Case Report

Management of Edentulous Spaces with Autotransplantation of A Tooth with Complete Root Formation Using an Interdisciplinary Approach and with A Seven-year Follow-up

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Abstract

This case report presents a successful interdisciplinary dental treatment to manage edentulous spaces in a skeletal class III case using camouflage orthodontic treatment with autotransplantation of a tooth with complete root formation, by four specialties: prosthodontics, endodontics, oral surgery, and orthodontics. The treatment plan included extraction of the mandibular left first premolar and the maxillary right first premolar as well as autotransplantation of the maxillary right first premolar into the maxillary left premolar edentulous area. The keys to success of the autotransplantation were: (1) endodontic treatment of the donor tooth prior to orthodontic tooth alignment with round wire, (2) preapplication of orthodontic force before extraction, (3) preparation of the recipient socket guided by the periapical radiograph and study casts, (4) preservation of the donor tooth in its own bleeding socket during trying in, and (5) the use of a short-term suture splint. Comprehensive orthodontic treatment was completed, with favourable results. The treatment time was 38 months. The transplanted tooth was in excellent condition for a porcelain crown restoration, but the patient declined the treatment. After seven years of follow-up, the transplanted tooth was still in good condition with no signs of inflammation, or root resorption. This article thoroughly discusses the decision making for the treatment sequence and appropriate approaches from each specialist.

Keywords: Autotransplantation, Complete root formation, Orthodontic treatment

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Introduction

Edentulous spaces, as well as mutilated dentition, are among the most challenging orthodontic conditions to treat,[1,2] because the best results necessitate close collaboration among various dental specialists, including an orthodontist. An interdisciplinary approach can be used to deliver the next level of excellence more effectively.[3] Certainly the most important role in making appropriate diagnoses and considering interdisciplinary approaches for the best outcomes is played by the orthodontist, who can envision the occlusion at the end of orthodontic treatment and the subsequent need for future prosthetic work.

Since there is a high success rate of dental implants, they are now the gold standard in tooth replacement.[4] Unfortunately, this is not an option for every patient. Orthodontic

space closure may be a viable option for many patients because it reduces the number of dental implants needed. Because teeth are occasionally extracted in orthodontic practice to correct occlusal discrepancies and become available as donor teeth, autotransplantation of extracted premolars has become one of the major therapies to replace missing or hopeless teeth, resulting in minimal tooth movement.[5-7] The biological replacement of missing teeth is possible with autotransplantation. Using the periodontal ligament, the autotransplant can be moved by orthodontic force and erupt with adjacent teeth. Autotransplantation is thought to be an effective technique for improving prognosis. Although autotransplantation is reported to have a success rate of between 63.1% and 100%,[8-11] there are some undesirable outcomes, such as dentoalveolar ankylosis or root resorption, particularly in teeth with complete root form.[12] Modern medical advances, such as a better understanding of periodontal tissue and dental pulp healing, as well as root resorption mechanisms, have recently increased the reliability and success of autotransplantation.[11,13-16] As a result, appropriate transplantation protocols are required for a better prognosis. Even if the autotransplant fails, the patient has other options for replacing the missing tooth.

This case report demonstrates successful interdisciplinary dental treatment to manage a skeletal Class III case with a hypodivergent pattern in an adult patient with edentulous spaces, using an orthodontic camouflage plan with autotransplantation of a premolar, to achieve an appropriate treatment result, by four specialties: prosthodontics, endodontics, oral surgery, and orthodontics. After the completion of active orthodontic treatment, satisfactory results have been maintained for more than seven years.

Diagnosis and Etiology

The patient, a 22-year-old female, was referred by her family dentist for evaluation and treatment of her malocclusion, with chief complaints of anterior crossbite, and missing maxillary left premolars and mandibular right first molar which had been extracted four years prior due to severe caries.

She had a straight profile. No remarkable facial asymmetry was evident. The intraoral molar relationship on the left side was Angle Class I, and the relationship on the right side could not be judged due to the missing mandibular first molar, though it was speculated to be Angle Class I. On the right side, the canines had a Class I relationship, while on the left side, they had a Class III relationship. There was also mild maxillary and mandibular crowding. The maxillary dental midline was 3.5 mm to the left of the facial midline, while the mandibular dental midline was coincident to the facial midline. On the right side, overjet and overbite were edge-to-edge, while on the left side, they were 2.0 mm. When the patient was led into a centric relationship, she displayed an edge-to-edge incisor relationship on the right side, followed by a forward mandibular shift into an anterior crossbite position, allowing the posterior teeth to occlude. The functional evaluation revealed a significant disparity between centric occlusion and centric relation, with no obvious signs or symptoms of temporomandibular disorders (Fig. 1).

