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Research progress of maxillary molar distal displacement

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Abstract: *In the clinical work of orthodontics, it is a common problem for dentists to determine whether cases of crowding and convexity can be corrected without tooth extraction. In recent years, with the development of bracketless invisible orthodontic techniques and the wide application of anchorage nails in clinical practice, the method of pushing molar distalization to obtain the space required to align the teeth has been favored by more doctors. Molar distalization is more common in the maxilla, and exploring the limit of molar distalization depends on the maxillary retromolar space, mainly the length, width, and height of the maxillary tuberosity area. This article reviews the indications, boundaries, methods and effect evaluation of maxillary molar distalization, and provides some ideas and basis for the clinical treatment of maxillary molar distalization.*

Keywords: *Distalization of maxillary molars; maxillary tuberosity; implant anchorage; clear aligner*

1. Introdution

Generally speaking, mild and moderate bony malocclusions can be considered for masking orthodontic treatment, while deformities above moderate level are difficult to be completed by orthodontic means, and combined orthodontic-orthognathic treatment needs to be considered. From a clinical point of view, if the patient's teeth are aligned within the available alveolar bone without causing disorders in the lateral appearance of the facial soft tissues and problems with tooth inclination, arch width and occlusion, non-extraction orthodontics is the treatment of choice. Obtaining space by non-extraction treatment can generally be achieved by increasing arch width, interproximal deglazing and increasing arch length. It is known that increasing arch width may lead to recurrence after correction, and interproximal deglazing may cause tooth soreness and sensitivity, so it is more necessary to explore the efficiency of obtaining gaps by relying on increasing arch length. Molar distalization is more common in the maxilla. A comprehensive understanding of the relevant research progress of maxillary molar distalization and the selection of maxillary molar distalization methods according to local conditions can obtain a double effect with half the effort in clinical diagnosis and treatment.

2. Indications for maxillary molars distalization

For skeletal Class I malocclusion and Class II malocclusion with crowded dentition, molar distalization can provide clearance to align the dentition in patients with moderate or less crowding and can also provide clearance for adduction of maxillary anterior teeth. For skeletal Class III malocclusion with crowded dentition, the most important mechanism is maxillary hypoplasia, mandibular hyperdevelopment, or both maxillary hypoplasia and mandibular hyperdevelopment. When we use disguise therapy, there is no need to push the molars distally in the maxilla, and it is only necessary to make the mandible backward as much as possible to establish the overjet relationship of the anterior teeth. However, for patients treated with orthodontic orthognathic combination therapy, in order to prepare for orthognathic surgery, we still need to distally move the maxillary posterior teeth to match the postoperative arch and jaw relationship[1] . Before moving the maxillary first molar distally, it needs to be clear whether the third molar should be extracted to gain more clearance. When maxillary second molars are moved distally without eruption, faster movement speed and greater movement can be obtained. If the maxillary second molar has erupted, the rate of distal movement of the maxillary first molar will slow. When molar removal is required with a large distalization, may consider removing the

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second molar and replacing the second molar with a third molar. The maxillary molars are distantly displaced and sufficient post-molar space is a prerequisite, in addition to which: (1) patients with mild or moderate crowding; (2) patients with mild convexity deformity; (3) patients with vertical bone facial shape of low angle and even angle; (4) patients with combined orthodontic and orthognathic surgical treatment and preoperative decompensation to adjust the labial inclination of anterior teeth; (5) healthy periodontal tissues and no temporomandibular joint symptoms; (6) posterior teeth with abundant alveolar bone and no obvious bone cortical resistance.

