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Aamir Z Godil
Senior Lecturer, Department of Prosthodontics, M.A. Rangoonwala College of Dental Sciences and Research Centre, Pune, Maharashtra, India

Sanaa A Wadwan
Post-graduate Student, Department of Prosthodontics, M.A. Rangoonwala College of Dental Sciences and Research Centre, Pune, Maharashtra, India

Arshi I Kazi
Post-graduate Student, Department of Prosthodontics, M.A. Rangoonwala College of Dental Sciences and Research Centre, Pune, Maharashtra, India

Kashif Y Gandhi
Dental surgeon, Department of Prosthodontics, M.A. Rangoonwala College of Dental Sciences and Research Centre, Pune, Maharashtra, India

Taha A Attarwala
Post-graduate Student, Department of Prosthodontics, M.A. Rangoonwala College of Dental Sciences and Research Centre, Pune, Maharashtra, India

Aatif A Khan
Post-graduate Student, Department of Prosthodontics, M.A. Rangoonwala College of Dental Sciences and Research Centre, Pune, Maharashtra, India

Corresponding Author:
Sanaa A Wadwan
BDS, Post-graduate Student, Department of Prosthodontics, M.A. Rangoonwala College of Dental Sciences and Research Centre, Pune, Maharashtra, India

Aesthetic outcomes of two different flap designs in anterior implant restorations following guided bone regeneration

Aamir Z Godil, Sanaa A Wadwan, Arshi I Kazi, Kashif Y Gandhi, Taha A Attarwala and Aatif A Khan

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Abstract
The outcomes of anterior implant restorations are governed by the position and stability of the implant, the contours of the soft tissue and the type of final restoration. Flap design plays a crucial role for the success of guided bone regeneration procedures at the time of implant placement. In this case report two patients were treated for single tooth replacement in the aesthetic zone by means of an implant supported prosthesis. Treatment included a crestal incision followed by a trapezoidal flap elevation in one patient and triangular flap elevation in the other patient. Clinical and radiographic assessment using CBCT of both the subjects confirmed a deficiency of labial plate; thereby requiring guided bone regeneration at the time of implant placement. Screw-retained provisional restoration was used to achieve a desirable emergence profile, followed by placement of a cemented crown six months thereafter. Patients were clinically and radiographically re-examined after intervals of one week, three months and one year to assess implant survival and complications; hard and soft tissue outcomes. It can be concluded that triangular flap yields better aesthetic soft tissue outcomes when compared with a trapezoidal flap in anterior implant restoration following guided bone regeneration.

Keywords: Dental implant, aesthetic zone, soft tissue, trapezoidal flap, triangular flap, guided bone regeneration

Introduction
For a successful Guided Bone Regeneration (GBR) procedure Wang and Boyapati outlined four key factors: primary wound closure, angiogenesis, stability of blood clot and space maintenance [1]. For attaining a tensionless complete closure for a graft coverage and primary wound closure, the flap design and releasing techniques play a pivotal role [2]. Specific surgical procedures in the aesthetic area are employed with flap designs that aim at preserving the gingival integrity of adjacent restorations and teeth. The overall objective is to avoid gingival recessions, scarring and prospective loss of the interdental papilla, as these can have detrimental aesthetic impacts and may affect the teeth adjoining to those involved in GBR of the anterior zone. Some gingival flaps used for GBR can be employed to improve undesirable or indicative gingival deformities influencing adjacent teeth and/or restorations [3].
This report describes two patients who reported to the Department of Prosthodontics and Implantology at our institute with a chief complaint of a missing central incisor requiring a replacement with an implant supported prosthesis.

Case Description
Case A: A 32-year-old male, requiring replacement of maxillary left central incisor, lost due to trauma 3 years ago (Figure 1A).

Case B: A 22-year-old male, requiring replacement of maxillary right central incisor, lost due to trauma 1 year ago (Figure 1B).