Because of these findings, the patient was diagnosed with a symmetrical mesofacial type with a straight profile, an Angle's Class I malocclusion with anterior crossbite on the right side, missing maxillary left premolars and right mandibular first molar, and maxillary dental midline deviated to the left by 3.5 mm. The mandibular right edentulous space measured 10.5 mm and the maxillary left edentulous space measured 8.5 mm. In addition, the mandibular right second molar and maxillary left first molar had a mesial inclination (Fig. 2). A panoramic radiograph revealed that the third molars were developing normally. There was no significant alveolar bone resorption around the edentulous spaces of the mandibular right first molar or the maxillary left premolars, and no maxillary antrum was found in the maxillary left premolar area. Despite a mild degeneration of the right condyle, there was no restriction in mandibular motion (Fig. 3). A skeletal Class III

relationship with an ANB angle of -3.0° was revealed by lateral cephalometric analysis due to a retrognathic maxilla (SNA = 78.5°) and orthognathic mandible (SNB = 81.5°). Vertically, the patient had a low-angle tendency (FMA = 16.5°) and a normal interincisal angle (U1-L1 = 129.0o) due to maxillary incisor proclination and mandibular incisor retroclination (Fig. 4, Table I).

Figure 1 *Pretreatment facial and intraoral photographs*

Figure 2 *Pretreatment study casts*

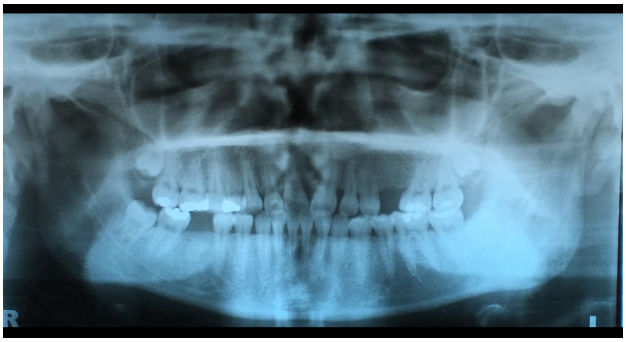

Figure 3 *Pretreatment panoramic radiograph showing missing maxillary left premolars and mandibular right first molar, mesial tipping of the adjacent molars, absence maxillary antrum, and the unerupted maxillary third molars*

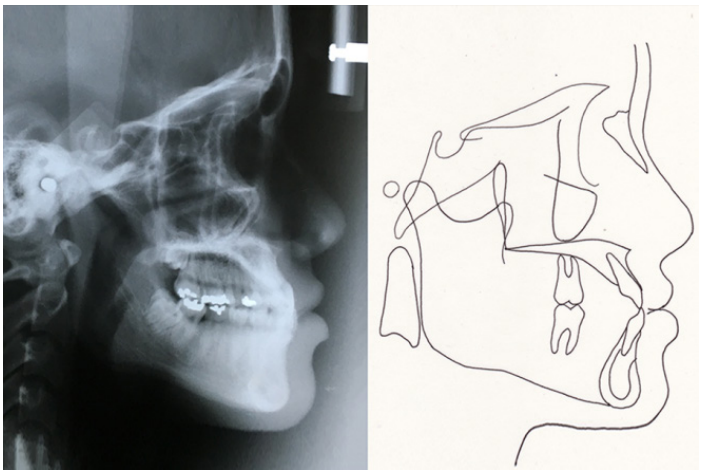

Figure 4 *Pretreatment lateral cephalogram and tracing*

Table 1 *Cephalometric measurements at pretreatment, posttreatment, and postretention*

Variable	Mean	SD	Pretreatment	Posttreatment	Postretention
Skeletal					
SNA (°)	84	3.58	78.5	79.5	79.5
SN-PP (°)	9	3.03	10.0	10.0	10.0
SNB (°)	81	3.59	81.5	80.5	80.5
SN-MP (°)	30	5.61	28.0	28.0	28.0
SN-Pg (°)	82	3.69	82.0	82.5	82.5
NS-Gn (°)	68	3.29	64.5	64.0	64.0
ANB (°)	3	2.50	-3.0	-1.0	-1.0
MP-PP (°)	21	5.25	17.0	16.5	16.5
FMA (°)	23	5	16.5	16.0	16.0
Dental					
U1-NA (°)	22	5.94	31.0	22.0	22.5
U1-NA (mm)	5	2.13	5.5	4.5	4.5
U1-SN (°)	108	6.13	110.0	102.5	102.5
L1-NB (°)	30	5.61	21.5	15.0	15.5
L1-NB (mm)	7	2.22	2.5	2.0	2.0
L1-MP (°)	97	5	92.5	91.0	91.5
U1-L1 (°)	125	8.03	129.0	142.0	142.5
Soft tissue					
Upper lip to E-line (mm)	-1.23	1.91	-4.0	-3.5	-3.5
Lower lip to E-line (mm)	1.68	2.03	0	-3.0	-3.0
Nasolabial angle (°)	91	8	97.0	100.0	100.0

