The use of orthodontic treatment and immediate implant loading to restore the traumatic loss of a maxillary central incisor

This clinical case describes a new orthodontic/surgical concept for immediate loading of hydroxyapatite-coated cylindric implants, placed at the end of orthodontic treatment, to restore a traumatically lost maxillary central incisor. Further clinical and histologic studies are necessary to promote routine clinical application of this technique. (Int J Adult Orthod Orthognath Surg 2001;16:47-53)

The Brånemark group revolutionized dentistry with their experimental and clinical data. Their studies demonstrate that, under strict surgical conditions, a rigid bone-implant interface can be maintained indefinitely.\(^1\)\(^-\)\(^4\) In the presence of functional loading associated with mastication, continual remodeling of the bone supporting the implant occurs\(^1\)\(^-\)\(^4\) to maintain this rigid bone-implant interface.

Understandably, the first area where orthodontics and implant dentistry have interacted relates to one of the most limiting aspects of orthodontic therapy: inadequate anchorage. Direct osseous loading has obvious clinical potential in orthodontics.\(^5\)\(^-\)\(^7\) As implant esthetics have evolved, the use of implants to replace missing teeth following orthodontic treatment and space reapportionment has been another important area of cooperation between clinical orthodontists and implant dentists.\(^8\)\(^-\)\(^11\)

Traumatic loss of an anterior maxillary tooth is a horrifying experience for any teenager and his or her parents. The dentist must provide an immediate solution for the initial loss of a tooth, await the end of the orthodontic treatment when suitable mesiodistal space for implant placement has been established, initiate 2 surgical procedures within a 6-month period, and provide a temporary anterior removable prosthesis in the interim.\(^8\)\(^-\)\(^11\)

One of the basic tenets of implant dentistry, as advocated by the Brånemark group, is to ensure a load-free condition for some months to avoid fibrous repair and enable primary healing with a significant bone-implant interface.\(^1\)\(^-\)\(^4\) Twenty years ago, the thought of allowing immediate loading after implant placement in the premaxilla would have been considered sacrilege. Today, it is merely a challenge.

The present case report describes a new orthodontic/surgical concept for immediate loading of hydroxyapatite-coated implants. Orthodontic treatment was first performed to improve alignment and create appropriate space following the traumatic loss of a maxillary central incisor, and an implant was then placed and loaded with a post and a functional crown.

History

The patient was a 15.5-year-old male in good physical health. He had been injured about 5 years previously diving into a swimming pool, and as a result his maxillary right central incisor was fractured.
and displaced incisally, and the left central incisor was avulsed. No treatment was initiated at that time.

The patient finally presented to the dental office approximately 5 years later complaining that, following the loss of the maxillary left central incisor, movement of adjacent teeth had occurred (Fig 1a). The face was slightly asymmetric as the result of a mandibular skeletal deviation to the right, and the soft tissue profile was slightly convex, with incompetent lips. On smiling, the patient displayed 2 mm of gingival tissue. He presented a Class II division 1 malocclusion in the permanent dentition, with 5.5 mm of overjet and 4.5 mm of overbite in the habitual occlusion. The molars were in a half-unit Class II relationship. The maxillary right central incisor, which was 8.5 mm in width, exhibited an uncomplicated crown fracture (enamel and dentin without pulp exposure), an extrusive displacement of about 2 mm beyond the maxillary occlusal plane, and a mesial drifting of 4 mm across the midline. The left lateral incisor was also mesially displaced, leaving 2 mm of residual space in place of the missing left central incisor. There were spaces between the maxillary canines and premolars associated with the mesial drifting. The mandibular midline was shifted 2 mm to the right relative to the facial midline, along with the entire mandible.

The lateral cephalometric tracing showed a convex profile, with a 4.5-degree ANB angle. Maxillary and mandibular incisor inclinations were within normal limits. A periapical anterior radiograph (Fig 1b) revealed reduced bone support for the root of the maxillary right central incisor, a result of apical resorption and the extrusive displacement consequent to the trauma. In the panoramic radiograph, agenesis of both mandibular third molars was noted.

