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Combined orthodontic and orthognathic treatment for mandibular prognathism with partial jaw deformity

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Objective: To investigate the clinical effect of combined orthodontic and orthognathic treatment in the treatment of mandibular protrusion with partial jaw deformity. Methods: The clinical effects of 18 cases of mandibular prognathism with partial jaw deformity were retrospectively analyzed by combined orthodontic and orthognathic treatment. Results: 2 of the 18 patients had lower lip numbness after the operation, and the symptoms disappeared after 1 year. The rest of the patients had no obvious recurrence after the operation and obtained a good occlusal relationship and satisfactory facial shape. Conclusion: Combined orthodontic and orthognathic treatment for mandibular prognathism with partial jaw deformity has a good clinical effect and few complications and can treat the patient's oral physiological function and facial aesthetics to the greatest extent.

Keywords: dentofacial deformities; Orthognathic surgery; Orthodontics (CLC number R783.50).

INTRODUCTION

Mandibular prognathism with partial jaw deformity is one of the more common skeletal deformities in clinical practice. Such patients not only have dental problems but also have abnormal jaw shape and position, lateral condyle development asymmetry, and so on. Such patients have three-dimensional deformities of the teeth and jaws, and the occlusal relationship is disordered. Some patients have temporomandibular joint symptoms. The treatment methods are complicated, and postoperative recurrence is easy. Therefore, combined orthodontic and orthognathic treatment is very important in the whole process of diagnosis and treatment.

MATERIALS AND METHODS

Case

2.1 General clinical patient's information

A total of 18 patients with mandibular prognathism with partial jaw deformity were treated in our department in recent two years, including 7 males and 11 females, aged 18 to 31 years old, with an average of 24 years old. All patients with chin deviation more than 3 mm from the midline of the face.

2.2 Patient's planes and surgical types

All patients received orthognathic surgery and rigid internal fixation, and orthodontic treatment before and after surgery.5 cases of bilateral sagittal split ramus osteotomy (*BSSRO)*, 4 cases of *BSSRO* + Genioplasty, 6 cases of LeFort type I osteotomy + *BSSRO*, and 3 cases of *LeFort type I* osteotomy + *BSSRO* + Genioplasty.

RESULTS

Clinical Results

All patients were followed up for 2 years without obvious recurrence. No obvious injury of the inferior alveolar neurovascular bundle was found during the operation. Two patients had numbness on one side of the lower lip after the operation, and the numbnes of the lower lip disappeared after 1 year of reexamination. The rest of the patients did not have lower lips after the operation. Complications such as numbness.

2.4 Typical case

A 20-year-old female patient, clinical diagnosis: mandibular prognathism with partial jaw deformity. The orthognathic surgery methods were: maxillary *Lefort I* osteotomy + mandibular bilateral sagittal split ramus osteotomy *(BSSRO)*, and satisfactory clinical results were obtained (Figures 1, 2, and 3).

Figure 1. Immediate photos: frontal, lateral profile before treatment and after treatment A: Before treatment; B: Before operation; C: After operation.

