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Original article

Anterior approach in humeral plating osteosynthesis

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ABSTRACT

Context: Humeral plating osteosynthesis is controversial, particularly regarding the choice between anterior and lateral approach, data for which in the context of a low-income country are lacking.
Hypothesis: The anterior approach is an easy surgical technique, allowing good anatomic reconstruction. We hypothesize that the anterior approach is associated with fewer neurovascular lesions and functional sequelae than the lateral approach.
Materials and methods: A retrospective study with assessment update was carried out over a period of 6 years 4 months from January 2010 to June 2016, with consecutive recruitment in the city of Yaoundé, Cameroon. It consisted in a review of medical records, with physical reassessment on pre-designed and tested data-sheet. Sixty-two osteosyntheses were documented in 60 subjects operated on for humeral fracture or non-union. The following variables were studied: sociodemographic data, fracture profile, clinical profile, and functional shoulder and elbow results. Data analysis used the Statistical Package for Social Sciences (SPSS), version 23.0. Associations between qualitative variables were assessed on Chi square test, or Fisher test when the expected sample size was less than 5, and between quantitative and qualitative variables on Student *t*-test for comparison of means; p values ≤ 0.05 were considered statistically significant.
Results: The anterior approach showed better results. Operative time was shorter, at 102.5 min on average, for 262 cm^3 blood loss, versus 141.6 min and 330 cm^3 on the lateral approach, with a significant correlation between the two variables. The incidence of postoperative radial paralysis was significantly higher with the lateral approach (22.6% versus 3.2%; $p = 0.02$), and there were likewise higher rates of postoperative infection (9.7% versus 6.5%), secondary displacement, implant damage, and malunion. Reduction was more often anatomical with the anterior approach (28.1% versus 11%) and cortical fixation was better (83.9% versus 61.3%). Functional shoulder and elbow recovery was nearly normal with both approaches, with superimposable values and no statistically significant difference in ($p = 0.4$).
Conclusion: Cameroon being a low-income country, the anterior approach is of therapeutic and prognostic interest, being easy to perform, with a low rate of postoperative complications and good functional outcome.

1. Introduction

Humerus fracture accounts for 3% of all fractures [1]. Low-energy trauma and osteoporosis are the main causes of superior humerus fracture, which accounts for 4% of humerus fractures. Humeral shaft fracture accounts for a further 1–5%, with incidence of 13/100,000 per year, showing a bimodal distribution with one peak for 20–30 year-old males and a second for 60–70 year-old females [2]. Although the gold-standard treatment in non-operative, 30% of these fractures require surgery, and the best method of surgical fixation is the subject of great controversy [3]. In practice, only a few approaches are used, each of which has drawbacks. The anterior approach consists in longitudinal incision from the coracoid process of the scapula to 5 cm above the elbow fold [4]. It can be extended proximally by a deltopectoral approach, providing complete exposure of the anterior side of the humerus,

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avoiding direct exposure of the radial nerve and extensive soft-tissue dissection. There is a risk of iatrogenic radial nerve lesion and above all musculocutaneous lesion, and the brachial muscle has to be sectioned to provide access to the humeral shaft [5]. The lateral approach involves a longitudinal incision from the anterior edge of the deltoid "V" and down along the lateral edge of the humerus. These approaches are widely used, providing adequate, simple and safe exposure of the proximal extremity and shaft, and thus of the anterolateral part; they are therefore combined under the term "anterolateral approach". Given the close anatomic relations between radial nerve and humerus, the major neural risk is postoperative radial paralysis. Previous studies [6,7] showed that the choice of approach to expose the humerus can affect postoperative results and functional outcome. The anterior approach is easy to perform, provides good anatomic reconstruction, and is associated with few neurovascular lesions and functional sequelae. In a low-income country such as Cameroon, it is less and less often indicated and implemented than the lateral approach, and data in its favor are lacking in the literature. The present study therefore compared fracture profiles, clinical profiles and functional results between the two approaches.

