

An Alternative Approach Sequence to Early Implant Placement and Bone Grafting Over Upper Incisor Traumatic Loss in a Malocclusion Patient

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INTRODUCTION

Dental implants have become the treatment of choice for partially edentulous patients.^{1,2} A single anterior tooth implant can offer highly predictable results when criteria such as minimum 2-mm bone thickness in the buccolingual dimension and adequate implant-tooth distance in the mesiodistal dimension are met.^{3,4} Treatment of traumatic injuries in the anterior maxilla can be challenging.^{5,6} Conditions such as increased overjet, short face profile, and Class II dentoskeletal malocclusions⁷⁻⁹ increase the risk of dental trauma. Furthermore, placing an implant in a protruded position, such as in a patient with increased overjet, increases the risk of further trauma to the implant, which can be catastrophic.

Staged management is often suggested for traumatic loss of maxillary anterior teeth, which includes initial orthodontic treatment to create adequate space for the implant before placement and possibly correcting dental trauma risk factors (increased overjet).¹⁰ However, if implants are placed initially, subsequent orthodontic treatment is restricted and may be compromised.¹¹ Currently, there is no standard guideline to manage this problem. We present a patient with posttraumatic anterior tooth loss who received an implant and subsequent orthodontic treatment that included proximal enameloplasty, stripping for tooth contouring, and tooth extraction to correct the malocclusion.

CASE PRESENTATION

A 38-year-old male teacher with a Class III malocclusion on a Class II skeletal base visited the dental department of Kaohsiung Veterans General Hospital for implant placement due to the traumatic loss of tooth 11 two weeks earlier. An extraoral examination revealed no significant facial asymmetry. The mandibular dental midline was located 2.5 mm to the right of

the maxillary midline. Maxillary and mandibular anterior teeth crowding compromised his oral hygiene, and there was moderate periodontal destruction around teeth 31, 32, 41, and 42. He was healthy and a nonsmoker. Clinical examination revealed a single-tooth implant site for tooth 11, which was covered with healing mucosa (Figures 1 through 3). His anterior teeth were crowded, with a 5-mm overjet and a 6.5-mm overbite (Figure 4a, b).

TREATMENT SUMMARY

The principal treatment plan included a single-tooth implant, a conventional fixed partial denture, and concomitant orthodontic treatment. Orthodontic treatment before implant placement was suggested, which the patient initially rejected. We used a temporary resin-bonded bridge to restore tooth 11 and improve its appearance (Figure 5).^{12,13} The crestal bone width was considered adequate for implant placement with simultaneous guided bone regeneration. Early implant placement with bone augmentation procedures were performed 4 weeks after traumatic loss of tooth 11. A slightly palatal crestal incision was made, and a mucoperiosteal flap with 2 relieving incisions was elevated. A standard tissue level implant (Straumann Regular Neck, SLA, 4.1-mm diameter, 12-mm length, Straumann, Basel, Switzerland) was placed in the correct three-dimensional position¹⁴ (Figure 6) in combination with a simultaneous contour augmentation on the facial aspect with autogenous bone chips and a low-substitution bone filler (Bio-Oss; Geistlich Pharma, Wolhusen, Switzerland). A resorbable collagen membrane (Biomend, Zimmer Dental, Carlsbad, Calif; Figure 7) was applied for the guided bone regeneration procedure. A tension-free primary wound closure was achieved with periosteal releasing incisions.

