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Advances in soft and hard tissue morphology of chin

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Abstract: *The chin has an important impact on the patient's facial aesthetics, and the shape of the chin not only affects the position and shape of other soft and hard tissues of the face, but also affects the overall coordination and balance of the jaws. Domestic and foreign studies have found that chin morphology is associated with gender, vertical facial pattern, and horizontal facial pattern. Orthodontists should fully consider the shape of the patient's chin when designing orthodontic treatment to achieve the greatest degree of soft and hard tissue appearance and obtain a good orthodontic effect.*

Keywords: *shape of chin; malocclusion; facial pattern*

Nowadays, more and more attention has been paid to the aesthetics of the face in the development of orthodontics, and aesthetics is one of the important indicators for people to evaluate others [1] The chin is an important structure that constitutes the lower third of the face, and changes in the size and shape of the chin not only affect the location and shape of other soft and hard tissues of the face, but also affect the coordination and balance of the jaws. Therefore, the shape of the chin is also an important factor to consider in orthodontic treatment design, mainly including the shape of the soft and hard tissue of the chin [2, 3]

1. Gender Differences in Chin Morphology

Scholars such as Tatiana [4] have found that men have wider chin than women and consider chin width as a feature of sexual selection; chin thickness is similar in men and women. Huda Abutayyem [5] concluded that males have more prominent lips and chin than females. This may be because men have thicker soft tissue structures. The lips of adult men in the UAE looked more backward with reference to the E plane, which was more due to soft tissue protrusion in the chin. Tatjana Perović [6] used cephalometric techniques to compare male and female facial soft tissue thickness (FSTT) characteristics in 120 patients with different malocclusion, with thicker facial soft tissues in male patients with Class I and Class II division 2 malocclusion than in female patients, and thicker facial soft tissues in mentolabial folds and chin in female Class II division 1 patients. In FSTT, there was no significant difference between male and female patients with Class III malocclusion.

2. The shape of the chin is associated with the vertical skeletal facial types

Harshal Santosh Patil [7] et al concluded that in skeletal class II, the high-angle group showed greater chin soft tissue thickness at Pog-Pog 'than the low-angle and mean-angle groups; the low-angle group showed greater chin soft tissue thickness at Me-Me' and Gn-Gn 'than the mean-angle and high-angle groups; and that all STC (Soft tissue thickness of the chin) were greater in men than in women. Anthony Tannous Macari [8] concluded that chin soft tissue thickness measurements were smaller in adults in the high-angle group than adults in the mean-angle and low-angle groups; all STC values were higher in males than in females, consistent with the Harshal Santosh Patil's study. T. M. Perović ć [9] concluded that in skeletal class I patients, there was a significant difference between the low-angle and high-angle groups on Gn-Gn '; there was a significant difference between the mean-angle and high-angle groups on Me-Me', but no significant difference was found on Pg-Pg '; in addition, they concluded that patients in the high-angle group had thinner soft tissues on Gn-Gn' and Me-Me ', but not on Pg-Pg'.

Domestic scholars such as Meng Jing and others [3] concluded that the lateral appearance of soft tissues, especially the chin morphology, is obviously different in different vertical skeletal facial types

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of skeletal Class II. There are differences in chin shape between high and low angle malocclusion, which are mainly manifested as different chin heights. Zhou Han [10] concluded that there is an interconnection between different vertical skeletal facial types of skeletal Class II and mental morphology, and patients in the skeletal Class II low-angle group have a wider and more prominent mental morphology than patients in the high-angle group, and there is a correlation between the morphological characteristics of the chin and different vertical skeletal facial patterns. Both are consistent with the study results of Sun Yi [11] .

Liu Jia [2] et al. concluded that the soft tissue profile, especially the shape of the chin is significantly different under different vertical skeletal facial patterns. Different vertical skeletal facial types had a significant effect on the soft and hard tissue morphology of the chin in patients with Angle 's Class II division 1 malocclusion, while gender and body mass index had little effect on it. The bone index is not completely consistent with the soft tissue index, and the soft tissue surface pattern has some independence. Wang Wenting [12] concluded that among patients with Class II division 1 malocclusion of different vertical skeletal facial patterns, the upper lip convexity gradually increased, the facial convexity gradually increased, and the chin morphology developed to inconspicuous from low to mean and then to high angles. The mechanism of causing the difference between Class ii division 1 malocclusion patients with different vertical facial patterns mainly focuses on the structure of the lower lip and chin, the thickness of the base of the lower lip, and the thickness of the soft tissue at the chin apex.

Jia Peizeng [13] et al. concluded that there were differences in the shape of the chin between skeletal Class I adolescent females with different vertical skeletal facial patterns, mainly manifested as different chin heights; the results of this study showed that the chin angle in the high-angle group was smaller than that in the mean-angle group and the low-angle group, suggesting that there was some counterclockwise rotation of the chin itself in those with high angles, and this rotation partially counteracted adverse changes such as chin retraction caused by steep mandibular plane and maintained the coordination of soft and hard tissue facial patterns in the sagittal direction. This also reflects coordination and compensation mechanisms between different structures. Fan Jiabing [14] found that the shape of the chin in adult female patients with skeletal Class I high angle was not obvious, relatively slender, and the lower anterior teeth were lingually inclined, which was related to the occurrence of posterosuperior rotation of the chin with high angle, which was consistent with Jabezeng [13] 's point of view; in addition, he chin morphology of low-angle patients is thicker and shorter, and the chin is more prominent; the adult female bony Class I chin morphology is associated with vertical orientation development.

