Journal of Hand Therapy xxx (2017) 1–8

Contents lists available at ScienceDirect

Journal of Hand Therapy

journal homepage: www.jhandtherapy.org

Scientific/Clinical Article

Postoperative treatment of metacarpal fractures—Classical physical therapy compared with a home exercise program

Joachim Gülke MD [a,*], Barbara Leopold PT [b], Daniel Grözinger MD [a], Björn Drews MD [a], Stephan Paschke MD [c], Nikolaus J. Wachter MD [d]

[a] Klinik für Unfall-, Hand-, Plastische und Wiederherstellungschirurgie, Universitätsklinik Ulm, Ulm, Germany
[b] Ulmkolleg, Lehr- und Weiterbildungsinstitute für Physiotherapie, Massage und Podologie, GmbH & Co. KG, Ulm, Germany
[c] Klinik für Allgemein- und Viszeralchirurgie, Universitätsklinik Ulm, Ulm, Germany
[d] Klinik für Hand-, Plastische und Mikrochirurgie, Klinikum Stuttgart, Stuttgart, Germany

ARTICLE INFO

Article history:
Received 25 April 2016
Received in revised form
18 January 2017
Accepted 6 February 2017
Available online xxx

Keywords:
Hand
Home exercise program
Mediocarpal fracture
Physical therapy
Postoperative treatment

ABSTRACT

Study Design: Prospective cohort randomized controlled trial.
Purpose of the Study: Is either a home exercise (HE) program or traditional physical therapy (PT) more effective in the postoperative management of metacarpal fractures?
Methods: Sixty patients suffering from nonthumb metacarpal fractures who received mobilization-stable open reduction and internal fixation were included. All patients were prospectively randomized into either the PT group or the HE group. Follow-up examinations at 2, 6 and 12 weeks postoperatively.
Results: After 2 weeks, the range of motion (ROM) in both groups was still severely reduced. Twelve weeks after surgery the ROM improved to 245° (PT) and 256° (HE). Grip strength after 6 weeks was 68% (PT) and 71% (HE) when compared to the non-injured hand, improving to 91% (PT) and 93% (HE) after 12 weeks.
Conclusion: Study results show that both HE program and traditional PT are effective in the postoperative management of metacarpal fractures.
Level of Evidence: II.

Introduction

Hand fractures are very common,[1] with metacarpals making up one third of those fractures.[2] Mainly young adults suffer from metacarpal fractures, and the subsequent incapacity to work has a socioeconomic relevance. Considering this fact, there is a strong interest in quick rehabilitation of hand function after surgical treatment of these injuries.

When looking at displaced shaft fractures, research has focused on the different methods of fracture fixation over the last years. It became evident that the surgical method had no relevant influence on the functional outcome or patient satisfaction.[3-5] It is crucial although that fracture fixation provides stable conditions to allow early functional treatment to prevent scar tissue adhesions and limited movement.[6,7] Postoperative treatment in Germany is usually performed by a physical therapist, although instructing the patient to autonomously exercise is becoming more and more important. At this time, there are no suggestions from professional organizations concerning form, intensity, and duration of postoperative treatment. A well-trained physical therapist is of great importance during the postoperative treatment regimen. Advantages might be seen on different levels, if a home exercise (HE) program was made available to the therapist and patient. An easier explanation of exercises would save time. Larger intervals in between sessions could also be convenient for patients and overloaded therapists. This would lead to a decrease in costs without trade-offs in patient outcome.

One big challenge the German health system faces is the fact that postoperatively most patients are supervised by less-specialized general practitioners instead of specialized hand surgeons. In many cases, these patients are also treated by therapists without specialized hand training.

Purpose of the study

With this in mind, it can be advantageous if patients could receive a professional HE program to support them and their therapists. We want to assess the potential benefit of such a

* Corresponding author. Universitätsklinik Ulm, Hand and Plastic Surgery, Albert-Einstein Allee 23, 89081 Ulm, Germany. Tel.: +4973150054576.
E-mail address: joachim.guelke@uniklinik-ulm.de (J. Gülke).

0894-1130/$ – see front matter © 2017 Hanley & Belfus, an imprint of Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jht.2017.02.005

program with the next study. Therefore, we want to compare 2 different postoperative regimens. Our hypothesis is that the conventionally prescribed physical therapy (PT) is superior to an HE program where patients themselves are responsible for the execution of the exercises.

