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## Treatment of Congenitally Missing Maxillary Lateral Incisors: An Interdisciplinary Approach

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Dentists have several treatment options when restoring patients with congenitally missing maxillary lateral incisors. Endosseous implant therapy combined with orthodontics can achieve predictable outcomes while meeting patient expectations. This case report exhibits an interdisciplinary approach involving orthodontics, implant surgery, and prosthodontics to resolve this common dental concern.

**Key Words:** *orthodontics, congenitally missing incisor, mini dental Implants (MDI), zirconium abutments*

## INTRODUCTION

Restorative dentists and orthodontists have various treatment plan options when restoring partially edentulous patients. However, the use of endosseous implants has become the treatment of choice for restoring patients with congenitally missing maxillary lateral incisors. Endosseous implant therapy can restore such patients with an acceptable esthetic and functional outcome as well as an enhanced clinical prognosis and patient satisfaction.<sup>1,2</sup>

The orthodontic phase must achieve several clinical criteria before the initiation of the implant surgical stage.<sup>3,4</sup> The occlusion must ensure a stable posterior intercuspation with ideal overjet and overbite. The anterior edentulous area has to be created to allow for sufficient space between an implant and the adjacent tooth, thereby allowing for stable crestal bone levels and ideal dental papilla formation.<sup>5</sup> In addition, this parameter allows for the establishment of the ideal width proportion of the maxillary lateral incisor to its adjacent central incisor. This relationship is referred as the "Golden Proportion," which states that the width of the lateral incisor should be two-thirds the width of the central incisor.<sup>6</sup> Finally, orthodontic treatment

should establish parallel or divergent roots to allow adequate space for surgical placement of endosseous implants.<sup>7</sup>

The case presented in this article demonstrates a multidisciplinary approach for the treatment of congenitally missing maxillary lateral incisors. The treatment plan included the extraction of the deciduous canines and orthodontic movement of the maxillary permanent canines into the ideal position. Endosseous implants were placed and restored in the ideal lateral incisor position with cement retained crowns. In addition, a residual diastema distal to the left maxillary canine was restored with a mini-endosseous implant.<sup>8,9</sup> The treatment was completed over a 3 and a half year period, and the patient demonstrated a stable orthodontic, functional, and esthetic outcome.

