Multimodality Imaging of the Painful Elbow

Current Imaging Concepts and Image-Guided Treatments for the Injured Thrower's Elbow

Cristy N. Gustas, MD[a,*], Kenneth S. Lee, MD[b]

KEYWORDS

• Elbow injuries • Ultrasound • Throwing athlete • UCL • Epicondylosis
• Valgus extension overload syndrome • PRP

KEY POINTS

- Overhead sport athletes are at risk for several causes of elbow pain, including epicondylosis, ulnar collateral ligament injury, and bony and nerve injury.
- During the throwing motion, large valgus and extension forces lead to tensile stress on the medial structures, compressive forces laterally, and shear forces on the posterior structures resulting in characteristic injuries.
- Throwing athletes are subject to chronic repetitive overuse injuries of the elbow.
- Imaging can serve as an adjunct tool to establish a diagnosis or to guide treatment.
- Ultrasound-guided percutaneous injection therapies are emerging as an alternative treatment for some ligament and chronic tendon injuries about the elbow.

INTRODUCTION

Recent decades have seen a sharp increase in overhead throwing athletes competing in sports such as baseball, softball, football, tennis, volleyball, and various track and field events. Not surprisingly, this growth in participation has led to an increase in the incidence of elbow injuries. More than 50% of high school, college, and professional baseball players experience elbow pain.[1] Sports that require repetitive gripping and throwing impart high valgus and extension loads to the athlete's elbow. These forces lead to tensile stress on the medial structures, compressive forces laterally, and shear forces on the posterior structures. A characteristic pattern of acute and chronic injuries or progressive structural changes is often the result.

A thorough history and physical examination of the thrower's elbow frequently establishes the diagnosis for elbow pain. Imaging can afford additional information when the clinical picture is unclear or further information is necessary for risk stratification and treatment planning. Radiographs and computed tomography (CT) play a role in the evaluation of osseous lesions (bony avulsions, calcifications, intraarticular bodies). The large field of view in MR imaging is particularly useful in cases

[a] Musculoskeletal Imaging, Department of Radiology, Penn State Milton S. Hershey Medical Center, 500 University Drive-H066, Hershey, PA 17033, USA; [b] Musculoskeletal Imaging, Department of Radiology, University of Wisconsin School of Medicine & Public Health, University of Wisconsin Hospital and Clinics, E3/366, 600 Highland Avenue, Madison, WI 53792, USA
* Corresponding author.
E-mail address: cgustas@hmc.psu.edu

Radiol Clin N Am 54 (2016) 817–839
http://dx.doi.org/10.1016/j.rcl.2016.04.005
0033-8389/16/$ – see front matter

of vague or diffuse elbow pain. Superior contrast resolution enables quick recognition of bone and soft tissue pathology and provides a planning tool for rehabilitation or surgery. Ultrasound (US) imaging is rapidly growing in popularity and offers focused high-resolution imaging of tendons, ligaments, and nerves about the elbow. Unique advantages of US include accessibility as well as the capability for dynamic assessment and quick comparison with the contralateral side. US imaging is also useful for guided therapeutic procedures. This article focuses on current imaging concepts and image-guided treatments for injuries commonly affecting the adult throwing athlete's elbow. Topics discussed include lateral and medial epicondylosis, ulnar collateral ligament (UCL) injury, bony injuries, and nerve impingement. Conditions typically seen in the skeletally immature thrower's elbow, such as medial epicondyle apophysitis (little league elbow), medial epicondyle avulsion fracture in adolescent pitchers, and osteochondritis dissecans are addressed in other dedicated articles in this issue.

TENDINOSIS

Tendon injuries about the elbow may result from an acute traumatic event, repetitive microtrauma, or a combination of these processes. In overhead throwing athletes, tendinopathies are often related to overuse resulting in microtearing and progressive tendon degeneration owing to an incomplete reparative response.[2,3] Histologic analysis of the pathologic tendon reveals angiofibroblastic hyperplasia, mucoid degeneration, chondroid metaplasia, and fibrillary degeneration of collagen.[4] Over time, scar tissue forms that is vulnerable to chronic repetitive trauma. This vicious cycle of microtear and disorganized repair can lead to larger tears with worsening symptoms and eventual biomechanical failure of the tendon.[3] Inflammation is noted only in the earliest stages of the healing process and declines by postinjury day 10 as the proliferative healing phase begins.[5,6] Indeed, 1 study found no histopathologic evidence of either acute or chronic inflammation to correspond with areas of tendon signal abnormality on MR imaging.[7] For this reason "tendinosis," rather than "tendinitis," is considered the preferred name for the clinical entity of chronic tendon degeneration.

Lateral Epicondylosis

Lateral epicondylosis, or "tennis elbow," is the most common cause of lateral elbow pain in skeletally mature athletes, occurring in more than 50% of racquet sport players.[2,8] Repetitive activities involving wrist extension and supination (eg, the backhand swing in racquet sports) can result in degeneration of the common extensor tendon (CET) origin at the lateral epicondyle. Several studies have identified the extensor carpi radialis brevis component of the CET as almost universally affected in lateral epicondylosis.[3,7,9] The anterior edge of the extensor digitorum communis is involved 50% of the time.[2] Typical symptoms include focal tenderness at the lateral epicondyle and lateral elbow pain, particularly with wrist extension. Patients occasionally report weakened grip strength.[3]

Lateral epicondylosis is diagnosed by history and physical examination in most cases, but imaging may be helpful to confirm the diagnosis or evaluate the extent of tissue injury in recalcitrant cases of lateral elbow pain. Elbow radiographs are often negative, but may show enthesophytes or heterotopic ossification along the lateral epicondyle.[3] On MR imaging, tendon morphology is assessed most easily on the coronal and axial images. The normal CET should be uniformly low in signal on all sequences. Tendinosis presents as intermediate intratendinous signal on both T1-weighted and fluid-sensitive sequences with or without tendon thickening (**Fig. 1**A, B).[3,10] Partial or complete tears can result from acute traumatic events or as a sequelae of chronic advanced tendinosis. Partial thickness tears are seen as hyperintense fluid signal interrupting a portion of the tendon fibers with associated tendon thinning (**Fig. 2**A–C). A full-thickness tear appears as a fluid signal intensity gap completely interrupting the tendon fibers or a fluid signal gap between the proximal tendon and lateral epicondyle in the setting of avulsion injury.

On US imaging, the extensor carpi radialis brevis makes up a major portion of the CET attachment and is the most anteriorly located of the tendons at the lateral epicondyle. On long axis imaging, the normal CET demonstrates a compact fibrillar pattern of uniform echogenicity.[8,11] Tendinosis commonly presents as tendon thickening with hypoechogenicity and loss of the typical compact fibrillar pattern.[12] Hyperemia representative of neovascularity may be seen on Doppler investigation (**Fig. 1**C).[8] Other US findings occasionally seen in lateral epicondylosis include intratendinous calcification and bone irregularity in the adjacent lateral epicondyle.[13] Tears appear as a focal anechoic or fluid-filled gap in the tendon with accompanying tendon discontinuity (**Fig. 2**D). Previous studies have shown that US is accurate for the diagnosis of lateral epicondylosis with a similar specificity (67%–100%) but slightly diminished sensitivity (64%–82%) compared with