Orthodontic treatment

Following the traumatic loss of a central incisor, 2 treatment options should be considered: orthodontic space closure and space maintaining/opening for autotransplantation, or future prosthetic rehabilitation of the missing tooth. Stenvik and Zachrisson have published a comprehensive list of factors that influence this final treatment decision. The typical candidate for space closure by moving the lateral incisor to replace the central incisor is a young individual with a full profile,
no gingival display on smiling, a crowded maxillary arch, enlarged overjet, open bite, large lateral incisors, and small white canines. Compensating extractions in the maxillary arch to obtain a symmetric final result are usually required. However, this approach seldom leads to a lasting esthetically satisfactory result. The recent development of transplantation techniques and prosthetic therapy has minimized the need for orthodontic space closure. Autotransplantation is a viable option with partially developed or full-length premolar roots with a wide open apex. After this age, space must be maintained until skeletal growth is complete for a single-tooth implant restoration to be successful.

The treatment objective in the present patient was to open the space for the prosthetic reconstruction of the missing left central incisor. The decision was based on the discrepancy in crown form and size between the central and the lateral incisors, the spaces between the upper teeth, the gingival display on smiling, and the facial morphology. The alternatives were non-extraction, ie, reduce the Class II molar relation by distally directed extraoral force applied to the maxillary molars; or extraction of 2 maxillary premolars to move the canines into a Class I relation and the molars into a full-unit Class II relation.

The non-extraction approach was chosen, taking into account the patient's mildly retrognathic profile. Kloehn-type cervical headgear was used to distalize the maxillary molars into a Class I relationship. Since at age 15.5 years, facial growth in boys is not complete, it was hoped that the extraoral appliance might effect some retardation of maxillary growth and encourage mandibular growth to reduce the skeletal Class II pattern and improve the profile. However, compliance was poor, and it took a year before a straight-wire edgewise appliance could usefully be placed to move the remaining maxillary teeth distally into a Class I canine relationship, correct the upper midline, and open the required space for the absent tooth. The headgear therapy was continued through the entire period of fixed appliance treatment. At the end of this stage, the patient was 17.5 years old, and growth had slowed. The appliances were removed, and 3 days later, the surgical procedure was performed and maxillary and mandibular Hawley retainers were placed (Fig 2).

Surgical technique

Oral examination included an assessment of the intra-arch relationship, the buccolingual width, and the maxillomandibular relationship. Radiographs were evaluated for bone quantity (mesiodistal width and available length) and root angulation of the adjacent teeth. Tomographic radiographs were taken to confirm adequate buccolingual width. The implant site demonstrated 22 mm of available bone length and 5.2 mm of bone width. An externally hexed, hydroxyapatite-coated, cylindric SteriOss implant (Nobel Biocare; 16 mm long and 3.8 mm wide) was used.

The implant treatment alternatives were explained to the patient. The possibility of 1-stage surgery and loading, versus 2-stage surgery or 1-stage surgery and a 6-month waiting period, was explained. Informed consent for the described procedure was obtained.

One gram of amoxicillin was administered 1 hour prior to surgery. Chlorhexidine rinses were used prior to surgery, and amoxicillin and chlorhexidine rinses were continued for 7 days postsurgery.
No flaps were raised. A round high-speed bur was used for soft tissue contouring. At the end of soft tissue contouring, elimination of soft tissue over the osteotomy site was confirmed. The distance between the gingival margin and the bone was measured by the aid of a periodontal probe and was found to be 3 mm.

Implant site preparation proceeded with the aid of a surgical stent. A 2-mm pilot drill was then used, and drilling proceeded to the depth of 19 mm from the gingival margin (16 mm—the required implant length—plus 3 mm—the distance from the alveolar crest to the gingival margin). The osteotomy site was prepared according to the manufacturer’s instructions. The implant was placed at the most coronal part of the buccal alveolar crest and was checked for clinical stability, including an absence of rotational movement.

The cover screw was removed and the implant location at the alveolar crest was verified. A fixed abutment was then placed (Fig 3), the occlusion was checked, and the required modifications were marked. The abutment was removed from the implant, placed over the implant analog, and modified extraorally. It was then replaced over the implant. Finishing modifications were performed intraorally, and appropriate adaptive soft tissue contouring was performed with a high-speed drill. Final tightening of the abutment was performed with a 35-N·cm torque wrench and a 0.050-inch hex insert. No movement of the implant was observed during the above-described prosthetic adjustments.