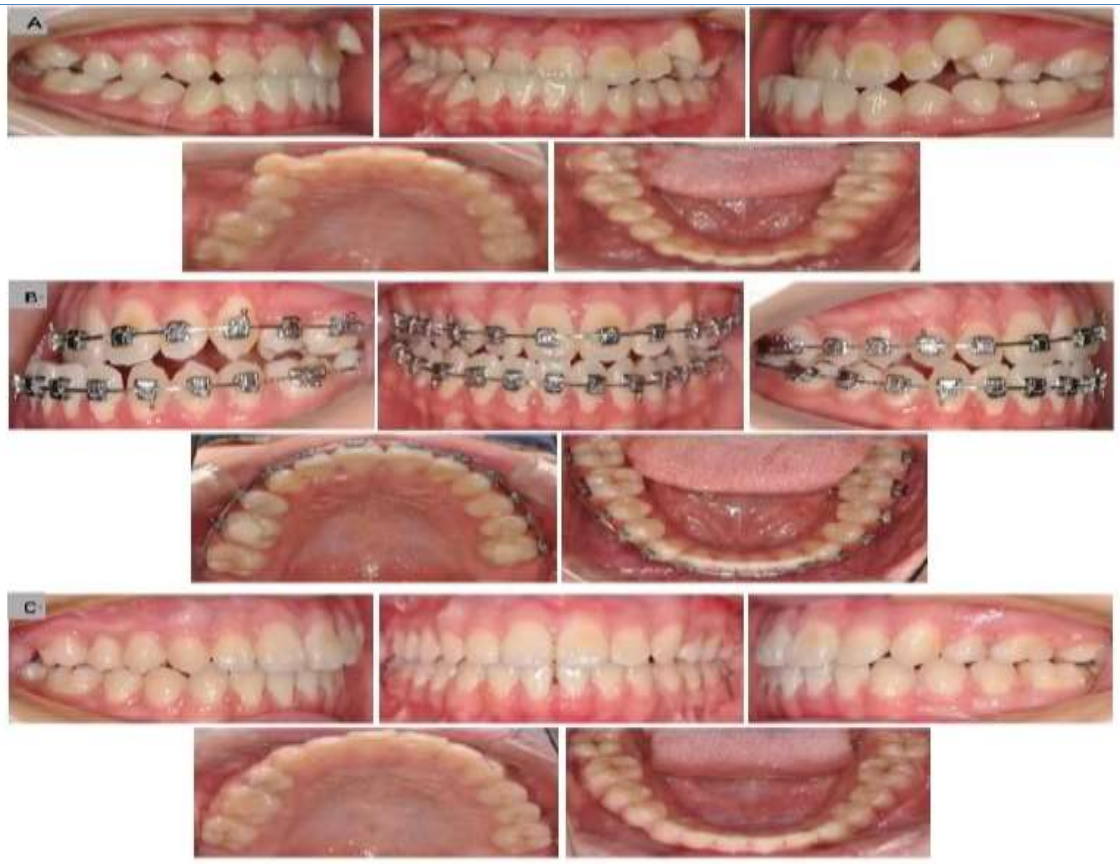

Figure 2: Intraoral views before and after treatment
A: Before treatment; B: Before operation; C: After operation.

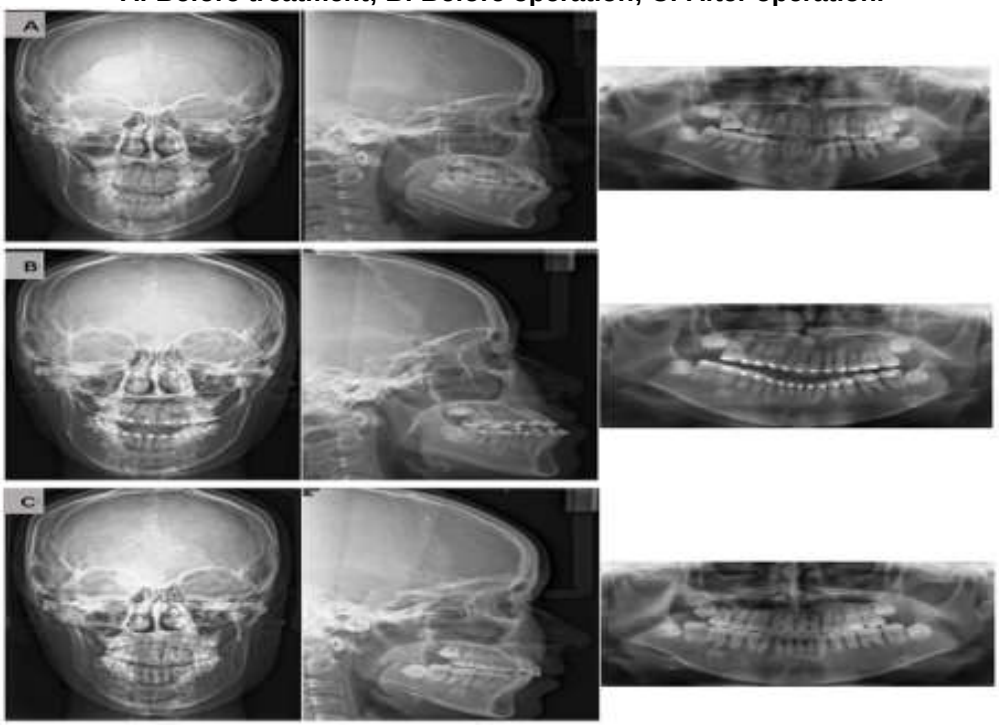

Figure 3: Radiograph views before and after treatment
A: Before treatment; B: Before operation; C: After operation.

