ISSN 2618-1584 Vol. 5, Issue 9: 66-70, DOI: 10.25236/FMSR.2023.050913

Influencing factors of the curative effect of maxillary molar distalization

Yuwei Han[1], Lan Lan[1], Yishan Liu[1,2,*]

[1]Department of Pediatric Prevention of Stomatology, The First Afiliated Hospital (Afiliated Stomatological Hospital) of Xinjiang Medical University, Urumqi, 830054, China
[2]Xinjiang Uygur Autonomous Region Institute of Stomatology, Urumqi, Xinjiang Uygur Autonomous Region, 830054, China
[*]Corresponding author

Abstract: *In recent years, with the development and maturity of orthodontic technology, the indications of non-tooth extraction orthodontic methods are constantly expanding. On implementing all types of tooth movement, molar distalzation is the most efficient. However, clinical prone to molar distal tilt, loss of anchorage and other problems. This review reviews the basic patient characteristics, posterior maxillary molar space characteristics and the treatment design, to provide a reference for orthodontists' upper molar distal design to improve mobility efficiency.*

Keywords: *maxillary molar distalization; retromolar space; influencing factors; Clinical effect*

1. Introduction

Molar distalization is the process of increasing the length of the arch by moving the teeth backwards. For more than 100 years, maxillary molar displacement has been successfully used in orthodontic treatment of many cases, especially Class II malocclusion. This technique is commonly used to obtain gaps to relieve congestion and to alleviate deep coverage [1] without the need for tooth extraction. However, due to many factors, there is a certain difference between the actual and the designed movement of the maxillary molar distal movement, which affects the final correction effect. Therefore, the basic characteristics of the patient, the characteristics of the maxillary molar posterior space and the program design are reviewed in this paper.

2. Influence of patients' basic conditions on the distal displacement of maxillary molars

2.1 The type and severity of the malocclusion are closely related to the efficiency of molar distancing

Studies [2-3] showed that in patients with different vertical bone surface types, the maxillary molar posterior space was significantly smaller in the high-angle group, while the maxillary molar posterior space was the largest in the low-angle group. Tooth movement was limited by anatomical factors. When the tooth movement range exceeded the anatomical limit, tooth root absorption, tooth movement obstruction, alveolar bone resorption, and even bone fenestration and bone crack would occur. The thickness of bone cortex in patients with high Angle is lower than that in patients with average Angle and low Angle, and tooth movement is difficult to achieve. Some scholars [4] found that adult class II high Angle cases with distally moving maxillary dentition had good treatment results with microscrew implants as strong anchorage.

2.2 Patient age and gender are closely related to the amount of tooth movement

Animal studies have shown [5] that there are more osteoclasts in the old group and less alveolar bone calcification in the adolescent group, and the alveolar bone remodeling occurs faster under the action of mechanical stimulation. Clinical studies [6] have found that the therapeutic effect of orthodontic traction on maxillary impacted fangs at different ages is different, and the effect is better in juvenile patients. At present, the reports about gender are mainly related to the difference of alveolar bone thickness in different dental arch segments, and the reports about the speed and amount of tooth movement have not been found.

ISSN 2618-1584 Vol. 5, Issue 9: 66-70, DOI: 10.25236/FMSR.2023.050913

2.3 Patient compliance is an important factor affecting molar distancing

Children often have difficulty with dental treatment, so it is difficult to manage dentition problems in children wearing orthodontic devices. The pendulum appliance in the clinic reduces the need for patient cooperation. There have been studies [7] on the application of pendulum orthodontics in the treatment of Class II malocclusion in children with mixed dentition, which achieved distal maxillary molar displacement. In recent years, with the development of invisible correction technology without brackets, it also has significant advantages in pushing molar distant, and the wearing condition of patients is closely related to the effect of correction.

Therefore, in clinical application of maxillary molar displacement technology, it is necessary to take into account the type and severity of malocclusion and the age and gender of patient 2, develop an appropriate treatment plan and perform regular clinical monitoring to ensure the treatment effect.

3. Influence of maxillary molar posterior space on maxillary molar removals

In recent years, the development of implant anchorage technology and invisible correction technology without brackets provides conditions for the realization of molar removals; The rational use of the posterior space of the molar to achieve distant molar displacement is an important method for the correction of partial malocclusion [8-10], which effectively reduces the risk of complications such as bone window opening and bone cracking caused by tooth extraction and correction. Therefore, there is sufficient bone in the space behind the molar, so that it can be targeted in the treatment process. It is generally believed that the posterior molar space in the upper jaw refers to the distal surface of the maxillary first molar to the distal surface of the maxillary third molar. If the second and third molar have not yet erupted, the posterior boundary of the maxillary tubercle should be measured.