Treatment Objectives

On the basis of diagnostic records, the treatment objectives were as follows: (1) to correct the anterior crossbite, to establish optimal overjet and overbite, and to maintain a normal interincisal angle, (2) to correct the discrepancy between dental and facial midlines, (3) to close the edentulous space of the missing mandibular right first molar, (4) to substitute the missing maxillary left premolars with either a dental prosthesis or autotransplantation, (5) to obtain a Class I canine relationship and establish optimal occlusion, (6) to improve the skeletal relationship by lingual movement of the mandibular incisors, and (7) to maintain he soft tissue profile.

Treatment Alternatives

Following the collection of data, dental specialists discussed treatment options with the patient, who had a Class III skeletal jaw relationship with a hypodivergent pattern and edentulous spaces on opposite sides. Orthognathic surgery was recommended for skeletal correction. To reduce the need for prosthetic restoration, orthodontic space closure could be attempted. The treatment options were as follows.

The first treatment option was orthognathic surgery combined with orthodontic treatment. Since the patient's jaw relationship was retrognathic maxilla and orthognathic mandible, with maxillary incisor proclination and mandibular incisor retroclination, orthognathic surgery with maxillary advancement was an appropriate treatment for the patient. To achieve normal inclination and correct the discrepancy between dental and facial midlines, the maxillary right premolar had to be extracted and the incisors retracted, whereas the mandibular incisors would be proclined for decompensation. Both maxillary left premolar and mandibular right molar edentulous areas necessitated tooth substitution. However, this surgical approach was rejected by the patient.

The second treatment option was non-extraction orthodontic treatment. The anterior crossbite can be corrected, an effort will be made to correct the dental midline-facial midline correspondence, and maintain the soft tissue profile. Tooth substitution was required in both the maxillary left premolar and mandibular right molar edentulous areas. The treatment alternatives for tooth substitution options were: 1) autotransplantation of the maxillary left third molar into the maxillary left premolar space, 2) dental implant with crown, 3) fixed permanent restorations from the maxillary left canine to molar, 4) removable prosthesis, and 5) space closure with a mini-implant as anchorage.

The third treatment option was camouflage orthodontic treatment. Since the amount of jaw discrepancies was not too severe, dental compensation could be introduced. Extraction of two premolars in the quadrants that had no missing teeth was possible. With complete orthodontic space closure, only one edentulous area of the maxillary left premolar would be left for tooth substitution. The treatment alternatives for tooth substitution options were: 1) autotransplantation of the maxillary right first premolar into the maxillary left premolar space, 2) dental implant with crown, 3) fixed permanent restorations from the maxillary left canine to molar, 4) removable prosthesis, and 5) space closure with a mini-implant as anchorage.

A meeting was scheduled between the dental specialist team and the patient. Following the discussion, the patient and her parents declined the orthognathic surgery option due to their fear of surgery and the high cost. To achieve the treatment goals, the patient preferred the orthodontic camouflage plan with autotransplantation. The mandibular right edentulous space was to be closed using tooth movement and the maxillary left edentulous space was to be closed by transplanting the maxillary right first premolar as a donor tooth (Fig. 6, A). The maxillary left third molar was not preferred as a donor tooth because the bucco-palatal width of the alveolar bone in the maxillary left premolar area is insufficient, the surgical procedure for preparing the recipient site is more complicated, failure is increased, and occlusion after treatment is also questionable. After consulting with the endodontist, the donor tooth was determined to be the maxillary right first premolar. Even if the treatment for the maxillary left edentulous space fails, it is critical that the posttreatment results are not worse than the pretreatment status. According

to Gary *et al.*[17], patients who had missing tooth spaces closed were significantly healthier periodontally than patients who had prosthetic teeth. This results in an advantage of autotransplantation that is superior to that from the use of implants. After the treatment, the teeth are all close together.

Treatment Progress

The treatment objectives were discussed with the patient, and informed consent was obtained. The treatment plan was indicated, with appropriate treatment sequences for each specialty (prosthodontics, endodontics, oral surgery, and orthodontics) (Fig. 5).

