Arthrotomography of the Temporomandibular Joint: New Technique and Preliminary Observations

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A technique for arthrography of the temporomandibular joint using multidirectional tomography is described that greatly simplifies interpretation. In 21 attempts, 20 successful arthrograms were obtained in patients complaining of pain, tenderness, and clicking and locking of the joint who had not responded to conservative therapy. Abnormalities demonstrated were perforation of the meniscus, anterior dislocation and subluxation of the meniscus, and redundancy of the bilaminar zone. In all 11 patients who underwent surgical meniscoplasty, disc abnormalities included thinning, perforation, flaccidity, and bilaminar redundancy. No permanent complications of the arthrographic procedure occurred, but temporary postprocedure discomfort was frequent. This preliminary experience with temporomandibular joint arthrotomography suggests this easily performed procedure offers reliable information about disc function and integrity that may assist in a selection of patients for meniscoplasty and other surgical treatment.

Arthrography is not a widely used procedure for evaluation of abnormalities of the temporomandibular joint. It has only been sporadically performed and infrequently reported, mostly in the oral surgical literature [1-3]. Previously described techniques for arthrography of the temporomandibular joint are complicated, not easily successful, and potentially hazardous to the patient [3, 4]. Of great interest is Nørgaard's original 1947 monograph [5] on temporomandibular joint arthrography; however, his technique is not applicable to current concepts of disc dysfunction.

Symptoms of temporomandibular joint dysfunction are common and many patients do not respond to conservative therapy. Surgical procedures previously used for intractable symptoms, including resection of the mandibular condyle, meniscectomy, and gap arthroplasty, have also not been totally successful. Other surgical techniques are now evolving, including meniscoplasty alone and meniscoplasty with superficial condylar shaving. Preliminary results from these techniques suggest improvement in joint function and symptoms (C. Wilkes, personal communication). Arthrography seems potentially useful for pre- and postoperative evaluation of soft tissue anatomy of the joint if it were simple to perform and reliable in interpretation.

We describe a technique that uses multidirectional tomography after instillation of contrast material into the joint, and our initial experience with 21 patients is reported.

Anatomy

The temporomandibular joint is a combined hinge-sliding articulation between the condyle of the mandible and the glenoid fossa and eminence of the temporal bone (fig. 1). The meniscus (or disc) forms a complete partition dividing the joint space into two diarthrodial compartments [6, 7]. The lower joint space is smaller and more tightly reinforced by a fibrous capsule; the upper joint space is larger and not as well reinforced. The volume of the normal lower joint space has been reported to be 0.9 ml and the volume of the normal upper joint space is 1.2 ml [3]. The articular surfaces of the temporomandibular joint are fibrocartilaginous in nature. The meniscus is an oval fibrous plate, centrally thinner than at the periphery and pliable when normal. Its central region is avascular. The posterior attachment of the meniscus, termed the bilaminar zone, consists of fibrovascular connective tisue with laminar elastic and collagenous tissue components. Medially and laterally the meniscus is attached to the mandibular condyle. Anteriorly the meniscus blends with the capsule and is attached to the superior head of the lateral pterygoid muscle. On opening the mouth, the meniscus rotates posteriorly and translates forward beneath the articular eminence.

Technique

The patient is laterally recumbent with the head resting on a fluoroscopic table. The side of the face to be studied is uppermost and parallel with the table top. The skin just anterior to the external auditory meatus is prepared and draped.

Lower Joint Space

Under fluoroscopic guidance, the posterosuperior aspect of the mandibular condyle is identified. Local anesthetic (lidocaine 1%) is infiltrated into this region. A scalp vein needle and attached tubing is filled with contrast material; care is taken to eliminate air bubbles. In a perpendicular direction, the 23 or 25 gauge needle, at least 2 1/3 cm long (Sherwood Medical Ind., Inc., St. Joseph, Mo.), is introduced through the skin to the

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predetermined region (fig. 2A). After advancement of the needle, fluoroscopic observation assures proper positioning. The appropriate needle depth is usually obtained when the plastic hub is near the skin surface. When the condyle is encountered, the needle is either directed slightly more posterior or the patient is instructed to open the mouth one finger width and the needle is advanced. Successful placement can be determined by movement of the needle behind the condyle with slight opening of the mouth. Changes in the fluid level within the tubing may also be observed with condylar excursions. Occasionally some fluid can be aspirated from the joint.

