Two Cases of Skeletal Open Bite Treated by Sagittal Splitting Osteotomy of the Mandibular Ramus

—A Comparison Between Successful Treatment and Subsequent Relapse—

Minoru HORI¹, Keiko OWADA¹, Toshihiko ISHII¹,
Hiromitsu YAMANOI², Toshiyuki KUNO¹,
Hiroshi TANAKA¹, Hideyuki KATO³ and
Michiyoshi TAKAHASHI⁴

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Abstract

Sagittal split-ramus osteotomy was performed on two patients with severe open bite due to Class I malocclusion. The original open bite was -9 mm in case 1 and -6 mm in case 2. After presurgical orthodontic treatment, these values were changed to -7 mm and -8 mm, respectively. The surgical procedure for treating these patients required mobilization of the mandible to close the open bite. The operation was successful in one case, but partial relapse occurred in the other during retention. The factors leading to the relapse were considered by comparison between the two cases.

Introduction

Open bite has been classified into simple open bite and compound open bite. Compound open bite has been defined as open bite existing from the premolar area, but not including the molars^[1].

In particular, adult patients with compound open bite have one of the most difficult problems to correct by orthodontics and oral surgery. Surgical-orthodontic correction of open bite malocclusion has frequently confused and frustrated clinicians, and severe open bite is a dentofacial deformity that has been reported to show one of the most marked tendencies to recur after treatment^[2].

堀 稔¹, 大和田恵子¹, 石井俊彦¹, 山野井弘充², 久野敏行¹, 田中 博¹, 加藤栄行³, 高橋道義⁴ :

1 *1st Department of Oral Surgery, Nihon University School of Dentistry*

2 *Department of Oral Surgery, Kasukabe City Hospital, Saitama*

3 *Private Orthodontist, Saitama*

4 *Private Orthodontist, Tokyo*

To whom all correspondence should be addressed: Dr. Hiroshi TANAKA, 1st Department of Oral Surgery, Nihon University School of Dentistry, 1-8-13 Kanda-Surugadai, Chiyoda-ku, Tokyo 101, JAPAN.

This report describes two cases of severe open bite of the Class I malocclusion type. Presurgical orthodontic treatment with alignment at the lower and upper arches was done for about 1 year, and the surgical procedure required mobilization of the mandible to close the open bite by sagittal split-ramus osteotomy. A comparison was then made of individual differences in these two similar cases, one of which showed partial relapse during retention, whereas the other did not. Two factors, one major and one minor, were identified as the cause of relapse.

Case Report

Case 1 (Table 1 and Figs. 1-4)

Clinical evaluation

The patient, a 17-year-old Japanese female, was seen for orthodontic treatment at Nihon University Dental Hospital. Her chief complaint was an inability to chew because of anterior open bite.

Clinical evaluation of the patient and examination of the records led to a diagnosis of Class I skeletal open bite due to slight retrusion of the maxillary anterior teeth with protrusion of the mandibular anterior teeth. It was observed that no excessive gingiva was displayed during smiling. Dentally, the molars were in Class I occlusion. There was slight crowding of the upper anterior teeth and there was a dental open bite between the right and left premolars. The only posterior teeth in contact were the first and second molars. A reverse curve of Spee of the mandibular occlusal plane was also present. It was also felt that the tongue was relatively large. An association between tongue thrusting and open bite has been recognized.