A temporary prefabricated crown was prepared and placed over the abutment with a minimum of temporary cement (Fig 4). Attention was paid to the elimination of incisor contact with the temporary crown during protrusive movements, and contact in centric occlusion was minimized. Surgical flaps had not been raised and therefore sutures were not needed. The patient was instructed to be on a soft diet for 2 weeks, after which normal mastication could be resumed. The patient was seen once a month for a subsequent 6-month period. Healing was uneventful,
no swelling was observed, and the patient did not require any analgesics.

At the time of traditional second-stage surgery (6 months after implant placement), radiographs of the implant sites were taken, and the implant received a fixed ceramometal crown restoration, while the fractured maxillary right central incisor was restored with composite bonding material. The anterior view at this stage demonstrated good symmetry and esthetics (Fig 5). At the 1-year follow-up, the papilla between the 2 central incisors reached the contact point, resulting in elimination of the "black triangle" (Fig 6). This favorable change was facilitated by 5 mm of distance between the contact point and the alveolar crest.18

Discussion

Dental implants are popular among patients and dentists because of the new prosthetic possibilities and the highly successful results. These successes have been attributed to the maintenance of the integrity of osseointegration under occlusal loading. The view has long been held that placing implants in a 2-stage surgical protocol allows the implant to develop a direct bony interface, rather than a fibrous tissue interface.1–4 However, there are situations in which allowing 3 to 6 months of healing may be associated with significant discomfort and inconvenience related to the need to wear a removable prosthesis for prolonged periods of time, particularly in the anterior maxilla. The purpose of the present technique has been to avoid the need for 2-stage surgery and for a temporary removable prosthesis.

One of the most suitable indications for the described technique is traumatic loss of a maxillary incisor. Most of these situations are associated with either traumatic alveolar bone loss or significant buccolingual bone resorption. In the presented case, the mesial drift of the right central incisor and the left lateral incisor resulted in maintenance of a sufficient buccolingual width to perform implant placement, even after orthodontic reopening of this space had been achieved. As soon as orthodontic treatment was completed, the patient was referred to a maxillofacial surgeon. This timing is important; otherwise, significant bone resorption may occur, leading to the need for complicated bone grafting procedures.

The appropriate timing of implant placement in growing individuals has been addressed by several authors.19–21 They have recommended waiting until the clinical signs of growth cessation occur: stabilization of shoe and garment size, arrest of height increase or reaching height of parents, and shaving among males.

To minimize postoperative pain and swelling, to maintain the adjacent papillae, and to prevent gingival recession, no
flap was raised. As can be seen from the final result, gingival esthetics were very satisfactory. It may be concluded that, provided that the bony anatomy is known and sufficient, there is no need for flap elevation in the anterior area. The use of osteotomes is also of great help.

The minimum ridge width required for placement of a 3.8-mm-diameter implant is 6 mm. In the presented case, the alveolar ridge width was 5.2 mm, and the use of osteotomes to split the ridge resulted in widening of the buccolingual dimension. Therefore, patients with 5 mm of width do not require bone augmentation, provided that this osteotomy technique is performed. The employment of osteotomes in this way contributed to the achievement of maximal stability, which enabled immediate placement of the abutment and the temporary crown.22

The question remains as to why cylindrical hydroxyapatite-coated implants are most suitable for immediate loading procedures. The advantages of hydroxyapatite include faster osseointegration and greater reverse-torque resistance compared to non-coated implants.23–27 Both those qualities are helpful in cases of immediate loading; however, the use of the cylinder has both advantages and disadvantages. It is more difficult to achieve initial stabilization with cylinder-type implants, although once achieved it is more difficult to disrupt.23–27 Screw-type implants achieve initial stabilization more easily, but reverse torque will often disrupt this stability on the day of implant placement. The advantages of the presented 1-stage procedure are obvious and include immediate function and esthetics. Second-stage surgery is eliminated and adjacent papillae are well preserved, contributing to a favorable esthetic result.

Although the present technique seems simple, it is highly sensitive and is not recommended for novices. Until more data is gathered and published, the surgeon, the orthodontist, and the patient must be aware of potential complications, and treatment alternatives should be thoroughly explained to the patient. Further clinical and histologic studies are necessary to allow routine clinical application of this technique.

Conclusion

The use of orthodontic treatment and immediate implant loading to reconstruct the traumatic loss of a maxillary central incisor should be considered as a viable treatment alternative.

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References


