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Dislocation of the Temporomandibular Joint Meniscus: Contrast Arthrography vs. Computed Tomography

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A prospective study to determine the accuracy of computed tomography (CT) for the diagnosis of dislocation of the temporomandibular joint (TMJ) meniscus was made by performing both CT and contrast arthrography on 18 joints suspected of meniscus dislocation. Arthrography rather than surgery was chosen as the quality standard for comparing CT findings, as not all patients undergoing the studies underwent surgery. The CT protocol included scanning with both closed- and open-mouth series, 1.5-mm-thick slices, soft-tissue and bone-detail settings, and coronal and sagittal reformations. Arthrography was done with linear tomography, after both lower and upper compartmental injections under fluoroscopic control. The results of each test were reported independently by the radiologist who obtained either all of the arthrograms or all of the CT scans. For dislocation of the meniscus, there was excellent agreement between the two methods. Nine menisci were dislocated according to both arthrography and CT. One meniscus was thought to be dislocated by CT, but this was not confirmed with arthrography. CT seems to be nearly as accurate as arthrography for showing meniscus dislocation, is performed with lower x-ray exposure, and is noninvasive. Arthrography discloses more detailed information about the joint meniscus, such as perforation and maceration, and should continue to be used when this kind of information is clinically important.

Claims have been made in recent reports that a dislocated meniscus of the temporomandibular joint (TMJ) may be demonstrated with computed tomography (CT), thus avoiding invasive contrast arthrography before treatment [1-6]. To judge the accuracy of such claims, we began a prospective study with a group of patients clinically suspected of having a dislocated TMJ meniscus. Both CT and arthrography were performed for the purpose of comparison in each subject. Two basic steps were taken to avoid bias of the results. First, CT and contrast arthrography were performed and interpreted, each by a separate radiologist, and each test result was unknown to the other examiner. Second, the referring dental specialist (E. C.) included case material representing joint pathology not "classic" for dislocation of the TMJ meniscus but still requiring that differential diagnosis. This established an effective subgroup of controls, so that the study group was not biased in the sense of having only dislocated TMJ menisci, and thus little possibility for false-positive CT diagnoses.

Operative findings were not chosen as the standard for correct diagnoses because some in the group would likely not require surgery. Arthrography was chosen as the "gold standard" because it has come into use as the most definitive radiographic test in planning for surgical treatment.

Both CT and arthrography may provide useful information about the pathology of the TMJ in addition to the possibility of determining whether or not the joint meniscus is dislocated. A comparison of the relative value of CT and arthrography in terms of defining their diagnostic strengths and weaknesses was therefore also made by evaluating findings with each technique for each joint studied.

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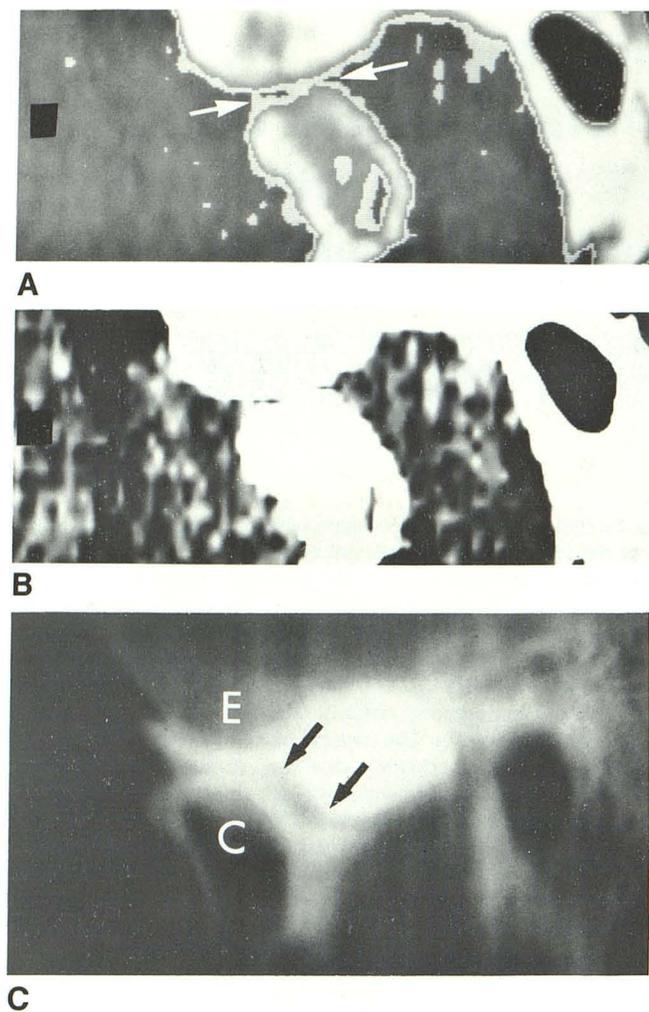


