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*ORIGINAL STUDY*

# (Un)importance of physical therapy in treatment of displaced supracondylar humerus fractures in children

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**Elbow joint stiffness is a common complication following supracondylar humerus fractures. In prospective study, dynamics of establishing a full range of motion in the elbow joint following the treatment of supracondylar humerus fractures were assessed, together with the effects of physical therapy on improvement in the range of motion.**

**Two groups of patients were observed. Physical therapy was administered to the first group, comprised of 25 patients. The second group, comprised of 28 patients, underwent no physical therapy.**

**In the first few months following treatment, the range of motion was significantly greater in the patients who had undergone physical therapy, but after 12 months, the range of motion was almost equal in the two groups.**

**This study has shown that it takes about 12 months to establish a full range of motion after the injury, and that it is not necessary to apply physical therapy in patients with elbow fractures.**

**Keywords** : elbow fracture ; children ; joint stiffnes ; flexion ; extension ; physical therapy.

## INTRODUCTION

The extension type of supracondylar fracture is the second most frequent type of fractures in children, representing approximately 16.6% of fractures in this population (*6,9,13*). They are most commonly seen in the age group under seven years (*9*). One of the common complications of the supracondylar humerus fracture is a decrease in the range of motion (ROM). Full range of motion is usually restored with time. In most cases, this limited movement range is most prominent after removal of the cast immobilization. The available literature data on the time to establishment of full range of motion following cast removal in supracondylar humerus fractures vary, as do the data on the effects of physical therapy on range of motion recovery.

Some authors have noted rapid recovery of elbow motion after closed reduction and percutaneous pinning. Shrader stated it is the rare child who does not have full range of motion 6 to 8 weeks after immobilization (*11*). Numerous authors expected return of motion 1 month after pin removal (*10,13*).

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Conversely, many authors pointed out that achieving maximum elbow motion after such injuries took 12 months or more and there was considerable individual variation among patients in this regard (*2,4*).

In addition, views on the necessity of physical therapy following orthopedic treatment of supracondylar humerus fracture also vary. Even though many authors note that there are no indications for physical therapy after supracondylar fracture treatment, certain orthopedic surgeons still prescribe physical therapy to these patients (*1,3,8*). Our aim was to estimate and define the time period, following a supracondylar humerus fracture, by which an improvement in range of motion can be expected and after which the final results of treatment could be adequately assessed ; our second objective was to establish whether physical therapy affects final results of treatment of these fractures in children.

## MATERIALS AND METHODS

The prospective randomized study encompassed 53 patients were treated uniformly by 3 pediatric orthopedic surgeons for supracondylar humerus fractures type II and type III in period from January 2010 to June 2013. All patients were treated by closed reduction and percutaneous pinning using Kirschner wires in a crossed configuration. The treated patients were classified in 2 groups : Group 1 comprised 25 patients who underwent physical therapy, while Group 2 comprised 28 patients, who underwent no physical therapy. Collected data included age, gender, side of injury and fracture type (degree of dislocation).

The physical therapy started after removed cast and wires (3-4 weeks after fracture). The physical therapy was prescribed by a physiatrist and was administered three times a week for 30 minutes**,** in a period of 6 to 8 weeks. Different types of physical therapy were used in this period. In addition to kinesitherapeutic procedures, other forms of physical therapy were also applied (thermotherapy, interferential current, diadynamic current, laser, hydrotherapy, magnet, transcutaneous electrical neural stimulation (TENS)). In addition, parents were trained and instructed to administer exercises at home, three times a day. The exercises mostly comprised passive and active extension of soft tissues of the elbow joint.

Patients who were treated solely by closed or open repositioning, those who had open humerus fractures and those with neurological lesion were not included in the study.

The parameters assessed were : the flexion, extension and range of motion (ROM) of the fractured elbow as well as that of the normal, contralateral elbow, as measured by plastic goniometer with minimal detectable change of 1 degree. Range of motion is the sum of the flexion and extension movements of the assessed elbow. Measurements of these parameters were performed at each visit, beginning at the time of cast removal, then at 8, 24 and 50 weeks.

