CONTINUING EDUCATION ARTICLE

Idiopathic condylar resorption: Diagnosis, treatment protocol, and outcomes

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Idiopathic condylar resorption is a poorly understood progressive disease that affects the TMJ and that can result in malocclusion, facial disfigurement, TMJ dysfunction, and pain. This article presents the diagnostic criteria for idiopathic condylar resorption and a new treatment protocol for management of this pathologic condition. Idiopathic condylar resorption most often occurs in teenage girls but can occur at any age, although rarely over the age of 40 years. These patients have a common facial morphology including: (1) high occlusal and mandibular plane angles, (2) progressively retruding mandible, and (3) Class II occlusion with or without open bite. Imaging usually demonstrates small resorbing condyles and TMJ articular disk dislocations. A specific treatment protocol has been developed to treat this condition that includes: (1) removal of hyperplastic synovial and bilaminar tissue; (2) disk repositioning and ligament repair; and (3) indicated orthognathic surgery to correct the functional and esthetic facial deformity. Patients with this condition respond well to the treatment protocol presented herein with elimination of the disease process. Two cases are presented to demonstrate this treatment protocol and outcomes that can be achieved. Idiopathic condylar resorption is a progressive disease that can be eliminated with the appropriate treatment protocol. (Am J Orthod Dentofacial Orthop 1999;116:667-77)

Idiopathic condylar resorption (ICR), also known as idiopathic condylysis, condylar atrophy, and progressive condylar resorption, is a well-documented but poorly understood disease. There are a number of local and systemic factors or diseases that can cause mandibular condylar resorption. Local factors include such entities as ICR, osteoarthritis, reactive arthritis, avascular necrosis, infection, and traumatic injuries. Systemic connective tissue and autoimmune diseases that can create condylar resorption include: rheumatoid arthritis, psoriatic arthritis, scleroderma, systemic lupus erythematosis, Sjögren's syndrome, ankylosing spondylitis, and others. ICR has a different cause and pathosis than other condylar resorption conditions and therefore a specific method of treatment is indicated.

ICR can create occlusal and skeletal instability, dentofacial deformities, TMJ dysfunction, and pain. Several authors[1-10] have described the occurrence of ICR and association with orthodontics and othognathic surgery. Previously recommended treatment for ICR[5,6,11-14] include the following options: (1) splint therapy to minimize joint loading; (2) "nonloading" orthodontic and orthognathic surgical procedures after 6 to 12 months of remission; (3) deferment of treatment until ICR remission; (4) arthroscopic lysis and lavage; (5) condylar replacement with a costochondral graft if the ICR cannot be controlled or recurs; and (6) maxillary surgery only to correct the occlusal deformity. No method of management has yet been described for ICR that will provide predictable stable outcomes for the TMJ, provide optimal functional and esthetic results, and eliminate pain. This article will address the diagnosis of ICR and the specific treatment protocol we have developed to achieve predictable and stable outcomes.

PATIENT PREDISPOSITION

People with the following specific facial morphologic characteristics appear to be most susceptible to ICR: (1) females (approximately 9:1 female to male ratio); (2) age range from 10 to 40 years old with a strong predominance for teenagers in their pubertal growth phase; (3) high occlusal plane angle and mandibular plane angle; and (4) predominance of Class II skeletal and occlusal relationship with or without open bite. ICR rarely occurs in low occlusal and mandibular plane angle facial types or in Class III skeletal relationships.

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Fig 1. Case 1: **A-B**, Fifteen-year-old girl has active idiopathic condylar resorption. Note the significant retruded position of the mandible, high mandibular plane angle, and associated facial morphology. **C-D**, Patient is 3 years posttreatment of ICR with removal of hyperplastic synovial tissues, articular disk repositioning, and simultaneous double-jaw orthognathic surgery.

PATHOGENESIS OF ICR

The specific cause of ICR has not been clearly identified. Its strong predilection for teenage females gives credence to the theory of hormonal mediation. This is further supported by identification of estrogen receptors in female primates,[15,16] human TMJ tissues that appear to correlate to TMJ symptoms,[17] and in osteoarthritic knee joints.[18] Estrogen is known to mediate cartilage and bone metabolism in the female TMJ. An increase in receptors may predispose an exaggerated response to joint loading from parafunctional activity, trauma, orthodontics, or orthognathic surgery.

In our ICR patient population, the majority of cases occur in young teenage girls in their pubertal growth phase. Our hypothesis is this: the sex hormones mediate biochemical changes within the TMJ causing hyperplasia of the synovial tissues that stimulates the production of destructive substrates that initiates breakdown of the ligamentous structures that normally support and stabilize the articular disk in position. This allows the disk to become anteriorly displaced. The hyperplastic synovial tissues then assume a position around the head of the condyle, further increasing exposure of the condyle to the substrates that create the resorptive phenomena. In this disease process, the condyle shrinks in all 3 planes of space. The condylar resorption appears to occur in the subcondylar bone without clinically apparent destruction of the fibrocartilage on the condylar head and roof of the fossa, unlike the arthritides where the fibrocartilage is destroyed by the inflammatory disease processes. ICR may eventually go into remission. However, if the condyle and the hyperplastic synovial tissues receive excessive loading (ie, parafunctional habits, trauma, orthodontics, orthognathic surgery) the resorption process may be reinitiated.

