



Fusion of a Maxillary Central and Lateral Incisor With a Congenitally Missing Lateral: A 10-Year Conservative, Esthetic Approach

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Abstract: Dental fusion and agenesis present unique esthetic challenges for the dental team when discovered in a developing child. This article highlights treatment of a 9-year-old girl with fusion of a maxillary central and lateral incisor with a congenitally missing lateral over a 10-year period. The article defines the developmental anomalies, provides a review of treatment options for the clinical team, and highlights clinical management using a conservative, interdisciplinary approach to esthetic treatment.

LEARNING OBJECTIVES

- discuss the difference between dental fusion and gemination
- describe the clinical problems associated with fusion and agenesis
- describe the need for a multidisciplinary and conservative approach

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AEGIS COMMUNICATIONS

Dental fusion is defined as the embryologic union of two separately developing tooth buds to form one tooth, with a confluence of dentin and/or enamel.^{1,4} The pulp chambers and canal may be joined or separate depending on the degree of development when the union occurs.⁵⁻⁷ Although the etiology is unknown, a force or physical pressure produces contact of the developing teeth that results in subsequent fusion and necrosis of the intervening tissues.^{8,9} Genes have been suggested as a cause.^{2,3,10} The extent of fusion depends on the degree of tooth development. The earlier fusion occurs, the more complete it is.^{3,9} If fusion occurs before the beginning of calcification, the union is complete, resulting in the formation of a single large tooth.¹¹

In contrast, gemination is caused by the incomplete division of a single tooth bud, which results in a complete or incomplete crown with a single root and root canal system.^{10,12} Fusion can be clinically differentiated from gemination by a reduced number of teeth in the arch, unless fusion occurs with a supernumerary tooth.^{2,5,13} A full complement of teeth is indicative of gemination, whereas one tooth less than a full arch indicates fusion.^{5-7,10,13-16} The broad fused tooth may display clinically as a groove delineating two crowns, a bifid crown, or an incisal notch,^{1,6} and geminated teeth display clinically as mirror images of the joined crown.^{4,15} Radiographically, fused

teeth tend to have a double pulpal space, while geminated teeth have an undivided pulp.^{6,14} The interdental cementum is generally absent between the fused roots.⁶

The incidence of these anomalies is more common in the primary dentition with an occurrence of 0.5% in contrast to 0.1% in permanent dentition.^{13-15,18} An investigation of 3517 plaster casts revealed 57.2% with this anomaly were fused and 42.9% were geminated.^{1,13} Dental fusion is more common in the anterior region and the mandible, and central incisors are most commonly affected, with an occurrence of 3.6%.¹² Males and females are affected at equal rates.^{6,14,13,19}

Tooth agenesis is one of the most common developmental anomalies. Agenesis occurs more frequently in permanent rather than primary teeth, with an occurrence of 1.6% to 10%, excluding third molars.²⁰⁻²² Premolars and maxillary laterals are most commonly affected.²³ Permanent maxillary laterals are absent in 1% to 2% of the population²² and account for approximately 20% of all cases of agenesis.²¹ Maxillary lateral incisors also display the highest genetic variability in the general population.²⁰

The clinical problems associated with dental fusion and congenitally missing lateral incisors are both esthetic and functional and can include a lack of arch symmetry, diastemas, malocclusion, crowding, and protrusion, as well as dental caries.^{4,11,12,14} Periodontal

problems can occur because of the presence of fissures or grooves in the union between fused teeth, and subgingival fissures can result in bacterial plaque accumulation.¹¹ Treatment in both cases requires a multidisciplinary approach.^{1,12,14,24-28}

This case report reflects the 10-year documentation of a patient with both a fused central-lateral incisor and congenitally missing lateral incisor. The conservative, multidisciplinary treatment employed to restore esthetics and function is also described.

