Review Article

Management of missing maxillary lateral incisor: A contemporary review

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ABSTRACT

Missing maxillary lateral incisor is the most prevalent developmental dental anomaly. The management of missing lateral incisor, either need to be closed and use canine as substitution or create space orthodontically for the prosthetic replacement of the missing lateral incisors. A careful diagnosis and treatment plan are deemed essential to address the patient's needs as the spacing is present in the esthetic region of the jaw which is very challenging so it should be managed by multidisciplinary approach including specialists in orthodontics, prosthodontics, operative dentistry and periodontist.

Space closure with canine lateralization option seems less invasive, treatment can be completed relatively in short period of time and it's adaptation with the facial changes throughout life without having artificial prosthesis provided other factors favoring for this option.

This review article describes the various treatment options and their ideal indications, contraindications, advantages and disadvantages as well as emphasize on some modifications in the treatment mechanics which is crucial to achieve the optimal esthetic and to improve the occlusion.

KEYWORDS: Canine lateralization, Missing maxillary lateral incisor, Orthodontic treatment, Prosthetic replacement, Space closure

INTRODUCTION

Variations in the form of maxillary lateral incisors are more than any other tooth in the mouth except the third molars. Maxillary lateral incisor agenesis is the most common developmental dental anomaly. Studies revealed that it's prevalence rate is more among Asians and common in female.[1,2] Prevalence of agenesis of maxillary lateral incisor among Nepalese orthodontic patients is 5.82%.[3]

There may be multiple reasons for the agenesis of maxillary lateral incisor like trauma, infection, medication, mutation of genes (MSX and PAX9) and some syndromes including ectodermal dysplasia, Down syndrome and cleft lip and palate.[4]

Patients with missing teeth may suffer from a reduced chewing ability, inarticulate pronunciation, and an unfavorable esthetic appearance that ultimately affects their communication behavior, self-esteem and professional performance (Fig.1).[5]

Fig. 1 A 21 year old female with missing maxillary lateral incisors on both sides

As the missing tooth present in esthetic region, it affect the patient's social behavior, confidence, quality of life and professional performance, hence management is very challenging and need multidisciplinary approach including specialists in orthodontics, prosthodontics, operative dentistry and periodontist. Optimal treatment results require patient's compliance, co-operation and proper team work.[6]

MANAGEMENT OF MISSING MAXILLARY LATERAL INCISOR

Management of missing teeth, especially lateral incisors, either need to be closed and use canine as substitution (canine lateralization) or create space orthodontically for the prosthetic replacement of the missing lateral incisors.

For decision making between two options, it depends on various factors like size, shape and colour of the canine, location, age of the patient, profile of the patient, smile line, arch length tooth size discrepancy, ridge thickness, existing occlusion, patient's esthetic expectation from treatment and co-operation for the treatment should be taken in to consideration during treatment planning for a balanced dentition and optimal esthetic outcomes.[7-10]

Orthodontic space opening followed by prosthesis:

When maxillary lateral incisors are missing, orthodontic space opening for future restorations is indicated if enough room is available in the maxillary arch. Patients with accentuated dentoalveolar protrusions and soft-tissue convexity are not good candidates for such procedures.[11] However, if upright maxillary incisors need to be protruded, or tipped labially, to help correct anterior crossbites or to gain upper lip support such as in patients with a cleft lip or palate then orthodontic space opening for one or both missing lateral incisors is indicated even if minimal or no space is available in the maxillary arch.

When orthodontic space opening is indicated, orthodontic treatment will maintain or establish a normal buccal occlusion (Angle's Class I), redistribute the available space, close the midline diastema, and retract and upright maxillary canines until adequate lateral incisor spaces are created for future prosthetic replacement. Teeth adjacent to the missing lateral incisor space should have parallel roots, especially if implants are considered.

