

Effects of maxillary protraction therapy on facial soft tissue in patients with skeletal class III malocclusion.

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Abstract

Objective: To explore the effects of maxillary protraction therapy on facial soft tissue in patients with skeletal class III malocclusion (Occ).

Methods: From May 2016 to March 2017, 25 patients with skeletal class III malocclusion enrolled in our hospital were chosen as the study objects. All patients were treated with rapid maxillary expansion and protraction, and changes of their facial soft tissue profile were measured and analysed before and after therapy.

Results: After treatment, distance from the nasal apex to the Y axis (Y-Prn), upper lip angle (S-Ns-Sn), the upper lip protrusion distance (UL-E), convex upper lip thickness (UL-U1), distance from upper lip concave point to Y axis (Y-As), distance from labrale superius to Y axis (Y-UL) and chin angle (LL-Bs-Pos), thickness of symphysis (Pos-Po), soft tissue under the high (Sn-Mes) and H angle were all increased. And these data contrasts were significant before and after the treatment ($P < 0.05$). After treatment, soft tissue facial angle (FH-Ns Pos), lower lip base angle (S-Ns-Bs), and the distance from soft tissue pogonion to the Y axis (Y-Pos) were decreased. And these data contrasts were significant before and after the treatment ($P < 0.05$).

Conclusion: Maxillary protraction therapy can improve the facial soft tissue of patients, move up the upper lip and improve mentolabial relationship.

Keywords: Maxillary protraction, Rapid expansion correction, Skeletal class III malocclusion, Facial soft tissue.

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Introduction

Skeletal class III malocclusion is the abnormal growth of the teeth and its incidence is about 5% to 14%, which would become worse with the growth of teeth. In the treatment of skeletal class III malocclusion, the maxillary protraction therapy can improve patients' defects in maxillary hypoplasia greatly, and thus significantly straighten the skeletal class III malocclusion [1]. In patients with class III malocclusion, 65%-67% of which exhibit retraction of the upper jaw. Therefore, it's necessary to select an appropriate way to improve the maxillary [2]. In this research, 25 patients with skeletal class III malocclusion were selected as the research objects, and they were all treated with maxillary protraction. And the influence of maxillary protraction therapy on the facial soft tissue was analysed.

Data and Methods

Patients

From May 2016 to March 2017, 25 patients (15 males and 10 females) with skeletal class III malocclusion enrolled in

Qingdao Central Hospital were selected as the research objects. All patients are 8 to 14 y old with the average age of 9.5 ± 2.5 y old. All cases were diagnosed as Hellman III B stage, which was presented as maxillary hypoplasia, mandibular normal or slightly projecting forward, anterior crossbite or full dentition crossbite and mandibular not back to the cut position. All cases have never received any orthodontic treatment and none of them had family history.

Materials

The spiral expander (standard type) and front traction mask (adjustable) produced by Xinya Automation Meter Factory in Hangzhou, and the elastic rubber ring produced by ORMCO Company in America [3].

Straightening method

Rapid maxillary expansion should be performed prior to protraction and should be straightened 2 times a day, one in the morning and another in the evening with 90° per time. It's not until patients' upper posterior tooth tip can touch the tip of the lower buccal tip did these operations stop. According to patients' transverse development situation, after ligation of the

fixed orthodontic force for 7-14 d, it's time to ligate and fix the spiral afterburner hole in the tooth, and then start the front traction. Traction direction was under and forward, and it's included angle with occlusal plane angle was 25 to 30°. Each side should be forced about 4.9 N. It should be wear as much as possible except the eating time, which meant patients should wear it more than 12 h per day for about 7 months [4].

