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DENTAL TRAUMATOLOGY

Case Report

Multidisciplinary approach for the rehabilitation of dentoalveolar trauma

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Abstract – Satisfactory dental rehabilitation of dentoalveolar trauma requires intense effort and time. Usually multidisciplinary treatment planning and teamwork are necessary to deal with multitask problems associated with these cases. Dental implants have been successfully used for replacement of missing teeth, but in trauma cases insufficient alveolar bone hinders implantation. In this report we present the multidisciplinary approach for the treatment of a trauma case. Maxillary segmental alveolar osteotomy in conjunction with interpositional and onlay bone grafting was performed to prepare the site for placement of osseointegrated implants. Titanium microplate and screws were used to provide orthodontic anchorage for intrusion of the extruded mandibular incisors. The patient was rehabilitated by implant supported fixed partial denture 6 months after implant placement.

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Oral rehabilitation problems that were historically very difficult can be solved today by dental implants (1). Trauma patients having missing teeth and bone can be successfully rehabilitated with fixed implant-supported prosthesis (1). The ideal implant treatment plan is on the patient's needs, desires, and financial commitment (2). The dentist has to be creative treating his patient, otherwise applying the routine technique to all patients will not lead to satisfactory solutions.

Severe trauma patients have always been the most complicated cases for dental rehabilitation. Teeth and alveolar bone loss, together with fibrotic scar formation hardens the treatment. For a successful implant restoration; interarch space, existing occlusal plane, arch relationship, implant permucosal position, arch form, existing occlusion and prosthesis, number and location of missing teeth, lip line, and mandibular flexure should be very well determined (2).

Following a careful clinical and radiographic examination, the prosthodontist and the surgeon should establish a treatment plan. For some cases, especially when there is limited space for implantation, in order to reach a good result, orthodontic treatment may be necessary.

Case report

A 20-year-old female presented to the clinics of Çukurova Dental Faculty on July 1999, complaining of dental esthetic problems. She had been injured in a traffic accident 3 years ago, resulting in loss of tooth numbers 11 and 21–24, and had undergone intermaxillary fixation therapy for the treatment of maxillary segmental alveolar fracture for 4 weeks in a private hospital. One month later she had her teeth rehabilitated with a fixed partial denture starting from the right maxillary canine to the left first maxillary molar supported by tooth numbers 12, 13, 25, and 26, in a private dental office. There was a little asymmetry in her face, and she was mostly complaining of her smile.

Intraoral examination revealed a superiorly curved occlusal line in the anterior and left premolar regions (Fig. 1a,b). Mild marginal gingivitis was

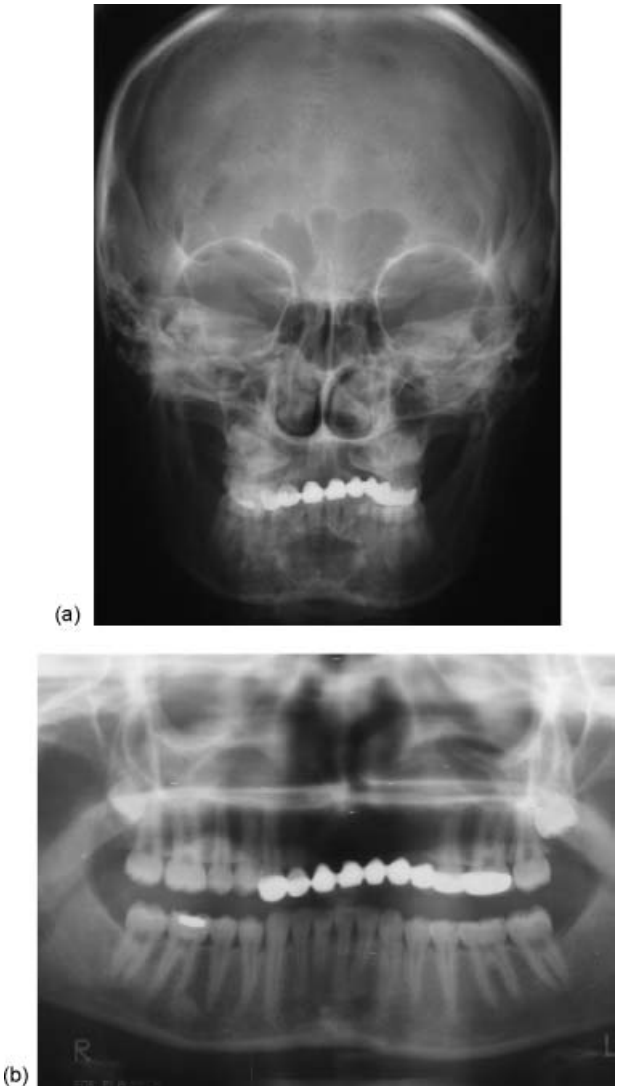

Fig. 1. Anteroposterior cephalometric radiograph (a) and orthopantomographic view (b) before treatment.

present mostly related to her fixed partial prosthesis. Maxillary third molars were impacted.