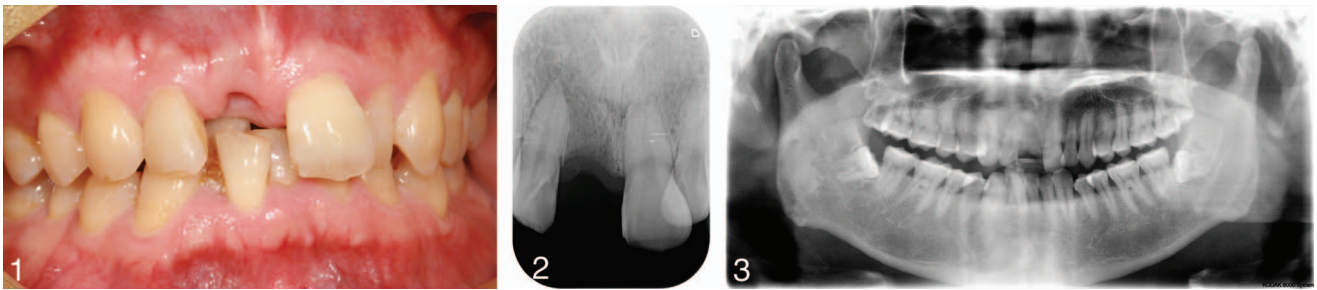
After a 3-month healing period, a screw-retained provisional crown was prepared before fabricating the permanent restoration for peri-implant soft tissue conditioning (Figure 8). During soft tissue conditioning, the patient changed his mind and decided to undergo orthodontic treatment. Thus, orthodontic treatment was scheduled and performed. The Bolton anterior ratio¹⁵ was 0.78; the width length ratio of tooth 21 was 0.9. According to the above parameters, extraction of tooth 42, tooth stripping, and enameloplasty were performed for teeth with a

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FIGURES 1–3. **FIGURE 1.** Tooth 11 loss caused by dental trauma Intraoral (frontal view) at the first visit to the hospital. **FIGURE 2.** Initial periapical radiograph. **FIGURE 3.** Initial panoramic radiograph.

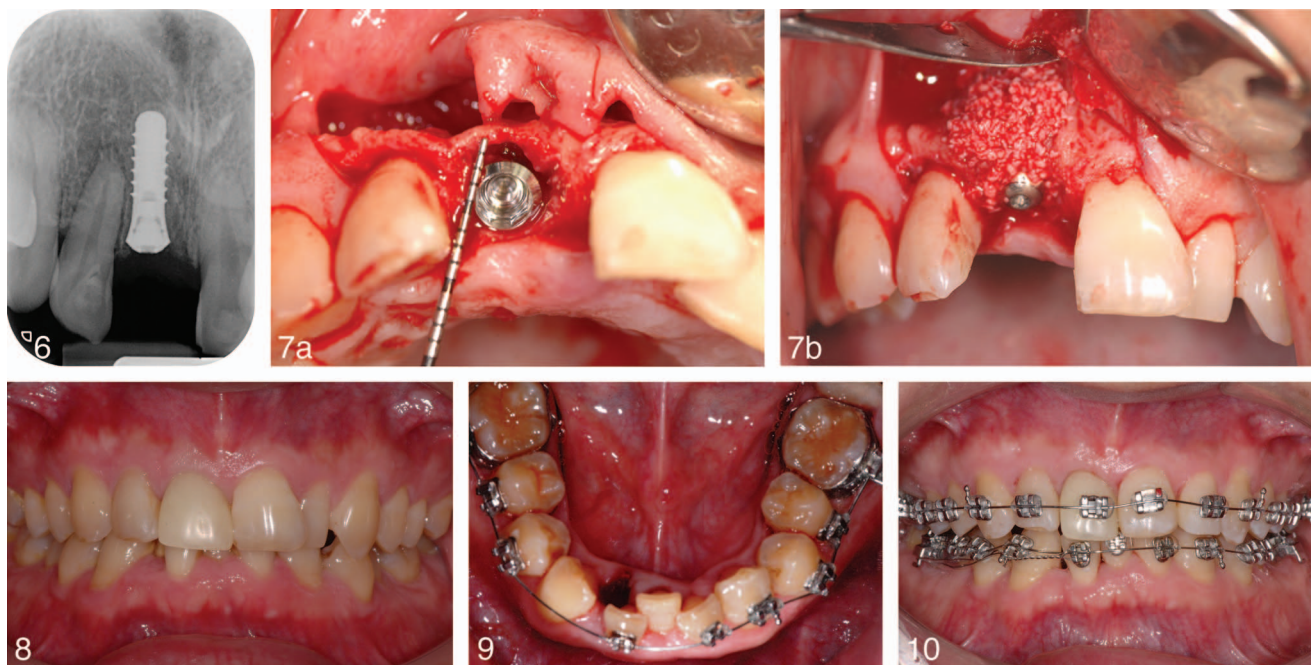
higher width/length ratio (Figures 9, 10), and the anterior arch area was also expanded to help correct the crowded dental arch. After 8 months of treatment, the malocclusion with crowding, deep overbite, and increased overjet was corrected; there was a normalized width/length ratio for the maxillary central incisor (0.78; normal range, 0.75–0.8; Figure 11). A removable retainer was applied to stabilize the dental arch and another provisional crown was placed over the implant to optimize tooth morphology and overall esthetic appearance. At the end of treatment, a permanent prosthesis for the implant was delivered; the pink esthetic score plus white esthetic score (PES/WES) was 16 (Figure 12). Satisfactory esthetic and functional results were observed at the 2-year follow-up (Figures 13, 14).