Clinical Report

A 9-year-old girl, referred to a prosthodontic office by her pediatric dentist, presented with her mother's chief complaint: "The kids are teasing her about her big front tooth." Findings from radiographic and clinical examinations revealed fused maxillary central-peg lateral incisors, teeth Nos. 7 and 8, and a congenitally missing lateral incisor, tooth No. 10 (Figure 1 through Figure 3). An implant was selected as the ideal treatment to replace tooth No. 10 when somatic growth was complete. A diagnostic wax-up was fabricated to determine if the fused tooth could be made to resemble two teeth, using pink composite to give the illusion of an interproximal papilla. The patient was referred for an orthodontic consultation to plan for closure of the diastema between teeth Nos. 8 and 9 and achievement of proper alignment for implant No. 10. The patient was also referred to a periodontist for pretreatment assessment of the tooth No. 10 site. An endodontist was consulted should exposure of the large pulp occur during tooth preparation.

Using the wax-up as a guide, a composite restoration was fabricated for fused teeth Nos. 7 and 8 by roughening the affected area without pulpal exposure, etching the enamel, and applying primer and adhesive. Composite shade A1 was bonded to the mesial and distal surfaces, with gingival dark composite applied to the cervical "interproximal" region. The tooth was then carved to resemble two teeth, matching the width of the created tooth to tooth No. 9 (Figure 4 and Figure 5). The patient and her family were very pleased with the result, and no postoperative sensitivity was reported.

The patient saw her pediatric dentist for regular maintenance, returning to the orthodontist for yearly assessments until she reached the age of 12 years, 1 month, at which time orthodontic therapy commenced. Fixed edgewise orthodontic therapy was performed for 2 years and 7 months to create an ideal space for implant tooth No. 10, close the diastema between teeth Nos. 8 and 9, and coordinate the facial-to-maxillary dental midlines (Figure 6). When the appropriate coronal and apical mesial-distal space was created by the orthodontist for implant placement (age 14 years, 3 months), a resin-bonded retainer was fabricated for optimal stability of coronal and root position,²⁹ and cemented with a resin cement (Figure 7 and Figure 8). Also, a conventional removable retainer was delivered.

When the patient was age 17 years and 5 months, a cone-beam computed tomography (CBCT) scan³⁰ was taken that revealed she had only 4.5-mm thickness of buccal/palatal alveolar ridge. The periodontist recommended lateral ridge augmentation to provide an additional 3 mm to 4 mm to achieve a stable long-term



Fig 1.



Fig 2.



Fig 3.

Fig 1 and Fig 2. Pretreatment photographs. Patient at 9 years of age on presentation. **Fig 3.** Radiographic scan of fused maxillary central-peg lateral incisors, teeth Nos. 7 and 8, and congenitally missing lateral incisor, tooth No. 10.



Fig 4 and Fig 5. The fused tooth was carved to resemble two teeth, matching the width of the created tooth central to tooth No. 9. **Fig 6.** Fixed edgewise orthodontic therapy.

result.^{22,31} A root concavity on fused teeth Nos. 7 and 8 was also detected, which was thought to pose a complication for achievement of optimal gingival health.¹¹ Alveolar bone augmentation of the buccal ridge at site No. 10 was performed. Following 6 months of healing, the second lateral cephalometric radiograph was taken by the orthodontist to verify cessation of somatic growth.^{29,31-33} Alginate impressions were taken by the prosthodontist to construct a surgical stent,³⁴ and the final treatment plan was confirmed. As a result of the esthetic success achieved by the interim composite restoration, a lithium disilicate veneer³⁵ using gingival porcelain to restore the missing interproximal papilla was proposed for fused teeth Nos. 7 and 8. The patient also requested a veneer for the adjacent central

incisor, tooth No. 9. A ceramic implant crown and custom abutment were planned for site No. 10.

When the patient was 18 years old, an implant was placed in site No. 10 with no complications (Figure 9 and Figure 10). Three months later, a periapical radiograph was taken, the implant was torqued tested, and a healing abutment (3 mm by 4 mm by 4 mm) was placed.

