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Early Rehabilitation in Patients with Proximal Humeral Fracture: A Comparative Analysis of Functional Outcomes Between Surgical and Conservative Treatments.

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ABSTRACT

Proximal humeral fracture is a common trauma, with a significant impact on upper limb function. Treatment options vary between conservative and surgical approaches, while rehabilitation management plays a crucial role in recovering movement and reducing disability. The existing literature highlights a lack of studies in this area, this study aims to compare the functional outcomes of patients with proximal humeral fracture treated with surgical and non-surgical strategies, who underwent a rehabilitation program versus patients who did not perform it, with a further distinction based on the timing of rehabilitation intervention. The Constant-Murley scale indicated a functional score of 33.2 ± 1.9 before rehabilitation treatment, in the face of a functional score post-treatment value of 91.7 ± 2.9 ($p < 0.001$). The therapeutic success was dictated by the precocity of the rehabilitation intervention, regardless of the surgical or conservative therapeutic choice.

Keywords: proximal humeral fracture, early rehabilitation, Constant-Murley scale.

INTRODUCTION

Proximal humeral fractures are classified based on the number of bone fragments present; a fragment is defined as a key anatomical structure if displaced by more than 1 cm or angulated beyond 45° from its physiological position. The four key anatomical structures of the proximal humerus are:

- The anatomic neck
- The surgical neck
- The greater humeral tuberosity
- The lesser humeral tuberosity

For example, if no fracture component is displaced or angulated, the fracture has a single fragment. If one element is angulated or displaced, it is a two-part fracture. Nearly 80% of proximal humeral fractures involve a single fragment; these are generally stable, held together by the joint capsule, rotator cuff, and/or periosteum. Fractures with ≥ 3 fragments are rare. A second classification system, developed by the Association for the Study of Osteosynthesis (AO), categorizes proximal humeral fractures based on severity, emphasizing the vascularization of the articular segment and dividing fractures into types A, B and C; the recent LEGO classification by Hertel (Local Evaluation of Glenohumeral Outcomes) focuses on the vascularization of the humeral head [1].

High-energy fractures typically affect young individuals under the age of 40, while low-energy fractures are more common in patients over 65 years old. The symptoms in this type of fractures involve shoulder and upper arm pain, swelling, and difficulty in lifting the arm. Single-fragment

fractures rarely require reduction; most of these (almost 80%) are treated with an elastic brace, sometimes with a sling and early mobilization exercises, such as Codman exercises. These exercises are particularly useful for elderly patients. Since contractures are a risk, early mobilization is preferable, even if the alignment of the fracture is anatomically imperfect.

Fractures with ≥ 2 fragments require immobilization, and patients are referred to the orthopedic surgeon. These fractures may require open reduction with internal fixation or prosthetic surgery (shoulder prosthesis) [2].

MATERIALS AND METHODS

A retrospective analysis was conducted on 180 patients (mean age: 68 years; 135 women and 45 men) diagnosed with proximal humeral fractures and treated in Functional Recovery and Rehabilitation Medicine Operating Unit, Umberto I Hospital, Enna (Italy) from 2022 to 2023. Patients with pathological fractures due to tumor-related causes were excluded from the study. The included patients were divided into two groups: group A (100 patients treated surgically) and group B (80 patients not treated surgically, but immobilized with a brace for 20 days); patients in group A followed a rehabilitation program immediately after surgery (from the second day). Group B was further subdivided into two subgroups: B1 (50 patients who adhered to the rehabilitation program, starting immediately after brace removal on twenty-first day [3], and group B2 (30 patients who, by their choice, did not adhere to the rehabilitation treatment immediately after brace removal) considered as the control group.

All patients included in the study were evaluated with follow-up 60 days after the trauma.

The rehabilitation protocol for Groups A and B1 consisted of passive mobilization to restore the joint range of motion and standardized exercises to aim the recovery of muscle strength; the program lasted 30 days with a frequency of 5 treatments per week, each lasting 1 hour.

The results were evaluated using the Constant-Murley scale, chosen for the multidimensionality of the data provided, both objective clinical and subjective, relating to the part filled out by the patient, together with the measurement of quality of life using the EuroQol-5 Dimension (EQ-5D) questionnaire, considered an effective tool in assessing quality of life.

The analyzed data were entered into a Microsoft Excel program in compliance with privacy regulations and personal data protection laws, for statistical purposes only. Using the same program, mean values and standard deviations of the recorded parameters were calculated, along with Student's t-test, applying Bonferroni correction, which resulted in $p < \alpha$.

