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Measurement and Clinical Significance of Gingival Biotype in Anterior Teeth

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ABSTRACT

The morphological characteristics of periodontal tissue and tooth tissue in gingival biotype are one of the indicators reflecting the individual differences of periodontal tissue in patients. Gingival biotypes of anterior teeth are often related to the prognosis of smile aesthetic treatment, which is one of the reference indexes for predicting the success rate of aesthetic treatment such as restoration, implant, periodontal, orthodontic and so on. Gingival biotypes have individual differences, so different gingival biotypes have different responses to different external stimuli. In the current clinical work, the correct evaluation of gingival biotype, especially the accurate measurement of gingival thickness, is the basis of reasonable choice of treatment and prognosis evaluation.

1. Introduction

With the continuous improvement of people’s quality of life and aesthetic, the requirements of patients for oral restoration effect are not only limited to the restoration of occlusal function, but also hope to get a more natural, beautiful and harmonious restoration effect, especially in the anterior teeth area, more and more attention is paid to the aesthetic and long-term effects. Different gingival biotypes have different histological characteristics. As one of the important factors affecting aesthetic restoration, correct evaluation of gingival biotype before treatment can not only increase the success rate of treatment, but also accurately judge the prognosis. Clinically, gingival biotypes have been widely concerned. This paper reviews the gingival biotypes.

2. Definition of Gingival Biotype

Ochsenbein first proposed the concept of gingival biotypes. At the same time, oechsenbein divided gingival biotypes into “thin type” and “thick type” according to different clinical characteristics and anatomical morphology of gingival tissue. Gingival biotypes can be divided into broad sense and narrow sense. Generalized gingival biotype refers to periodontal phenotype, which is used to describe the morphological characteristics of alveolar bone, tooth body and gingival soft tissue affected by gene and environmental factors. Gingival biotype in narrow sense refers to periodontal biotype, which is used to describe the characteristics of periodontal soft tissue and alveolar bone tissue, reflect the thickness of gingiva, the width of keratinized gingiva, the shape of crown and the height of gingival papilla, and is related to the quantity and shape of alveolar ridge below.

3. Measurement of Gingival Biotype

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3.1 Direct Observation

This method does not need any tools. Doctors can judge the gingival biotype by naked eye observation of oral soft and hard tissue characteristics and clinical experience. Kan [7] et al. Measured gingival biotypes by visual assessment, periodontal probing measurement and direct measurement after tooth extraction, and pointed out that the visual assessment of gingival biotypes was not reliable enough to obtain accurate classification. Although this method is fast, economical, simple and often used in clinical practice, it is not recommended for clinical use because of its strong subjectivity and lack of diagnostic criteria.

3.2 Direct Measurement

The direct measurement method needs to be carried out under local anesthesia. The doctor uses an enlarged file with a marker valve to probe into the gingiva at 2 mm from the root of gingival margin perpendicular to the bone surface, and then the reading is measured. The accuracy of this method has been greatly improved. However, due to the trauma of the operation and the different acceptance of the patients, there is a certain resistance in the popularization of the method. At the same time, due to the influence of the angle of penetration and the position of the enamel cementum boundary, the measurement data also has some errors. Clinicians can consider the use of local anesthesia after obtaining the consent of patients.

3.3 Transparent Method of Periodontal Probing Observation

Kan [1] et al. Proposed a method to determine the periodontal biotype by probing the periodontal probe into the gingival sulcus. If the probe contour is visible, it is thin gingival type, if not, it is thick gingival type. Memon [4] proposed that the periodontal probing method is a reliable and objective measurement method, which has no statistical difference compared with direct measurement. In 2018, Fischer [5] proposed to use the double ended periodontal probe to determine the gingival morphology. This method also classifies the gingival biotype by observing the contour of the periodontal probe. The probe can be used at both ends, with the diameter of 0.50 mm at one end and 0.75 mm at the other end. If the tip with a diameter of 0.75 mm can be observed, it is classified as thick gingival type; if the diameter is 0.5 mm, it is classified as thick gingival type. If the tip of 0.75 mm cannot be observed, it is medium thick type. Some scholars such as Ledi [6] have also proved the feasibility of this method by measuring gingival biotypes of Chinese people. Compared with direct measurement, this method is basically non-invasive and widely used in clinical diagnosis and treatment. However, it is only qualitative analysis, and it also has measurement subjectivity, so its accuracy is not as good as direct measurement, especially in aesthetic area.