Descriptive statistics and statistical hypotheses testing methods were used for the analysis of primary data. Independently from the physician, patients were randomized postoperatively using random number generator in "R" software environment. According to this randomization method, only even numbers were treated by physical therapy. Of the descriptive statistics, central tendency measures (mean, median), variability measures (standard deviation) and relative numbers (structural indicators) were used. The following statistical hypotheses testing methods were also used : t-test for two independent samples, Mixed between-within subject ANOVA and chi-squared test. Statistical analyses were performed using SPSS for Windows, version 22. In all analyses, the significance level was set at 0.05.

## RESULTS

Patients' demographic data are shown in Table I. Of 53 treated patients, 36 were boys and 17 girls with a mean age of 6.5 years (1.5 to 13 years). There was no statistically significant difference between the groups regarding age, gender, left/right side and fracture type of the injured arm. Negative effects of physical therapy were not occurred during this study.

### Flexion

Mean percent flexion of the injured arm in comparison to the uninjured arm, at different time points, in both groups is presented in Table II. There is a statistically significant increase in the percentage of injured arm flexion in comparison to the healthy arm in the observed time ($p < 0.001$). Overall, in the observed period, there was a statistically significant difference between the patients in the group that underwent physical therapy and the

Table I. — Demographic Characteristics and Type of fracture

| | Group 1 | Group 2 | p-value |
|---|---|---|---|
| Age (years) ± SD | 6.7 ± 2.1 | 6.7 ± 1.9 | 0.959 |
| Gender, n (%) | | | 0.243 |
| Male | 15 (60.0%) | 21 (75.0%) | |
| Female | 10 (40.0%) | 7 (25.0%) | |
| Side of the injury, n (%) | | | 0.132 |
| Left | 10 (40.0%) | 17 (60.7%) | |
| Right | 15 (60.0%) | 11 (39.3%) | |
| Fracture type, n (%) | | | 0.569 |
| Type II | 10 (45.5%) | 15 (53.6%) | |
| Type III | 12 (54.4%) | 13 (46.4%) | |

Table II. — Flexion (percentage in comparison to the uninjured arm)

| Flexion, percentage of mobility of the uninjured arm ± SD | Group 1 | Group 2 | p-value |
|---|---|---|---|
| At cast removal | 80.2 ± 1.3 | 79.5 ± 0.9 | < 0.001 |
| After 8 weeks | 89.6 ± 2.3 | 87.8 ± 2.1 | |
| After 24 weeks | 94.8 ± 0.6 | 93.9 ± 1.3 | |
| After 50 weeks | 97.5 ± 0.8 | 97.1 ± 0.9 | |

group that did not, in the percentage of flexion of the injured arm, compared to the uninjured arm ($p < 0.001$). This difference is significant at 8 weeks ($p = 0.020$) and at 24 weeks ($p = 0.008$). At the time of cast removal and 50 weeks following the cast removal there is no statistically significant difference in the percent of flexion of the injured arm, compared to the uninjured arm, between the patients who did and those who did not undergo physical therapy ($p = 0.096$ and $p = 0.368$, respectively) (Fig. 1). There was no statistically significant interaction (correlation) between the administration of the physical therapy and the change in percentage of the flexion of the injured arm, compared to the uninjured arm, with time ($p = 0.084$).

## Extension

There is a statistically significant increase in the percentage of injured arm extension in comparison to the healthy arm in the observed time ($p < 0.001$) (Table III). Overall, in the observed period, there was a statistically significant difference between the patients in the group that underwent physical therapy and the group that did not, in the percentage of extension of the injured arm, compared to the uninjured arm ($p = 0.015$) (Fig. 2).

