of pigmented type of PODC, with minimal tolerated side effects. It is cheap and is considered as a simple in-office technique. On the other hand, carboxytherapy is an effective and novel method for the treatment of PODC especially in the cases of patients with periorbital wrinkles. Nevertheless, expensive treatment sessions may be a limiting factor for such method. Additional studies are recommended on a larger number of patients with PODC to get better evaluations.

Author contributions

The idea of the study was that of Hassan AM. The design of the study, collection of patients, the sessions that were done for the patients were performed by Hassan AM, Hassan GFR, Aldalies HY, The preparation of the gel used for peeling was done by El Maghraby GM. Also, the analysis and interpretation of data; drafting the article and revising it critically for important intellectual content; and final approval of the version to be published were done by all authors.

Conflict of interest

The authors declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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References

1. Freitag FM, Cestari TF. What causes dark circles under the eyes? J Cosmet Dermatol 2007; 6(3): 211–215. doi: 10.1111/j.1473-2165.2007.00324.x.
2. Roh MR, Chung KY. Infraorbital dark circles: Definition, causes, and treatment options. Dermatol Surg 2009; 35(8): 1163–1171. doi: 10.1111/j.1524-4725.2009.01213.x.
3. Cymbalista NC, de Oliveira ZNP. Treatment of idiopathic cutaneous hyperchromia of orbital region (ICHOR) with intense pulsed light. Dermatol Surg 2006; 32(6): 773–784. doi:10.1111/j.1524-4725.2006.32160.x.
4. Roh MR, Kim TK, Chung KY. Treatment of infraorbital dark circles by autologous fat transplantation: A pilot study. Br J Dermatol 2009; 160(5): 1022–1025. doi: 10.1111/j.1365-2133.2009.09066.x.
5. Yeh CC, Williams III EF. Midface restoration in the management of the lower eyelid. Facial Plast Surg Clin North Am 2010; 18(3): 365–374. doi: 10.1016/j.fsc.2010.04.001.
6. Momosawa A, Kurita M, Ozaki M, Miyamoto S, Kobayashi Y, *et al*. Combined therapy using Q-switched ruby laser and bleaching treatment with tretinoin and hydroquinone for periorbital skin hyperpigmentation in Asians. Plast Reconstr Surg 2008; 121(1): 282–288. doi: 10.1097/01.prs.0000293869.00522.ec.
7. Rigopoulos D, Gregoriou S, Katsambas A. Hyperpigmentation and melasma. J Cosmet Dermatol 2007; 6(3): 195–202. doi:10.1111/j.1473-2165.2007.00321.x.
8. Khunger N. Standard guidelines of care for chemical peels. Indian J Dermatol Venereol Leprol 2008; 74(7): 5–12.
9. Brandi C, D'Aniello C, Grimaldi L, Caiazzo E, Stanghellini E. Carbon dioxide therapy: Effects on skin irregularity and its use as a complement to liposuction. Aesthet Plast Surg 2004; 28(4): 222–225. doi: 10.1007/s00266-004-2068-z.
10. Sheth PB, Shah HA, Dave JN. Periorbital hyperpigmentation: A study of its prevalence, common causative factors and its association with personal habits and other disorders. Indian J Dermatol 2014; 59(2): 151–157. doi: 10.4103/0019-5154.127675.
11. Vavouli C, Katsambas A, Gregoriou S, Teodor A, Salavastru C, *et al*. Chemical peeling with trichloroacetic acid and lactic acid for infraorbital dark circles. J Cosmet Dermatol 2013; 12(3): 204–209. doi: 10.1111/jocd.12044.
12. Paolo F, Nefer F, Paola P, Nicolò S. Periorbital area rejuvenation using carbon dioxide therapy. J Cosmet Dermatol 2012; 11(3): 223–228. doi: 10.1111/j.1473-2165.2012.00633.x.
13. Kotz S, Balakrishnan N, Read CB, Vidakovic B, Johnson NL. Encyclopedia of statistical sciences. 2nd ed. Hoboken, NJ: Wiley-Interscience; 2006.
14. Kirkpatrick LA, Feeney BC. A simple guide to IBM SPSS statistics for version 20.0. Student ed. Belmont, California: Wadsworth, Cengage Learning; 2013.
15. Mashood AA. Treatment of hyperpigmentation disorders. Journal of Pakistan Association of Dermatologists 2006; 16: 65–68.
16. Gendler EC. Treatment of periorbital hyperpigmentation. Aesthet Surg J 2005; 25: 618–624. doi: 10.1016/j.asj.2005.09.018.
17. Slavin JW. Considerations in alpha hydroxy acid peels. Clin Plast Surg 1998; 25(1): 45–52.
18. Nach R, Zandifar H, Gupta R, Hamilton JS. Subcutaneous carboxytherapy injection for aesthetic improvement of scars. Ear Nose Throat J 2010; 89(2): 64–66.
19. Chun EY, Lee JB, Lee KH. Focal trichloroacetic acid peel method for benign pigmented lesions in dark-skinned patients. Dermatol Surg 2004; 30(4): 512–516. doi: 10.1111/j.1524-4725.2004.30166.x.
20. Usuki A, Ohashi A, Sato H, Ochiai Y, Ichihashi M, *et al*. The inhibitory effect of glycolic acid and lactic acid on melanin synthesis in melanoma cells. Exp Dermatol 2003; 12(Suppl 2): 43–50. doi: 10.1034/j.1600-0625.12.s2.7.x.
21. Sachdeva S. Lactic acid peeling in superficial acne scarring in Indian skin. J Cosmet Dermatol 2010; 9(3): 246–248. doi: 10.1111/j.1473-2165.2010.00513.x.
22. Sharquie KE, Al-Tikreety MM, Al-Mashhadani SA. Lactic acid chemical peels as a new therapeutic modality in melasma in comparison to Jessner's solution chemical peels. Dermatol Sur 2006; 32(12): 1429–1436. doi: 10.1111/j.1524-4725.2006.32352.x.
23. Varlaro V, Manzo G, Mugnaini F, Bisacci C, Fiorucci P, *et al*. Carboxytherapy: Effects on microcirculation and its use in the treatment of severe lymphedema. Acta Phlebol 2007; 8: 1–13.
24. Zenker S. Carboxytherapy: Carbon dioxide injections in aesthetic medicine. Prime Europe 2012; 2(1): 42–50.
25. Ferreira JCT, Haddad A, Tavares SAN. Increase in collagen turnover induced by intradermal injection of carbon dioxide in rats. J Drugs Dermatol 2008; 7(3): 201–206.

