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Rendezvous with Musculoskeletal Ultrasonography for "Pulled Elbow"

Author
Dr Sharat Agarwal
Professor (Associate), Orthopaedics & Trauma, North Eastern Indira Gandhi Regional Institute of Health & Medical sciences (NEIGRIHMS), Shillong (India)-793018
Email: *drsharat88@yahoo.com*, Phone- +91-9436336213

Abstract
Pulled elbow is a disorder commonly observed in children in routine medical practice, Pulled elbow or nursemaid's elbow is a radial head subluxation caused by a sudden pull on the extended pronated forearm.; however, when the circumstances involved in the injury are unknown, difficulty has been encountered in differential diagnosis whether it is a bone fracture or pulled elbow. One of the reasons involved has been the unavailability of diagnostic imaging in confirming the diagnosis of the pulled elbow. Nursemaid's elbows are indistinguishable from healthy elbows on radiograph. This article reviews the key issues to be considered while assessing these patients with real time musculoskeletal ultrasonography.
Keywords: *Pulled elbow, Nursemaid's elbow, musculoskeletal ultrasonography.*

Introduction

While x-rays are useful for some conditions, two more useful tools for evaluation of soft tissue, such as muscle and tendon, are MRI and Musculoskeletal Ultrasound which uses high frequency linear transducer. In certain situations, X-ray or MRI cannot be used with issues of radiation exposure radiographs are especially to be avoided in pregnancy. However, musculoskeletal Ultrasound is safe and can be done on anyone even during pregnancy. Some injuries categorized as "instabilities" can be visualized extremely well on Ultrasound when the patient's tissue or joint is stressed. During musculoskeletal ultrasonography, it is not uncommon for the technician to press on the skin "at painful spot" and visualize image at the a depression at the same point, which confirms the pain generator in real time. In fact, non-symptomatic abnormalities are found many times on imaging, but in the report, it's important to be able to highlight the pain generator so that it can be treated accordingly. Comparing possible pathology on both sides is helpful in determining if the pathology is in fact, the pain generator. For example, on occasion, thickening of a tendon can be seen on both sides of the body regardless if symptomatic or not. Musculoskeletal Ultrasound can also be used to locate the exact specific structure (like bursa, tendon, joint, etc.) so that the pathology can be managed with intervention through the injection at the specific location, thereby directly improving the effectiveness of the procedure.

Musculoskeletal Ultrasound is a dynamic study that allows following a structure all the way from its origin to its attachment. Nerve symptoms, like

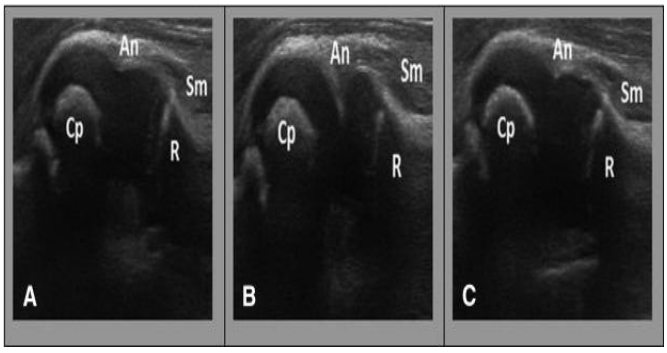
numbness in the fingers, can be the result of compression or swelling around the nerve anywhere along its course down the limb. The majority of its course can be evaluated with this modality. The same goes for muscles, such as the hamstrings, biceps brachii, pronator teres etc. It can reveal exact location and severity of the injury or tear of the muscle. Besides, musculoskeletal Ultrasound is quite cost effective also. It has been found the MSUS (musculoskeletal ultrasonography) has Sensitivity of 85.1% and Specificity of 92.0%, which can be compared with MRI (magnetic resonance imaging) which has been found to have Sensitivity of 85.5% and Specificity of 90.4%.

Accordingly, High-resolution ultrasonography is a convenient, practical, and cost-effective method for primarily evaluation of a variety of musculoskeletal disorders that affect the pediatric patient, where in the immature skeleton there is an increased ratio of cartilage to bone. Ultrasonography not only allows the examiner to readily distinguish cartilage from soft tissue from bone, but also to show changes in structural relationships that occur with motion, and to easily compare, in different planes, symptomatic to normal contra lateral sides. Its increasing popularity in pediatrics is due to the fact that it does not involve radiation, has an ability to visualize non-ossified cartilaginous and vascular structures, allows dynamic imaging and quick contra lateral comparison [1].

