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〔ORIGINAL〕

The effects of sagittal ramus osteotomy for mandibular prognathism on maximum mouth opening and condylar movement

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Abstract

Maximum mouth opening and condylar movement before and more than 6 months after surgery were analyzed in 23 cases of sagittal ramus osteotomy of the mandible for correction of mandibular prognathism. Condylar movement (translation and rotation) did not show postoperatively a significant difference pre-and postoperatively, and then was a tendency to a reduction of maximum mouth opening was found.

Key words : Mandibular prognathism, Sagittal ramus osteotomy, Maximum mouth opening, Condylar movement.

Introduction

There are several reports of alterations in mandibular mobility following orthognathic surgery[1–7]. It is important to consider both the movement of the condylar translation and rotation in mandibular mobility[8]. There are some reports of mandibular border movement (mandibular opening, lateral excursion and protrusion) after surgery[9–12] but no information is available about alterations in condylar translation and rotation.

The aim of this study was to examine the effect of sagittal ramus osteotomy for mandibular prognathism on maximum mouth opening and condylar movement.

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Materials and Methods

The study includes 23 patients (4 males, 19 females of 17 to 38 years of age) who had mandibular sagittal ramus osteotomy for the correction of mandibular prognathism. X-ray observations were made at closed and maximum mouth opening positions before and more than 6 months after surgery. The images were measured systematically and analyzed. Thirty volunteers (30 females, 18 to 35 years of age) with no problems of the temporomandibular joint (TMJ), normal occlusal contacts, and normal bimaxillary relationships were examined with similar measurements.

Maximum mouth opening

The amount of maximum mouth opening was measured with a plastic ruler positioned between the incisal edges of the maxillary and mandibular central incisors. Subjects were asked three times to open the mouth as wide as possible; and the largest opening was recorded.

Radiographic investigation

Left and right transcranial TMJ radiographs were taken with the teeth in occlusion and with the mouth held open at the previously recorded largest opening. The measurements used a standardized lateral temporomandibular radiograph device (Morita Co, Ltd., Tokyo, Japan) consisting of an x-ray tube and a head positioner, including connected ear rods and cassette. The x-ray beam was placed at a 25° caudal angle to enter the upper parietal region and to exit in the TMJ region adjacent to the film (transcranial view).

Each radiograph was covered with tracing paper and the condyle, the glenoid fossa, the articular eminence, and postglenoid spine were outlined. The following landmarks were used (Fig. 1) : S, the point of the apex of postglenoid spine ; E, the point of the summit of the articular eminence ; F, the point on a tangent to the most superior aspect of the glenoid fossa parallel to

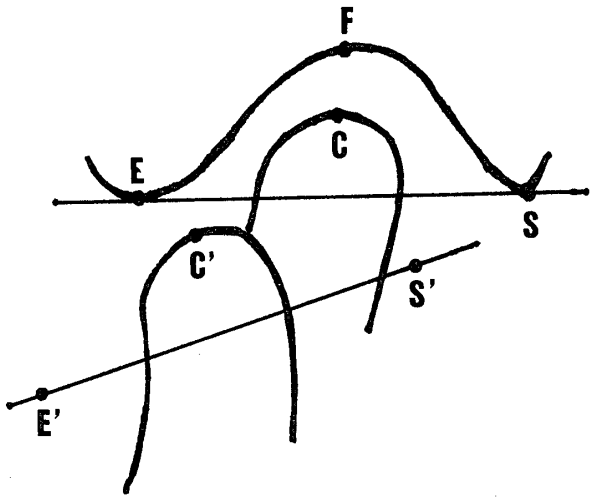

Fig. 1 Landmarks and reference line used for measuring the condylar movement. A more detailed explanation is provided in the text.

the S-E line that intersects the fossa ; C, the most superior point of the condyle ; C', E', and S', the C, E and S points superimposed on the condyle at both the closed and maximum mouth opening position.

The following linear and angular measurements were made : C-C' (condylar translation), the distance between points C and C'; S-E to S'-E' (condylar rotation), the angle between the S-E and S'-E' lines.

Linear and angular values were recorded and differences between the means were evaluated using the Student t-test. The reliability of the standardized lateral radiograph of the TMJ was described elsewhere[13].

Results

Maximum mouth opening

Mean maximum mouth opening in the patients of skeletal Class III before and after surgery were 49.5mm (SD 8.3) and 43.9mm (SD 7.5) respectively (Table 1). The difference was not significant. The value before surgery did not demonstrate a statistically significant difference in comparison with the control group 47.1mm (SD 5.1).

Condylar translation

Mean condylar translation in the controls and patients before and after surgery were 20.2mm (SD 2.7), 16.9mm (SD 6.1), and 15.2mm (SD6.4). Condylar translation did not decrease significantly following sagittal ramus surgery. However compared to the control group, the value was significantly lower ($P<0.01$) (Table 2).