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ORIGINAL RESEARCH ARTICLE

Tear trough – Anatomy and treatment by autologous fat grafting

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Abstract: Tear trough is the main irregularity at midface, of which treatment is difficult. There is no agreement in literature about its anatomy and best treatment. The author presented an anatomical study and personal autologous fat grafting technique for tear trough treatment. Anatomical dissections were done on two fresh cadavers to examine the skin, subcutaneous, muscle and bone layers, spaces, and attachments. Safety and efficacy were evaluated via retrospective analysis of the last 200 consecutive procedures performed by the author. Tear trough is caused by the abrupt transition of the palpebral orbicular oculi muscle (OOM) (*i.e.*, thin skin without subcutaneous fat compartment) to the orbital OOM (*i.e.*, thicker skin with malar fat compartment). The tear trough region is located at the OOM bony origin at the medial canthus where no specific ligament was found. The grafted fat volume stabilized at two or three months after the procedure, instead of six months as stated in literature, with excellent results and no severe complications. Tear trough is a personal characteristic, a natural anatomical depression caused by subcutaneous irregularity and can worsen with age. The lack of volume is not effectively corrected by surgeries and thus it must be filled. Fat grafting has several advantages over alloplastic fillers, although it may be more difficult. Fat graft is autologous and abundant, and tissue transplantation could enhance skin quality. Fat grafting is a simple, safe, and effective solution for adding extra volume to correct the deflation phenomenon of the midface aging process. There is no specific anatomical plane for volume injection; the fat graft must be evenly distributed in the deep and superficial plane for uniformity.

Keywords: Tear trough; fat graft; lid cheek junction; facial anatomy; aging face

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Introduction

The most important characteristic in the concept of beauty and youth in facial contouring is the uniformity and regularity of the malar prominence that is in smooth continuity with the orbitopalpebral region (**Figure 1**). The main irregularities of this region are the lateral lid-cheek junction, the central "V" deformity, and especially the marked medial tear trough[1]. Inferior palpebral fat compartments may be also prominent enhancing the upper volume and causing a deeper impression of the periorbital sulcus. The inferior palpebral skin is usually darker, further highlighting the deformity (**Figure 2**).

These are definitely personal characteristics since childhood (**Figure 3**) and could worsen with age[2], but these are not "deformities". It could also be iatrogenic through excessive release of the inferior palpebral fat pad during blepharoplasties (**Figure 4**).

It has been known that the aging process is not a gravitational descent of facial or body tissue. Aging is genetically programmed, with quality and quantity alterations of tissues. In the face, the skin loses collagen and elastic fibers, decreasing in vascularity and appendages,

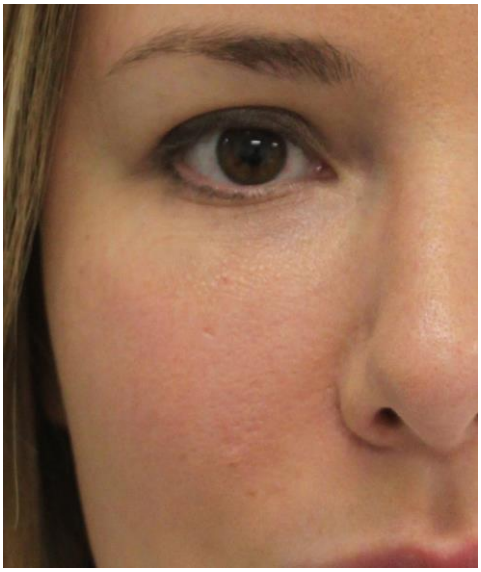

Figure 1. The beauty pattern: Regular malar prominence, in continuity with the orbitopalpebral region, forming one aesthetic unit