## CASE REPORT

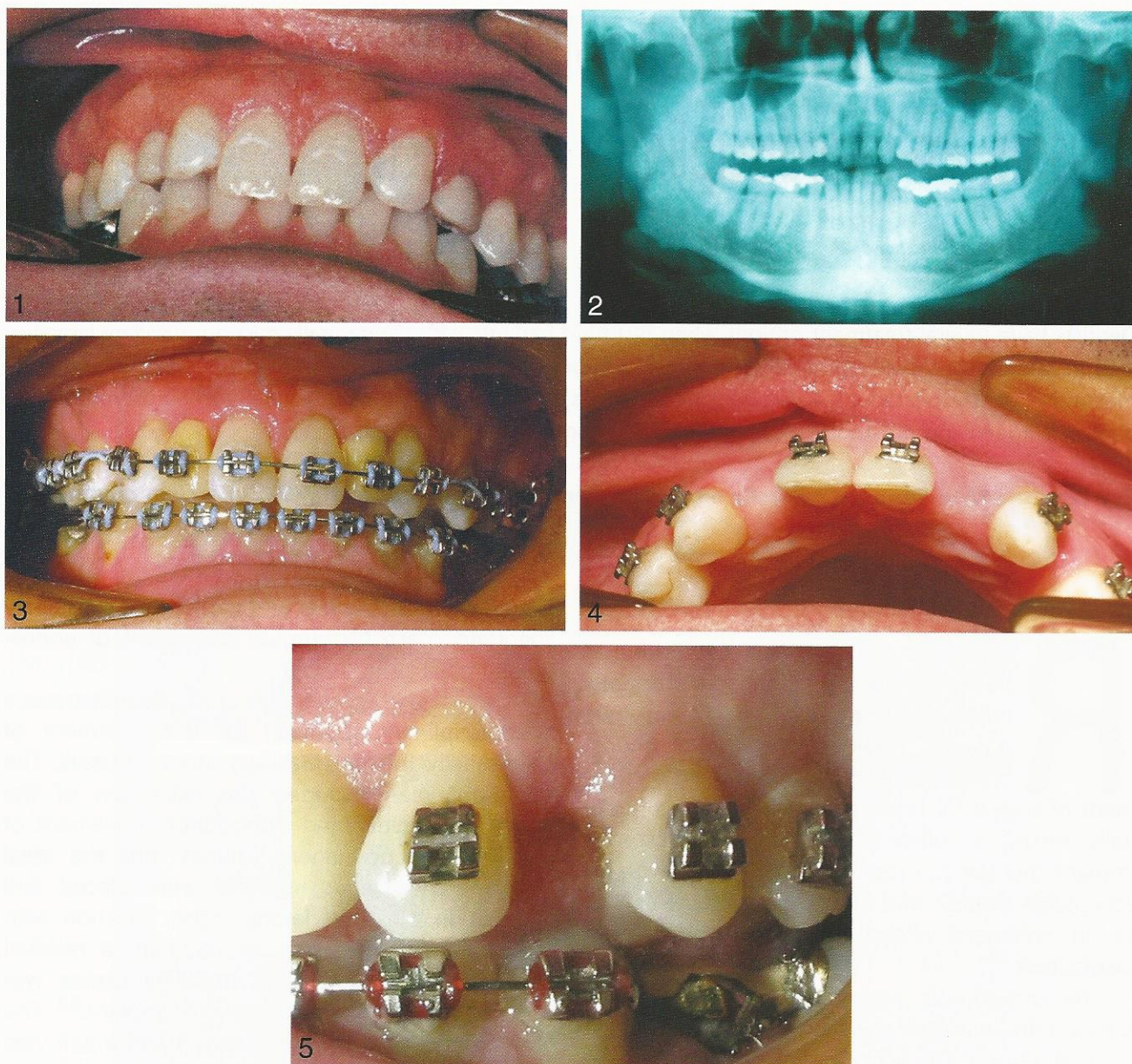
A 43-year-old man presented to our office with bilateral congenitally missing maxillary lateral incisors (Figure 1). The patient's medical history demonstrated no significant findings. The dental examination revealed permanent maxillary canines located in the lateral incisor position (#7 and #10) and the deciduous canines in the permanent canine location (#6 and #11). The diagnostic examination included a thorough medical history, dental history, diagnostic study models, panorex, cephalograph, site-specific periapicals, and photographs (Figure 2).

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**FIGURES 1–5.** **FIGURE 1.** Preoperative view of the centric occlusion. **FIGURE 2.** Panorex view of the congenitally missing maxillary lateral incisors. **FIGURE 3.** Prosthetic teeth bracketed and incorporated into orthodontic arch wire. **FIGURE 4.** Preimplant sites #7 and #10. **FIGURE 5.** Preimplant site, diastema distal to maxillary left canine.

The patient decided to proceed with the ideal treatment plan consisting of the orthodontic component. Surgical consent was reviewed and signed with emphasis on the proximity of adjacent teeth, dental papilla development, and esthetics.

#### ***Orthodontic and preimplant treatment***

Fixed straight wire orthodontic appliances were placed in both arches using mini-twin, prescription brackets with a .025 slot. Resin incisal shelves (Z-100, 3M ESPE, St Paul, Minn) were bonded on the

palatal inclines of the central incisors to disocclude the dental arches by 2 mm, thus facilitating orthodontic movement, especially distal translation of the permanent canines. Once initial leveling and aligning were achieved, the deciduous canines were removed. The sockets were degranulated with a double-ended curette and grafted with a mineralized irradiated bone allograft (Puros, Zimmer Dental, Carlsbad, Calif). The allograft was contained with a nonresorbable dense polytetrafluoroethylene (Cytoplast, Osteogenics Biomedical, Lub-



