

CASE REPORT

ESTHETIC EVALUATION OF IMPLANTS PLACED AFTER ORTHODONTIC TREATMENT IN PATIENTS WITH CONGENITALLY MISSING LATERAL INCISORS

Abu-Hussein Muhamad¹, Abdulgani Azzaldeen², Watted Nezar³, Zahalka Mohammed⁴

¹University of Naples Federic II, Naples, Italy, Department of Pediatric Dentistry, University of Athens, Athens, Greece, ²Department of Orthodontics, Arab American University, Jenin, Palestine, ³Department of Conservative Dentistry, Al-Quds University, Jerusalem, Palestine, ⁴Postgraduate student, Program of Implantology, Gothe University in Frankfurt/Germany

ABSTRACT

Congenitally missing teeth are frequently presented to the dentist. Interdisciplinary approach may be needed for the proper treatment plan. Several treatment options exist for the replacement of congenitally missing lateral incisors. These options include canine substitution, resin bonded fixed partial dentures, cantilevered fixed partial dentures, conventional fixed partial dentures and single tooth implants. Depending on which treatment option is chosen, a specific criterion has to be addressed. Interdisciplinary treatment plays a vital role to achieve an excellent, esthetic result for a most predictable outcome. This article aims to present a case report of replacement of bilaterally congenitally missing maxillary lateral incisors with dental implants

Key words: congenitally missing lateral incisor, interdisciplinary treatment, dental implant.

Corresponding author: Dr. Abu-Hussein Muhamad, University of Naples Federic II, Naples, Italy, Department of Pediatric Dentistry, University of Athens, Athens, Greece.

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INTRODUCTION

Agenesis, the absence of permanent teeth, is a common occurrence among dental patients. The total incidence of tooth agenesis is about 4.2% among patients that are seeking orthodontic treatment^[1]; and with the exception of third molars, the maxillary lateral incisors are the most common congenitally missing teeth with about a 2% incidence.^[2] Esthetically correcting congenitally missing maxillary lateral incisors is a common challenge that every orthodontist and dental team will face, and dentists must consider the treatment options that are most appropriate for each patient. The main treatment options are: implants, resin-modified bridges (RMB), and orthodontic space closure. Not every case is suitable for each of the three treatment options, and there is a little in the literature to indicate which treatment leads to the most esthetic outcome. The objective of this study was to have orthodontists, prosthodontists, and general dentists evaluate the esthetics of treated cases utilizing one of the three aforementioned options.^[3]

The smile arc allows dental professionals to correlate the upper anterior teeth to the lower lip. If the maxillary anterior incisal edges follow the curvature of the lower lip while smiling, it is called consonant. A flat smile arc is characterized as nonconsonant. Research has shown that flatter smile arcs are less attractive.^[4] From an anterior view, the maxillary teeth should follow the guide of the golden proportion: the maxillary lateral incisor appearance in the smile should be 2/3 or 62% the width of the central incisor. The maxillary canine should be about 62% of the lateral incisor width; thus a tooth will show 62% of the tooth mesial to it in an anterior view.^[4-6] The inherent shape and proportion of the anterior teeth are other key factors that affect a patient's overall smile. Each person's anterior teeth have nuances in shape and size that affect appearance. The maxillary central and lateral incisors should ideally have a width/height ratio of 8/10 or 80%.^[4-6] Several factors may contribute to a discrepancy in these proportions. A short clinical crown height could be due to inherent tooth size, attrition, incomplete passive eruption, or vertical gingival