A) Patient selection and pre-surgical preparation

A detailed case history was recorded and a comprehensive treatment was planned for both the patients. A Cone Beam Computed Tomography (CBCT) scan was advised to evaluate the underlying osseous ridge contour and density and dimensions of the residual alveolar bone at the proposed implant site. Both patients were systemically healthy individuals, with only single central incisor missing and other teeth intact. Clinical and radiographic assessment using CBCT of both the subjects revealed a deficiency of labial plate (Seibert's class I) [4]; thereby requiring guided bone regeneration at the time of implant placement. Both patients had identical bone density (D2), thick biotype and adequate mesiodistal width of edentulous span (Figures 2A-3B). The patients were explained about the current state, alternative treatment plans and the proposed treatment plan. Consequently, a written informed consent was acquired from the patients. To minimise the potential complications a staged treatment procedure was planned.

The International Team for Implantology (ITI) SAC assessment tool categorized both the cases as "advanced" and the implant placement protocol was Type 4: delayed placement [5]. Prior to surgical appointment, for guiding the implant position a diagnostic wax-up was prepared to aid in fabrication of a vacuum pressed thermoplastic stent [6]. All surgical and prosthetic procedures were performed by the same operator to minimize bias.

B) Surgical phase

Prior to the surgical appointment, thorough oral prophylaxis was carried out and prophylactic antibiotics were started three days prior. The patient was instructed to have a preprocedural intraoral rinse of chlorhexidine (Calypso mouthwash, Septodont, Saint-Maur-des-Fossés Cedex, France). Perioral skin preparation was done using povidone-iodine solution 5% w/v (Wokadine, Wockhardt Ltd, India). The surgical site was infiltrated with local anaesthesia with 2% lignocaine hydrochloride with adrenaline bitartrate (XICAINE®, ICPA Health Products Ltd, Mumbai, India).

Case A: A mid crestal incision with bilateral oblique vertical releasing incisions (extending above the mucogingival junction) were given and a full thickness trapezoidal flap was elevated (Figure 4A and 5A). Case B: A mid crestal incision with unilateral oblique vertical releasing incision (extending above the mucogingival junction) was given on the adjacent lateral incisor and a triangular flap was elevated (Figure 4B and 5B).Subsequently, For both the cases a 3.75*10 mm implants (Adin® Touareg™ S, Alon Tavor, Israel) were placed with sequential drilling ; the implant shoulder was placed 2 mm subcrestally and a low collar gingival former (Adin® RS healing abutment Ø3.5×2 mm Length) was placed over the implants. Autogenous bone was harvested from the adjacent tooth sites and the anterior nasal spine using a bone scrapper (Hu-Friedy Mfg. Co., LLC, Chicago, IL, USA). Intramarrow penetration was performed at the recipient site with 0.5-mm round bur to decorticate the implant site. Intramarrow penetration improves the blood supply to the graft from the trabecular bone blood vessels consequently accelerating revascularization. Surgical trauma also accelerates regional acceleratory phenomenon which results in 2–10 times faster healing [7]. A layer of autogenous bone was laid over it (Figure 6A and 6B). Small particle xenograft (0.5 – 1.0 mm, Cerabone ®, Botiss, Zossen, Germany) was layered over the autogenous bone and secured with a resorbable amnion membrane (Tata Memorial Hospital, Mumbai) (Figure 7A-8B). The flap was undermined to ensure a tension free adaptation of the wound margins before final closure. Closure of the site was done by interrupted sutured using monofilament suture (Prolene,4-0 reverse cutting, Ethicon US, LLC). The patient was given postoperative instructions and antibiotic therapy with Non-steroidal Anti-inflammatory Drugs for five days. The patient was advised to rinse with 0.12% chlorhexidine gluconate three times a day for a period of two weeks. Oral hygiene instructions were reinforced, the site was allowed to heal for two weeks, followed by suture removal. Stage II procedure was carried out after six months of healing where periapical radiograph was taken which showed successful osseointegration. Subsequently the low collar gingival former was replaced with a high collar gingiva former (Adin® RS healing abutment Ø3.5×5mm Length) over the osseointegrated implant (Figures 9A-10B).