This difference is significant at 8 weeks ($p < 0.001$) and 50 weeks ($p < 0.001$) following the removal of the cast, but not statistically significant immediately after the removal of the cast ($p = 1.000$) as well as 24 weeks after cast removal ($p = 0.592$). These differences are not clinically significant, because they are a consequence of a smaller range of motion in extension, which allows the small difference between the two groups to gain statistical significance.

There was a statistically significant interaction (correlation) between the use of physical therapy, or the lack thereof, in rehabilitation and the change in extension values for the injured arm, compared to the uninjured arm, with time ($p < 0.001$). The percentage of injured arm extension increased faster in those patients who underwent physical therapy, which is probably the consequence of greater differences in extension between the individuals.

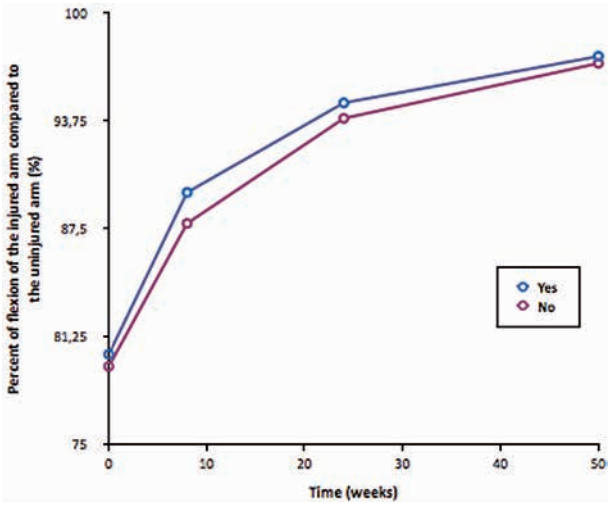


*Fig. 1.* — Flexion of the injured arm compared to the uninjured arm (with and without physical therapy).

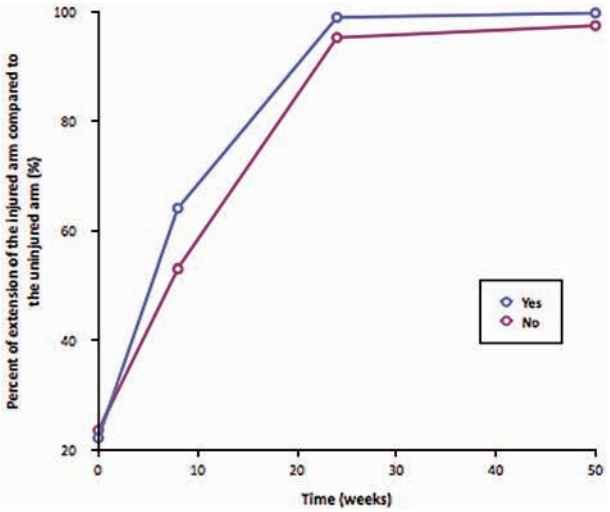


*Fig. 2.* — Extension of the injured arm compared to the uninjured arm (with and without physical therapy).

Table III. — Extension (percentage in comparison to the uninjured arm)

| Extension, percentage of mobility of the uninjured arm ± SD | Group 1 | Group 2 | p-value |
|---|---|---|---|
| At cast removal | 22.2 ± 7.8 | 23.6 ± 12.2 | < 0.001 |
| After 8 weeks | 64.1 ± 5.9 | 53.1 ± 6.6 | |
| After 24 weeks | 98.9 ± 2.3 | 95.3 ± 12.2 | |
| After 50 weeks | 99.8 ± 0.9 | 97.5 ± 2.5 | |

## Range of Motion

The mean range of motion, in patients who underwent physical therapy (Group 1) was 84.0 ± 6.8 at the time of cast removal. This arc of motion reached 116.2 ± 7.6 by Week 8. By Weeks 24 and 50, the mean arc of motion was 137.6 ± 8.1 and 141.7 ± 8.4. The mean range of motion in patients who did not undergo physical therapy (Group B), at the time of cast removal, was 82.4 ± 9.1. This arc of motion reached 109.0 ± 7.2 by Week 8. By weeks 24, and 50, the mean arc of motion was 135.3 ± 7.8 and 141.5 ± 9.0.