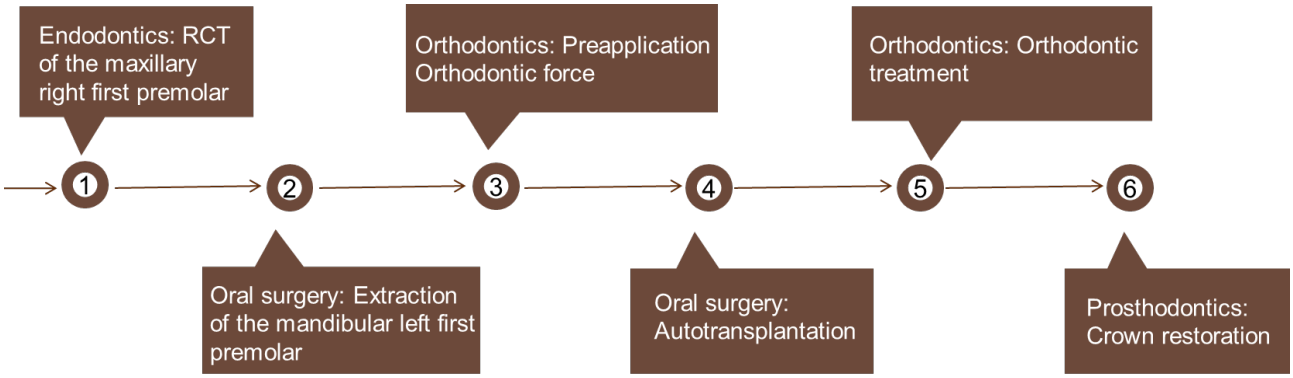

Figure 5 *Diagram of treatment sequence for each specific specialty:*

1. Endodontics: Root canal treatment (RCT) of the maxillary right first premolar to ensure root canal filling quality while avoiding periodontal tissue injury.

2. Oral surgery: Only the mandibular left first premolar was extracted.

3. Orthodontics: Fixed appliance treatment for four weeks on both maxillary and mandibular teeth, including the maxillary right first premolar, with preloading force from 0.016" superelastic nickel-titanium alloy to enhance periodontal ligament and ease extraction.

4. Oral surgery: The maxillary right first premolar was autotransplanted into the maxillary left premolar space. To achieve good adaptability with under-occlusion and avoid trauma from unintentional bite force, the periapical radiograph and study casts were used to estimate the dimensions and location of the recipient site socket. The maxillary right first premolar was extracted and gently preserved in its own socket during trying in. Non-absorbable sutures and a suture splint were used to secure the maxillary right first premolar in under-occlusion.

5. Orthodontics: To continue orthodontic treatment, a bracket was attached to the maxillary right first premolar (donor tooth). The treatment took 38 months to complete.

6. Prosthodontics: Crown replacement on an autotransplanted tooth.

The maxillary right first premolar was referred to an endodontist for one visit intentional root canal treatment. The root canal treatment included pulp removal and calcium hydroxide dressing, as well as rinsing, cleaning, and shaping root canals with sodium hypochlorite solution before root filling with gutta-percha and a sealer (Fig. 6, A and B). The left mandibular first premolar was extracted. Four weeks after the root canal treatment, both dental arches were fitted with 0.018-in slot Roth prescription pre-adjusted edgewise appliances [Tomy, Tomy International, Chiyoda-ku, Tokyo, Japan], including the maxillary right first premolar. To widen the periodontal ligament space, 0.016-in improved superelastic nickel-titanium alloy wires [Sentalloy, Tomy International] were placed four weeks before transplantation in both arches.[18] The increased periodontal ligament space also made tooth extraction easier and reduced the risk of root damage during the extraction. The patient was then referred to an oral and maxillofacial surgeon for trans-

plantation. The maxillary right first premolar was extracted with forceps and reinserted into the alveolar socket; extraction of tooth prior to preparation ensures that the tooth remains safe after extraction and leaves the remaining balance in the tooth socket to prevent PDL cells from being damaged, whereas the maxillary left premolar region (recipient site) was assessed with a periapical radiograph and study casts. The recipient site was prepared using the implant surgical kit. The donor tooth was placed into the recipient site once the recipient site was ready. To avoid excessive occlusal stimuli, the donor tooth was carefully seated into the socket under-occluded. Non-rigid fixation was used to stabilize the mucoperiosteal flap by cross-suturing between the mesial and distal interdental papillae of the transplanted tooth with a Polyamide [4-0 Ethilon®, Johnson & Johnson Ptv. Ltd., Aurangabad-MH, India] monofilament (non-absorbable suture, diameter 4-0). The occlusal surface of the transplanted tooth was then stitched with a figure-of-eight suture, also known as a suture splint.[19] Only 24-48 hours after surgery did the suture splint remain extremely tight. The suture became loose after that, but the transplanted tooth remained in the dental socket due to the formation of periodontium from blood clots. Normal healing progressed gradually, and the gingivae were eventually tightened. After the surgery, antibiotics were prescribed for a week.