The required amount of space needed for replacing missing lateral incisors is determined by two factors: The first is the esthetics of mesiodistal width between the anterior teeth. The width relationship between lateral and central incisors should follow the golden proportion: one lateral incisor is equal to two-thirds of a central incisor when viewed from the frontal side.[12] Occlusion is the second factor that affects the amount of space that needs to be created. Achieving good buccal intercuspation with a normal canine relationship, coinciding midlines, and optimal overbite and overjet relationship should provide adequate space for a prosthetic lateral incisor that is esthetically pleasing.[13]

The optimal canine substitution patient is one who has small canines with crowns that match the shade of the central incisors. Ideally, he or she should also have a nice profile, a Class II dental relationship, and no crowding in the mandibular arch. However, many patients do not meet these criteria, and multiple veneers often need to be placed on the anterior teeth to overcome the esthetic compromise that typically arises. Unfortunately, by doing this, we start to lose the conservative nature of the overall treatment. Even though veneers might be considered "conservative" and "ultrathin," they are nonetheless restorations that will need to be maintained and replaced throughout the young patient's life. There is philosophy that for patients who do not meet the specific qualifications necessary to be considered optimal candidates for canine substitution, an alternative form of treatment must be considered.[8]

Restorative treatment alternatives can be divided into 2 categories: a single-tooth implant and a tooth-supported restoration. The 3 types of tooth supported restorations available today are a resin bonded fixed partial denture (FPD), a cantilevered FPD, and a conventional full-coverage FPD. The primary consideration when deciding which option to choose is conservation of tooth structure. Ideally, the treatment of choice should be the least invasive option that satisfies the expected esthetic and functional objectives. Although any of the 3 restorative treatment options can be used to achieve predictable esthetics, function, and longevity, if a treatment option is used in the wrong patient, the final result might be less than ideal. Therefore, the orthodontist should know the final restorative treatment plan to position the adjacent teeth properly and facilitate the final restoration.[8]

Creating an orthodontic space opening for missing maxillary lateral incisors is reported to be advantageous

both functionally and occlusally, as it favors an ideal intercuspation of canines through first molars.[14] In addition, minimal equilibration and reshaping are required on sound teeth.

The major disadvantage of orthodontic space opening is that it commits the patient to a permanent prosthesis in an area of the mouth in which tooth shade, gingival contour and margins are critical and not always easy to control.[15]

Maryland bridge were subject to cementation failure, which prompted preparation modifications to improve their stability.[16] One of the limitations of bonded prostheses was the graying effect sometimes caused by the metal wings on thin, transparent, light-shaded abutment teeth. This problem was overcome recently with the introduction of the all-ceramic bridges.

Nowadays, osseointegrated implants are the most biologically conservative and most commonly used option for replacing missing lateral incisors.

When implants are part of the treatment plan, their size dictates the amount of space that needs to be opened. The standard Brånemark implant, which was designed to support dentures and bridges and was not intended to be used as a single- tooth replacement, is 3.75 millimeters in diameter.[17] The minimum interdental space needed for a 3.75 mm implant that provides optimal gingival health and sufficient bony support is about 6 mm. When the available space is less than 6 mm, placement of such an implant not only is hazardous and not healthy periodontally but sometimes is impossible.[18]

To overcome esthetic and narrow interdental space problems, esthetically oriented prosthetic components are available that either can be screwed on directly to the fixture or on an abutment, or can be cemented on an abutment that has been prepared as a tooth that is to be crowned. These components include smaller-sized fixtures of 2.9, 3.0 and 3.3 mm width. When the space is adequate and the corresponding implant size is determined, bone thickness should be evaluated. An alveolar bone augmentation procedure such as an onlay bone graft at the implant site may be needed in cases in which the alveolar crest is thin, making implant placement a two-step surgical procedure.

