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Rehabilitation methods in non-displaced fractures of the proximal humerus

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Abstract

Fractures of the proximal humerus account for 4% to 5% cases out of all fractures, and about 85% of them are minimally displaced. *The purpose* of the study was to observe the effectiveness of physiotherapeutic methods used in the proximal fractures of the humerus. *Material and method*: the research was performed on a group of 13 patients who have been orthopedically treated for fractures at the proximal end of the humerus. Five subjects followed the TECAR therapy and physical exercise, and eight subjects followed classical physiotherapy and physical exercise**.** The evaluations have been performed at the beginning of the recovery, after 14 days, after 28 days and after 42 days of treatment. Pain intensity (VAS score), joint amplitude (goniometry), muscle strength and functionality (the PENN questionnaire) were assessed in all patients. *The results* of the evaluations showed a decrease in pain, after the first 14 days, especially for the patients who underwent the Tecar therapy. Also, the results showed that the patients with surgical neck fractures had the best evolution in cases of goniometry evaluation, compared to the rest of the patients. In *conclusion*, physical therapies for proximal humerus fractures play an important role in the recovery and reintegration of the patients into family and at work.
***Key words**: humerus, fracture, physiotherapy.*

Rezumat

Fracturile părţii proximale a humerusului, reprezintă 4% până la 5% din totalul fracturilor, iar aproximativ 85% din ele sunt cu deplasare minimă. *Scopul* acestui studiului a fost de a observa eficienţa metodelor fiziokinetoterapeutice utilizate în cazul fracturilor proximale ale humerusului. *Material şi metodă*: cercetarea a fost efectuată pe un lot de 13 pacienţi, care au suferit fracturi la nivelul extremităţii proximale a humerusului şi au urmat un tratament orthopedic. Cinci subiecţi au urmat terapie TECAR şi exerciţii fizice iar 8 subiecţi au urmat pizioterapie clasică şi exerciţii fizice. Evaluarea a avut loc la începerea recuperării, la 14 zile, la 28 de zile şi la 42 de zile. Pentru evaluare s-a folosit scala VAS, goniometria şi chestionarul PENN. *Rezultatele* în urma evaluărilor, au arătat o scădere a durerii în primele 14 zile, în special la cei care au efectuat terapia TECAR. De asemenea în cazul evaluarii gomiometrice, rezultatele au evidenţiat că pacienţii cu fractură de col chirurgical au aprezentat cea mai bună evoluţie în comparaţie cu restul pacienţior. În concluzie, terapiile fizicale au un rol important în eficientizarea recuperării medicale şi în reintegrarea bolnavilor cât mai repide în familie şi la locul de muncă.
***Cuvinte cheie**: humerus, fractură, fiziokinetoterapie.*

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Introduction

The fractures of the proximal humerus represent 4% to 5% of the total fractures. Studies show that about 85% of them are minimally displaced, and they are fast and efficiently recovered with physical-kinetic methods.

The purpose of this study was to observe the effectiveness of physiotherapeutic methods for joint mobility, improvement of painful symptoms and resumption of normal activities (ADL, I-ADL) in a number of patients who suffered a fracture of the proximal humerus, orthopedically treated.

Patients and Methods

This research included a group of 13 patients who have been orthopedically treated for fractures at the proximal end of the humerus. The age of the patients was between 20 and 45 years. The group was composed of 3 women and 10 men: 6 of them had surgical neck fractures, 3 of them had humeral head fractures, 2 of them had greater tuberosity fractures, and 2 of them had anatomical neck fractures. Of all the studied cases, 6 had the left part affected, and 7 had the right part affected.

The study was conducted in two physiotherapy clinics in Timisoara, between October 2018 and April 2019. The patients were followed up for 42 days to observe the effects of the applied therapies.

The fractures were treated orthopedically: immobilization of the shoulder in a functional position (abduction at 30 degrees, mild flexion) for a period of 14 days, or immobilization in Dessault bandage for 3-4 weeks, followed by a recovery treatment.

The evaluations were carried out at the beginning of the rehabilitation treatment, after 14 days, 28 days and 42 days of treatment.

