Original Article

Recovery of the muscle function after stable elbow fractures

STEFANIYA BELOMAZHEVA-DIMITOVA

Faculty of Education, St. Cyril and St. Methodius University of Veliko Tarnovo, BULGARIA

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Abstract

Problem statement

Recovery of the function of the elbow joint after intra-articular fractures is a difficult goal for achievement. The literature review on that topic showed that there is no published physiotherapy method for restoration of muscle function in the elbow joint after intra-articular fractures. This provokes us to apply our own method and to follow its effect on the restoration of the muscular function in the elbow. **Purpose** of the study is to determine the impact of own physiotherapy method on the recovery of muscular function in the elbow joint after stable intra-articular fractures. **Approach** The functional recovery of 30 patients was monitored for a period of three months after the removal of immobilization of the upper limb. During that period of time manual muscle testing and hand dynamometry data were collected. **Results and Conclusions** After removing of the immobilization were observed suppression of muscle function in elbow manifested in weakness and inability to perform active movements. At the end of the experiment were achieved 95.28% of strength of the hand and more than 50% of patients have maximal evaluation of manual muscle testing of flexors, extensors and rotators of elbow joint. During the course of physiotherapy muscle strength were gradually recovered. We did not find a significant difference at the end of the experiment in the analyzed indicators compared to the healthy upper limb. All that results allows us to conclude that careful selection of tools of physiotherapy designed to restore muscle function gives good result and allows early involvement of upper extremity in daily and work activities.

Key words: elbow, fractures, strength, muscle function.

Introduction

The elbow joint represents very important link of the upper extremity. The main function of the elbow is to place the upper limb and arm in a different position in space (Qureshi, F., Stanley, D., 2006). It also allows the upper limb to occupy different lengths and heights when performing various daily, self-care and work activities (Maitland, 1997).

% of all body fractures represents the elbow joint fractures (Ennis et al, 2008). The accurate selection of therapeutic method after elbow fractures is of a key importance for successful recovery. Most of the elbow fractures are minimally dislocated and they require conservative treatment. These elbow fractures which are dislocated and these which are combined with luxation of the elbow joint are prescribed for surgical intervention (Ennis et al, 2008). High congruency of articular surfaces, rich vegetative innervation and intimately connected articular capsule and ligaments make the elbow joint strongly reactive to various traumatic processes (Laakso, 2010; Myden, Hildebrand, 2011). After trauma expansion of the zones of irradiation of the nerve impulses is observed. It results in increasing of reflex response from the muscles surrounding the joint, consisting in higher tonus and spasticity. At the same time muscle strength is reduced to completely inhibited because of pain syndrome and the presence of edema, which is seen immediately after removing the immobilization (Belomazheva-Dimitrova, 2013). Edema, hematoma, muscle imbalance, muscle rigidity and a reflex muscle guard are the main complications after elbow joint fractures and subsequent immobilization. Due to these complications, it is necessary to apply very carefully physiotherapy means. The elbow should be flexible, stable, to have enough strength and to be painless to allow the upper extremity to perform independently daily activities (Da'vila, Johnston-Jones 2006). 5% reduction in the range of movement in the elbow joint leads to 80% reduction in the functionality of the upper limb (Sojberg, J.O., 1996).

The optimization of the recovery of the elbow after stable intra-articular fractures, particularly the recovery of the muscle function provokes us to apply own method of physiotherapy and to monitoring its impact. **The purpose** of the study is to determine the impact of own physiotherapy method on the recovery of muscular function in the elbow joint after stable intracranial fractures.

Materials and Methods

30 patients with stable intra-articular fractures of the elbow joint represent the contingent of the study. They are treated conservatively by means of immobilization with average duration of 24.6 days. During the immobilization

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Corresponding Author: STEFANIYA BELOMAZHEVA-DIMITOVA, E-mail: stefania1@abv.bg

the position of the elbow was neutral for the forearm and 90° flexion for the elbow.

The average age of the monitored patients is 44 years. From them - 53.3% are men and 46.7% are women. The measurement of the studied indicators is conducted for the period of three months. Patients visit physiotherapy office 5 times per week, during working days, at the first month and after that they continued with home physiotherapy program, prescribed by authors, until the end of the third month after the removing of immobilization.

Restrictive conditions

This research does not include patients with complicated or comminuted fracture of the elbow joint and with neurological complications.

Survey methods

Manual dynamometry

This evaluation method was conducted to establish the strength of grip of the hand using standard manual dynamometer for adults. The measure unit of evaluation is kilogram. Results are recorded as a difference between both upper limbs (healthy and affected).