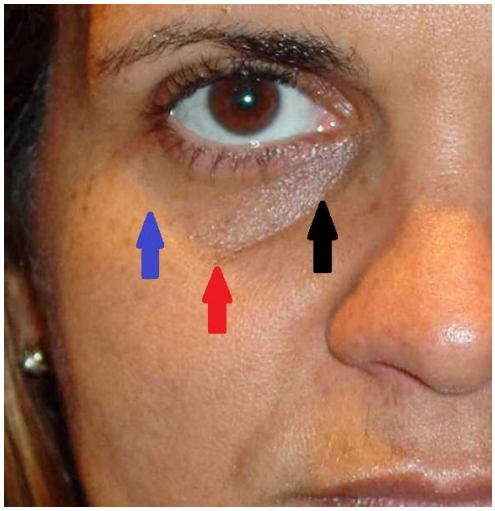

Figure 2. Periorbital deformities: Tear trough (black arrow), central "V" deformity (red arrow), and palpebromalar sulcus (blue arrow)

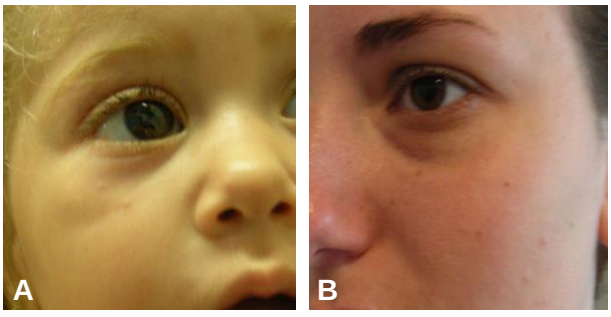

Figure 3. A three-year-old child (A) and a 23-year-old girl with tear trough (B)

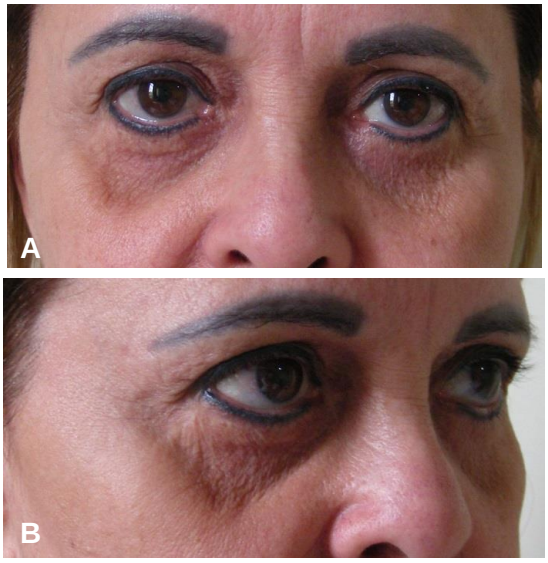

Figure 4. Excessive release of the inferior palpebral fat pads during previous blepharoplasties, front view (A), oblique view (B)

thus becoming thinner and flaccid. Fat compartments change the volumetric distribution, and the facial bones are in continuous remodeling throughout life[3-10]. Hence, in the midface, there is a deflation phenomenon. Treatment must be directed against these targets[11-15].

However, there are disagreements in literature regarding the anatomy of these landmarks. The present work presented an anatomical study via cadaveric dissection and personal autologous fat graft technique for tear trough treatment.

Methods

Anatomical study

The study was made via analysis of surgical dissection of two fresh male cadavers, both estimated to be about 40 years old. Dissection was performed layer by layer, with a particular interest on the skin thickness, the presence of subcutaneous fat, the position of muscles, and bone attachments.

Fat grafting technique

Patient evaluation and surgical plans were made in the orthostatic position. Facial deformities were marked. The inferior palpebral fat pads can be highlighted but rarely have indication for release nowadays and hence must be carefully valued. The ideal malar projection should be slightly more prominent than the palpebral region, with a smooth curve (**Figure 5A**). When the fat pad is more prominent than the eye, it must be released and the de-

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pression around the eyes be filled (**Figure 5B**). When the fat pad is evidenced by the depression around the eyes but is not projected, all tissues must be filled without surgical release of the fat pad (**Figure 5C**).