Following the removal of the fixed partial denture, vertical and horizontal alveolar bone loss in the maxillary anterior and left premolar region was detected. Mandibular incisors and left canine were elongated because of loss of the opposing teeth (Fig. 2). A three-step treatment plan was established; intrusion of the elongated mandibular teeth by orthodontic forces followed by maxillary segmental alveolar osteotomy in conjunction with interpositional and onlay bone grafting for augmentation of alveolar bone defect and application of four screw-type titanium plasma sprayed ITI® (Straumann Institute, Waldenburg, Switzerland) dental implants after bone grafting.

Titanium microplates (Microplus® Titanium Plating System, Leibinger GmbH, Freiburg, Germany) were used for orthodontic anchorage. A four-hole microplate was cut into two equal pieces, and each piece was bent 90° in the middle. Under local anesthesia, a mucoperiosteal flap was reflected and each microplate was fixed with a 6-mm microscrew between the roots of lower lateral incisors and lower canines. Following two weeks, a 0.021 in. × 0.025 in. stainless steel archwire was bent between left and right lower lateral incisors. The anterior segment was bent gingivally distal to the lower lateral incisor where it formed a hook. A ligature wire was also tied to the two-hole titanium bone plate, which was used as a hook. An elastic chain was tied between the ligature wire and the hook of the anterior segment in order to apply the orthodontic force (Fig. 3). Cephalometric radiographs were taken before and after orthodontic treatment. Mandibular plane was used as a reference plane (Fig. 4). Perpendicular distance of the tip of the lower incisor to mandibular plane was measured to find out the amount of intrusion (Fig. 4). Change in

Fig. 2. Elongation of the lower incisors because of loss of the opposing teeth.

Fig. 3. Elastic thread was used to apply 75 g of orthodontic force.

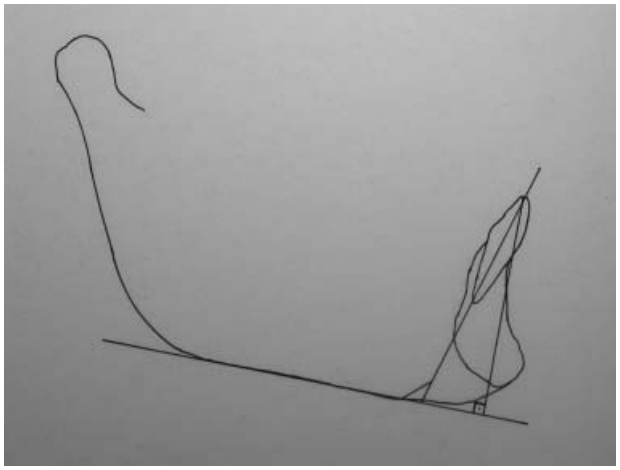

Fig. 4. Reference lines used to determine intrusion and labial tipping of the lower incisors.

axial inclination of the lower incisor was determined by measuring the angle between mandibular plane and the line connecting the tip and the apex of the lower incisor (Fig. 4). The patient was undergone maxillary segmental alveolar osteotomy under general anesthesia after intrusion of the lower incisors. Access to the anterior maxillary region was obtained by an incision made in the labial mucosa creating an anterior lingually based flap, incorporating a periosteal incision at the depth of the vestible. The flap was raised up to the alveolar crest and palatinal mucoperiosteum was left attached to the bone. An inverted 'U' shaped osteotomy line with a horizontal component parallel to the nasal floor and two vertical components parallel to the long axis of the tooth numbers 12 and 25 was created, and the alveolar bone segment was mobilized inferiorly to correct the occlusal line. A block of bovine bone graft (Surgibone®, Unilab Inc., Canada) was inserted in the osteotomy gap, and a block of autogenous bone, harvested from mental symphysis, was fixed on the buccal aspect of the alveolus using a 9-mm cortical screw to increase the alveolar width. Five months later, the ligature wires were removed together with screws and microplates. The microscrew and the bent mictoplate on the left side were left there because of the breakage of the screwhead; no complication is recorded during the follow-up period. Because of partial resorption of the graft, remaining alveolar bone width appeared to be insufficient for implant placement. Thus, the labial aspect of the alveolar ridge was grafted with xenogenic bone microchips and covered by an absorbable membrane (Gore Resolut XT®, Gore, USA). Two months after bone grafting, four ITI dental implants (narrow neck, screw-type, titanium plasma sprayed) were placed. Following an osseointegration time of 6 months, a vestibuloplasty operation was performed to eliminate the fibrous scar tissue in the labial mucosa and to increase the vestibular depth. The patient was rehabilitated with implant-supported fixed partial denture according to routine prosthetic protocol. Implants were restored with cement-retained porcelain-fused-to-metal bridge and crown (Fig. 5a,b). There have been no complications during the follow-up period of 18 months (Fig. 6a,b).