Manual muscle testing of the muscle motors of the elbow joint

Our research was conducted on the muscle flexors, extensors, supinators and pronators of the elbow joint. For testing the flexors and the rotators in the joint was used starting position lying on back with upper limb near to the body. For testing the extensors was used starting position lying on face, where the shoulder joint is abducted to 90°, and the forearm is outside the couch. Gravitation is used as a criterion for evaluating the muscle strength. Evaluation in manual muscle testing is graded in 6 grade scale from 0 to 5. We use signs plus (+) and minus (-) which can be added to each evaluation for the purpose of making it more precise.

Physiotherapy methodology

We apply physiotherapy means according to described by N. Popov (2007) periodization of the functional recovery after fractures and immobilization. The author prescribes one more period of the recovery process. That is immediate post-immobilization period which includes first week after the removal of the immobilization and is characterized by specific functional problems and limitations.

Means of Physiotherapy applied during immediate post-immobilization period - first week after the immobilization: controlled passive movements on the physiological axes without pain; careful passive joint traction; passive oscillations at the end of the possible range of motion; manual-mobilization means for the suppression of mechanical pain, direct soft-tissue mobilization; isometric contractions from painless position; controlled active-assisted exercises, free active exercises for unaffected joints;

Means of Physiotherapy applied during early post-immobilization period - until the end of the first month after the immobilization: passive stretching with proximal manual resistance; passive joint game; muscle inhibition techniques (retention – relaxation, isotonic contraction – relaxation, isotonic contraction - relaxation - passive pressure, retention - relaxation - contraction of the antagonist); isometric contraction with submaximal and maximal intensity; joint mobilization during movement; free active movements for the elbow joint; for the unaffected joints: free active exercises, exercises against resistance, exercises against resistance in an open kinematic chain.

Means of Physiotherapy applied during late post-immobilization period – until the end of the third month after the immobilization: treatment with a position for stretching the ligaments and joint capsule; autostretching – by standing in an end position from the range of movement to the direction of extension, flexion or pronation, supination, an additional pressure of less weight or that of the healthy upper limb is given within the range of comfort area; active exercises on the physiological axes, exercises against resistance; exercises in closed kinematic chain.

During that period patients perform the prescribed exercises in their home after achieving painless range of motion and precision in performing each exercise.

Results and Discussion

Analysis of the results from the manual muscle testing of extensors and flexors

results from the manual muscle testing of extensors and flexors in the elbow joint, at the beginning and at the end of the experiment can be seen on figure 1 and figure 2. The initial results from the manual muscle testing show moderate muscle weakness in both groups of muscles which is explained by the presence of post-traumatic edema and pain that inhibited muscle activity.

Figure 1 shows that in the beginning grade “3” prevails – 56.7% of the patients, on second place, according to the frequency, is grade „3-” – 26.6% and on third place – grade „3+” – 16.7% of the patients. At the end of the experiment we register grades „4+” in 13.3% of the patients, „5-” in the largest number of patients – 56.7% and grade „5” in 30% of the cases which proves the good effectiveness of the applied means of physiotherapy with regard to muscle strength recovery.

Figure 1. Comparison of manual muscle testing of extensors in elbow joint at the beginning and at the end of the experiment

Figure 2 shows that grade “3” prevails at the beginning – in 50% of the examined persons, on second place, according to the frequency, is grade „3-” – in 30% of the examined patients and grade „3+” – in 20% of the patients.

At the end of the experiment was found that with regard to the evaluation from the manual muscle testing of the flexors in the elbow joint, there are grades „4+” in 6.8% of the patients, „5-” in 43.2% and grade „5” in the largest number of patients – 50 % of the cases, which proves the good effectiveness of the applied means of physiotherapy (figure 2).

Figure 2. Comparison of manual muscle testing of flexors in elbow joint at the beginning and at the end of the experiment

Analysis of the results from the manual muscle testing of rotators

Figures 3 and 4 illustrates the results from the manual muscle testing of the rotators in the elbow joint, which shows the existence of moderate muscle weakness in the beginning of the experiment.

Figure 3. Comparison of manual muscle testing of supinators in elbow joint at the beginning and at the end of the experiment

The manual muscle testing of the supinators immediately after removing of the immobilization shows that grade “3” prevails in 66.7 % of the patients, on the second place, according to the frequency, is grade „3-” – 30% of the patients and on the third place - grade „3+” – 3.3% of the cases, shown by the results (figure 3).

