EFFECTS OF ORTHODONTICS COMBINED WITH PROSTHODONTICS ON CEPHALOMETRIC VALUES OF HARD TISSUE, ANGLE VALUES OF SOFT TISSUE, OVERBITE AND COVERAGE OF ANTERIOR TEETH IN PATIENTS WITH ANGLE'S CLASS II MALOCCLUSION

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ABSTRACT

Objective*: To explore the therapeutic effect of orthodontics combined with prosthodontics on patients with Angle's Class II malocclusion.*

Methods: *A total of 97 patients with Angle's Class II malocclusion admitted to our hospital from January 2017 to February 2019 were selected as research objects. Fifty-one patients received orthodontics combined with prosthodontics, which was regarded as combined group (CG). The other 46 patients only received orthodontics treatment, which was regarded as routine group (RG). The clinical efficacy, oral function, incidence of adverse reactions, occlusal angle, soft tissue angle, overbite and coverage of anterior teeth and satisfaction were compared between the two groups.*

Results: *The cure rate, masticatory function and language function scores in CG were higher than those in RG (P<0.05), while the incidence of adverse reactions was lower than that in RG (P<0.05). After treatment, the angle SNB was higher than that before treatment, while the angle ANB, overbite and coverage of anterior teeth were lower than that before treatment (P<0.05). After treatment, the FH-B'LL, H angle and Ns-Sn-Pos in CG were higher than those in RG, but the LL-B'-Po was lower than that in RG (p<0.05). After treatment, the E Angle, A'UL-B'LL, Z angle UL, S-N'-B', LL-B'-Po were all lower than before treatment, while FH-B'LL, H angle and Ns-Sn-Pos were all higher than before treatment (P<0.05).*

Conclusion: *Orthodontics combined with prosthodontics is effective and safer in the treatment of Angle's Class II malocclusion, which can coordinate the development of maxilla and mandible and improve the patient's facial shape to a certain extent. It is worth popularizing in clinic.*

Keywords: *Angle's Class II malocclusion, orthodontics combined with prosthodontics, ANB, soft tissue, overbite of anterior teeth.*

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Introduction

Malocclusion is a very common oral disease in dentistry, which is more common in teenagers and children. It is a very complex disease in the process of oral growth and development[(1)]. At present, it is believed that the occurrence of malocclusion is closely related to many genetic factors and external factors in clinic, including family history, bad oral habits, mixed dentition disorder, trauma, periodontal disease and many other conditions, which may cause malocclusion[(2)]. According to the survey, more than 5%~15% people suffer from different degrees of malocclusion in the world[(3)], and this number has been on the rise in recent years[(4)]. Malocclusion not only has a great influence on the beauty of teeth, but also may cause abnormal development of craniofacial, resulting in oral dysfunction and periodontal diseases. In more serious cases, the probability of oral cancer diseases will be greatly increased[(5)]. Therefore, the treatment of malocclusion has long been a hot topic in clinical research.

In order to facilitate the diagnosis and treatment of malocclusion in clinic, the diseases are usu-

ally classified according to Anger's classification (Anger's)[6]. Angle's Class II malocclusion refers to distal malocclusion, which is a very common malocclusion, accounting for about 12% ~ 20% of all patients[7], and it is also a kind of disease with great difficulty in treatment[8]. The surgical treatment (traditional treatment methods for malocclusion) of Angle's Class II malocclusion requires moving bone blocks to improve the effect of malocclusion. This operation has a great possibility to cause negative effects on chewing function and tooth beauty[9], so it is not applicable. A safe, reliable and effective scheme is urgently needed in clinical practice to treat Angle's Class II malocclusion. Orthodontics combined with prosthodontics is a non-operative scheme commonly used in the treatment of congenital missing teeth, and its therapeutic effect on tooth defect and missing has been recognized clinically[10, 11].

Not only that, but some studies have proposed that orthodontics has achieved excellent results in treating Angle's Class II malocclusion[12]. However, there are still few related studies on the application of orthodontics combined with prosthodontics in Angle's Class II malocclusion. We have suspected that orthodontics combined with prosthodontics may have a significant effect on Angle's Class II malocclusion, and it is safer than surgery. In order to confirm our conjecture, we explored the effect of orthodontics combined with prosthodontics on Angle's Class II malocclusion in this experiment, aiming to provide a reliable theoretical basis for future clinical treatment of such patients.

Materials and methods

Research objects

From January 2017 to February 2019, a total of 97 patients with Angle's Class II malocclusion admitted to our hospital were selected.