3.4 Cone Beam CT (Cone-beam Computerized Tomography, CBCT)

CBCT is mainly used for developing oral hard tissue. For soft tissue of teeth, radiation development technology can be used to coat developer on gingival surface with impression to make measurement more accurate. In this method, gingiva and labiobuccal mucosa are separated by means of isolation device of labiobuccal mucosa, and the thickness of gingiva is accurately measured by CBCT through image processing technology [7]. Borges [8] and others have proved that CBCT is an effective and quantifiable method for determining gingival biotype. Amid [9] proposed that CBCT can be used to measure gingival biotype and facial soft and hard tissues. Nikiforidou [10] and others conducted a cross-sectional study using CBCT. The results showed that among 42 periodontal healthy subjects, about 50% of gingival biotypes were thin gingival type and thick gingival type, and the rest were medium thick type. However, CBCT also has limitations, because it mainly carries out quantitative analysis and cannot judge the inflammation state of gingiva. Therefore, in order to avoid misjudgment, the oral cavity of patients should be examined and gingival biotypes should be classified under the condition of periodontal health [11]. Although CBCT has large amount of information, high accuracy and small trauma, its cost is high and its popularity rate is low, so its clinical use is limited.

3.5 Evanson Method (Iwansons Gauge)

This method is mainly used to clamp the gingival flap to be measured with Evanson instrument. Rathee [12] used this method to measure gingival biotypes of 115 young people in northern India, and proposed the evidence that there may be medium thick gingival biotypes in addition to thin gingival type and thick gingival type. Although the accuracy of this method is high, it needs to use flap or measure after tooth extraction, which is traumatic and difficult to be accepted by patients.

3.6 Ultrasonic Measurement

Rajpoot [13] and others carried out ultrasonic measurement on incisors, canines, premolars and molars of 50 peri-
4. Influencing Factors of Gingival Biotype

4.1 Alveolar Bone Thickness

There was a positive correlation between alveolar bone thickness and gingival thickness. Amid [14] et al. performed CBCT scanning on the gingival thickness and alveolar bone thickness at 2,4,6 mm of the labial enamel cementum boundary of 621 upper anterior teeth. The results showed that the bone thickness of each point of the two gingival biotypes were significantly different, and the alveolar bone covered by thick gingiva was also thicker. Younes [15] and other studies also confirmed a positive correlation between gingival thickness and alveolar bone thickness.

4.2 Width of Attached Gingiva

Previous studies on gingival biotypes have not included the discussion of attached gingival width, and the correlation between the two is still controversial. Some studies have shown that the width of attached gingiva of the thick gingival biotype is larger, but Kaya [16] and others have carried out clinical research on the mandibular anterior teeth with crowding dentition, and found that there is no obvious correlation between the two.

4.3 Crown Aspect ratio

The influence of tooth morphology on gingival biotype has been recognized by many scholars. The larger the ratio of clinical crown width to length is, the thicker the gingiva is. That is, the smoother the gingival arc and the lower the height of gingival papilla, the thicker the gingiva. Therefore, the classification method is also vividly called “thick flat type” and “thin fan type”.

4.4 Depth of periodontal pocket

Deep periodontal pocket is easy to form in thick gingival type when periodontal tissue inflammation occurs, while gingival recession and root surface exposure are easy to occur in thin gingival type when periodontal tissue inflammation occurs. Muller [17] and others found that even in healthy periodontal tissue, the depth of periodontal probing in patients with thick gingival biotype is greater and the gingival sulcus is deeper, but this index needs more clinical research to confirm.

4.5 Biological Width

The width of connective tissue in the crown of alveolar ridge is about 1.07mm, and the biological width (BW) is about 2.04mm, which is composed of 0.97mm and 0.07mm respectively. After the eruption of adult teeth, the combined epithelium adheres to the enamel cementum boundary. Therefore, in periodontal healthy people, the biological width is the distance from the top of alveolar ridge to the enamel cementum boundary. Belgian scholar younes [18] measured the distance from labial enamel cementum boundary to labial alveolar ridge top of 21 patients with maxillary central incisors by CBCT, and the result was (1.98 ± 0.92) mm. Zhao Yuxiao [19] measured and analyzed CBCT imaging data of 118 Chinese subjects’ maxillary central incisors. The results showed that the distance from labial enamel cementum boundary to labial alveolar ridge top of maxillary central incisors was (2.63 ± 0.98) mm It is suggested that the distance from enamel cementum boundary to labial alveolar ridge top may be of racial difference. Whether the biological width is related to gingival biotype has also attracted scholars’ attention. In Zhao Yuxiao’s study, no correlation was found between the distance between the enamel cementum boundary of maxillary central incisor and the top of labial alveolar ridge and gingival biotype.