The appropriate time to open the space to place an implant is based on a patient's facial growth. As the face grows and the mandibular rami lengthen, the teeth must erupt to remain in occlusion. Implants cannot erupt. If an implant is placed before a patient has completed his or her facial growth, significant periodontal, occlusal (infra-occlusion), and esthetic problems can be created. The timing for implant placement after the end of growth is generally about 20 to 21 years of age for men and 16 to 17 years of age for girls.[9]

The optimal long-term management of the congenitally missing maxillary lateral incisor continues to cause controversy within the specialty. Opinions remain divided, as evidenced by the 'point/counterpoint' discussion published in the American Journal of Orthodontics and Dentofacial Orthopedics as to whether to open or close the resultant space with either a restorative replacement or canine substitution, respectively.[8,9]

In light of this, the Angle Society of Europe (ASE) meeting 2012 dedicated a day to address some of the current controversies relating to the management of these missing lateral incisors.[19]

The following considerations were thought to be important before placing implants in the anterior region:

1. Implants could be contraindicated in light of the patient's medical history and/or sustained smoking habit.
2. A 3D evaluation of the available bone using CBCT (or equivalent) was crucial.[20]
3. Await skeletal maturity.[21]
4. Orthodontic treatment delayed as long as possible, taking account of the patient's concerns.
5. Appropriate retention was important, particularly following placement of a resin-retained bridge if orthodontic treatment was undertaken 'early'.[8]
6. The presence of a gummy smile and a long face were considered contraindications to implant placement.[22]
7. The patient's sporting activity should be taken account of in planning the type of replacement. The preference was again to consider implant replacement in the posterior regions of the dentition.
8. Consider the use of a minimal length anterior implant.

Orthodontic space closure and canine lateralization:

Lateral incisor agenesis patients with an excessive gingival display in smiling, especially young ones, should not be treated with space reopening and lateral incisor implant placement. It is inconceivable that

such a technique can achieve the long-term occlusal, gingival, and periodontal results in the esthetic zone that are seen with space closure. Another important advantage of the space closure alternative is that the healthy gingival tissues and intact interdental gingival papillae will change in synchrony with the patient's own teeth over a lifetime.[23]

Closing spaces and replacing missing maxillary lateral incisors by using the canines is indicated in full-lip profiles when anterior teeth are severely protruded, or tipped labially. In such cases, opening spaces for the missing lateral incisors will make anterior teeth protrude even more, thus worsening the patient's profile and compromising the long-term stability of the end result. If the patient has a balanced profile with normally inclined anterior teeth and minimal or no space available in the maxillary arch, orthodontic space closure is indicated.

Whenever teeth in the mandibular arch need to be extracted for orthodontic reasons such as severe crowding or protrusion then the orthodontic space closure by using canines to replace missing lateral incisors is indicated in the maxillary arch.

The indications for space closure are summarized by Rosa & Zachrisson:[7,23]

- A tendency toward maxillary crowding
- A well-balanced profile and normally inclined incisors
- Canines and premolars of similar size
- Dentoalveolar protrusion
- Class II molar occlusion
- Mandibular crowding or protrusion.

Mesial drift of the canines during eruption frequently takes place, and this may represent an additional indication because the distribution of spaces may prevent replacement of lateral incisors by restorative methods. If orthodontic measures need to be initiated anyway, spaces may just as well be closed by mesial movement of teeth.[15,23]

If only one lateral incisor is missing, removal of the contralateral incisor that is present may sometimes lead to improvement of the final result. The indications for extraction may include peg-shaped and diminutive teeth, severe crowding, and improved prognosis for obtaining symmetry and coinciding midlines. If the lateral incisor present is of, or can be made to, acceptable size and shape, unilateral space closure may be attempted.

Treatment planning for maxillary lateral incisor orthodontic space closure should include a trial diagnostic setup, which consists of cutting teeth on the plaster model without altering their mesiodistal width and then repositioning them with sticky wax in the desired position position. This trial diagnostic setup helps identify any tooth-mass problems and the amount of tooth reshaping and interproximal reduction needed for a functional and esthetic result.[15,24]

Canine lateralization procedure

For optimal esthetic and functional results in orthodontic space closure, canines need to be transformed to better resemble and function as lateral incisors.[15,25] To produce a flat incisal edge, there are three possibilities, all of which depend on the gingival level and the overall shape of the canine: flatten the tip of the canine by trimming it, create composite buildups at the mesial and distal angles, or use a combination of both the first and second options. If the gingival level of the canine initially is apical, it will have to be extruded orthodontically, and extensive cusp-tip trimming will be necessary.[26]

