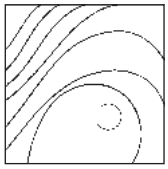
Implant Repositioning by Segmental Osteotomy: A Case Series and Review



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Although every effort is made to place dental implants in a proper position, the restorative dentist does not always succeed. Historically, treatment options for poorly placed implants included removing the implant or leaving it "sleeping." Recent modifications of an existing technique, the segmental osteotomy, may offer hope in these situations by rendering many of these "hopeless" implants salvageable. This paper presents lessons learned from a series of cases in which segmental osteotomies were performed to improve the esthetic outcome of implant malpositioning. Two clinical cases (one successful, one failed) utilizing segmental osteotomy to surgically correct malposed implants are presented with a review of the literature associated with the technique. With adherence to proper case selection and detailed surgical protocol, segmental osteotomy is a viable treatment option to correct misaligned dental implants. (Int J Periodontics Restorative Dent 2011;31:e102–e108.)

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For over 2 decades, the criteria of Albrektsson et al[1] have served as the benchmark by which dental implant success is measured (Table 1). Although these criteria are the current gold standard, they do not address contemporary concerns such as esthetics or restorability secondary to implant positioning. A poorly angulated dental implant replacing a central incisor may satisfy each criterion, but if the implant is functionally and esthetically nonrestorable, can this still be considered a success?

Implant malpositioning is an unfortunate but realistic complication of the dental profession. Historically, a poorly placed dental implant diagnosed as nonrestorable was left untouched in the bone as a "sleeper," removed via trephine and replaced, or masked with heroic periodontal plastic surgery procedures. In many cases, these options proved undesirable, leaving both patient and practitioner frustrated and searching for alternative treatment options. Recent modifications of an existing technique, the segmental osteotomy, may offer hope in these situations by rendering many of

Table 1	Criteria for implant success*
No clinical mobility	
No radiographic peri-implant radiolucencies	
Less than 0.2 mm of annual bone loss following the implant's first year of service	
Lack of pain, infection, paresthesia, or violation of the mandibular canal	
Minimum of 85% success at 5 years	

*Based on the criteria of Albrektsson et al.[1]

Fig 1 *Intial presentation of the splinted implants at the maxillary left lateral incisor and first premolar sites on a study cast. Note the extreme facial position of the implant at the lateral incisor site.*

these "hopeless" implants salvageable. The purpose of this paper is to present lessons learned from a series of cases in which segmental osteotomies were performed to improve the esthetic outcome of implant malpositioning.

Case report

Patient 1

A 53-year-old man was referred to the periodontics department at the Naval Postgraduate Dental School, Bethesda, Maryland, for evaluation and treatment of a severely malpositioned implant compromising his esthetics. A 4 × 18-mm osseointegrated dental implant in the maxillary left lateral incisor site was misaligned, while a 4 × 15-mm osseointegrated dental implant in the maxillary left first premolar site was well positioned (Fig 1). The implants were provisionalized and splinted together. After an evaluation and treatment-planning phase between the prosthodontic and periodontic departments, several conservative attempts were made to compensate for the severe facial displacement of the implant at the lateral incisor site. These conservative attempts included a gingivectomy to balance the adjacent gingival margins, a connective tissue graft to correct the apically positioned gingival margin, and an Atlantis custom abutment (Astra Tech) to decrease the facial profile. Unfortunately, these conservative measures could not compensate for the severe facial displacement of the implant at the lateral incisor site (Fig 2). After further evaluation, several options were presented to the patient, including removal of the implant in combination with regeneration and replacement of the implant at a later date, surgically repositioning the implant and replacing the prosthetic restoration, and leaving the implant as is and accepting the compromised esthetics. The patient opted for segmental osteotomy to reposition the implant.