Table 1 Cephalometric measurements in case 1

Cephalometric Analysis						
Case No. _____	Name _____	Sex _____	y _____	m _____	Dr. _____	
Factor Analysis	9 yr. old Norm (S.D.) + Change w/ Age	JAPANESE at age 9	INITIAL	PRESURGERY	POSTSURGERY	RETENTION
Chin in Space						
1. Facial Axis	90'(3') None	86'(3) None	86.5	86.0	91.0	89.0
2. Facial Depth	87'(3') + 1'/3yr	86'(3') + 0.3'/Y	88.5	89.0	90.5	90.5
3. Mandibular Plane Angle	26'(4') - 1'/3yr	30'(4') - 0.2'/Y	30.0	29.5	25.0	26.5
4. Facial Taper	68'(3.5') None		62.0	61.5	64.5	63.5
5. Lower Facial Height	47'(4') None	49'(4') None	57.5	57.0	53.0	53.5
6. Mandibular Arch	26'(4') + 1/2/yr.	25'(4') + 0.3'/Y	27.0	28.0	32.5	31.5
Convexity						
7. Convexity	2mm(2) - 1mm/3yr.	4mm(2) - 0.2mm/Y	3.0	2.5	0.5	0.5
Teeth						
8. Lower Incisor to APO	+ 1mm(2) None	3mm(1.5) None	8.0	10.0	8.0	7.5
9. Upper Molar to PTV						
	Age + 3mm(2) + 1mm/yr	11mm(3) + 1.0mm/Y	25.0	23.5	24.0	24.5
10. Lower Incisal Angle	22'(2) None	25'(5') None	35.0	39.0	28.0	27.5
Profile						
11. Lower Lip to E Plane						
	-2mm(2')w/Gro. Decr.	+2mm(1.5) less protrusive	3.0	6.0	3.0	2.5

There was an anterior vertical over-bite of -9 mm, and an over-jet of 0 mm. Cephalometric evaluation showed that the facial axis was 86.5° , lower facial height 57.5° , convexity 3.0 mm and lower lip to E plane 3.0 mm.

Fig. 1 Pretreatment facial photographs, panoramic radiogram and intraoral photographs of dental occlusion (case 1)

Fig. 2 Intraoral photograph after presurgical orthodontic treatment (case 1)

Fig. 3 Intraoral photograph after postsurgical orthodontic treatment (case 1)

Fig. 4 Intraoral photograph during retention (case 1)

Treatment

The objectives of the treatment were reduction of the anterior facial height, alignment of the upper and lower dentition, and correction of the dental bite. The treatment plan devised to achieve the treatment goals called for presurgical orthodontic treatment to align the upper and lower dentitions and close the open bite by sagittal split-ramus osteotomy to rotate the mandible counter-clockwise. After presurgical orthodontic treatment, over-bite was -7 mm, and over-jet 2 mm.

The patient was admitted to the hospital on July 8, 1987, and sagittal osteotomy was performed the following day. Fixation of the lateral segment of the mandible was by intraosseous wiring. After completion of the lateral osteotomy and inferior border osteotomy, the mandibular ascending ramus was split. The masseter muscle, the medial pterygoid muscle and the stylomandibular ligament were then detached. An attempt was made to rotate the mandible counter-clockwise, but the desired occlusion could not be achieved because of the high

tension of the muscles. Several vertical incisions were therefore made through the lateral periosteum to help achieve improved relaxation of the soft tissue. The dental intermaxillary fixation was removed 8 weeks after the operation. Postsurgical orthodontic treatment was planned as the final stage of active treatment.

Treatment results

Relatively little change was observed in the overall facial appearance. Since facial esthetics were not the chief complaint and were not severely compromised by the lack of occlusion prior to treatment, this surgical technique allowed us to obtain good functional occlusion. The patient reported no paresthesia 3 months after surgery. However, after postorthodontic treatment, partial relapse during retention was noticed. After 3 years, slight open bite was present in the anterior tooth area. Over-bite was -1 mm, and over-jet 1 mm, but the lower and upper arches were acceptable.

Case 2 (Table 2 and Figs. 5-8)

Clinical evaluation

The patient, a 20-year-old Japanese female, was examined for surgical treatment on November 28, 1989 at Kasukabe City Hospital. The patient had been undergoing orthodontic treatment for one year to correct her initial malocclusion. Her chief complaints were inability to chew with the front teeth, and severe crowding of the upper and lower incisors,

Clinical evaluation of the patient and examination of the records at her private orthodontic clinic led to a diagnosis of Class I skeletal open bite. Over-bite