bock, Tex) barrier and 4.0 vicryl sutures. After the deciduous teeth were removed, traditional retracting mechanics were used to begin distalization of the permanent canines. Open coil springs were placed distal to the maxillary central incisors while condensing elastics extending from the maxillary first molars to the canines were used. Once 5 mm of sufficient space was achieved, lateral incisor prosthetic teeth were shaped, bracketed, and placed on the archwire in the 7 and 10 positions. The pontics were contoured so as not to impinge on the attached gingiva while establishing an enhanced interim esthetic result (Figure 3). Retracting mechanics and bracket position were modified during treatment to achieve the desired distalization of the canine clinical crowns and an ideal root parallelism. Once the mesial-distal space objective of 7 mm for the implant sites was achieved without root encroachment, the patient was transferred for the implant surgical stage. Also, during this treatment phase excess maxillary arch width and length were consolidated to allow for future implant placement of a third bicuspid in the posterior left quadrant.

#### ***Endosseous implant surgery***

The endosseous implant surgical stage was initiated when 7 mm of mesial-distal space was established between the central incisors and canines (Figure 4). The patient was prepped, draped, and asked to rinse with a chlorhexidine mouthwash for 30 seconds. Platelet-rich plasma (PRP) was prepared after a 20-mL blood draw was obtained via the left medial cubital vein.<sup>10</sup> The PRP was prepared within 10 minutes using a single spin (Clinseal, Salvin Dental, Charlotte, NC) centrifuge.<sup>11</sup>

A local anesthetic of 2% lidocaine with 1:100 000 epinephrine was administered in the buccal and palatal tissues adjacent to the maxillary lateral incisor position. A full mucoperiosteal flap with a 15C Bard Parker blade and a periosteal elevator was used to expose the alveolar crest. A surgical template was placed and osteotomy dimples were made with a #2 long shank round bur followed by the use of a 1.3-mm pilot osteotomy drill to full depth of 13 mm. A 2.3-mm and a 2.8-mm drill were used to widen the implant osteotomy. Parallel pins, surgical guides, and periapicals radiographs were used to aid with implant position and angulation. Two 3.7 mm × 13 mm MTX Tapered Screw-vent (Zimmer Dental) implants were positioned using a

fixture mount and a 2.5-mm hex tool. After a confirmation periapical, a final impression was made with a polyvinyl siloxane (Imprint III, 3M) material. The surgical site was closed using horizontal mattress sutures before PRP application. A maxillary-mandibular registration, mandibular alginate impression, and shade were performed to complete the restorative aspect of the procedure. The patient's orthodontic wire was repositioned, followed by postoperative instructions and discharge.

#### ***Laboratory aspect***

During the osseointegration period of 4 months, the commercial laboratory (Implant I, Gardali Crown & Bridge Laboratory, Utica, NY) performed several steps in the fabrication process of the final prosthesis. Zirconia abutments were designed and fabricated using computer-aided design/computer-aided manufacturing technology (Atlantis, Astra Tech, Waltham, Mass). The commercial lab fabricated abutment orientation jigs, aluminum oxide copings, and temporary crowns to be used and placed at the second-stage uncover surgery.

