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Proper elbow arthroscopy portal placement in pediatric and adolescent patients

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ABSTRACT

We sought to evaluate proper elbow arthroscopy portal placement in pediatric and adolescent patients. Overall, 109 pediatric and adolescent patients who underwent elbow arthrography were included. Condylar width was measured and the proximal anterior joint capsule location was determined using the ulna-capsular distance. Condylar width and Bone mass index(BMI) also had a high positive correlation coefficient with the proximal joint capsule location.

Proximal ulnar border is recommended new bony landmark in pediatric and adolescent patients who undergo elbow arthroscopy. In particular, condylar width and BMI were found to have a high positive correlation with the proximal joint capsule location.

1. Introduction

With the advancement of experience, techniques, and instrumentation, elbow arthroscopy has emerged as a safe and effective option to treat patients with a wide range of acute and chronic elbow pathologies.[1] Previously, the role of elbow arthroscopy was primarily limited to treating patients with osteochondritis dissecans (OCD).[2] Given the minimally invasive nature of arthroscopic treatment for elbow pathology, pediatric patients stand to benefit from an expanded role of elbow arthroscopy by avoiding the complications and large dissections associated with open techniques.[1]

However, arthroscopic procedures of the elbow are challenging due to the intimate relation between nerves, vessels, and capsule, as well as portal sites and narrow joint space.[3,4] Iatrogenic nerve injury is one of the most common, and most serious, complications in elbow arthroscopy.[3]

Understanding the anatomy of the joint capsule is essential to create a proper arthroscopic portal, and perform a successful procedure without complications. Several adult cadaveric studies have been conducted on portal placement and anatomy of the elbow capsule.[5,6] However, data on its anatomy and portal placement in pediatric and adolescent patients are limited.

The purpose of this study was to evaluate proper elbow arthroscopy portal placement in pediatric and adolescent patients undergoing elbow arthrography.

2. Methods

A total of 109 patients who underwent elbow arthrography between February 2005 and March 2017 were retrospectively enrolled. This study was exempt from Institutional Review Board approval (Dankook University Medical IRB: 2017-09-013).

The inclusion criteria were pediatric and adolescent patients (mean age years: 5.7, range 1–15 years) who underwent elbow arthrography due to injury around the elbow. Exclusion criteria were poor radiologic images; displaced fractures (> 2 mm) of the humerus after reduction, including lateral condyle, medial condyle, supracondyle, and epiphyseal injury; disruption of the elbow joint capsule; and previous surgery on the same elbow.

Correlations between demographic data, including age, sex, weight, height, and bone mass index (BMI), and the elbow join capsule were evaluated.

2.1. Conventional arthrography

Patient laid down with the arm parallel to the radiograph table in the fluoroscopy or operation room. General anesthesia was performed in surgical cases. The skin was prepared and draped, and a 22-gauge 1.5-in needle was inserted perpendicular to the elbow at the radiocapitellar joint. The needle was advanced under fluoroscopy until resistance was felt upon entering the joint capsule, at which point the needle was advanced another 2 mm. This location is approximately

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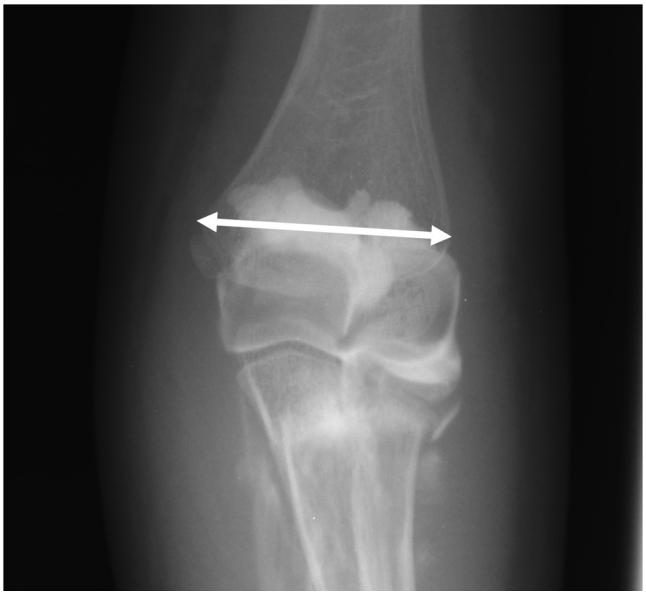

Fig. 1. Condylar width was measured the widest distance from medial to lateral condyle on elbow anteroposterior arthrogram.

1 cm from the joint surface.

2.2. Radiological evaluation

Radiologic measurements were evaluated on the anteroposterior and lateral views of the elbow on simple radiography. The condylar width was defined as the distance between the most prominent medial and lateral condyle (Fig. 1). The proximal anterior joint capsule location in lateral radiography was defined as the distance between the proximal ulna and most proximal contrast outline (Fig. 2).