There was a statistically significant increase in range of motion of the injured arm in the observed time ($p < 0.001$) (Table IV). Overall, in the observed period, there was no statistically significant difference in the range of motion in the injured arm between those patients who did and those who did not have physical therapy as part of their rehabilitation ($p = 0.173$) (Fig. 3). There was a statistically significant interaction (correlation) between the inclusion of physical therapy in rehabilitation, or lack thereof, and the change in the range of motion of the injured arm with time ($p < 0.001$). The range of motion in the injured arm increased faster in those patients who did undergo physical therapy.

## DISCUSSION

Supracondylar humerus fractures are second most frequent fractures in childhood. Closed reduction with percutaneous pinning has become the method of choice in the treatment for almost all types of supracondylar humerus fractures. With the advantages of decreased duration of hospital stay, stable fixation and early mobilization, this method results in a satisfactory functional and cosmetic outcome. Postoperative evaluations include assessing functional and cosmetic results. One of the ways of

Table IV. — Range of motion

| Arc of motion of the injured arm ± SD | Group 1 | Group 2 | p-value |
|---|---|---|---|
| At cast removal | 84.0 ± 6.8 | 82.4 ± 9.1 | < 0.001 |
| After 8 weeks | 116.2 ± 7.6 | 109.0 ± 7.2 | |
| After 24 weeks | 137.6 ± 8.1 | 135.3 ± 7.8 | |
| After 50 weeks | 141.7 ± 8.4 | 141.5 ± 9.0 | |

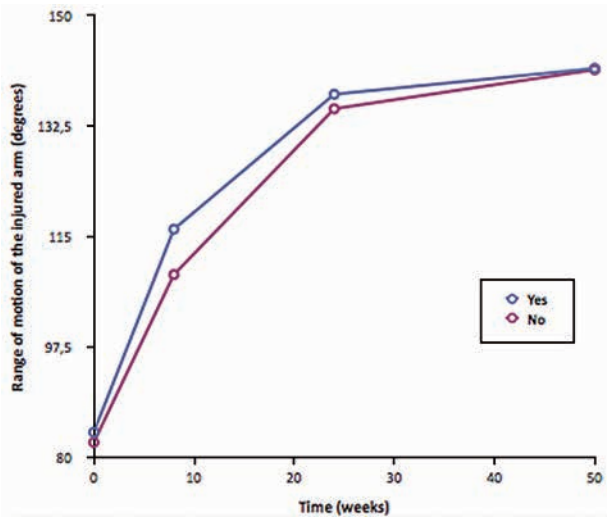


***Fig. 3.*** — Range of motion of the injured arm

assessing functional results of treatment is to compare the range of motion of the treated elbow to that in the untreated elbow.

Many authors have reported the results of treatment of supracondylar humerus fractures, but without precise reporting on the time of the assessment in relation to the time of the injury. All authors agree that there is a certain limitation in movement after removal of the cast immobilization. Very few authors have reported on the dynamics of reestablishing the range of motion in the treated elbow (*7, 12,14,15*). A small number of orthopedic surgeons still recommend physical therapy after cast removal in cases of supracondylar humerus fractures (*1,3,8*). Conversely, many authors emphasize that physical therapy is not necessary following the treatment of supracondylar humerus fractures (*7*). Certain authors only advise the inclusion of physical therapy in those cases in which there is a pronounced stiffness in the elbow and in which, after a certain period of time, the range of motion is not satisfactory (*13*).

In his study, Keppler observed the effects of physical therapy on restoring the arc of motion following supracondylar humerus fractures (*7*). He included 51 patients that were treated by open reduction only. After 12-13 weeks from the injury, the limitation in the arc of motion, when compared to the uninjured arm, was 35 degrees in those patients who did not undergo physical therapy and 20 degrees in those who did. After 18-19 weeks, this limitation was 20 degrees in patients who did not undergo physical therapy and 9 degrees in those who did, while a year after the injury there was no difference in the arc of motion between those who did and those who did not undergo physical therapy. The authors concluded that physical therapy accelerates the recovery of a complete arc of motion in the first 20 weeks following injury, but 12 months after the injury the established arc of motion is the same in both groups of patients, so there is no need to prescribe physical therapy after the removal of cast immobilization in supracondylar humerus fractures.