CLINICAL EVALUATION

A diagnosis is usually based on patient history, clinical evaluation, and imaging. Patients may report a progressive worsening of their occlusion and esthetics with or without TMJ symptoms and associated pain. Bilateral cases usually reflect a relatively symmetric posterior shifting of the mandible and development of an anterior open bite (Fig 1*A* and *B* and Fig 2*A* and *B*). In unilateral cases, the mandibular dental midline and chin shifts toward the affected side with ipsilateral Class II occlusion, crossbite, and posterior occlusal prematurities, as well as an open bite on the contralateral side. Although TMJ symptoms can be present, often times they are very mild or relatively nonexistent. In fact, 25% of patients in our study[19] had no TMJ symptoms. Clicking and popping may be absent because the hyperplastic synovial tissues increase the joint space, which provides a smooth transition onto the displaced disk during condylar translation. Rarely are other joints involved in mandibular ICR. Laboratory studies may be indicated, particularly if other joints are involved, to evaluate for connective tissue and autoimmune diseases, which can also cause condylar resorption. There are no laboratory tests specific for ICR.

Reactive arthritis resulting in condylar resorption is another common TMJ pathologic development in females, however, it usually begins after the age of 20 years. Factors that differentiate reactive arthritis from ICR include the following: a decreased joint

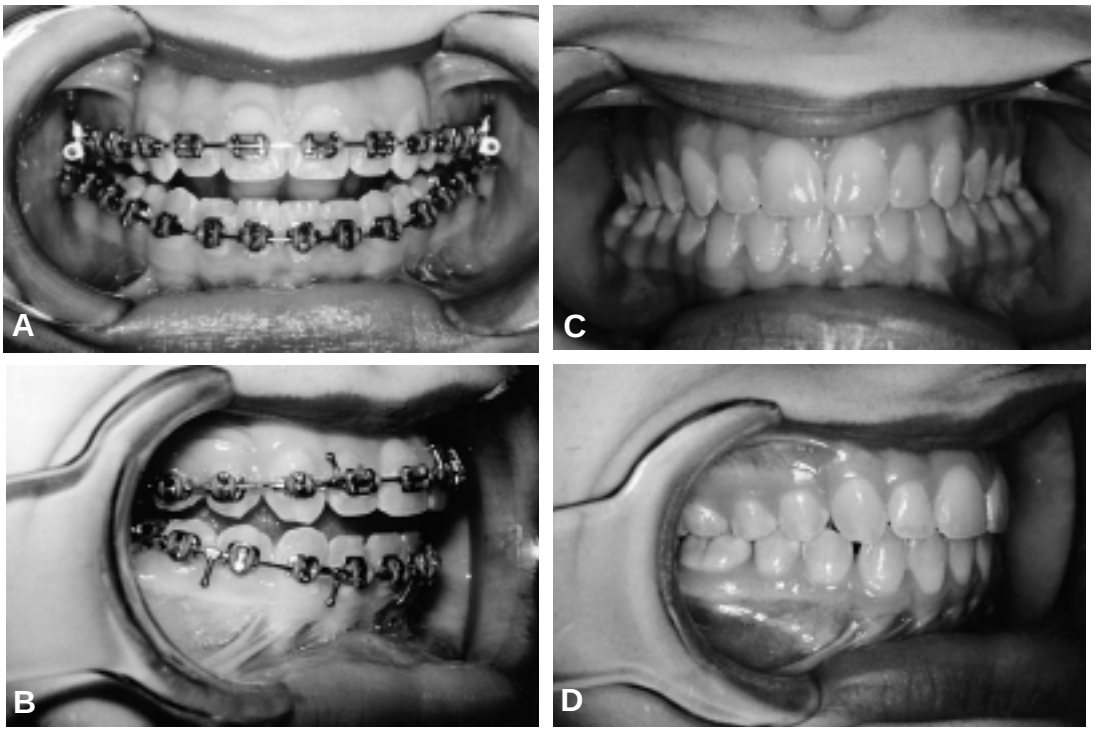

Fig 2. Case 1: **A-B**, Presurgical occlusion demonstrates anterior open bite and a Class II end-on canine occlusal relationship. **C-D**, Occlusion remains stable 3 years postsurgical treatment.

space, erosion of condyle and fossa with loss of fibrocartilage, osteophyte formation, anterior beaking, involvement of other joints, and other systemic problems (ie, female reproductive system, urinary tract, chronic upper and lower respiratory infections, gastrointestinal problems). Reactive arthritis may be related to bacterial infections (ie, chlamydia, mycoplasma)[20,21] requiring different treatment considerations.

IMAGING FINDINGS

Common lateral cephalometric radiographic findings in bilateral TMJ ICR include the following: (1) skeletal and occlusal Class II deformity; (2) anterior open bite; (3) high mandibular occlusal plane angle; (4) high mandibular plane angle; (5) decreased vertical height of the ramus; (6) the lower incisors may appear overangulated (Fig 3*A*); and (7) a significant decrease in the oropharyngeal airway can occur in the more severe cases. Serial lateral cephalograms will demonstrate slow but progressive retrusion of the mandible during the active resorption phase. Unilateral involvement includes (1) unilateral skeletal and occlusal Class II deformity; (2) vertical height difference at the mandibular inferior border, ramus, and occlusal plane; and (3) an open bite on the contralateral side. Serial P-A cephalograms may show worsening of the asymmetry.

