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## Abstract

The hand is considered to be one of the most important structures of the human body, with the help of which we can do different kinds of activities. A lesion of the hand can destabilise the patient from a physical point of view but also from a psycho-social one. The distal radius fractures are the cause of morbidity for patients and determine the decrease of the workforce, despite the restoration of the bone alignment and even if the fracture is cured from an anatomical point of view. The hand traumatism, especially the fractures, may have as causes osteoporosis, age, medication by corticoids, repeated traumatism and physical deficiencies. The objective of this trial is the evaluation of parameters (the movement amplitude, the muscular force, the prehension, the functional coefficient, the quality of life) which enable the clinical - functional recovery of patients who had hand traumatism and their social- professional reinsertion. The study was conducted for a period of 6 months in the ambulatory and included 20 patients diagnosed with post-fracture sequelae at the distal radius level. The evaluation of the patients was made at the beginning and at the end of the treatment, as well as at the examination 6 weeks after the end of the treatment. For this purpose, electrotherapy, lymphatic drainage massage and the kinesiotherapy program were applied. After making the joint balance sheet, it is found the favorable evolution in the recovery on all the mobilisation directions, but also the functional coefficient, in all the evaluation moments: initial, final and control. By applying the evaluation methods and scales to the 3 moments of assessing the patients, the efficiency of the complex recovery program can be seen.

**Key words:** *clinical - functional recovery, hand traumatism, the distal radius fractures,*

## Introduction

The hand is considered to be one of the most important structures of the human body, with the help of which we can do different kinds of activities. The hand is also the organ of sensitivity, of the elaborated expressivity and also the organ of speech for the deaf and dumb. A lesion of the hand can destabilise the patient from a physical point of view but also from a psycho-social one. The distal epiphysis radius fractures represent approximately 74.50% of the fractures of the upper limb, 14% of the total fractures at the extremities of the limbs (1) and about 18.7% of the total number of fractures of the locomotion system whereas the fractures of the metacarpal bones and of the phalanx represent 10% of the total number of fractures, but 70% are encountered in patients aged 11-45 (2). The distal radius fractures are the cause of morbidity for patients and determine the decrease of the workforce, despite the restoration of the bone alignment and even if the fracture is cured from an anatomical point of view. Therefore, it is important to take into account the rehabilitation of the soft tissue lesions that are considered to be responsible

for the reduction of the mobility, of the muscular force and of the functional ability. (3).

The statistical analysis of the conservatory treatment results shows that in approximately 23.8% – 42% of the cases, the radius fractures at the distal extremity may be complicated by secondary movements under the cast. These secondary movements are the consequence of the reduced oedema and may occur in the 5th and 10th day since the traumatism (4).

A trial on 11 patients reveals that the average angulation value was 19° before the reduction of the fracture, it was 5° after the reduction and it was 4° after the bone repair. The fractures with the angulation over 15° had normal functionality due to a complete process of bone remodelling.

The distal radius fractures are the most frequent orthopaedic lesions, representing 1/6 of the total number of fractures and can be associated to the styloid ulnar fractures (5,6) There are trials which show some complications of the distal radioulnar fractures (7,8): pain, instability, disability, even without serious consequences (9,10,11,12). The stability of the distal radioulnar joint and of the

ulnar-carpal one is determined by the presence of the triangular fibrocartilage and of ligaments (5,13,14). The lesions of the triangular fibrocartilage and of the ligaments are frequently encountered at the fist, being detected by radiography, arthroscopy (15) and magnetic resonance (16).

In a trial of 2019 (3) the researchers discovered that arthroscopy was useful and valuable in determining the prevalence and gravity of the soft tissue lesions in case of lesions that could not be detected on the standard radiographies.

In another trial of 2016 (17) for the patients with a distal radius fracture and in some cases with an ulnar styloid fracture, the fist and the forearm were immobilised in the cast for 6 weeks, in the flexion position of the fist at 30° and its ulnar inclination of 15-20°. The patients were encouraged to start moving both their joints, respectively the elbow and the metacarpal-phalanges. Then the sick limb and the healthy one were tested from a functional point of view by means of the Quik Dash scale; the muscular force was measured by means of the dynamometer and of the imagery elements (radiography and magnetic resonance) that could show the presence of possible signs of instability and osteoarthritis after the traumatism and immobilization. Among the 38 cases taken into account there were 10 cases where the triangular fibrocartilage was sick, a case of instability at the level of the radioulnar distal joint and one case that had modifications at the level of the ulnar styloid whereas the decrease of the muscular force of the sick limb was obvious. It is the first trial that evaluates the mobility of the joints at the level of the fist, correlated to the muscular force and to the functional ability (18). The trial also points out the importance of the supination, which is affected in the ulnar styloid fracture, and the fact that the pain and the limitation of the mobility are the consequence of the instability in the radioulnar distal joint. The muscular force decreased in the supination in the persons with instability of the radioulnar distal joint after the fracture at this level.

