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Original article

Elbow arthroscopy: An alternative to anteromedial portals

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ABSTRACT

Background: Elbow arthroscopy is considered to be a difficult procedure with a high complication rate. These two disadvantages are due to the proximity of neurovascular structures.
Hypothesis: The aim of our study was to evaluate the efficacy and complication rate of a new elbow arthroscopy technique without anteromedial portals. This approach was taken because of the high rate of ulnar nerve damage using the medial portal, and the difficulty of performing triangulation of opposite portals in a patient in the lateral decubitus position.
Material and methods: Fifteen patients were operated on by the same surgeon between 2010 and 2012. Range of motion and the "MEPS" elbow score were calculated preoperatively and at the final postoperative follow-up. The average age of patients was 38.3 years. The follow-up was 11.1 months. Personal portals (high anterolateral and intermediate anterolateral portals) were used instead of the anteromedial portals.
Results: Elbow flexion increased from 113° preoperatively to 129° at the final follow-up ($P = 0.009$). Extension increased from −33° to −10° ($P < 0.0001$). The preoperative and final postoperative "MEPS" scores were 56.3 and 94 respectively ($P < 0.0001$). Two patients (13.3%) had radial nerve palsy with complete recovery 6 and 9 months after surgery.
Discussion: The rate of nerve complications following elbow arthroscopy varies from 0 to 14%. The rate in our series (13.3%) is comparable to the results of the literature. This rate should be placed in perspective (since one patient had multiple open surgery elbow operations before arthroscopy). All complications were transient. Improved elbow range of motion in our study is consistent with the results in literature.

1. Introduction

In 1931, Burman concluded that arthroscopy should not be used in the elbow based on a cadaveric study [1]. As progress was made in equipment and surgical techniques improved, the use of arthroscopy of the elbow was reconsidered.

In the first in vivo elbow arthroscopy in 1985, Andrews et al. described anteromedial, anterolateral and posterolateral portals [2–4]. The most frequently used portals are the proximal anterolateral, the standard anterolateral, the proximal anteromedial, the standard anteromedial, the direct lateral portal or "soft spot" portal and the superior posterolateral portal [5,6]. The rate of neurovascular complications is higher in arthroscopies of the elbow than in other joints, because of the proximity of neurovascular structures [7].

The goal of our study was to evaluate the efficacy and rate of complications of a new elbow arthroscopy technique. This technique involves using accessory anterolateral portals as an alternative to anteromedial portals, thus avoiding complications associated with these portals, and to perform elbow arthroscopy despite the presence of instability or ulnar nerve transposition.

2. Materials and methods

This was a retrospective study. The medical files and surgical reports of 15 patients who underwent elbow arthroscopy between 2010 and 2012 at hôpital Cochin in Paris and the Arago clinic in Paris were reviewed and the following information was obtained: age, gender, dominant side and operated side, diseases and symptoms, length of follow-up, preoperative and final postoperative range of motion: elbow flexion, extension, pronation and supination, preoperative and final postoperative "Mayo Elbow Performance Score" (MEPS), perioperative and immediate postoperative complications and late complications.

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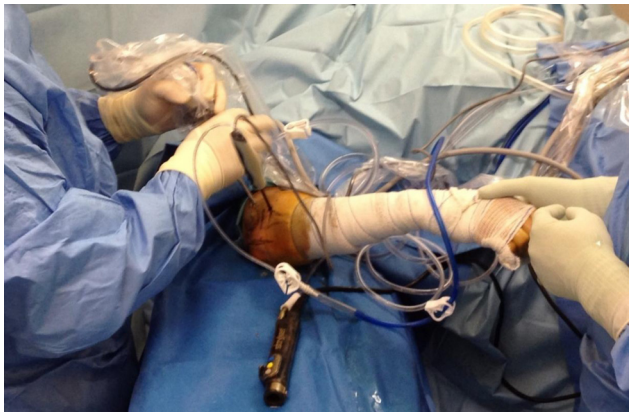

Fig. 1. Patient is in the supine position. The upper limb is on an arm surgery table. The forearm is wrapped in an elastic bandage. The surgeon is next to the patient's head. The assistant is facing him/her. The column is in front of them. The arthroscope and the instruments are inserted by the anterolateral portals.

Fig. 2. Anterolateral portals. 1. Standard anterolateral portal. 2. Middle anterolateral portal. 3. Superior anterolateral portal. 4. Intermediate anterolateral portal. 5. High "sub-radial" anterolateral portal. 6. Radial nerve.