Cephalometric tomographic evaluation of the TMJ usually shows a relatively normal or excessive joint space because of hyperplasia of the synovial tissues. The involved condylar head will appear smaller in size, the degree of which will be dependent on length of time since onset of the pathosis and aggressiveness of the disease. There may be some loss of integrity of the cortical bone on the head of the condyle. Superimposition of serial cephalometric tomograms will help document the presence of active condylar resorption. Bone scans may be of no significant diagnostic benefit for ICR.

The MRI findings include the following: (1) decreased condylar volume; (2) anterior disk displacement with or without reduction on opening; (3) extreme thinness or loss of continuity of cortical bone on the head of the condyle; and (4) often thick amorphous-appearing soft tissue occupying the space between the condyle and fossa (Fig 4). The degree of deformation and degenerative changes of the disk will be dependent on the length of time of the disk displacement. Determination must be made relative to salvageability of the disk and adequacy of the remaining condyle to withstand normal functional loading and stress forces.

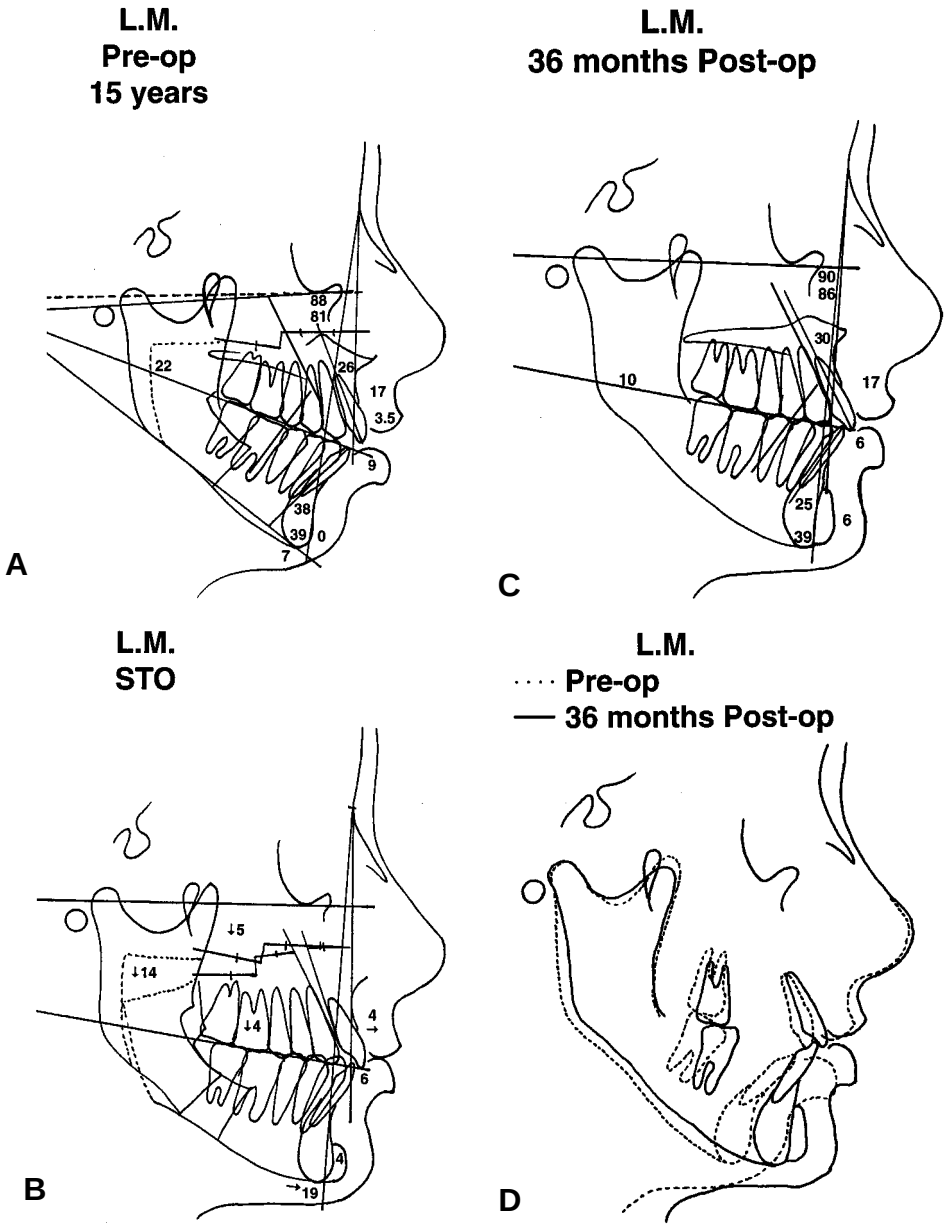

Fig 3. A, Common cephalometric appearance for ICR includes skeletal and occlusal Class II, anterior open bite, steep mandibular occlusal and mandibular plane angles, and overangulated lower incisors. **B**, STO (prediction tracing) demonstrates the orthognathic procedures required to achieve a good functional and esthetic result including maxillary and mandibular osteotomies with upward and forward rotation of the occlusal plane and augmentation genioplasty. **C**, Cephalometric analysis at 36 month postsurgery demonstrates good facial balance. **D**, Superimposition of the pretreatment and 36 month follow-up cephalometric tracings demonstrate the treatment results achieved for this patient.