encroachment. The connector between the maxillary centrals tends to be about 50% of the tooth height, 40% between the central and lateral incisors, and 30% between the lateral incisor and canine. The areas incisal or gingival to the connector are called the embrasures. The embrasures are smallest between the central incisors and larger in the posterior. Gingivally, the embrasures should be filled with the papillary tissue; but if the interdental papilla is absent, an unesthetic dark triangle occurs.^[4,5] Anderson (2005) researched the different tooth shapes of male and female patients. He divided the shapes of anterior teeth into: square, square-round, and round. For female patients, general dentists preferred round incisors while orthodontists preferred round and square-round incisors. For the male patient, dentists and orthodontists both preferred square-round incisors.^[7] For patients with a congenitally missing maxillary lateral incisor, multiple factors should be considered when formulating a treatment plan. These should include available space for the crown and root, canine position, molar occlusion, smile/dental/gingival esthetics, bone quality and quantity, age, facial profile, lip posture, and finances. Whatever treatment option is chosen will depend primarily on two factors: occlusion and anterior esthetics. In the past, orthodontists thought the presence or absence of a major malocclusion was the most important factor, but with anterior esthetics as a more recent major orthodontic goal this may not always hold true. Currently, treatment planning is becoming more directed toward the importance of anterior esthetics and the position of the maxillary incisors, the best treatment may be one that provides the best esthetic outcome. Anterior esthetics and occlusion must both be considered together; since a less favorable treatment plan may be implemented if only one is considered.^[8] However, finances also factor into the decision making process and resulting treatment. Unfortunately, not every patient will follow through with ideal treatment, or any treatment at all due to monetary constraints.^[9]

The purpose of this study was to determine the best time to start preprosthetic orthodontic treatment for the single-tooth implant in order to optimize the amount of bone available and the inclination incisor.

CASE REPORT

The initial clinical exam revealed diastema, congenitally missing maxillary lateral incisors with the canines located in the lateral incisor positions,

and the primary maxillary canines still located in their original positions. These aspects created not only esthetics deficiencies but also malocclusion. Therefore, a multidisciplinary treatment was suggested to restore both esthetics and function.^[2,6,10-16]

Phase 1: Planning

All dental professionals involved in the treatment (orthodontist, periodontist, master ceramist, and operative dentist) evaluated the clinical case individually to decide which noninvasive procedures were indicated. Next, the four professionals discussed the prognosis and limitations of the case. The master ceramist performed a diagnostic wax-up to provide a model of the multidisciplinary treatment. After patient approval, the conservative treatment was then split into three restorative phase orthodontic, surgical, and restorative.^[12-16]

Phase 2: Orthodontics Fig.1a-e

Dental implants have become a common method for restoring missing teeth. However, especially upper lateral incisor implants are esthetically challenging. The orthodontic improvement of the procedure and the final attendance result of these patients can be accomplished best by positioning the remaining natural dentition in the anatomically correct location. This treatment should be closely coordinated with the implant placement and the restorative team. In cases of extensive dento-alveolar and skeletal malformations, occlusion and facial proportions additionally must be improved by orthognathic surgery and sometimes even by esthetic plastic surgery.^[2,9,16,17] The orthodontic treatment used the following parameters for evaluation: sagittal relationship between the dental arches; posterior occlusion; location, shape, and size of the canines; amount of remaining interdental space; and profile and facial skeletal pattern of the patient.^[5,6-8,11]



Figure 1a: Initial view

After orthodontic treatment was finalized, the orthodontic brackets were removed and a removable appliance was used to replace the missing maxillary lateral incisors.



