Beatrix Hesse · C. Lampert

Arthroscopy of the elbow joint—video analysis of the anatomy and function

Accepted: 13 March 2002 / Published online: 15 June 2002
© Springer-Verlag 2002

Abstract The anatomical structures of the elbow joint were dissected in layers in human cadavers. The surgical dissection was divided into to deep and superficial areas. Each step was documented by digital video and photographs. The functional and anatomical preparation allowed us to establish the limits and scope of diagnostic and therapeutic procedures by arthroscopy.

Résumé Les structures anatomiques de l'articulation du coude ont été disséquées plan par plan sur des cadavres. La vidéo numérique et des photographies ont documenté chaque étape. La dissection chirurgicale a été divisée en dissection superficielle et profonde. La préparation fonctionnelle et anatomique nous a permis d'établir les limites et les possibilités des procédures diagnostiques et thérapeutiques par arthroscopie.

Introduction

Arthroscopy of the elbow joint requires detailed understanding of the surgical anatomy due to the proximity of neurovascular structures to all approaches. This involves not only the main peripheral nerves and vessels but numerous small cutaneous branches. The video-documented anatomical dissection of the elbow joint allows the description of local topography from the dynamic and functional points of view and identifies the risks associated with the different approaches. The demonstration also allowed an understanding of the arthroscopic findings that are available from the different approaches.

Materials and methods

Preparation was made from fresh human cadavers. Each layer of the elbow joint was video documented in its static and functional anatomy. Thus, the different arthroscopic approaches could be demonstrated in their surroundings. Some unusual cuts were made to facilitate the view of the functional anatomy of the joint.

Anterolateral approach

The anterolateral approach is the most important and most frequently used arthroscopic approach. We mark the osseous structures, which allows orientation (Fig. 1). We identify the gap between the lateral epicondyle of the humerus and the radial head. The lateral antebrachial cutaneous nerve, which is the terminal branch of the musculocutaneous nerve, is visible in the preparation of the subcutaneous layer. Risk of damaging this nerve is minimized by flexing the elbow and pronating the forearm (Fig. 2). We introduced the arthroscope into the joint anteriorly to the lateral epicondyle over the radial head in the direction of the cubital fossa. The radial nerve lies between the brachialis and the brachioradialis muscles (Fig. 3). The nerve is protected from the

Fig. 1 Landmarks. Radial head and the course of the lateral antebrachial cutaneous nerve

Presented at the SICOT/SIROT conference, Paris, France, 2001

B. Hesse (✉) · C. Lampert
Department of Orthopaedic Surgery,
Kantonsspital Rorschacherstrasse 59 9007 St. Gallen, Switzerland
e-mail: beatrix.hesse@gmx.net
Tel.: +41-71-4941111, Fax: +41-71-4942869

Fig. 2 Superficial layer of the anterolateral approach. The lateral antebrachial cutaneous nerve as a variation, the basilic vein medial to the cutaneous nerve

Fig. 4 Deep layer of the anterolateral approach. Division of the radial nerve in the region of the cubital fossa

Fig. 3 Anterolateral view with the arthroscope in position. The radial nerve lies between the extensor muscles; the basilic vein is in the superficial layer

arthroscope by the brachialis muscle. It divides in the cubital fossa into deep and superficial branches (Fig. 4).

Anteromedial approach

Medially we see the medial antebrachial cutaneous nerve in the superficial layer. The ulnar nerve leaves the medial head of the biceps muscle to pass dorsal to the medial epicondyle in the

Fig. 5 Medial view with the medial cutaneous nerve and the ulnar nerve posterior to the medial epicondyle

groove of the ulnar nerve and then distally beneath the fascia (Fig. 5). We penetrate the ulnar structures from the anterolateral approach in the Wissinger technique to find the anteromedial approach without endangering the median nerve. The medial complex of nerves and vessels is immediately superior to the capsule, protected by the brachialis muscle (Fig. 6). The median nerve, between the heads of the pronator teres muscle, is stretched in extension and relaxed in flexion. The ulnar nerve is behind the medial epicondyle and therefore not compromised by the arthroscope (Fig. 7).