A test injection of contrast material, less than 0.5 ml of Reno-M-60 (diatrizoate meglumine 282 mg/ml bound iodine, Squibb), will be observed to flow freely anterior to the condyle when the needle is properly placed (fig. 2B). A total of less than 1 ml of contrast material completes the injection. The needle is withdrawn after spot filming in closed and open mouth positions and the patient is immediately transferred to the tomographic unit.

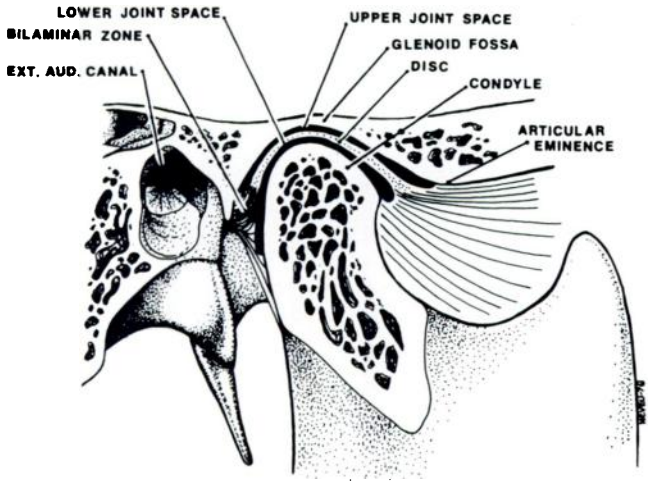


Fig. 1.—Radiographic-anatomic landmarks for temporomandibular arthrography. Saggital plane through temporomandibular joint.

The patient lies prone on the table with the face oriented so that the flat surface of the ramus of the mandible is parallel to the table top ("near lateral" tomograms) [8]. Either "figure-of-eight" or hypocycloidal motion is used to obtain images in the closed mouth position to serve as a scout for determining the proper tomographic depth. Additional tomograms are then obtained at one, two, and three finger widths of mouth opening when possible and at maximal opening. Three to five tomograms at 3 mm levels are obtained in each position of the mouth.

Upper Joint Space

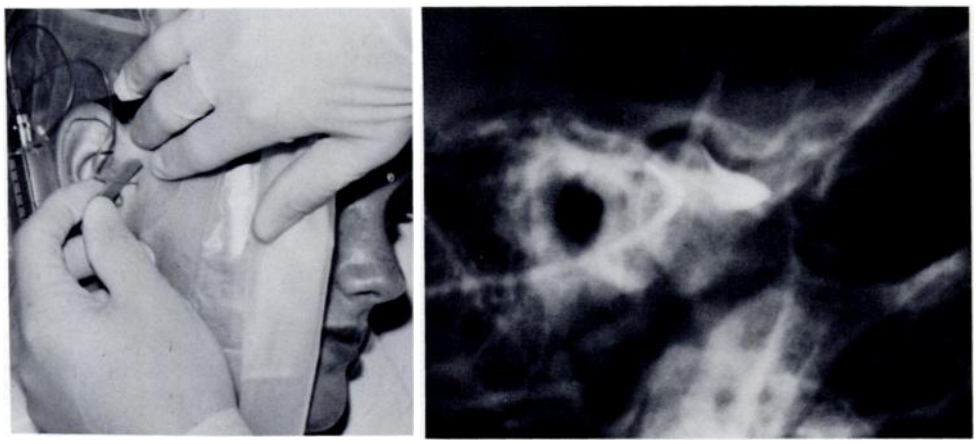
The needle is directed under fluoroscopic guidance at the midportion of the inferior margin of the glenoid fossa. With successful entry, contrast material will flow freely under the glenoid fossa and eminence. Tomograms are obtained as described for the lower joint space.

Indications

Clinical indications for temporomandibular joint arthrography in our patients have included pain, tenderness, and clicking and locking of the joint; these problems did not respond to conservative therapy. The primary objective of temporomandibular joint arthrography in these patients was to evaluate the extent of movement and integrity of the meniscus. All patients in our series were potential operative canditates for meniscoplasty and high condylar shaving. However, we do not consider rheumatoid or degenerative arthritis as indications for arthrography, since these conditions may be diagnosed by plain films alone.