The study included: patients with orthopedically treated fractures of the proximal end of the humerus, patients who were available and were able to obtain complete clinical and functional data according to our study objectives, at the time of the study, and patients who followed all the evaluations and the complex rehabilitation program over a 42-day period.

Exclusion criteria were as follows: associated dislocation, multiple fractures of the upper limb, fractures associated with muscular or tendon injury, failure to follow the rehabilitation program.

The study protocol included: electrotherapy, TECAR therapy, massage, taping, and an individualized exercise program. Eight of our patients followed classic physiotherapy and the exercise program, and five of them were treated by the TECAR Therapy and the exercise program.

Initially, we made an assessment of pain, joint amplitude, muscle strength, and functionality. In the evaluation, we used the visual analogue pain scale, the goniometry, and the PENN questionnaire.

For pain, we used the visual analogue scale (VAS) through which each patient made a self-assessment for pain intensity from 0 to 10 (0 = absent pain and 10 = maximum pain).

For mobility, we used goniometry, measuring the amplitude of flexion, abduction, extension, internal rotation, and external rotation. Assessments were performed on the first day, after 14 days, 28 and 42 days.

Muscle testing was used starting with F3 directly because all patients initially had a F2+ score.

In the case of the PENN Shoulder Score questionnaire, the subsection for functionality was used. This questionnaire is based on the score of 20 questions. Response options include: 0 (cannot do at all), 1 (a lot of difficulty), 2 (with some difficulties), and 3 (without difficulty). A patient receives 60 points if all activities can be performed without difficulty. Because some of the activities in the questions may not be applicable to all patients, the option "not done before the damage" is available, in which case the possible total score is reduced by three points [1].

The *electrotherapy program* followed by patients consisted of:

- *TENS*, symmetrical biphasic, 100 Hz, 10 minutes, placed anteroposterior to the affected shoulder.
- *Interferential current (IFC),* carrier frequency 4500 Hz, beat low-high 0-100 Hz, 10 minutes, placed anteroposteriorly to the affected shoulder.
- *Laser therapy*, analgesia program, on painful points.
- *Monophasic Rectangular Pulsed* 50 Hz, on brachial biceps / triceps, progressive time - 5-7-10 minutes.
- *SIS therapy,* fracture protocol, head located on the affected shoulder, 10 minutes.

The super inductive system (SIS) technology is based on the high intensity of the electromagnetic field, which has positive effects on human tissues

such as: immediate improvement of all painful stages (whether acute or chronic), speeds up the healing of the fractures (it increases the blood circulation in the affected area and supports the formation of the callus, thus, the progressive process of cartilage matrix mineralization, and bone remodelling is started), myorelaxation and myostimulation (the interaction of the electromagnetic field inside the neuromuscular tissue leads to nervous depolarization and muscle contraction, thus, depending on the frequency selected, the effects of muscular facilitation or fortification can be obtained) [2].

• *TECAR therapy* (made with Winback)

The Capacitive and Resistive Energy Transfer (TECAR) is a non-invasive therapy that uses high-frequency currents that enter the tissue and turn into heat. The equipment consists of two electrodes (one negatively charged, the other with a positive charge) connected to a generator that creates a potential difference. An electrode is placed at a fixed point throughout the session and the other is moved by the therapist in the affected area as a light massage using a conductive cream. Electrodes release high frequency currents that cause tissue heating, thus contributing to increased microcirculation, vasodilation, and improving local cellular metabolism [3].

The TECAR can be used in two ways: resistive or capacitive, using insulated electrodes of various sizes, and the neutral electrode, which has the role of closing the circuit.

In the capacitive mode (CET), the effect is concentrated under the surface of the electrode. It works on soft tissues, rich in water - muscles, lymphatic system. There is a second level of depth in the CET, named DEEPCET, which allows a faster elimination of deep tensions, while avoiding overheating of the epidermis, which greatly improves patient comfort.

In the resistive mode (RET), efficiency is manifested in all types of high resistance and low water content. The biological effect is strongly felt in the treatment of bone tissues, joints, tendons, ligaments and cartilage [4].