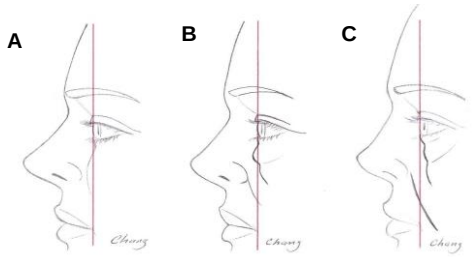

Figure 5. The ideal profile (A); Inferior palpebral fat pad more prominent than the eye: An indication for surgical release and filling around the depression (B); Fat pad highlighted by tissue depression around the eyes: No indication for release, only filling (C)

Periorbital filling is the first procedure done in a facelift surgery, before the appearance of edema. The choice of region of donor fat can be according to the patient's or physician's preference. If general anesthesia is used, no infiltration is made. If anesthesia is local, the solution to be used would be lidocaine 0.4% with adrenaline 1:200,000, injected evenly in the subcutaneous at a proportion of 1:1. On the face, the infraorbital and zygomatic facial nerves are blocked with a minimum quantity of anesthetic solution (**Figure 6**).

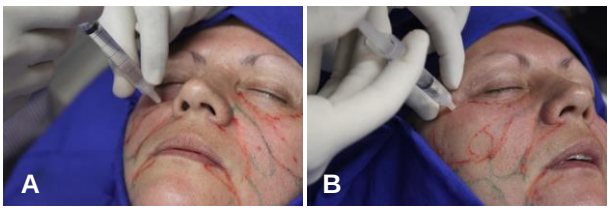

Figure 6. Infraorbital nerve block (A); Zygomatic facial nerve block (B)

Fat was harvested via negative pressure, either pump-assisted or by syringes, using a 2- or 3-mm diameter conventional cannula. Harvested fat was decanted without washing until three segments are defined. Supernatant oil and its underlying liquid were separated, and the fat was passed to a 1-mL syringe (**Figure 7**). The fat grafting technique used is called slow retro-injection, with small quantities or "fine tunnels".

A cannula of 1.2 mm in diameter with one lateral hole at the tip can be used. For the periorbital region, the entrance point is several millimeters under the orbital rim, below the lowest point of the "V" deformity. This point allows medial access for tear trough correction, lateral and central access for lid check junction and "V" deformity, and inferior access for malar augmentation. The fat graft was retro-injected first at the supraperiosteal plane (**Figure 8**) and subsequently at more superficial planes, always in small quantities with each passage, until the desired volume and superficial regularity was reached (**Figure 9**).

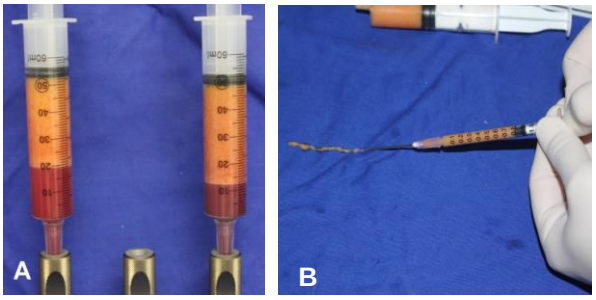

Figure 7. Decanting the suctioned fat until three segments are defined (A); Retro-injection technique with 1 mL syringe and microcannula (B)

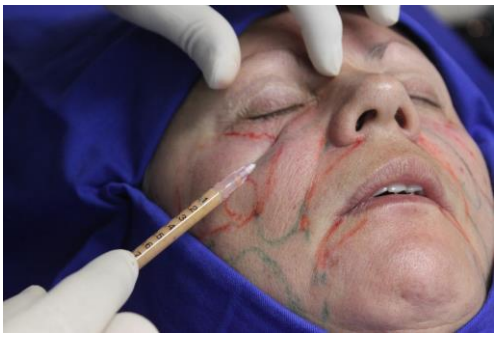

Figure 8. Tear trough filling beginning at the supraperiosteal plane

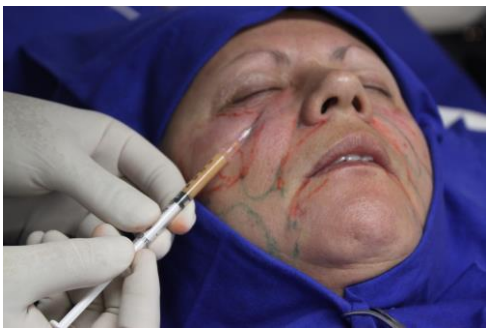

Figure 9. Uniform distribution is applied, always in small quantities, until the ideal volume and uniformity has been reached

The injection pressure must be minimal. In case of any resistance, it must not be forced, and the syringe and microcannula must be changed. This probably indicated a bigger fat fragment and could cause irregularities if

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injected under the skin. Care must be taken to avoid superficial irregularities, the main complication in difficult reversion. There is no need for hypercorrection as the fat graft frequently retains near 100%. In the author's experience, definitive results are established at the second or third month after fat grafting. Any corrections can be done after this period.

In almost all cases, the lower lid blepharoplasty is performed, releasing only the skin, without touch the muscle, just like the pinch blepharoplasty technique[20].