2.1. Patients

The mean age of patients was 38.3 (17–77). There were nine men (60%) and six women (40%). Fourteen patients (93.3%) were right handed. Eight of these 14 patients were operated on the dominant side and six on the non-dominant side. Only one left-handed patient (6.7%) was operated on the dominant side. The mean length of follow-up was 11.1 months. All patients were operated on by the same surgeon using the specific technique described below.

2.2. Surgical technique

2.2.1. Patient positioning

In most cases this intervention is performed under loco regional anaesthesia (axillary or humeral nerve block), with or without a catheter depending on whether postoperative analgesia was necessary for cases requiring aggressive surgical procedures (arthrolysis...) The patient was installed in the supine position with the upper limb on an arm surgery table (Fig. 1). A tourniquet was placed at the root of the arm. It was inflated to 10 mm Hg above the patient's systolic pressure. Bone landmarks (radial head, epicondyle, olecranon process as well as the portals were drawn in with a dermographic pencil (see Section 2.2.2). To limit the risk of diffusing saline solution in the forearm during arthroscopy the patient's arm was wrapped in a sterile band from the hand to the proximal forearm leaving the portals accessible. The equipment used was a 4 mm 30 degree offset arthroscope and an electric scalpel. We preferred to use a low-pressure pump. Arthroscopy was preceded by an intra-articular injection of 10–20 mL of saline solution into the "soft spot". To establish the portal, only the skin was cut and subcutaneous tissue splitting with a fine tipped forceps made it possible to enter the distended joint and minimize neurological risks. The surgeon was sitting at the patient's head and the assistant was in front of him/her. The arthroscopy column was installed on the side of the non-operated limb.

2.2.2. The portals

Before beginning surgery, the hypothetical and usual course of the radial nerve and especially where it usually crosses the lateral aspect of the humeral diaphysis was drawn in. This reference point was very important to identify our anterolateral portals because we had to keep a safety margin under the trunk of the radial nerve where it runs along the lateral aspect of the inferior third of the humerus. No medial portal was used during the procedure.

Conventional posterior and anterolateral portals were used as well as the two following personal portals (Fig. 2):

- the high "sub-radial" anterolateral portal was located 2 cm below where the radial nerve crosses the lateral column of the humerus in a plumb line to the lateral epicondyle. Only the skin was cut, then a blunt trocar using the lateral aspect of the diaphysis as a reference, penetrated the distended joint following injection of 10 mL of saline solution through the soft spot. The point of entry was quite distant from the median nerve;
- the intermediate anterolateral portal: it was located between the proximal anterolateral portal (located 2 cm above and 1 cm in front of the lateral epicondyle) and the high "sub-radial" portal. It made it possible to use a surgical spatula and or a surgical elevator to recline the brachialis muscle.

2.3. Elbow evaluation score

The "Mayo Elbow Performance Score" (MEPS) (Table 1) was used to evaluate the elbow [8,9]. The total maximum score is 100 points. The higher the score, the better the elbow function. If it is between 90 and 100, the results are considered "excellent"; between 75 and 89, "good"; between 60 and 74 "average » and scores under 60 are considered "poor". This score was considered preoperatively and at the final postoperative follow-up.

Table 1
Mayo Elbow Performance Index.

Function	Points	Definition (Points)
Pain	45	None (45) Mild (30) Moderate (15) Severe (0)
Motion	20	Arc > 100 degrees (20) Arc 50–100 degress (15) Arc < 50 degrees (5)
Stability	10	Stable (10) Moderate instability (5) Gross instability (0)
Function	25	Comb hair (5) Eat (5) Perform hygiene (5) Put on shirt (5) Put on shoes (5)
Total	100	

2.4. Statistical analysis

Data were collected on SPSS® software version 20 (IBM, USA). The Shapiro-Wilke test was used to determine the normal distribution of the population. The studied variables were normally distributed. The means and standard deviations of the variables were determined. The differences between the preoperative and postoperative means were evaluated using the "paired-*t*-test". All tests were bilateral, and $P < 0.05$ was considered to be significant.

3. Results

3.1. Etiologies

Ten patients presented with post-traumatic stiffness of the elbow, eight following a fracture and two after dislocation. Two patients had rheumatoid arthritis, two had a deforming bone disease resulting in joint stiffness and one had osteochondritis dissecans of the capitellum.

