Total alloplastic temporomandibular joint reconstruction combined with orthodontic treatment in a patient with idiopathic condylar resorption

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This case report describes the successful treatment of an adult patient with skeletal Class II open-bite malocclusion secondary to idiopathic condylar resorption. Total alloplastic joint reconstruction and counterclockwise rotation of the maxillomandibular complex combined with orthodontic treatment provided a satisfying outcome with maximum functional and esthetic improvement. (Am J Orthod Dentofacial Orthop 2011;140:404-17)

Diaphysic condylar resorption, also known as progressive condylar retrusion, is described as dysfunctional remodeling of the temporomandibular joint (TMJ) manifested by morphologic changes or resorption of the condyle.1 When this occurs in an adult, progressive resorption of the condyle results in a hyperdivergent skeletal Class II malocclusion. In addition to the skeletal changes, clinical signs and symptoms of idiopathic condylar resorption include reduction in masticatory performance, muscle and joint pain with function, limited range of motion, and occlusal and skeletal instabilities.1 Although the incidence in adults is rare, several authors have reported idiopathic condylar resorption and its association with orthodontics and orthognathic surgery.2,3

The goals for managing idiopathic condylar resorption are to decrease pain, increase joint function, and prevent further joint damage and disability.4 As a general rule, the management of TMJ disease is to evaluate the patient’s response to noninvasive modalities before considering invasive surgical or salvaging procedures.4,5 However, for patients with advanced condylar resorption with evident changes in profile and occlusion, reconstruction therapy should also be considered.6,7 Here, we report the treatment process and its outcome of an adult with idiopathic condylar resorption who underwent total TMJ reconstruction.

DIAGNOSIS AND ETIOLOGY

A 28-year-old woman was referred from the TMJ clinic at Gangnam Severance Dental Hospital in Seoul, Korea, for evaluation and treatment of her occlusion. She had complaints including difficulties in chewing, recent changes in profile, moderate joint pain in both TMJs, headache, and neck, muscle, and shoulder pain. She reported no parafunctional habits such as bruxism or clenching.

She had a history of previous orthodontic treatment for 4 years with maxillary first premolar extraction. Her chief complaint before her orthodontic treatment was lip protrusion. During and after the previous orthodontic treatment, she had experienced severe pain in both TMJ regions. Since the previous orthodontic treatment, she also experienced changes in her profile and difficulty in chewing.

She had an obvious skeletal Class II profile with severe chin retrusion. Occlusal canting was also noted. An anterior open bite was present with Angle Class II molar and canine relationships. Her maxillary arch was slightly
narrow with a crossbite tendency on the right. The mandibular midline was deviated to the left (Figs 1 and 2).

Evaluation of the panoramic radiograph and the TMJ tomograms showed severe condylar resorption. On the left side, there was complete resorption to the level of the sigmoid notch. Magnetic resonance imaging confirmed the complete resorption of the left side and also active resorption of the right condyle, presumably from the loss of cortical bone coverage (Figs 3 and 4).

The cephalometric radiographs showed a significantly retruded mandible (SNB angle, 68°) compared with a relatively well-positioned maxilla (SNA angle, 80°), indicating a skeletal Class II malocclusion (ANB angle, 12°). A hyperdivergent profile was evident with a high mandibular plane angle (59°) and a facial height ratio of 50.0. The maxillary incisors were retroclined, possibly caused by the previous orthodontic treatment, which had been focused on camouflage of the skeletal Class II by extraction of the maxillary premolars (Fig 5, Table).

We collected preorthodontic photos and a panoramic radiograph from the previous orthodontist. Although the patient had a poorly shaped condyle to begin with, it was evident that the etiology of the severe Class II hyperdivergent profile and recent changes in occlusion and profile were due to progressive condylar resorption during the 5-year postorthodontic period (Fig 6).
Fig 2. Pretreatment study models.

Fig 3. Pretreatment radiographs.
Systemic diseases such as rheumatoid arthritis can also produce similar symptoms and degenerative changes in the TMJ. Therefore, a blood sample was evaluated for diagnostic markers of rheumatoid arthritis including rheumatoid factor. Since she had no other joint symptoms and the blood test was within normal limits, the possibility of rheumatoid arthritis was ruled out.

According to our evaluation of the orthodontic records and the patient’s history, she was diagnosed as skeletal Class II with idiopathic condylar resorption.

**TREATMENT OBJECTIVES**

The treatment objectives were to (1) relieve joint pain and establish proper joint function, (2) correct the anterior open-bite malocclusion, and (3) improve facial esthetics.

**TREATMENT ALTERNATIVES**

Three treatment options were considered. The first option was conservative TMJ therapy including an occlusal splint and medication to relieve pain. After pain relief and remission, conventional orthodontic treatment could be performed to correct the anterior open bite. This option would be a conservative modality to improve the occlusion, but there would be no improvement in facial esthetics. In addition, the uncertainty of the TMJ condition and its prognosis made it...
difficult to decide on the proper timing for active orthodontic treatment.

