

SUCCESS OF ORTHODONTIC SPACE CLOSURE VS. IMPLANT IN THE MANAGEMENT OF MISSING FIRST MOLAR: SYSTEMATIC REVIEW

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ABSTRACT

The purpose of this systematic review was to determine the efficacy and success rates related to the use of orthodontic closure and dental implants to replace missing first molars. The preferred reporting items of systematic reviews and meta-analyses (PRISMA) framework were used to present the findings of the studies considered in this paper. A total of 32 articles were excluded because of duplication. The remaining articles were reviewed, including their abstracts as well as their full texts to determine their eligibility for this systematic literature review, whereby 8 of them were selected because they met the inclusion criteria. Three studies were used to present support for the orthodontic closure, whereas five studies were included to offer support for implants for the replacement of the missing first molar. Dental implants seem to be a better choice of treatment as compared to orthodontic closure as it does not involve the other teeth around the missing tooth, which is the case with orthodontic closure which entails complete dentition.

Key words: Space closure, Implants, Orthodontics, First molar.

Introduction

First molars are one of the most important teeth in the oral cavity [1-3]. Missing the first molar makes chewing food more difficult, as one can imagine. Foods such as crunchy vegetables, fruits, and other tough foods may be difficult to eat. When this happens, you need to have replacement options available [4].

The first molars erupt in the mouth when an infant is thirteen to fifteen months old and play an important role in maintaining proper arch shape and occlusal patterns. The anterior teeth usually decay first, and adult patients generally require dental crowns to restore the integrity of their teeth and replace previous large restorations [5, 6].

Dental implants can be used to replace missing first molars for patients. A dental implant is a replacement tooth root surgically inserted into your jawbone. Implants work similarly to natural roots when in place. In addition to supporting dental crowns and bridgework, dental implants can also support full dentures. Patients will generally eat again after tooth loss and have an improved smile aesthetic. Because the dental implant needs to fuse with the jawbone, the entire treatment is expected to take several months. Osseointegration is the process of fusing the dental implant. An implant can help replace multiple teeth (say molars and premolars) in a row if a few of them are missing. Usually, a

denture will be the best option when a patient misses most of their teeth. We can go into more detail about these options during a consultation [7, 8].

Space closure is one of the most complicated orthodontic procedures, as it requires a thorough understanding of biomechanics to prevent undesirable effects. Clinicians can better determine anchorage and treatment options when they understand the biomechanical basis of space closure. Though there are a variety of appliance designs, space closure can be accomplished with either friction or frictionless mechanisms, each with its advantages and disadvantages. Sliding mechanics or friction mechanics are popular due to their simplicity. An orthodontic solution for missing molars involves closing or opening up the space. A thorough assessment of the case must be conducted before treatment to ensure the benefits of the treatment will outweigh any potential risks associated with the treatment [9, 10].

In some cases, space closure remains the best option, particularly for children whose prosthetic rehabilitation continues to be problematic and should be delayed until the growth and eruption process has been completed. It is necessary to consider adult patients' biological and psychological characteristics to achieve desired outcomes. Among other factors influencing the decision-making process are concomitant malocclusions, the third molar

development, and the presence or absence of other teeth. The goal of orthodontic treatment is to attain the patient's expectations by applying reasoned biomechanical principles [11, 12].

Numerous side effects are associated with the uncompensated absence of molars, which complicates the treatment in most cases. Managing these cases can sometimes be challenging. The key is to prevent these cases and treat them early through multidisciplinary management. It mostly depends on the eruption of the first molars in both arches when the first molars are prematurely lost [13].

In addition to the posterior effects, the mandibular arch length may also be compromised by a distal and lingual shifting of anterior teeth toward the side where the first primary molar teeth are lost. Therefore, the absence of a first primary molar in either arch, which approximates the eruption of the first molars, suggests using a space maintainer to stabilize the positioning of the second primary molars and canines. During balanced occlusion, the first permanent molars play an important role. Due to dental caries, the first molars are lost, negatively affecting both arches and occlusion [14].