2. Materials and methods

A retrospective study was conducted with an inclusion period of 6 years 4 months, from January 2010 to June 2016, with a subsequent reassessment period of 7 months. The study was performed in the orthopedic surgery and traumatology departments of the three hospital centers of Yaoundé, Cameroon: Central Hospital, General Hospital and Rodolphe Orthopedics and Traumatology Foundation. It consisted in a review of medical files with consecutive recruitment, and physical reassessment of patients operated on for humeral fracture or non-union using a pre-designed and tested data form. Inclusion criteria comprised: patient aged ≥ 16 years, operated on via an anterior or a lateral approach, and with at least 6 months' follow-up. Exclusion criteria comprised: pathologic fracture, preoperative radial paralysis, floating shoulder, floating elbow, joint fracture, non-consent, loss to follow-up and unanalyzable data. Study variables comprised: sociodemographic data, fracture profile, clinical profile, and functional shoulder and elbow results on Constant-Murley Shoulder Outcome Score and Mayo Elbow Performance Index (MEPI). Sixty-two fractures were analyzed in 60 patients, with 31 anterior and 31 lateral approaches for internal fixation. Prior approval was obtained from the Faculty of Medicine and Biomedical Sciences ethics and research review board and the review boards of the three recruiting centers. Data were coded and analyzed on the Statistical Package for Social Sciences (SPSS) version 23.0. Associations between qualitative variables were assessed on Chi^2 test, or Fisher test for expected sample sizes < 5, and between quantitative and qualitative variables on Student *t*-test for comparison of means. The significance threshold was set at $p \leq 0.05$.

3. Results

Data for 109 patients with humerus fracture treated by screw-plate were retrieved, but with 49 exclusions: 4 joint fractures, 5 preoperative radial paralyses, 4 floating elbows, 1 floating shoulder, and 35 non-analyzable files. Analysis thus concerned 62 fractures in 60 patients, with 31 anterior and 31 lateral approaches.

3.1. Sociodemographic data

The series comprised 45 male and 17 female patients: i.e., sex ratio, 2.9. The main age peak was at the end of the 3rd decade; mean age was 41.8 ± 12.2 years (range, 24–71 years) for anterior approaches and 34.1 ± 10.8 years (range, 16–57 years) for lateral approaches. The affected side was dominant in 95.2% of cases. Two patients were smokers, and 1 was taking anti-inflammatory medication.

3.2. Fracture profile

Most patients ($n = 46$) were operated on for closed fracture. There were 7 open fractures, and 9 non-unions. In both approaches, more than half the cases ($n = 32$) showed simple fracture lines. The shaft was involved in 42 cases, the proximal humerus in 4, and the distal humerus in 19. The main etiology was road accidents ($n = 48$; 20 with anterior and 28 with lateral approach), followed by physical aggression ($n = 4$), falls ($n = 4$) and work accidents ($n = 4$, all treated by an anterior approach) There were 15 non-displaced fractures; displacements comprised 23 translations, 18 overlaps and 7 angulations.

3.3. Clinical profile

Surgery was within 1 week of the accident, at a mean 4 days in the case of both approaches. Mean follow-up was 28 ± 23 months (range, 11–71 months). Mean operative time was 102.5 ± 18.6 min (range, 90–120 min) with 262 ± 114.2 cm^3 blood loss (range, 200–300 cm^3) on anterior approaches, and 141.6 ± 39.5 min (range, 90–240 min) and 330 ± 75 cm^3 (range, 300–350 cm^3) on lateral approaches, these differences being significant ($p < 0.001$ and $p = 0.04$, respectively). There was a strongly significant linear correlation between surgery time and blood loss in both approaches.

Short- and medium-term complications rates were higher with the lateral approach. The main lesion was postoperative radial paralysis: 7 cases with a lateral approach (22.6%) versus 1 case with an anterior approach (3.2%), this difference being significant ($p = 0.02$). There were 3 cases of postoperative infection with the lateral approach (9.7%) and 2 with the anterior approach (3.2%). There were 3 cases of plate breakage and 1 malunion with the lateral approach, although this was not significant.

Reduction quality on immediate postoperative X-ray (Fig. 1) was better with the anterior approach, with 9 anatomic reductions compared to 2 with the lateral approach, although the difference was non-significant ($p = 1$); likewise, there were 26 cases of bicortical fixation with the anterior approach, compared to 19 with the lateral approach (Fig. 2).

Bone consolidation was systematically good, at a mean 16 weeks (range, 9–51 weeks) with the anterior approach and 20 weeks (range, 7–72 weeks) with the lateral approach.

3.4. Functional results

Functional recovery was assessed on Constant score for the shoulder and MEPI for the elbow. Shoulder scores were excellent or good in 96.1% of cases for the anterior approach and in 100% of cases for the lateral approach; elbow scores were systematically excellent or good with both approaches (Fig. 3). Mean Constant score was 96.6 ± 10.7 (range, 51–100) and mean MEPI 98.6 ± 6.8 (range, 65–100) with the anterior approach and respectively 97.3 ± 3.9 (range, 85–100) and 99.2 ± 2.2 (range, 90–100) with the lateral approach, these differences being non-significant ($p = 0.4$).

3.5. Anterior approach performance

The postoperative complications risk was higher with the lateral than the anterior approach. The risk of operative time exceeding 120 min was 5-fold higher ($p = 0.01$; 95%CI = 0.05–0.7), blood-loss exceeding 250 cm^3 20-fold higher ($p = 0.001$;

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