C) Prosthetic phase

The provisionalization was done using a screw retained provisional restoration to achieve the desired emergence profile (Figure 11A and 11B). The final open tray impression was made using polyether impression material (Impregum heavy body, 3MESPE, 3M India Ltd, Bangalore) in a special tray, fabricated on the diagnostic cast. The final impression was made using a customized impression post for recording the emergence profile and was sent to the laboratory; straight stock abutments (Adin® RS 1 mm) were used for the fabrication of cement retained metal–ceramic crown prosthesis (Figures 12A-14B). The metal try-in was performed and the appropriate shade was selected in the natural light. Later, bisque trial was done followed by final glazed metal ceramic crown (Figure 15A and 15B). Prior to final prosthesis cementation, abutments were preloaded with a torque driver at 20 Ncm (Figure 16A and 16B). The patient was recalled after one week, three months, and one year (Figure 17A and 17B).

D) Assessment of outcome

At recall, the soft tissue over and adjacent the surgical site for both the implants were evaluated for any infection and discharge, probing depths and periapical radiographs were taken. The macro aesthetics like the soft tissue contour and emergence profile for both the cases were satisfactory. However, the micro aesthetics showed that the triangular flap is better as the trapezoidal flap manifested gingival recession on the adjacent tooth where a vertical releasing incision was made even after one-year follow-up.

Discussion

In-depth knowledge of ridge anatomy for site analysis that provides the basis for successful implant planning and placement is crucial for the clinician. Levine and Martin introduced an aesthetic risk assessment tool which was adapted by the International Team for Implantology's (ITI) straightforward, advanced and complex classification of Implant Dentistry [5, 8]. This assessment considers the individual's risk factors involved in the aesthetic zone and should be used before treatment commences [8]. Furthermore, the gingival biotype should be assessed as it will to some extent determine the risk for postsurgical recession [9, 10]. A thin, highly scalloped gingival biotype is affected by trauma from surgical or restorative procedures and, inevitably is more vulnerable to recession in contrast with a thick, flat gingival biotype [6]. The long-term stability of aesthetic soft tissue

around an implant restoration is influenced by the presence of adequate soft tissue volume in a vertical and buccolingual direction [11]. Correspondingly, an adequate volume of soft tissue also provides a good emergence profile of the implant restoration and serves to obscure the underlying metal implant, especially when combined with suitably apical placement [6].

In any surgical procedure, the design of the incision is based on anatomical location, surgical technique, and desired healing outcome. Depending on which a flap can be designed according to which tissues are incorporated (full vs partial thickness), the number of incisions used to create them (envelope, papilla sparing), or by secondary incisions (unilateral releasing incision-triangular flap, bilateral releasing incision-trapezoidal flap), that dictate the flaps direction (rotating vs coronally vs apically advancing). However, a flap retains a portion of the native blood supply to continuously perfuse the tissue regardless of the design or number of incisions used [12]. Any incision in the mid crestal area of an edentulous space is a safe and predictable location to begin without hampering the blood supply. The amount of release and visualization required for any procedure determines the inclusion of a vertical releasing incisions. Besides more prominent the vertical and horizontal hard and soft tissue loss more critical is the need to add vertical releasing incision for advancement of flap and tension-free closure. Also priority must be given to locate them outside the aesthetic zone, avoid any buccal root prominence, and make them as long as needed but as short as possible [13, 14]. Furthermore at sites requiring hard tissue augmentation it should be extended into the vestibule with scoring of the periosteum to provide proper release and tension-free primary closure [15].