It has been suggested that early extraction of these teeth leads to tilting of neighboring teeth, super-eruption of teeth on the opposite side of the mouth, unilateral chewing, shifts in the midline, and malocclusions of teeth. The early loss of first molars also causes periodontal problems. Parental neglect of this tooth is common as it is viewed as temporary. Due to its deep pits and fissures, the first molar is considered the most decay-prone tooth in the permanent dentition. That is why it is so important to make every effort to save this tooth if it has decayed. There is no cure for prevention! [15].

Literature review

Various treatment options are presented in the literature review for the loss of first molars. Since teeth and their periodontal genetic structure can be preserved using an auto transplant, no artificial materials are necessary; however, the procedure may expose the patient to surgical trauma, root resorption, infection, and ankylosis with variable success rates. These patients may also benefit from a fixed prosthetic solution, but there are certain limitations, including cost, partial abrasion of the basic tooth structure, secondary Mechanics errors, and decay. Several patients choose implants. Dental implants are recommended for patients with missing teeth or adequate bone density around the tooth loss area. Ensure that they are in good health overall and will not have any severe health complications following oral surgery [16].

The tooth can be replaced with a single dental crown in cases where only one first molar is missing. In more extensive cases, there are various options to consider [17].

The orthodontic repositioning of neighboring teeth provides an alternative solution for the loss of first molars; this alternative eliminates the need for implants or prosthetics and the trauma and cost associated with their installation. Furthermore, if other orthodontic problems need to be corrected, the treatment will have a minimum amount of additional time [18].

During the closure of extraction spaces, exact control of orthodontic movement plays an important role in orthodontic mechanics, including axial tipping and rotation, and anchorage units. It is possible to generate different moments with the segmented arch technique to result in the desired force system based on the clinical scenario. Equal and opposite moments are created with negligible vertical forces when the T-loop is positioned in the center. Decentralized T-loops generate a higher root translation/movement of the segment close to them, while the distant component is tipped in the direction of the extraction area [19].

The protraction of the second lower molar into the area of the atrophic bone crest also resulted in the space closure between the lower first molars. The incisors and second lower molars were protracted simultaneously using a modified helical loop in a 0.018 x 0.025 mm continuous arch. At the end of this orthodontic treatment, no areas of bone dehiscence/fenestrations or root resorption were observed, even though there was a certain amount of vertical bone loss before tooth movement because the first lower molars were lost so early. Other authors have reached similar conclusions [20, 21].

From this case, it is pertinent to note the final positioning of lower roots. As a result of some tipping of the second molars as the space was closed, their last position was not vertical. Instead, the teeth were angled toward the secure area. In general, root parallelism is considered an important goal for long-term stability in orthodontic treatment. Despite the nonparallel roots at the end of the treatment, teeth positions remained stable for six years, as documented by the six-year follow-up record [20, 22].

Aims of the study

The purpose of this systematic review was to determine the efficacy and success rates related to the use of orthodontic closure and dental implants to replace missing first molars.

Materials and Methods

Study selection

The preferred reporting items of systematic reviews and meta-analyses (PRISMA) framework were used to present the findings of the studies considered in this paper. The articles reviewed in this paper were located online after performing a literature search through different electronic databases, including Cochrane Library, Web of Science, and PubMed. The search yielded a total of 112 relevant articles

as shown in **Figure 1**. A keyword strategy was used to increase the chances of identifying the most relevant articles with studies linked to the topic. The most important keywords and phrases that were used include “Orthodontic space closure”, “Implant”, “missing the first molar”, and “replacing the first molar”. This was followed by a review of the titles of the identified articles to determine their relevance to the topic of the research. A total of 32 articles were excluded because of duplication as shown in **Figure 1**. The remaining articles were reviewed, including their abstracts as well as their full texts to determine their eligibility for this systematic literature review, whereby 8 of them were selected because they met the inclusion criteria as shown in **Figure 1**.

Inclusion criteria

Articles were selected if they met all of the following criteria. First, the article must be a Case-control or cohort or

controlled or randomized control study. Secondly, it must be a study Published between 2010 and 2020. Third, it must have been published in English. Fourth, participants must be humans.