Discussion

Satisfactory dental rehabilitation of dentoalveolar trauma requires intense effort and time. Multidisciplinary approach is usually necessary to deal with complicated dentoalveolar trauma cases. The recent introduction of implants and microscrews into orthodontics has provided clinicians with reliable means of solving anchorage problems. Use of dental implants as orthodontic anchorage is troublesome for patients because of the severity of the surgery, the discomfort of initial healing, and the difficulty of oral hygiene (3). Microscrews are small enough to place in any area of the alveolar bone, even apical bone (4). The surgical procedure is easy enough for an orthodontist or general dentist to perform and minor enough for healing.

In the present case, the lower incisors were extruded to the space of the missing upper anterior teeth. Because of the severe curve of Spee and the deep bite, the treatment plan was to intrude the mandibular incisors. Cephalometric evaluation revealed that the lower incisors were proclined. An intrusive force through the center of resistance of any tooth will intrude the tooth without producing any labial or lingual rotation, which is the ideal way for intrusive movement (5). The center of resistance for the anterior teeth is located near to the geometric center of their roots. If the intrusive force is labial to the center of resistance, a moment is produced which flares the crowns labially while the roots move lingually (5). This situation can be handled by applying the vertical force lingual to the center of resistance of the anterior teeth. In particular, microscrews have been shown to produce en masse intrusion of the four anterior teeth with no loss of anchorage, thus reducing treatment time (6). In the present case, we used two titanium microscrews and microplates, placed symmetrically between the apices of the mandibular lateral incisors and canines. Therefore, the point of force application was lingual to the center of resistance of the lower incisors. After 5 months, the mandibular incisors had been intruded 5 mm with acceptable labial tipping (Figs. 7 and 8). The deep curve of Spee was corrected by bodily intrusion of lower incisors, and neither root resorption nor periodontal pathology was evident. Also, intrusion of incisors

Fig. 5. The smiling appearance of the patient before (a) and after (b) the treatment, and the intraoral view of the final restoration (c).

created adequate space for prosthetic restoration. The patient had not complained of any discomfort during the orthodontic treatment.

Fixed appliance therapy is probably the most preferred method to level the curve of Spee. Various segmented and continuous arch techniques can be recommended. It has been shown that both treatment techniques produce similar results such as incisor intrusion and proclination, and premolar and molar extrusion (7–10). It is well known that extrusive tooth movements occur far more quickly than intrusive tooth movements. Leveling of Spee is usually accomplished by extrusion of premolars and molars rather than intrusion of incisors (7, 11). Unfortunately extruded premolars and molars would tend to relapse during the later stages of the treatment or during the retention, and protrusion of incisors has also been associated with an increased incidence of relapse (12, 13). On the other hand, Reitan & Rygh (14) have stated that intruded teeth are more stable than extruded teeth. With the method presented in this article, lower incisors were intruded almost in bodily manner, and insignificant change was measured for the vertical position of the lower molars because of the fact that the lower molars were not included in the anchorage unit. Therefore, avoidance of extrusions of the lower molars and achieving significant intrusion of the lower incisor teeth as a group lead us to expect stable results. Furthermore, proper overbite and