X-cephalometric analysis: The head X-ray examination was performed before and after treatment. After examination, the lateral radiographs were traced and measured by the same person. A stable reference system is used in this study, that is, the X axis is a plane parallel to the center of the Sella (S) and the orbital plane (FH), and the plane S is perpendicular to the X axis as the S point [5]. Measurement index are as follows: Y-Prn (distance from nasal vertex to the Y axis), Y-As (distance from upper lip concave point to Y axis), Y-Bs (distance from lower lip concave point to Y axis); Y-UL (distance from the upper lip protrusion point to Y axis), UL-E (upper lip convex distance), UL-U1 (upper lip thickness), S-Ns-Sn (upper lip base angular), LL-E (lower lip convex distance), LL-Bs-Pos (chin angle), Pos-Po (chin thickness), Sn-Mes (soft tissue under high), FH-Ns Pos (angle H, soft tissue pogonion distance to the Y axis), S-Ns-Bs (lower lip angle), Y-Pos (distance from soft tissue pogonion to the Y axis), Cm-Sn-UL (nasolabial angle).

Observation index

The facial soft tissue profile changes were measured and analysed before and after treatment.

Table 1. Analysis on surface measurement index of soft tissue changes before and after treatment.

Treatment	FH-Ns Pos (°)	S-Ns-Sn (°)	S-Ns-Bs (°)	Y-Prn (mm)	Sn-Mes (mm)
Before treatment	91.34 ± 2.62	89.23 ± 14.36	93.14 ± 2.04	86.78 ± 6.45	65.24 ± 2.67
After treatment	87.42 ± 2.71	97.89 ± 14.23	87.62 ± 2.47	91.02 ± 5.43	71.38 ± 2.53
t	5.19	2.14	8.61	3.41	8.34
P	0.037	0.033	0.037	0.041	0.036

Note: there was significant difference before and after treatment P<0.05.

Table 2. Analysis on changes of lip soft tissue measurement index before and after treatment.

Treatment	Cm-Sn-UL (°)	UL-U1 (mm)	UL-E (mm)	LL-E (mm)	Y-As (mm)	Y-UL (mm)	Y-Bs (mm)
Before treatment	98.49 ± 9.02	13.76 ± 2.47	-3.02 ± 2.17	1.57 ± 2.03	74.21 ± 6.56	78.62 ± 7.13	76.39 ± 7.32
After treatment	93.03 ± 9.78	15.62 ± 2.03	0.24 ± 2.52	2.65 ± 2.28	76.92 ± 4.23	83.64 ± 6.32	72.04 ± 7.96
t	2.05	2.90	4.17	2.21	2.09	2.63	2.01
P	0.032	0.042	0.019	0.045	0.039	0.026	0.030

Table 3. Analysis on the measurement index of chin shape before and after treatment.

Treatment	Pos-Po (mm)	Y-Pos (mm)	LL-Bs-Pos (°)	H (°)
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Statistical method

The data were analysed with SPSS19.0 statistical software. All measurement data were presented as mean ± standard deviation and tested by t-test. Counting data was expressed as percentage and tested by Chi-square test. P<0.05 suggests that the difference is statistically significant.

Results

Analysis on patients' changes of soft tissue profile before and after treatment

With the comparison of and analysis on two groups' changes of soft tissue profile before and after treatment, the data showed that patients after treatment were obviously better than those before treatment (Table 1).

Analysis on lip soft tissue measurement index changes before and after treatment

With the analysis on changes of patients' lip soft tissue measurement index before and after treatment and the data showed that there was a big difference before and after treatment (Table 2).

Analysis on the change of the soft tissue's chin shape before and after treatment

The comparison found that there was significant difference in the change of the soft tissue's chin shape before and after the treatment (Table 3).