Table 2 Cephalometric measurements in case 2

Cephalometric Analysis						
Case No. _____	Name _____	Sex _____	y _____	m _____	Dr. _____	
Factor Analysis	9 yr. old Norm (S.D.) + Change w/Age	JAPANESE at age 9	INITIAL	PRESURGERY	POSTSURGERY	RETENTION
Chin in Space						
1. Facial Axis	90'(3') None	86'(3') None	83.5	84.0	89.0	90.0
2. Facial Depth	87'(3') + 1'/3yr	86'(3') + 0.3'/Y	90.0	90.5	94.0	94.5
3. Mandibular Plane Angle	26'(4') - 1'/3yr	30'(4') - 0.2'/Y	33.0	32.5	22.5	21.0
4. Facial Taper	68'(3.5') None		58.0	58.0	63.5	65.0
5. Lower Facial Height	47'(4') None	49'(4') None	55.0	55.0	48.0	46.5
6. Mandibular Arch	26'(4') + 1/2/yr.	25'(4') + 0.3'/Y	25.0	25.0	34.0	32.5
Convexity						
7. Convexity	2mm(2) - 1mm/3yr.	4mm(2) - 0.2mm/Y	2.0	-0.5	-2.5	-2.5
Teeth						
8. Lower Incisor to APO	+ 1mm(2) None	3mm(1.5) None	8.0	10.5	7.5	7.5
9. Upper Molar to PTV						
	Age + 3mm(2) + 1mm/yr	11mm(3) + 1.0mm/Y	26.0	25.0	25.5	24.5
10. Lower Incisal Angle	22'(2) None	25'(5') None	29.0	29.0	34.0	33.5
Profile						
11. Lower Lip to E Plane	-2mm(2')w/Gro. Decr.	+2mm(1.5) less protrusive	4.0	5.0	1.0	0.5

Fig. 5 Pretreatment facial photographs, panoramic radiograph and intraoral photographs of dental occlusion (case 2)

Fig. 6 Intraoral photograph after presurgical orthodontic treatment (case 2)

Fig. 7 Intraoral photograph after postsurgical orthodontic treatment (case 2).

Fig. 8 Intraoral photograph during retention (case 2)

was -6 mm, and over-jet was -2 mm. An upper right canine was impacted. Dentally, the molars were in Class I occlusion, and there was dental open bite between the right and left premolars. There was excessive palatal inclination and severe crowding of the upper incisors. The maxillary arch tended to be somewhat narrow and V-shaped, whereas the mandibular arch was wide and U-shaped.

Treatment

The objectives of treatment were reduction of the anterior facial height, alignment of the upper and lower dentition, and correction of the dental bite, as in case 1.

The plan devised to achieve the treatment goals called for presurgical orthodontic treatment of the upper and lower dentition, extraction of the upper right impacted canine, and sagittal split-ramus osteotomy to rotate the mandible counter-clockwise as in case 1. After presurgical orthodontic treatment, over-bite was -8 mm, and over-jet 0 mm. The patient was admitted to the hospital on

August 10, 1989, and sagittal splitting osteotomy was performed the following day.

Fixation of the lateral segment of the mandible was of the ridged internal type using 3 screws on each side. Dental intermaxillary fixation was removed 2 weeks after the operation. Postsurgical orthodontic treatment was planned in order to complete the therapy. This was expected to be minimal and of short duration because the presurgical orthodontic treatment had been satisfactory. Prosthetic replacement of the missing canine tooth was also recommended. Thus, use of sagittal splitting osteotomy alone proved to be sufficient.

Treatment results

An improvement in overall facial esthetics was obtained. Furthermore, good functional occlusion was achieved through the efforts of the orthodontic-surgical team. The patient reported no paresthesia 2 months after surgery.

Discussion and Conclusion

A variety of surgical techniques have been used and advocated for the correction of open bite deformity^[2,3]. These include surgical manipulation of the anterior maxilla and mandible, posterior maxilla, simultaneous anterior and posterior maxilla, mandibular body, and ascending ramus.

Ramus surgery is often used in cases where the suprahyoid muscle restricts counter-clockwise surgical movement of the mandible, resulting in open bite^[4]. Skeletal relapse after sagittal splitting osteotomy has been discussed by various authors^[5-7]. However, KASAZAKI et al.^[8] have reported the use of sagittal splitting osteotomy for severe skeletal open bite (over-bite of more than 10 mm), achieving good results without suprahyoid myotomy.