The surgical team consisted of a periodontist, prosthodontist, surgical assistant, and separate periodontist running the intravenous sedation. Verbal and written consent was obtained informing the patient of treatment options, risks, complications, and benefits. Postoperative management was reviewed with the patient and the patient's escort prior to induction of the moderate intravenous sedation. The patient was placed on amoxicillin (500 mg tid for 10 days), motrin (800 mg q6h for 4 days and then prn thereafter), a medrol dose pack (6-day tapering dosing), and 0.12% chlorhexidine solution (rinse bid starting 24 hours postsurgery for 10 days; Peridex, Procter & Gamble). In addition, the patient was instructed to be on a soft diet for 3 to 4 weeks and minimize physical activity for 1 week. Prior to surgery, the prosthodontist prefabricated components needed for stabilization and proper positioning of the segment. A surgical guide was designed for proper implant alignment, and a prebent stainless steel archwire and restorative abutments for acrylic resin provisionalization were fabricated for stabilization. The surgical guide

Fig 2 (above) *Patient presentation after conservative surgical therapy.*

Fig 3 (right) *Preoperative periapical radiograph of the implant at the lateral incisor site.*

would serve not only as a guide to where the implant needed to be positioned for an optimal restorative outcome, but also as a template for the provisional restoration. Prior to surgery, several challenges were identified, including proposed movement of the implant (18 mm), close root proximity, high smile line, and severity of the facial displacement (Fig 3).

The patient was given a presurgical rinse with 0.12% chlorhexidine and 6 mg of dexomethosone intravenously. After induction of sedation, the patient was anesthetized with 2% lidocaine with 1:100,000 epinephrine via maxillary infiltration on both the facial and palatal tissues. A sulcular incision was made mesial to the left central incisor to the distal aspect of the implant at the lateral incisor site, keeping the papilla intact (Fig 4). Two beveled vertical releasing incisions were made from the mesial aspect of the central incisor to the distal aspect of the implant. A full-thickness mucoperiosteal flap was elevated using a Buser elevator (Hu-Friedy) extending high into the vestibule. A palatal flap was not elevated to maintain blood supply to the alveolar segment. The implant at the lateral incisor site had a slight facial dehiscence of three threads. The interproximal distance between the implant at the lateral incisor and the distal surface of the central incisor was 1 to 1.5 mm with greater than 3 mm of interproximal bone between the implants at the lateral incisor and first premolar sites.

An oscillating saw (ACE Surgical) with a 0.4-mm-thick blade was used to make parallel cuts extending through the facial and palatal cortexes at the mesial and distal aspects of the implant at the lateral incisor site without perforating the palatal tissue. An apical cut that did not perforate the palatal cortex was made 19 mm from the implant platform (Fig 5). A guide pin was screwed in place into the position of the implant in the maxillary left first premolar site to act as a lever for movement. With finger pressure, the alveolar segmental housing of the dental implant was slowly moved palatally into the surgical guide provided by the prosthodontist (Fig 6). With the dental implant in optimal position with the surgical guide, the segment was fixated with two 1.5 × 11-mm fixation screws (KLS Martin). The fixating screws served as the first phase of stabilization of the segment (Fig 7). With the screws in place, the prosthodontist fabricated a provisional restoration using a template with an opaque provisional abutment and sectioned provisional fixed partial denture luted together with methyl methacrylate. The provisional restoration served as the second phase of stabilization. With the provisional in place, the segment was grafted with freeze-dried bone allograft (Lifenet) and covered with