Clinical Findings

Twenty arthrograms were successfully performed in 21 patients: 18 women, 17–42 years old; three men, all 21 years old. One arthrogram was unsuccessful. One patient was believed to have normal features; two were indeterminate. The other 17 arthrograms were regarded as demonstrating abnormality. Eleven patients underwent a meniscoplasty.



A B

Fig. 2.—**A**, 23 gauge scalp vein needle introduced perpendicularly into lower joint space. **B**, Spot radiograph under fluoroscopic guidance confirms proper needle placement into lower joint space after contrast medium injection. (Radiographs oriented with the patient's facial region to the right.)

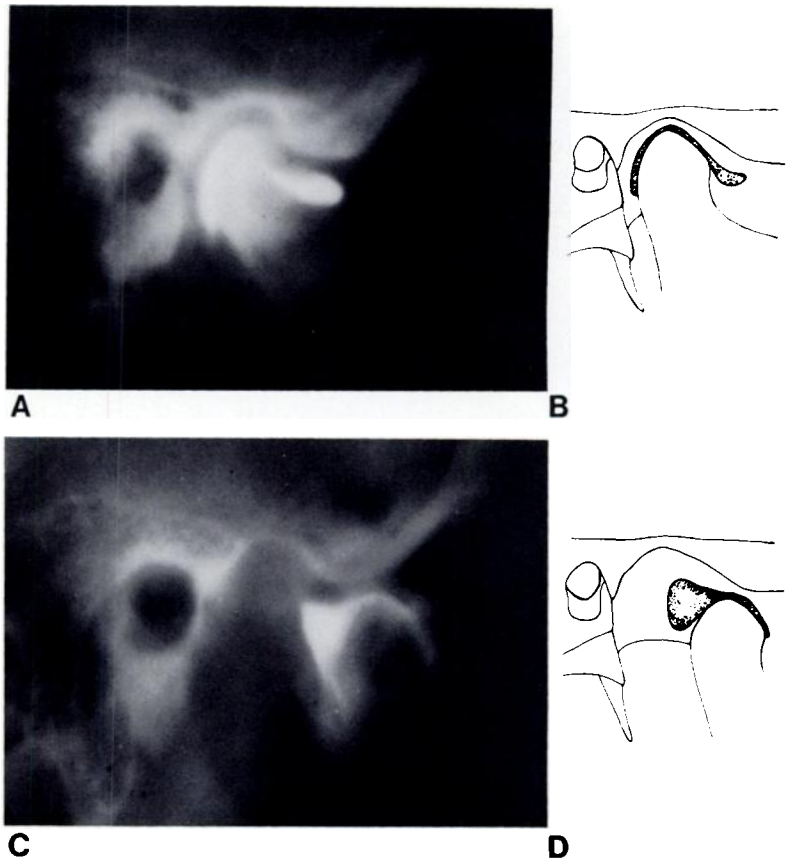


Fig. 3.—**A** and **B**, Normal lower joint space in closed mouth position after introduction of contrast material. Anterior aspect of joint space in smooth teardrop configuration. **C** and **D**, Normal lower joint space in open mouth position. Mandibular condyle has translated anteriorly beneath eminence and joint opens posteriorly.

Normal Arthrograms

The lower joint space is contiguous with the articular surface of the mandibular condyle. In the closed mouth position the posterior aspect of this space is thin, conforming to the posterior and superior aspect of the condyle (figs. 3A and 3B). The joint space is widest anteriorly, forming a smooth teardrop configuration. With opening of the mouth, the condyle translates anteriorly under the eminence and contrast material flows into the joint space posteriorly (figs. 3C and 3D). Only a thin rim of contrast material remains along the anterosuperior margin of the condyle. The posterior aspect of the joint space is smoothly convex inferiorly and the superior margin is slightly concave.