3.1 Aging changes in posterior space of maxillary molars

Generally, the space provided by pushing the molar to the distal part is used to relieve mild and moderate dentition congestion. When the distance displacement of the molar exceeds 4mm, extraction and correction may be considered. The influence of growth and development on the postmolar space should be considered in the design of molar push for adolescent patients. Some scholars [11-12] believed that the posterior maxillary arch space gradually increased with age, and the posterior maxillary arch space increased by 3.29mm on each side in females and 5.25mm in males. The maxillary posterior bone remodeling basically ended when females were 14 years old and males were 15 years old. That is, the changes in horizontal growth and development are basically over; The mandible increases by an average of 1.38 mm per year around puberty (10-14 years).The growth of posterior maxillary molar space is closely related to the development of maxillary tubercle and maxillary sinus. Han Rui et al. [13] studied the changes in the positions of anterior maxillary sinus wall and posterior maxillary trochanter wall in children aged 4-14 years and found that the maxillary horizontal and vertical growth occurred simultaneously during the peak period of the development and growth of the first molar, and the eruption of the second molar played a certain role in the vertical growth of the maxillary.

3.2 Influencing factors of maxillary retromolar space

In previous research results, it can be found that there are many factors affecting the retromolar space, such as: (1) Different vertical bone surface types; (2) Third molar; (3) Age and sex; (4) Type of malocclusion [14]. According to literature reports [15-16], in the posterior maxillary molar space of patients with different sagittal bone facial types, the posterior molar space of type II patients was significantly larger than that of type I patients. In adult patients with type III bone malocclusion, disharmony between tooth mass and bone mass in the posterior maxillary dental arch was found, which was often manifested as congestion in the posterior dental arch and excessive eruption of molar teeth in the vertical direction. The eruption height of the maxillary third molar was positively correlated with the posterior space of the maxillary third molar, and negatively correlated with the posterior occlusal plane. Guo Xueqiang et al. [17] studied the posterior space of right mandibular molars in 86 adult patients with class I bone with uniform Angle. In all measurement planes, the available space in the normal eruption of third molars group and the vertical impacted group was no less than that in the group without third molars, the horizontal impacted group and the mesio-impacted group. Marchiori et al. [18] found that in the maxilla and mandible of children aged 8-13 years, the postmolar space was significantly positively correlated with the occurrence and progression of third molar development, and insufficient postmolar

ISSN 2618-1584 Vol. 5, Issue 9: 66-70, DOI: 10.25236/FMSR.2023.050913

space was associated with late third molar development. AronAC et al. [19] studied the influence of the Angle of the maxillary third molar on the posterior space, and showed that the correlation between the two was not statistically significant.

For children and adolescents with dental congestion with growth potential accompanied by upper and lower dental arch stenosis or overdevelopment of upper jaw type II malocclusion, the distant displacement of the first molar can create a space to relieve the anterior segment congestion, but the second molar and third molar are more likely to be impacted, which may also cause congestion in the posterior molar segment. Most of the third molar teeth need to be removed in the later stage [20]. Therefore, it is necessary to evaluate whether the posterior molar space is sufficient before carrying out molar distancing.

4. Effect of protocol design on distal displacement of maxillary molars

For malocclusion cases with the same clinical manifestations, different protocol design and tooth movement modes may be adopted due to differences in doctors' level or experience, or patients' requirements for correction or problems associated with periodontal disease or TMD, etc. Therefore, it is of great clinical significance to design personalized scientific treatment goals based on patients' subjective and objective conditions.

4.1 Molar distalization design scheme

In the course of correction, the design of distal displacement scheme affects the curative effect of molar distal displacement.The type and timing of the first molar movement (before or after the eruption of the second molar) are two important factors affecting the outcome of molar removals. However, the timing of the distancing is controversial. Hashem believed that the distancing of the first molar before the eruption of the maxillary second molar was more effective. Compared with the eruption of the second molar, the distancing of the first molar was significantly larger, the period was shorter and the loss of anchorage was less. According to the three-dimensional finite element mechanical analysis, KANG et al. believe that the best time to push molar remote displacement should be after the second permanent molar completely erupt, because this can effectively prevent the mesiobuccal rotation of the first permanent molar during the push molar remote displacement. Sequential remote molar is a routine design step for invisible correction of remote molar. Usually, the second molar starts to move from both sides, and after the second molar is moved into place, the adjacent teeth move away successively. The tooth movement scheme is typical "V" shape, and the performance characteristics of the device ensure simultaneous contact with multiple teeth, so that a few teeth can be used to push most teeth. The time of correction can be further reduced, but the requirement of anchorage is higher. Different movement modes have their own advantages and disadvantages, such as the number of steps for single molar distant correction, the greater the support required for synchronous distant first and second molar, and the largest support required for the whole dentition of distant dentition, so it should be fully considered clinically.