Figure1b: Full thickness flaps raised - zone #7

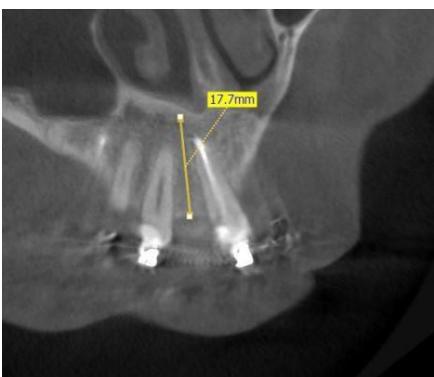


Figure1c: Full thickness flaps raised - zone #7

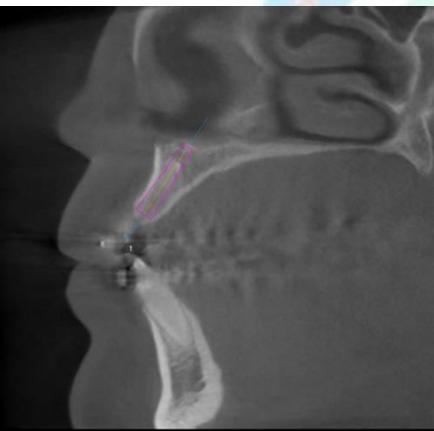


Figure1d: Virtual implant placement - zone #7

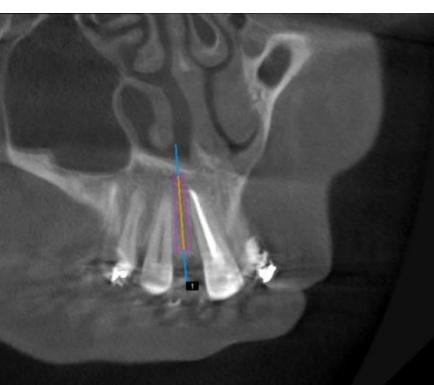


Figure1e: Virtual implant placement - zone #7

Phase 3: Surgical Fig.2-11

A more recent option for treating congenitally missing lateral incisors, and one that currently is recommended often, is the single-tooth implant. Over the past several years, the predictability and long term success rates of implants have made them an obvious restorative choice, especially when teeth adjacent to the space are healthy, of normal size and shape, and unrestored. Furthermore, placement of an implant may provide a functional stimulus to help preserve bone and prevent resorption. However, when choosing the single-tooth implant as a restorative option, several factors must be taken into account such as growth considerations, space requirements, and site development.^[2,3,15] Because an implant acts essentially like an ankylosed tooth, any vertical alveolar growth and eruption of teeth would cause a discrepancy between the gingival margin of the natural tooth and the implant. Therefore, implant placement should occur only after growth has been completed, and it has been suggested that neither chronological age nor hand-wrist radiographs are reliable enough to make that determination. Instead it would be best to compare superimposed cephalometric radiographs taken at 1-year intervals until no growth changes are detected.^[16,17] Also, the amount of space between the roots is critical to successful implant placement, and orthodontic intervention usually is necessary to achieve not only the amount of interradicular space needed, but also the proper root angulation. Because orthodontic treatment usually occurs at an early age, several years of maintenance therapy may be required until the appropriate age for implant placement. It is also important to maintain proper spacing for ideal tooth proportions of the final restoration. In addition to the tooth width requirements for mesiodistal spacing, the alveolar width in a buccolingual direction must be adequate for implant placement. Often an additional surgical appointment is necessary to graft or augment the alveolar ridge before an implant can be placed. It has been suggested in the literature that by allowing or guiding the eruption of the canines into the lateral position and orthodontically moving them to their natural position, the necessary amount of buccolingual alveolar thickness for implant placement can be achieved naturally, without the need to perform any ridge augmentation.^[17,18]

Although not completely understood, it has been shown that very little, if any, resorptive change in alveolar bone width is observed when space is opened orthodontically compared with the

decrease in alveolar ridge width after extraction of maxillary anterior teeth. However, a disadvantage of orthodontic canine distalization for implant site development is the potential for loss of arch length when the canines are allowed to erupt mesially.^[9,17-19] When agenesis of maxillary lateral incisors is diagnosed in a young patient, usually primary maxillary lateral incisors are retained. In such cases, it may be necessary to selectively extract the primary lateral incisors to encourage the permanent canine to erupt mesially, adjacent to the central incisor. The canine will influence the thickness of the edentulous alveolar ridge due to its large buccolingual width; otherwise the osseous ridge will not fully develop due to the absence of the lateral incisor.^[2,4,17,18]

As the canine is moved distally to open space for the lateral incisor implant and crown, the root movement creates an increased and adequate alveolar ridge which allows proper implant placement. However, the time of implant placement should be relative close to the orthodontic treatment. This procedure is called "Implant site development". If inadequate alveolar ridge is present, ridge augmentation may be necessary using bone grafts.^[17-19]

Adequate implant space: The amount of space needed for the implant and crown is generally determined by the contralateral lateral incisor. However, if both lateral incisors are missing or the contralateral one is peg-shaped, the amount of space should be determined by one of the methods below:

- The golden proportion or a recurrent esthetic proportion
- The Bolton analysis
- A diagnostic wax-up
- Mean values