DISCUSSION

The treatment plan in this case was based on the patient's preference and the ridge resorption process after tooth extraction. After implant insertion, the patient decided to undergo orthodontic treatment. If the patient accepted orthodontic treatment initially, the treatment sequence would have followed the traditional protocol, that is, orthodontic treatment for moving the adjacent teeth in an upright and parallel direction, creating adequate space in the mesiodistal dimension, ridge augmentation, implant placement at the edentulous site of tooth 11, and finally, delivering a permanent restoration. The result of implant-incorporated treatment can



FIGURES 4 AND 5. **FIGURE 4.** Intraoral view of the upper and lower dentition. **FIGURE 5.** Temporary resin bonded bridge for tooth 11.

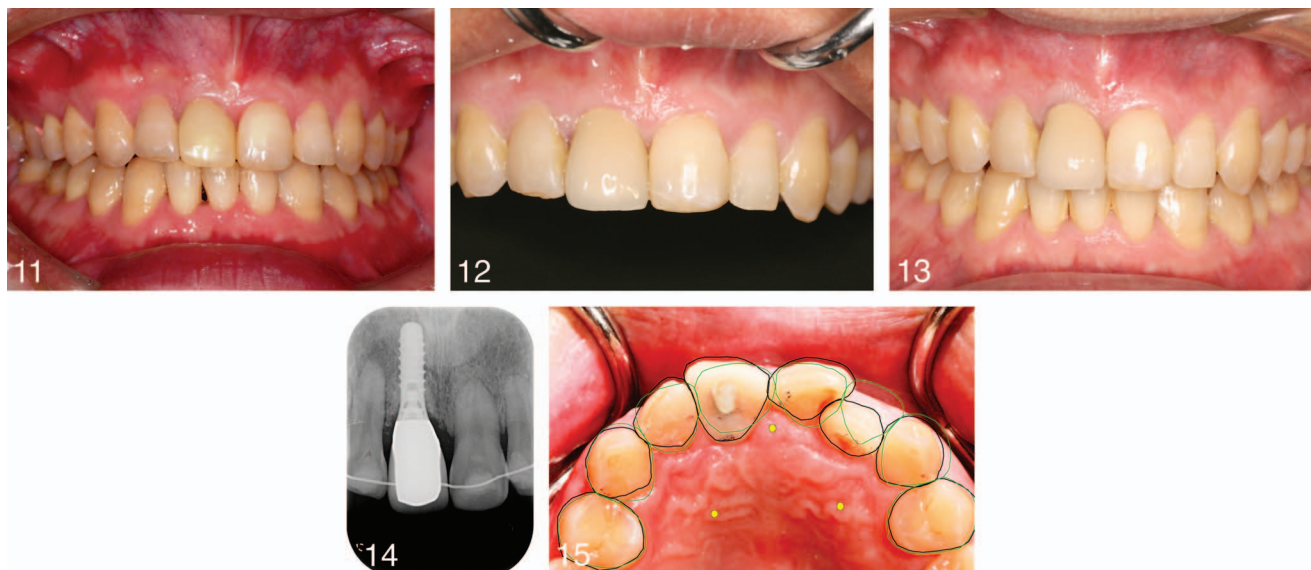


FIGURES 6–10. **FIGURE 6.** Periapical radiograph taken after placing the implant. **FIGURE 7.** (a) Horizontal bony destruction over buccal bone. (b) Autogenous bone chips and a low-substitution bone filler with a resorbable collagen membrane were applied to augment the implant site. **FIGURE 8.** Screw-retained provisional crown for soft tissue conditioning. **FIGURE 9.** Extraction of tooth 42. Level and alignment stage of the orthodontic treatment. **FIGURE 10.** Tooth stripping and enameloplasty was performed.