Results

Anatomical study

The following characteristics were found and are in agreement with Haddock *et al.*[16,17], Hirmand[12], Yang *et al.*[18], and Yang *et al.*[19]:

(1) The tear trough and lid-cheek junction are not located at the bony orbital rim but are situated several millimeters caudally;

(2) The sulcus corresponds to the abrupt transition from the thin palpebral skin, without underlying subcutaneous fat, to the thicker orbital skin, with the presence of malar fat compartment (**Figure 10**);

(3) This transition is at the cranial limit of malar fat compartment;

(4) The tear trough is not caused by the volume of nasal alar and upper lip elevator muscle, which is more caudal and medial;

(5) The tear trough is located at the transition of the palpebral and orbital part of the orbicular muscle; medially, the bone attachment is the muscle origin with no ligaments found (**Figure 11**).

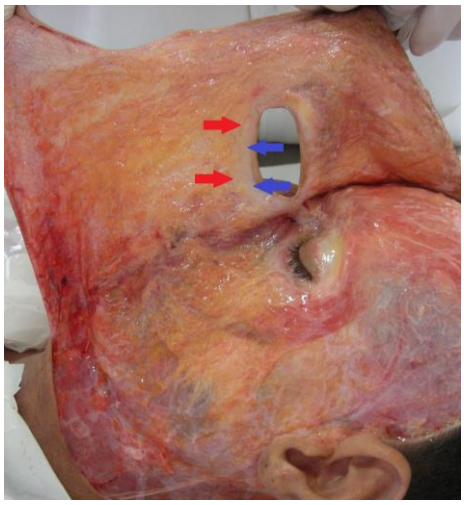

Figure 10. Palpebral skin without subcutaneous fat (blue arrows), and the abrupt transition to the malar skin and cranial limit for malar fat compartment (red arrows)

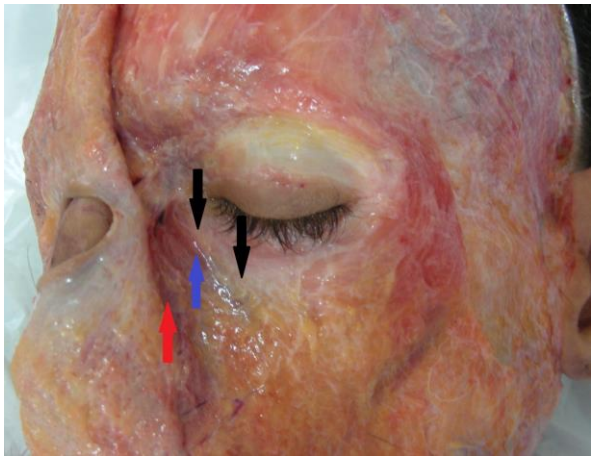

Figure 11. The tear trough (black arrow) is located caudally to the orbital rim on the OOM origin (blue arrow), superior and lateral to the nasal alar and upper lip elevator muscle (red arrow)

Autologous fat grafting

The last 200 consecutive procedures by a single surgeon were evaluated. Edema and bruises were spontaneously resolved in three or four weeks. Two patients with dark lower lid skin had worsening periorbital hyperpigmentation and needed dermatological treatment. One patient was a 23-year-old woman with acne after facial fat grafting. The other had previous festoons with prolonged malar edema and hypertrophic blepharoplasty scars. There were no other complications (**Figures 12–16**).

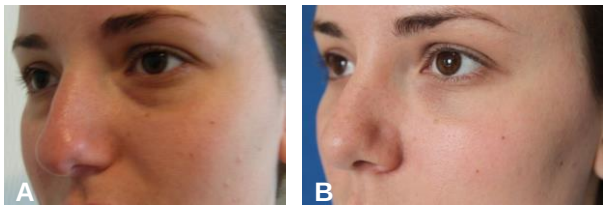

Figure 12. A young, 23-year-old patient with marked tear trough (A); Six months after periorbital and malar fat grafting (B)

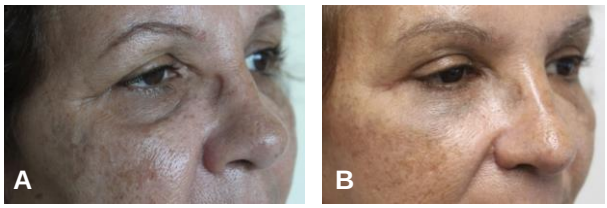

Figure 13. A 68-year-old patient with marked tear trough and lid-cheek junction (A); Seven months after blepharoplasty, periorbital, malar fat grafting, and full face lifting (B)

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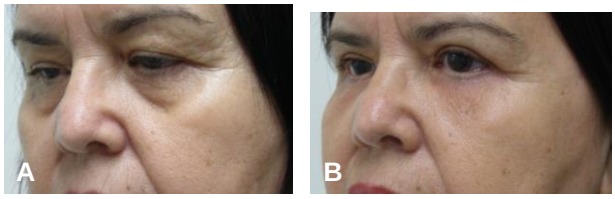