The frequency of the fist fractures, according to some research, increases 10 times, for 15 years, after the menopause occurs, but continues to be stable. Osteoporosis is one reason why the distal radius fractures occur, that is why the early diagnosis of this health condition enables the prevention of the

fracture by evaluating the fracture risk and it also enables to establish the appropriate therapeutic strategy (19).

It is very important the calcium intake from food and medication (20,21) but also the D vitamin that has its role in the bone metabolism, which reduces the risk to have a fracture (22). As for the fractures of the children, it is important to mention the role of calcium, of magnesium and of D vitamin in the recovery after the fracture and in the presence of the vasomotor tonus. In this context, the calcium reference intervals can provide with the necessary information about adding or not adding these elements essential to the normal bone development. The serum levels of the magnesium ion represent only 1% of its contents in the body because most of it is stored in bones, muscles and soft tissues (20, 22).

As for the post-traumatic recovery of the fist and of the hand, it is important to find the affected soft parts, respectively the hand tendons that have a special structure and on which depends the stability at this level. In this context, it is recommended to apply kinetic techniques apart from electrical therapy procedures in order to enable the recovery and reintegration of patients in the professional activities (23). A trial conducted from 2003 to 2004 in six European countries monitored the incidence of the household traumatism in a group of over 88,000 children aged 0-18 years. Thus, it was noted that the age group 5-18 years revealed a maximum risk of sprains followed by contusions, wounds and fractures. According to the location, on the first place were identified the traumatism at the level of the upper limbs (55.79%), which represents more than half of the total number (24). According to a trial conducted in 2015 in the Emergency Cases Department in Italy, the most frequent hand traumatism were the phalanx contusions 20.8%, the phalanx fractures 7.9% and the closed radius fractures 5.8%. The occurring tendency of the traumatism recorded 2 peaks: at the age of 12 and in the elderly (25). According to the data received from the Emergency Department of the County Hospital Suceava, from 1 to 17 January 2018, 41 persons aged 5 and 88 needed medical healthcare after having had traumatism because they fell from the same level whereas 19 of them had fractures and contusions in the upper limb.

From the anatomical point of view, the hand has 27 bones distributed in 3 regions: 8 carpal, 5 metacarpal and 14 phalanges. The muscles of the hand are complex and are distributed in 3 regions: the muscles of the thenar eminence, of the hypothenar eminence and of the palmar middle region (26). Chronic dysfunction of the musculoskeletal system or compression of the nerve is a other major cause of disability. Diagnosis of these conditions is a vibrant subject of research, which aims to increase the quality of life, while reducing the costs for healthcare (27,28). The most frequent hand traumatism are sprains, luxations and fractures, tendon ruptures or lesions of the radial and cubital nerves.

The hand traumatism, especially the fractures, may have as causes osteoporosis, age, medication by corticoids, repeated traumatism and physical deficiencies. The sequelae after fractures are: the capsule- ligament adherence, muscular -ligament adherence, the muscular atrophy, the redness in the joints, the decrease of the functional ability.

The treatment of the sequelae after the fracture is complex and involves:

[1] the antalgic and antiinflammatory medication to reduce the algic /inflammatory symptomatology,

[2] the electric therapy (29) has different roles: antialgic/ antiinflammatory, vasodilating, myorelaxing/ relaxing

- the currents of low frequency: TENS, with electrodes applied on the painful spot, the frequency 50-100 Hz, the intensity 10-40mA, the duration of 10 minutes

- The ultrasounds in pulsatile application, with a frequency of 1 MHz, the intensity of 0.4- 0.6W/cm<sup>2</sup> by using the antiinflammatory gel (30,31).

The application of ultrasound is useful in the pathology of the soft tissues but also in the joint one whereas the mechanical and thermal effects are deeply felt and provide with the blood flow necessary to the recovery process (21,32).

The ultrasound have their role in reducing the pain, the joint stiffness and the muscular contraction. After the application of the ultrasound, the number of red blood cells is reduced, the coagulation process is influenced, and variations of the serum calcium are recorded (32). For an adequate treatment, it is important to establish correctly the values of these blood elements. (33).

The ultrasound are applied in order to increase the permeability of the cellular membrane, to stimulate the blood circulation, the fibrolysis and the vasodilation, which determine the antalgic, antiinflammatory action. Furthermore, the ultrasound have the role of influencing the periosteal reconstruction (32).

