



Major approaches to minimally traumatic surgery in dentistry: a systematic review

Guilherme Oliveira Bonatto^{1,2*}, Afonso Pontes Maia Silva^{1,2}, Carlos Alberto Costa Neves Buchala^{1,2}

¹ University Center North Paulista (Unorp), Graduate in Dentistry, Sao Jose do Rio Preto, Sao Paulo, Brazil.

² Post graduate and continuing education (Unipos), Postgraduate in dentistry, Sao Jose do Rio Preto, Sao Paulo, Brazil.

*Corresponding author: Guilherme Oliveira Bonatto,
Unorp/Unipos - Post graduate and continuing
education, São José do Rio Preto SP, Brazil.

Email: guilherme_o_bonato@hotmail.com

DOI: <https://doi.org/10.54448/mdnt21517>

Received: 09-11-2021; Revised: 10-27-2021; Accepted: 11-13-2021; Published: 12-14-2021; MedNEXT-id: e21517

Abstract

Introduction: It is estimated that in minimally traumatic dental surgery, synthesis studies with meta-analysis and decision analysis represent almost 29% of all studies. Most of the selected studies were carried out in the USA, Netherlands, and UK. These three countries and 15 journals accounted for nearly 50% of all publications. The remaining works were published in another 61 journals and originated from 32 other countries, including Brazil. **Objective:** This study aimed to demonstrate, through literature review and case reports, the evolution and consequent importance of improving minimally traumatic surgery techniques in dentistry. It was hypothesized that there were statistically significant results about advances in the attempt to minimize trauma. **Methods:** The research was carried out from July 2021 to October 2021 and developed based on Google Scholar, Scopus, PubMed, Scielo, and Cochrane Library. The inclusion and exclusion criteria were systematic review studies, meta-analysis, controlled and randomized cases, non-randomized clinical cases, and opinion articles, which addressed the term minimally traumatic surgery in dentistry. The quality of the studies was based on the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument. **Results:** Since the most primordial extraction techniques were created and developed, several attempts have been made to minimize the professional's effort, reduce surgical time and alleviate bleeding and inflammatory processes, edema, pain, and ecchymosis that can affect the patients, in the trans and postoperative periods. Thus, the maximum preservation of the integrity of the soft

tissues (papillae and free and inserted gingival band) adjacent to the prosthetic spaces should be sought; preservation of the alveolar bone ridge level. Based on the histological concept in which living tissues are formed by cells joined by thin elastic tissue and with nerve fibrils, capillaries, lymphatic and blood vessels. The disruption of these cells by surgical trauma provides the release of enzymes that delay healing. For this reason, surgical trauma should be minimized.

Conclusion: There are many attempts to minimize the professional effort, reduce surgical time and alleviate bleeding and inflammatory processes, edema, pain, and ecchymosis that can affect patients. Thus, the maximum preservation of the integrity of the soft tissues adjacent to the prosthetic spaces and the preservation of the level of the ridge of the alveolar bone to achieve a minimization of surgical trauma must be sought.

Keywords: Minimally Traumatic Surgery. Implantology. Dental implants. Extraction.

Introduction

In minimally invasive or atraumatic surgery or dental procedures, there are about 245 clinical studies [1-4]. This selection of data was due to the significant increase in quantitative synthesis methods in the dental literature from the beginning of the 21st century [5]. Most of the selected studies were carried out in the USA, Netherlands, and UK. The remaining works were published in another 61 journals and originated from 32 other countries, including Brazil [5,6].

Thus, the studies were classified in the areas of periodontics, cardiology, implantology, endodontics,

orthodontics, oral pathology, maxillofacial surgery, prosthesis, and others [6,7]. However, the uncertainty is about the conclusions obtained from a set of studies on minimally traumatic surgery [5].

As a corollary, dental transplantation appears as an alternative treatment for all social strata, being called biological prosthesis [8]. Thus, the transfer of a natural tooth from its socket to another site is related to extensive caries, root resorption, periodontal disease, coronaradicular fracture, agenesis, and aplasia of teeth. The technique must be minimally traumatic for a better prognosis of the tooth to be transplanted since the periodontal ligament must not be manipulated, as it is necessary to repair periodontal tissues [8].