Fig 4 *Incision design.*

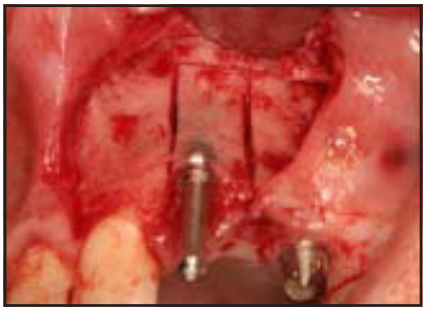


Fig 5 *Segmental cuts completed prior to placement into the surgical guide.*

Fig 6 *Segment moved into the surgical guide.*

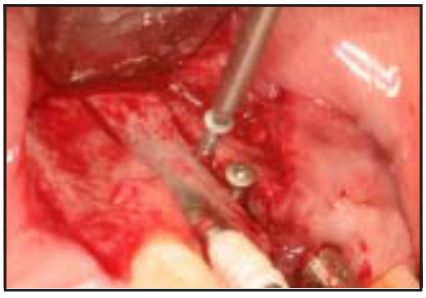
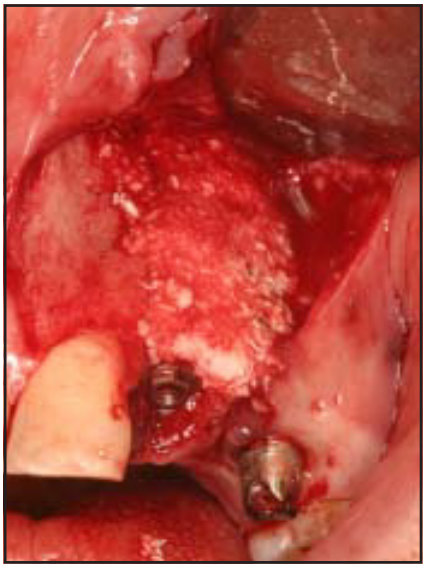


Fig 7 (left) *Stabilization screws in place.*

Fig 8 (right) *Grafted segment prior to membrane placement.*

Fig 9 (left) *Flap sutured and archwire fixed with composite resin bonding material.*



a resorbable collagen membrane (Ossix, Oropharma) (Fig 8). The flap was repositioned using periosteal releasing incisions and reapproximated to the newly positioned implant and provisional. Finally, a prebent stainless steel wire was bonded using composite resin from the maxillary right canine to the implant at the left first premolar site, serving as the last phase of fixation (Fig 9).

Postoperatively, the patient was followed weekly for 1 month, biweekly for 2 months, and then monthly until the 4-month mark. Normal postoperative maintenance and hygiene were performed. Periapical radiographs were taken the day after surgery and at 2 and 4 months postoperative (Figs 10 and 11). The osteotomy sites appeared continuous with the adjacent bone, with minimal radiographic appearance of the osteotomy procedure at 4 months. Clinically, the gingival tissue appeared within normal limits.

Four months after surgery, the fixation wire was removed and a new provisional restoration was delivered. Gingival recontouring was performed following provisional placement (Fig 12). A definitive restoration was completed and delivered 8 months after surgery.

Patient 2

A 25-year-old man was referred to the periodontics department at the Naval Postgraduate Dental School, Bethesda, Maryland, for evaluation and treatment of a severely malpositioned implant resulting in compromised esthetics. The patient had an anteriorly displaced 4 × 13-mm osseointegrated dental

Fig 10 (left) *Periapical radiograph taken immediately after surgery.*

Fig 11 (right) *Postoperative periapical radiograph taken at 4 months. Note the segmental radiographic healing.*

Figs 12a and 12b *Improved* (left) *implant position and* (right) *esthetics after segmental repositioning.*

implant replacing the right maxillary central incisor. The implant was placed in a site grafted with block allograft (Lifenet). A preoperative protocol similar to that for case 1 was followed. Likewise, a similar surgical protocol was used, but a membrane was not placed over the mobilized segment and graft. The prosthodontic protocol was the same; however, there was added treatment time because components for stabilization were not prefabricated. The same postoperative protocol was followed. Four months after surgery, during removal of the stabilization components, marginal erythema and purulence were noted. During elevation of the facial gingival tissue, the facial plate of the allograft dehisced and soft tissue encapsulation of the implant was noted (Fig 13). The implant was removed, and the site was degranulated and grafted for future implant placement.