The surgical sutures were removed ten days after the transplant, despite the fact that the transplanted tooth mobility was grade III. However, no evidence of gingivitis was discovered. Six weeks after transplantation, a bracket was also bonded to the transplant, the surrounding gingiva was in the same condition as the adjacent teeth, and the transplanted tooth's mobility had decreased. On the periapical radiograph, the dense white shadow around the root indicated bone repair (Fig. 6, C). After bonding a bracket to the transplant, the arch was aligned with 0.012-in nickel-titanium alloy wire to use stable light orthodontic forces while also protecting the transplanted tooth from excessive occlusal stimuli. Mesialization of the mandibular right second and third molars closed the mandibular right first molar space. The occlusion was corrected, and periapical radiographs revealed no pathologic radiolucency or root resorption; bone induction was observed around the transplanted tooth, and periodontal space was also confirmed (Fig. 6, D).

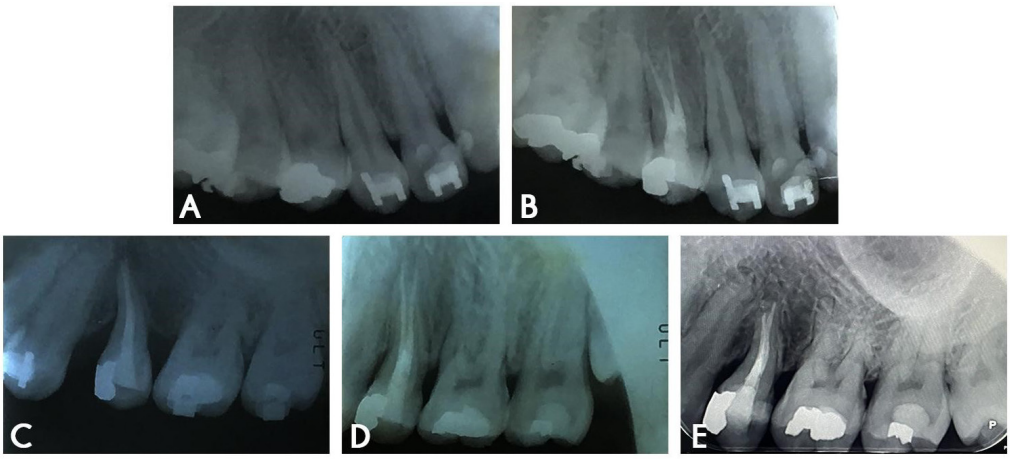

Figure 6 *Intraoral radiographs of the maxillary right first premolar (donor tooth): A, before treatment; B, after one visit intentional root canal treatment; C, six weeks after autotransplantation of the maxillary right first premolar to maxillary left premolar site; D, 2 years 11 months after transplantation; parallelism of dental roots, no pathologic radiolucency or root resorption; E, 9 years and 2 months after transplantation, the restoration and root filling are still compact, and there is a cervical one-third vertical bone defect on the mesial side of the transplanted tooth*

During orthodontic treatment, the transplanted tooth had an excellent prognosis, with no ankylosis or deepened periodontal pockets and no obvious root resorption. The brackets were removed after 38 months of active treatment. Circumferential retainers were delivered and used full-time for two years before being used only at night. The functional and esthetic outcomes were completely satisfactory to the patient. The autotransplanted tooth was scheduled for crown restoration after three months in retention. Regrettably, the patient refused treatment. However, the patient was encouraged to have the crown restoration at every retainer check-up visit, but the patient declined our recommendation.

Results

The posttreatment facial photographs revealed an acceptable facial profile, with the dental midline nearly paralleling the facial midline. Acceptable intraoral interdigitation and good occlusion were also achieved with Class I canine relationships. In the clinical photograph, there was a small black triangular space between the maxillary central incisors (Fig. 7). The spaces left by missing maxillary left premolars and mandibular right first molars were closed with autotransplantation and molar mesialization, respectively. The autotransplanted tooth's gingiva was not inflamed, tooth mobility was normal, and pocket depths were within 3 mm. To have the crown on the transplanted tooth restored, the patient was referred to a prosthodontist. Because the greatest stiffness losses were associated with the loss of marginal ridge integrity, the transplant tooth has OM cavity preparation, making it more susceptible to fracture.[20] The patient was satisfied with the outcome of the treatment (Fig. 7 and 8). Radiographs revealed parallelism of dental roots and no root resorption of the autotransplanted tooth or other teeth, but there was a slight increase in horizontal resorption of the alveolar bone (Fig. 9).