be unpredictable and compromised if implant placement is performed before necessary orthodontic treatment.¹¹

The dimensions of the alveolar ridge decrease with tooth extraction.^{16,17} Cardaropoli et al reported that residual ridge dimensions in the posterior area of the maxilla or mandible change significantly 4 months after extraction, with a 4.48 ± 0.65 -mm reduction in ridge width and a 1.54 ± 0.33 -mm

reduction in ridge height.¹⁸ Similarly, Barone et al reported a 4.3 ± 0.8 -mm horizontal resorption and a 3.6 ± 1.5 -mm reduction in buccal ridge height 7 months after tooth extraction.¹⁹ Lekovic measured ridge reduction 6 months after tooth extraction using pin re-entry and reported a 1.2–1.5-mm reduction in the vertical ridge height and a 4.4–4.56-mm change in horizontal dimensions.^{20,21} The post-extraction



FIGURES 11–15. **FIGURE 11.** Width/length ratio of upper central incisor = 0.78. **FIGURE 12.** Esthetic score (PES/WES) of tooth 11 final restoration was 16. **FIGURE 13.** Two-year follow-up after delivery revealed a stable esthetic treatment outcome. **FIGURE 14.** Periapical radiograph taken at 2 years’ follow-up. **FIGURE 15.** The black line represents the tooth contour before orthodontic therapy, and the green line represents the tooth contour after orthodontic therapy.

vertical and horizontal resorption of bone may compromise the ridge dimensions and lead to a single-wall peri-implant defect, which is a particularly wide defect of facial bone (bundle bone) in anterior teeth. Furthermore, the delayed grafting procedure for posttraumatic soft and hard tissue damage in patients with a missing tooth²² probably exaggerates ridge resorption, atrophy of the alveolar process, and formation of scar tissue in that area. Guided regeneration of bone should be considered to increase ridge dimensions before implant insertion to optimize implant position.²³

Therefore, in this patient, significant resorption could be inevitable as the time-consuming orthodontic treatment performed prior to implant placement and the more complicated staged bone augmentation therapy were necessary for ideal implant position at the cost of more time, money, and morbidity.

Despite violation of the traditional protocol involving orthodontic treatment before implantation, the contributors to satisfactory esthetic results in this case included the ideal position of the implant in the mesiodistal dimension, minimal displacement of peri-implant teeth in the mesiodistal and orofacial dimensions during orthodontic treatment (Figure 15), and appropriate width/length ratio achieved by tooth contouring, all of which are essential for maxillary central incisor esthetics.

The original width/length ratio of the left maxillary central incisor measured 0.9, which exceeded the normal range published by Duarte (0.85 for the width/length ratio of maxillary central incisors).²⁴ Tsukiyama et al compared the width/length ratio of maxillary central incisors between Asians and Caucasians. He reported that Asians have a lower ratio than Caucasians (0.72 vs 0.78, respectively).²⁵ However, Ku et al reported a width/length ratio of 0.77 in a Korean population.²⁶ After tooth shaping and contouring, the width/length ratio of maxillary central incisors was 0.78 in this case, which was ideal for the Asian group. Tooth shaping was performed for a 1.2-mm reduction at the widest mesiodistal area.

At the end of treatment, the esthetic result was evaluated by PES/WES (the highest score is 20).^{27,28} PES/WES in our patient was 16, which was higher than the mean value of 14.7 ± 1.18 reported by Belser et al for a maxillary anterior single-tooth implant.²⁷

Considering the higher rate of dental injury in patients with malocclusion (ie, increased overjet), further research is necessary to determine the optimal sequence of implant placement and orthodontic treatment in this group.

CONCLUSION

Placing implants before orthodontic treatment can provide satisfactory functional and esthetic results in patients with traumatic loss and malpositioned anterior teeth, even without following the traditional protocol of completing orthodontic treatment before implant placement. The essential factors for treatment success are as follows:

- Implant placement in an appropriate three-dimensional position

- Minimal displacement of peri-implant teeth in the mesiodistal and buccolingual/palatal dimensions during orthodontic treatment
- Performing tooth shaping and contouring, if necessary, to achieve an appropriate width/length ratio

ABBREVIATION

PES/WES: pink esthetic score plus white esthetic score

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