Fig. 1.—Meniscus in normal position. **A**, Sagittal CT reformation using 4000 H windowing and blink-mode highlighting of pixels having attenuation in range of TMJ meniscus. Open-mouth view of right TMJ with normal position of joint meniscus (arrows). **B**, Same section, with 240 H window and no highlighting. **C**, Dual-compartment sagittal tomography, open-mouth position. Forward translation of condyle (C) onto articular eminence (E); normal-appearing meniscus (arrows) interposed.

Subjects and Methods

Eighteen symptomatic TMJs in 15 patients were selected for study as part of a prospective comparison of CT and contrast arthrography. In each there was a clinical suspicion of dislocation of the meniscus. Thirteen of the 15 patients were women. Age range was 19–32 years except for two women aged 43 and 59.

The technique of contrast arthrography was standardized for all joints and carried out by the same radiologist (D. S.) who was experienced with TMJ arthrography. Arthrography was performed either before or after CT according to the convenience of scheduling. Two longitudinal-motion linear scout tomograms spaced at 5 mm in the sagittal plane of the joint were obtained with the Siemens multipanigraph. Local infiltrative anesthesia of the skin and periarticular tissues, without a direct attempt to block the auriculotemporal nerve, was performed with 1% lidocaine injected through a 25-gauge needle. The lower joint compartment was tapped first, and 0.5 ml of diatrizoate meglumine 60% containing 1/20,000 parts epinephrine was