Figure 14. A 46-year-old patient with marked tear trough highlighting the palpebral fat pads (A); four months after blepharoplasty, periorbital, and malar fat grafting, without release of palpebral fat pads (B)

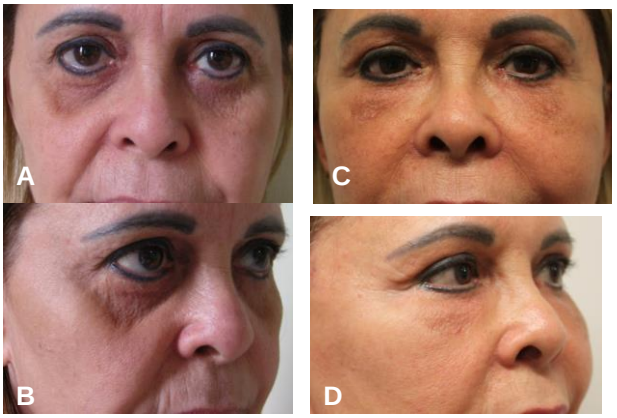

Figure 15. A 48-year-old patient with iatrogenic severe periorbital depression after three blepharoplasties (A and B); Six months after the 2nd face lift and 4th blepharoplasty, tarsal strip, periorbital, and malar fat grafting procedures were performed (C and D)

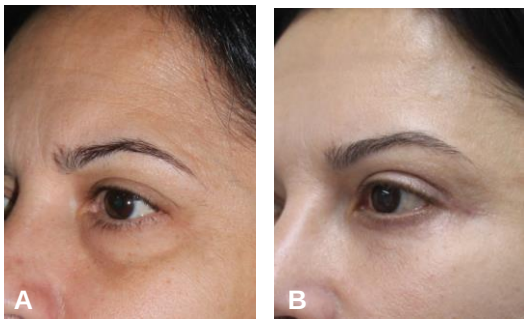

Figure 16. A 46-year-old patient presenting tear trough and lid-cheek junction (A); Four months after face lift, blepharoplasty, periorbital, and malar fat grafting (B)

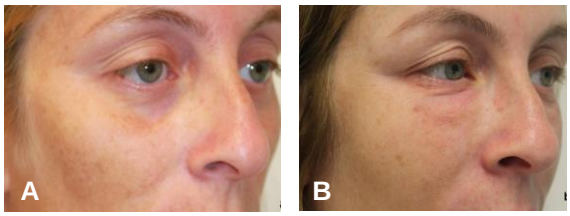

Figure 17. A 32-year-old thin patient with deep eyes (A); 15 months after periorbital fat grafting, 12 kg above her normal weight because of pregnancy, and grafted fat graft was also hypertrophic (B)

Discussion

The tear trough is frequently neglected in aesthetic facial treatments as the results are unpredictable, the procedure is difficult, the anatomy is complex and the tissue involved is delicate. Several explanations have been formulated for the cause of tear trough such as bony orbital rim; depression between the OOM, nasal alar and upper lip muscle; tissue descent by gravity, etc.[16]. The few anatomical studies in fresh cadaver dissections revealed that the main problem is subcutaneous fat[16-19]. The existence of a ligament was in doubt[21]. Our dissections proved that the attachment is of muscle origin[22] and not a specific ligament.

Tear trough can be corrected using inferior palpebral medial fat pad transposition during blepharoplasty[23] but it requires the presence of excess fat pad. This procedure is much more invasive and it only corrects the deep plane and not the superficial plane.

Alloplastic materials such as hyaluronic acid are a good option when patients want procedures which are more practical[24]. Fat grafting is the author's preference due to many reasons: the fat is abundant, the procedure is autologous, fat grafting is a cell transplant which has anti-inflammatory "anti-fibrotic" and "trophic" effects with a possibility of achieving better skin quality, and the results are natural[25-27].

In literature, there is no difference in clinical results regarding the donor site, the use of anesthetic agents, vasoconstrictors, negative pressure, harvested fat process methods (centrifugation, decanting, washing, etc.)[28,29], supplementation with stromal vascular fraction[30], or platelet rich plasma[31].

In the author's experience, the most important influences are:

(1) Age: As a person gets older, the probability for success is smaller;

(2) Women usually have more predictable and better results;

(3) Tobacco has a negative influence; and

(4) Injection technique: Fine tunnels are well distributed in three dimensions, avoiding "bolus" injection.

In retrospect, the transplanted and retained volumes were not measured; the evaluation efficacy was made subjectively based on patient's and physician's satisfaction. The safety assessment was based on the complication rate. The grafted fat stabilized at the second or third month after the procedure and, in the author's experience, is in disagreement with literature that described stabilization at six months. In the patient evaluation, hyperpigmentation influenced more than the retained volume but

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the author was more demanding in the overall result, especially in uniformity for aesthetic unity. No other comparisons such as gender, age or body mass index were made, due to inadequate sampling. However, aesthetic results were excellent and quite uniform and the complication rate is extremely low, which is in agreement with literature[32,33].