The study by Ziontis, regarding 63 cases of supracondylar humeral fractures, reports that 86% of elbow motion is restored 12 weeks following the injury, while 26 weeks following the injury this increases to 94%, after which there is a slow improvement in the range of motion until week 50, without physical therapy (*15*).

In his study of 45 patients that sustained supracondylar humeral fracture, Wang concludes that it takes 5 weeks after cast removal to recover 94% of the range of motion in patients treated without physical therapy (*14*).

In his study encompassing 373 patients, Spencer determined that nine weeks following cast removal, 85% of the elbow motion was restored in patients treated by percutaneous fixation, as compared to

92% in patients treated by cast immobilization alone and by closed reduction and cast immobilization ; at 24 weeks, patients treated by percutaneous fixation recovered 94% of elbow motion while those treated by cast immobilization and closed reduction recovered 98% (*12*). In this study, the authors noted that an initial rapid recovery in elbow motion could be expected after a supracondylar humeral fracture in a child, followed by a progressive improvement for up to one year after the injury. This motion recovery was slower in older patients and in those with more severe injuries.

In our prospective study, we followed two groups of patients treated by percutaneous fixation of supracondylar humerus fractures for 12 months following the injury. In patients who underwent physical therapy following cast removal, there was a significantly greater recovery of motion at 8 weeks compared to the group that did not undergo physical therapy. At 24 weeks, the range of motion in those undergoing physical therapy was still better. In both groups of patients, significant recovery of motion is observed until week 24. After that, there is a tendency of slow improvement of elbow motion until week 50. Compared to the observations made by Ziontis, in our patients, the range of motion recovered somewhat slower after 8 weeks, but at 24 and 52 weeks it was similar to the range observed in the patients studied by Ziontis. Compared to the initial recovery of elbow motion in our patients, in Wang's study 94% of the arc of motion was recovered significantly faster. One explanation could be the decreased severity of the fractures : 15 patients in the Wang study (33%) had type I fractures on the Gartland classification (*5*), which were treated only by cast immobilization. Hypothetically, we could explain the slower recovery of motion in our patients by an increased severity of the fracture, as well as by any additional injuries in the soft tissues of the elbow arising from the placement of wires.

In our patients, 12 months from the day of injury there was no difference in the range of motion between the group of patients that underwent physical therapy and the other group, which did not. Keppler's study reached similar results, with the authors concluding that physical therapy accelerates the recovery of a complete arc of motion in the first 20 weeks following injury, but 12 months after the injury the established arc of motion is the same in both groups of patients.

Based on these parameters, it can be concluded that physical therapy is not necessary in patients treated for supracondylar humerus fractures. In addition, it was observed that complete elbow motion recovery took 12 months and that functional results of treatment of supracondylar humerus fractures should not be assessed before 12 months have elapsed from the day of surgery.

Lessons learned from this study include the assessments of physiological restoration of movement, including the time points in which the results of supracondylar humerus fracture treatment should be assessed. Furthermore, this study shows that it takes time to recover a full range of motion and that pediatric orthopedic surgeons and physiatrists should be advised that intensive physical therapy is not necessary following supracondylar humerus fractures, while the concerned parents should be advised on the time it takes until full motion recovery. In addition, it would be quite significant to determine the parameters that would help identify the severity of motion limitation in which other modes of treatment should be considered, whether surgical or physiatric.

One shortcoming of this study lies in the fact that the range of motion was only assessed in patients treated by closed reduction and percutaneous pinning. This included a small number of patients, so it was impossible to assess the effects of age on the restoration of motion, as well as fracture severity.

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