DISCUSSION

3.1 The Research Background

The occlusal structure of the normal population is not completely symmetrical. (Lee et al. 2015) found that the incidence of facial asymmetry in Chinese people can reach 25%. Mild asymmetry is rarely noticed, and serious asymmetry is not. Symmetry not only affects aesthetics but can even cause functional impairment. (Mercier et al. 2014) found that mandibular deviation is more common in facial asymmetry. Mild skeletal class III with partial maxillary deformity can generally be achieved by conventional orthodontic masking treatment, while moderate to severe deformity is caused by underdevelopment of the maxilla or (and) significant prognathic deviation of the mandible, in addition to facial incongruity, It is also accompanied by severe dentition and occlusal relationship disorders, which requires close cooperation between orthognathic surgeons and orthodontists, and careful design of treatment plans to achieve satisfactory treatment results.

3.2 Three stages of combined orthodontic and orthognathic treatment and their importance

The first stage: is preoperative orthodontics: the fundamental purpose is to move the upper and lower teeth to their correct positions in the jaw as much as possible, that is, to decompensate, and guide the alignment of bone fragments in orthognathic surgery. It is also conducive to the stability of the occlusion and jaw position after surgery and achieves the purpose of restoring occlusal function and improving aesthetics, but it cannot be completely removed in clinical practice. The main difficulties in preoperative orthodontics: Remove the three-dimensional dental compensation of the patient; Coordinate the shape and width of the dental arch; Adjust the occlusal plane. (Reitzik et al. 1972) believes that if orthodontic treatment is not performed before surgery, only surgical osteotomy to regress the mandible to the normal position will lead to a disordered occlusal relationship and increase the possibility of postoperative recurrence. During the treatment process, the shape and width of the upper and lower dental arches should be constantly coordinated, and the model should be taken regularly for analysis to remove occlusal interference and prevent postoperative recurrence (Spalj et al. 2008).

The second stage : Orthognathic surgery: The purpose is to correct jaw deformities. Through preoperative simulation prediction and model surgery, a detailed surgical treatment plan is formulated. Orthognathic surgery is divided into maxillary surgery and mandibular surgery. In skeletal class III with partial jaw deformity, mandibular sagittal split and retraction, subapical osteotomy and retraction, and maxillary *LeFortI* osteotomy and advancement are usually used genioplasty, etc, and the final use of single-jaw or double-jaw surgery depends on the treatment plan. *BSSRO* is currently the most common method for surgical treatment of skeletal class III malocclusion. Significant changes occurred within.

The third stage of postoperative orthodontics: Strictly speaking, postoperative orthodontic treatment starts about 1-3 months after surgery. The principle of correction is the same as that of comprehensive orthodontic treatment, and the new jaw is maintained through slight intermaxillary traction. relationship to adapt the post-operative teeth to the new canine-fossa relationship. Generally, the bite plate is removed about 7 days after the operation, and intermaxillary traction and fixation are started. Since the jaw has not yet healed, the fixed traction performed during this period can play a role in fixing the jaw to promote healing, and it can also assist the traction consistent with the direction of the operation (Class III traction). Appropriate use of functional appliances can prevent a recurrence. It can prevent dislocation healing and postoperative recurrence (Kau et al. 2006).

