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Effects of Early Period Physical Therapy and Ergotherapy Applications on Daily Activity Levels After Open Reduction and Internal Fixation in Metacarpal Fractures

Metakarp Kırıklarında Açık Redüksiyon ve İnternal Fiksasyon Sonrası Erken Dönem Başlanan Fizik Tedavi ve Ergoterapi Uygulamalarının Günlük Aktivite Düzeylerine Etkilerinin İncelenmesi

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ABSTRACT

Objectives: Metacarpal fractures are one of the most common fractures. The primary goal in the post-operative rehabilitation of surgically treated metacarpal fractures is to bring the locomotor function of the relevant region closer to its pre-injury function. The aim of our study was to examine the effects of physical therapy and ergotherapy applications, which are initiated after the early period of plate osteosynthesis in metacarpal fractures, on the activity levels of daily life.

Methods: A post-operative rehabilitation program was started with 20 volunteers who had undergone an operation due to a metacarpal fracture. In the first stage, after pain control was achieved on the same post-operative day, patients were started with finger and wrist range of motion exercises. In the second stage, physical therapy exercises were given. In the third stage, the ergotherapy program was implemented. The Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, Milliken Daily Living Activity, Assessment, and Hand Grip Strength Measurement Test were performed 3 times for each patient in the early post-operative period, after physical therapy, and after ergotherapy.

Results: In the evaluation of the DASH scores which were performed after the operation, after physical therapy, and after ergotherapy, the scores after ergotherapy were found to be statistically significant ($p<0.001$). In addition, when comparing the results of Milliken scoring and Hand Grip Strength Measurement Tests, the scores after ergotherapy were found to be statistically significant ($p<0.001$).

Conclusion: Three weeks of combined physical therapy and ergotherapy for surgically treated metacarpal fractures within 8–16 weeks post-operatively have been shown to have better functional outcomes, better grip strength, and higher efficacy compared to physiotherapy alone.

Keywords: Ergotherapy; metacarpal fractures; physical therapy.

ÖZET

Amaç: Metakarp kırıkları sık görülen kırıklardan biridir. Cerrahi olarak tedavi edilen metakarp kırıklarının postoperatif dönem rehabilitasyonunda primer amaç ilgili bölgenin lökomotor fonksiyonunu, yaralanma öncesi fonksiyonuna en yakın hale getirmektir. Çalışmanın amacı, metakarp kırıklarında plak osteosentez uygulaması sonrası erken dönem başlanan fizik tedavi ve ergoterapi uygulamalarının günlük yaşam aktivite düzeylerine etkilerinin incelenmesidir.

Yöntem: Metakarp kırığı nedeniyle opere edilen 20 gönüllü birey ile postoperatif rehabilitasyon programına başlandı. İlk aşamada postoperatif aynı gün ağrı kontrolü sağlandıktan sonra hastalara parmak açma kapama, el bileği eklem hareket açıklığı egzersizleriyle başlandı. İkinci aşamada fizik tedavi egzersizleri verildi. Üçüncü aşamada ise ergoterapi programı uygulandı. Kol, Omuz ve El Sorunları Anketi, Milliken Günlük Yaşam Aktivite Değerlendirmesi ve El Kavrama Kuvveti Ölçüm Testi postoperatif erken dönem, fizik tedavi uygulaması sonrası ve ergoterapi uygulaması sonrası olmak üzere her hasta için üçer kez yapıldı.

Bulgular: Operasyon sonrası, fizik tedavi sonrası ve ergoterapi sonrası yapılan Kol, Omuz ve El Sorunları Anketi sonuçlarının değerlendirilmesinde ergoterapi sonrası skorlar istatistiksel olarak anlamlı farklı ($p<0,001$) olarak tespit edildi. Çalışmada değerlendirilen Milliken Günlük Yaşam Aktiviteleri Değerlendirmesi ve El Kavrama Kuvveti Ölçüm Testlerinin sonuçlarının karşılaştırılmasında da ergoterapi sonrası skorlar istatistiksel olarak anlamlı farklı ($p<0,001$) olarak saptandı.

Sonuç: Cerrahi olarak tedavi edilen metakarp kırıklarının postoperatif 8 ila 16 haftalık süre içinde üç haftalık fizik tedaviye ergoterapi uygulamalarının eklenmesi daha düşük Kol, Omuz ve El Sorunları Anketi skoru, daha iyi Milliken Günlük Yaşam Aktivitesi skoru ile kavrama kuvvetinde daha yüksek etkinliğe sahiptir.

Anahtar sözcükler: Metakarp kırıkları; ergoterapi; fizik tedavi.

Metacarpal fractures, which make up 40% of all upper extremity fractures, are the most common orthopedic injuries seen in emergency departments.[1] Falling and direct impact are the two most common mechanisms of injury.[2] It is generally considered metacarpal fractures that are more distal and/or ulnar are better tolerated.[3] After spiral and oblique fractures, shortening of the finger is often observed. Shortening of the finger can change the movement balance provided by internal and external forces.[1] In addition, shortening of the metacarpal length over 5 mm, joint stepping over 1 mm, joint surface involvement of more than 25%, and multiple metacarpal fractures that cause stabilization problems are among the indications for surgical interventions.[4] Percutaneous Kirschner (K) wire fixation, internal fixation with plate-screw, or mini external fixator applications can be used in the surgical treatment of metacarpal fractures. Proximal metacarpophalangeal joint stiffness, extensor loss, and decreased grip strength are the most common complications after surgical treatments.