3. Margin of maxillary molars distalization

As the maxillary molar erupts, the anterior boundary of the maxillary tubercle extends from the distal first molar to the distal last molar, and its bone mass plays a decisive role[2] in the amount of maxillary dentition distalization. The maxillary tubercle is the shortest in length at 3.0 mm from the root of the enamel cementum boundary of the maxillary second molar, so distance at this site should be measured when the maxillary molar moves distally. The growth of maxillary tubercles is uneven and their growth peaks at a certain age. It was found that 8-9 years old and 10-11 years old were the rapid growth and development stage of maxillary tuberosity, and the increase of maxillary tuberosity area accounted for 45.3% of the total increase of maxillary tuberosity at 6-20 years old, and the growth of maxillary tuberosity did not stop until 20 years old. During the growth of maxillary tuberosity, the vertical growth was significantly greater than the horizontal growth. There were differences in bone mass in the maxillary tuberosity area between patients with different sagittal bone surface types, and the length of the maxillary body longer, their bone mass was greater. Bone mass in the maxillary tuberosity region of skeletal Class III is relatively small and molar distalization is the most limited, so skeletal Class III patients who require orthodontic orthognathic combination therapy should use molar distalization more cautiously when removing maxillary anterior compensation. The length and width of the maxillary tubercle in patients with skeletal class I and skeletal class II were greater than those in skeletal class III, but there was no significant difference between skeletal class I and skeletal class II. Meanwhile, the eruption of third molars promotes the development of maxillary tubercles[3] , and those without third molars have less bone mass than those with third molars[4] . The width of each type of facial maxillary tuberosity area showed a tendency to narrow from the distal to posterior second molar, with changes most evident in skeletal Class III. When performing molar distalization in orthodontic clinical practice, it is necessary not only to consider the length of the maxillary tuberosity area, but also to consider its width to prevent contact with the bone cortex during dentition distalization, which affects the amount of dentition distalization and even leads to root resorption, bone fenestration and bone dehiscence[5] .

4. Methods of maxillary molars Distalization

4.1 Distalizing molars with face bow

Common devices for pushing molar distalization by face bow method include head cap facial arch, head cap J-hook combined with intraoral fixed appliance and extraoral arch combined with sliding rod[6] . These devices are designed intraorally as bands with buccal canals for molars, extraorally distracting maxillary molars posteriorly with headrest as anchorage, and buccal canals in the intraoral molar region for insertion of the internal arch to transmit extraoral forces to the maxilla. Face bow is effective in pushing molar distalization , but use requires high compliance and should often be worn for more than 12 hours each day. If due to insufficient time, it is easy to cause the reciprocating movement of molars, the correction effect will be greatly reduced. Meanwhile, At the same time, doctors should pay attention to the root resorption of patients due to the large orthodontic force of extraoral arch[7] .

4.2 Nance as an anchorage against molar distalization

4.2.1 Pendulum appliance

The pendulum appliance consists of two parts: force application and anchorage[8] . The applied force portion was spring-loaded and anchorage consisted of a Nance base placed in the anterior maxillopalatine and four bases extending into the ipsilateral premolar junction within the base[9] . The pendulum appliance uses the bone of the anterior palate and the upper premolars as anchorage and can achieve a distalization effect of pushing molars of 2 to 5.9 mm by applying force at each return visit[10] .

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However, pushing the molar distally with the pendulum appliance may cause mesial tilt and mesial movement of the first premolar, mesiobuccal rotation and distal tilt of the first molar[11] . This molar distalization is mainly caused by distal inclination of the crown, which tends to recur because the root does not distalize with the crown at the same time[12] .

4.2.2 Frog molar distalization appliance

The principle and structure of Frog molar distalization appliance is similar to pendulum appliance. Both of them consist of a Nance support, a premolar retention arm and a molar band. The difference is that the activation part of Frog molar distalization appliance is composed of distally moving spring. Frog can push the molar distally by 1 mm every 90 ° of rotation by rotating the center of distally moving spring. Because the Frog molar distalization appliance is located at the furcation of the maxillary molar and is closer to the impedance center of the maxillary molar than the pendulum appliance, it can effectively control the overall movement of the molar distally and avoid excessive coronavirus distalization or elongation of the maxillary molar during distalization. The Frog molar distalization appliance produces a mean molar distalization of 4.25 mm, but produces mesial inclination of premolars and labial inclination of incisors during molar distalation[13] .