The small size of the maxillary lateral from 5,5-8,0 mm requires careful planning for an implant to be placed. Orthodontic movement has distanced not only the crowns, but the roots of the adjacent teeth too. Generally, the adequate coronal space should be no less than 6.3mm whereas the interradicular space no less than 5.7 mm. «At least, 1.5 mm between of the implant and adjacent roots is desirable as it is cited that narrower distances between them are more likely to show a reduction in bone height over time. In addition, fixed retention is suggested rather than removable appliances to prevent relapse. crowns, but the roots of the adjacent teeth too.^[2,9-11] Generally, the adequate coronal space should be no less than 6.3mm whereas the interradicular space no less

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Figure 2a: Osteotomy performed - zone #7



Figure 2b: X ray with guide drill



Figure 3: Implant placed-zone #7



Figure 4a: Intraoral post-op Xray-zone #7

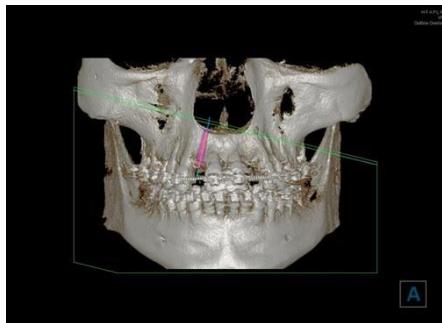


Figure 4b: 3D simulation with implant-zone #7



Figure 8b: Post-op intra-oral X ray - zone #10



Figure 5: Cover screw in place - zone #7



Figure 9: Xenograft used to augment vestibular wall deficiency - zone #10

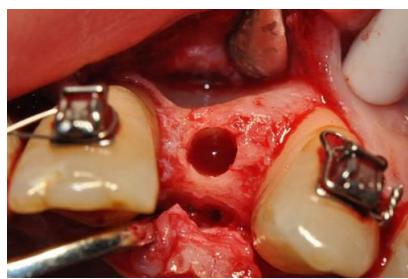


Figure 6: Full thickness flaps raised. Severe bone concavity at vestibular wall of zone #10

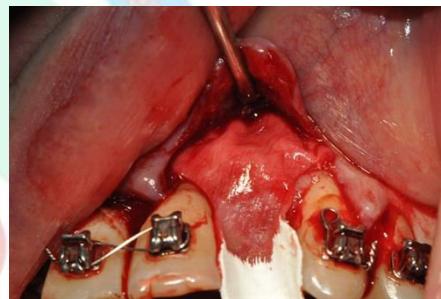


Figure 10: Collagen membrane placed to protect augmented zone - zone #10

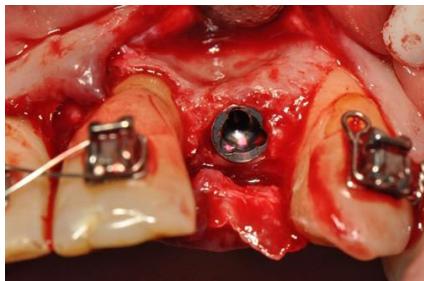


Figure 7: Implant placed -zone #10



Figure 11: Tension free flaps suturing

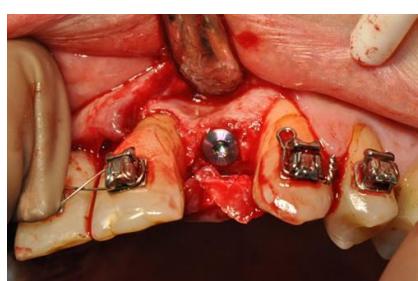


Figure 8a: Cover screw in place - zone #10

Generally, implants must not be placed until the patients have completed their facial growth and the majority of their tooth eruption.^[2,6,8,11] As the face grows and the mandibular rami lengthen, teeth must erupt to remain in occlusion. However, the implant behaves like an ankylosed tooth and will not follow the changes of the alveolar processes

due to the eruption of adjacent teeth. This may result in clinical infra occlusion of the implant supported crown and cause a discrepancy in the occlusal plane and between the gingival margins of the implant and the adjacent natural teeth. Thus, evaluation of the completion of facial growth by cephalometric radiographs must be done and subsequently, the patient should be informed for the optimal time of implant placement. However, even mature adults can exhibit major vertical steps after anterior restorations with implants to the same extend as adolescents.^[4,5,7,17]

Phase 4: Restorative Fig.12-14

Six weeks after surgery the patient returned for the restorative phase of treatment. The healing abutment on the implant was then modified to create a better emergence profile (1,2,%). This was achieved with air abrasion of the healing abutment, application of metal primer, bonding agent and flowable composite.