3.3 Intraoperative and postoperative complications

Injury of the inferior alveolar neurovascular bundle is one of the common and serious complications in the treatment of mandibular prognathism in patients with hemocline deformity (Kim et al. 2007). The inferior alveolar neurovascular bundle is directly damaged during mandibular osteotomy and lingual tissue stripping. The exposure of the inferior alveolar neurovascular bundle during intraoperative dissection will cause long-term numbness of the lower lip after surgery, and even permanent numbness in severe cases. Sexual numbness. To avoid the occurrence of this complication, all patients should undergo three-dimensional CT reconstruction and oral panorama examination before surgery to understand the direction of the inferior alveolar neurovascular bundle and be familiar with individual anatomical differences, which can reduce the direct damage to the inferior alveolar nerve blood vessels during the operation. the probability of the beam (Yoshioka et al. 2010). The sagittal splitting operation should be performed skillfully. The thin osteotome should be used to enter the cancellous bone and gradual incline to the lateral bone plate. When it reaches the mandibular nerve canal, the operation should be performed close to the inner surface of the lateral bone plate, which can also reduce the damage to the nerve blood vessels. Intraoperative compression or injury. In this study, 2 patients had lower lip numbness after the operation, which may be related to the longer exposure time of the inferior alveolar neurovascular bundle during the operation, but it was not severed, so the patient's numbness disappeared after 1 year.

Causes of recurrence after surgery: ① The pulling effect of the skin and masticatory muscles on the jaw segment, after mandibular osteotomy, the muscle connective tissue and the tendon attached to the bone surface are pulled, which destroys the balance of the

neuromuscular and the distal bone after the operation. The segment must bear a larger and backward force than before the operation, resulting in postoperative displacement and recurrence. ② The influence of different internal fixation methods of the jaw, the intraoperative fixation material was improved from the early wire fixation to the strong internal fixation of titanium plate. Strong internal fixation can directly contact the broken ends of the bone, promote rapid bone healing, facilitate postoperative stability and reduce recurrence.

Intraoperative abnormal fracture or ectopic split: Usually caused by the operator's unfamiliarity with the anatomical relationship, inappropriate selection of intraoperative tools, and lack of careful preoperative design and analysis, often resulting in many postoperative complications (Veras et al. 2008). Ectopic splitting is generally caused by an incomplete incision of the medial and lateral cortical bone or when there is still a bone bridge, followed by excessive force when rotating and splitting the two bone segments. There were no abnormal fracture complications in this study. All patients underwent cephalometric frontal and lateral radiographs, oral and maxillofacial panoramic radiographs, and three-dimensional CT reconstruction examinations before surgery. Great convenience to minimize the occurrence of such complications.

3.4 Postoperative stability and influence on temporomandibular joint

Many factors can affect postoperative stability, including changes in the position of the *condyle,* the precision of the surgical procedure, the method of reduction of the condyle, the type of internal fixation, the duration of intermaxillary distraction, and the distraction of the muscles and ligaments attached to the mandible. These factors can affect postoperative stability either independently or intersect with each other (Joss et al. 2008). The reconstruction and changes of the temporomandibular joint after combined orthodontic and orthognathic treatment have always been the focus of attention of clinicians. Orthognathic surgery can achieve good results in skeletal class III with hemihedral deformity. Whether the impact of the joint *temporomandibular joint, (TMJ*) can cause joint symptoms is still controversial. Changes in the position of the mandibular condyle are considered to be a key factor in assessing postoperative stability and recurrence of patients (Santos et al. 2012). Orthognathic surgery can directly cause changes in the position of the mandibular condyle, but the results of different studies on the direction of postoperative condyle displacement vary. (De Paula et al. 2013) believed that the condylar shift direction after surgery was posterior and inferior, while (Santos et al. 2012) believed that the postoperative condyle shift was mostly anterior and inferior to the articular fossa. (Panula et al. 2000 and Scolozzi 2015) studies found that orthognathic surgery can improve the treatment of patients with temporomandibular joint dysfunction, and rarely has new adverse effects on the temporomandibular joint. A study arranged by (Katsumata et al. 2006) found that a new bone layer was formed in the posterior part of the condyle after orthognathic surgery in June, and the slight changes in the height of the upper part of the condyle, the inner and outer diameters, and the anterior and posterior diameters reflected the adaptability of the condyle in the new position. remodel. Some scholars (Kim et al 2015) believe that BSSRO will not have a significant impact on the TMJ of patients, some scholars (Yoon et al 2015) believe that the operation can improve the symptoms of the existing temporomandibular joint disorder (TMD), and some scholars (Hu et al. 2000) believe that While correcting the positional relationship between the jaws, surgery may cause changes in the positional structure of the TMJ, thereby producing or exacerbating the original TMD symptoms. The correction of bony partial occlusion is mainly through orthognathic surgery to adjust the position of the upper and lower jaws to achieve the same effect on the upper and lower midline. Rehabilitation training to treat the premaxillary muscles and temporomandibular joint function was started 4 to 5 weeks after the operation. The effect of postoperative orthodontics on the position of the temporomandibular joint needs more in-depth clinical research.