3.2. Complications

Two patients presented with postoperative palsy in the territory of the radial nerve. The first had hereditary multiple exostoses syndrome and had undergone arthrolysis of the elbow with resection of the radial head because of deformity from the disease. This patient had already undergone open surgery of the elbow four times. This patient had transient postoperative radial nerve palsy, limited to the posterior interosseous nerve, with complete recovery six months after surgery. The second patient had post-traumatic stiffness and underwent arthrolysis with resection of the radial head. He developed postoperative radial palsy (in the territory of the posterior interosseous nerve) with preserved sensitivity. The patient had completely recovered nine months after surgery. There were no vascular complications.

3.3. Treatment

The 10 patients with post-traumatic stiffness underwent arthrolysis. In addition, one of these 10 patients underwent resection of the radial head, one underwent resection of osteophytes and a third underwent total resection of the capitellum following non-union of a capitellum fracture that had not been stabilized nine months before presenting to our institution. The two patients with the deforming bone disease underwent arthrolysis with removal of loose bodies, resection of osteophytes and resection of the radial head (in one of the two patients). The patient with osteochondritis of the lateral condyle underwent synovectomy with removal of loose bodies. The two patients with rheumatoid arthritis underwent arthrolysis with synovectomy and resection of the radial head.

3.4. Range of motion

Mean preoperative elbow flexion was113° ± 18.3; it increased to 129° ± 11.2 at the final follow-up ($P = 0.009$). Mean extension increased from preoperative −33° ± 20.5 to 10° ± 9.9 at the final follow-up ($P < 0.0001$). Preoperative and final postoperative flexion-extension were 80° ± 27.4 and 119° ± 17.6 respectively ($P < 0.0001$) with a mean increase of 39°. Two patients had a preoperative flexion-extension range of motion of 100° while13 patients had a flexion-extension range of motion above 100° at the final follow-up. Mean preoperative and postoperative pronation were 74° ± 13.5 and 85° ± 5 respectively ($P = 0.005$). Mean preoperative and postoperative supination were 61° ± 27.2 and 80° ± 10 respectively ($P = 0.005$). Preoperative pronation-supination was 135° ± 37.3 and it was 165° ± 13.5 at the final follow-up ($P = 0.001$) with a mean improvement of 30°. Only one patient presented with a decrease in flexion from 120° preoperatively to 100° at the final follow-up due to development of complex regional pain syndrome (Table 2).

Table 2
Mean preoperative and final follow-up values of elbow range of motion.

	Preoperative scores	Scores at final follow-up	*P*
Flexion	113° ± 18.3	129° ± 11.2	0.009
Extension	−33° ± 20.5	−10° ± 9.9	<0.0001
Range of motion F/E	80° ± 27.4	119° ± 17.6	<0.0001
Pronation	74° ± 13.5	85° ± 5.1	0.005
Supination	61° ± 27.2	80° ± 10.6	0.005
Range of motion P/S	135° ± 37.3	165° ± 13.5	0.001

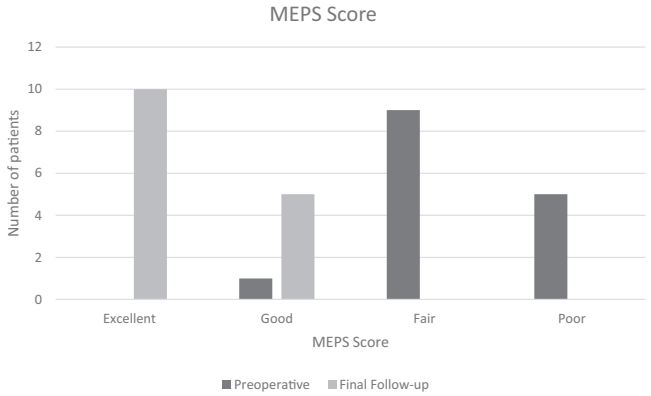

Fig. 3. Preoperative and final follow-up MEPS score.

3.5. The MEPS Score

Preoperatively none of the patients had a score > 90 (excellent), only one patient had a score of 75 (good), nine patients had a score between 60 and 74 (average) and five patients had a score < 60 (poor) (Fig. 3). At the final follow-up, 10 patients had a score of > 90 and five patients had a score between 75 and 89 (Fig. 3). The mean preoperative score was 56.3, and it reached 94 at the final follow-up ($P < 0.0001$).