This paper has described the application of sagittal splitting osteotomy for two cases of severe skeletal open bite, one of which showed partial postoperative relapse during retention at the anterior teeth, revealing an over-jet of 1 mm and an over-bite of 1 mm, whereas the other case did not.

Relapse was evaluated clinically and by cephalometric tracing. The cephalometric evaluation is illustrated in Figs. 9 and 10. In each figure, the top panel shows the change produced by presurgical orthodontic treatment, the middle panel shows the change produced by surgery, and the lower panel shows the period from postsurgical orthodontic treatment until retention. The factors affecting relapse will now be considered by comparison of these two cases.

1) Dental factors

In case 1, the results of presurgical orthodontic treatment, shown by cephalometric tracing superimposed on the cranial base, revealed some extrusion of the maxillary anterior teeth. After surgical treatment, for example, during dental intermaxillary fixation, a slight increase in the extrusion of the upper and lower incisors occurred. This phenomenon was due to the problem encountered in obtaining desirable occlusion, which made counter-clockwise rotation difficult. Therefore, it was necessary to perform forceful intermaxillary fixation.

In case 2, presurgical orthodontic treatment produced labial tipping of the anterior maxillary teeth, and slight extrusion of the anterior teeth occurred.

The presurgical treatment successfully corrected the former problem. How-

Fig. 9 Case 1 Superimposition of cephalometric tracings
 pretreatment (—) and presurgical orthodontic treatment (·····)(top),
 presurgical orthodontic treatment (—) and postsurgery (·····)(center),
 and postsurgery (—) and retention (·····)(bottom)
 S₁: Changes in the chin and hyoid bone position
 S₂: Change in the A-point
 S₃: Intra-arch dental changes in the mandible
 S₄: Intra-arch dental changes in the maxilla
 S₅: Change in the soft tissue line

Fig. 10 Case 2 Superimposition of cephalometric tracings pretreatment (—) and presurgical orthodontic treatment (·····)(top), presurgical orthodontic treatment (—) and postsurgery (·····)(center), and postsurgery (—) and retention (·····)(bottom)

S₁: Changes in the chin and hyoid bone position
 S₂: Change in the A-point
 S₃: Intra-arch dental changes in the mandible
 S₄: Intra-arch dental changes in the maxilla
 S₅: Change in the soft tissue line

ever, no attempt was made to correct the latter condition at that time, unlike case 1 in which extrusion was the aim of the presurgical treatment.

After surgery, only the anterior mandibular teeth showed a tendency to relapse during retention. This result suggests that the presurgical orthodontic treatment was responsible for the extrusion of the anterior teeth. Therefore, in case 1, intermaxillary fixation may have been one of the causes of the relapsing tendency.

2) Skeletal factors (change in hyoid bone position)

According to cephalometric tracing superimposed on the cranial base, pre- and postsurgical skeletal and hyoid bone positions moved forward and upward. During retention, the hyoid bone position returned to the surgical position and the mandible similarly revealed a tendency to relapse. In contrast, after surgical treatment in case 2, the hyoid bone position changed in a backward and upward direction, and the mandible moved forward and upward.

WICKWIRE and his colleagues^[9] mentioned that any repositioning of the mandible in Class II and Class III cases resulted in a change of position of the hyoid bone and associated musculature. From the present two cases, it also seems that there was some degree of skeletal relapse associated with the procedure of sagittal splitting osteotomy alone, but not exclusively. During retention, the hyoid bone moved towards the presurgical direction, but the mandible did not, suggesting that the hyoid bone which was moved during surgery showed a tendency to relapse towards the presurgical direction during retention, this movement being most distinct in case 1. This may have been due to the geniohyoid muscle gradually pulling the mandible downwards and backwards during active postsurgical orthodontic treatment.

3) Fixation of the sagittal split fragments

In case 1, intraosseous wiring was performed, whereas in case 2 external rigid fixation with 3 screws on both sides was used. There are insufficient data for determining to what extent, if any, the method of fixation contributed to relapse. The amount by which the counter-clockwise rotation of the mandible would be restricted by the suprahyoid muscle and masticatory musculature could not be predicted. However, our experience with these cases suggests that selection of the most appropriate surgical procedure should be given more consideration when planning the treatment for cases of severe open bite.

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