The amount of extrusion and occlusal trimming is limited by the inclination of the canine's palatal aspect. When it occupies the lateral incisor position, the canine's greater labiolingual dimension will interfere with the lower incisors. Therefore, composite buildups, rather than extensive occlusal and palatal trimming, will have to be done, leaving a more apical gingival level on the future lateral incisors in some cases.[13] While this is acceptable if the patient's smile line is low, it can be esthetically unpleasant in gingival smiles.[15]

Reducing canine width through proximal grinding also should be performed. The central incisors' size and the diagnostic setup will dictate the amount of proximal reduction needed. On average, canines are 1.2 mm wider than the lateral incisors they are replacing.[15,27] Therefore, canine proximal reduction generally is not extensive and should be accomplished at the expense of the more bellshaped distal surface.[28] On the other hand, smaller maxillary first premolars partially offset the width difference between the canines and the lateral incisors they are replacing.[15] Canine proximal reduction can usually be accomplished in a single visit, preferably at the beginning of orthodontic treatment. If canines are in contact with neighboring teeth, canine proximal grinding can be done later through treatment when access to proximal surfaces is easier.[7]

Canine palatal enamel is reduced throughout orthodontic treatment whenever prematurities with the lower incisors are detected. Flattening the canine labial surface is deferred until orthodontic treatment is completed. This allows for better bond strength of the orthodontic bracket during treatment.[24] Canine labial surfaces should be reduced with care, as the procedure can result in a yellower or grayer tooth.[29]

Clinical and histologic human studies have shown that fairly extensive dental grinding can be performed without significant discomfort and with minor or no pulp and dentin reactions. Long-term observations indicate that any unfavorable reactions are temporary.30 Gentle grinding techniques using diamond burs and abundant cooling water are recommended, followed by paper disk and pumice polishing and topical fluoride applications.[7,30]

When replacing missing lateral incisors by using the canines, mesial rotation of the maxillary first premolars should be done for esthetic reasons. This will favor a better contact point and camouflage the premolars' flat mesial surfaces.[14,30] First premolars should be extruded relative to the adjacent teeth to simulate canines. Grinding of the palatal cusps also is recommended to avoid interferences during lateral movements.[31]

The most common error in maxillary canine lateral incisor substitution cases is inadequate palatal torque of the relocated canine.[30] Although proper bracket selection can improve the canine torque, there is some disagreement regarding which bracket to choose. The choice of bracket for a relocated maxillary canine should be based primarily on two factors: the palatal torque and the shape of the bracket base.[32]

In this type of case, inverted MBT canine brackets on the canine to deliver +7° degree labial crown torque that matches nearly with the torque of lateral incisor on contralateral side. The cases which requires maximum labial crown toque of +17° can be achieved by using the inverted lower second premolar bracket. Advantage of using these techniques is that prior enameloplasty is not needed as the bracket base matches the surface contour of the tooth.

Other variations can be the use of lateral incisor bracket on the canine to provide +10° crown torque on the canine and central incisor bracket on the canine to provide +17° crown torque on the canine but it requires prior enameloplasty on the canine to seat the bracket properly, as the central or lateral brackets have flat bases.

The major advantage of orthodontic space closure is the permanence of the finished result. The need for removable retainers until the prosthesis is completed and patient dependence on a permanent restoration is avoided.[29,30] At the end of orthodontic treatment, the overall treatment is completed and the result is permanent.