In this study the therapy was used as follows:

- return plate fixed above the wrist, 3 minutes CET, 2 minutes DEEPCET, 10 minutes RET, 5 minutes CET (in the initial phase, the first 3-4 days).
- return plate fixed above the wrist, 3 minutes CET, 2 minutes DEEPCET, 5 minutes RET with passive mobilizations, 5 minutes RET +, 5 minutes CET (after the fourth session).
- mobile return plate, 3 minutes CET, 2 minutes DEEPCET, 5 minutes RET with passive mobilizations, 5 minutes RET +, 5 minutes CET (after the fourth session).

Figure 1. TECAR application

• Initially, *tapping* was applied for drainage (where appropriate), fan-shaped strips, proximal to distal application, slight stretch (10%). Secondarily, the tape was applied, with 100% stretch, as “I" type bands (Fig. 2). The tapes were also used to facilitate muscle toning on biceps and triceps, from proximal to distal, mild stretch (up to 25%), "I" type.

Figure 2. Taping application

• *Massage* was recommended after fracture consolidation and consists of:
1. Regional massage, which contains heating manoeuvres over a larger area than the area to be treated; working time will be 3 to 4 minutes;
2. Zonal massage, i.e. manoeuvres applied to the area to be treated, for 3 to 4 minutes;
3. Selective massage will be done more on the fascicle, muscle scarring and contractures; for 2-3 minutes;
4. Passive, active and active with resistance physical therapy; for 10 minutes [5].

• *Exercises Protocol*
The fracture of the anatomical neck allows all active movements. The amplitude of the movements and opposite resistance are dictated by the intensity of the pain caused by the movement.
In the humeral head fracture, the physical-kinetic treatment starts using the Codman technique, associating the various axial traction movements of the arm.
The fracture of the surgical neck is extra-articular, which is why it has less influence on the function of the shoulder. In this type of fracture, counter-resistance movements or sockets that turn the humerus into a lever are not allowed. Therefore, glenohumeral re-harmonizing techniques, traction, as well as passive movements are contra-indicated [6].
General principles that have to be respected:
1. Non-displaced means less than 1 cm of displacement and less than 45° of angulation.
2. Bone healing occurs usually within 6 to 8 weeks in adults.
3. External and Internal Rotation should not be performed until 6 weeks.
4. Return to normal function and motion may require 3 to 4 months.
Goals of the treatment:
1. Increase ROM while protecting the fracture site.
2. Control pain and swelling (with exercise and modalities).
3. Perform frequent gentle exercises to prevent adhesion formation [7, 8]
The statistical analysis was performed with Graph Prism 6, using the following tests: paired and unpaired t-tests depending on which one was needed in some conditions; and the ANOVA test. The graphs were made using the Graph Prism and Microsoft Excel.

Results

Following the evaluations, the results obtained are:

A. Pain control (VAS)
Our patients have achieved satisfactory results regarding pain after the treatment. At the second evaluation, there was a significant decrease in pain, the average being initially between 3 and 4, with a maximum of 5, and at the second evaluation the average was between 1 and 2, the maximum being 2. At the third evaluation, the decrease was also significant, with very few patients accusing pain, the maximum VAS score being 1. At the last evaluation, no patient accused pain (Fig. 3).
Based on comparative statistics, a single procedure proved to be more effective against pain, and that was the Tecar therapy. Although the unpaired T test resulted in $p > 0.05$, there was a difference between those who undertook this therapy and those who did not.
This difference can only be seen at the second and third evaluations (day 14 and day 28).

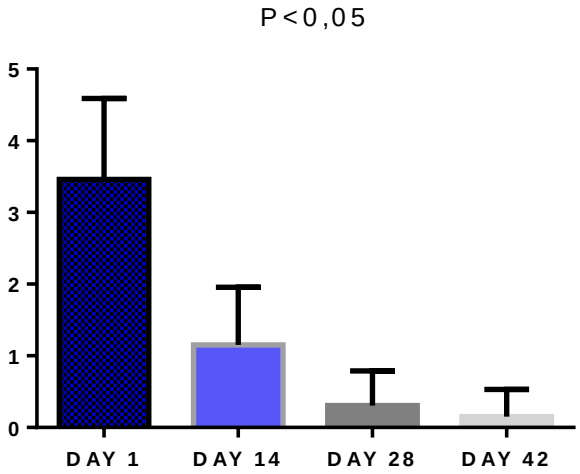

Figure 3. VAS scale results

B. ROM - Goniometry:

As for the amplitude of the movements, the evolution was very good and statistically significant, but with some particularities that can be observed in figure 4.