Furthermore, with the increasing modernization of implant dentistry, we have immediate implants as the procedure with the highest probability of success among the rehabilitation treatments of the oral cavity, using osseointegrated implants [8]. Immediate implants are those installed soon after the extraction of compromised roots or teeth, using, for this, the remaining alveolus to install the implant, minimizing trauma and optimizing treatment [8-10].

Among the several advantages that immediate implants provide, there is good acceptance by the patient, a reduction in the number of surgical interventions, in addition to limiting the resorption of the residual alveolar bone ridge [8]. Added to this, there is the possibility of installing a temporary tooth in acrylic resin or light-curing, fixed on the newly installed implant, further reducing bone loss and preserving the gingival contour of the region, restoring esthetics, smile, and reintegration social [11]. Thus, this procedure is called "immediate esthetics" over the immediate implant. However, for results with a good critical level of significance, the implant must have a large part of its spiral surface anchored in healthy and natural bone [5,8].

Also, a significant and useful procedure, directly associated with immediate implants, is the technique known as root burial, which allows for a proliferation of the inserted gingiva sufficient for sometimes total covering of the alveolus after the installation of the immediate implant, without the need for total flap relaxation, if it does not receive a temporary tooth in the same implant installation session [5,8]. However, it is not a technique widely used by some specialists, although it is easily feasible and can provide great biological and aesthetic benefits [12].

This study aimed to demonstrate, through a literature review, the evolution and consequent importance of improving techniques for minimally traumatic surgeries in dentistry. It was hypothesized

that there were statistically significant results about advances in the attempt to minimize trauma.

Methods

Study Design

The present study was followed by a systematic literature review model, according to the PRISMA rules [13].

Data sources and research strategy

The search strategies for this review were based on the descriptors "*Minimally Traumatic Surgery, Implantology, Dental implants, and Extraction*". The research was carried out from July 2021 to October 2021 and developed based on Google Scholar, Scopus, PubMed, Scielo, and Cochrane Library. The inclusion and exclusion criteria were systematic review studies, meta-analysis, controlled and randomized cases, non-randomized clinical cases, and opinion articles, which addressed the term minimally traumatic surgery in dentistry.