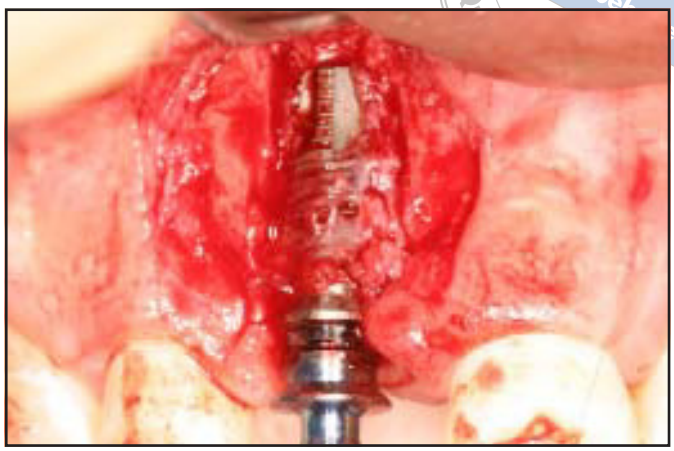


Fig 13 *Block allograft dehiscence and soft tissue encapsulation of the implant.*

Discussion

Segmental osteotomy procedures have been used in dentistry for nearly 100 years.[2] Historically, this technique has been used by the oral and maxillofacial community for orthognathic procedures and as an adjunct for orthodontic treatment of bimaxillary protrusion.[3] Segmental osteotomy procedures have been reported successfully and used for many years to correct malposed teeth in orthodontic surgery.[4–7] While many modifications of this technique have been implemented over time, the underlying concept and purpose of the procedure remain relatively constant.[8–12] Segmental osteotomy for the treatment and management of severely malposed implants has been reported with success throughout the literature.[13–19]

The dental literature dictates that segmental osteotomy is indicated in situations where substantial movement of teeth is required but repositioning by orthodontic applications is not possible.[20] Dental implants essentially function as ankylosed teeth, rendering orthodontic movement of these fixtures impossible. As such, situations requiring movement of dental implants are ideal for treatment by segmental osteotomy.

Segmental osteotomy applications for implant repositioning are based on three basic tenets: establishing mobility of the implant alveolar housing, maintenance of the periosteal integrity, and rigid fixation of the transposed segment.[21] Mobility of the implant alveolar housing is typically accomplished by mesial, distal, and apical bony cuts created with oscillating/reciprocating saws or piezoelectric surgical units. In case 1, the apical cut extended through the cortical bone but not completely, as seen with the mesial and distal cuts. By keeping the apical bone intact, the segment can be compressed and moved while keeping the blood supply intact, as opposed to freeing the segment. When making these cuts, maintenance of the palatal tissue-bone interface is critical, as demonstrated in this case series. Conservation of palatal periosteal integrity provides optimum preservation of the blood supply to the transposed alveolar unit and improves the chance for successful outcomes.[14] Once mobile, healing of the alveolar unit follows the standard principles of bony fracture healing. To achieve a stable osseous union of the mobile unit, rigid fixation is required.[22] Techniques for stabilization of implant-associated segmental osteotomies are often situation-specific, requiring careful thought and consideration. Published fixation techniques for implant-associated segmental osteotomies range from simple fixation screws to miniplates to screw-retained metal substructure fixed partial dentures.[14,15] In the cases

presented, fixation was properly achieved through fixation screws, the provisional itself, and composite resin and archwire. Once fixated with the proper fracture margin approximation, initial healing via osseous callus formation is usually accomplished in 4 to 6 weeks, with subsequent maturation and remodeling over the next 6 to 9 months.[14] As presented in case 1, grafting with freeze-dried bone allograft will help minimize the dead space during healing and act as a lattice for new bone growth. A membrane is critical in protecting the graft and segment during healing. A membrane will act in wound stability, graft containment, space maintenance, and prevent epithelial migration.

Case selection is another critical factor in determining success. The medical status of the patient, local anatomy, tissue type, and ability to adequately stabilize the situation within the case parameters are keys for case selection. One of the factors suspected in the failure of case 2 was poor case selection. Movement of a site grafted with a block allograft may have proven disastrous because of questionable vitality of the block. As such, the clinician should proceed with caution when considering a segmental osteotomy; a failure may result in a large soft and hard tissue defect. Failure may subject the patient to now having to receive multiple procedures to correct the defect created by the failed osteotomy procedure. Therefore, the patient and clinician should be prepared that in the event of a failure, the defect may warrant a larger and more complicated procedure to replace the implant.