[3] the massage in order to improve the properties of the muscles and to increase the local metabolism by enabling a faster recovery

[4] the hydro-thermo-therapy: the use of the partial bath with warm water of 36-37<sup>0</sup> C for 15-20 minutes or use cryotherapy in case of local inflammation

[5] Kinetic therapy- with its role of increasing the joint mobility, the muscular force, the prehension and the functional coefficient. It is for this purpose that the posturation is used (the antideclive to reduce the oedema and to enable the circulation), manipulations, passive mobilisation, passive-active, active at first and then active with resistance, which is applied for each joint separately on all the physiological movement directions (34, 35).

**The objective** of this trial is the evaluation of parameters (the movement amplitude, the muscular force, the prehension, the functional coefficient, the quality of life) which enable the clinical - functional recovery of patients who had hand traumatism and their social- professional reinsertion.

### **Material and method**

The objectives pursued in the recovery program were:

- to reduce the pain and inflammatory syndrome
- to fight edema
- to increase the joint amplitude
- to keep / increase the muscle strength
- to increase the muscle tone
- to increase the quality of life

The study was conducted for a period of 6 months in the ambulatory and included 20 patients diagnosed with post-fracture sequelae at the distal radius level.

The evaluation of the patients was made at the beginning and at the end of the treatment, as well as at the examination 6 weeks after the end of the treatment. The data processing involved the use of quantitative variables (age, sex, living environment) but also qualitative (pain, joint amplitude, functional coefficient of mobility, muscle strength, quality of

life).For this purpose, the VAS scale (Visual Analogue Scale) was used to assess the pain (value 0 means lack of pain, value 10 represents maximum pain), joint balance sheet to assess the joint mobility (it was performed on all the hand joints, on the physiological directions of movement and the goniometer was used), the functional coefficient Rocher to establish the functionality degree, the dynamometry to quantify the useful muscular force for the prehension, the LEE functional index (the general functional assessment where the rating is 0 if the activity is normal, 1 if the activity is done with difficulty and 2 if the activity is impossible to be done), the QOL scale (Quality of life) to assess the patients' quality of life (psycho-socio-family). During the recovery treatment, pulsatile ultrasonotherapy was applied, also by using anti-inflammatory gel, with a frequency of 1 MHz and a working intensity of 0.6W / cm<sup>2</sup>.

The lymphatic drainage massage was applied to reduce the edema, but also sedative massage for the fingers, fist and forearm area. The massage lasted for 15 minutes and was made from the distal joints to the proximal ones.

The kinesiotherapy program lasted for 15 days and was strictly individualized. The following were performed:

- the passive and active mobilizations of the fingers and fist joints
- active exercises to recover the prehension
- active exercises with resistance
- exercises at the Canadian table - occupational therapy
- emphasis on the recovery of supination

The criteria for including the patients in the study were:

1. diagnosis of the radius / ulna post distal fracture sequelae
2. no chronic decompensated diseases
3. patients who agreed to participate in the study

Exclusion criteria:

- ✓ trauma at another level of the upper limb
- ✓ surgically treated intra-articular fractures
- ✓ bilateral fractures
- ✓ open fractures
- ✓ presence of osteosynthesis elements at the level of the hand or forearm
- ✓ patients with neuro-psycho disorders

✓ patients who did not agree to participate in the study

All the patients received information about the recovery treatment that is to be applied, the methods applied were non-invasive, and the obtained data were used only for this study. The following devices were used: Chattanooga device and equipments from the kinesiotherapy room (balls, elastic bands, Canadian plate, 0.5 kg weights).

### Statistical analysis

The obtained data were recorded and processed by using Microsoft Excel version 2010, by using the median, the standard deviation, the t-student test, in order to compare the obtained results and to verify the work hypothesis. The t- student test helped to evaluate the value of the p-index that can indicate the occurrence of an error related to the work hypothesis whereas the statistically significant value was for p<0.05.

### Results and discussions

The trial group was made of 20 patients, and the distribution according to the age group, sex and life style is found in Table 1.

Table 1. Distribution of patients

age group(years)	women	men	urban	rural
20-35	2	1	1	2
36-50	1	3	2	2
51-70	4	3	5	2
>70	3	3	4	2

It is noticed in the chosen group that the patients are equally represented according to sex, and that there are more patients from the urban places (60%). The greatest occurrence of fractures was recorded in the age group 51-70 years (35%) followed by the age group over 70 years (30 %), the age group 36-50 years (20%) and the age group 20-35 years (15%).