Anatomical aspects of the cubital fossa

We have a view from above with the arthroscope in position. We hold aside the supinator muscle and move the arthroscope anterior to the radial head. The deep branch of the radial nerve passes dis-

Fig. 6 Anteromedial approach in the Wissinger technique. The median nerve is visible after removal of the flexor muscles. The ulnar nerve is posterior to the medial epicondyle

Fig. 7 Medial complex of nerves and vessels (the median nerve and brachial artery) is stretched in extension. The ulnar nerve is not compromised by the arthroscope in flexion or extension

Fig. 8 Cubital fossa from above. The radial nerve divides into deep and superficial branches; the median nerve and brachial artery are seen after removal of the flexor muscles

Fig. 9 Dissection of the anterior capsular structures after removal of the flexor muscles and dissection of the brachialis muscle

Fig. 10 Open joint after dissection of the anterior capsular structures

Fig. 11 Humeroulnar joint with a view of the ulnar nerve

Fig. 12 Landmarks of the posterolateral approach

Fig. 14 Trochlea after osteotomy of the olecranon

Fig. 13 Posterior radioulnar joint after dissection of the triceps muscle

Fig. 15 Posterolateral view into the joint after dissection of the triceps muscle and capsular structures

tally through the septum of the supinator muscle. The median nerve, protected by the brachialis muscle, is visible after removal of the flexor muscles (Fig. 8).

In order to get a better view we elevate the articular capsule from the coronoid process. The insertion of the capsule is distal to the tip of the coronoid process, which can easily be seen arthroscopically (Fig. 9). After dissection of the brachialis muscle and the capsular structures, we have a view of the opened joint. During function, the radial head is centered. If the geometry is correct the radial head retains its position during rotation of the forearm and flexion of the elbow, even after removal of the annular ligament (Fig. 10). The ulnar nerve is not compromised by the arthroscope because it lies posteriorly (Fig. 11).

Posterolateral approach

We palpate the lateral margin of the olecranon and identify the gap between the tip of the olecranon and the lateral epicondyle. Note that the tip of the olecranon is more cranial, and you can palpate because there is fatty tissue in the olecranon fossa (Fig. 12). After some dissection of the triceps muscle we see the olecranon fossa from the radial aspect and the posterior radiohumeral joint (Fig. 13). After osteotomy of the olecranon we have a view of the trochlea (Fig. 14). We have removed the dorsal articular capsule to show the head of the radius and the entry point of the arthroscope at the lateral margin of the olecranon. The lateral collateral ligament remains in place giving a central and congruent position of the radial head. The radial collateral ligament, which is essential for stability of the elbow joint is still in place (Fig. 15).

Arthroscopic view

Finally the arthroscopic evaluation of the joint; from the antero-medial approach you see the coronoid process, not to be mistaken

Fig. 16 Anterolateral approach with a view of the coronoid process

Fig. 17 Anterolateral approach with a view of the radial head and the radioulnar joint

for a loose body (Fig. 16). The radioulnar joint and the radial head, which can be identified by rotation of the forearm, can be seen from both the anteromedial and the anterolateral approaches (Fig. 17). The posterolateral approach also allows a good view of the radioulnar joint (Fig. 18). It is also possible to inspect the olecranon fossa and the dorsal recess from the posterolateral approach.

Fig. 18 Posterolateral approach with a view of the radioulnar joint

Conclusions

The macroscopic and dynamic video documentation of the elbow joint facilitates an understanding of the arthroscopic and functional anatomy, and allows the use of the arthroscopic approaches without damaging neurovascular structures. In addition, the dynamic dissection makes it possible to demonstrate the interrelationships between tendons, vessels, and nerves around the elbow joint. The limitations and possibilities for diagnostic and therapeutic arthroscopic procedures can be identified. Unusual cuts during dissections make it possible to visualize the problem zones around the arthroscope. We recommend that the ulnar approach in the Wissinger technique be performed in flexion of the elbow in order to minimize the risk of damage to the ulnar and median nerves. The three approaches demonstrated allow sufficient access to all intraarticular structures. The most difficult area for arthroscopic treatment is the posterior region. Complete synovectomy (e.g., for patients with villonodular synovitis or chronic polyarthritis), chondromatosis, or posterior osteophytes often require an arthrotomy. Severe post-traumatic deformities are also difficult to treat, due to a difficult approach, a limited range of movement, and joint incongruity. Arthroscopic fixation of the fragment in osteochondritis of the capitellum is similarly difficult. The main indications for a therapeutic arthroscopy are loose bodies, synovitis, arthrofibrosis, osteochondritis dissecans, and infection. Comparing the standard approaches with the dissected surrounding tissue helps in understanding the static and dynamic topography of the elbow joint and preventing damage to local structures.