4.2 Anchorage Design

Anchorage has always been considered to play an important role in the treatment of malocclusion malocclusion. Whether the orthodontic teeth can move in the direction and degree required by design has an important relationship with the design of the anchorage part. Some wrong anchorage design or orthodontic reinforcement, there is not much movement of the orthodontic teeth but a lot of movement of the orthodontic teeth (such as tilt, torsion or excessive forward movement), resulting in the failure of the correction. The anterior teeth can be protected by intermaxillary anchorage and implant anchorage during the backward molar push. In clinical application, some scholars reported that the compression of upper anterior teeth under type II traction is well controlled, but the actual effect of this hypothesis needs to be verified by subsequent simulation analysis and clinical trials. In the case of good patient compliance, the addition of intermaxillary traction can be considered in the initial stage of molar pushing, and the control of the vertical height of the maxillary molar can be designed. After the distant movement of the molar, the traction force can be appropriately increased to make the anterior tooth retraction. For patients with poor compliance who are willing to cooperate with treatment, microimplant nails can be used as an alternative to traction anchorage.K1RCAL1M et al. also adopted micro-implant anchorage combined with swing orthodontic device to achieve good molar displacement effect. Due to the avoidance of root obstruction, the micro-implant anchorage implanted in the upper palate can produce greater molar displacement than the micro-implant anchorage implanted between the roots of the buccal teeth.

ISSN 2618-1584 Vol. 5, Issue 9: 66-70, DOI: 10.25236/FMSR.2023.050913

5. Molar distalization correct method

With the maturity and development of orthodontic technology, push molar orthodontic methods are also improving, the following simple analysis of the advantages and disadvantages of various types of orthodontic devices applied to push molar distant.

5.1 The extraloral arch

The extraloral arch method can push the molar distal to the common head-cap arch, head-cap J-hook combined with oral internal fixation device, and extraloral arch combined with sliding bar, which has remarkable effect in the Class II dislocation correction. It can effectively push the maxillary first and second molar distal to achieve a neutral relationship between the molar teeth, and will not cause the lip tilt of the anterior teeth in the process of remote molar displacement. However, the use of the extra-oral bow is very dependent on the cooperation of the patient, and wearing more than 12 hours a day can ensure the effect of pushing the molar far away, and insufficient time will cause the reciprocating movement of the molar, so that the correction can not achieve the desired effect.

5.2 Molar distalization with Nance as anchorage

The pendulum appliance and Frog molar remover are supported by Nance, but both of them can cause the mesial tilt of the first premolar during molar remover.

5.3 GMD appliance

GMD appliance is a double-track appliance consisting of molars, premolars, buccal and palatine canals, rails, NiTi spiral push springs, Nance brackets, and brackets. With the orthodontic technique, NiTi spiral push springs are used simultaneously on the buccal and lingual sides of the first molar to push the molar to the distal part. However, due to the large area of the Nance base, it is not only difficult to achieve good oral hygiene because the base is close to the palate, but also easy to compress the palate mucosa leading to edema and inflammation, thus causing discomfort to patients.

5.4 Invisible correction without bracket

Invisible correction without bracket also has a unique advantage in pushing molar distant displacement. Unbraced invisible correction technique is a goal-oriented technique. The principle is that the deformation of the transparent braces exerts a certain light and sustained force on the dentition to move the teeth in a preset direction. By wrapping the teeth and exerting force, transparent braces can to a certain extent avoid the problems of molar distal tilt, mesial buccal rotation and elongation caused by molar distant displacement. In addition, based on the integrity of the transparent braces, molar distant displacement does not have to wait until the front teeth are aligned. In this way, for patients in need, the invisible correction technique without brackets can carry out molar distant displacement and arch expansion of the back teeth from the very beginning to create enough gap for the back teeth to align with the front teeth. Compared with traditional correction, this method avoids the lip inclination of the front teeth in the alignment process.

6. Conclusion

In many years of clinical application, the effect of pushing molar distant displacement is encouraging. Through various means, the distant molar can be moved to the target position relatively accurately. The current design of molar push has been relatively mature, and clinicians should use conical beam CT to make a comprehensive and comprehensive analysis of the posterior space of maxillary molar, and at the same time design a suitable personalized correction plan for patients in combination with the patient's age and gender, tooth type and bone type and compliance, so as to improve the realization efficiency of maxillary molar remote displacement. At present, the commonly used methods of pushing molar distal mainly include pendulum appliance, implant support and invisible appliance without bracket. The dynamic mechanical analysis of the teeth in the tooth arch in the process of remote molar displacement with different techniques needs to be further studied, and the research results can guide clinical practice.