4.2.3 GMD appliances

GMD appliances are two-track appliances consisting of molars, premolar bands, buccal and palatal canals, tracks, NiTi spiral push springs, Nance brackets, and brackets[14] . Combined with the straight wire appliance technique, the molars were pushed distally by using NiTi spiral push springs simultaneously on the buccal and lingual sides of the first molars. The large area Nance tray can obtain strong anterior anchorage to prevent labial inclination of the anterior teeth and can play a role in stimulating maxillary forward growth to some extent. The GMD appliance avoids the problem of poor results due to patient incompliance compared with the use of Nance as anchorage to push molars distally versus selecting extraoral arch distally. However, because most of its anchorage is undertaken by the Nance base, in order to obtain greater anchorage it is often necessary to increase the area of the Nance base, not only the base is close to the palate, it is difficult to achieve good oral hygiene, but also easy to compress the palatal mucosa leading to edema and inflammation, which causes patient discomfort.

4.3 Micro-implant anchorage assists in molar distalization

The use of microimplant anchorage to assist molar distalization is currently a commonly used method for molar distalization in clinical practice[15] . According to the different treatment methods adopted, the implantation site of implant anchorage also changes correspondingly. If straight wire appliance combined with microimplant anchorage is used to push the maxillary molars distally, it is generally selected to be implanted between bilateral maxillary first molars and second premolars. Implants can also be placed in the midpalatal suture as anchorage with fixed appliances to distally move molars. Microimplants are widely used because they provide absolute anchorage and avoid loss of anterior and premolar anchorage while producing substantial molar distalization distances[16] . However, because microimplants have the risk of implant screw fracture, loosening and infection after implantation, there are some limitations in application.

4.4 Clear aligner for molar distalization

With the rapid development of clear aligner in recent years, the appliance has gradually shown its advantages in pushing molar distalization. From the effect of orthodontic treatment, bracketless invisible orthodontic treatment can achieve 2 ~ 3 mm distal displacement of maxillary bilateral molars[17] without the use of implant anchorage and complete the correction of mild to moderate crowding cases. The transparent braces apply force by wrapping the teeth and avoid problems such as distal inclination of molars and mesiobuccal rotation and elongation during pushing molars distally[18] . At the same time, because the transparent braces have a certain thickness, the molars can be pressed in without planting nails in the process of distal molar movement[19].

The limitation of clear aligner technique in pushing molar distalization lies in that while invisible appliance distally moves maxillary second molar, the overall palatal force of maxillary incisors is greater than the labial force, and maxillary incisors show a tendency of overall labial movement[20] . This reminds the physician to fully evaluate the thickness of the labial bone plate in the anterior region when pushing the molar distally with a clear aligner in clinical practice, and if the bone wall in the

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anterior region is weak, microimplant anchorage should be used accordingly to avoid excessive labial movement of the incisors.

5. Conclusion

In summary, the use of maxillary molar distalization to obtain spaces to align teeth greatly expands the range of cases treated with non-extraction. With the gradual deepening of clinical research in the future and the continuous attention of orthodontists to the aesthetics of the profile, it is believed that more new methods of maxillary molar distalization will be produced to help orthodontic clinical work improve efficiency, improve results, and have a more positive and far-reaching impact on orthodontics.