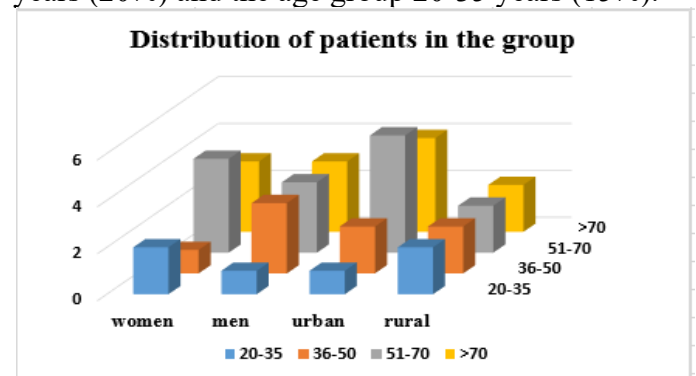


Fig. 1. Distribution of patients in the group



After making the joint balance sheet, it is found the favorable evolution in the recovery on all the mobilisation directions, but also the functional coefficient, in all the evaluation moments: initial, final and control.

Table 2. Evolution of the joint mobility

joint balance sheet	initial	final	control
flexion	12±1.85	22±2.63	36±3.53
extension	10±1.59	18±2.56	28.5±2.87
radial inclination	9±1.79	16±1.94	18.5±0.81
ulnar inclination	13±1.61	22±1.44	25±1.22
functional coefficient	21±4.69	39±2.69	57±3.12

The graphic representation of the mobility of the patients' fists is presented in Figure 2

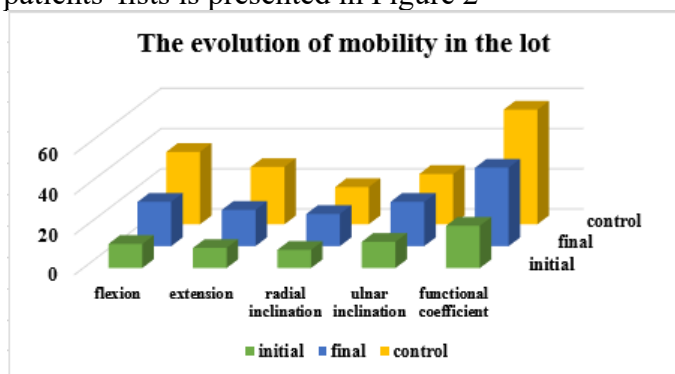


Fig. 2. Evolution of mobility of the fist

When evaluating the muscular force by means of the dynamometer, it was found a favourable evolution, presented in Table 3 and in Figure 3.

Table 3. Evolution of the parameter muscular force

moment	initial	final	control
Dynamometry	15±12.51	25±12.38	34±12.39

The muscular force of the flexor muscles of the hand was evaluated by making 3 repeated measurements and by calculating their average.

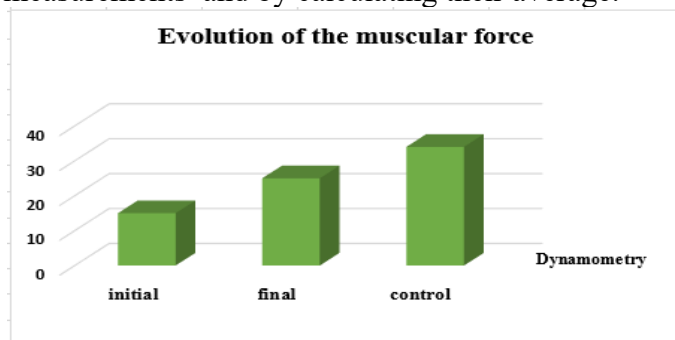


Fig. 3. Evolution of the muscular force

After the completion of the VAS scale for the evaluation of the pain, it resulted that the pain was reduced in the group, and matched the other parameter to evaluate the patients' health condition, respectively the quality of life that was improved.

Table 4. Evolution of VAS scale and QOL scale

Scale	initial	final	control
VAS	8±0.94	6±1.05	3±0.76
QOL	83±6.34	90±5.54	100±4.75

At first the patients had moderate to severe pains that prevented them from doing their daily activities, but, after the recovery program, the pain was decreased and enabled them to do their normal daily activities.

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### Conclusions

By applying the evaluation methods and scales to the 3 moments of assessing the patients, the efficiency of the complex recovery program can be seen. So:

- The pain decreased from the initial to the final moment, the result being statistically significant, with  $p < 0.0138$
- The joint mobility increased on all the movement directions, with statistically significant values, namely:
  1. Flexion  $p < 0.0207$
  2. Extension  $p < 0.0186$
  3. Radial inclination  $p < 0.0052$
  4. Ulnar inclination  $p < 0.0034$
- The functional mobility coefficient registered an increase, with  $p < 0.0134$
- The increase of the muscle strength, assessed in the flexors of the hand, was statistically significant with  $p < 0.0481$
- The increase of the mobility parameters values enable the patients to do their daily activities close to normal, which implies the social independence of the patients
- The applied individualized recovery treatment enabled the increase of the patients' quality of life materialized in the statistically significant value of the index of quality of life with  $p < 0.0379$

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**Informed consent:** *An informed consent was obtained from the patients included in this study.*

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