The trapezoidal flap provides more visibility, accessibility and tension free wound closure over the triangular flap, whereas the triangular flap provides better design for containment of the GBR considering the more conservative flap design [12]. In this study, follow-up intervals of one week, three months and one year, revealed that triangular flap when used for implant surgeries in the aesthetic zone followed by GBR resulted in more favourable soft tissue outcomes compared to that with a trapezoidal flap which showed gingival recession on the adjacent tooth.

A multidisciplinary approach with extensive treatment planning along with proper case selection for each technique will help to curtail complications. The aim of this article is to emphasize on important factors that influence healing leading to predictable aesthetic results. Above all the desired end point or aesthetic outcome should be considered while planning and designing any incision in the aesthetic zone.

Fig 1A: Preoperative intraoral: Frontal view

Fig 1B: Preoperative intraoral: Frontal view

Fig 2A: Clinical assessment showing labial plate deficiency in anterior maxilla

Fig 2B: Clinical assessment showing labial plate deficiency in anterior maxilla

Fig 3A: Preoperative CBCT image showing thin labial cortex for implant placement

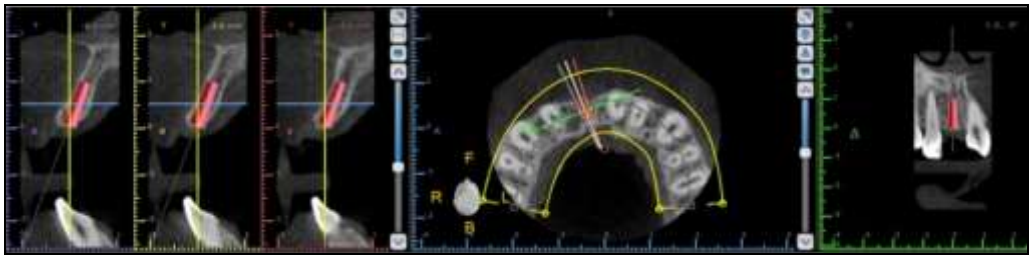

Fig 3B: Preoperative CBCT image showing thin labial cortex for implant placement

Fig 4A: Mid crestal incision with bilateral oblique vertical releasing incisions

Fig 5A: Full-thickness trapezoidal flap elevated

Fig 4B: Mid crestal incision with unilateral oblique vertical releasing incision

Fig 5B: Full-thickness triangular flap elevated

Fig 6A: Implant placed (3.75*10 mm implant, Adin® Touareg™ S, Alon Tavor, Israel) and covered with a low collar gingival former (Adin® RS healing abutment Ø3.5×2 mm Length). Decortication followed by grafting with autogenous bone harvested with a bone scrapper from the adjacent tooth sites and the anterior nasal spine

Fig 6B: Implant placed (3.75*10 mm implants, Adin® Touareg™ S, Alon Tavor, Israel) and covered with a low collar gingival former (Adin® RS healing abutment Ø3.5×2 mm Length). Decortication followed by grafting with autogenous bone harvested with a bone scrapper from the adjacent tooth sites and the anterior nasal spine

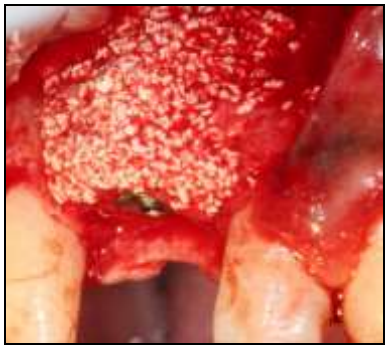

Fig 7A: Small particulate xenograft (0.5 – 1.0 mm, Cerabone ®, Botiss, Zossen, Germany) layered over the autogenous bone

Fig 7B: Small particulate xenograft (0.5 – 1.0 mm, Cerabone ®, Botiss, Zossen, Germany) layered over the autogenous bone