References

[1] Almuzian M. , Alharbi F. , White J. , McIntyre G. Distalizing maxillary molars - how do you do it?

ISSN 2618-1584 Vol. 5, Issue 9: 66-70, DOI: 10.25236/FMSR.2023.050913

Orthodontic Update. 2016; 9 (2): 42-50.
[2] Chen Lin, Wu Jiahua, Gu Weihuai, et al. Evaluation of distal maxillary molars with invisible appliance without bracket [J]. Journal of Practical Stomatology, 2017, 33 (2): 203-207.
[3] Xu Jianguang, Shen Jun, Zhang Zheng, Liu Yajun, Wang Yuanyin. Cone-beam CT study of maxillary cortical thickness in patients with different vertical bone surface types [J]. Chinese Aesthetic Medicine, 2019, 28(04): 74-77.
[4] Zhai Junhui, Wang Mingfeng, Wang Qian. A clinical study on the upper dentition of Class II high Angle patients with remote implantation nails [J]. Chinese Journal of Aesthetic Medicine, 2018, 27(11): 67-71. (In Chinese)
[5] Henrioues F P, Janson G, HenriouesJ F, et al Effects of cervical headgear appliance: a systematic review [J]. Dental Press Journal of Orthodontics, 2015, 20 (4): 76-81.
[6] Guo Y. Comparative analysis of the effect of orthodontic traction on maxillary impacted fangs of different ages [J]. World Latest Medical Information Journal, 2018, 18(82): 44-46.
[7] Kircali M, Yuksel A S. Evaluation of Dentoalveolar and Dentofacial Effects of a Mini- Screw-Anchored Pendulum Appliance in Maxillary Molar Distalization [J]. Turkish Journal of Orthodontics, 2018, 31(4): 103-109.
[8] Silva DBHD, Gonzaga AS. Importance of orthodontic intervention of the Class III malocclusion in mixed dentition. Dental Press J Orthod. 2020Sep-Oct; 25(5): 57-65.
[9] Choi YT, Kim YJ, Yang KS, Lee DY. Bone availability for mandibular molar distalization in adults with mandibular prognathism. Angle Orthod. 2018Jan; 88(1): 52-57.
[10] Lai Wenli. Clinical application strategy for pushing molar teeth backward by invisible correction technique without bracket [J]. International Journal of Stomatology, 2019, 46 (4): 373-382
[11] Chen L, Lin J X, Xu T M, et al. A longitudinal study on the changes of posterior arch space available in Chinese normal adolescents aged 13-18 years [J]. Journal of Orthodontics, 2007, 14(1): 25-28.
[12] Iliadi A, Koletsi D, Eliades T. Forces and moments generated by aligner-type appliances for orthodontic tooth movement: a systematic review and meta-analysis [J]. Orthod Craniofac Res, 2019, 22(4): 248-258.
[13] Han Rui, Ma Lei, Mi Congbo, Wang Li, Wang Yongliang, Zhang Qian. Auto-CAD computer aided design software for fixed-point measurement of anterior wall of maxillary sinus and maxillary tubercle in children [J]. Chinese Journal of Tissue Engineering, 2016, 20(02): 202-207.
[14] Qu Zhuli, Guo Jie. CBCT study on posterior space of second molar in adult patients with bimaxillary protrude [D]. Shandong: Clinical Stomatology of Shandong University, 2012.
[15] Liu Liping, Yang Tongtong, Cheng Jiaxiu. Analysis of anatomical characteristics of posterior space of Class II maxillary molars [J]. Shanghai Journal of Stomatology, 2019, 30(04): 410-413. (In Chinese)
[16] Tian Jincong, Cang Song. Correlation between third molar space and posterior molar plane in adult patients with Class III malocclusion [J]. Journal of Guangdong Medicine, 2019, 43(03): 351-355.
[17] Guo Xueqiang, Liu Xinqiang, Wang Zheng, Zhao Rui, Kong Lei. Three-dimensional study on the relationship between the posterior space of mandibular molar and the third molar in adults [J]. Chinese Journal of Orthodontics, 2019, 28(02): 74-79.
[18] Marchiori DF, Packota GV, Boughner JC. Initial third molar development is delayed in jaws with short distal space: An early impaction sign? Arch Oral Biol. 2019 Oct; 106: 104475.
[19] Aron AC, Guilherme J, Ernesto AL, Vinicius L, Daniela G. Effect of posterior space discrepancy angulation on anterior overbite. Am J Orthod Dentofacial Orthop. 2018. 154(4).
[20] Kang JM, Park J H, Bayome M, et al. A three- dimensional finite element analysis of molar distalization with a palatal plate, pendulum, and headgear according to molar eruption stage [J]. Korean Journal of Orthodontics, 2016, 46(5): 290300.