Two-and-a-one-half weeks later, the prosthodontist made an open-tray implant-level impression, which was sent to the laboratory for creation of a soft-tissue model, custom abutment, provisional, and zirconia coping. The 3-mm custom abutment was inserted with a resin jig and, on verification with a periapical radiograph, torqued to 15 Ncm, according to the manufacturer's recommendation. The provisional was placed and modified following initial tissue blanching to raise and scallop the tissue, develop a proper emergence profile, and prosthetically guide the soft-tissue development.³⁴ After the screw-access hole was filled with polytetrafluoroethylene tape, the provisional was cemented by carefully painting a thin layer of temporary cement to minimize excess and meticulously checked for complete cement removal.

Following soft-tissue maturation, the desired shades with characterization were selected including the gingival shade for the pink porcelain, and fused teeth Nos. 7 to 8 and tooth No. 9 were prepared for veneers (Figure 11). Care was taken to dip into the preparation facially at the interface between the proposed central-lateral teeth, and shorten the distal-incisal to provide room for the laboratory to create the appearance of two separate teeth with a shorter lateral incisor. Retraction cord was placed for gingival displacement, the zirconia coping was inserted on the implant abutment, and

an impression of the fused teeth Nos. 7 and 8 and tooth No. 9 was made, picking up the zirconia coping (Figure 12).

When the patient was 19 years old, the lithium-disilicate veneers and the ceramic crown were tried in and evaluated. Following modification, the veneers were carefully cemented with an adhesive resin cement following application of silane to the intaglio surfaces, etch of the enamel, and application of primer and adhesive. The intaglio surface of the implant crown was treated with a porcelain etch product and silane, and the crown was cemented with carboxylate luting cement with 1 drop of water for retrievability. A paintbrush was used to apply a thin layer of cement to minimize excess. Any excess cement on the veneers and crown was meticulously removed, and the margins and occlusion were carefully checked. The patient returned 2 weeks later (Figure 13 through Figure 18) for a review of her oral hygiene and for fabrication of a nightguard. The patient was happy with the esthetic result and exclaimed she had been stopped on the street and told she had a beautiful smile.

Discussion

This clinical report describes a conservative approach to restoring esthetics, function, and occlusion in cases of dental fusion and congenitally missing lateral incisors. An interdisciplinary approach in treatment planning and execution is essential to provide the patient with optimal care.^{11,13,18,25,27,29,36}

Treatment alternatives for patients with congenitally missing lateral incisors have included orthodontic treatment with canine substitution, conventional fixed bridges, cantilevered fixed partial dentures, resin-bonded bridges, removable partial dentures,



Fig 7. A resin-bonded retainer. **Fig 8.** Palatal view. **Fig 9 and Fig 10.** An implant placed in site No. 10. **Fig 11.** Fused teeth Nos. 7 and 8 and tooth No. 9 were prepared for veneers. **Fig 12.** Impression of the fused teeth Nos. 7 and 8 and tooth No. 9.

autotransplantation, and single-tooth implants.^{26,29,31,35-37} Canine substitution can be considered in cases of angle class II malocclusion with no crowding in the mandibular arch, angle class I malocclusion with mandibular crowding necessitating extractions, and canines with similar width and convexity to the lateral incisor and similar color to the central incisor.^{22,29}

While minimal reduction is necessary for resin-bonded bridges, a shallow overbite with moderate thickness of the abutment teeth is preferable to allow a maximum surface for bonding and a reduction of lateral forces.^{31,38} Contraindications for placement of resin-bonded fixed partial dentures include mobility of the abutment teeth, parafunction, deep overbite, and proclined teeth.^{31,38} The failure rates range from 54% for 11 months to 10% for 11 years, with debonding being the most frequent cause.^{22,39,40}

A cantilevered fixed partial denture is an option using the canine as an abutment, which can be ideal given its root length and crown dimensions.³⁹ This restoration is independent of the degree of proclination or mobility of the abutment tooth, and can employ partial coverage with pins for retention and resistance if the size and location of the pulp permit. The success of a cantilevered fixed partial denture is dependent on the control of occlusal forces on the pontic, and all excursive contacts on the cantilever must be eliminated. If eccentric contact is present on the cantilever, risks include loosening of the restoration, migration of the abutment tooth, and/or fracture.^{22,31,39}