The upper joint space is contiguous with the glenoid fossa and articular eminence of the temporal bone. In the closed mouth position, the posterior aspect of the space conforms closely to the margin of the glenoid fossa (figs. 4A and 4B). The space extends anteriorly beneath the eminence with a horizontally directed teardrop configuration similar to the lower joint space. On opening the jaw, the posterior aspect of the upper joint space widens, forming a D-shape configuration (figs. 4C and 4D). The anterior aspect of the joint space becomes thinned with its contour paralleling that of the condyle.

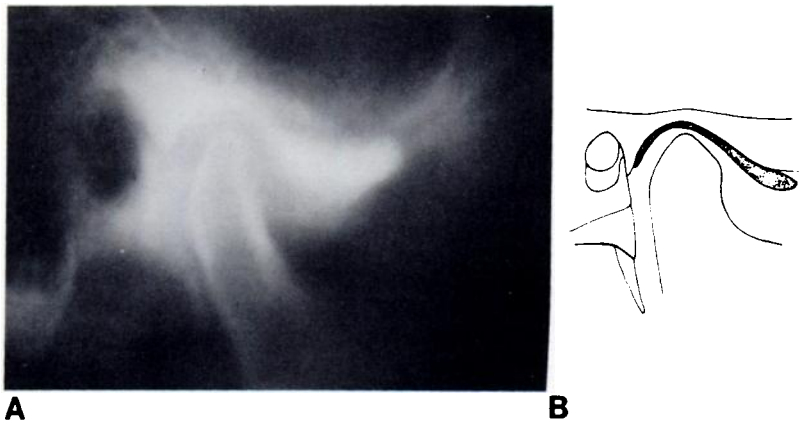
The meniscus is interpreted indirectly from its relations with the joint spaces. As noted, the normal disc allows no communication between the upper and lower joint spaces. Our experience with normal temporomandibular joints is limited to one patient and one volunteer subject. We would like to be able to describe more experience with normal joints, but cannot justify examination of symptomless joints.

Abnormal Arthrograms

When functioning abnormally, the disc appears as a mass impression on the configuration of the joint spaces. Abnormalities that may be encountered are: (1) disc perforation, (2) anterior dislocation of the disc, (3) anterior subluxation of the disc, (4) tenting (redundancy) of the disc in the region of the bilaminar zone, (5) increased joint volume, (6) rupture of the capsule, and (7) adhesions and synovial membrane proliferation.

Disc perforation. Tears or perforations of the disc are easily recognized when simultaneous filling of the upper joint space occurs with injection of contrast material into the lower joint space (fig. 5). At surgery a central tear in the disc was confirmed and repaired. The patient was seen with intermittent locking, clicking, severe pain, and a shearing sensation upon mandibular movements. Only one patient in this series had a recognizable disc perforation.

Anterior dislocation of the disc. In patients with anterior displacement of the disc, the inferior joint space is normal in the closed mouth position. With attempted maximal opening of the mouth there is decreased ante-



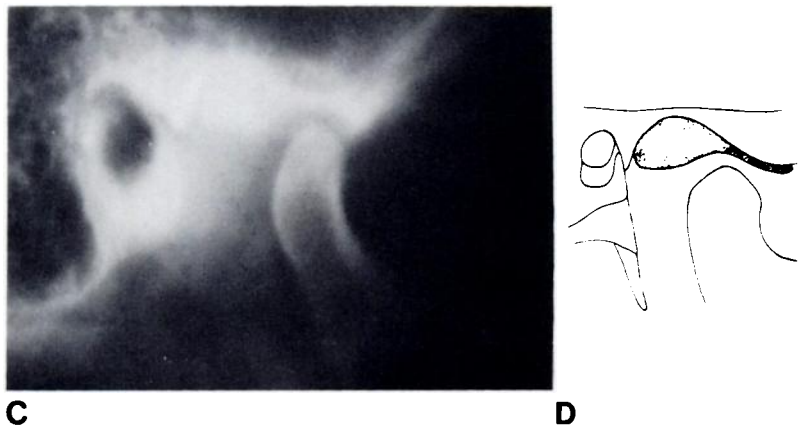


Fig. 4.—**A** and **B**, Normal upper joint space in closed mouth position after introduction of contrast material. Joint space is contiguous with glenoid and eminence of temporal bone. **C** and **D**, Normal upper joint space in open mouth position. Posterior aspect of upper joint space widens forming a D shape directed superior.