Exclusion criteria

Articles were excluded from the systematic review based on the following criteria. First, participants were treated for missing teeth other than the first molar. Secondly, all non-English articles were excluded. Third, non-empirical publications (including expert opinions and narrative reviews) did not meet the threshold for inclusion in this systematic review. Fourth, articles publishing studies out of the specified time range. Finally, the articles involve animal studies or laboratory-based studies.

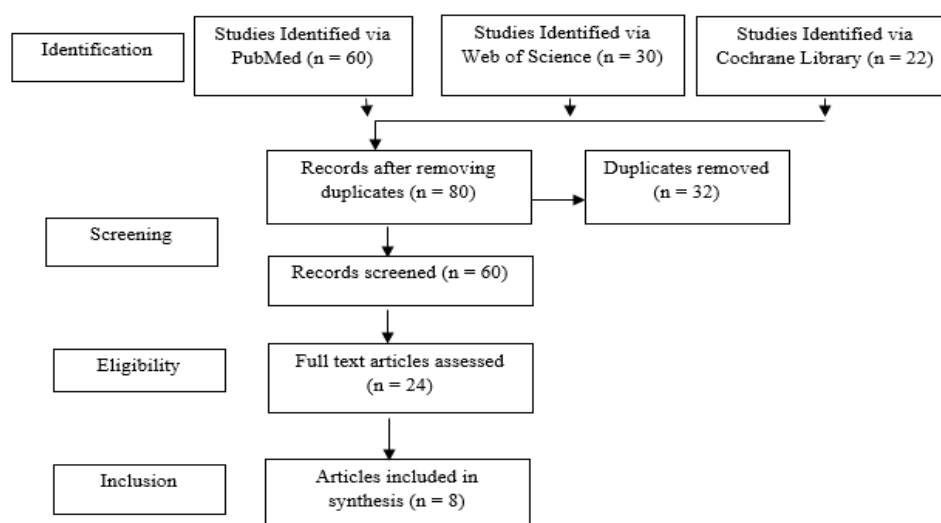


Figure 1. Flow Diagram

Risk of bias assessment

All studies were evaluated for quality using the Cochrane risk of bias assessment tool (**Table 1**).

Table 1. Summary of Cochrane Risk of Bias Assessment

Study	Selection Bias/Appropriate control selection/baseline characteristics similarity	Selection bias in randomization	Selection bias in allocation concealment	Performance-related bias in blinding	Reporting bias/Selective reporting of outcomes	Detection bias Blinding outcome assessors	Accounting for confounding bias
Mazor <i>et al.</i> , 2012 [14]	+	+	+	+	+	+	-
Anitua <i>et al.</i> , 2015 [23]	+	+	+	-	-	-	-
Chhibber and Upadhyay, 2015 [24]	+	+	+	+	+	-	-

Kumar <i>et al.</i> , 2015 [25]	+	+	+	+	+	+	-
Shah, Shah, and Raiyani, 2016	+	-	+	+	+	+	+
Raveli <i>et al.</i> , 2017 [26]	+	+	+	-	+	+	+
Dhole and Maheshwari, 2018 [27]	+	+	+	+	+	+	-
Meloni <i>et al.</i> , 2018 [28]	+	+	+	+	+	+	-

Results and Discussion

Orthodontic closure

Chibber and Upadhyay (2015) showed that a fixed functional device for anchoring reinforcement was beneficial during the protraction of the mandibular second molar into the first molar extraction site [24]. According to Dhole & Maheshwari (2017), the third molars should be considered during the orthodontic appliance's initial setup and leveling phase [27]. Orthodontic auxiliaries might aid in uprighting molar teeth that have been tipped or slanted in extraction gaps. This method of gap closure aims to ensure that the roots of the second molars and the premolars are parallel. Patients who have had their first molars removed or are at risk of losing them might still benefit from orthodontic space closure therapy if they are motivated to do so.

With a segmented arch approach based on differential moments of the T-loop, as Raveli *et al.* (2017) suggested, it is possible to treat edentulous space in adult patients without implants or prostheses [26]. Early loss of the first lower permanent molars may be repaired by extracting the upper bicuspids in connection with retraction. This procedure did not result in any bone fenestrations or dehiscence and did not cause root resorption. Therefore it offers a safe alternative treatment option.