Figure 7 *Posttreatment facial and intraoral photographs*

Figure 8 *Posttreatment dental casts*

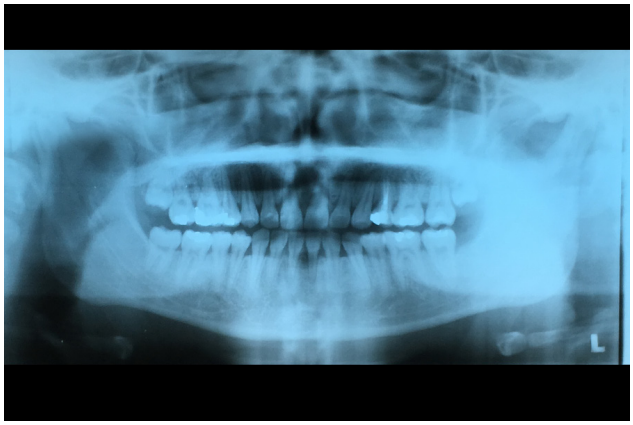

Figure 9 *Posttreatment panoramic radiograph*

Because appropriate vertical control was applied to both the maxillary and mandibular molars, by adding a reverse curve of Spee on the main arch wires, there were changes in the ANB (+2.0°) and FMA (-0.5°) but no increase in facial height in the lateral cephalometric analysis between pretreatment and posttreatment stages. Furthermore, both the maxillary and mandibular incisors showed lingual inclinations with an increase of 13.0° in the interincisal angle (Fig. 10 and 11, Table I). Moreover, both the maxillary intercanine width slightly increased by 0.5 mm between the cusp tips as a result of the corrected anterior crossbite and symmetry. According to the cephalometric superimposition, the mandibular right molars were mesialized, and the interincisal angle was increased, while the soft tissue profile indicated the lower lip lingually moved.

There were no significant changes in the facial profile or occlusion during the postretention phase, which occurred seven years and two months after the completion of active treatment. The maxillary midline shifted slightly to the right relative to the mandibular midline. The maxillary incisors were contoured with composite resin to eliminate the black triangular space visible in the postretention facial photographs (Figs. 12 and 13). The maxillary right first molar received root canal treatment, and the maxillary right third molars developed normally; however, the maxillary left third molar had supererruption, and the patient was advised to have this tooth extracted (Fig. 14). The comparison of posttreatment and postretention lateral cephalograms revealed only minor differences in the U1-NA, L1-NB,

L1-MP, and interincisal angle (Fig. 15, Table I). Following that, at nine years and two months after transplantation, periapical radiographs revealed that there was a cervical one-third vertical bone defect on the mesial side of the transplanted tooth, but clinical evaluation revealed that the periodontal condition remained good and no abnormalities were found (Fig. 6, E).

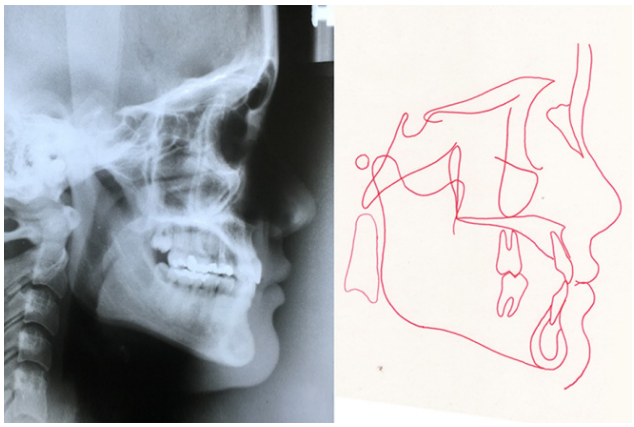

Figure 10 *Posttreatment lateral cephalogram and tracing*

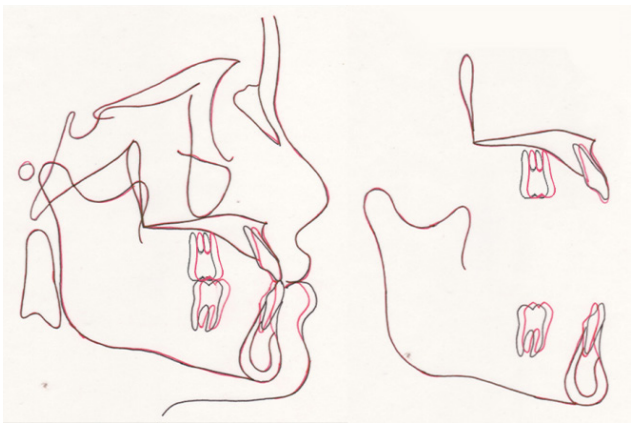

Figure 11 *Cephalometric superimpositions between the pretreatment and posttreatment stages: overall, maxilla, and mandible. The black lines and the red lines show pretreatment and posttreatment, respectively*