Autotransplantation of a premolar is another treatment alternative, but is technique sensitive and the timing is critical. The optimal time for autotransplantation is when the premolar root has reached two-thirds to three-quarters of its final length, usually in a patient

9 to 12 years old. This results in periodontal healing of more than 90%, with continuation of root growth after transplantation.^{22,37} Reports of autotransplantation success are 79% to 90%.^{37,38} However, any damage to the periodontal ligament can result in ankylosis.^{22,37}

The least conservative restoration is a conventional full-coverage fixed partial denture, which may be considered when adjacent teeth require full-coverage restorations because of extensive caries or fractures.^{22,31} Placing crowns on adjacent teeth for young patients in cases of agenesis is considered by many to be inappropriate if these teeth have no restorations or wear.^{21,22}

Ideally, the treatment selected to restore congenitally missing laterals should be the least invasive option that satisfies esthetic and functional criteria.³¹ Implant-supported restorations offer high success rates with a survival rate of 96.8% at 5 years,⁴¹ maintain the alveolar ridge, enhance function and esthetics, and may be regarded as the most conservative approach by leaving the adjacent teeth untouched.^{22,32,35}

When implants are selected, they should be placed only after the completion of somatic growth,^{21,22,31-34,40} which is generally finished in females at ages 16 to 17 years and in males ages 20 to 21 years.³¹ If an implant is placed and restored too early, the adjacent teeth may continue to erupt while the implant mimics an ankylosed tooth, resulting in a discrepancy in the gingival margins and the creation of periodontal, occlusal, and restorative problems.^{31-34,40} If the canine has erupted into the site of the missing lateral, distal movement of the canine through “orthodontic site development” will create adequate buccolingual alveolar width through stretching of the periodontal ligament.^{21,33,34} When the canine has not erupted into the lateral site, the osseous ridge will not fully develop.^{22,33,38} The alveolar ridge



Fig 13.



Fig 14.



Fig 15.



Fig 16.

thickness may need to be augmented to provide implant support and a stable esthetic soft-tissue framework for the implant restoration.^{27,31} The use of CBCT scans can improve the assessment of the implant receptor site, and interactive virtual treatment software enhances surgical and prosthetic treatment planning.³⁰

Many approaches have been suggested to restore cases of dental fusion to enhance esthetic display. These include extraction of the fused tooth, followed by orthodontic therapy and a resin-bonded retainer with possible future implants;¹⁶ endodontic therapy with periodontal surgery to reduce the root diameter and narrow the emergence profile, followed by a cast post and metal-ceramic crown;¹⁰ and endodontic therapy and veneering with tooth-colored and pink composite.²⁸

When the fusion involves a supernumerary tooth, treatment options have included extraction with orthodontic therapy and lateral substitution for a fused central, followed by a porcelain veneer;⁴² a mucoperiosteal flap with separation and removal of the supernumerary tooth (although this can result in gingival inflammation and periodontal pocketing); or extraction of the fused tooth, with extraoral separation and reimplantation.¹ Risks for this latter technique include periodontal inflammation and probing depth, but with a high risk for pulpal necrosis, ankylosis, and external or internal resorption.^{1,42,43} Additional treatment options have included endodontic therapy or partial pulpotomy, hemisection of the supernumerary tooth, restoration with composite, free gingival graft, and orthodontic therapy.^{1,44}

One of the challenges in esthetically restoring a broad tooth in cases of dental fusion involves replication of the missing dental papilla. Adhesive dentistry has been employed to bond pink composite cervically between the fused central and lateral incisors, followed

by closure of a diastema with composite resin and orthodontic therapy.¹³ Endodontic therapy with a labial access, followed by preparation and veneering with resin using pink composite in the gingival embrasure region, has also been used.²⁸ A metal-ceramic crown with pink porcelain in the gingival embrasure following endodontic therapy, a periodontal flap to reduce the root diameter and narrow the emergence profile, and a cast post and core have been suggested.¹⁰ Recently, application of a ceramic veneer with pink porcelain to replicate the interdental papilla and simulate the presence of two teeth has been reported.⁴⁵