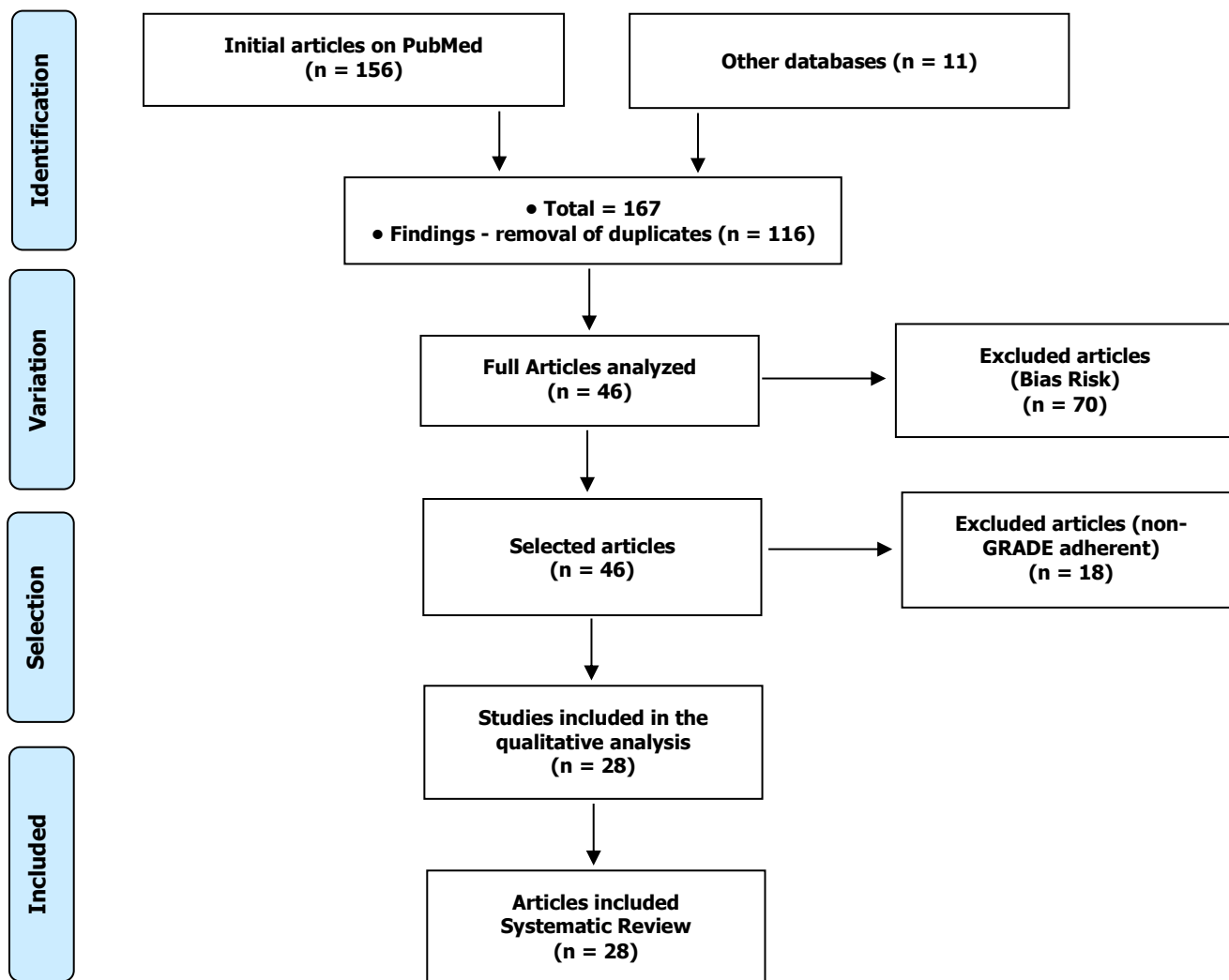
Study quality and risk of bias

The quality of the studies was based on the GRADE instrument [14], with randomized controlled clinical studies, prospective controlled clinical studies, and studies of systematic review and meta-analysis listed the studies with the greatest scientific evidence. The risk of bias was analyzed according to the Cochrane instrument [15].

Results and Discussion

Figure 1 shows that out of a total of 167 articles found, 46 articles were evaluated and 18 were rejected for not meeting the GRADE classification, and only 28 articles were used in this study to compose the textual part. As literary support, a study evaluated the stability of immediate implant placement for alveolar bone augmentation and preservation with bovine bone graft after minimally traumatic tooth extraction. Therefore, the insertion of immediate implants in bovine bone extraction cavities with an increase in the buccal gap was able to preserve a greater amount of alveolar ridge volume. There are no clinical studies evaluating the feasibility of a new technique for the surgical extrusion of non-restorable teeth with subgingival caries [1,2].

In this context, a randomized controlled study evaluated the resorption of the alveolar ridge using the "socket shield" (SST) technique without immediate placement of dental implants. This trial included 27 patients: 14 maxillary non molar teeth were partially extracted using the SST (test group) and 13 were extracted using a minimally traumatic extraction

Figure 1. The selection process of scientific articles.


approach (control group). SST without immediate implant placement showed greater preservation of vestibulopalatal crest dimension and less preservation of vestibular wall thickness compared to minimally traumatic extraction. Furthermore, it provided superior maintenance of the basal height of the vestibular wall. Modified SST is a promising approach, but factors that interfere with the results must be investigated [16].

Besides, immediate implant placement (IIP) in fresh extraction sockets exhibits survival and success rates similar to late implant placement in healed sockets. Several advantages of IIP involve reducing the total treatment time, reducing the number of invasive surgeries, and subsequently reducing patient discomfort due to the lack of additional surgeries. The main deficiencies in IIP, however, include the inability to obtain early bone support, the presence of a gap between the extraction socket and the accessory, and the inability to cover the accessory with soft tissue, leading to an increased risk of infection and implant loss. When IIP is performed, atraumatic or minimally traumatic extractions, conservation of the septal bone in

molars, minimal elevation of the flap or flapless surgery, bone grafting in the gap between the fixation and the extraction socket, and covering with soft tissue or membrane should be considered. [17].

Another study analyzed that the combination of piezo-surgical surgery and conical expanders allows a safe displacement of the selected bone flap, as well as the immediate placement of the implant, avoiding the risk of slipping, overheating, or fracture, allowing operational comfort. Thus, non-traumatic bone expansion is a reliable, reproducible, conservative, and cost-effective procedure [18].

Thus, the application of minimal intervention concepts in dentistry and minimally invasive surgical techniques can offer a powerful arsenal to the general dentist to provide ethical and conservative treatment to elderly patients. When it is unavoidable, surgical intervention should be as minimally invasive as possible in elderly patients to preserve the longevity of their natural dentition [19].