The periorbital sulcus is a natural anatomical depression of a personal characteristic, and it can be highlighted by aging. The pseudoptosis is one of the mechanisms of midface aging process and, according to Rohrich, is due to decreased volume of fat compartments especially at the medial deep malar fat compartment[6]. This lack of volume cannot be corrected with only face lifts or blepharoplasties. Extra volume filling is a simple and effective solution.

Conclusion

The main mechanism of midface aging process is the deflation phenomenon. It must be specifically treated by extra volume filling, and not only with surgeries. Despite not having measured the retained volume, the treatment of tear trough by autologous fat grafting seems effective and safe, and may be more advantageous than alloplastic materials. Anatomically, there is no specific plane for volume injection. For uniformity of the palpebromalar region, the fat graft must be evenly distributed in deep and superficial planes.

Conflict of interest

The author declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

References

1. Goldberg RA. The three periorbital hollows: A paradigm for periorbital rejuvenation. Plast Reconstr Surg 2005; 116(6): 1796–1804. doi: 10.1097/01.prs.000018562 3.367 95.38.
2. Pessa JE, Desvigne LD, Lambros VS, Nimerick J, Suguanan B, *et al*. Changes in ocular globe-to-orbital rim position with age: Implications for aesthetic blepharoplasty of the lower eyelids. Aesth Plast Surg 1999; 23(5): 337–342. doi: 10.1007/s002669900295.
3. Donofrio LM. Fat distribution: A morphologic study of the aging face. Dermatol Surg 2000; 26(12): 1107–1112. doi: 10.1046/j.1524-4725.2000.00270.x.
4. Lambros V. Observations on periorbital and midface aging. Plast Reconstr Surg 2007; 120(5): 1367–1376. doi: 10.1097/01.prs.0000279348.09156.c3.
5. Rohrich RJ, Pessa JE. The fat compartments of the face: Anatomy and clinical implications for cosmetic surgery. Plast Reconstr Surg 2007; 119(7): 2219–2227. doi: 10.1097/01.prs.0000265403.66886.54.
6. Rohrich RJ, Pessa JE, Ristow B. The youthful cheek and the deep medial fat compartment. Plast Reconstr Surg 2008; 121(6): 2107–2112. doi: 10.1097/PRS.0b013e318 17123c6.
7. Pessa JE. An algorithm of facial aging: Verification of Lambros's theory by three-dimensional stereolithography, with reference to the pathogenesis of midfacial aging, scleral show, and the lateral suborbital trough deformity. Plast Reconstr Surg 2000; 106(2): 479–488. doi: 10.1097/00006534-200008000-00040.
8. Pessa JE, Chen Y. Curve analysis of the aging orbital aperture. Plast Reconstr Surg 2002: 109(2): 751–760.
9. Shaw RB Jr, Kahn DM. Aging of the midface bony elements: A three-dimensional computed tomographic study. Plast Reconstr Surg 2007; 119(2): 675–681. doi: 10.1097/01.prs.0000246596.79795.a8.
10. Mendelson BC, Hartley W, Scott M, McNab A, Granzow JW. Age-related changes of the orbit and midcheek and the implications for facial rejuvenation. Aesth Plast Surg 2007; 31(5): 419–423. doi: 10.1007/s00266-006-0120-x.
11. Yaremchuk MJ, Kahn DM. Periorbital skeletal augmentation to improve blepharoplasty and midfacial results. Plast Reconstr Surg 2009; 124(6): 2151–2160. doi: 10.1097/PRS.0b013e3181bcf5bc.
12. Hirmand H. Anatomy and nonsurgical correction of the tear trough deformity. Plast Reconstr Surg 2010; 125(2): 699–708. doi: 10.1097/PRS.0b013e3181c82f90.
13. Yaremchuk MJ. Infraorbital rim augmentation. Plast Reconstr Surg 2001; 107(6): 1585–1592. doi: 10.1097/0000 6534-200105000-00047.
14. Trepsat F. Periorbital rejuvenation combining fat grafting and blepharoplasties. Aesth Plast Surg 2003; 27(4): 243–253. doi: 10.1007/s00266-003-2126-y.
15. Trepsat F. Lipostructure du tiers moyen du visage (French) [Midface reshaping with micro-fat grafting]. Ann Chir Plast Esth 2009; 54(5): 435–443. doi: 10.1016/j.anplas.20 09.03.008.
16. Haddock NT, Saadeh PB, Boutros S, Thorne CH. The tear trough and lid/cheek junction: Anatomy and implications for surgical correction. Plast Reconstr Surg 2009; 123(4): 1332–1340. doi: 10.1097/PRS.0b013e31819f2b36.
17. Pessa JE. Discussion: The tear trough and lid/cheek junction: Anatomy and implication for surgical correction. Plast Reconstr Surg 2009; 123(4): 1341–1342. doi: 10.1097/PRS.0b013e31819f25ec.
18. Yang N, Qiu W, Wang Z, Su X, Jia H, *et al*. (Chinese) [Anatomical studying of the tear trough area]. Zhonghua