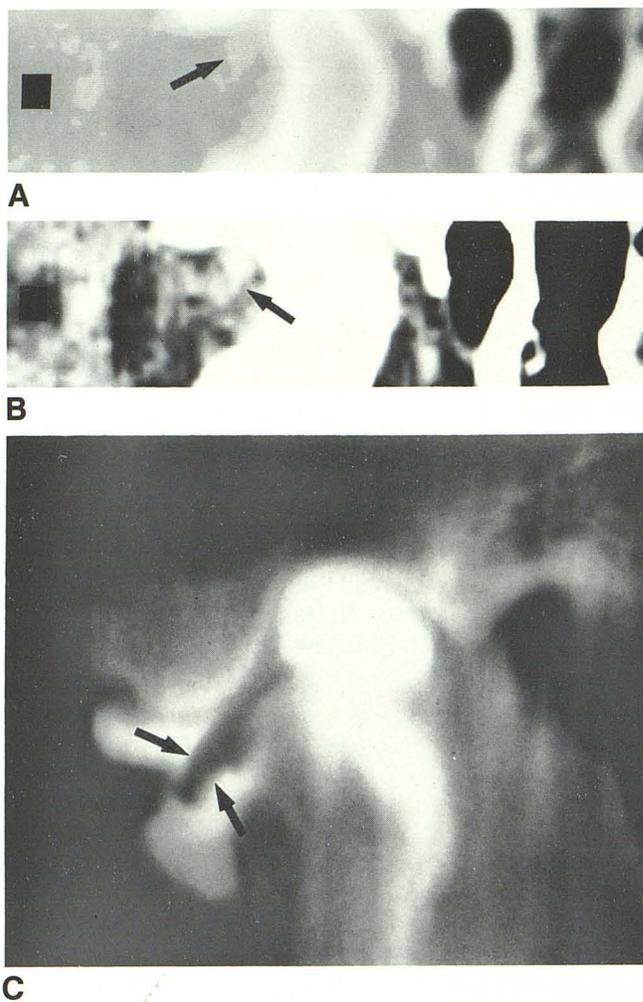


Fig. 2.—Meniscus dislocated. **A**, Sagittal CT reformation of right TMJ in open-mouth position using 4000 H window and blink-mode highlighting. Bunched-up meniscus shadow anterior to condyle (arrow); lack of normal condylar translation. **B**, Same section, with 240 H window. Abnormal meniscus shows equally well (arrow). **C**, Dual-compartment sagittal tomography in open-mouth position for comparison confirms meniscus dislocation (arrows).

injected under fluoroscopic control. Joint movements were observed fluoroscopically, and two tomograms were made at 2-mm intervals in three jaw positions: isocentric, half-open or before the click or pop, and fully open. In the same fashion, the upper compartment was subsequently injected with 0.7 ml of the contrast agent and the same sequence repeated, except for obtaining four tomograms rather than two at 2-mm intervals in each jaw position. The radiologic report was made without knowledge of any preceding CT report.

CT scanning of both TMJs was done in all 15 patients using the GE 8800 CT/N according to the following standard protocol. A lateral scanned projection radiograph (ScoutView) was made of the head, with the infraorbitomeatal line perpendicular to the floor in order to obtain true axial plane sections without using angulation of the gantry.

Series of 18–20, 1.5-mm sections through the joints were made at 1-mm scan intervals. Radiographic technique factors were 120 kVp and 250 mAs. The total scanning time was about 6 min. This scanning protocol was performed twice, first with isocentric (closed mouth without occlusal pressure) jaw positioning and then with the

mouth opened to the point of pain tolerance. A quickly formed polyresin (Citricon, Sybron Kerr Co.) occlusal bite block was placed to stabilize the jaw in open position for scanning. Images of all sections were made with prospective soft-tissue and retrospective bone-detail (ReView) target algorithms and in coronal and sagittal planes using the ARRANGE software. Filming of all axial, sagittal, and coronal images was done with both soft-tissue and bone-detail windowing. In addition, the CT number highlighting (blink mode) and magnification features were used. Film interpretations were made on all patients by the same radiologist (J. T.) without knowledge of the arthrographic findings.

In this analysis, a dislocated meniscus is one that has migrated or slipped from its normal position between the articulating surfaces of the mandibular condyle and temporal bone and is not reduced at any point during joint movement. A displaced meniscus, on the other hand, is one that is abnormally placed when the condyle is in the closed position but which reduces to normal position at some point in condylar translation. A displaced meniscus that reduces would therefore not ordinarily be expected to be visible on CT in the open-mouth position, but should be easily delineated on contrast arthrography.

Results

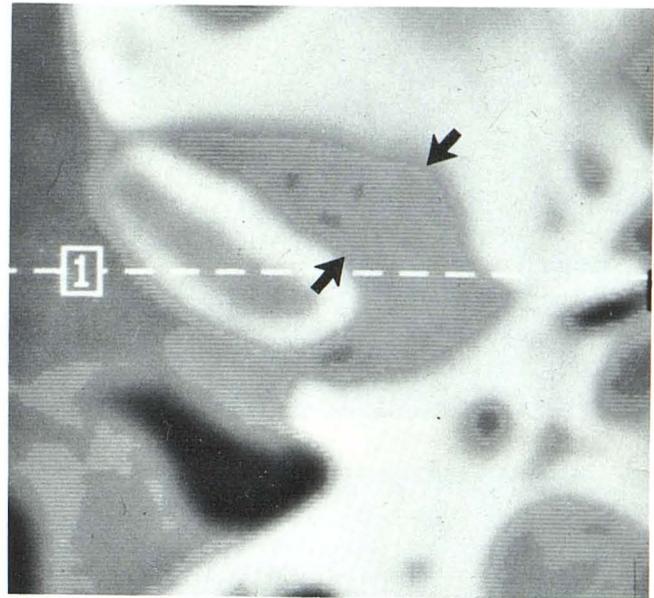
Joints that are shown by arthrography to have normally positioned menisci may show menisci in their normal intra-articular positions on CT and no similar radiodense tissues visible in the pericondylar spaces (fig. 1). When dislocated, however, the fibrocartilaginous meniscus, having CT attenuation higher than normal pericondylar soft tissues, becomes visible adjacent to the condyle (fig. 2). The meniscus theoretically may dislocate in any direction, but most commonly it moves anteriorly.