At the end of the applying physiotherapy was registered „4+” grades in 6.7% of the monitored patients, „4+” in 40% and grade “5-” in the largest number of patients – 53.3%. The last result approximates to the result of the

healthy upper limb which proves that the applied methods take good effect with regard to the recovery of the muscle strength of the supinators.

Examination with manual muscle testing of pronators shows that at the beginning grade “3” prevails – 73.3% of the cases, on the second place, according to the frequency, is grade „3-” – in 26.7% of the patients (figure 4).

At the end of the experiment was registered grades „4” in 6.7% of the patients, „4+” in 43.3 % and grade “5-” in the largest number of patients – 50% of the cases (figure 4). The last grade is quite similar to the grade of muscle strength of the pronators of healthy upper limb.

Figure 4. Comparison of manual muscle testing of pronators in the elbow joint at the beginning and at the end of the experiment

Analysis of the results from the examination with manual dynamometry

The variation analysis of the results from manual dynamometry is presented at table 1.

The dispersion of the indicator in the initial study is acceptable and the coefficients of As and Ex shows that there is normal distribution of the indication.

Table 1. Variation analysis of the results from the manual dynamometry (represented as deficiency in the muscle strength of grip on the affected to the unaffected upper limb)

Testing	n	Min	Max	R	$\bar{x}$	S	V%	As	Ex
Initial	30	14	22	8	18.5	2.13	4.81	-0.88	1.04
1 st week		12	18	6	14.7	1.59	2.52	-0.68	-0.80
2 nd week		8	13	5	10.7	1.48	2.21	-0.45	-0.68
1 st month		2	8	6	5.73	1.36	1.85	-0.88	-0.99
3 rd month		0	4	4	1.8	1.18	1.4	-0.24	-0.52

In the initial study of the patients, carried out after removing of the immobilization, can observed a serious deficit in the strength of the grip (table 2). The average value of the deficit in the strength of the grip between affected and unaffected upper limb is 18.5 kilograms. This large deficit is due to long inactivity of the muscles and the ensuing hypotrophy and due to the presence of pain and edema, which inhibit muscle activity.

Table 2. Statistical reliability of the differences in the results from the manual dynamometry between each subsequent study

	$\bar{x}$	S		$\bar{x}$	S		$\bar{x}$	S		$\bar{x}$	S
Initial testing	18.5	2.13	1 st week	14.7	1.59	2 nd week	10.7	1.48	1 st month	5.73	1.36
1 st week	14.7	1.59	2 nd week	10.7	1.48	1 st month	5.73	1.36	3 rd month	1.8	1.18
d	3.8	-	d	4	-	d	4.97	-	d	3.93	-
t	3.26	-	t	3.54	-	t	3.36	-	t	6.13	-
Pt	99.8%	-	Pt	99.9%	-	Pt	99.9%	-	Pt	99.9%	-

Table 2 shows that in any subsequent study was found statistically important differences in the average level of the results from the manual dynamometry which proves that the registered changes are result of the purposeful application of physiotherapy.

At figure 5 can be seen the confirmation of the effectiveness of the applied means of physiotherapy for the recovery of the muscle activity through inhibition of the pain symptoms occurring during motion. Muscle weakness registered immediately after removing of the immobilization is huge. It decreases gradually during the recovery process. The examined indicator recovers successfully as clear differences are observed after the second week of the functional recovery.

Figure 5. Average values of the manual dynamometry results

Figure 6 illustrates the difference in percentage in comparison with the strength of the grip of the healthy upper limb, examined at the end of the third month of the functional recovery. It is noticed that 95.28% of the strength of the grip of the healthy limb are recovered in the affected upper limb.

Figure 6. Percentage comparison of the strength of the grip between healthy and affected upper limb in the end of the experiment

Conclusions

The muscle weakness observed in active motions immediately after removing of the immobilization as a treatment method for stable elbow fractures is considerable. The statistical data from the study via manual muscle testing and manual dynamometry give us the reason to claim that the applied experimental method of physiotherapy have good effectiveness regarding the recovery of muscle function in elbow joint after conservatively treated stable fractures. The focus on techniques, aiming suppressing of the painful movement and efforts to regulate muscle tonus in the experimental physiotherapy method, allows the inclusion of means for recovery of the muscle strength earlier, which speeds up the recovery process after stable elbow fractures. Results achieved at the end of the study allow complete inclusion of the affected upper limb in daily, self-care and work activities.

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