The management of the process after the surgery, which aims to provide full functional recovery, is as important as a good surgery. Patients are often guided to physical therapy after upper extremity injuries to manage the pain and improve the range of motion, regaining grip strength and its full functionality.[5-7] While physical therapy methods aim to restore joint mobility and functional recovery in the functionally impaired extremity, and ergotherapy primarily aims to increase the individual's ability to perform daily life activities and improve functional performance.[8-10]

The main goal of rehabilitation of metacarpal fractures is to bring the locomotor function of the relevant region closer to the pre-injury function. The physical therapy and ergotherapy methods, which are the main components of rehabilitation, are extremely important for high satisfaction and great results. In our study, we aimed to investigate the effects of early physical therapy and occupational therapy interventions on daily life activity levels in patients with metacarpal fractures who underwent open reduction and internal fixation.

Methods

Our study was conducted with 20 volunteers who applied to the orthopedics and traumatology clinic and underwent open reduction internal fixation due to metacarpal fracture. The study included patients who underwent surgery for metacarpal fractures, aged between 18 and 65 years, who had surgery not more than 3 months ago, had no history of upper extremity surgery or trauma in the past 6 months, had no physical or mental problems that would prevent them from receiving physical therapy and occupational therapy, and who agreed to sign an informed consent form.

In the first stage, physical therapy and rehabilitation for finger opening-closing and wrist joint range of motion exercises (flexion, extension, ulnar deviation, radial deviation, pronation, and supination) were started on the same day post-surgery after the pain control was achieved. The patients were followed by rest splint for the first 2 weeks, and then, the second stage of the 6-week physical therapy rehabilitation program was started after stitches were removed at the follow-up clinic visits. In the second stage, isometric exercises, finger, hand-wrist flexion and extension exercises, grasping-squeezing exercises, wrist supination-

pronation exercises, and finger abduction and adduction exercises were given to the patients according to their ability to perform them at the regular follow-up clinic visits after discharge. Then, in the third stage, the ergotherapy application was started.

The common goals in ergotherapy are to increase efficiency in hand movements during daily life activities, increase endurance in activities that are supported by the hand and put load on the hand and wrist, shorten the time to return to work, and increase the duration of the hand use in both work and daily life activities. For this purpose, patients and their relatives were informed, and a guide was provided that contains the movements to be done and not to be done. As a result of ergotherapy applications, the target point was determined as reaching the activity level before the fracture. The results were evaluated and performed 3 times with the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, Milliken scoring, and Hand Grip Strength Measurement Test. These evaluations were performed 3 times for each patient, in the post-operative early period (period until discharge), after physical therapy, and after ergotherapy.

Statistical Analysis

The data were analyzed with SPSS, version 22.0 (IBM Corp, Armonk, NY). Follow-up clinical outcomes, DASH, Milliken score, and Hand Grip Strength Measurement Tests, were evaluated. In evaluating the study data, descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum, and maximum) were used, as well as nonparametric tests for the comparisons of three or more groups that did not show normal distribution, like the Kruskal–Wallis test, and the One-way analysis of variance (post-hoc Tamhane's T2) test was used to determine the group that caused the difference. Qualitative data were compared using the Fisher-Freeman-Halton test and Fisher's exact test. Significance was evaluated at the $p<0.05$ level.

Results

In the early postoperative period, after physical therapy applications, and after the ergotherapy applications, a statistically significant difference was found ($p=0.001$) in terms of the DASH scores. According to the comparisons made to determine the group that creates the difference, the measurements in the early period after the operation and after the physical therapy applications were found to be significantly higher than the measurements after the ergotherapy applications ($p<0.001$ and $p<0.001$). In terms of the DASH score, early postoperative measurements were also observed to be significantly higher than measurements after physical therapy applications (Table 1).

Statistically significant differences were found among the Milliken GYA Evaluations and hand grip strength measurement tests in the early postoperative period, after the physical therapy applications, and after the ergotherapy applications ($p=0.001$).

According to the comparisons made to determine the group that creates the difference, measurements in the early postoperative period and after the physical therapy applications were found to be significantly lower than the measurements after the ergotherapy applications ($p<0.001$ and $p<0.001$). Early postoperative measurements were also significantly lower than the measurements after physiotherapy applications (Table 2).

Discussion

In this study, it was aimed to investigate the effects of early physical therapy and ergotherapy interventions on daily life activity levels after open reduction and internal fixation applied in metacarpal fractures, and statistically significant results were obtained. When the literature is examined, a randomized controlled study conducted by Gülke et al.,[11] 2–5 included 60 patients with metacarpal fractures who underwent stable open reduction and internal fixation with

Table 1. Comparison of the DASH scores postoperatively, after physical therapy, and after occupational therapy

	Postoperative	After physiotherapy	After ergotherapy	p*
The Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire				
Mean±SD	65.53±4.62	30.20±2.82	12.66±2.72	<0.001
Median	65.83	29.16	11.60	<0.001

*p<0.005 accepted as significant.