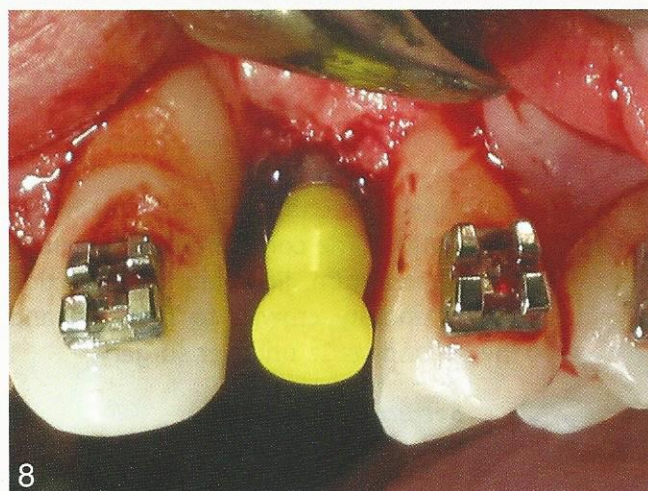
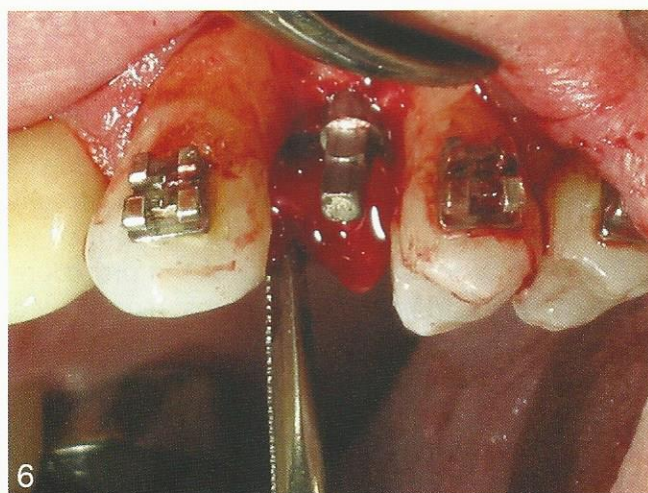
#### ***Second-stage surgery***

The patient was anesthetized with local anesthesia, and a subtraction surgical technique was used to expose the submerged implants. The cover screws were removed with a 1.25-mm hex tool, and the final zirconia abutments were placed. After orientation jig placement and a confirming periapical radiograph, the retaining screw was torqued down to 30 Nt/cm. The laboratory-processed provisional crowns were temporarily cemented with a zinc eugenol (TempBond NE, Kerr, Orange, Calif). The final shade-matching and restorative placement were scheduled to be performed after ideal tooth alignment and soft-tissue maturation was complete.

#### ***Surgical revision***

After stable orthodontic incisor stability and consolidation of excess maxillary space were established, a residual diastema existed between the left maxillary canine and first premolar (Figure 5). The space measured 5.5 mm in the mesial-distal and 5.0 mm in the buccal-palatal dimension. A 2.4 × 15 mm<sup>2</sup> collared mini-implant (3M ESPE, St Paul, Minn) was planned to resolve the edentulous space. The





**FIGURES 6–10.** **FIGURE 6.** Mini dental implant (MDI),  $2.4 \times 15$  mm acid etched. **FIGURE 7.** Alumni copings: pick-up polyvinyl siloxane impression. **FIGURE 8.** The 2.4 mm impression cap, MDI. **FIGURE 9.** Final, centric occlusion left sextet. **FIGURE 10.** Final, centric occlusion.



surgical site was anesthetized in the same manner as for the previous surgical procedures. After flap elevation, a 7-mm partial osteotomy with a 1.1-mm drill was performed. A 2.4 × 15 mm acid-etched mini dental implant was autoadvanced with a finger driver and thumb wrench to final position (Figure 6). The flap was closed with 4.0 vicryl sutures, the orthodontic wire was placed, and the patient was released.

### **Restorative stage**

The final restorative stage for the maxillary lateral incisors and the posterior mini dental implant was performed 4 months after implant placement. The final alumni copings were placed on the maxillary lateral incisor abutments, and a 2.4-mm snap impression cap was secured over the posterior squared collared mini implant. A heavy-bodied polyvinyl siloxane impression material (Imprint III, 3M) was used to pick up the aluminum oxide copings and impression cap (Figures 7 and 8). A maxillary/mandibular registration, mandibular alginate impression, and shade were performed to complete the procedure. After 2 weeks, the final all-ceramic crowns were placed with a zinc oxide phosphate cement (Flecks Cement, Mizzy, Inc, Cherry Hill, NJ) (Figures 9 and 10). The patient was evaluated 1 week after insertion to reconfirm implant occlusal principles.