Figure12a: Emergence profiles created



Figure12b: Procera Zirconia individual abutments-closer view



Figure13: Procera Zirconia crowns cemented



Figure14: One year follow-up photo - upper teeth restored with composites. Soft tissues around implants is stable, Procera Zirconia crowns well integrated.

The desired effect was achieved in that the soft tissue moved in a bucco-apical direction creating a more labial emergence profile. A harmonious gingival contour with the adjacent teeth was established. It was suggested from the outset that a crown lengthening procedure on the peg shaped lateral would create a longer crown length and a more symmetrical gingival contour in relation to the contra-lateral incisor.^[4,7,8,11] The patient decided to keep treatment simple and avoid further surgery and cost.^[2]

An open tray NC impression coping was connected to the implant and verified radiographically. The 12,22 was minimally prepared for a full coverage veneer. A polyether impression compound was used to take the final impression, taking great care to record the soft tissue emergence profile. A customised final abutment was cast accordingly and torqued to 35 Ncm. The porcelain fused to metal crown was cemented with Tempbond. The Emax full coverage veneer was luted with transparent Rely-X veneer cement, and the upper Hawley retainer adjusted to fit.

DISCUSSION

Treatment options available for patients with missing lateral incisors and no other malocclusion include implants, RMBs, or even a conventional bridge. Orthodontics may not need to be a part of this procedure if the teeth are in good alignment and the lateral space is sufficient for prosthesis. Treatment of malocclusions having agenesis of one or both maxillary lateral incisors generally falls into two possible options. The space can be either opened or closed.^[4,5] If the space is opened, a prosthetic procedure is required to replace the missing tooth. Implants are becoming the treatment of choice, but resin-modified bridges (RMB), cantilevers, or conventional fixed partial dentures are still performed due to finances or because they are a less invasive procedure, or there is deficient bone volume for implants.^[8-10] If the space is

closed, the canine must be reshaped to resemble a lateral incisor, and the first premolar will substitute for the canine. This is called canine substitution.^[8-11]

There will be different esthetic demands depending on the treatment. For example, canine substitution cases may present more difficulty in achieving the golden proportions or matching the shade and shape with the contralateral lateral incisor. RMBs make it difficult to create a good emergence profile and maintain a good bony alveolar ridge. Ideally, canine substitution, RMBs, or an implant will aim for correct papilla projection, contour, and a natural zenith point. For example, a canine substitution case will require disguising the canine eminence and a higher gingival contour in the lateral site, while an implant restoration may have difficulty creating an ideal papilla projection and no gray coloring of the gingiva.^[17]

With lateral incisor agenesis and available space, implants are usually the treatment of choice. Implants are a favorable option because no adjacent tooth is prepared for restorations, and implants have a success rate of 90% over 10 years.^[10,11] Pre-implant orthodontics must leave adequate room for the implant between the adjacent roots as well as sufficient crown space. This can be achieved by using the golden proportion, the contralateral lateral incisor, a Bolton analysis, or a diagnostic wax-setup. Generally the lateral incisor site should be 5-7mm. Space between the roots of the adjacent teeth and the implant can be no less 0.75mm, with 1.5-2mm space between the adjacent crowns and implant head.^[8,9] Implants must be placed after growth cessation due to the continuing vertical growth of the jaws. If growth has not stopped, this can lead to infraocclusion of the implant with an unesthetic gingival architecture. On average boys finish growth at 21 years of age and girls at 17 years.^[10,11] After orthodontics, the adjacent roots must be maintained out of the edentulous site, and the alveolar ridge may need bone grafting in the future if the ridge narrows. The lateral incisor space will also need a temporary pontic, which is often built into a retainer or a RMB. If the implant is placed too labially, the thin buccal bone can resorb and the gingiva can appear gray in color. Poor soft tissue management can also lead to loss of papillary esthetics; the papilla distal to the lateral incisor implant can be particularly difficult to fill in the embrasure space.^[18-20] For patient's having missing maxillary lateral incisors that have been treated by RMBs, implants, or canine substitution, this research seeks to accomplish three goals.