The second option was to combine orthognathic surgery with orthodontic treatment. After extraction of the mandibular first premolars and mandibular incisor retraction, maxillary impaction along with mandibular advancement and genioplasty would correct the occlusion and improve the profile. However, the result of this option also depends on the prognosis of the TMJ. With complete resorption of the left side and active resorption still on the right side, conventional orthognathic surgery would instantly show improvement in the profile but could result in poor stability because of the preexisting TMJ pathology.4,8

The third option was to consider total joint reconstruction. Custom-made joints could be designed for maximum esthetic and functional results, and replacement surgery could be combined with maxillary surgery.7,9

Table. Cephalometric summary

<table>
<thead>
<tr>
<th>Variable</th>
<th>Norm</th>
<th>Pretreatment</th>
<th>Presurgery</th>
<th>Postsurgery</th>
<th>Posttreatment</th>
<th>Postretention</th>
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<tr>
<td>SNA (°)</td>
<td>81.6</td>
<td>79.5</td>
<td>79.5</td>
<td>80.9</td>
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<td>SNB (°)</td>
<td>79.1</td>
<td>67.0</td>
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<tr>
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<td>Ramus height (mm)</td>
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<td>10.0</td>
<td>6.1</td>
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</table>

Fig 6. Recollected records from the previous clinic (5 years before).
allow the maximum amount of mandibular advancement, mandibular premolar extraction and retraction could be done before jaw surgery. Conservative joint therapy could also be performed in conjunction with preoperative orthodontic treatment to relieve pain.8,9

After thorough discussion with the patient, the third option was selected. The patient had high hopes of improving her profile, and, considering the severity of her TMJ condition and age, TMJ replacement was a promising option.

**TREATMENT PROGRESS**

We bonded 0.022-in preadjusted edgewise brackets to all teeth. In the maxillary arch, a precision transpalatal arch with a 0.032 × 0.032-in beta-titanium alloy wire was placed for correction of the upper first molar rotations and mild expansion of the arch. Maxillary incisor torque was improved by adding a compensating curve to the archwire during the initial stage of treatment. In the mandibular arch, anterior retraction was achieved after extraction of the mandibular first premolars.

Three months before the main reconstruction surgery, gap arthroplasty was performed to remove the resorbed condyle and articular fossa followed by inter-positional silastic block implantation. A computed tomography scan was taken, and a 3-dimensional polymer model was constructed for 3-dimensional model surgery. To increase the amount of mandibular advancement, which is the key for esthetic improvement, counterclockwise rotation with ANS impaction, canting correction of the maxilla, and additional advancement genioplasty were planned along with mandibular advancement (Fig 7). The counterclockwise rotation of the maxilla also can improve the maxillary incisor torque. Total TMJ prostheses (TMJ Concepts, Ventura, Calif) include a mandibular component and a fossa component. According to the model surgery, both components can be custom-made for a patient.10,11

After 14 months of preorthodontic treatment, total joint reconstruction surgery was done as reported, along with LeFort I osteotomy and genioplasty.9,10 Dramatic changes were shown after the surgery, and the joint pain was relieved. In addition, the patient also reported improvement in her sleeping pattern, because breathing was much easier after the surgery, as has been previously reported.12,13 The occlusion was corrected to Angle Class I molar and canine relationships with ideal overjet and overbite (Figs 8 and 9). Analysis of the cephalometric superimposition showed total impaction with counterclockwise rotation of the maxilla (the amount of anterior nasal spine impaction was greater than that of posterior nasal spine impaction) and a significant amount of mandibular advancement. Advancement genioplasty also improved the prominence of the chin. According to the hard-tissue changes, soft-tissue profile changes were also evident, and the airway was enlarged (Fig 10).
Fig 8. Presurgical and postsurgical intraoral photographs.

Fig 9. Postsurgical radiographs.
After the primary healing period, active physical therapy was recommended 3 weeks postoperatively. Two months after surgery, orthodontic treatment was initiated for detailing with intermaxillary elastics. After a total treatment time of 24 months, the brackets were debonded. Class I molar and canine relationships were achieved with ideal overjet and overbite (Figs 11-13). Total alloplastic TMJ reconstruction and combined orthognathic surgery resulted in counterclockwise rotation of the maxillomandibular complex, improving both esthetics and function (Fig 14).

After debonding, lingual fixed retainers were bonded from canine to canine in both arches. Additional circumferential retainers were delivered and used full time for 6 months. The maxillary circumferential retainer was slightly activated to close the minor space left from the molar bands. During the retention period, old restorations on the mandibular molars were replaced with new gold crowns, and the surgical plates were removed after 6 months. In addition these changes, the patient's occlusion and skeletal relationship were stable after 1 year of retention (Figs 15-17). No TMJ-related symptoms were reported during or after the orthodontic treatment, and she was fully satisfied with the functional and esthetic outcome.