Figure 12 *Postretention facial and intraoral photographs*

Figure 13 *Postretention dental casts*

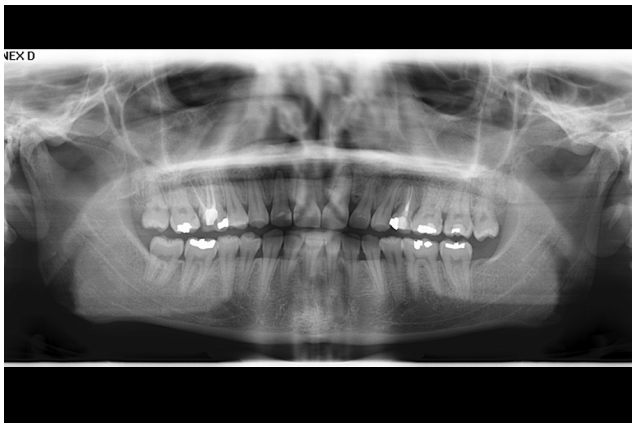

Figure 14 *Postretention panoramic radiograph*

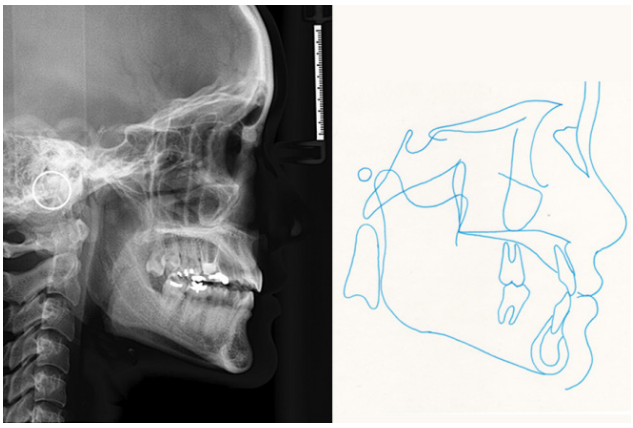

Figure 15 *Postretention lateral cephalogram*

Discussion

Although each situation necessitates a unique approach, each specialized dentist in each field must collaborate to develop the best treatment plan for the patient. However, some of the best plans may be refused by patients. This type of case, a skeletal Class III jaw relationship with edentulous spaces on opposite sides, is one of the most difficult to treat,[21] and an interdisciplinary planning approach involving orthodontics, prosthodontics, endodontics, and oral surgery was critical to the treatment's success.

Based on her jaw relationship, orthognathic surgery was the best treatment option for the patient. However, consent from the patient and parents was required, with higher costs and risks associated with the surgical procedures.[22] Furthermore, tooth substitution would have been required in two areas, one in the maxilla and one in the mandible, raising the cost of treatment and possibly necessitating additional minor surgery for implantation. Ultimately, the patient chose orthodontic treatment over surgery. This option required sacrificing the facial profile, incisal inclinations, and position. Because of her mild jaw discrepancy and adequate alveolar support, this option was viable. Aside from avoiding the risk of surgery and the additional surgical cost, this option had the advantage of requiring only one tooth substitution.

Tooth substitution or orthodontic space closure may be options for an edentulous area at the maxillary left premolar. Closure may be difficult due to the large size of the orthodontic space, which has aggravated the mechanic for correcting the skeletal Class III patient's problem. A mini-implant or intermaxillary Class III elastic

anchorage would be required with a longer treatment time. Occlusion following treatment would also be questionable, because a maxillary molar with a large occlusal table would occlude with a mandibular premolar with a smaller area.[23] As a result, we do not prefer the orthodontic space closure technique of mesializing the maxillary left molar. Although this option gives the maxillary left third molars occlude with the mandibular left second molar. Tooth replacement, whether by implant or prosthesis, would necessitate additional surgery or tooth preparation. An implant or fixed prosthesis is also more expensive than autotransplantation. Although a removable prosthesis requires little tooth preparation, the patient carries a great deal of responsibility for wearing it. Otherwise, if the patient does not wear the prosthesis frequently enough, spacing may occur.

