

History of Arthrography

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KEYWORDS

- Arthrography • Injections • History • Contrast
- Joint • Internal derangement

Arthrography has been used to evaluate joint pathology for more than 100 years.¹ First reports used air and early iodinated contrast agents, but arthrography really did not flourish until the mid portion of the last century when better-tolerated water-soluble iodinated contrast media became more readily available.² Early articles described single-contrast techniques, but double-contrast techniques soon became used for most applications.^{3,4} Arthrography saw its widest use in the 1960s and 1970s, but indications for many joints decreased significantly after the introduction of cross-sectional imaging modalities such as CT and MR imaging.² The use of arthrography has grown again with the introduction of CT and MR arthrographic techniques, which were introduced the 1980s and continue to be refined. This article revisits the history of arthrography from the early 1900s to modern MR and CT arthrography techniques of the twenty-first century. This article is not a comprehensive review of the literature but rather is a retrospective review of many articles that shaped arthrography throughout the years.

SHOULDER-JOINT ARTHROGRAPHY

Shoulder-joint arthrography was first introduced in 1933 by Oberholzer,⁵ who evaluated distortions in the shoulder-joint capsule resulting from anterior dislocations using intra-articular air as a contrast medium. He specifically studied the “inferior recess” of the shoulder joint, a term he used to encompass the axillary recess and the anterior, and posterior bands of the inferior glenohumeral ligament.⁵ Shortly thereafter, in 1939, Lindblom⁶ introduced arthrography of the shoulder using an iodinated contrast medium. In his article,

“Arthrography and Roentgenography in Ruptures of the Tendons of the Shoulder Joint,” Lindblom described the use of single-contrast arthrography of the shoulder to characterize rotator cuff pathology and abnormalities of the long head of the biceps tendon. His article reported 50 rotator cuff tears evaluated with intra-articular injection of contrast medium in the glenohumeral joint and three cases of rotator cuff tear evaluated with injection of contrast medium into the subacromial-subdeltoid bursa.⁶ The arthrographic technique was remarkably similar to modern techniques, apart from the target site for the injection and the postprocedural imaging:

The patient lies back with his arm adducted and relaxed. A hypodermic needle 1 mm in diameter and with a short point is inserted about 1 cm ventro-lateral to the acromioclavicular joint in the direction of the center of the head of the humerus. The point of the needle pierces the cutis, subcutis, fascia, deltoid muscle, subacromial bursa, tendon aponeurosis, joint space and articular cartilage. Then it meets bony resistance, the surface of the head. The patient is now instructed to relax completely, and attempts to inject Novocain are made. When the point of the needle is in the cartilage, the injection often is balked, but the resistance ceases, if under continued pressure on the piston, the needle is withdrawn about a millimeter, ie, to the joint space. The contrast medium, 6 cc. of 35% perabrodil mixed with 1 cc. of Novocain, is now injected, with the patient relaxed. The needle is removed immediately, and a number of passive movements of the arm

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*are made, to spread the contrast medium throughout the joint. The roentgenograms are taken without delay, since the contrast medium becomes rapidly absorbed.*⁶

The article subsequently describes four separate patient positions for obtaining postprocedure radiographs. In postprocedural imaging, two views depicting the distal supraspinatus and infraspinatus tendons in profile, similar to the anteroposterior internal and external rotation views commonly obtained today, were obtained with the patient in the erect position. A third view was obtained posteroanteriorly at a greater obliquity to evaluate better the anterior supraspinatus and superior subscapularis tendons. The final view was obtained from below the shoulder joint, resulting in an image similar to an axillary view.⁶

Throughout the 1940s, 1950s, and 1960s, subtle changes in the technique for shoulder arthrography occurred. There was continued development of safer and more reliable iodinated contrast media, with less discomfort and transient synovitis following the procedure. Postprocedural imaging with conventional radiography gradually gave way to fluoroscopy as continued improvement in fluoroscopic equipment resulted in better image quality and less dose administered to the patient.

In 1975, Schneider and colleagues⁷ first described the approach for anterior shoulder-joint injections that is used most commonly today. They described placing the patient on the fluoroscopy table in the supine position with the arm in neutral to mild external rotation and using a direct anterior approach under fluoroscopy aiming straight for the glenohumeral joint space. This approach now is known as the “Schneider technique” for shoulder-joint injections (Fig. 1).⁷



Fig. 1. Schneider technique for shoulder-joint injections. After the patient is placed in the supine position with the arm in neutral to slight external rotation, the glenohumeral joint is accessed via fluoroscopy using a direct anterior approach.

Double-contrast arthrography of the shoulder was first popularized by Ghelman and Goldman,^{8,9} who authored articles demonstrating the efficacy of double-contrast arthrography for the evaluation of rotator cuff tears (Fig. 2). This technique was the first significant change in shoulder-joint arthrography since the early publications in the 1930s and 1940s. In 1979, Mink and colleagues¹⁰ described the added utility of double-contrast arthrography for evaluating glenoid labral pathology.

Shoulder arthrotomography (tomographic imaging of the shoulder following intra-articular contrast administration) was introduced by El-Khoury and colleagues¹¹ in 1979, although this technique soon was replaced with CT arthrography. The first article describing CT arthrography was authored by Tirman and colleagues¹² in 1981, and a number of publications soon followed discussing the various potential uses for CT arthrography in the evaluation of shoulder-joint pathology.^{13–16} CT arthrography of the shoulder provided a major advance in three-dimensional evaluation of the shoulder joint, glenoid labrum, and articular cartilage; these structures often had been evaluated incompletely with conventional shoulder arthrographic techniques (Fig. 3).

MR arthrography was introduced in the late 1980s. Hajeck and colleagues^{17,18} introduced MR arthrography in 1987, with a cadaveric study of several joints including the shoulder, and discussed potential contrast agents for MR arthrography later that year. Palmer and colleagues^{19,20} explored the clinical relevance of shoulder MR



Fig. 2. Double-contrast shoulder arthrography. Popularized in 1977 by Ghelman and Goldman, the double-contrast shoulder arthrogram delineated rotator cuff pathology and allowed better definition of glenoid labral abnormalities and cartilaginous defects.

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