DISCUSSION

The pathophysiology of idiopathic condylar resorption might be partially due to excessive mechanical loading of the TMJ that exceeds the normal host adaptive capacity, resulting in dysfunctional remodeling. Mechanical factors capable of initiating changes in the condylar structure are largely divided into occlusal therapy, internal derangement, parafunction, trauma, and unstable occlusion. Combined with the degree of mechanical overloading, the host adaptive capacity factors such as age, hormones, and systemic illness are thought to determine the degrees of TMJ, occlusal, and skeletal changes. Similar to the previously reported cases of idiopathic condylar resorption, this woman was in her twenties and had received previous orthodontic treatment. Although the initial cause of her dysfunctional remodeling is unknown, as it was initiated, predisposing unstable occlusion or occlusal therapy might have caused additional condylar compression, leading to further unstable occlusion and accentuating the resorption.

In the case of active idiopathic condylar resorption with major skeletal discrepancies, occlusal stabilization through orthodontic treatment alone might not be sufficient; therefore, invasive protocols such as orthognathic surgery are combined for functional and esthetic recovery. Unfortunately, it is well documented that preexisting TMJ pathology can lead to unfavorable surgical outcomes, with only a few reports of successful management. Wolford and Cardenas and Wolford developed a specific treatment protocol for idiopathic condylar resorption that includes TMJ surgery to remove hyperplastic synovial and bilaminar tissue, disk repositioning, and ligament repair, followed by orthognathic surgery with favorable outcomes and stability. However, this protocol is based on early detection and surgical intervention with an adequate remaining condyle and salvageable disks. In our patient, the left condyle was completely lost with no detectable disk apparatus, and there was still active resorption on the right side. Alloplastic implants are reported to be an acceptable approach to achieve optimal symptomatic and functional improvement for extensively damaged, degenerated, or lost condyles.

The patient desired maximum improvement in both function and esthetics. Therefore, orthodontic and surgical procedures were focused to increase the amount of mandibular advancement. Orthodontically, the mandibular first premolars were extracted, and the mandibular anterior teeth were completely retracted. Since the
previous camouflage orthodontic treatment with maxillary premolar extraction induced retroclination of the maxillary incisors, the maxillary incisor torque was controlled during the early phase with an additional compensating curve. Surgically, counterclockwise rotation of the maxillomandibular complex, which rotates the anterior aspect of the maxillomandibular complex upward and the posterior aspect downward, and additional advancement genioplasty were performed.9,10 The counterclockwise rotation of the maxilla not only allowed more forward movement of the mandible, but also improved the maxillary incisor torque. The steep occlusal plane and mandibular plane angles were also decreased. Conventionally, counterclockwise rotation of the maxillomandibular complex can create a large gap between the fossa and the mandibular ramus. But, with the custom-made joint prosthesis, accurate adaptation to the surrounding anatomic structure was possible.10

As with any other treatment modality, long-term stability is important. Because the concept of alloplastic total joint reconstruction is rather new, the longest study reporting its outcome and stability is based on a 14- to 18-year follow-up.7,12,13,15 According to these reports, improvements in mandibular function and quality of life were clearly noted, indicating effective and reliable long-term management.7,12,13,16 When long-term
Fig 12. Posttreatment study models.

Fig 13. Posttreatment radiographs.
stability in terms of surgical relapse was evaluated in patients with total alloplastic TMJ reconstruction combined with LeFort I osteotomy by using the same prosthetic system, it also showed improved functional and aesthetic outcomes with good surgical stability. Our patient also had a stable occlusion and excellent surgical stability after the 1-year follow-up. In addition, there were decreased TMJ symptoms including pain, improvement in her breathing pattern at nights, and increased quality of life.

Identical to the well-proven orthopedic joint reconstruction devices for hip and knee replacements, the materials used for TMJ prostheses are composed of titanium covered with ultrahigh molecular weight polyethylene and titanium with chromium, cobalt, and molybdenum. Therefore, disadvantages associated with any implantable alloplast such as material wear and potential device failure are possible in the long term; this calls for careful monitoring. Because of its complexity, total joint reconstruction surgery is performed with an extraoral approach through preauricular and submandibular incisions, which leave minor scar tissue after surgery. However, satisfying and predictable outcomes of total joint reconstruction combined with orthodontic treatment in patients with severely damaged TMJs far exceed these limitations, as demonstrated in this patient.

CONCLUSIONS

This case report illustrates the treatment process of a skeletal Class II malocclusion associated with idiopathic condylar resorption. Total alloplastic joint reconstruction was successfully designed to improve both esthetics and function with posttreatment stability.

REFERENCES


Fig 15. Postretention photographs.
Fig 16. Postretention study models.

Fig 17. Postretention radiographs.