1. To compare the opinions of orthodontists, prosthodontists, and general dentists as to which type of treatment they consider most esthetic.
2. To determine if orthodontists, prosthodontists, and general dentists can differentiate between non-restored and restored lateral incisors and identify the type of treatment provided.
3. To determine the treatment preferences of orthodontists, prosthodontists, and general dentists when planning treatment for patients with a congenitally missing lateral incisor.^[17]

For patients with a Class I molar occlusion, orthodontists and prosthodontists more often choose to place implants at a greater rate than general dentists. With Class I occlusions orthodontists prefer to maintain the maxillary lateral incisor space in order to limit the duration of orthodontic treatment. This can help minimize other orthodontic risks such as root resorption and white spot lesions. Prosthodontists place many implants and thus are probably comfortable with making the decision to place them.^[20-22]

For patients with Class II molar occlusions, orthodontists are more willing to recommend canine substitution than are prosthodontists or general dentists. With a Class II posterior occlusion, there is less room for the prosthetic replacement of the maxillary lateral incisor. Many orthodontists expressed that they often choose canine substitution in these cases even if the anterior smile esthetics and lip projection would be better if the space were opened and the missing tooth replaced in another fashion. The rationale results from the difficulty in moving the whole upper dentition into a Class I occlusion in order to obtain enough lateral incisor space. The only other way to create lateral incisor space would be to extract the first premolar, leaving molars in Class II and canines Class I. This is generally not considered an option because it requires an unnecessary extraction to place a lateral incisor implant. In a 2002 article, Savage states the importance of the molar occlusion as the 'first factor to analyze' in patients with lateral incisor agenesis.^[23-26] Orthodontists do not always agree with the general dentists and prosthodontists views on what factors are the most important for treatment planning these types of cases. It is obvious that a discussion needs to take place between dental professionals so that they understand each other's points of view. Opening space for lateral incisor prosthesis in a Class II case is difficult. All too often general dentists and

prosthodontists are not aware of the advantages and disadvantages of orthodontics. Moving the whole maxillary dentition from Class II to Class I requires a longer time in appliances with the subsequent risks such as root resorption, decalcified enamel, gingival hyperplasia, and carious lesions.^[8-11,25,26] Implant supported fixed partial prosthesis is the most conservative way of treatment because of protection of the supported teeth, preventing of the alveolar bone resorption and esthetic outcomes.^[17,20] In this case report the patients were evaluated both radiographically and clinically at each appointment. All patients were placed in a recall system comprising periodic clinical, radiographic and hygiene controls. Neither bone nor soft tissue shrinkage was visible at both implant sites.

CONCLUSIONS

- Orthodontists, prosthodontists, and general dentists equally prefer the esthetics of maxillary lateral incisor implants, the three doctor groups also ranked the esthetics of RMBs equally. Orthodontists and general dentists prefer the esthetics of canine substituted lateral teeth the same, while prosthodontists find this option less esthetic.
- Orthodontists, prosthodontists and general dentists could correctly identify the procedure preformed (implant, RMB, canine substitution, or natural) about $\frac{3}{4}$ of the time.
- For patients with a Class I molar occlusion and lateral incisor agenesis, orthodontists and prosthodontists are more likely to prefer an implant than general dentists. For patients with a Class II molar occlusion and lateral incisor agenesis, orthodontists are more likely to prefer canine substitution than prosthodontists or general dentists.
- It is the practitioner's or dental institution's obligation to explain the limits and risks of extensive orthodontic, restorative, and implant therapy to other dental professionals so all can mutually agree while planning treatment.
- It appears that with the right conditions and attention to detail each treatment category can reach a clinically esthetic result.

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