Comparison of the results of CT and arthrography showed that of the 18 joints studied, nine had dislocated menisci on both CT and arthrography. In the other nine joints, the menisci were not dislocated on arthrography, but one was thought to be dislocated on CT. Thus, using arthrography as the gold standard, there were no false-negative CT studies and one false-positive study.

This false-positive CT examination was reviewed, and the report was found to be in error. No abnormal periarticular meniscus shadow was seen, and therefore, despite indirect signs of disk pathology, a diagnosis of meniscus dislocation should not have been made.

Indirect signs of internal joint pathology were seen on CT in eight joints (including degenerative joint changes in four found to show a meniscus dislocation on arthrography). Three joints found to have displaced, not dislocated, menisci on arthrography showed degenerative joint changes or other indirect signs on CT. CT gave information about 12 contralateral joints that had no arthrographic correlation. In five of the 12 patients, dislocated menisci were seen on CT on the side contralateral to the dislocated menisci shown by arthrography.

In one patient in whom both joints were studied, a problem with the interpretation of findings was encountered with both CT and arthrography. CT revealed lateral meniscus positions bilaterally, but no abnormal periarticular meniscus shadows were noted. Arthrography was also difficult to interpret. Despite restricted jaw mobility, the menisci did not appear dis-



A



B

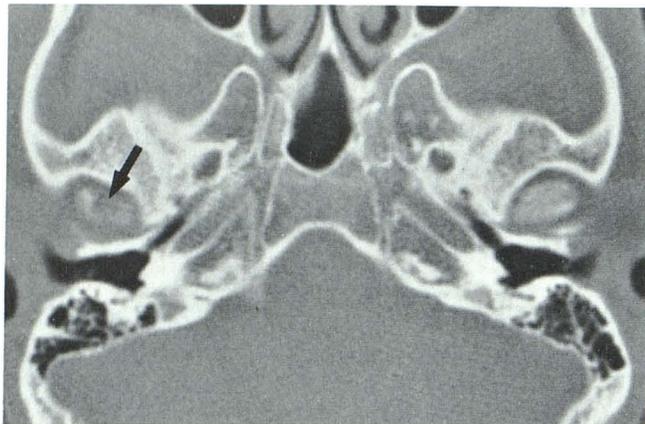
Fig. 3.—Axial section with blink mode through right joint. Dashed cursor line (1) locates coronal section (B). Indirect sign of widened anterior medial joint space (arrows). B, Coronal reformation with blink mode. Medially positioned meniscus (arrowhead) would likely have been missed with sagittal images alone. Arthrography showed anterior dislocation of meniscus, but its medial position in joint was not appreciated.

located. CT arthrography showed lateral dislocations of both menisci, proving a false-negative result for both CT and conventional arthrography. These were not counted as false-negative CT results for the purpose of this study, however, because CT agreed with the arthrography, the standard with which it was compared.