Patients were selected in strict accordance with the inclusion and exclusion criteria (Patients met the diagnostic criteria of Angle's Class II malocclusion)[13]:

• The age was 12~40 years old;

• Craniofacial structure and function were normal;

• Patients had the ability to take care of themselves;

• Patients with active bleeding and other periodontal diseases were excluded;

• Patients with other cardiovascular and cerebrovascular diseases, autoimmune defects, mental diseases and organ dysfunction were excluded;

• Pregnant and lactating patients were excluded;

• Patients with incisor compensation were excluded;

• Patients who transferred to other hospital were excluded).

This study has been approved by the Ethics Committee of our hospital, and the investigation has been carried out with the knowledge and consent of all subjects.

Methods

Ninety-seven patients were admitted to hospital. Next, fifty-one patients received orthodontics combined with prosthodontics, which was regarded as CG. The other 46 patients only received orthodontics treatment, which was regarded as RG. Treatment plan in RG: Oral cavity was cleaned before surgery, oral X-ray examination was completed, and alveolar bone and temporomandibular joint were carefully examined. The positioning, middle and terminal jaw plates were made with free traction hooks and stainless steel square wires.

The gap was closed, the occlusal relationship was adjusted in place to ensure that the sagittal position relationship remained ideal, and the overbite relationship of anterior teeth was adjusted. Then, the operation was completed until the conditions of dentition and abutment teeth were satisfied. After orthodontic treatment for 3 days, patients in CG received prosthodontic treatment.

After investigating the characteristics of malocclusion, teeth and periodontal conditions, the medical staff used standard straight wire arch to correct the upper and lower dentition positions and adjust the relationship between teeth and bones. The patient's upper and lower dental arch was adjusted to reduce the interference of the jaw. In both groups, the correction period was 12 months.

Observation indexes

Clinical efficacy

The occlusal relationship of the affected teeth returned to normal, the tooth torsion was not developed, the dentition was arranged in order, and there was no gap in the dentition, which was judged as markedly effective; The occlusal relationship was obviously better than that before treatment, the tooth torsion was reduced, the dentition was basically neat, and there was no obvious gap in the dentition, which was judged as effective; If the clinical efficacy did

not conform to the above judgement, it was ineffective. The cure rate was calculated in the two groups. Cure rate = (patients with markedly effective+patients with effective)/total ×100%.

Oral function

The patients were investigated before and after treatment with the self-made mastication and language function rating scale, with a total score of 24. The higher the score, the better the function.

Adverse reactions

The adverse reactions were recorded from the beginning of treatment to the completion of treatment, such as occlusal elevation, no occlusal contact, periodontal diseases. The incidence of adverse reactions was calculated. Incidence of adverse reactions = the number of cases/total number of adverse reactions ×100%.

Occlusal angle

The head positioning photo was taken by the doctor in our hospital. When taking the photo, the patient's head was in a natural relaxed state, and the upper and lower lips were naturally closed. The head positioning photo was fixed and measured for 3 times, and the results were averaged. It included angle of sellar point - nasion - upper alveolar point (<SNA), angle of sellar point - nasion - lower alveolar point (<SNB) and angle formed by upper alveolar point, nasion and lower alveolar point (<ANB), which were investigated before and after treatment.

Soft tissue angle

The operation was the same as above, including E angle, angle of inclination of lower liple (FH-B'LL), upper and lower lip angle (A'UL-B'LL), H angle, Z angle UL, convexity angle (Ns-Sn-Pos), soft tissue facial angle (FH-Sn-Pos), lower lip base angle (S-N'-B') and mentolabial sulcus angle (LL-B'-Pos), and these were investigated before treatment and after prognosis for 1 year, respectively.

Occlusion and coverage of anterior teeth

The oral model was made in the mouth of the patient, and the oral cavity was measured by vernier caliper, ruler and compass outside the mouth. They were investigated before and after treatment.

Patients' satisfaction

After treatment, the self-made dental aesthetic satisfaction questionnaire in our hospital was used to investigate, and the full score was 100 points. A score above 90 indicated satisfactory; 80~89 was basically satisfaction; A score below 80 indicated unsatisfactory. The satisfaction rate was calculated. Satisfaction rate = (patients with satisfactory+patients with basically satisfaction)/total ×100%.

Statistical methods

The results of this experiment were analyzed and processed by SPSS22.0-statistical software. The counting data were used to calculate percentages and record in the form of (%). The Chi-square test was used for comparison between groups. The measurement data were used to calculate the mean and record in the form of (mean ± standard deviation). The independent sample t test was used for comparison between groups.

The paired t test was used for comparison before and after treatment. The difference was statistically significant with $p<0.05$.