The pulp of a completely developed donor tooth cannot regenerate, because healing of the pulp cannot be expected after apical closure.[11] Thus, if endodontic treatment is performed too late after transplantation, inflammatory resorption may develop from the infected root canal.[24] It is possible that the extraction of an endodontically treated tooth would make the tooth more likely to fracture. However, Reeh *et al.*[20] indicated that the brittleness of endodontically treated teeth and vital teeth showed no statistical difference. Endodontic procedures reduced tooth stiffness by only 5%, which is contributed entirely by the access opening. The 5% reduction in stiffness from endodontic procedures was insensitive to sequence, as the same reduction resulted in whether restorative procedures followed or preceded endodontic procedures. The *in vitro* study of Lewinstien and Grajower showed that the hardness of root dentin is not altered after endodontic treatment.[25] As a result, endodontic treatment was performed first to ensure that the root canal filling was of high quality, with no trauma to the apical periodontal tissue and no excess root canal filling. Furthermore, it is unlikely that extraction of an endodontically treated tooth will cause the tooth to fracture. For successful autotransplantation, a one-month follow-up is recommended to confirm healthy periodontal tissue.

Periodontal ligament (PDL) injuries are common during donor tooth extraction; preserving the vital PDL on a donor tooth is critical for successful tooth autotransplantation.[26] The application of orthodontic force to the donor tooth prior to extraction increased the PDL width and eased extraction,[18] which may help prevent the occurrence of denuded root surfaces due to tooth extraction, potentially leading to a reduction in ankylosis and root resorption after tooth transplantation. As a result, orthodontic preloading was used for four weeks prior to transplantation in this case. This is consistent with the findings of Nakdilok *et al.,* who found that four weeks of orthodontic preloading with 0.016" NiTi was the shortest time required to adequately enhance the PDL and facilitate tooth extraction.[27] Round wire is preferred for force application because rectangular wire may torque the root, injuring the periodontal tissue and causing hyalinization, which is not appropriate for tooth transplantation.

The procedure for tooth transplantation must be completed in under an hour.[13] Socket preparation is critical because it must fit the donor tooth well while also being wide enough to allow the donor tooth to be carefully seated into the socket under-occluded to avoid occlusal force. [Even if the opposing tooth (the mandibular right premolar) was extracted, the transplanted tooth should still be under-occluded to reduce the force from large food boluses.] The best way to evaluate socket preparation was with three-dimensional imaging, and a rapid prototyping model was used to fabricate a replica of the donor tooth,[28] which was then used for socket try-in. After the socket has been properly prepared, the donor tooth is extracted and placed in the recipient site. The periodontal tissue is thus exposed for a very brief period of time. A 3-D printed model was not available for this patient. The periapical radiograph was used by the oral surgeon to estimate the tooth length. The crown size of the maxillary right premolar in the study cast, which is larger than the root widths, was used to estimate the mesio-distal and bucco-lingual widths. As a result, the socket would be a little wider to accommodate the transplanted tooth's apical positioning.

It is critical to use an appropriate preserve storage medium when inserting the extracted tooth into the socket. Andreasen[29] concluded that saliva and physiological saline offer good protection against root resorption during the extra-alveolar period. The oral surgeon, on the other hand, decided to use the extracted socket, which was filled with the patient's blood, to preserve the periodontal ligament; the blood-filled socket could be considered superior to the aforementioned storage media.

The patient received short-term fixation. Andreasen[30] stated that mechanical stimuli, such as occlusal force, may promote PDL cell regeneration. Long-term firm fixation may have a negative impact on healing, whereas non-rigid fixation for seven to ten days stimulates alveolar ligament cell activation and bone healing.[31,32] Based on those findings, the transplant was placed slightly below the occlusal plane and secured with a suture splint, a figure-of-eight suture. The fixation period after transplantation was limited to ten days. This physiological splint may allow for some tooth movement, allowing for healing. Allowing for minor movement reduces the risk of ankylosis and has a negative impact on the periodontal healing of the tooth.[33]

One of many concerns was incisor stability due to the compromised incisal inclination. Throughout the orthodontic treatment, static and dynamic occlusion were closely monitored, and no premature contacts were observed.[34] After seven years of monitoring, the teeth were still almost completely occluded with no evidence of functional or periodontal problems. The transplanted tooth was also in great condition, with no signs of ankylosis or root resorption. Despite the fact that a permanent restoration was not placed on the transplanted tooth as planned due to patient objection, the tooth was in good condition with no signs of broken restoration or tooth fracture.

Conclusions

Autotransplantation for the management of edentulous spaces is an effective method for occlusion stability and a viable treatment option to avoid prosthetic rehabilitation or to maintain good alveolar bone condition, especially when combined with well-planned orthodontic treatment and an interdisciplinary approach.

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