Before treatment	10.67 ± 1.65	74.68 ± 9.07	144.10 ± 8.63	6.18 ± 5.62
After treatment	13.27 ± 1.36	70.03 ± 6.21	152.64 ± 6.82	12.43 ± 2.18

t	6.07	2.11	3.88	5.18
P	0.025	0.021	0.011	0.017

Discussions

Skeletal class III malocclusion is a kind of disease that results from ateliosis of maxilla. Years of clinical researches show it will be better to treat skeletal class III malocclusion with maxillary protraction, which can change patients' bones and teeth obviously and promote patients' recovery effectively [6,7]. These mainly include: mesial movement of the upper molar, maxillary forward displacement, lower incisor tongue tilting, maxillary counter clockwise rotation, mandibular clockwise rotation, upper incisor lip inclination, and distal molar movement [8]. As to the current clinical effect, maxillary protraction is thought to be an effective method for orthodontic treatment. It can improve patients' mentolabial relationship effectively, thus changes patients' soft tissue profile and has a remarkable treatment effect on patients [9]. Therefore, an important goal is to obtain a more consistent profile in the treatment of skeletal class III malocclusion.

After the protraction, the shape and spatial position of the soft tissue had changed, which made the convexity of the surrounding tissue become more obvious and improved the depression profile of the patients significantly. It was mainly because after the therapy of the maxillary protraction, patients' maxilla moved forward, while the mandible rotated backward, leading to the position changes on the mandibular soft tissue coverage space. Thereby it effectively improved the facial soft tissue especially the position of mentolabial, and changed the facial profile [10,11]. The soft tissue changes with the bone remodeling, and the soft tissue changes are closely related to the change of the hard tissue while the extent of improvement is related to the soft tissue itself [12]. The hard tissue changes more obviously in the upper lip and chin area. The forward growth of the maxilla and alveolar bone effectively alter the invagination position of the upper lip, but have slowly responded to lower lip and cause less effects on regulation [13]. In addition, the increase of craniofacial height in soft tissue is mainly caused by clockwise rotation of mandible.

There are many factors that affect the changes of facial soft tissue, mainly including the growth and development, related tissue changes and characteristics of their own. For the formation of an ideal profile, the development of the nose, the position of the upper lip, the position of the lower lip, and the chin position of the soft tissue are closely related. [14]. The growth of maxillary bone will affect the position of the upper lip, and at the same time inhibit the development or direction of the mandibular, which thus changes the position of the soft tissue chin lip toward maxillary anterior teeth and lower anterior teeth move to the tongue. These will directly affect the position of the upper and lower lips. Especially for patients with skeletal class III malocclusion, it's common that the upper incisors are covered by the lower lip after the reduction of the occlusion. Therefore, the upper incisor not only affects the patient's upper lip position, but also affects the position of the

lower lip [15,16] And the conditions above can influence the location of the upper and lower lips, the shape, tension and thickness of the lips. UL-U1 is closely related to the location of the upper teeth.

It is better to do the anterior traction at the peak stage of growth and development with the potential of rapid growth of the jaw to improve the treatment. The neutral traction applied to the bony suture around the maxilla could stimulate the maxillary sutures and the cell activity, which survives the osteoblast and osteoclast, promotes the suture of bone remodeling effectively, and advances the growth of maxillary bone [17]. At the peak stage of growth and development, the plasticity of bone tissue is strong. When the orthodontic force is involved, it is easy to be changed, thus achieving significant and stable bone change. At the time of deceleration, the developmental potential of the jaw is weak. The straightening of patients' teeth makes their alveolar bone and the forward tooth lip incline forward, which can just compensate for the deficiency of the maxillary bone to a certain extent but cannot play a compensatory role [18]. For patients with malocclusion of skeletal type III caused by hypoplasia of maxilla, orthodontic treatment or post-adolescent treatment is simply performed on the anterior lip. Its effect is limited to the alveolar process change, which is it only changes the convexity of upper lip and patients' base of the upper lip remains depression. Patients' face cannot be effectively improved. The patients in this study are all in the peak period of growth and development, so their treatment effects are obvious, and their facial profiles have been improved significantly.