Fig. 5.—Disc perforation indicated by simultaneous opacification of lower and upper joint spaces. Extravasation of contrast material along posterior aspect of mandibular neck (*arrows*). Surgical confirmation.

rior excursion of the condyle. A mass impression is created by the atonic, folded disc on the anterosuperior margin of the lower joint space which may assume an obtuse angle (fig. 6). Six patients were seen with locking and pain in the joint. Four of the six patients underwent surgical exploration and had pathology of the disc that included thinning, flaccidity, and perforation.

Anterior subluxation of the disc. Disc dysfunction is less severe with subluxation than with overt dislocation and locking of the condyle. When suspected, the patient is instructed to open the mouth to a point just before the click occurs, and tomograms are then obtained. Although the arthrogram is normal in the closed mouth position, the lower joint space is deformed by a mass impression of the subluxed disc similar to the dislocated disc at this point of condylar excursion. Figure 7 shows open mouth appearance just before the click. At full opening, the joint may appear entirely normal with full anterior excursion of the condyle. In the patient illustrated, surgery revealed an atonic disc. Seven others were thought to have subluxation, and four of these had surgery. These discs were flaccid or atonic and, in two cases, spurs on the condyle were found.

Redundancy of bilaminar zone. The closed mouth arthrogram is normal (figs. 8A and 8B). After anterior excursion of the condyle, a "tent" is seen at the pos-

Fig. 6.—Dislocation of disc. Maximal opening of mouth, but with decreased anterior excursion of mandibular condyle. Contrast material does not flow posteriorly and mass impression on upper margin of lower joint space is believed due to anteriorly dislocated disc. No surgical proof.

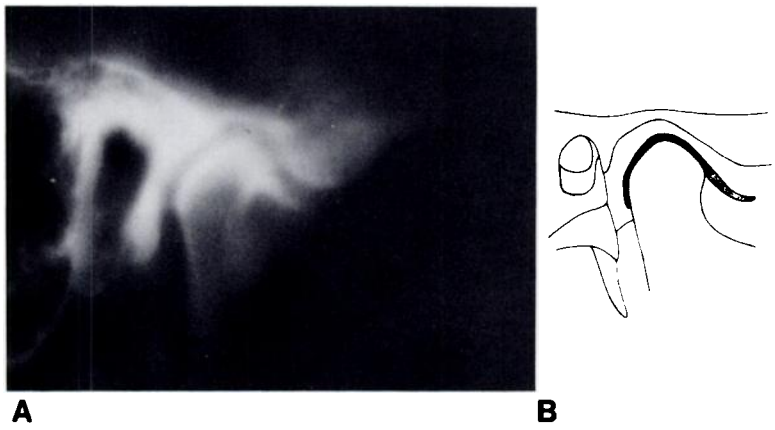


Fig. 7.—Subluxation of disc. Tomogram just before the patient experiences click on opening of mouth. Thinning of anterior aspect of lower joint space with sharp pointed configuration indicates anteriorly displaced disc which reduces with audible click on full anterior condylar excursion. Surgery revealed atonic disc.

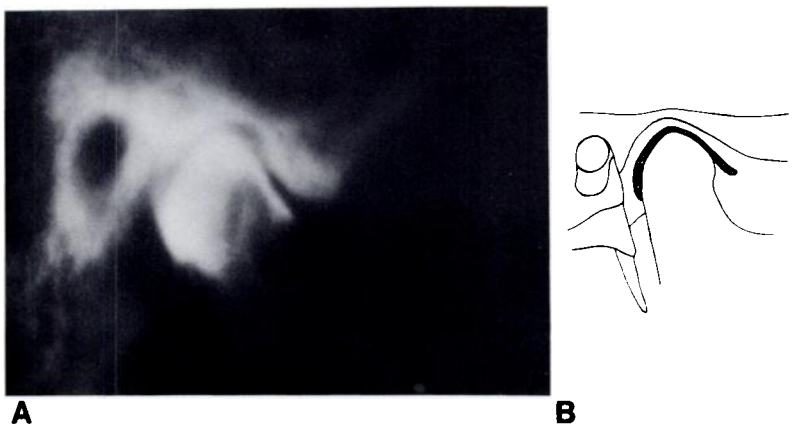


Fig. 8.—**A** and **B**, Redundancy of bilaminar folds. Closed mouth appearance of lower joint space is normal. **C** and **D**, During opening of mouth there is anterior excursion of condyle and tenting of posterior aspect of lower joint space. Surgical confirmation.

