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Research progress of temporomandibular joint in adolescent malocclusion

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Abstract: *The prevalence of malocclusion in permanent dentition was 72.97%. Temporomandibular joint (TMJ) is one of the most important joints in human body, and its functional structure is the most complex. The shape and position of the temporomandibular joint in patients with malocclusion were affected by occlusal occlusion. This review focuses on the effects of different types of malocclusion on the morphology and function of temporomandibular joint (TMJ) in adolescents.*

Keywords: *Malocclusion, Temporomandibular joint, Condyle*

1. Study on condyle of temporomandibular joint in patients with different malocclusion

1.1 The shape of condyle of temporomandibular joint

Temporomandibular disorders (TMD) is a kind of functional organic disease, which can affect the temporomandibular joint area and the surrounding soft tissue structure, thus leading to severe functional disorders. It mainly includes joint snapping, abnormal mandibular movement track, masticatory muscle tenderness in maxillofacial region and temporomandibular joint area, and so on. The pathogenesis of this disease is very complicated and has not been fully understood until now [1-3] , it is one of the commonly used disorders of the oral and maxillofacial system in current medicine, and the incidence of malocclusion is also very high, therefore, it is considered that malocclusion is one of the most important causes of temporomandibular joint dysfunction[4]. Condylar cartilage is the largest growth center in cranio-maxillofacial region. Condyle morphology of temporomandibular joint may be different in different malocclusion patients. Some scholars found that the condyle volume and surface area of TMD patients were smaller than that of healthy people, song Zhenglu and others studied the temporomandibular joint morphology of Class I, Class III, Class III and class III malocclusion patients and found that there were significant differences between them, the average ratio of anterior to posterior condylar diameter was the smallest in class III 1 patients [5]. By comparing the temporomandibular joints of young and adult patients with class II malocclusion, Xu Xiaomei et al., the results showed that the condyle diameter, the condyle diameter, the main axis of condyle and the height of condyle top in adults were all higher than those in the youth group, the bilateral temporomandibular joints of adolescent patients with Angle III 1 malocclusion have certain normal growth potential [6]. Circumstantial [7] et al showed that skeletal class II, condylar long axis diameter is the smallest, and joint imbalance is the most, therefore, in oral orthodontic surgery should be especially careful to prevent the occurrence of TMD. The study by Burke et al showed no significant difference in the proximal-distal condyle inclination among the different vertical facial patterns[8]. However, Li Chen's [9]study found that the condyles in low-angle patients tended to be less inclined and more retrorse, and numerous data have shown no significant difference in condyle height among skeletal class II patients in the various vertical planes, however, some data show that the condyle height of Class II low-angle patients is lower, while other data show that the condyle height of high-angle patients is very small [10] . Saba Ahmed et al found significant differences in condyle inclination, condyle width, and condyle length between high and low angles in skeletal class II patients, with the highest condyle inclination at high angles and in the sagittal plane The vertical condylar inclination of the anterior and posterior condylar inclination increased in the high angle, showing more condylar posterior rotation, and decreased in the low angle, showing more condylar anterior rotation. The results of this study are similar to those of Gail Burke et al., gail Burke et al demonstrated that vertical facial morphology features angular backward condyles, whereas patient-level

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facial morphology has forward-sloping condyles [8]. Et al found similar results in a typical long face syndrome in which condyle retroversion is evident, whereas in a typical short face syndrome, condyle anteversion is present [11].

1.2 Position of condyle of temporomandibular joint

In some studies, the relationship of condylar fossa varies according to the malocclusion of the patient. Angle classification, especially the sagittal bone classification, is the most widely used classification in orthodontics, although it cannot be regarded as completely consistent in clinical work, but it cannot be independent. The position of the condylar center within the fossa is generally considered optimal, but this remains controversial.

In many cases in class I patients, the predominance is anterior displacement and median, with the median being the most common type. In Class III, most of the patients had anterior displacement and median displacement, and most of the patients had anterior displacement and median displacement, and the number of patients in Class III was equal. Unlike the first three types, in Class II, subclass II cases, the majority present as median and posterior dislocations [5]. Studies by Ding Yuanfeng and Xu Xiaomei have also demonstrated that in Class III 2, the condyle on the distal side of the relationship is mainly posterior displacement [6,12]. The condyle of Angle III patients with high angle was the same as that of homogeneous angle patients, the position of the skull was backward, and the joint space was larger. In low-angle patients, the skull is lower, so the space between the front and back of the joint is larger. In this case, the condyle tends to move backward, which is more common in high-angle patients.

It has been shown that differences in the shape and location of the various vertical facet-type joints in skeletal class II are more reflected in the joint space and its condylar position, with a gradual increase in the proportion of condylar posterior positions from low to high angles [13]. The ratio of condylar posterior position in patients with skeletal type II high angle is gradually increasing, which is consistent with the results obtained by Kikuchi[14] in patients with mandibular clockwise direction rotation, in which the condylar position is relatively backward. This has been shown to be more common in low-angle patients in some studies [15]. Lin[16] also demonstrated that in high-angle patients, the space above the joint is smaller and the condyle is more posterior and superior. One researcher observed that the temporomandibular joint (TMJ) before and after treatment with osteogenic type II correction was reduced in the anterior space and enlarged in the supra-articular space and posterior space after treatment, it showed that the condyle shifted forward and downward [17-19] . It also showed that the condyle of skeletal class II patients was mainly posterior displacement. Paknahad et al[20] found that the condyle position of skeletal class II patients was higher than that of skeletal class I and III patients, the formation of these different results may also be related to the age of the samples collected, race, and the different methods of condylar position calculation.