Thus, performing indiscriminate extractions, without the objective of immediate or delayed

rehabilitation of the new prosthetic space, promote serious biological and social consequences generated by tooth loss without adequate rehabilitation [5]. Thus, as a result of the enormous advance in minimally invasive techniques and the spread of modern implantology, and the level of safety of the treatment provided by it, in addition to the refined techniques for making conventional prostheses relatively safe if planned correctly, the patient can have adequate rehabilitation with various techniques [20,21].

If the maintenance of the original tissue contours is respected, the chances of achieving good esthetic levels and acceptable functional conditions increase considerably. These cares are even more important and critical when the surgical act is performed in the anterior regions of the mouth [5]. The preservation of interproximal bone levels becomes essential to maintain the vertical level of the interdental papillae, avoiding dark areas and spaces between natural and artificial teeth, which can impair the aesthetic result that can produce real patient satisfaction [22].

Likewise, the preservation of bone and gingival integrity can drastically reduce the volumes of medication administered in the postoperative period and facilitate the making of appropriate profiles and contours of temporary gingival conditioning, even if conventional prosthesis procedures and techniques or immediate implants with immediate esthetics, are used for the rehabilitation of the case [5,8,23].

Thus, since the most primordial extraction techniques were created and developed, several attempts have been made to minimize the professional's effort, reduce surgical time and alleviate bleeding and inflammatory processes, edema, pain, and ecchymosis that can affect patients, in the trans and postoperative periods. Thus, the maximum preservation of the integrity of the soft tissues (papillae and free and inserted gingival band) adjacent to the prosthetic spaces should be sought; preservation of the alveolar bone ridge level [3,24].

Furthermore, the atraumatic restorative treatment (ART) was developed by Frencken in Africa to control the evolution of caries. The main functions of the ART are a preservation of the tooth structure with minimal operative intervention, reduction of endodontic treatment or tooth extraction, and reduction of patient discomfort due to no need for local anesthesia. About the partial removal of carious tissue, Imperato et al. (2010) cited the systematic review of the Cochrane Library by Ricketts et al. (2006) [25].

Furthermore, Barreto (2007) cited works by Van Amerongen (2003) and Deery (2005) that compared the psychological behavior of children when using ART to

conventional treatment [7]. Heartbeats were monitored throughout the procedures and researchers concluded that manual instruments in atraumatic treatments caused less discomfort and anxiety than rotary instruments in the conventional technique. As for Guedes-Pinto (2003), ART can work as a preparatory treatment for restorations, as it can eliminate the cariogenic microbiota within 48 h.

Still, glass ionomer cement (GIC) are widely used in dentistry for their cariostatic effect, due to the release of fluorine in the most superficial layers of restorations [26]. Also, in addition to releasing fluoride, the GIC can incorporate it again from toothpaste. However, the limitations regarding the use of the GIC are related to its physical properties and aesthetic limitations.

Based on the histological concept in which living tissues are formed by cells joined by thin elastic tissue and with nerve fibrils, capillaries, lymphatic and blood vessels. The disruption of these cells by surgical trauma provides the release of enzymes that delay healing. For this reason, surgical trauma should be minimized. Trauma prevention is done through good surgical planning, teamwork, good lighting, force control, knowledge of topographical anatomy, control of movements and gestures, search for a support point to reduce tremor, and decreased surgery time [27,28].

The basic rules that guide the doctrine of minimally traumatic surgical technique are tension-free surgeons, minimal and precise movements, dissecting only what is essential, reducing tissue exposure to a minimum, gentle handling, use of correct instruments and techniques, use of swabs soaked in warm saline solution [29]. As proof, minimally traumatic extraction techniques have several advantages over conventional techniques currently performed, especially with regard to maintaining the integrity of the alveolar bone and attached gingiva. They consist of controlled techniques, with a high level of predictability [30].

Added to this, with regard to cardiology, there is the ART which provides a glimpse of several minimally traumatic treatment options, depending on factors such as esthetics, tooth function, patient expectations, cost of restoration and optimization of surgical techniques. Thus, several authors have listed the advantages of ART, such as greater preservation of the tooth structure, curative and preventive technique in a single procedure, preservation of the innermost dentin, reduced trauma, less risk of pain, no need to use anesthesia, reduced anxiety of patients, greater acceptance by adults and children, lower cost, speed of execution, possibility of correcting the inadequate technique, good clinical performance in restorations of one face, possibility of performance in social spaces such as schools, day care

centers or at home [2,7,23,31].