Results

Comparison of baseline data

By comparing the age, BMI, course of disease, marital status, family history, smoking and gender, it was found that there was no difference in the two groups (P>0.05), which confirmed that patients were comparable in the two groups. (Table 1).

	CG (n=51)	RG (n=46)	t or χ^2	P
Age (years old)			0.553	0.596
	24.1±12.8	25.6±11.9		
BMI (KG/cm^2)			0.697	0.488
	18.64±4.75	17.94±5.14		
Course of disease (years)			0.166	0.868
	2.14±1.42	2.09±1.54		
Marital status			0.336	0.562
Married	35 (68.63)	29 (63.04)		
Unmarried	16 (31.37)	17 (36.96)		
Family history			0.078	0.780
Yes	18 (35.29)	15 (32.61)		
No	33 (64.71)	31 (67.39)		
Smoking			0.072	0.788
Yes	28 (54.90)	24 (52.17)		
No	23 (45.10)	22 (47.83)		
Gender			0.053	0.819
Male	30 (58.82)	26 (56.52)		
Female	21 (41.18)	20 (43.48)		

Table 1: Comparison of baseline data [n(%)].

Comparison of clinical efficacy

By comparing the clinical efficacy in the two groups, it was found that the cure rate was 96.08% in CG, which was higher than that in RG (82.61%, P = 0.029). (Table 2).

	Markedly effective	Effective	Ineffective	Cure rate (%)
CG (n=51)	30 (58.82)	20 (39.22)	2 (3.92)	96.08
RG (n=46)	22 (47.83)	16 (34.78)	8 (17.39)	82.61
c^2				4.746
P				0.029

Table 2: Comparison of clinical efficacy [n(%)].

Comparison of oral functions

By comparing the oral functions in the two groups, it was found that there was no difference in mastication and language function scores between the two groups before treatment (P>0.05), while the mastication and language function scores in CG were higher than those in RG after treatment (P<0.05), and the mastication and language function scores in the two groups after treatment were higher than those before treatment (P<0.05). (Figure 1).

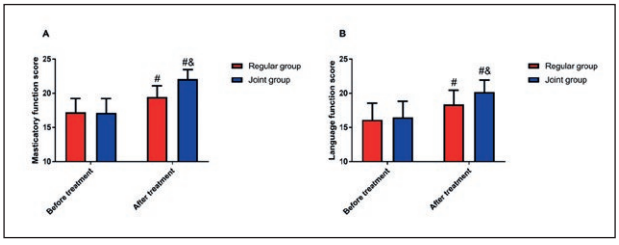

Figure 1: Comparison of oral function between the two groups. (A) Comparison of masticatory function scores between the two groups before and after treatment; (B) Comparison of language function scores between the two groups before and after treatment.

 # represents the comparison with the scores in the same group before treatment, #P<0.05; & represents the comparison with the scores in RG after treatment, &P<0.05.

Comparison of adverse reactions

By comparing the adverse reactions between the two groups, it was found that the incidence of adverse reactions was 7.84% in CG, which was lower than that in RG (23.91%) (P = 0.029). (Table 3).

	Occlusal elevation	No occlusal contact	Periodontal diseases	Dental caries	Food impaction	Incidence rate (%)
CG (n=51)	0 (0.00)	1 (1.96)	1 (1.96)	0 (0.00)	2 (3.92)	7.84
RG (n=46)	1 (2.17)	2 (4.35)	3 (6.25)	2 (4.35)	3 (6.25)	23.91
χ^2						4.778
P						0.029

Table 3: Comparison of adverse reactions between the two groups [n(%)].

Comparison of occlusal angles

By comparing the occlusal angles between the two groups, it was found that there was no difference in SNA, SNB and ANB angles before treatment, and there was no difference in SNA and SNB angles after treatment (P>0.05), but the ANB angle in CG was higher than that in RG (P<0.05). There was no difference in SNA angle between the two groups before and after treatment (P>0.05), while after treatment, SNB angle was higher than that before treatment, and ANB angle was lower than that before treatment (P<0.05). (Figure 2).

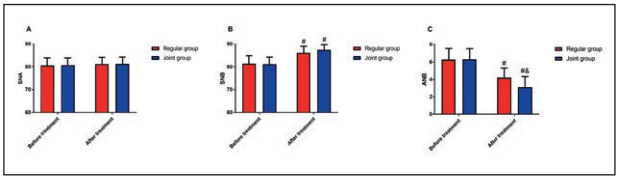

Figure 2: Comparison of occlusal angle between the two groups. (A) Comparison of SNA angle between the two groups before and after treatment; (B) Comparison of SNB angle between the two groups before and after treatment; (C) Comparison of ANB angle between the two groups before and after treatment.