Importantly, pediatric musculoskeletal Ultrasonography rarely requires any need for sedation; if need be, even the most anxious child can be examined comfortably in the arms of a parent. The quality and consistency of the sonographic examinations rely on the expertise and patience of the examiner and requires a long learning curve for using this modality effectively. US Can be used in developmental, infectious, inflammatory, neoplastic, and traumatic conditions that can affect joints, extremities, growth centres, and paraskeletal soft tissues of infants, children, and adolescents.

Ultrasound (US) can be used to evaluate a variety of musculoskeletal pathologies related to developmental anomalies like developmental dysplasia of the hip (DDH) and also infection, inflammation, and trauma. It is possible to directly visualize the cartilaginous epiphyses that are not demonstrated on radiographs, joints, and soft tissues. US also has the advantage of real-time imaging, which can be useful in evaluation of subluxation or clicking syndromes.

Musculoskeletal sonography is typically performed using a high-frequency linear transducer, although a lower-frequency probe may be necessary when imaging deeper structures such as the hip or shoulder joint. The advent of high frequency transducers allows the musculoskeletal system to be examined in exquisite detail, giving in-plane resolution of down to 200 µm and section thicknesses of 0.5 mm, far exceeding the capability of MR-Imaging. Apart from the lack of ionising radiation, ultrasound has several advantages over other imaging modalities: It allows a real time dynamic assessment of musculoskeletal conditions, compared to MR-Imaging there is excellent patient tolerance without any need for sedation and it can also be used to guide interventional procedures [2]



Pulled elbow is a disorder commonly observed in children in routine medical practice, Pulled elbow or nursemaid's elbow is a radial head subluxation caused by a sudden pull on the extended pronated forearm [5]; however, when the circumstances involved in the injury are unknown, difficulty has been encountered in differential diagnosis whether it is a bone fracture or pulled elbow. One of the reasons involved has been the unavailability of diagnostic imaging in confirming the diagnosis of

the pulled elbow. Nursemaid's elbows are indistinguishable from healthy elbows on radiograph. Thus, the term "radial head subluxation" appears to be a misnomer, and pre-reduction radiographs should only be used to eliminate the possibility of fracture. From a radiologic perspective, nursemaid's elbows remain a diagnosis of exclusion [4]. However, according to one report, pulled elbow is classified into two types of pathology[7]. We also assume that there are two types of pulled elbow: total subluxation of the radial head and subtotal subluxation of the radial head.

Point-of-care ultrasound (POCUS) can assist decision-making and clinical management for these patients [3]. Therefore, ultrasonography can be performed using a high-resolution 14-MHz linear probe on a GE S5 ultrasound machine (GE Healthcare, Milwaukee, WI, USA) With Careful observation of the specific ultrasonographic images of anterior long-axis view of the radiohu-meral joint before and after the manipulation.

There have been many attempts to diagnose pulled elbow through radiologic findings, but results have been ambiguous[6-8]. When physicians diagnose pulled elbow, they usually depend on a history, such as passive traction by parents, and on physical examinations. But patients with pulled elbow are too young to get an exact history from and to perform definite physical examination on. For this reason, misdiagnosis of a fracture as a pulled elbow may be possible. One study reported that there were 11 cases of fractures misdiagnosed as pulled elbow over a 36-month period [9]. There have been attempts to diagnose pulled elbow using radiographs, with a few measurement methods, but these methods provided ambiguous results [11,12]. Currently, radiographs are taken to rule out fractures. The diagnosis of pulled elbow depends on history of mechanism and physical examination[8]. Reduction may be attempted without radiographs if clinical presentation is typical of a pulled elbow [10,13]; however, in case of an unclear mechanism of injury, unnecessary radiographs are often taken [14,15].

Even though there have been some reports for diagnosing pulled elbow by ultrasonography, those studies have been difficult to standardize in practice. Because the studies discuss the relationship of the radius and capitellum in terms of distance, they are too vague to distinguish between normal and abnormal findings [8,13]. It has been found that before the manipulation in all the cases, both the supinator muscle originating from the annular ligament and the annular ligament itself are entrapped within the radiohumeral joint, and a hypoechoic image of J-shape (J-sign) is observed. After the manipulation, the hypoechoic image of the J-shape disappears and normal annular ligament image is observed (Fig.1).