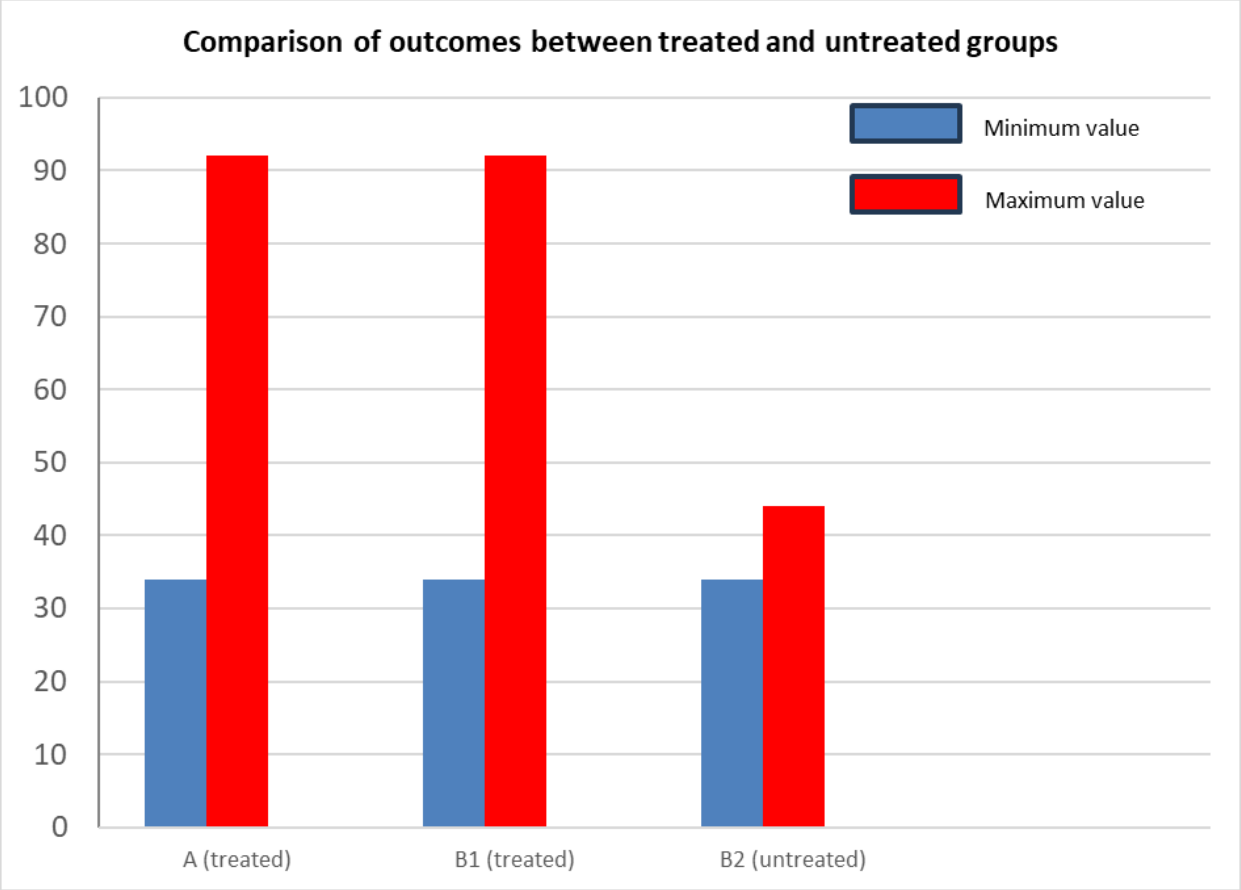
No approval was requested from the Ethics Committee because it was a retrospective observational study.

Informed consent was obtained from all patients.

RESULTS

Patients in group A and group B1, who started the rehabilitation protocol immediately, showed a significantly better functional recovery, with improved range of motion and strength; the Constant-Murley score card provided, indicated a pre-rehabilitation score of 33.2 ± 1.9, which increased to 91.7 ± 2.9 post-treatment ($p < 0.001$) compared to those in group B2 who did not undergo rehabilitation (Graph 1).

The improvement range (difference between minimum and maximum value) in the treated groups is significantly wider, confirming a more marked positive effect of early rehabilitation. In contrast, group B2 shows a more limited recovery, with significantly lower maximum values. These data confirm the importance of a timely rehabilitation approach in improving the functional outcomes of proximal humeral fractures [4].



Graph 1. *Comparison of Constant-Murley scores in patients from Group A (surgical and rehabilitative treatment), Group B1 (conservative and rehabilitative treatment), and Group B2 (no treatment).*

DISCUSSION

All patients included in our study, with proximal humeral fracture, who were referred to our Functional Recovery and Rehabilitation Medicine Operating Unit, underwent an early rehabilitation protocol with a differentiated timing: patients treated surgically were included in a rehabilitation program the day after surgery; while patients treated conservatively with limb immobilization using an orthotic brace for 20 days began rehabilitation on the day following the removal of the orthopedic device.

Patients who opted not to follow a rehabilitation program, were evaluated and compared to patients treated 60 days after the fracture event. The rehabilitation protocol consisted of passive mobilization to restore the joint Range of Motion (ROM) and subsequently an exercise program for strengthening the muscles of the shoulder complex, according to the Neer protocol, reported by Rockwood and Matsen [5], since no other validated protocols are highlighted in the literature.

The comparison of outcomes between rehabilitated patients, group A and B1, and untreated patients, group B2, revealed that early initiation of rehabilitation following proximal humeral fracture leads to functional recovery, improved quality of life, and a return to daily and occupational activities [6]; while the untreated patients presented signs of adhesive capsulitis, pain and conditions of disability in daily activities, resulting in an inability to resume work.

CONCLUSIONS

The study suggests that, regardless of the surgical or conservative therapeutic approach, an early rehabilitation protocol leads to functional recovery and facilitates reintegration into daily and occupational activities [7], thereby reducing the potential costs associated with prolonged disability.

- Further prospective studies with a larger sample size are warranted to confirm these findings and assess outcomes beyond 60 days, with a longer follow-up.
- Additional rehabilitation protocols should be explored to identify the most effective approach.
- Analyze the cost-effectiveness values, to quantify the economic savings associated with early rehabilitation.

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