 # represents the comparison with the same group before treatment, #p<0.05; & represents the comparison with the RG after treatment, &P<0.05.

Soft tissue angle

By comparing the soft tissue angles in the two groups, it was found that there was no difference in various indexes between the two groups before treatment, and there was no difference in E angle, A'UL-B'LL, Z angle UL, FH-Sn-Pos and S-N'-B' after treatment (P>0.05), while FH-B'LL, H angle and Ns-Sn-Pos in CG were higher than those in RG, and LL-B'-Po was lower than that in RG after treatment (P<0.05). After treatment, the E Angle, A'UL-B'LL, Z angle UL, S-N'-B', LL-B'-Po were all lower than before treatment, while FH-B'LL, H angle and Ns-Sn-Pos were all higher than before treatment (P<0.05).

Comparison of overbite and coverage of anterior teeth

By comparing the overbite and coverage of anterior teeth in the two groups, it was found that there was no difference in overbite and coverage of anterior teeth between the two groups before treatment (P>0.05), but the overbite and coverage of anterior teeth in CG were lower than those in RG after treatment (P<0.05). After treatment, the overbite and coverage of anterior teeth in both groups were lower than those before treatment (P<0.05). (Figure 4).

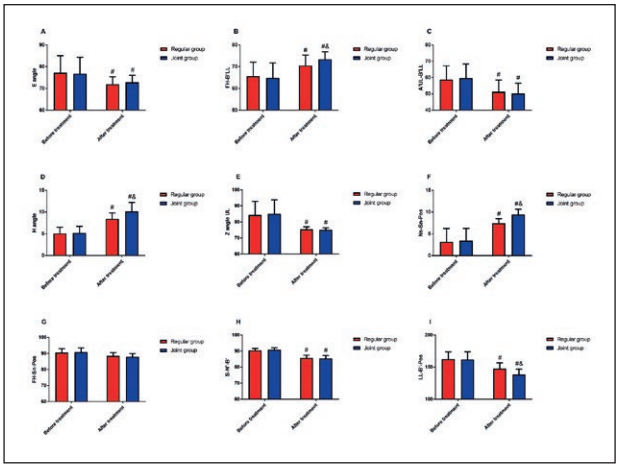

Figure 3: Comparison of soft tissue angles between the two groups. (A) Comparison of E angle between the two groups before and after treatment; (B) Comparison of FH-B'LL between the two groups before and after treatment; (C) Comparison of A'UL-B'LL between the two groups before and after treatment; (D) Comparison of H angle between the two groups before and after treatment; (E) Comparison of Z angle UL between the two groups before and after treatment; (F) Comparison of Ns-Sn-Pos between the two groups before and after treatment; (G) Comparison of FH-Sn-Pos between the two groups before and after treatment; (H) Comparison of S-N'-B' between the two groups before and after treatment; (I) Comparison of LL-B'-Pos between the two groups before and after treatment.

 # represents the comparison with the same group before treatment, #P<0.05; & represents the comparison with the RG after treatment, &P<0.05.

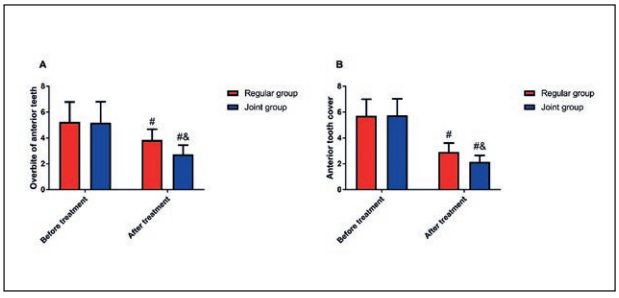

Figure 4: Comparison of overbite and coverage of anterior teeth between the two groups. (A) Comparison of the overbite of anterior teeth before and after treatment between the two groups; (B) Comparison of the coverage of anterior teeth before and after treatment between the two groups.

 # represents the comparison with the same group before treatment, #P<0.05; & represents the comparison with the RG after treatment, &P<0.05.

Comparison of satisfaction

By comparing the satisfaction of patients in the two groups, it was found that the satisfaction rate of CG was 96.08%, which was higher than that of RG (78.26%) (P = 0.008). (Table 4).

	Satisfactory	Basically satisfaction	Dissatisfied	Satisfaction rate (%)
CG (n=51)	35 (68.63)	14 (27.45)	2 (3.92)	96.08
RG (n=46)	17 (36.96)	19 (41.30)	10 (21.74)	78.26
χ^2				7.083
P				0.008

Table 4: Comparison of satisfaction between the two groups [n(%)].