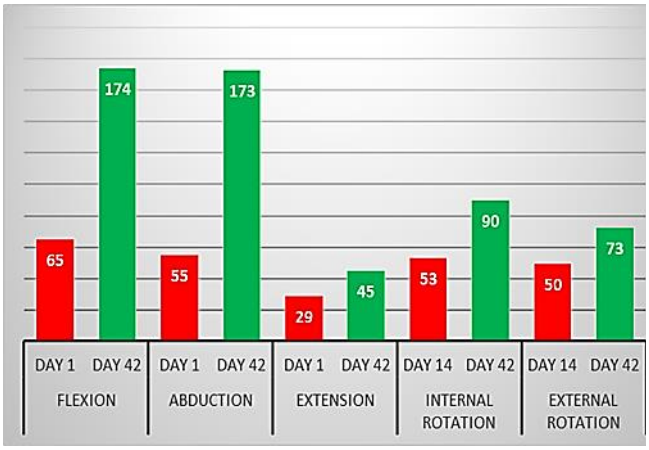

Figure 4. Amplitude evolution

• ***Flexion***

The evolution of flexion was favourable over the treatment, the maximum value reached at the last assessment being 180˚, and the minimum value being 163˚ (Fig. 5).

As for the type of fracture, patients with fracture of the surgical neck of the humerus had the most favourable evolution, while patients with humeral head fracture had the weakest evolution.

• ***Abduction***

The evolution of abduction was favourable during the treatment, the maximum value reached at the last assessment being 178˚, and the minimum value being 162˚ (Figure 5).

As for the type of fracture, patients with fracture of the surgical neck had the most favourable evolution, while patients with humeral head fracture had the weakest evolution.

• ***Extension***

The evolution of the extension was favourable, with the maximum value reached at the last assessment being 52˚and the minimum value 37˚ (Figure 5).

As for the type of fracture, patients with fracture of the surgical neck had the best progression, while patients with humeral head fracture had the weakest evolution.

• ***Internal Rotation***

The evolution of internal rotation was favourable, the maximum value reached at the last assessment being 90˚ and the minimum value 87˚ (Figure 5).

As for the fracture type, patients with fracture of the surgical neck had the best evolution, while patients with fracture of the humeral head and anatomical neck had the weakest evolution, their average amplitude being equal.

• ***External Rotation***

The evolution of internal rotation was favourable, the maximum value reached at the last testing being 79˚ and the minimum value 64˚ (Figure 5).

As for the type of fracture, patients with fracture of the surgical neck had the best evolution, while patients with fracture of the greater tuberosity had a less favourable evolution.

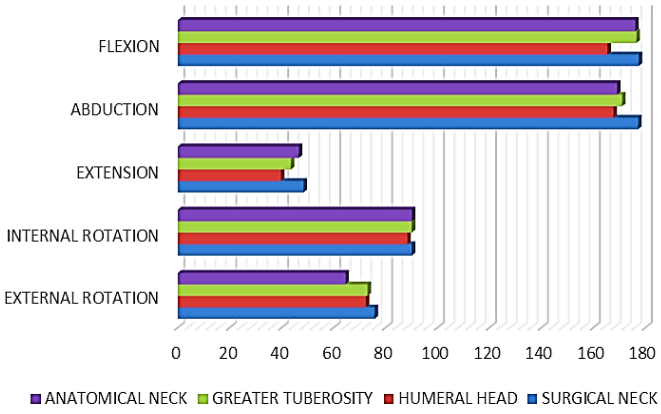

Figure 5. Amplitude evolution according to the type of fracture

C. Muscle Testing:

At the first evaluation, all patients had a F3 strength score after testing. At the second evaluation, two of the patients reached F4, the rest remained at F3 due to the contraindication of resistance movements. At the third evaluation, one patient remained at F3, ten patients reached F4, and two reached F5. At the last assessment, 11 patients reached the F5 score and two remained with F4. Of those two, who remained with 4, one suffered a fracture at the level of the greater tuberosity, and the other one suffered a fracture of the humeral head.