Liu Ziyang [15] pointed out that the shape of the chin in patients with skeletal Class III is generally better than that in patients with skeletal Class II, and the curvature of the chin is deeper, and its position will also be relatively anterior due to the overdevelopment of the mandible, but the shape of the chin in patients with high-angle Class III tends to be poorly developed, the corresponding soft tissue chin is tense, and the mentolabial furrow are not obvious. This is consistent with Shu Yan [16] et al. `Guanmer [17] concluded that individuals with different vertical skeletal facial patterns had different chin morphologies, which was consistent with the former study; patients with skeletal class III high-angle had thinner chins and low-angle type had a shorter chin height; the high-angle group had a small chin angle and a large chin curvature, which was more elongated and flatter from the morphological point of view, and the low-angle was the opposite.

3. The shape of the chin is related to the sagittal skeletal facial types

Wang Ling [18] studied adolescents in Gansu Province and concluded that the characteristics of class II patients are mainly characterized by anterior protrusion of the upper lip and the lower lip’s morphology of such patients shows recession and ectropion of the lower lip due to the depth of the chin-labial groove in the chin is higher than class I and class III, while the chin protrusion of such patients is smaller, thus indicating that the chin of class II patients is underdeveloped. Class III patients are mainly characterized by lower lip relative to protrusion, and greater tension, their mentolabial furrows are shallow, and their chin length is long, so the chin of such patients is characterized by protraction and the shape of the chin is relatively slender, while the shape of the chin of Class II patients is relatively stout. In fact, it also shows that the chin of class III patients is overdeveloped, and the chin of class II patients is relatively underdeveloped.

Meng Jing [19] studied adolescents in Xi'an and concluded that the chin of skeletal Class II

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malocclusion was underdeveloped relative to normal syndesmosis, with a small mentolabial angle, a deep mentolabial furrow, a large arc, and a small protrusion. However, skeletal Class III malocclusion was overdeveloped relative to the normal symphysis chin, with a large mentolabial angle, shallow mentolabial furrrow, smaller arcs, and larger protrusion.

4. Clinical Significance of Chin Morphology

Chin morphology is an important factor to consider when performing orthodontic treatment designs [20] To adults, the shape of the chin has been unable to be changed by orthodontic means, and in order to achieve aesthetics of the profile, the position of the lip shape can only be adjusted when the nasolabial chin is coordinated. Especially for borderline cases, when the protrusion of the chin is large under the same other conditions, even if the incisors are labially inclined, it is acceptable from the perspective of aesthetics and coordination of the nose, lips, and chin, and the possibility of orthodontic treatment without tooth extraction increases; conversely, when the protrusion of the chin is small under the same other conditions, the labial inclination of the incisors easily destroys the coordination of the nose, lips, and chin, thus increasing the possibility of tooth extraction correction. The same is true for chin thickness, where the anterior teeth can move or tilt more labiolingually with greater chin thickness, while the opposite is true for those with smaller chin thickness, which is very important for the non-surgical treatment of bony malocclusion. Therefore, chin morphology has important reference significance in borderline cases of tooth extraction. Orthodontic means alone are unable to change the shape of the chin, can only compensate for the coordination of the relationship between the various tissue structures of the profile, so that the profile is improved. It is important to understand the influence of different bone facial shapes on the chin morphology to guide the orthodontist in clinical orthodontic diagnosis and treatment design. Patients with skeletal Class II malocclusion guide the mandible forward during growth and development to promote the growth and development of the chin, and can also mask the hypoplasia of the chin by tooth extraction or lip abduction of the lower anterior teeth. Skeletal Class III malocclusion inhibits mandibular growth and inhibits growth and development of the chin during growth and development. When the patient belongs to a critical case of tooth extraction, the protrusion of the chin will determine whether the coordination of the nose, lips, and chin can be altered after lip extension of the incisors. If malocclusion is severe, orthognathic surgery or chin plasty may be considered to address the cosmetic aspect of the profile.

5. Measurement Methods for Chin Morphology

Broadbent [21] and Hofrath [22] proposed cephalometric techniques have been widely used, and orthodontists are clinically used for the diagnosis and treatment of dental, jaw, and facial deformities based on measurements of soft and hard tissues. The landmarks were determined by tracing on the lateral cephalometric radiograph, and then the certain line distance, angle and line distance ratio delineated according to these landmarks were measured and analyzed to understand the structure of the skull, jaw, face, and teeth and their relationship with each other, so as to understand the internal structure of the teeth, jaw, and face and understand the mechanism, nature, and location of the deformity, which was helpful to make a correct diagnosis and correction design.

In recent years, with the popularization of CBCT, three-dimensional models are established by surface scanning images, and the internal structure of teeth can be analyzed and measured. The popularization of cone-beam CT has greatly improved the diagnostic rate of oral soft and hard tissue diseases, which is conducive to the planning of correction plans, as well as the expected judgment of treatment. Orthodontists are now beginning to widely embrace CBCT with a low radiation dose that is easily accepted by patients; high-definition three-dimensional images can accurately locate important anatomical landmarks and reduce errors in diagnostic measurements; and short shooting times reduce the impact of head position on images [23]

6. Conclusion

In clinical orthodontic treatment, the chin is located in the lower third of the face, which affects the aesthetics of the facial profile together with the nose and lips. With the improvement of cosmetic requirements, successful orthodontic treatment requires not only good occlusal relationship, but also good soft tissue profile, so the chin has far-reaching significance in the fields of orthodontics, aesthetics and plastic surgery. In the process of clinical diagnosis analysis, treatment planning and prognosis

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evaluation, comprehensive consideration and analysis should be made according to different vertical bone surface types, sagittal bone surface types, gender and mental morphological characteristics.

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