### **DISCUSSION**

There are various treatment plan options for treating a patient with a congenitally missing maxillary lateral incisor. Studies have demonstrated the advantage of orthodontically distalizing the permanent canine into its proper position followed by implant placement in the maxillary lateral incisor region. A major advantage is the development of a stable residual alveolar ridge in the incisor region as the canine is orthodontically distalized.<sup>12</sup> The protocols and goals for this treatment option were clearly delineated by Spear and associates<sup>4</sup> and Kokich<sup>7</sup> in a process they termed "orthodontic site development." This treatment approach allows for a use of a conventional implant surgery technique while minimizing the need for osteotomes or onlay grafting. Also, the final esthetic result is enhanced with implant-supported lateral incisor crowns versus tooth preparation of natural canines for veneer

or crown fabrication. Finally, the permanent canine establishes a stable occlusion with a canine-guided protected occlusion. During the orthodontic phase, retracting mechanics can cause undesirable distal tipping of the canine crowns and mesial rotation of the canine roots. With modification of forces and bracket repositioning, the canine roots can eventually catch up with the clinical crowns, and root parallelism is achieved.

A positive outcome of having an adequate ridge is the ability to take a fixture-level impression at the surgical placement stage. At second-stage surgery, the final abutment and an ideally contoured provisional crown are placed to guide soft-tissue contours. The main advantage to this approach is that it affects soft-tissue healing and enhances the final esthetic outcome. After soft-tissue healing, the coping can be captured in an impression for final ceramic application. In addition, this approach expedites the fixed restorative stage by eliminating the need for a removable partial denture or prosthetic pontic bracketed to an orthodontic wire at second-stage surgery.

Research has demonstrated that the use of mini endosseous implants elicits a predictable long-term success.<sup>13,14</sup> The 1-piece, nonsubmergible design has advantages of width, strength, early biological width development, and use of simple restorative techniques. The use of a mini implant retaining a single crown can manage a space of 5 mm in the mesial-distal dimension. The smaller width allows for implant placement in the required space needed between an adjacent tooth and an implant for long-term success.<sup>15</sup> In addition, the 1-piece design eliminates the micro gap, thereby reducing the harbor of pathogenic microorganisms and screw loosening. Also, the design allows for early biological width development, which enhances stable soft and hard tissues. The snap-on impression cap is used to capture the margin of the implant platform for final restoration fabrication.

The selection of the specific type of endosseous implants was based on scientific evidence for long-term success. The mesial-distal dimension space of the maxillary incisors demonstrated an adequate area for placement of standard-size, 2-stage, submergible implants, and the premolar space allowed for a mini, 1-piece, nonsubmergible design. The 2-stage conventional implant selected in the incisor region allowed for abutment versatility with regards



to angulation and materials. A 2-piece design allows for the use of custom abutments to idealize implant angulation with relation to final crown contours. Titanium, zirconium, or gold abutments are options that can be considered with the 2-piece implant design. The mini dental implant lacks versatility in abutment selection because of its 1-piece titanium design. The nonsubmergible design is limited to a straight titanium abutment but it is strong and lacks a micro gap and retaining screw.<sup>16</sup> The final restorations for the different implant systems can be fabricated in an all-ceramic material or porcelain fused to metal material.

Implant occlusal concepts are essential for the long-term prognosis of endosseous implants.<sup>17,18</sup> The implants restored in the maxillary lateral incisors and first premolar were designed and developed with these critical concepts. The maxillary lateral incisors and premolars demonstrated zero contact in centric occlusion, protrusion, and lateral excursion. A point contact was developed on the implant-supported crowns in maximum occlusal contact. The buccal-palatal dimension of the first premolar was reduced in accordance with implant occlusal principles. This design reduces the force component on the crown, thereby reducing the stress to the crestal bone.<sup>19</sup> The final porcelain crowns were cemented with zinc oxide phosphate cement, which exhibits maximum strength characteristics in compressive and tensile properties.

### CONCLUSION

Patients that present with congenitally missing lateral incisors are a common dental concern. Although dentists can restore a partially edentulous patient with various prosthetic options, the use of endosseous implants should be considered. The synergy of orthodontics and implant dentistry can resolve this condition in an ideal manner. It is critical that dentists and orthodontists present this option to their patients to achieve an optimal functional and esthetic result.

### ABBREVIATION

PRP: platelet-rich plasma

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