SURGICAL FINDINGS

Observations at surgery reveal an anterior or anteromedial displaced disk. When the disk is pulled back into position, the hyperplastic synovial tissues bunch posteriorly (Fig 5*A*). The tissue may appear amorphous in nature, with little vascular component, and usually no inflammation. The glenoid fossa and the condylar head usually have an intact fibrocartilage covering (Fig 5*B*). The articular disk may or may not demonstrate significant deformation and degenerative changes depending on the length of time of the disk displacement. Histologically, the retrodiskal tissues

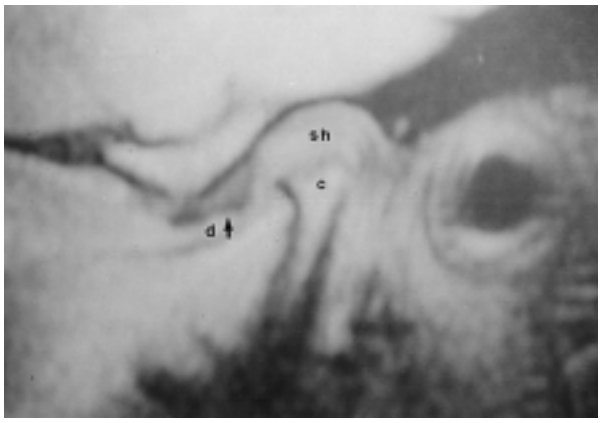

Fig 4. MRI sagittal view of the left TMJ of case 1 shows an anteriorly displaced articular disk (*d*) and an increased thickness of amorphous tissue (synovial hyperplasia) (*sh*) overlying the condyle (*c*). Note the diminutive size of the condyle, with some anterior beaking and with loss of definition of the cortical bone over the head of the condyle.

will demonstrate synovial hyperplasia. If the fibrocartilage is absent and erosion present on the condyle and fossa, the disease process is not ICR.

NEW SURGICAL TREATMENT PROTOCOL

The most effective and predictable treatment method to arrest ICR is open joint surgery, specifically, disk repositioning and stabilization with removal of the hyperplastic synovial tissues. Our preference of treatment to maximize disk stability is the Mitek mini-anchor (Mitek Surgical Products Inc, Westwood, Mass) placed in the posterior aspect of the condylar head with 2 O-Ethibond sutures attached; these function as artificial ligaments to secure the articular disk to the condyle[22,23] (Figs 5*C* and 6*A* and *B*). One Ethibond suture is placed in a mattress fashion into the medial aspect of the posterior band of the disk and the other through the lateral aspect. We perform simultaneous TMJ and orthognathic surgery to eliminate the pathologic TMJ disease and correct the functional and esthetic dentofacial deformity with one surgical procedure. If the surgeon prefers, the TMJ surgery can be done as a separate procedure from the orthognathic surgery, but the TMJ surgery must be done first. Treating ICR cases with orthognathic surgery alone is a strong inducer of further condylar resorption and results in significant risk for redevelopment of functional and esthetic deformities, worsening TMJ symptoms and dysfunction, and pain.

Because most patients with ICR have high occlusal plane and mandibular plane angles, optimal functional

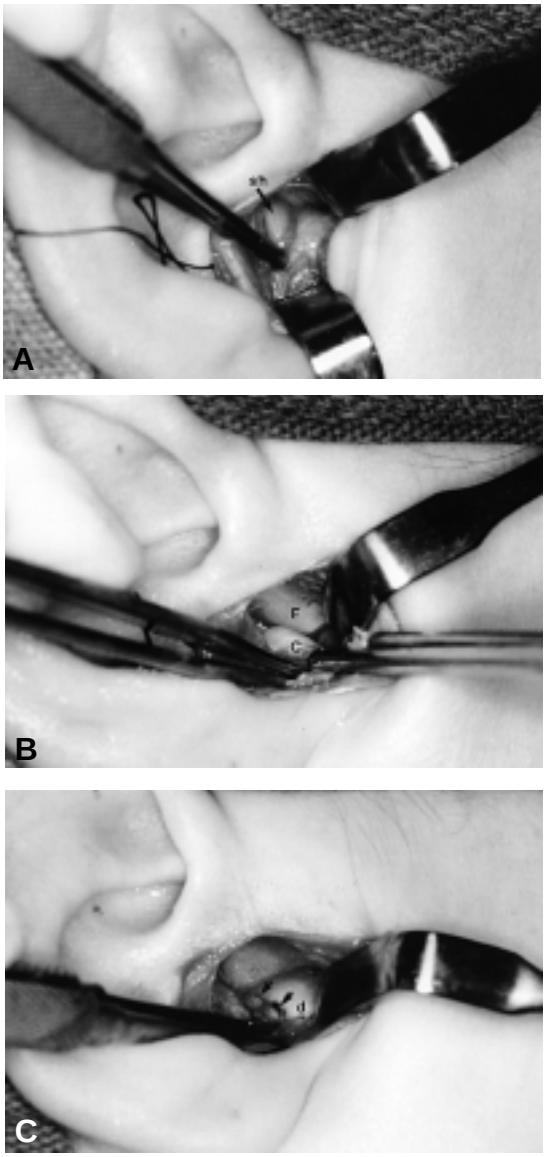

Fig 5. A, Through an endaural incision, the right TMJ displaced articular disk is being pulled back toward a normal position over the condyle. Notice the folding of synovial hyperplasia (*sh*) tissue in the posterior aspect of the fossa (*arrow*). **B**, Bilaminar tissues have been resected, and the disk has been temporarily displaced forward so that the fibrocartilage covering the condyle (*c*) and fossa (*f*) can be observed. **C**, Articular disk (*d*) has been repositioned with the Mitek anchor and 2 artificial ligaments. The horizontal component of the mattress sutures can be seen (*arrows*).

