

REVIEW ARTICLE



The influence of flap design and technique on dental implant success, prognosis and morbidity: Mini review

Mohammed Jasim Al-Juboori¹, Luiz Carlos Magno Filho²

¹Department of Oral Surgery, Dental Faculty, MAHSA University, Kuala Lumpur, Malaysia, ²Department of Oral Implantology, C.A Implantas, São Paulo, Brazil

Correspondence

Dr. Mohammed Jasim Al-Juboori,
MAHSA University, Dental Faculty, Block E,
4th Floor, Pusat Bandar Damansara, Damansara
Height, 50490, Kuala Lumpur, Malaysia.
Tel.: +60-0162417557, Fax: +60-320909998.
E-mail: doctor_mohamed_2006@yahoo.com

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Abstract

The importance of flap design come from the need of healthy, integrated and esthetically acceptable soft tissue around the implant. The aim of this mini review tries to address the factors that may affect the flap design in dental implant. The references that included in this study that focus on the flap design, types of flaps and flaps technique from incision to closure. Some of the factors have significant and direct impact on the implant success. Although other factors still mandatory to achieve optimum results especially in esthetic zone. This mini review concluded that factors affecting the flap design some related to the patient (patient factor) and more factors related to operator skill and proper treatment plane (operator factor).

Keywords: Dental implant, flap, flapless, incision, periosteum

Introduction

All dental implant placement procedures begin with tissue incision and reflection to expose the bone for dental implant osteotomy and placement. The final procedure in dental implant placement is flap or soft tissue closure. Thus, a dental implant placement procedure begins and ends with soft tissue handling, starting from the incision and ending with suturing for primary closure. Studies have found that flap design has an influence on many phases of dental implant treatment. Flap design and technique have effects on crestal bone resorption and blood supply to the implanted area.^[1,2]

With the evolution of esthetic implant dentistry and tissue regeneration (hard and soft tissue), flap design plays a crucial role in the maintenance and regeneration of the marginal gingiva and interdental papillae around dental implants.^[3,4]

Preservatives and a traumatic soft tissue handling have effects on tissue healing and regeneration.^[5] For example, an unplanned incision line can heal with scar tissue that yields aesthetically unpleasant results.^[5]

Furthermore, the recession of the interdental papillae can lead to considerable aesthetic impact, particularly in the anterior

maxillary area, like an exposure of the prosthetic implant platform.^[6]

Therefore, there are situations in which it might possible to obtain good aesthetic results solely through manipulating or augmenting soft tissues numerous techniques have been proposed to design flaps for management soft tissues, but it is still unclear which techniques achieve the best results in a predictable way. Many variations have strong proponents with surgeons claiming that a particular technique offers improved esthetics. However, there is frequently disagreement, and this area is controversial.^[7]

Flap Design in Different Tissue Biotypes and Tooth Shapes

Flap design is a greater concern when implants are placed in esthetic zones. In these zones, there are three tissue biotypes. The thick gingival biotype with square-shaped teeth is more favorable for implants placed in the anterior region. Thick gingiva provides greater support for the gingival margin during recession, when the crestal bone is resorbed, or when the mucoperiosteal flap is raised to place the implant.^[8-10] In addition, the square

shape of the teeth and long proximal tooth contact area make the interdental papillae short and blunt and therefore easy to regenerate, and they can be masked with square-shaped teeth.^[8,9] If we work on thin biotype with the conical tooth shape, which is the least favorable in dental implantology, gingival margin recession will occur when the crestal bone is resorbed or when a full-thickness flap is raised during implant placement procedures therapy.^[11-14] Moreover, the interdental papillae are tipped and long due to a short proximal tooth contact area (conically shaped teeth), making the interdental papillae difficult and sometimes impossible to regenerate.^[8,9,15,16]

The incision line should be planned on a case-by-case basis, depending on the gingival biotype and the tooth shape. With the thin gingival biotype, more conservative tissue reflection is observed, and interdental papillae are always preserved.^[4,17] If an immediate implant is planned, flapless implant placement is more favorable for preserving the tissue from reflection, which can lead to tissue recession and implant exposure.

Type of Soft Tissue Attached to the Implant: Keratinized or Non-Keratinized

Healthy keratinized mucosa can more easily surround and attach to the implant because it resists recession and inflammation.^[18,19] Non-keratinized mucosa is thin and can form pockets around the implant; thus, the patient can experience difficulty in keeping the area clean.^[18,19] Clinicians recommend at least 1.5 mm of keratinized buccal mucosa surrounding the implant. A crestal incision line on the edentulous area should include keratinized tissue at the buccal surface so that the keratinized tissue will attach to the buccal surface of the implant during flap closure.^[20] However, if there is difficulty when the alveolar bone is resorbed, and the^[20] vestibule becomes shallow, not much keratinized buccal tissue will be left, and most of this tissue will be oral mucosa. In such cases, the crestal incision should be made more lingually, where keratinized tissue can still be found.^[20] Therefore, a raised flap will include keratinized tissue, and this tissue should be placed buccally.