In one recent study performed in Japan with 70 cases of pulled elbow, the researchers displayed J-shaped hypoechoic images as a pathognomonic finding of pulled elbow. They reported that the sensitivity, specificity, and accuracy of ultrasonographic diagnosis of pulled elbow were all 100% [16].

The radial annular ligament (RAL) is examined for integrity and interposition, with measurement of the radiocapitellar distance. Reduction is recommended to be performed following the hyperpronation technique. Accordingly, Pulled elbow is classified as type I, with an interposed RAL, and type II, with torn ligament (Fig.2).

The following ultrasonographic information has been documented in the literature which emphasizes on:

1) whether there was a change in the shape of the supinator muscle,
2) whether there was an annular ligament in place, and
3) whether there was an enlargement of the synovial fringe. A pulled elbow can easily be confirmed by ultrasonography when the annular ligament is displaced (Fig.3).

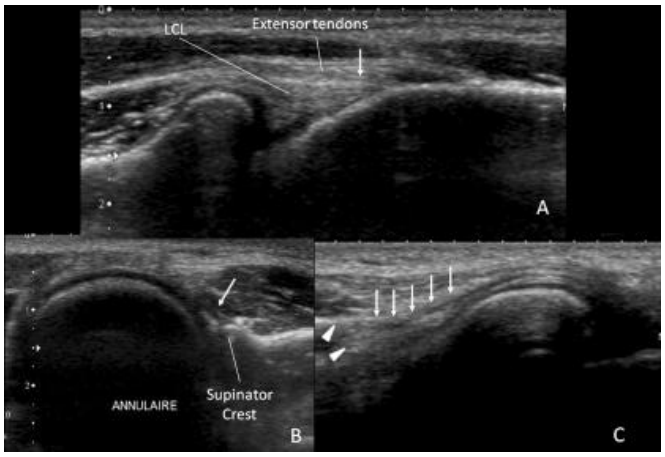


Figure 1- It shows the structures on the lateral aspect of the elbow (LCL – Lateral Collateral ligament, Extensor tendons, Annular ligament and supinator crest especially supinator crest, which gets distorted in patients of "Pulled Elbow"

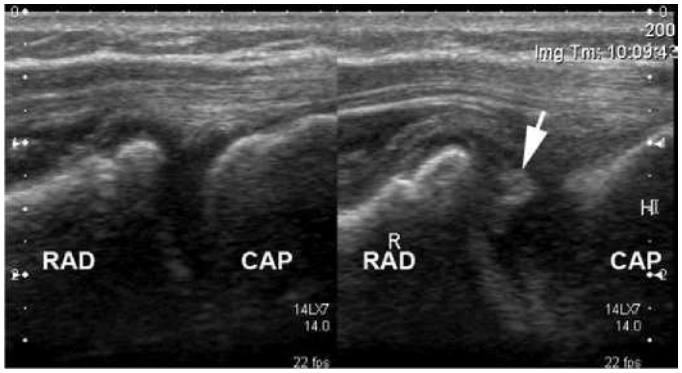


Figure 2- Ultrasound image revealing alteration in the shadow of annular ligament (arrow)

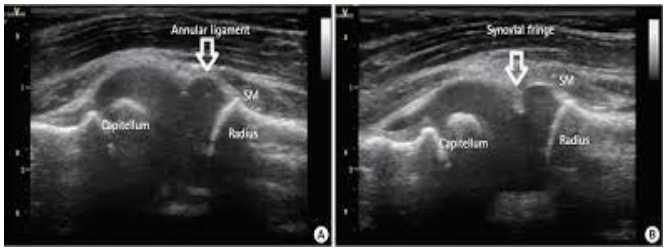


Figure 3- Ultrasound image showing synovial fringe getting inside in the "Pulled elbow"

Conclusion

We believe it would be useful to use ultrasound to confirm pulled elbow in terms of reducing unnecessary radiation, especially when the mechanism of injury is not evident or physical examination seems inconclusive. Moreover, ultrasound could be performed with the patient's arm in a neutral position, which could minimize unrecognized complications such as occult fractures. Additionally, we could reduce the length of stay in the ED and prevent patients from having to go to an X-ray room and waiting until the immobility is resolved. Unlike X-ray, ultrasonography is a real-time method: we could diagnose the pulled elbow, reduce the subluxation of the arm, and can confirm normalization.

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