To sum up, maxillary protraction therapy has obvious treatment effects on patients with skeletal class III malocclusion. Before and after treatment the changes of soft tissue in each group are significantly different. The research shows that maxillary protraction therapy can significantly improve patients' facial profile and deserves clinical promotion and application.

References

1. Xiong Z, Ke J, Zhao G. The effect of combined protraction and protraction on the soft tissue changes of skeletal Class III malocclusion. *Chinese J Aesthetic Med* 2016; 25: 78-81.
2. Qiao Y, Qiao A, Li Y. Retrospective study of maxillary protraction in the treatment of maxillary hypoplasia. *China Pract Med* 2014; 16: 26-27.
3. Chao J, She P, Qian L. Changes of nasal morphology before and after replacement of skeletal Class III malocclusion with combined rapid maxillary expansion and maxillary protraction. *Chinese Gene Pract* 2013; 16: 3976-3978. Chen XH, Xie XQ. The effect of two different methods of rapid maxillary expansion on treatment results of skeletal class III malocclusion patients with maxillary protraction in early permanent dentition. *Shanghai J Stomatol* 2012; 21: 580.
4. Feng Y, Zhang L, Chen W. CT observation of the effect of rapid maxillary protraction in the treatment of bony

- crossbite at the replacement stage. *Progress in Modern Biomedicine* 2015; 15: 6074-6077.
5. Chen X, Wu Z, Liu D. Study on CBCT combined with rapid palatal expansion affect airway malformation patients of class III malocclusion anterior traction. *J Shandong Univ (Health Sci)* 2015; 53: 71-78.
 6. Wang H, Qi S, Zhang C. Cone-beam CT evaluation of upper airway following rapid maxillary expansion and maxillary protraction for the treatment of skeletal class III malocclusion. *J Pract Stomatol* 2016; 32: 532-536.
 7. Hino CT, Cevidanes L HS, Nguyen TT. Three-dimensional analysis of maxillary changes associated with facemask and rapid maxillary expansion compared with bone anchored maxillary protraction. *Am J Orthodont Dentofac Orthop* 2013; 144: 705-714.
 8. Li H, Zhu G, Huang W. Application effect of multi-slices spiral ct in orthodontic treatment of skeletal crossbite during mixed dentition by rapid maxillary expansion device combined with anterior traction. *Med Innov China* 2016; 13: 123-126.
 9. Yu S. Clinical effect of rapid maxillary expansion protraction therapy with maxillary deficiency in skeletal class III malocclusion in children. *Anhui Med Pharm J* 2016; 20: 1889-1891.
 10. Zhang Y, Shen G. The effects of maxillary protraction treatment with rapid maxillary expansion for skeletal class III malocclusion. *Shanghai J Stomatol* 2016; 25: 327-333.
 11. Lu J, Zhang M. Research on hyrax appliance in the treatment of mixed dentition skeletal class III malocclusion with maxillary protraction. *China Med Cosmetol* 2015; 5: 95-96.
 12. Tian R, Xie X, Gao Y. Evaluation of the treatment of mixed dentition skeletal class III malocclusions with screw traction. *Chinese J Gene Pract* 2016; 14: 1480-1482.
 13. Li B. Clinical study on treatment of early permanent dentition class (occlusal) with rapid palatal expansion and ahead of traction. *Guide China Med* 2017; 15: 30-31.
 14. Zhang H, Sun X, Zhang H. Correction of skeletal class III malocclusion with maxillary protraction. *Chinese J Aesthetic Plast Surg* 2015; 26: 109-111.
 15. Chen X, Liu D, Liu J. Three-dimensional evaluation of the upper airway morphological changes in growing patients with skeletal class iii malocclusion treated by protraction headgear and rapid palatal expansion: a comparative research. *Plos One* 2015; 10: 0135273.
 16. Sun D, Wang H, Li J. Influence of protraction appliance on the development and profile of maxilla and mandible in children with skeletal class III malocclusion. *Prog Mod Biomed* 2017; 17: 2106-2109.

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