Segmental osteotomy of a malpositioned implant is a viable option when more conservative treatments fail. Keys to success are proper case selection, adequate healing time, and strict follow-up. Preplanning by having prefabricated stabilization components and an adequate stabilization plan are recommended. Additional studies evaluating segmental osteotomy procedures are certainly warranted.

References

1. Albrektsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: A review and proposed criteria of success. Int J Oral Maxillofac Implants 1986;1:11–25.
2. Cohn-Stock G. Die chirurgische Immediatre-gulierung der Keifer, speziell die chirurgische Behandlung der Prognathie. Vjschr Zahnheilk Berlin 1921;37:320.
3. Lee JK, Chung KR, Baek SH. Treatment outcomes of orthodontic treatment, corticotomy-assisted orthodontic treatment, and anterior segmental osteotomy for bimaxillary dentoalveolar protrusion. Plast Reconstr Surg 2007;120:1027–1036.
4. Bell WH. Biological basis for maxillary osteotomies. Am J Phys Anthropol 1973;38:279–289.
5. Bell WH, Schendel SA, Finn RA. Revascularization after surgical repositioning of one-tooth dento-osseous segments. J Oral Surg 1978;36:757–765.
6. Burke JL Jr, Provencher RF Jr, McKean TW. Small segmental and unitooth ostectomies to correct dentoalveolar deformities. J Oral Surg 1977;35:453–460.
7. Bays RA. Rigid stabilization system for maxillary osteotomies. J Oral Maxillofac Surg 1985;43:60–63.
8. Bell WH, Condit CL. Surgical-orthodontic correction of adult bimaxillary protrusion. J Oral Surg 1970;28:578–590.
9. Cupar I. Surgical treatment of alterations in form and position of the maxilla [in German]. Osterr Z Stomatol 1954;51:565–577.
10. Epker BN. A modified anterior maxillary ostectomy. J Maxillofac Surg 1977;5:35–38.
11. Wassmund J. Lehrbuch der Praktischen Chirurgie de Mundes und der Keifer, vol 1. Leipzig: Barth, 1935:260–282.
12. Wunderer S. Experiences with vertical osteotomy in the maxilla [in German]. Dtsch Zahn Mund Kieferheilkd Zentralbl Gesamte 1972;59:5–12.
13. Storum K, Carrick JL. Implant-osseous osteotomy for correction of the misaligned anterior maxillary implant. Dent Clin North Am 2001;45:181–187.
14. Kassolis JD, Baer ML, Reynolds MA. The segmental osteotomy in the management of malposed implants: A case report and literature review. J Periodontol 2003;74:529–536.
15. Raghoebar GM, Visser A, Vissink A. Correction of a malpositioned endosseous implant by a segmental osteotomy: A case report. Int J Oral Maxillofac Implants 2005;20:627–631.
16. Hallman M, Carlson B. Surgical correction of malpositioned implants: A case report Clin Oral Implants Res 1996;7:316–319.
17. Watanabe F, Hata Y, Mataga I, Yoshie S. Retrieval and replacement of a malpositioned implant: A clinical report. J Prosthet Dent 2002;88:255–259.
18. Warden PJ, Scuba JR. Surgical repositioning of a malposed, unserviceable implant: Case report. J Oral Maxillofac Surg 2000;58:433–435.
19. Stacchi C, Costantinides F, Biasotto M, Di Lenarda R. Relocation of a malpositioned maxillary implant with piezoelectric osteotomies: A case report. Int J Periodontics Restorative Dent 2008;28:489–495.
20. Park JU, Hwang YS. Evaluation of the soft and hard tissue changes after anterior segmental osteotomy on the maxilla and mandible. J Oral Maxillofac Surg 2008;66:98–103.
21. Warden PJ, Scuba JR. Surgical repositioning of a malposed, unserviceable implant: Case report. J Oral Maxillofac Surg 2000;58:433–435.
22. Jagodzinski M, Krettek C. Effect of mechanical stability on fracture healing—An update. Injury 2007;38(suppl 1):S3–S10.