Discussion

At present, the incidence of malocclusion is increasing year by year, so it is necessary to explore and find an effective way to treat malocclusion as soon as possible in clinic[14]. The effect of orthodontics has been confirmed in traditional periodontal diseases, and the effect on malocclusion is also remarkable[15]. In this study, it is confirmed that orthodontics combined with prosthodontics can achieve better results and provide reliable reference for clinical practice by exploring the treatment effect of orthodontics combined with prosthodontics on Angle's Class II malocclusion.

In this study, we first preliminarily evaluated the clinical efficacy of the two treatment methods. The results showed that the cure rate of the patients in CG was higher than that in RG, which suggested that the orthodontics combined with prosthodontics could improve the clinical efficacy of the patients. This is also consistent with Hariri et al.[16] 's research on the therapeutic effect of orthodontics combined with prosthodontics on tooth defects, which can prove the results of this experiment. Then, we compared the oral function in the two groups before and after treatment. The results showed that the masticatory function and language function in CG were higher than those in RG after treatment, which also suggested that the orthodontics combined with prosthodontics was more significant for the recovery of oral function. After that, we compared the adverse reactions between the two groups during treatment. The results showed that the incidence of adverse reactions in CG was lower than that in RG, which also indicated that the orthodontics combined with prosthodontics had higher safety and could be widely used in clinical practice.

Through the above evaluation, we preliminarily confirmed that the effect of orthodontics combined with prosthodontics was better than that of single orthodontics. In order to further evaluate the reasons of the differences caused by the two treat-

ment methods, we took the skull positioning photos of patients in the two groups and made a more detailed comparison. X-ray of lateral skull is the most obvious index to evaluate the development of maxilla and mandible in children[17], and SNA angle, SNB angle and ANB angle are important indexes to evaluate the positional relationship between skull base and maxilla and mandible[18].

In this study, we found that there was no difference in SNA and SNB between the two groups after treatment, and SNB in CG after treatment was higher than that in RG, while ANB was lower than that in RG. SNB angle and face angle represent the degree of mandibular protrusion and contraction. There is a high positive correlation between SNB angle and facial angle, which indicates that the SNB angle is larger and the mandible is anterior protrusion, while ANB angle has a negative correlation with facial angle and a high positive correlation with angle of conrexity. The larger the angle of ANB is, the more backward the relative position of mandible is[19, 20]. We have speculated that the reason may be that the number of research subjects included in this study is too small, which results in the chance of statistical analysis. Secondly, it may be that the maxilla is pulled forward during orthodontics, which stimulates the maxilla to move forward.

At the same time, the oral device is supported by mandible, and the sagittal relationship between maxilla and mandible tends to be coordinated by inhibiting the growth of mandible and improving the relative position of maxilla and mandible. However, there was no difference in SNA between the two groups before and after treatment. We have speculated that the upper and lower anterior teeth of patients with Angle's class II malocclusion (class 2) are too lingual inclined, and the tension between upper and lower lips is small. After orthodontics, the axial inclination of upper and lower anterior teeth improved, but the tension of upper and lower lips increased. The deformation of soft tissue caused the interaction of forward movement, which was why we further evaluated the change of soft tissue angle between the two groups. First of all, we found that there were significant differences in the soft tissue between the two groups after treatment, indicating that the soft tissue profile of the patients improved significantly after operation, which was consistent with the research results of Gonen et al.[21]. Moreover, the overbite and coverage of anterior teeth were significantly improved compared with those before orthodontics, which also showed that the malocclusion of patients in the two groups was effectively corrected to establish the normal maxillo-mandibular relationship after treatment. The prosthodontics can further promote the orderly arrangement of upper and lower dentition, promote the restoration of dental arch curve, and have a better preventive effect on the recurrence of malocclusion after operation.

Of course, there are still many shortcomings that need to be improved in this study. For example, our experimental period is short, we can't evaluate the prognosis and recurrence of patients in the two groups. For other types of malocclusion, we still don't know the effect of orthodontics combined with prosthodontics. Because there are too few research objects in this study, it is not ruled out that the comparison of some results is accidental. In view of the above deficiencies, we will carry out a more in-depth and comprehensive analysis as soon as possible to obtain the best experimental results for clinical reference.

To sum up, orthodontics combined with prosthodontics is effective and safer in the treatment of Angle's Class II malocclusion, which can coordinate the development of maxilla and mandible and improve the patient's facial shape to a certain extent. It is worth popularizing in clinic.

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