D. PENN questionnaire

The evolution of the results of the PENN questionnaire is favourable, but also statistically significant following the ANOVA test. No patient achieved a score of 60 (maximum), this fact having no effect on recovery. Some of the activities in the questions may not be applicable to all patients, so the answer option "was not done before the damage" was used by them, which is why the possible total score was reduced by three points.

The maximum score was 57, and among the activities that were not performed before the injury, the most often selected was number 16 - Place a heavy object (4-5 kg) on a shelf above the shoulder (Figure 6).

There was a difference in the results of the questionnaire and between the types of fracture. The best scores were obtained by patients with fracture of the surgical neck and the lowest scores were obtained by patients with fracture of the greater tuberosity.

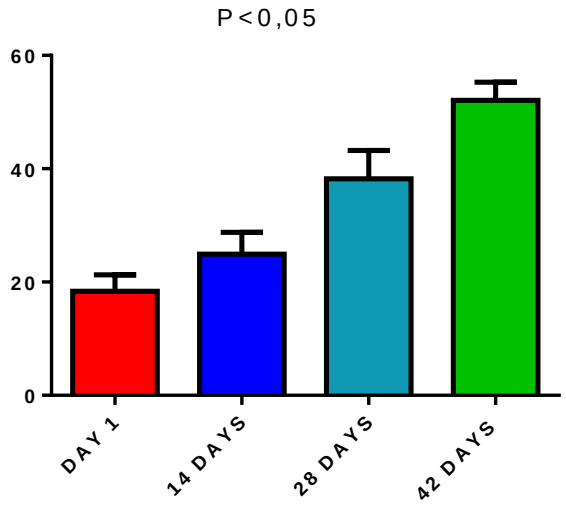

Figure 6. PENN Questionnaire evolution

Discussions

Physical therapy represents an essential factor for the clinical outcome after a fracture. There are studies that show the efficiency of electrotherapy and physical exercise after immobilization in fractures, but the use of the TECAR therapy has been studied only in the case of musculoskeletal disorders [9, 10]. The study by Sanguedolce (2009) on the rotator cuff tendon shows a decrease in pain and improvement in the quality of life in the patients treated with the Tecar therapy [11]. In our study we wanted to follow especially the difference between applying the TECAR therapy and classical physiotherapy. As it can be seen in the graphs above (fig.3), a significant reduction in pain has been obtained following the recovery treatment. Using the pain intensity scale (VAS scale) for evaluation, we observed that the patients who followed the TECAR therapy had better results in reducing pain. All patients initially presented a restricted amplitude of motion in all planes, which affected their activities of daily living. The mobility shoulder increased in the first period of treatment in the patients who underwent the TECAR therapy and physical exercises more than in the patients who underwent classical physiotherapy and exercise procedures. In some cases, pain may be a greater problem than the restriction in range of motion.

Our study is the first to report that patients diagnosed with proximal humeral fractures treated orthopedically, who underwent the TECAR therapy,

experienced less pain after 28 days and improved range of motion. The excellent pain relief and evolution of mobility is a strong indication for treating the fractures of the proximal humerus with the TECAR therapy in addition to the exercises protocol.

In our study, we also noticed that there is a difference between the types of fracture in the evolution of recovery. The patients that suffered a fracture of the surgical neck, had the best results in evaluations, most probably because this fracture is an extra-articular one, which is why it has less influence on the function of the shoulder.

Some factors as age, sex, or the affected part (right or left shoulder) were not relevant for the results.

We will continue the study on a larger group of patients to validate the results.

Conclusions

1. The fractures of the proximal end of the humerus have a very good evolution following a recovery treatment.
2. The TECAR therapy is very effective as a method of physiotherapy treatment in relieving pain, especially in the first 14 days.
3. Due to decrease in pain when applying the TECAR therapy the subjects also presented a better evolution of the shoulder's range in motion, which resulted into an improvement in daily activities.
4. The pain almost disappeared after 28 days in all patients, but the functional recovery was complete after 42 days of rehabilitation treatment.
5. The fractures at the surgical neck level have the best evolution, while the humeral head fractures have the weakest evolution.
6. A complex rehabilitation approach is recommended with specific kinesiotherapy protocols.

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