and esthetic results are often best achieved by the upward and forward rotation of maxillomandibular complex. Wolford et al[24,25] described the facial characteristics of individuals with high occlusal plane angle facial types. These correspond with the facial charac-

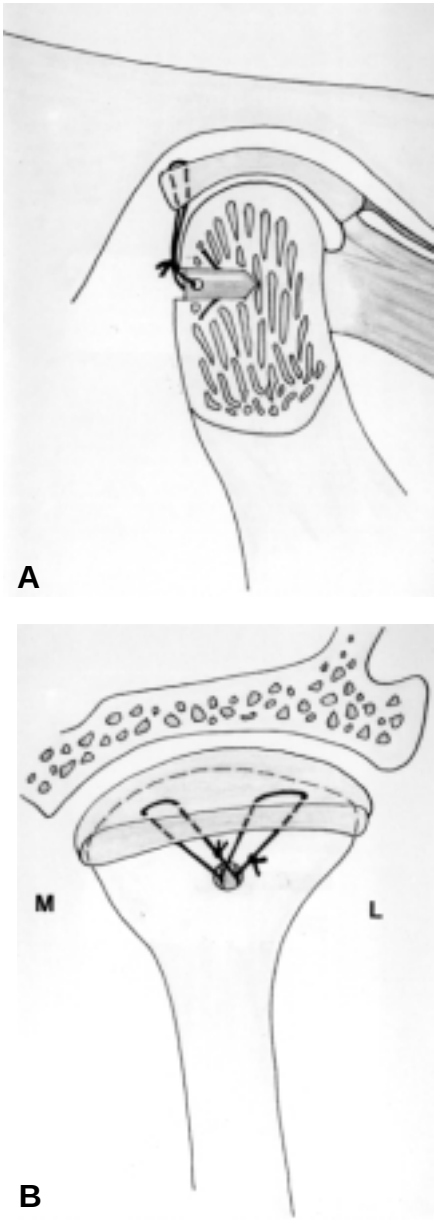

Fig 6. A, Sagittal cross-section; **B**, posterior view of the TMJ. A Mitek anchor with two 0-Ethibond sutures placed through the eyelet is inserted into the posterior head of the condyle, lateral to the midsagittal plane, about 8 to 10 mm below the top of the condyle. The two sutures are then attached in a mattress fashion; one medial and one lateral through the posterior band of the articular disk and tied to secure the disk to the condylar head.

teristics of many ICR patients. Chemello et al[26] demonstrated that upward and forward rotation of the maxillomandibular complex is a very stable procedure in the presence of healthy joints. Cottrell et al[27] reported minimal condylar change in healthy TMJs after upward and forward rotation of the maxillomandibular complex. In our treatment protocol for ICR, the TMJ disks are surgically repositioned and stabilized. With adequate remaining condyle, the TMJs can withstand upward and forward rotation of the maxillomandibular complex.

In the ICR patient, with salvageable disks and condyles, our surgical sequencing is as follows: (1) TMJ surgery to remove hyperplastic synovial tissue, reposition the articular disk, and stabilize with Mitek anchor; (2) mandibular ramus sagittal split osteotomies, reposition the mandible, and stabilize with rigid fixation[28]; (3) maxillary osteotomies, reposition the maxilla, and stabilize with rigid fixation and appropriate grafting; and (4) other procedures as necessary (ie, rhinoplasty, cheek augmentations, chin procedures, etc). This treatment protocol has proved to be very successful in ICR patients with salvageable disks and adequate remaining condyles.[19]

As arthroscopy and arthrocentesis do not remove the hyperplastic synovial tissue or reposition the articular disk into a normal functional position, they are predictably unsuccessful procedures in treating ICR, particularly if correction of the jaw deformity is attempted. In ICR cases where the disk is nonsalvageable but adequate condyle remains, the hyperplastic synovial tissue should be removed and the disk replaced with autologous tissues. However, treatment results will be far less predictable. A meniscectomy alone is not recommended as this will introduce other arthritic conditions. In more severe cases, where the condyle is nonsalvageable, condylar replacement may be necessary with either a sternoclavicular joint graft, costochondral graft, or FDA-approved total joint prosthesis.

STABILITY OF RESULTS

Wolford et al[19] reported on 12 patients with ICR with documented active condylar resorption that were treated by this specific protocol; their average age was 21 years (range, 14 to 36 years). With an average 8-month presurgery evaluation, the average amount of condylar resorption was –1.1 mm (range, –2.5 to –0.5 mm). Point B moved posteriorly an average of –1.8 mm (range, –3 to –1 mm) and the mandibular occlusal plane increased an average of 1.5° (range, 0° to 3°). The average rate of condylar resorption was 0.12 mm per month or 1.5 mm per year, indicating that ICR is a slow but progressive disease process. Surgical changes included point B moving forward an average of 10.9 mm (range, 2 to 18 mm) and the occlusal plane angle decreasing an average of –7.8° (range, -5° to -12°).

The long-term follow-up average of 33.2 months

Fig 7. Case 2: **A-B**, Sixteen-year-old girl developed a Class II end-on occlusion and anterior open bite. Her condition was diagnosed as ICR in a progressive state. **C-D**, She was seen 6 years after surgery and showed good stability of the functional and esthetic outcome with elimination of the idiopathic condylar resorption.