Methods

The study was approved by the University Ethics Committee (no. 254/10), and written consent was given by each patient. The patients were divided into 2 different postoperative treatment groups using standardized controlled block randomization. Randomization list was created by a computer program (http://sealedenvelope.com/). Our trial design did not allow for blinding. Strict inclusion and exclusion criteria were chosen to ensure comparability between the 2 groups. Included were patients who suffered an isolated diaphyseal or metaphyseal second to fifth metacarpal fracture (Table 1). The fracture either led to a rotational error, a shortening of at least 5 mm, or volar dislocation higher than 10° (index and middle fingers) or higher than 30° (ring and small fingers). Surgical treatment with screws or plates provided mobilization stability. Intramedullary nailing was not included. Because of our strict inclusion criteria, sample size was small and sample size calculation was not performed. In preparation of this study, a total case number of 60 patients was deemed feasible when looking at the caseload of patients over the previous years. All surgeries took place between 2009 and 2014. Exclusion criteria were younger than 18 or older than 60 years, joint fractures, comminuted fractures, functionally relevant accompanying injuries (ie, tendon injuries), previously sustained damage to the hand, complications (ie, wound infection, implant failure, complex regional pain syndrome), psychological illness, lacking cognitive abilities, or lacking compliance.

All patients wore a functional dorsal orthotic device for 2 weeks postoperatively that was custom made of Light Cast (Lohmann & Rauscher, Germany) and fixated using an elastic wrap (Hartmann, Germany) (Fig. 1). Metacarpophalangeal joints (MCPJs) were flexed at 70°, and proximal interphalangeal joint (PIJ) and distal interphalangeal joint (DIJ) were allowed to move freely. After 2 weeks, the sutures and orthotic device were removed.

Types of postoperative treatment

Patients in both groups were followed up by a hand surgeon at 2-week intervals over the first 3 months postoperatively.

Group 1 represented the PT group. Two weeks after surgery, all patients received 12 units of PT consisting of 30 minutes each over the course of 6 weeks (postoperative week 3-8). Neither the patients' choice of therapist nor the performed training exercises were controlled for in the study. As is customary, the therapists were instructed to teach exercises to the patients that they can autonomously perform at home. Compliance was verified through the notes of the PT on the prescription and by asking the patients themselves. To recreate an everyday routine setting, no further influence was taken.

Patients in the HE group also began exercising after 2 weeks postoperatively for a period of 6 weeks. They were given a booklet containing individual exercises, a written manual, and pictures (Table 2). The exercise booklet was designed by hand surgeons and physical therapists who specialized in treating hand injuries and training other therapists. After reading the booklet, all patients' questions concerning the exercises were answered by a hand surgeon. Patients were advised to discontinue exercises if their pain was excessive. The booklet also contained information about repetitions, intensity, periods of rest, and provided a checklist to sign off the performed exercises. A weekly diary to write down anything noteworthy was included. The exercises were supposed to be performed over a period of 6 weeks. Each day consisted of 3 exercise cycles (morning, midday, and evening) with each cycle containing 4-6 exercises and lasting 20-30 minutes. The exercises began to modify after the first week addressing the different states of scar tissue formation and fracture healing. During the first 2 weeks, focus was placed on minimizing restrictive scar tissue formation, reducing soft tissue edema, and increasing active and passive mobilization exercises. In weeks 3 and 4, dexterity exercises were introduced. These exercises did not involve resistance but required a higher level of muscular activity, especially in the intrinsic muscles. During the final 2 weeks, exercises were carried out against moderate resistance to build up muscle strength. Meanwhile, the exercises to prevent scarring were continued throughout the whole 6 weeks.

After reaching postoperative week 8, both patient groups continued to work on their individual limitations independently. Those limitations (scar management, decreased range of motion [ROM], or strength) were assessed by a hand surgeon. The next exercises did not necessarily end after the 12-week follow-up but after full ROM or patient satisfaction was achieved.

Follow-up

This study was not blinded because all examinations and measurements were performed by the authors. During the follow-ups, general patient data and secondary diagnoses relevant to the healing process (nicotine abuse and diabetes) were recorded.

Routinely, the metacarpals were X-rayed with standard views (anterioposterior and oblique) directly postoperatively and after 6 weeks. The fractures were divided into proximal and distal

Table 1
Location, type, and kind of osteosynthesis of the metacarpal fractures

Location	Type	PT group				HE group			
		Treatment				Treatment			
		Subtotal	POS	SOS	Total	Subtotal	POS	SOS	Total
Distal metaphysic	Transverse	2	2	0	8	1	1	0	6
	Oblique	4	3	1		3	3	0	
	Spiral	2	1	1		2	0	2	
Epiphysis	Transverse	5	5	0	16	6	6	0	18
	Oblique	6	5	1		9	6	3	
	Spiral	5	3	2		3	1	2	
Proximal metaphysis	Transverse	1	1	0	6	0	0	0	6
	Oblique	4	4	0		3	3	0	
	Spiral	1	1	0		3	2	1	

PT = physical therapy; HE = home exercise; POS = plate osteosynthesis; SOS = screw osteosynthesis.