2. Study of temporomandibular joint symmetry in patients with different malocclusion

The temporomandibular joint (TMJ) is a bilateral joint. The normal position of the condyle is beneficial to the smooth development of oral and facial functions and the health of the TMJ, it also contributes to the health and stability of orthodontic and post-operative patients. Xu Jing [21] used three-dimensional reconstruction techniques to analyze the shape and symmetry of the temporomandibular joint in patients with class II malocclusion in three directions, and found that there was a high degree of asymmetry. A CBCT analysis of bilateral condyle symmetry in class III malocclusion of the maxilla and mandible shows that the relative position of the condyle on the inclined side and on the non-inclined side, as well as the length of the condyle inside and outside, are significantly different [22] .In the early development of maxillary and mandibular deviation, the shape of bilateral condyle is the same, but with the increase of age, bilateral condyle gradually shows symmetry. Some scholars have found that the asymmetry of mandible, maxilla and condyle is the main component of bone asymmetry in patients with facial asymmetry class III. Orthodontic treatment has limitations and potential treatment risks. For patients with a deviation greater than 4 mm, combined orthodontic and orthognathic treatment may be the best option [23].

3. The shape of temporomandibular fossa in patients with different malocclusion

Marissa et al. [24] found that there were significant differences in the shape of temporomandibular fossa between Class I and Class II malocclusion adolescents, and there was no significant difference in

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the symmetry of the left and right fossa; There was no significant difference in the symmetry of the left and right joint fossa. Gender had no significant effect on the development of the temporomandibular fossa, however, the development of Class III fossa was significantly backward compared with the same age women. The width of Class III joint fossa was the largest, followed by Class I and Class III 1, and Class III 2 was the smallest. In addition, the depth of Class II II fossa was also the most significant, followed by Class III fossa and Class I, while Class III Fossa had the shallowest depth [5]. In patients with skeletal class III malformations, the fossa position was higher in high-angle patients than in low-angle and mean-angle patients, and the same conclusion was reached in the study by Xu Xin et al[25]. The research of some scholars shows that the inclination angle of the articular tubercle is different because of the different depth of the articular fossa of various vertical skeletal types. He also pointed out that low-angle patients had deep and steep sockets, while high-angle patients had shallow and flat sockets, it is suggested that these differences may be one of the main factors affecting the vertical development of the patient: the condyle is more likely to rotate clockwise during the growth process because of the poor restraint of the shallow and flat fossa on the condyle, the appearance of backward or directional growth of the situation, and therefore produce a high angle of the face. Conversely, deep and steep sockets allow the mandibular head to grow counterclockwise throughout the growth process, resulting in a low-angle facet [26]. In addition, some researchers have pointed out that differences in the functional load of the temporomandibular joint between the sexes also affect the functional shape of the temporomandibular fossa [27]. Jasinevicius et al. [28,29] have shown that the slope of articular nodules varies with age.

4. Treatment of adolescent malocclusion and temporomandibular joint relationship

Temporomandibular joint disorder diseases, it has been suggested that normal mastication promotes the development of the temporomandibular joint due to trauma, muscular factors, psychosocial factors[30], and autoimmune factors, joint development is closely related to the occlusal relationship[31], and joint disorders during the growth and development of the mandible can cause slow growth and abnormal facial morphology, which can also affect the growth and reconstruction of the joint, aggravate the occurrence and development of TMD, affect the basic function of joints, facial beauty, airway, growth and development[32], etc.If TMD occurs during orthodontic diagnosis and treatment, it will affect the clinical effect of orthodontics. Therefore, orthodontists should carefully study and observe the changes of temporomandibular joint before, during and after treatment, so as to make early diagnosis, eliminate the influencing factors as soon as possible and avoid potential risks. Early diagnosis is helpful to the treatment of orthodontic patients with TMD. The temporomandibular joint (TMJ) is closely related to the health of orthodontic patients. The balanced, reasonable and correct condylar orientation is helpful to the rehabilitation of TMJ and the maintenance of the balance of the Oromandibular system, and health stability after orthodontic surgery. CBCT is a new imaging method which has been applied in human oral and maxillofacial region in recent years. It has the advantages of high resolution, low irradiation dose and short irradiation time, the observation of temporomandibular joint bone structure also has a special advantage. CBCT can be used to study the changes of temporomandibular joint (TMJ) before and after orthodontic treatment, so as to evaluate the effect of orthodontic treatment, and to understand the effect of orthodontic treatment on TMJ, the development of temporomandibular joint and mandible were predicted, it also has some guiding significance on how to carry out orthodontic treatment, the change of patients' facial shape and occlusal function after treatment, orthodontic treatment and the use of orthodontic appliances[33].

5. Summary

Currently, the study population of temporomandibular joints with different malformations is predominantly adolescents [19], whereas the focus of orthodontic treatment is primarily on young adults in the early stages of permanent dentition, compared with the general adult population, this population has the advantage of growth and can change the position relationship between temporomandibular joint and condyle to achieve a stable balance by orthodontic treatment. Orthodontists should pay close attention to the changes of temporomandibular joint (TMJ) during the diagnosis and treatment of different malocclusion, adolescent patients were followed up after the examination to see if they developed temporomandibular joint symptoms [34]. With the development of imaging technology, people can make more concrete and accurate detection of TMJ from three-dimensional direction, so as to explore the stable and healthy structure of TMJ, it is helpful to solve the problem of temporomandibular joint and give more accurate guidance in the process of malocclusion and orthodontic treatment.

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