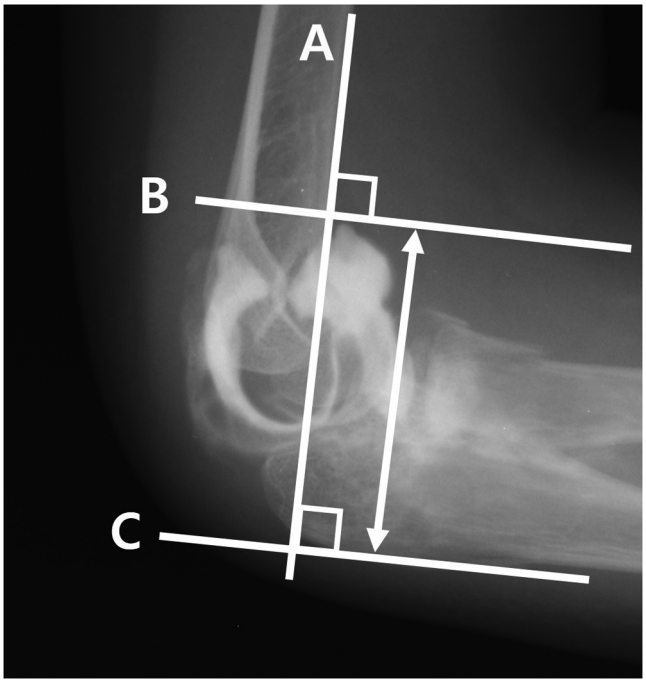

Fig. 2. Ulna-capsular distance was measured the between the proximal ulnar border and proximal anterior capsule location condyle on elbow lateral arthrogram. A: anterior humeral line, B: perpendicular line of anterior humeral line at the proximal anterior capsule location, C: perpendicular line of anterior humeral line at the proximal ulnar border.

All measurements were performed electronically on simple radiography using a measurement software for picture archives and communication system. All image measurements were performed by two blinded observers via a consensus readout (K.S.J. and L.J.Y.). Measurements were performed independently, and the results were not disclosed to the other surgeon. The mean value of the duplicate scores was used as the representative value.

2.3. Statistical analysis

Spearman's correlation coefficient was used to estimate the correlation between proximal joint capsule location, and age, sex, weight, height, BMI, and condylar width. The weighted kappa (k) coefficient was used to estimate inter-observer reliability, which was classified based on the k coefficients as follows: slight agreement, 0.00–0.20; fair agreement, 0.21–0.40; moderate agreement, 0.41–0.60; substantial agreement, 0.61–0.80; and almost perfect agreement, 0.81–1.00. All statistical analyses were performed with SPSS version 20.0 (SPSS Inc., Chicago, II, USA). The level of significance was set to $P < 0.05$.

3. Results

Condylar width showed the highest positive correlation coefficient with the proximal anterior joint capsule location ($r = 0.783$, $p < 0.001$, Fig. 3). BMI also had a high positive correlation coefficient ($r = 0.717$, $p < 0.001$, Fig. 4), while weight had a low positive correlation coefficient with the proximal anterior joint capsule location ($r = 0.328$, $p = 0.001$).

Sex ($p = 0.774$), age ($p = 0.271$), and height ($p = 0.719$) were not correlated with proximal anterior joint capsule location.

Cases were divided according to the condylar width and BMI to present the mean value of the proximal anterior joint capsule location. They were divided into 9 groups based on condylar width, in 5-mm increments (Table 1). Cases were also divided into 5 groups based on BMI, in increments of 5 (Table 2).

Inter-observer reliability of measurements A and B were in almost perfect agreement, with a weighted kappa coefficient of 0.87 and 0.83, respectively.

4. Discussion

In this retrospective study, we demonstrated that condylar width and BMI showed a high positive correlation coefficient with the proximal anterior joint capsule location.

Elbow arthroscopy is a safe and effective procedure, and has

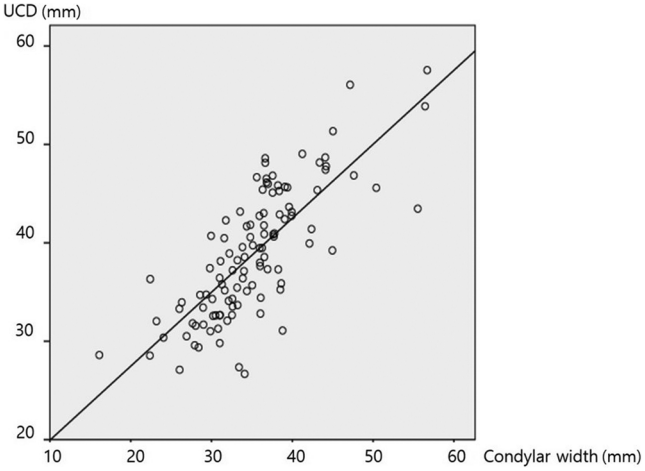

Fig. 3. Ulna-capsular distance according to the condylar width. It shows the highest positive correlation coefficient.