6 Interventional Procedures

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6.1 Introduction

Many interventional techniques of the shoulder require imaging guidance by X-ray fluoroscopy, computed tomography (CT), and ultrasound. In more recent studies, magnetic resonance imaging (MRI) has been proposed as a promising method. This chapter will consider those imaging techniques, in particular MRI, and clinical applications including distention arthrography for frozen shoulder, aspiration for calcific tendinitis, and aspiration of cystic lesions. The technique of bone and soft tissue tumor biopsy and abscess drainage is not specific to the shoulder, and not discussed here.

6.2 Hardware, Needles

The needle approach to the shoulder using conventional X-ray fluoroscopy has been widely published. The needle tip is easily controlled with fluoroscopic guidance. The X-ray beam can be tilted to confirm the needle tip location (Normandin et al. 1988). Biplane fluoroscopy may be more comfortable for checking the needle position. A CT-guided procedure may be another option. The patient lies on the CT table and the point of skin puncture is decided in conjunction with metallic indicators on the skin and positioning lights of the gantry. CT fluoroscopy may be available using spiral CT. The principal advantage of CT is better soft tissue contrast than fluoroscopy. However, a vertical approach to the shoulder with a long needle may be difficult because of the limited size of the gantry opening. The combination of fluoroscopy and CT guidance has also been introduced. The common disadvantage of X-ray fluoroscopy and CT is patient exposure to ionizing radiation during the intervention procedure.

With ultrasound there is no ionizing irradiation and it has the advantage of real-time imaging capabilities. Ultrasound is also cost-effective. A high-resolution transducer (7.5 MHz) is preferable to provide a high resolution image of the shoulder lesions. However, determining the site of skin puncture using ultrasound is limited, and the contrast of ultrasound is inferior to that of CT and MRI. Technical difficulties may also be encountered in obese patients.

MRI has been introduced as a promising tool for shoulder interventions (Schenck et al. 1995; Beau- lieu et al. 1999; Penner 1998). The open magnet technology and real-time imaging sequences are mandatory for interventional MRI. There are two types of open magnet MRI: vertically and horizontally open magnets. The vertically open MRI system (Signa SP; GE Medical Systems, Milwaukee, Wisconsin) allows radiologists and surgeons direct vertical access to the patient through an opening, with near real-time imaging. The Signa SP system is a whole-body scanner operating with a 0.5 T superconducting magnet with a 58-cm vertical gap and 60-cm patient bore actively shielded gradients. The flexible RF coil with sterile covers is placed on the patient shoulder when an intervention is performed (Fig. 6.1). MR compatible needles, catheters, and surgical supplies (drapes, disposable procedure...
trays, etc.) should be prepared prior to the intervention. Stainless steel or titanium alloy needles are acceptable, due to their limited artifact. The liquid crystal display monitor inside the gap displays MR images during procedures. Fast imaging sequences like steady-state gradient-echo sequences are chosen to provide higher signal-to-noise ratio images, and better discrimination of lesions from adjacent structures. The near real-time reconstruction also allows arthrographic injection during MR fluoroscopy (Fig. 6.2).

The ideal skin entry point can be determined with a “finger pointing technique.” With this approach, the radiologist pushes the skin with his fingertip to mimic needle insertion, and MR images are scanned with a couple of contiguous sections using fast sequences. The point of skin puncture is easily identified from MR images of the fingertip and the skin dimpling. The low field horizontally open MRI (0.2–0.35 T) is used for a variety of interventional procedures, because of its wide openness and patient comfort, but it limits intervention capabilities for the shoulder, as the horizontal opening generally extends only 35–45 cm. Thus, vertical access from above the patient is not possible in this configuration.

MRI has several advantages over other equipment for interventional guidance: MRI does not expose patients, radiologists, or surgeons to ionizing radiation; it provides excellent soft tissue contrast; has multiplanar imaging capability; and provides real-time or near real-time imaging capability.

### 6.3 Clinical Applications

Three clinical entities are currently treatable via interventional radiologic techniques: frozen shoulder syndrome (adhesive capsulitis), calcific tendinitis, and cystic lesions about the shoulder. The following is a brief discussion of the disease processes, followed by a description of the techniques, as well as a review of therapeutic outcomes.

#### 6.3.1 Frozen Shoulder Syndrome

Frozen shoulder syndrome, also known as adhesive capsulitis, was first described in 1872 by Duplay. This disease progresses in three stages: a painful period of weeks to months, followed by several months of stiffness, after which spontaneous gradual resolution occurs with variable degrees of residual functional restriction. A multitude of therapies have been studied, but the self-limiting nature of the disease makes evaluation difficult. For example, Bulgen et al. (1984) reported no long-term differences in outcomes between intraarticular steroids, physical therapy, ice therapy, or no treatment at all. However, for this clinical entity the focus of a particular therapeutic modality should be to palliate the months of potentially disabling stiffness.

As the period of decreased range of motion is associated with a dramatic decrease in glenohumeral joint capacity – usually only a few cc (Parlier-Cuau et al. 1998) – it is not surprising that distention of the joint during arthrography has emerged as a therapeutic modality, first described in 1965 by Andrén and Lundberg. In the supine position on the fluoroscopy table, the patient holds the palm up in order to keep the shoulder in external rotation. The skin is then prepared, draped and anesthetized in the usual fashion and, under fluoroscopic guidance, a 20-gauge needle is advanced into the anterior glenohumeral joint. Injection of contrast confirms appropriate positioning within the joint space. The joint is subsequently distended with 20–40 cc of fluid, during which the patient is expected to have increased pain. Composition of the fluid depends on physician preference and a variety of protocols have been proposed. Generally, 15–30 cc of normal saline or water soluble contrast, either mixed with or injected after 5–10 cc of corticosteroids and local anesthetic, would be reasonable (Parlier-Cuau et al. 1998; Rizk et al. 1994; Elkund and Rydell 1992). Even air has been used as a distending agent instead of saline or contrast...