Full-thickness Versus Partial-thickness Flaps

Studies have shown that periosteal disruption will cause a loss of blood supply to the bone, which can enhance bone resorption. A full-thickness (mucoperiosteal) flap will raise the periosteum from the bone, which can cause temporary hypoxia in the surrounding bone, resulting in bone resorption.^[21] In addition, after disruption, the periosteum requires 1 month to reattach to the bone, which means a delay wound in healing. A less invasive flap reflection technique is the partial-thickness flap, in which the periosteum is left attached to the bone, and only the mucosa is reflected. The blood supply to the bone will remain intact, and the bone cells will not suffer from hypoxia or loss of nutrition.^[22,23]

There are some technical difficulties associated with partial thickness flaps that require skill, and flap perforation is a common

complication.^[23] Careful assessment is mandatory for evaluating the type of flap needed for each case, particularly when crestal bone resorption significantly affects the implant success rate.

Flap Design When Hard and/or Soft Tissue Grafting is Planned

Flap designs differ between soft tissue grafting and hard tissue grafting. Soft tissue grafts do not require complete soft tissue coverage; however, a good blood supply is required. Hard tissue grafts require complete closure of the flap or soft tissue to achieve better healing.^[20] Due to horizontal and vertical alveolar bone resorption after extraction, bone augmentation is mandatory. The incision line should be designed in a manner that allows for complete soft tissue coverage of the implanted site and total isolation of the augmented site from the oral environment. Incision opening during the healing period is the most common complication due to flap closure under tension and muscle pulling.^[20] Thus, a wide periosteal release and papilla-included flap design are the initial principles of flap design when bone augmentation is chosen.^[20] In contrast, soft tissue grafting requires a minimal tissue reflection, which preserves the blood supply to the grafted tissue. Tunneling and pouching are usually performed when the interdental papillae are intact, and the soft tissue is trapped between the gingiva and the implant or tooth structure.^[9] Further, part of the soft tissue is sometimes exposed to the oral cavity to close the defect in the incision line or to cover an exposed part of the implant.

Understanding Soft Tissue Healing on Different Surfaces

Today, flap closure is performed not only on bony tissue but also on many natural and synthetic surfaces. As mentioned above, flap closure opposite to bony tissue requires 1 month for periosteal reattachment. During healing, different tissues grow at different speeds; for example, epithelial tissue grows 1 mm daily, bony tissue grows 60 μm daily, and blood vessels grow 300-600 μm daily.^[24] Different tissues also grow at different rates on different surfaces: Bony tissue prefers rough acidic surfaces on which to grow and attach, while soft tissues prefer to grow on smooth surfaces.^[25] Research has found that soft tissue grows better on smooth titanium and zirconium oxides surfaces and less well on acrylic and gold.^[26,27] Flap tissue and soft tissue can grow on and attach to synthetic surfaces by hemidesmosome bonding, and the number of hemidesmosomes is also variable between different surfaces.^[27,28]

Flap Versus Flapless Techniques

The flapless weather punch or transmucosal procedure is considered a blind procedure that can cause bone dehiscence or perforation during implant socket preparation or placement.^[29,30] Thus, most clinicians recommend that flapless procedures should

only be performed when the ridge width is 8 mm or greater.^[31] With the evolution of technology for dental implantology, such as cone beam computed tomography and computer aided design/computer-aided manufacturing (CAD/CAM), implant placement is now well planned, and implants are more precisely^[32,33] positioned. Moreover, the implant can be functionally loaded in the same day when performing flapless procedure.^[7]

Thus, flapless procedures are now becoming more common with the guidance of CAD/CAM surgical stents.^[34] Flapless procedures offer many advantages because there is no flap raised.^[35] Thus, no bleeding is expected perioperatively or post-operatively.^[18,36]

There is rapid healing (no tissue detachment), which is more convenient for the patient, and the pain and swelling are decreased.^[18] No sutures are needed, which can decrease the number of patient follow-up visits.^[23] However, precise implant placement is still insufficient when the implant site is compromised with horizontal bone resorption and some soft tissue defects.^[37] A full-thickness flap is still needed for better access^[38] and for soft and hard tissue grafting. The decision between a full-thickness flap procedure and a flapless procedure should be made before the surgery because experience, skill and advanced equipment and training are needed to perform safe and predictable flapless procedures.

Suture Material and Technique

Soft tissue flap closure should be a traumatically and primarily closed, and the tissue handling method, type of needle and type of suture material should be chosen carefully to achieve optimal results.^[21] Suture material selection is important in implant dentistry; a fine gauge suture (4-0 or 5-0) and use of an atraumatic needle are mandatory^[21] when microsurgery or tissue preservation implant placement is performed. The suture material itself can play a role in tissue healing; therefore, monofilament material (polytetrafluoroethylene), which is more hygienic (less plaque accumulation) and has good physical properties (such as high tensile strength that can hold the two sides of the flap together during soft tissue healing), should be used. In addition, the suture technique itself should be chosen properly, and flap closure should be performed in an everted manner with periosteal contact, which can speed healing and prevent the incision line from opening. Most clinicians recommend the vertical mattress suture for better flap closure with fewer complications related to incision line opening.

Conclusion

Factors affecting the flap design some related to the patient (patient factor) and more factors related to operator skill and proper treatment plane (operator factor).

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