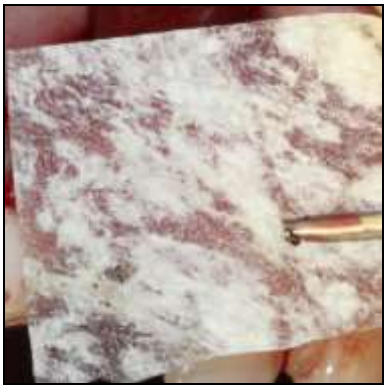

Fig 8A: A resorbable amnion membrane (Tata Memorial Hospital, Mumbai) secured over the graft

Fig 8B: A resorbable amnion membrane (Tata Memorial Hospital, Mumbai) secured over the graft

Fig 9A: Six months post healing and stage II procedure with a high collar gingiva former (Adin® RS healing abutment Ø3.5×5mm Length)

Fig 9B: Six months post healing and stage II procedure with a high collar gingiva former (Adin® RS healing abutment Ø3.5×5mm Length)

Fig 10A: Periapical radiograph: Six months post healing and stage II procedure with a high collar gingiva former (Adin® RS healing abutment Ø3.5×5mm Length)

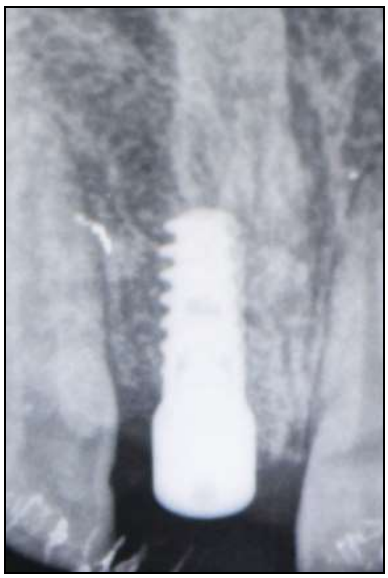

Fig 10B: Periapical radiograph: Six months post healing and stage II procedure with a high collar gingiva former (Adin® RS healing abutment Ø3.5×5mm Length)

Fig 11A: Provisionalization using screw retained provisional restoration: Frontal view

Fig 11B: Provisionalization using screw retained provisional restoration: Frontal view

Fig 12A: Emergence profile achieved using screw retained provisional restoration: Occlusal view

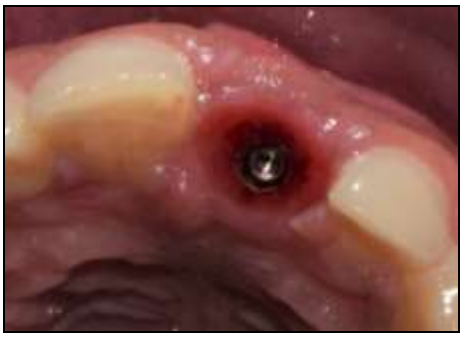

Fig 12B: Emergence profile achieved using screw retained provisional restoration: Occlusal view

Fig 13A: Emergence profile achieved using screw retained provisional restoration: Frontal view

Fig 13B: Emergence profile achieved using screw retained provisional restoration: Frontal view

Fig 14A: Customized impression post for recording the emergence profile

Fig 14B: Customized impression post for recording the emergence profile

Fig 15A: Final metal ceramic prosthesis

Fig 15B: Final metal ceramic prosthesis

Fig 16A: Immediate post-cementation: Frontal view

Fig 16B: Immediate post-cementation: Frontal view

Fig 17A: One Year follow up: recession noted on adjacent natural tooth

Fig 17B: One year follow up

Conclusion

In this case report, the triangular flap has been found to be better than trapezoidal flap and promotes better soft tissue outcomes in aesthetic zone followed by GBR. With the present sample size, we conclude that more clinical research with substantial sample size comparing both triangular and trapezoidal flaps for periapical surgeries in the aesthetic zone should be implemented in the future.

Clinical Significance

The triangular flap design owing to the virtue of adequate visibility and tension free wound closure confers a great alternative for better soft tissue outcomes in the aesthetic zone following GBR and successful implant placement in correct prosthetic position.

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