doi: 10.18282/jsd.v1.i2.45

Zheng Xing Wai Ke Za Zhi 2014; 30(1): 50–53.
19. Yang C, Zhang PP, Li JH, Xing X. (Chinese) [Anatomic study on the mechanism of tear trough deformity and palpbromalar groove deformity]. Zhonghua Zheng Xing Wai Ke Za Zhi 2010; 26(2): 139–142.
20. Rosenfield LK. The pinch blepharoplasty revisited. Plast Reconstr Surg 2005; 115(5): 1404–1412. doi: 10.1097/01.PRS.0000157020.67216.31.
21. Wong CH, Hsieh MKH, Mendelson B. The tear trough ligament: Anatomical basis for the tear trough deformity. Plast Reconstr Surg 2012; 129(6): 1392–1402. doi: 10.1097/PRS.0b013e31824ecd77.
22. Pessa JE. Discussion: The tear trough ligament: Anatomical basis for the tear trough deformity. Plast Reconstr Surg 2012; 129(6): 1403–1404. doi: 10.1097/PRS.0b013e3182507a08.
23. Youn S, Shin JI, Kim JT, Kim YH. Transconjunctival subperiosteal fat reposition for tear trough deformity: Pedicled fat redraping versus septal reset. Ann Plast Surg 2014; 73(5): 479–484. doi: 10.1097/SAP.0b013e31827f5455.
24. Hill RH 3rd, Czyz CN, Kandapalli S, Zhang-Nunes SX, Cahill KV, *et al*. Evolving minimally invasive techniques for tear trough enhancement. Ophthal Plast Reconstr Surg 2015; 31(4): 306–309. doi: 10.1097/IOP.0000000000000325.
25. Chang YC, Rovaris DA. Lipoenxertia autóloga periorbitária no rejuvenescimento facial: Análise retrospectiva da eficácia e segurança em 31 casos (Portuguese) [Autologous periorbital fat grafting in facial rejuvenation: A retrospective analysis of efficacy and safety in 31 cases]. Rev Bras Cir Plást 2012; 27(3): 405–410. doi: 10.1590/S1983-51752012000300013.
26. Majollal A, Lequeux C, Shipkov C, Breton P, Foyatier JL, *et al*. Improvement of skin quality after fat grafting: Clinical observation and an animal study. Plast Reconstr Surg 2009; 124(3): 765–774. doi: 10.1097/PRS.0b013e3181b17b8f.
27. Covarrubias P, Cárdenas-Camarena L, Guerrerosanto J, Valenzuela L, Espejo I, *et al*. Evaluation of the histologic changes in the fat-grafted facial skin: Clinical trial. Aesth Plast Surg 2013; 37(4): 778–783. doi: 10.1007/s00266-013-0126-0.
28. Gir P, Brown AS, Oni G, Kashefi N, Mojallal A, *et al*. Fat grafting: Evidence-based review on autologous fat harvesting, processing, reinjection, and storage. Plast Reconstr Surg 2012; 130(1): 249–258. doi: 10.1097/PRS.0b013e318254b4d3.
29. Rochrich RJ, Sorokin ES, Brown SA. In search of improved fat transfer viability: A quantitative analysis of the role of centrifugation and harvest site. Plast Reconstr Surg 2004; 113(1): 391–395. doi: 10.1097/01.PRS.0000097293.56504.00.
30. Mailey B, Saba S, Baker J, Tokin C, Hickey S, *et al*. A comparison of cell-enriched fat transfer to conventional fat grafting after aesthetic procedures using a patient satisfaction survey. Ann Plast Surg 2013; 70(4): 410–415. doi: 10.1097/SAP.0b013e31827e5353.
31. Sagarello M, Visconti G, Rusciani A. Breast fat grafting with platelet-rich plasma: A comparative clinical study and current state of the art. Plast Reconstr Surg 2011; 127(6): 2176–2185. doi: 10.1097/PRS.0b013e3182139fe7.
32. Kim SM, Kim YS, Hong JW, Roh TS, Rah DK. An analysis of the experiences of 62 patients with moderate complications after full-face fat injection for augmentation. Plast Reconstr Surg 2012; 129(6): 1359–1368. doi: 10.1097/PRS.0b013e31824ecbb0.
33. Grahovac TL, Rubin JP. Discussion: An analysis of the experiences of 62 patients with moderate complications after full-face fat injection for augmentation. Plast Reconstr Surg 2012; 129(6): 1369–1370. doi: 10.1097/PRS.0b013e31824f4ffc.

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