Conclusion

It is concluded that, in the world and in Brazil, there have been several attempts to minimize the professional's effort, reduce surgical time and alleviate bleeding and inflammatory processes, edema, pain and ecchymosis that can affect patients. Thus, the maximum preservation of the integrity of the soft tissues adjacent to the prosthetic spaces and the preservation of the level of the ridge of the alveolar bone to achieve a minimization of surgical trauma must be sought.

Acknowledgement

Nil.

Funding

Not applicable.

Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

About the License

© The authors (s) 2021. The text of this article is open access and licensed under a Creative Commons Attribution 4.0 International License.

References

1. de Oliveira GB, Rebello IMC, Montanha Andrade K, Araujo NS, Dos Santos JN, Cury PR. Evaluation of alveolar process resorption after tooth extraction using the socket shield technique without immediate installation of implants: a randomised controlled clinical trial. *Br J Oral Maxillofac Surg.* 2021 Apr 8;S0266-4356(21)00130-3. doi: 10.1016/j.bjoms.2021.04.001. Epub ahead of print. PMID: 34256958.
2. Koshy E, Annamma LM, George BT, Menezes GA. The retrieval of a surgical blade broken within the alveolar bone during minimally traumatic tooth extraction. *BMJ Case Rep.* 2021 Jan 27;14(1):e240162. doi: 10.1136/bcr-2020-240162. PMID: 33504539; PMCID: PMC7843332.
3. Faciola Pessôa de Oliveira PG, Pedroso Bergamo ET, Bordin D, Arbex L, Konrad D, Gil LF, Neiva R, Tovar N, Witek L, Coelho PG. Ridge Architecture Preservation Following Minimally Traumatic Exodontia Techniques and Guided Tissue Regeneration. *Implant Dent.* 2019 Aug;28(4):319-328. doi: 10.1097/ID.0000000000000886. PMID: 31008823.
4. Areewong K, Chantaramungkorn M, Khongkhunthian P. Platelet-rich fibrin to preserve alveolar bone sockets following tooth extraction: A randomized controlled trial. *Clin Implant Dent Relat Res.* 2019 Dec;21(6):1156-1163. doi: 10.1111/cid.12846. Epub 2019 Oct 24. PMID: 31647177.
5. Al Qabbani A, Al Kawas S, Enezei H, Razak NHA, Al Bayatti SW, Samsudin AR, Hamid SAB. Biomechanical and radiological assessment of immediate implants for alveolar ridge preservation. *Dent Res J (Isfahan).* 15(6):420-429, 2018.
6. Amorim RE, Leal SC, Frencken JE. Survival of atraumatic restorative treatment (ART) sealants and restorations: a meta-analysis. *Clin Oral Invest,* 2011.
7. Barreto, V.C. Avaliação das restaurações minimamente traumáticas em pré-escolares. Dissertação (mestrado)-Universidade Federal do Rio Grande do Sul. Faculdade de odontologia. Porto Alegre, 2007.
8. Krug R, Connert T, Soliman S, Syfrig B, Dietrich T, Krastl G. Surgical extrusion with an atraumatic extraction system: A clinical study. *J Prosthet Dent.* 120(6):879-885, 2018 [doi: 10.1016/j.prosdent.2018.02.006. Epub 2018 Jun 28].
9. Carvalho PS. Gerenciando os Riscos e Complicações em Implantodontia. Ed. Santos. São Paulo, 2007.
10. Carvalho, L.S. Tratamento restaurador atraumático em cavidades atípicas. *Revista Gaúcha de Odontologia.* Porto Alegre, v.57, n.3, 357-362, 2009.
11. Coato AMGW, Mariotti A. Immediate placement of anatomically shaped dental implants. *J Oral Implantol;* 26:170-176, 2000.
12. Colares, V.; Franca, C.; Amorin F.H.A. O tratamento restaurador atraumático nas dentições decídua e permanente. *Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial.* V. 50, n.1, 35-41, 2009.
13. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009) Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med* 6(7): e1000097. <https://doi.org/10.1371/journal.pmed.1000097>.