Condylar rotation

The mean condylar rotation of the control group was 25.4° (SD 8.4) ; before surgery it was 24.4° (SD 9.4) ; after surgery, 21.5° (SD 10.2). Only the difference between the control group and patients after surgery was significant ($P<0.05$) (Table 3).

Table 1 Maximum Mouth Opening (mm)

	Mean±SD		Range
Control (N=30)	47.1±5.1		41.2−58.3
Preoperative (N=23)	49.5±8.3	*	36.5−70.1
Postoperatve (N=23)	43.9±7.5		32.2−62.7

* : Control and postoperative values were significantly different at $P<0.05$.
Preoperative and postoperative values were not significantly different.

Table 2 Condylar Translation (mm)

	Mean±SD		Range
Control (N=60)	20.2±2.7	*	11.1−26.8
Preoperative (N=46)	16.9±6.1	*	5.3−25.1
Postoperative (N=46)	15.2±6.4		6.1−24.5

* : Control and pre-/postoperative values were significantly different at $P<0.001$.
Preoperative and postoperative values were not significantly different.

Table 3 Condylar Rotation (degrees)

	Mean±SD		Range
Control(N=60)	25.4±8.4		11.5−40.9
Preoperative(N=46)	24.4±9.4	*	11.1−42.5
Postoperative(N=46)	21.5±10.2		7.3−43.8

* : Control and postoperative values were significantly different at $P<0.05$.
Preoperative and postoperative values were not significantly different.

Discussion

In this study, the mean value of the maximum mouth opening decreased after the mandibular setback by sagittal ramus osteotomy, but the decrease was not statistically significant.

A number of important variables must also be kept in mind when comparing the preoperative and postoperative measurements of maximum mouth opening. These chiefly include the condylar translation and rotation, and the length of the mandible.

Condylar translation and rotation

Condylar translation of skeletal Class III patients before surgery showed a statistically significantly lower value than the control group. However there were no significant differences in the condylar rotation of both groups. It has been thought that the restriction of condylar translation is mostly due to disc displacement without reduction[14]. In the patients here, the presence or absence of disc displacement without reduction was not clearly established because of the absence of MRI imaging or arthrography.

Mean values of both the condylar tarnslation and rotation decreased after surgery, but the degree of reduction were not significant. From these result, it seems that condylar movement was little affected by sagittal ramus sugery for mandibular prognathism. There are reports[1,4,6,15,16] that the reduction in maximum mouth opening was small in patients of skeletal Class III treated by intraoral vertical ramus osteotomy or sagittal ramus osteotomy, but in skeletal Class II patients receiving mandibular advancement by sagittal ramus osteotomy the reduction of maximum mouth opening was prominent. Neuromuscular reorientation and muscular stretching have been implicated in the reduction of condylar movement[11,17]. It seems that the procedure of mandibular setback is not the cause of alterations of muscle arrangement. Maxillomandibular immobilization was thought to develop the reduction of maximum mouth opening ,but this immobilization for periods up to 6 weeks may not have as strong an effect on mandibular function as once thought[6]. With animal experiments Lydiatt and Davis[18] stated that though intial immobilization produces destructive changes, the changes may well be

reversible. Although transient alterations in muscle fiber length and connective tissue proliferation may occur during rigid fixation[1], the functional restriction is usually transient.

The postoperative shortening of the mandible

Although in this series skeletal Class III patients before surgery showed a significantly low value in condylar translation but not in condylar rotation in comparison with the control group, the maximum mouth opening of the two groups showed no statistically significant difference. It is thought that one of the reasons is a larger mandible of skelletal Class III patients than the controls.

Theoretically, if the degrees of translation and rotation of the condyle before and after surgery do not change, the transverse movement of the mandibular incisal edeges may be decreased by the retroposition of the lower anterior teeth following postoperative shortening of the mandible. In our series the average reduction of mandibular length was 11.9㎜, and about a 10% reduction in postoperative maximum mouth opening was calculated mathematically considering hinge movement. However this is too simplistic and is biologically inaccurate as there is the possibility of changes in mandibular angle, ramus height, and over-bite.

Though condylar translation and rotation were not different before and after the surgery there was no significant reduction in the maximum mouth opening but only a tendency towards a reduction. This appears to be one of the results of the postoperative shortening of the mandible.

Conclusion

In this series of cases there was no systemic regimen of postoperative rehabilitation in jaw junction, but normal mouth opening was acquired more than 6 months after the sagittal ramus osteotomy for mandibular prognathism. This seems to fit well with current orthopedic thinking and experience with other joints[1]. Therefore it is suggested that the best course for patients to follow after the mandibular setback by sagittal ramus osteotomy is a conservative approach without active or vigorous jaw exercises.

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