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References

[1] Bai Ding, Editor-in-Chief Zhao Zhihe. Control and skills of orthodontic strategies [M]. Beijing: People 's Medical Publishing House, 2015; 3
[2] Apinhasmi W, Chompoopong S, Methathrathip D.Clinical Anatomy of the Posterior Maxilla Pertaining to LeFort I Osteotomy in Thais.Acta Anaesthesiol Scand, 2005, 18:323 – 329.
[3] Cheng Chaojie. Comparative observation of maxillary tuberosity bone mass before and after extraction of impacted maxillary third molars [D]. Guangzhou Medical University, 2020.DOI:10.27043/ d.cnki .ggzyc.2020.000045.
[4] Gong Ting. CBCT study of three-dimensional bone mass of maxillary tubercle and its relationship with third molar [D]. Anhui Medical University, 2020.DOI:10.26921/d.cnki .ganyu.2020.000060.
[5] Li Na. CBCT study of anatomical morphology of maxillary tuberosity in patients with different sagittal bone surface types [D]. Dalian Medical University, 2020.DOI: 10.26994/d. cnki. gdlyu. 2020.000040.
[6] Li Xiaoyan, Xu Juan, Liu Yongzhao, Liu Zhifeng. Clinical observation of extraoral arch pushing molar distalization in the treatment of Angle's ii ~ 1 case with degree iii deep coverage [J]. Journal of Clinical Stomatology, 2012, 28 (12): 755-757.
[7] Wang Lei, Duan Yinzhong, Shen Huan, Yao Wei. Effect of extraoral arch pushing molar distalization on root resorption [J]. Journal of Clinical Stomatology, 2007 (07): 421-423.
[8] Hilgers J J. The pendulum appliance for Class II non-compliance therapy. [J]. Journal of clinical orthodontics: JCO, 1992, 26 (11): 706-14.
[9] Bozkaya Erdal et al. Evaluation of the effects of the hybrid Pendulum in comparison with the conventional Pendulum appliance. [J]. The Angle orthodontist, 2020, 90 (2): 194-201.
[10] Nissen Shannon Hilgers. The Pendulum Appliance for Class II Non-Compliance Therapy. [J]. Journal of clinical orthodontics: JCO, 2017, 51 (9).
[11] Shetty Sushruth, Maurya Rajkumar, Raj H V Pruthvi, Patil Anand. Comparison of the Pendulum appliance and the Jones Jig: A comparative prospective study. [J]. European journal of dentistry, 2017, 11 (3).
[12] Guo Jun, Fa Yonghong, Cai Xingwei, Huang Changcheng, Yan Xin. Comparison of Implant and Pendulum Appliance in Distalization of Maxillary Molars [J]. Chinese Journal of Cosmetic Medicine, 2007 (08): 1120-1123.
[13] Shi Xinqin, Zhang Caidi, Li Xianglin, Lu Bai. Clinical comparative study of Frog molar distalizer and Cetlin molar pushing method [J]. Shaanxi Medical Journal, 2014, 43 (06): 683-685.
[14] Yang Yong, Zhao Jilin, Cen Yufeng. Distally mobile maxillary molars using modified GMD [J]. Journal of Practical Stomatology, 2013, 29 (02): 292-294.
[15] Carano Aldo, Siciliani Giuseppe, Bowman S Jay. Treatment of skeletal open bite with a device for rapid molar intrusion: a preliminary report. [J]. The Angle orthodontist, 2005, 75 (5).
[16] Ruan Xiaohui, Dai Haitao, Liu Haixia. Clinical application of microimplant anchorage in pushing molars distally [J]. Stomatology, 2014, 34 (06):444-446.DOI:10.13591/j.cnki.kqyx 2014. 06.012.

ISSN 2706-6819 Vol.5, Issue 1: 66-70, DOI: 10.25236/IJFM.2023.050112

[17] Li Zhifang, Wang Weicai, Mai Ideal. Effect of distalization molars without brackets in the treatment of mild to moderate crowding of upper anterior teeth [J]. Prevention and Treatment of Oral Diseases, 2018, 26 (05): 314-319.
[18] Chen Lin, Wu Jiahua, Qu Weiwei, Lin Jiong, Huang Wenbin, Xia Zeyang, Tan Jiali. Evaluation of the efficacy of clear aligner in the distal transfer of maxillary molars [J]. Journal of Practical Stomatology, 2017, 33 (02): 203-207.
[19] Cheng Xinyu. CBCT evaluation of the effect of rigid connection of microimplant nails assisted clear aligner in distalization of maxillary molars [D]. Nanchang University, 2020. DOI:10.27232/d. cnki.gnchu.2020.000348.
[20] Chen Wenxia. Clinical effect of molar distalization technique pushed by clear aligner [D]. Fujian Medical University, 2019.DOI:10.27020/d.cnki .gfjyu.2019.000244.