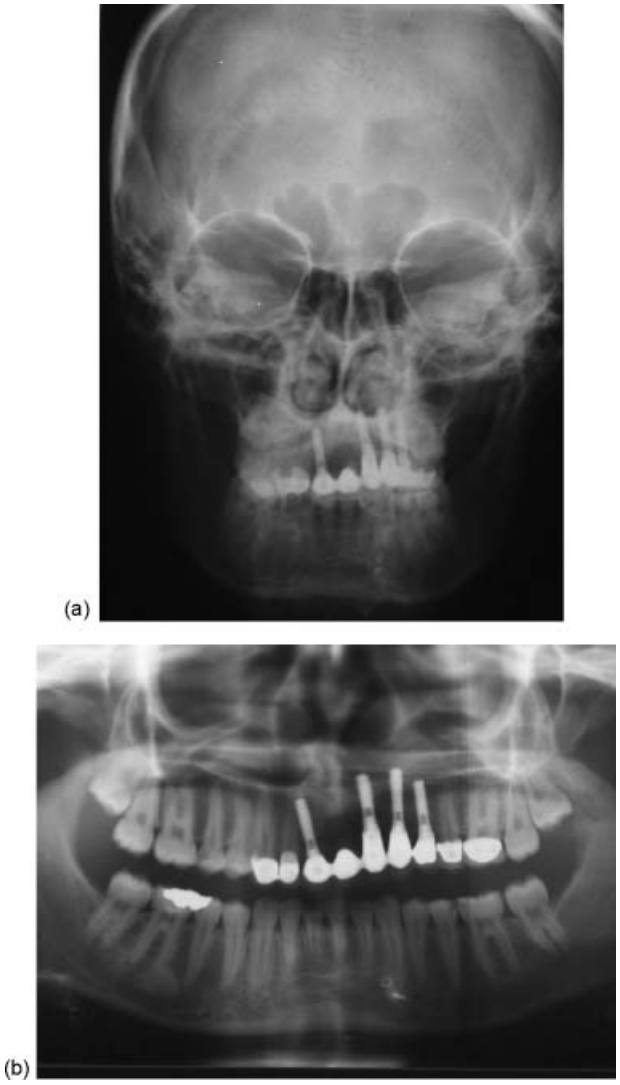

Fig. 6. Anteroposterior cephalometric radiograph (a) and orthopantomographic view (b) at the end of the follow-up period.

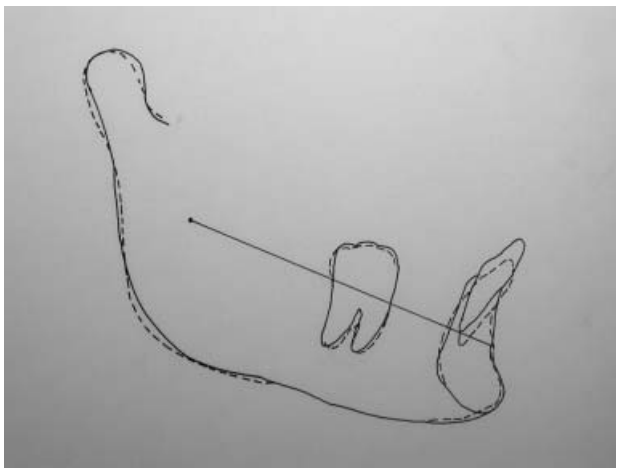

Fig. 7. Cephalometric superimposition of before-and-after treatment lateral cephalometric tracings.

Fig. 8. Lower incisor intrusion was clinically evident.

overjet relationships were established by means of the prosthodontic restoration at the end of treatment, which will prevent overeruption (or relapse) of lower incisors.

The number of the missing teeth, the pattern, and amount of the alveolar bone loss directly effects the endosseous implantation. The amount of attached gingiva and fibrous scar formation secondarily influences the treatment.

Vertical ridge augmentation using guided bone regeneration is frequently compromised by a collapse of the barrier membrane, owing to pressure of the overlying soft tissues; in order to prevent this decrease, the use of augmentation materials underneath the membrane has been advocated (15). The material used for augmentation can be osteoconductive, osteoinductive, or osteogenic (2). Autogenous bone is the preferred material because of its osteogenic activity followed by ostoeconductive property, the ability to resist soft tissue pressure and unique biologic properties (2, 15).

The inadequacy of the alveolar crest is one of the major problems in dental implantation. The insufficient alveolar height can be augmented in several ways. Costal autografts were recommended for onlay augmentation (16, 17), but long-term results showed that such onlay grafting procedures were unsuccessful because the graft was rapidly resorbing (18). Schliephake et al. (15) reported that onlay augmentation using bone particles with and without membrane coverage resulted in only a minor increase in bone height. Recently, alveolar distraction with intraoral devices has become popular (19–21). However, there are few reports regarding the long-term success rate of endosseous implants placed in the distracted bone (22).