4.6 Gender

Small sample size studies often suggest that there is no significant difference in gingival thickness between men and women. Joshi [20] and others studied the upper anterior teeth of 400 men and 400 women, and the results showed that there was a significant difference between male and female gingival biotypes. The proportion of thin gingival biotypes in women was higher, and the alveolar bone of women was thinner than that of men. The study of Agarwal [21] and others also confirmed the influence of gender on gingival biotype.

5. Clinical significance of gingival biotype

5.1 Application in Traditional Restoration

The thin gingival biotype is prone to gingival recession under the stimulation of inflammation. Therefore, clinicians should carry out personalized treatment in the aspects of mold removal, tooth preparation and crown edge placement when facing patients with thin buccal gingiva. For the patients with thin gingival biotype, the use time of gingival retraction line should not exceed 15min. The
edge of gingiva should not be damaged during shoulder preparation. The edge of prosthesis should be placed on the gingiva, because slight chronic stimulation or trauma may cause gingival recession, and the gingival transparency of thin gingival biotype is good. If the edge of porcelain fused to metal crown is placed under the gingiva, it may be permeable. Out of the metal edge color, thus affecting the beauty.

5.2 Application in Planting

According to hamsah [22], the buccal alveolar bone of the patients with thin gingiva is relatively thin, which may cause buccal alveolar bone invagination and narrow buccolingual alveolar bone after tooth extraction, thus affecting implant and orthodontic treatment; generally, tooth extraction cavity preservation or ridge preservation procedure are required. Mousa [23] believes that the risk of gingival recession and alveolar bone absorption in patients with thin gingival biotype is much higher than that in patients with thick gingival biotype. Even if implant with transfer platform, it is difficult to maintain the morphology of soft and hard tissue, while patients with thick gingival biotype can better predict the implant effect. Sch curated [24] and others studied 48 non-implantable immediate implants, and found that the presence rate of gingival papilla in patients with thick gingival biotype was 84%, while that in patients with thin gingival biotype was 42.8%. Misi [25] and others also believe that the thick gingival biotype has better regeneration ability in gingival papilla reconstruction than thin gingival biotype. However, Siqueira Jr s [26] and others believed that gingival thickness had no effect on the filling degree of gingival papilla. It is certain that the existence of gingival papilla depends on the distance between the implant and adjacent teeth (ITD) and the distance from the base of the contact point to the inter dental bone (CPB). The biological width around the implant is called periimplant mucosal dimensions, which is usually 3 mm, which is 1 mm wider than the biological width of natural teeth. Like the biological width of natural teeth, the width of mucosa around the implant can also resist the invasion of external bacteria, so it is necessary to ensure a certain width of mucosa around the implant. The thickness of peri implant mucosa was in direct proportion to gingival thickness. The thickness of peri implant mucosa in thin gingival biotype was less than 3 mm, while that in thick gingival biotype was > 4 mm. Linkevicius [27] and others suggested that it is best to place implants at the level of or under the alveolar crest of patients with thin gingival biotype; if the implants are placed above the alveolar crest, it will lead to the absorption and destruction of the alveolar crest, which may be related to the insufficient width of the mucosa around the implant. For the implant of maxillary anterior teeth, because it is located in the red aesthetic area, the thick biological gingiva can not only maintain the health of surrounding tissues, but also form enough peri implant “Biological width”, and the amount of gingival retraction after surgery is less, which can reduce the occurrence of “black triangle” of gingiva in anterior teeth area. Therefore, if the gingiva is too thin before planting, soft tissue transplantation should be performed to thicken the gingiva [28].

5. Summary

At present, most of the subjects related to gingival bioavailability are Caucasians, and there are few studies in China. The gingival biotypes have great ethnic differences [34], so we can not rely on foreign research results to define the gingival characteristics of the domestic population, but also need to conduct more in-depth discussion and Research on the gingival biotypes of Chinese people, so as to better serve the clinical work.

References