(range, 18 to 68 months) demonstrated an average condylar length change of +0.2 mm (range, –0.5 to +1.5 mm). Point B changed on average of + 0.3 mm (range, – 0.5 to 2 mm) and the average occlusal plane change was +0.04° (range, 0° to 0.5°). There was no statistically significant change from immediate postsurgery to the longest follow-up period. Five patients were under the age of 16 years and exhibited a modest amount of postsurgical condylar growth with an average increase in condylar height of 0.43 mm (range, –0.1 to 1.5 mm). In all 12 patients, jaw function remained unchanged with no statistically significant difference in the presurgical and postsurgical incisal opening (presurgical and postsurgical 47 mm) and excursion movements (preoperative and postoperative >7 mm). There was a significant decrease in pain on the visual analog pain scale (0 = no pain to 10 = worst pain); the presurgery average pain was 3.5 (range, 0 to 9) and the postsurgical average pain was 0.7 (range, 0 to 4).

DISCUSSION

ICR frequently develops during pubertal growth, so consequently these patients are often in orthodontic treatment at the onset of the disease. Because patients predisposed to ICR are usually high occlusal plane angle facial types with skeletal and occlusal Class II relationships,[22-24] they are often candidates for orthognatic surgery before the onset of the disease. In most cases, ICR will develop regardless of orthodontic or orthognathic procedures. However, if these procedures increase loading or stress to the TMJs, they may initiate or accelerate the rate of resorption. In some cases, ICR is self-limiting with only moderate amounts of bone resorption, whereas in other cases, the entire head and neck of the condyle can be resorbed. It is important to understand that if the disease does go into remission, it can be easily reactivated by orthodontics, orthognathic surgery, or other factors that load or stress the joint.

Because of lack of integrity in the ligaments that normally stabilize the disk, use of the Mitek anchor[25,26] has significantly improved the stability of results in ICR. The body of the anchor is a titanium alloy cylinder with a bullet tip at one end and a suture eyelet at the opposite end. A pair of superelastic nickel-titanium arcs project from the body. The arcs fold against the anchor body as the anchor is pushed through the interosseous hole in the cortex of the posterior head of the condyle, and they return to their original resting position once in the medullary bone, locking the anchor in position (Fig 6*A*). The Mitek anchor supports 2 artificial ligaments (O-Ethibond suture) threaded through the eyelet of the anchor and secured to the articular disk (Fig 6*B*). Fields et al[29] determined the average pull-out force of the Mitek mini-anchor from human cadaver condyles was 16.02 lbs. Fields et al[30] histologically demonstrated osseous integration between the anchor and the condylar bone.

Orthodontic and orthognathic surgery candidates with high occlusal plane and mandibular plane angles, Class II occlusions with or without anterior open bites, radiographic evidence of resorption or diminutive size of the condyles, or the presence of TMJ signs and symptoms should be scrutinized very carefully before and during treatment to determine if there is a presence or predisposition for ICR or other TMJ pathoses. After

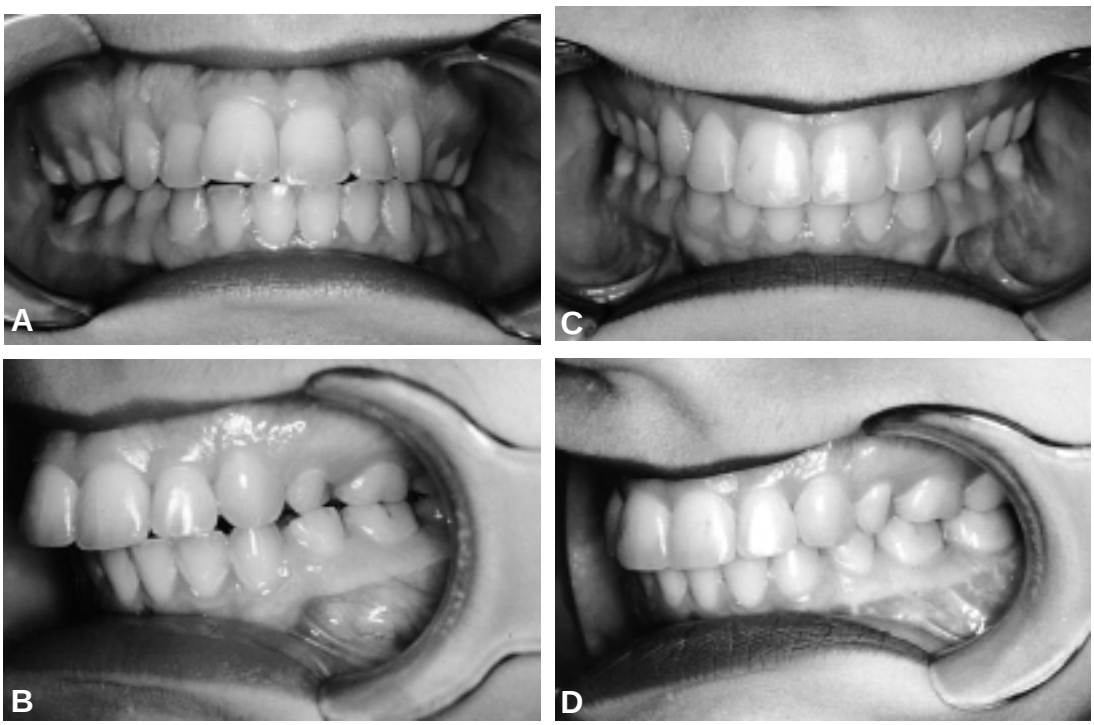

Fig 8. Case 2: **A-B**, Occlusion has been progressively opening anteriorly and shifting into a Class II occlusion. **C-D**, Six years after simultaneous TMJ and orthognathic surgery, the patient demonstrates a very stable Class I occlusal outcome.

appropriate diagnostic procedures, a proper treatment plan can be developed to address the TMJ pathosis and jaw deformity.