14. Balshem H et al. Grade guidelines: 3 rating the quality of evidence. *Journal of Clinical Epidemiology*, Maryland Heights, v. 64, n. 4, p. 401-406, 2011
15. Higgins J, Green S. *Cochrane Handbook for Systematic Reviews of Interventions*. Version 5.1.0 [updated March 2011]. The Cochrane Collaboration; 2011.
16. de Oliveira GB, Rebello IMC, Montanha Andrade K, Araujo NS, Dos Santos JN, Cury PR. Evaluation of alveolar process resorption after tooth extraction using the socket shield technique without immediate installation of implants: a randomised controlled clinical trial. *Br J Oral Maxillofac Surg*. 2021 Apr 8;S0266-4356(21)00130-3. doi: 10.1016/j.bjoms.2021.04.001. Epub ahead of print. PMID: 34256958.
17. Lee W. Immediate implant placement in fresh extraction sockets. *J Korean Assoc Oral Maxillofac Surg*. 2021 Feb 28;47(1):57-61. doi: 10.5125/jkaoms.2021.47.1.57. PMID: 33632979; PMCID: PMC7925164.
18. Iraqui O, Lakhssassi N, Berrada S, Merzouk N. Atraumatic bone expansion: Interest of piezo-surgery, conicals expanders and immediate implantation combination. *Rev Stomatol Chir Maxillofac Chir Orale*. 117(3):151-7, 2016 [doi: 10.1016/j.revsto.2016.04.002. Epub 2016 May 12].
19. Hayes M, Allen E, DA Mata C, Mckenna G, Burke F. Minimal intervention dentistry and older patients part 2: minimally invasive operative interventions. *Dent Update*. 41(6):500-2, 504-5, 2014.
20. Cooper LF, Rahman A, Moriarty J. Immediate mandibular rehabilitation with endosseous implants: simultaneous extraction, implant placement, and loading. *Int J Oral Maxillofac Implants*;17:517-525, 2002.
21. Covani V, Crespi R, Cornelini R, Barone A. Immediate implants supporting single-crown restoration: a 4 year prospective study. *J Periodontol*; 75:982-988, 2004.
22. Foschetti JHM. Tratamento restaurador atraumático associado a medidas preventivas na saúde pública brasileira. Trabalho de conclusão de curso (Especialização) – Universidade Federal de Minas Gerais, 2010.
23. Frencken, J.E.; Holmgren, C.J. Tratamento restaurador atraumático para a cárie dentária. São Paulo. Santos Editora, 2001.
24. Gomes, A.C. Tratamento restaurador atraumático como alternativa de tratamento em bebês portadores de fissura, relato de caso clínico. *Revista Odontológica de Araçatuba*, v.24, n.2, 52-55, 2003.
25. Groisman M., Frossard W.M., Ferreira H.M., De Menezes F.L.M., Touati B. Single-tooth implants in the maxillary incisor region with immediate provisionalization: 2-year prospective study. *Pract Proced Aesthet Dent*;15:115-122, 2003.
26. Irinakis T. Rationale for socket preservation after extraction of a single-rooted tooth when planning for future implant placement. *J Can Dent Assoc*;72:917-922, 2007.
27. Jahangiri L, Devlin H, Ting K, Nishimura I. Current perspectives in residual ridge remodeling and its clinical implications: a review. *J Prosthet Dent*; 80:224–37, 1998.
28. Wheeler SL, Vogel RE, Casellini R. Tissue preservation and maintenance of optimum esthetics: a clinical report. *Int J Oral Maxillofac Implants*;15:265-271, 2000.
29. Kan JY, Rungcharassaeng K, Lozada J. Immediate placement and provisionalization of maxillary anterior single implants: 1-year prospective study. *Int J Oral Maxillofac Implants*;18:31-39, 2003.
30. Vescovi P, Campisi G, Fusco V, Mergoni G, Manfredi M, Merigo. Surgery-triggered and non surgery-triggered bisphosphonate-related osteonecrosis of the jaws (BRONJ): a retrospective analysis of 567 cases in an Italian multicenter study. *Oral Oncol* 47:191–194, 2011.
31. Kim TK, Lee DW, Jue SS, Kwon YD. Simple and atraumatic technique for the advancement of the genioglossus muscle for treatment of obstructive sleep apnoea. *Br J Oral Maxillofac Surg*. 53(1):104-6, 2015. doi: 10.1016/j.bjoms.2014.10.004. Epub 2014 Nov 1.