The Helkimo index is a commonly used objective quantitative index for evaluating *TMD.* (Kordass et al. 2012) found that the index has a strong correlation with intra-articular murmurs when the mandibular movement deviates. In addition to assessing the clinical symptoms of TMD, the Helkimo index also It can be used to evaluate the severity of TMJ lesions by imaging examination. (Chan et al. 2018) studied 81 patients with *TMJ* osteoarthropathy and found that the higher the Helkimo index, the more pathological changes in the condylar bone and the joint socket bone in the joint area were detected by CBCT examination. The more serious it is, the Helkimo index is considered to have a significant correlation with the bone changes of the condyle and the articular socket. The results of (Guo et al. 2020) showed that the Helkimo index at 12 months after BSSRO was the same as that before the operation, indicating that *BSSRO* had no significant effect on the TMJ symptoms of the subjects in this study. In this study, it was found in 18 clinical patients that no patients had obvious joint discomfort. The reason may be that BSSRO caused the displacement of the distal and middle mandibular segments backward, outward, and downward, and then due to the traction of the *TMJ* ligament. As a result, the condyle tends to return to its preoperative position, and the remodeling of the condyle in the articular fossa needs further observation. *TMD* is a syndrome caused by a variety of physical, psychological, and social factors. Its pathogenesis has not been fully elucidated. It is not rigorous to deduce the effect of BSSRO on TMJ only from the changes in postoperative joint symptoms. Changes in bone structure to further

explore whether the operation will affect the *TMJ.*

3.5 The relationship between orthognathic surgery and obstructive sleep apnea syndrome (*OSAS)*

Mandibular retraction is a traditional surgical procedure for the treatment of mandibular prognathism. Some scholars believe that mandibular retraction surgery may cause airway stenosis and lead to *OSAS*. In this regard, (Yu Fei et al. 2016) showed that simple mandibular retraction surgery can lead to airway stenosis, but it does not lead to OSAS. Whether it is simple mandibular retraction or double jaw surgery, there is currently insufficient evidence to show their effect on patients with *OSAS*, and further clinical research is needed. Research by (Kim et al. 2009) has shown that dental and maxillofacial deformities have certain effects on patients' masticatory function, appearance, and psychology. (Yu et al. 2013) analyzed the motivation of 400 orthognathic patients in mainland China and pointed out that 77.5% of the patients sought medical treatment to improve facial appearance, 65% to improve occlusion, and 62.75% to improve self-confidence.

CONCLUSION

All patients combined orthodontic and orthognathic treatment for mandibular prognathism with partial jaw deformity has a good clinical effect and few complication, and can treat the patient's oral physiological function and facial aesthetics to the greatest extent.

Clinically, the objective evaluation of the success of orthognathic surgery is generally based on the improvement of the patient's appearance, the stability of the jaw, and the good occlusal relationship, and the surgical effect is consistent with the patient's subjective requirements as much as possible. Although combined orthodontic and orthognathic treatment has significantly improved the patient's facial shape and occlusal relationship, how to strengthen the cooperation of orthognathic treatment; how to achieve more effective and complete decompensation; how to ensure the effect and expectation of orthognathic surgery The same; how to strengthen the jaw stability and occlusal relationship after surgery; how to avoid a wide range of compensatory orthodontic treatment after surgery etc, are the direction that orthodontic and orthognathic surgeons need to discuss and work hard together.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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AUTHOR CONTRIBUTIONS

JW designed, and supervise throughout the work and HH implemented and also wrote the manuscript. HH performed the data analysis. JW designed experiments and reviewed the manuscript. All authors read and approved the final version.

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