A most interesting fact in our ICR study[19] is that 5 of the 6 patients who were 16 years or younger demonstrated some modest growth postsurgery. This indicates a reversal of the disease process from one of resorption to subsequent return of growth. The best results in the management of ICR involves early detection of the disease process and early TMJ surgery. The earlier ICR is treated, the more likely the following are to occur: (1) less resorption of the condyle occurs, thus, maintaining a greater dimensional component of the condyle, (2) less distortion and degeneration of the articular disk, and (3) better postsurgical distribution of loading forces on the joint structures. The high predictability of treatment outcomes with this protocol for ICR substantiates an early diagnosis and initiation of treatment to provide the best success functionally, occlusally, esthetically, and with long-term stability.

Case 1

This 15-year-old girl, who was under active orthodontic treatment, was referred by her orthodontist because she was developing a significant jaw deformity. Her mandible was becoming more retruded, and she had difficulty chewing because her teeth did not fit together. She had no pain, headaches, TMJ noises, or dysfunction. Her diagnoses included: (1) bilateral ICR; (2) A-P mandibular hypoplasia; (3) maxillary posterior vertical hypoplasia; (4) A-P microgenia; (5) high occlusal and mandibular plane angles; and (6) Class II open bite (Figs 1*A* and *B* and 2*A* and *B*). The MRI shows diminution of the condylar size bilaterally and anteriorly displaced disks (Fig 4). Serial cephalometric and tomographic analysis confirmed the active condylar resorption. Presurgical incisal opening was 43 mm and lateral excursive movements were 8 mm. Her treatment included: (1) presurgical orthodontics to continue to align and level the arches; (2) surgery (Fig 3*B*) including the following: (a) bilateral TMJ articular disk repositioning and ligament repair with Mitek anchors and removal of hyperplastic synovial tissue; (b) bilateral mandibular ramus osteotomies to advance the mandible in a upward and forward direction; (c) multiple maxillary osteotomies to advance, expand, and decrease occlusal plane angulation by downgrafting the posterior aspect of the maxilla; (d) augmentation genioplasty; and (3) postsurgical orthodontics to finish and retain.