The tendency of the space between the anterior teeth to reopen is the major disadvantage of space closure. 38 This can be overcome with long-term fixed retention using a palatally bonded multistrand wire on the central incisors and canines when occlusion permits.[24]

Canine-protected occlusion is not feasible with orthodontic space closure. As a result, the forces generated through canine guidance are placed on the smaller and thinner roots of the first premolar.[18] Some investigators fear loss of periodontal attachment due to the stress placed on the premolars.[28] Long term periodontal and occlusal studies, however, have shown that space closure is equally sound occlusally and is preferable periodontally to orthodontic space opening.[28]

Orthodontic space closure in unilateral lateral incisor agenesis can pose a matching size or shape problem. The canine replacing the missing lateral incisor will not be in harmony with the existing lateral incisor. Extraction of the existing lateral incisor has been advised for symmetry, especially when it is peg-shaped.[24]

In a few cases, poorly formed or extremely large canines cannot be adequately shaped into lateral incisors. Dark-shaded canines also will be esthetically unpleasant when positioned proximally to central incisors. Reshaping procedures, bleaching, composite buildups, veneers or all-ceramic crowns should be able to compensate in these particular situations.[24]

Orthodontic space closure of missing upper lateral incisor with canine lateralization can produce excellent long-term treatment results by performing the optimal torque control, differential intrusion of the first premolars and extrusion of the canines, gradual grinding of the canine cusps and buccal curvature, bleaching, minor surgical procedure for crown lengthening and additive reshaping of the six anterior teeth using either ceramic veneers or composite.[7,23,33,34]

Space closure treatment considered to be less invasive, to be finished within a relatively short period of time after orthodontic therapy, and achieved dentition can adapt with the continuous facial changes over the patient's life.[19]

In patients with missing teeth in the anterior maxilla, orthodontic space closure constitutes an effective treatment option: evidence-based, and most appropriate for ensuring periodontal health in the long-term. This approach is nowadays feasible in all malocclusions as the first step of an interdisciplinary approach, which aims not only at an optimum esthetic and functional result, but moreover at reducing the invasiveness of subsequent prosthodontic treatment. Therefore, space closure should be considered the first alternative in growing patients and when the gingival margins are visible.[35]

Even if the advent of osseointegrated implants has reduced the popularity of the orthodontic space closure alternative, there are still at least 3 major reasons to consider space closure the most adequate option:[5]

1. From a biologic, esthetic, and periodontal perspective, a tooth or a root is superior to any foreign body, and the possible negative side effects during life are minimal.
2. If orthodontic treatment is anyhow indicated for correction of spontaneous tooth migration, overall treatment time is shorter with a cost benefit ratio superior to all existing alternative approaches. This is especially interesting when treating growing patients and young adults.
3. Orthodontic space closure is an evidence-based, long-term-effective treatment approach, which:

- Produces results well accepted by the patient;
- Does not impair TMJ function;
- Encourages periodontal health; and
- Has proven not to affect function due to a different occlusal outcome than Class I canine relationship.[30]

After space closure, smile esthetics are suboptimal, even if reshaping of the mesialized canine has been performed. Apart from a tendency for space-reopening, the periodontal profile is altered, the canine appears too yellowish, and the premolar is undersized for an adequate substitution of the mesialized canine. In order to overcome those limitations, a new method was introduced to finalize orthodontic space closure and to optimize the overall esthetic outcome.[22,33,34]

The key aspects are:

1. Space closure with correction of the malocclusion.
2. Orthodontic extrusion of the canine and intrusion of the first premolar to level the gingival margins correctly.
3. Concomitant detailed torque control during extrusion and intrusion to maintain the roots within the bony envelope.
4. Minor restoration and vital bleaching of the mesialized and extruded yellowish canine.
5. Restoration and enlargement of the intruded first premolar for mimicking esthetics and function of a natural canine.
6. Restoration of the central incisors: not only of the lateral incisor substituting a missing central incisor, but also in patients with congenitally missing lateral incisors, because their entire maxillary dentition is undersized.[36]
7. Localized gingivectomy and periodontal surgical recontouring for selected patients.[34]

CONCLUSION

The choice of treatment option in patients having missing maxillary lateral incisor depends on various factors that needs careful treatment planning with multidisciplinary approach as the space is present in the esthetic region of jaw. Advantages and disadvantages of both treatment modalities and the various options for prosthetic replacements in an orthodontic space opening should be discussed with the patient. Space closure with canine lateralization option seems less invasive, treatment can be completed relatively in short period of time and it's adaptation with the facial changes throughout life without having artificial prosthesis provided other factors favoring for this option.

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