4. Discussion

The median nerve and the brachial artery are 4 mm (3–10 mm) and 9 mm (8–13 mm) respectively from the arthroscope when it is introduced by a standard anteromedial portal. With capsular distension, these distances become 14 mm and 17 mm respectively [10]. When the elbow is extended, the distance between this portal and the brachial artery, median nerve and ulnar nerve is reduced to a minimum**.** This distance between this portal and the ulnar nerve is not reduced to more than 15 mm [11,12]. Extension eliminates the protective effect of capsular distension [13]. The ulnar nerve is a mean 12 mm from the proximal anteromedial portal [11,12,14]. The distance between the radial nerve and the standard anterolateral portal is 3–4 mm in flexion and extension if the capsule is not distended [10]. After distension of the capsule this distance increases and can reach 11 mm [10,15]. This distance is the greatest during 90° elbow flexion. It is reduced during full flexion and full extension [7]. The radial nerve is 4.9 mm from the proximal anterolateral portal during extension of the elbow and 9.9 mm during flexion.

This portal is less dangerous than the standard anterolateral portal [4,16].

All of the risks associated with the proximity of the anteromedial portals and the ulnar nerve are eliminated if an alternative portal is identified.

In elbow arthroscopy the rate of neurological complications is between 0 and 14% [2,17,18]. Injury to all the nerves around the elbow has been mentioned in the literature even with highly experienced surgeons [19]. Kelly et al. reported 12 cases of temporary nerve damage (2%) out of 473 elbow arthroscopies (four radial nerve, five ulnar nerve, one anterior interosseous nerve, one posterior interosseous and one medial ante brachial cutaneous nerve). Among the complications more than half the cases of nerve damage included the ulnar or median nerves [17].

In our series of 15 patients, two had transitory palsy of the radial nerve (13.3%). This rate remains within the range of 0 and 14% reported in the literature. There was no ulnar nerve damage, damage to other nerves around the elbow, or vascular complications. The expected interest of our technique is to eliminate all the risks related to the anteromedial portals without increasing the rate of complications associated with the use of two anterolateral portals because our use of these accessory anterolateral portals is based on an understanding of conventional surgical approaches to the lateral column of the humerus. Indeed, the radial nerve crosses the column of the humerus on the average 8 and 10 cm proximal to the lateral epicondyle, and we always take into account this distance when creating our accessory portals.

Arthroscopic arthrolysis has been evaluated in several studies. In a series of 14 patients, Ball et al reported an improvement in flexion-extension range of motion from preoperative 82° to 123.6° at one year of follow-up (41.6° improvement) [20]. Kim et al. reported a series of 63 patients with a preoperative flexion-extension range of motion of 79° and 121° at the final follow-up (2 years) for an improvement of 42° [21]. Pederzini et al. divided their series of 212 patients into two groups: post-traumatic stiffness (64 patients) and degenerative stiffness (148 patients). The improvement in flexion-extension range of motion was 33° in the first group and 20° in the second. In the first group the MEPS score improved from 60 to 81 and in the second group from 65 to 91 [22].

In our series, the preoperative and final postoperative range of motions were 80° and 119° respectively. Thus, there was an improvement of 39°, which is comparable to the results in the literature. The preoperative MEPS score in our study was 56.3 and it was 94 at the final follow-up. Two patients (13.3%) had a preoperative flexion-extension range of motion of more than 100° while 13 patients (86.7%) had a range of motion of more than 100° at the final follow-up. Results with our technique are comparable to those in the literature.

One major advantage of this technique is that arthroscopy of the elbow can be performed in subjects with primary instability of the ulnar nerve whose rate in the population is 16% [23], and in subjects who have undergone ulnar nerve transposition.

The anteromedial portal can be realized from the lateral portal but the unstable ulnar nerve remains very exposed with this approach.

The patient must be installed in a lateral or ventral decubitus position for the anteromedial portals. Our technique, which does not include medial approaches, allows the patient to be in the supine position, which is comfortable for both the surgeon and the patient. With this technique, the surgeon and the assistant can operate in the seated position. The posterior approach is not a problem, allowing posterior synovectomies or fenestration of the olecranon fossa.

The small number of patients limits our study. Based on the encouraging results it should be confirmed by studies including a larger group of patients. A larger number of patients must be studied before conclusions can be reached on the reliability of this technique. Another limitation to this study is its retrospective design. A prospective randomized controlled study is necessary to validate the efficacy of the technique and the reduced rate of complications.

5. Conclusion

Elbow arthroscopy is considered to have a high risk of neurovascular complications. This study presents a new arthroscopy technique without anteromedial portals. Accessory anterolateral portals are used. The results of the series of 15 patients operated on by the same surgeon using this technique confirm the efficacy of this approach. Range of motion and MEPS score results were significantly improved, and the complication rate was similar to that in the literature. Further prospective, controlled, randomized studies are needed in larger groups of patients to confirm these results.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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