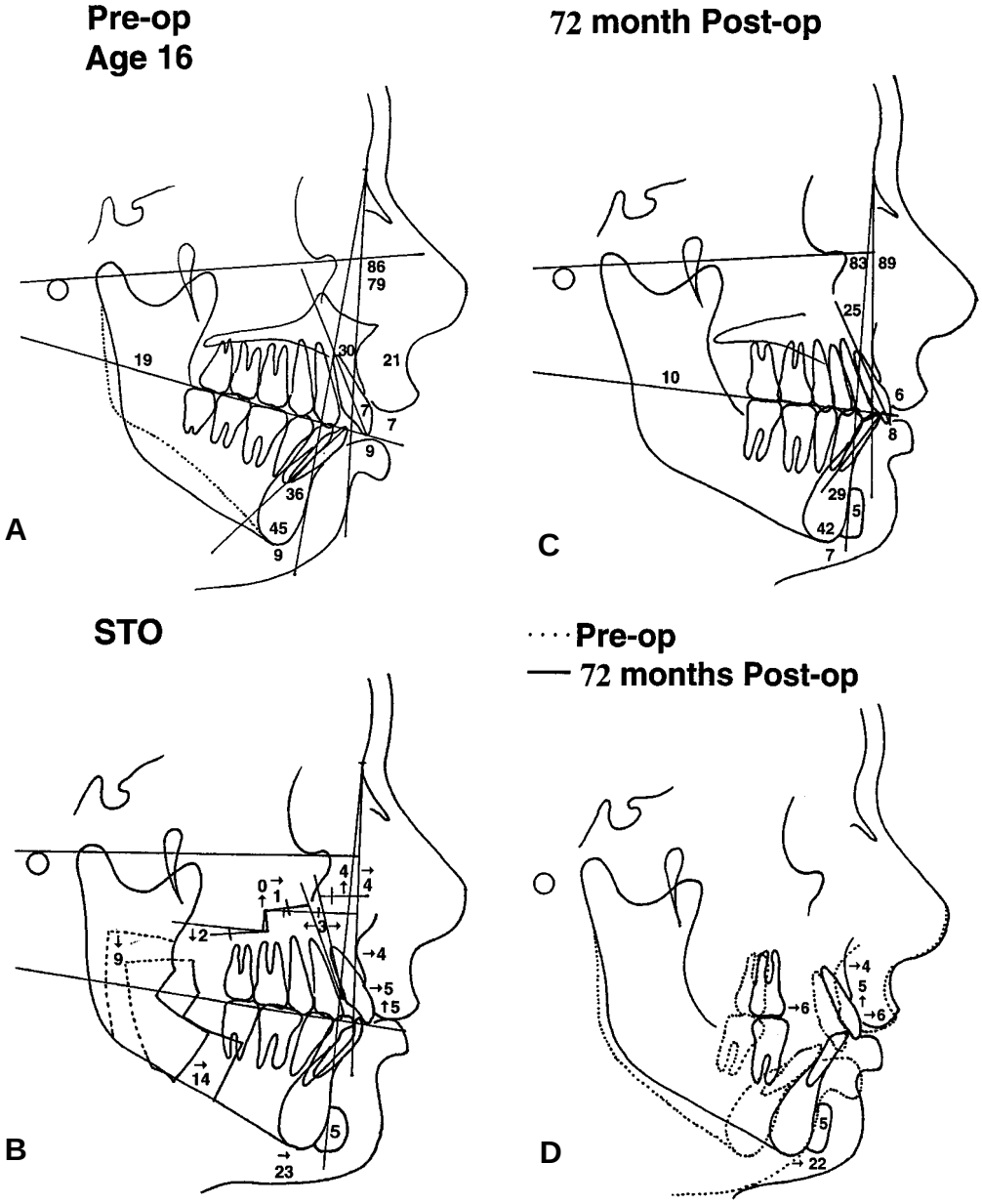

Fig 9. Case 2: **A**, Cephalometric tracing shows the Class II skeletal and occlusal relationship with an open bite tendency and the high occlusal and mandibular plane angles. **B**, STO demonstrates the proposed double-jaw orthognathic surgery with upward and forward rotation of the maxillomandibular complex and a genioplasty. **C**, Cephalometric analysis 6 years after surgery demonstrates good facial balance. **D**, Superimposition of the pretreatment and 6 year follow-up cephalometric tracings demonstrate the skeletal and occlusal changes achieved for this patient.

The patient was seen 3 years after surgery and showed excellent stability and significant improvement in her functional and esthetic facial balance (Figs 1*C* and *D*, 2*C* and *D*, and 3*C*). Incisal opening is 54 mm and excursive movements 7 mm bilaterally. She has no pain or headache problems. Postsurgical condylar change was 1 mm growth on the right side and 0 mm change on the left. (Orthodontics by Dr Fred Spradley, Ft Worth, Tex)

Case 2

This 16-year-old girl was referred because her lower jaw began shifting to the left, and she was devel-

oping a Class II occlusion and an anterior open bite tendency (Fig 7*A* and *B* and 8*A* and *B*). She also complained of severe headaches, jaw and neck pain, and difficulty chewing. Her diagnosis included: (1) bilateral ICR with the left side worse than the right side; (2) mandibular A-P deficiency; (3) maxillary anterior vertical hyperplasia; (4) A-P microgenia; and (5) myofascial pain, TMJ pain, and headaches. An MRI revealed bilaterally anteriorly displaced articular disks and diminutive condylar size. Incisal opening was 53 mm and lateral excursions were 8 mm. Serial TMJ tomograms revealed progressive condylar resorption. VAS pain scale recording was 9 (0 = no pain, 10 = most severe pain). Treatment included the following: (1) presurgical orthodontics to align and level the arches; (2) surgery (Fig 9*B*) including the following: (a) bilateral TMJ articular disk repositioning and ligament repair with Mitek anchor and removal of hyperplastic synovial tissues; (b) bilateral mandibular ramus osteotomies to advance the mandible in a upward and forward direction; (c) multiple maxillary osteotomies to move the anterior aspect superiorly, expand, and level the occlusal planes; (d) augmentation genioplasty; and (3) postsurgical orthodontics to refine occlusion.

The patient was seen 6 years after surgery and demonstrated excellent stability of results (Figs 7*C* and *D*, 8*C* and *D* and 9*C*) with an incisal opening of 52 mm, excursive movements of 8 mm in each direction, a significant decrease in her headache pain levels (VAS changed from 9 presurgery to 3 postsurgery), and no TMJ pain. The residual headaches appear to be vascular or stress-related. At the long-term follow-up visit, she had a 1 mm increase on the right condyle height and 1.5 mm increase on the left condyle height demonstrating that modest growth had occurred.

CONCLUSION

ICR is a poorly understood disease process, but it can be treated effectively with the specific treatment protocol described herein provided that the articular disks and condyles are still salvageable. Other pathologic TMJ conditions must be ruled out because they may not respond to this treatment protocol.

The following factors are important considerations when treating ICR:

1. Common facial characteristics predisposing to ICR include: (a) mandibular retrusion, (b) high mandibular occlusal plane angle, (c) high mandibular plane angle, and (d) Class II occlusion with or without anterior open bite.
2. ICR is a progressive TMJ disease process predominantly found in females that often begins during the pubertal growth phase and can occur unilaterally or bilaterally.
3. ICR appears to be hormonally mediated and can go into remission, but it can be reactivated with loading or stress to the TMJ (ie, orthodontics, orthognathic surgery, parafunctional habits, trauma).
4. The TMJ articular disk is displaced, and there may or may not be TMJ symptoms (25% of patients have no TMJ symptoms).
5. TMJ articular disk repositioning and stabilization with removal of the hyperplastic synovial tissues arrests the disease process when the disk is salvageable and adequate condylar head still remains. The Mitek mini-anchor has significantly improved the stability of the disk repositioning and treatment outcomes.
6. Early detection and treatment of the ICR will minimize the amount of condylar bone resorption and degenerative changes in the articular disk.
7. Simultaneous TMJ and orthognathic surgery can be done to correct the existing dentoskeletal deformity, (including upward and forward rotation of the maxillomandibular complex) with stable and predictable results.
8. In young patients, condylar growth may recur after surgical intervention with the outlined protocol.

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