Maxillary interpositional (sandwich) bone augmentation has advantages over onlay grafting

techniques in edentulous maxilla (23, 24). The major advantages are that interpositional augmentation does not resorb rapidly and that repositioning the maxilla is possible (23).

The treatment plan for the patient was to perform maxillary segmental alveolar osteotomy together with interpositional and onlay bone grafting following the intrusion of the mandibular incisors. Alveolar osteotomy and interpositional bone grafting was carried out to increase the alveolar bone height in the anterior region. Onlay bone grafting was also required to augment the alveolar width at the same region. Xenograft bone block (Surgibone®) and autogenous cancellous bone particles harvested from the mental symphysis was inserted into the osteotomy gap. Autograft was applied besides the xenograft to gain osteogenic activity. The application of xenograft in conjunction with autogenous bone was because of the limited amount of bone available from the gonial region and the patient's unwillingness regarding an operative donor site at iliac or costal region. As Hallman et al. (25) reported, bovine hydroxyapatite grafting together with autogenous bone has satisfactory results for endosseous implant placement after maxillary sinus floor augmentation procedures. The bone block harvested from the mental symphysis was applied on the labial aspect of the alveolar ridge and fixed with a miniscrew. We preferred to use the available autogenous bone block for onlay application to overcome the resorption problem associated with onlay grafting.

The recommended time for implantation after augmentation procedures is 4–6 months (2). Following a period of 5 months the patient was recalled for implantation but because of partial resorption of the onlay graft, the procedure had to be repeated. By means of a crestal incision and an envelope flap, xenogenic bone microchips (Surgibone®) were applied to the labial aspect of the alveolar ridge and was covered by an absorbable membrane (Gore Resolut XT®). This application provided the bone volume required for implantation. The quality of bone was suitable for implantation 2 months after bone grafting, and four endosseous implants were placed. The pressure of the overlying soft tissues is usually accused for this resorption (2, 15). This continuous force applied by the periosteum and soft tissue slowly resorbs the graft material and prevents the new bone formation.

Mechanical loading of bone is known to play a crucial role in bone remodeling and regeneration; Meyer et al. (26) in a cell culture model, showed that physiologic loading of osteoblast-like cells enhances the regenerative capacity of bone, whereas hyperphysiologic loads may impair bone regeneration. In our opinion, instead of delaying the implantation for 4–6 months following augmentation procedures, the implants could be placed after 2 months, since the grafted bone becomes stabilized and can give satisfactory support for the primary stabilization. Besides shortening the total time of treatment, early implantation may diminish the resorption rate of the grafted bone. Zhao et al. (27) reported that bone grafting around titanium alloy screw type implants with Surgibone® resulted in new bone formation along the surface of the implant following 21 days. The authors claimed that 84 days after bone grafting, newly formed bone replaced almost all of the trabecular bone of the graft and reached the shoulder level of the implant. Unlike many oral surgical applications, the soft tissue contouring can be planned before augmentation, using tissue-expanders. There are several studies on tissue-expanders between the years 1986 and 1993 reporting successful results (28–30). However, problems, including thinning of the overlying mucosa (31) and resorption of the underlying bone (32), have been reported. Although these two major problems seem to be contradictory to the idea of bone augmentation, careful application and preventing overinflation of the expanders can solve these problems (31). When there is limited space for augmentation because of soft tissue limitations, tissue-expanders could be considered to prepare the recipient site for bone augmentation (30). Subperiosteal-expanded tissue as a recipient bed for onlay grafting has been used mainly in the augmentation of atrophic alveolar ridge (32). Interpositional bone grafting in conjunction with onlay bone grafting and application of guided tissue regeneration technique offers the opportunity to improve the alveolar anatomy for implant placement in dentoalveolar trauma patients.

Conclusion

This clinical report has shown that teamwork is usually necessary for rehabilitation of most trauma patients. Interpositional and onlay grafting together with guided bone regeneration may not always improve the alveolar width and height satisfactorily. In our case, we could obtain a relatively sufficient alveolar width, but the alveolar height was not improved to the desired level; the duration of the healing period following augmentation procedures is critical. The use of titanium microplates for orthodontic anchorage is a very effective and easy method for intrusion of incisors without causing any negative side-effects such as extreme labial tipping. Dental implant-supported fixed partial dentures usually provide pleasing results for the patients.

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