The advantage of a porcelain veneer versus a less conservative approach is that it achieves excellent esthetics without extensive tooth removal.^{46,47} A minimally invasive procedure allows preservation of enamel to optimize the adhesive bond of the luting agent between the tooth and ceramic restoration.³⁵ Porcelain veneers also offer higher fracture strength because of the bond of resin cement to enamel, resulting in high survival rates with low failure rates.⁴⁷⁻⁵² Lithium disilicate provides a high flexural strength (350 MPa to 400 MPa) and excellent esthetics and can be milled using computer-aided design/computer-aided manufacturing.³⁵ In addition, the bond strength of lithium-disilicate restorations is increased when resin-luting cements are employed.³⁵

Conclusion

A conservative multidisciplinary approach has been presented to restore a case of dental fusion and a congenitally missing lateral incisor. Treatment included tooth-colored and pink composite resin to improve dental esthetics, orthodontic co-therapy, a resin-bonded retainer to maintain the space created for an implant, a series of lateral cephalometric radiographs to confirm completion of bone growth, a CBCT scan to evaluate the alveolar ridge thickness, bone graft, and implant placement. The final prostheses employing a lithium disilicate veneer using gingival porcelain to give the illusion of two teeth with a papilla and a ceramic implant crown reflect a conservative approach to improvement of the patient's occlusion, dental esthetics, and self-esteem.

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Fig 13 to Fig 16. Post-treatment photographs. **Fig 17 and Fig 18.** Post-treatment radiographs.

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- In the development of fusion, which of the following is false?
 - A force or pressure produces contact of the developing tooth buds, which results in fusion.
 - If fusion occurs after the beginning of calcification, the union is complete.
 - There is a confluence of enamel and/or dentin
 - The earlier fusion occurs during tooth development, the more complete it is.
- Dental fusion is more common in:
 - the permanent dentition than primary dentition.
 - the anterior region.
 - females than males.
 - the maxilla than the mandible.
- The occurrence of dental fusion in central incisors is:
 - 0.5%.
 - 0.1%.
 - 1.6%.
 - 3.6%.
- Aggenesis of permanent maxillary lateral incisors accounts for approximately what percentage of all cases of aggenesis?
 - 1% to 2%
 - 10%
 - 20%
 - 42.9%
- Canine substitution can be considered for replacement of missing lateral incisors:
 - in cases of angle class I malocclusion with mandibular crowding necessitating extractions.
 - in cases of angle class II malocclusion with mandibular crowding necessitating extractions.
 - when the canines have a similar width and convexity as the central incisor.
 - None of the above
- Contraindications for placement of resin-bonded fixed partial dentures include:
 - shallow overbite.
 - class III malocclusion.
 - moderate thickness of the abutment teeth.
 - mobility of the abutment teeth.
- Autotransplantation of a premolar to replace a congenitally missing lateral incisor should occur when:
 - the premolar root has reached one-half of its final length.
 - the premolar root has reached two-thirds to three-quarters of its final length.
 - the patient is 7 to 9 years old.
 - preservation of the periodontal ligament is needed.
- Implant-supported restorations offer high success rates with a rate of:
 - 90.1% at 2 years.
 - 96.8% at 5 years.
 - 98% at 5 years.
 - 98.9% at 10 years.
- Generally somatic growth is complete:
 - in males ages 16 to 17.
 - in males ages 18 to 20.
 - in females ages 16 to 17.
 - in females ages 18 to 20.
- Which of the following is not true for lithium-disilicate restorations?
 - They have a flexural strength of 200 MPa to 300 MPa.
 - They have a flexural strength of 350 MPa to 400 MPa.
 - They can be milled using computer-aided design/computer-aided manufacturing.
 - The bond strength increases when resin-luting cements are used.

Course is valid from 01/01/2017 to 01/31/2020. Participants must attain a score of 70% on each quiz to receive credit. Participants receiving a failing grade on any exam will be notified and permitted to take one re-examination. Participants will receive an annual report documenting their accumulated credits, and are urged to contact their own state registry boards for special CE requirements.

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