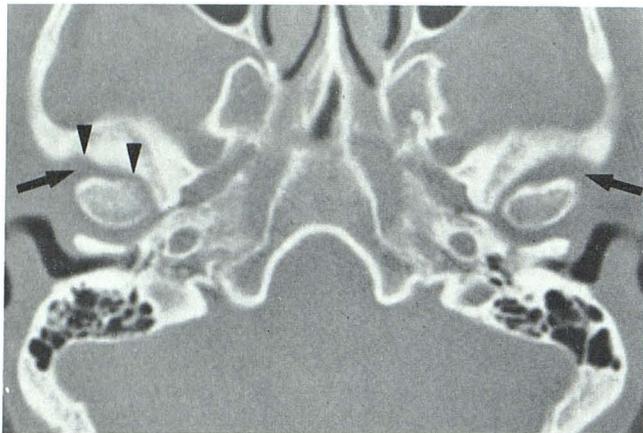
Discussion

The ability to view the TMJ in multiple planes, including the coronal, gives CT advantages for depicting a dislocated meniscus over sagittal views alone, particularly when the meniscus has moved rather lateral or medial to the condyle (fig. 3). Seeing the meniscus in more than one projection adds substantially to the level of confidence for the finding. In some patients, axial views alone show the dislocated meniscus quite plainly, but more often we have found that the coronal and sagittal images are necessary.

In addition to the direct sign of joint derangement, a visible disk dislocation, CT may also show signs of internal joint pathology when a dislocated meniscus is not visible [5] (fig. 4). These indirect signs include condylar reshaping, change



A



B

Fig. 4.—Deformed condyle in right TMJ. A, Bone-detail axial section at upper condylar level. Cystic rarefaction in subchondral cortex plainly visible on right (arrow). B, Axial section 3 mm lower. Widened lateral joint spaces (arrows) are indirect sign of laterally positioned menisci. Abnormally narrow medial joint spaces are also indirect sign of meniscus pathology. Reshaping of anterior joint surface (arrowheads). Coronal views may also demonstrate these changes to greater advantage than sagittal views.

in condylar joint angle, reduced joint space, decreased translation, degenerative joint changes, asymmetric pterygoid musculature, ipsilateral ramus shortening, and cephalad positioning of the coronoid process tip. Many of these signs were observed in all nine joints with meniscus dislocation and in seven that were not dislocated. The specificity of these changes has not been determined.

The advantages of CT over arthrography may be summarized. CT allows evaluation of both joints with one study. It affords better three-dimensional depiction of joint morphology. Certain indirect signs of joint pathology that may aid in understanding functional disturbances may be shown. The method is noninvasive. The radiation dosage is also lower than for arthrotomography. (Exposure to the center of the condyle with CT is 1800 mR/464 ($\mu\text{C}/\text{kg}$), whereas with arthrotomography it is 4700 mR/1213 ($\mu\text{C}/\text{kg}$) according to the radiographic techniques described under Subjects and

Methods [Christiansen E, et al., unpublished data].)

Conventional arthrography offers certain advantages over CT. The joint meniscus is directly depicted during the entire open-close cycle. The detail of meniscus morphology is clearly superior to that shown on CT. Meniscus perforation and maceration can be readily shown, and arthrography is helpful for documenting early meniscus pathology before dislocation occurs. Tears of the joint capsule may be shown with arthrography but are not demonstrable by CT [7, 8].

Certain CT scanner features are considered essential and others optimal for TMJ CT. High-resolution, thin-section (1.5–3 mm) images and software for coronal and sagittal reformatting are essential in order to get the detail required to see a dislocated meniscus. Scanned projection radiography (ScoutView) is necessary for proper localization and alignment in order to minimize radiation exposure and examination time. For optimal studies, a bone-detail program (ReView) provides much improved imaging of the bony structures, which reflect some of the indirect signs of joint pathology. The “blink mode” (CT number highlighting) can enhance the depiction of the dislocated meniscus.

CT can be used to document dislocation of the TMJ meniscus with the accuracy of arthrography and may therefore be more appropriate for preoperative screening for meniscus dislocation because of a lower radiation exposure and its noninvasiveness. Arthrography is necessary when information about the intrinsic structures other than meniscal dislocation is desired. The examinations may be complementary, as CT shows bony and periarticular structures with more detail than arthrography.

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