Implant placement

According to Anitua *et al.* (2015), a distal offset from a single implant may effectively restore a single lost posterior tooth [23]. Implants with follow-up times ranging from loading to around 10 years, on average 4 years, were studied for their long-term success in terms of survival, minimal bone loss, and prosthetic complications. This study's results correspond to the use of offset implant implantation to replace a single lost posterior tooth in a region of restricted mesiodistal dimension. Kumar *et al.*, 2015 investigated whether replacing a single missing tooth with an implant improves masticatory efficiency and patient comfort. According to the results of this research, patients are happier with implant restorations and prefer shorter treatment periods for rehabilitation.

The results of using two dental implants with a small diameter to restore a single molar region were given by Mazar *et al.*, 2012. To restore the whole set of teeth, 33

patients had implants to replace their missing first molars, for 66 implants. In light of the data, replacing a single missing molar with two dental implants of narrow diameter might be an effective treatment option with satisfactory and predictable long-term outcomes. A prospective randomized experiment using a split-mouth design was developed by Meloni *et al.* (2018) [28]. 20 patients were randomly assigned to receive either instantly loaded or traditionally loaded single implants to replace their missing mandibular first molars. Forty implants were successfully placed. Despite the study's drawbacks, the current findings support implants replacing lost primary molars.

This systematic review examined two standard approaches to losing a primary tooth. First, it is important to note that developing the mandible and the rest of the nasomaxillary complex involves several different factors. The capability of teeth and their supporting tissues to adjust to functional demands throughout life may account for the continuous changes that occur from infancy and adolescence through young adulthood and adults. Orthodontic therapy (space closure) or opening up for an implant or other prosthodontic replacements present challenges in this complicated site. Both choices have benefits and drawbacks, as shown by evaluating the available research from prior studies [29].

Without replacing a lost first molar, occlusal forces might shift the position of the adjacent teeth, causing a gap where the two sets of teeth would normally meet. Increased soft tissue pocketing caused by molars that have been tipped may harm the teeth' health towards the end of the distal teeth. It is possible to prevent these negative outcomes by protracting the remaining molars. Scientists have testified that by protracting the posterior teeth, they could seal off posterior mandibular gaps of 8 millimeters to 12 millimeters. Patients who had medialization and stabilization reported that their protruding posterior teeth persist in protruding without any reopening of the edentulous gaps or increase in pocket depth during subsequent follow-ups. In the past, it was thought that the health of a protracted molar in an edentulous area with a thin resorbed ridge would suffer. Previous research, however, suggests this may not be the case [30].

It was shown that the incisors integrated into the anterior anchoring unit were more negatively impacted by mesialization of the second molars in the absence of skeletal

anchorage in the anterior dentition/PM. These negative consequences cause a change in profile and a posterior movement of soft tissues. This is important to remember while using this treatment method [31]. The lengthy treatment period is a major issue with orthodontic closure. Bilateral maxillary orthodontic traction of the second and third upper molars into the missing maxillary first molar space was obtained via an implant-supported mechanical technique, with no need for retracting or even using the front teeth [32]. A 12-month treatment period is much shorter than the averages reported in the literature for molar mesialization. No unexpected issues arose in pursuing the desired expression and facial aesthetics, functional occlusion, and stability.

Although regulatory agencies lay out the groundwork for the clinical acceptability of implants, it is ultimately up to the dentist to decide which implant should be utilized in patients. In order to provide excellent treatment and lessen the risk of legal repercussions for mistakes, an evidence-based approach should be used in the clinical decision-making process. This is especially true when starting therapy in known high-risk categories. Although data on the success rates of multiple implant systems have been gathered over the short to medium term, it seems that long-term data comparing and evaluating the various benefits and drawbacks of different systems does not exist, and suitable criteria relevant to the collective clinical experience need to be established. Constant improvements in implant hardware and surgical procedure development are crucial for expanding field use [33].

Conclusion

- Time duration is an important factor in deciding whether dental implants or orthodontic closure can be chosen for the replacement of the missing first molar.
- Dental implants seem to be a better choice of treatment as compared to orthodontic closure as it does not involve the other teeth around the missing tooth, which is the case with orthodontic closure which entails complete dentition.

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