terosuperior aspect of the lower joint space (figs. 8C and 8D). Some contrast material may also be trapped anterior to the condyle by the mass impression effect of the abnormal disc. The patient illustrated had a grating noise in the joint associated with temporal headaches, and surgery revealed loose, redundant tissue in the bilaminar zone. Three other patients had similar redundancy, one of whom had surgical confirmation.

Increased joint volume. This was reported by Toller [3] to occur in patients with recurrent dislocations of the mandibular condyle. It alone is not significant for disc disorders. The volume of the lower joint space in these patients has been reported to average 1.1 ml, 20% greater than normal. The volume of the upper joint space averages 1.9 ml, 60% greater than normal. We have no experience in demonstrating this abnormality.

Rupture of the capsule. Contrast material is observed around the joint capsule, as well as within the joint. It has been reported to occur with trauma to the mandible [3]. Differentiation from extravasation in a technically difficult examination may not be possible.

Adhesions and synovial proliferation. These changes are reported in patients with chronic rheumatoid arthritis [4]. Arthrographic findings include decreased joint volume with numerous septations and adhesions. We have not included these patients in our study, as they are not candidates for meniscoplasty.

Complications

Though it has been well shown that opacification may be significantly prolonged using epinephrine mixed with the contrast material, we have found its use undesirable [9, 10]. Intravasation of epinephrine may readily occur since the temporomandibular joint region is highly vascular. One patient in our series experienced acute systemic reactions during the arthrogram. We have discontinued the use of epinephrine and obtain tomograms immediately after injection. Perhaps contrast media of larger molecular size (e.g., meglumine iocarmate, Dimeray) with a slower absorption rate would allow more time for radiographs [11].

Transient, ipsilateral facial nerve palsy occurred in one patient after a too vigorous injection of lidocaine around the joint. Only a small amount of skin and subcutaneous local anesthesia is needed. Extravasation of contrast material occurs commonly with difficult arthrograms. The patient experiences pain in the region, so we recommend meglumine preparations rather than sodium salts to minimize subjective discomfort. We have not encountered infection after arthrography. Adequate skin cleansing and sterile technique with small needles help minimize this possibility. Residual joint pain after the procedure frequently occurs. To some degree this is caused by the difficulty of the procedure and the quantity of contrast extravasated. It is treated symptomatically.

Discussion

Radiologic evaluation of the temporomandibular joint is currently limited to plain radiographs and tomograms. Arthrography as described here offers information that may be useful in considering the desirability of newer operative methods for repair of the disc. Tomography markedly simplifies the interpretation. It effectively eliminates overlapping soft tissues and bony structures that obscure basic joint definition. Without tomography, superimposition of the upper and lower joint spaces on the condyle may obscure the central disc region leading to confusion in interpretation of the radiographs. Review of our experience shows that the lower joint space provides the greatest diagnostic information and should be studied first. Operative findings substantiate the disc abnormalities demonstrated by lower joint arthrography.

From a clinical standpoint, it is interesting that most of the patients with symptoms of disc dysfunction are female. In general, temporomandibular joint dysfunction and pain are more common in females than in males. The principal symptoms are pain localized to the joint areas, tenderness to palpation over the joint, and, intrameatally, clicking or locking and limitation of opening with deviation of the mandible to the side of dysfunction.

Many patients with temporomandibular joint symptoms classify into the myofascial pain dysfunction syndrome that has a strong psychological overlay as one of its characteristics. This syndrome may in itself eventuate in true joint dysfunction resulting from muscle tension, clenching and grinding of the teeth. A thorough discussion of this complex and interesting syndrome is provided by Laskin [12].

The good correlation of radiographically demonstrable disc abnormalities and surgical observations is encouraging. We are optimistic that temporomandibular joint arthrography will provide objective criteria for separating functional from true organic symptoms and in the future help identify those patients likely to benefit from newer surgical techniques. Evaluation of this new method of joint examination is continuing.

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