Table 2. Comparison of Milliken daily living activity and hand grip strength scores postoperatively, after physical therapy, and after occupational therapy

	Postoperative	After physiotherapy	After ergotherapy	p*
Milliken daily living activity				
Mean±SD	136.65±2.99	192.95±8.88	215.05±2.66	<0.001
Median	136	193.5	214.5	<0.001
Milliken daily living activity combined score evaluation				
Mean±SD	328.85±25.41	456.4±41.39	532.80±46.78	<0.001
Median	318	443	520.5	<0.001
Hand grip strength				
Mean±SD	314.70±54.66	595.8±81.31	663.1±67.47	<0.001
Median	316.5	600	666	<0.001

*p<0.005 accepted as significant. **Kruskal–Wallis test.

mobilization. The study compared groups that received traditional physical therapy or a home exercise program. When the joint movement was evaluated, both groups showed significant improvement; however, when the joint movement of all affected fingers was evaluated, statistically, the group that received the home exercise program showed more significant improvement. There was no statistically significant difference in gripping strength parameters in the long term. These results show that a well-developed and instructed home exercise program after surgical treatment is as effective as or even more effective than conventional physical therapy. In our study, it was determined that the Milliken assessment and Hand Grip Strength Measurement Tests after physical therapy were statistically better than the results of the early post-operative period, and the results after ergotherapy were statistically better than the results after physical therapy.

Yalizis et al.[12] conducted a study on 16 Australian football players who had undergone surgery with anesthesia for the treatment of metacarpal fractures that were fully or minimally displaced between the second and fifth metacarpals, showing clinical and radiologic evidence. They carefully avoided damage to the extensor mechanism of the finger and applied a standard dorsal approach to the affected metacarpal. The protocol applied after surgery was that the forearm-based hand immobilization splint was applied during the operation, and the splint was replaced with a wound check 3 days after the surgery. No movement limitation was applied to the patient after the splint was removed. A waterproof plastic protective dressing was placed on the wound until the wound healed, and the stitches were removed. According to the results of the study, 12 participants returned to professional play within 2 weeks with a soft splint. This result emphasizes the importance of participation in treatment in the early postoperative period. In our study, we evaluated the results of patients who were operated up to 3 months ago and found that the physical therapy and ergotherapy applications, which were started in the early postoperative period, were statistically significant.

Harth et al.[13] evaluated the effectiveness of a patient-centered hand rehabilitation program compared to a standard program in terms of functional outcomes, return to work, patient satisfaction, and costs. The patients were taken in two consecutive cohorts, one cohort received the standard treatment program (n=75) and the other cohort received a program based on patient-oriented principles (n=75). The data were collected at the beginning, end, and 6 months after discharge of the rehabilitation program. The parameters include the range of motion and grip and pinch strength. Pain, upper extremity function, health status, satisfaction, and employment status are self-reported measures. The results showed that the patient-centered group had more positive results in terms of the DASH scores, pain, and patient satisfaction. In other words, the study shows that a patient-centered rehabilitation program leads to better functionality, higher patient satisfaction, and an earlier return to work compared to a standard rehabilitation program. In our study, we found statistically significant results when comparing the DASH scores during the post-operative period, the post-physical therapy period, and the post-physical therapy and ergotherapy treatment periods.

In a study conducted by Guzelcuk et al.[14] to compare the effectiveness of therapeutic activities that mimic daily living

activities in the treatment of hand injuries in young adult patients with those of traditionally used therapeutic exercises, 36 patients with hand injury-related loss of function were included. The patients were randomly divided into 2 groups, the study group consisted of 20 patients and the control group consisted of 16 patients. While an exercise program, including passive, active-assistive, and active range of motion and strengthening exercises, was applied to the control group in addition to physical modalities for 2 sessions per day, a program consisting of 25 activities imitating daily living activities was applied to the study group in addition to 1 session of the same program. The treatment was continued for 3 weeks, 5 days a week. Afterward, the patients were given a home program. When the patients were reevaluated 2 months later, it was observed that the therapeutic activities improved the functions of the hand more effectively. It has been suggested that therapeutic activities may be more beneficial than standard rehabilitation activities in the treatment of hand injury. They were able to show that the home exercise form was superior to only active or passive mobilization exercises. It includes daily activities as well as classical physical therapy. In accordance with our study, the importance of a home exercise program, which is included in the content of early rehabilitation and physiotherapy, is emphasized.

According to our study, in the evaluation of the tests performed after ergotherapy, more significant results were revealed in the Milliken and hand grip strength parameters. These results are in agreement with the general literature.[15] Alongside physiotherapy, functional ergotherapy represents part of a rehabilitation program aimed at improving arm functional capacity as it improves muscle strength and hand/arm dexterity with mobility. Over 8–16 weeks after the fracture, a higher efficacy of 3 weeks of combined therapy was demonstrated, with a statistically significant improvement in grip strength compared to physiotherapy alone. Although it was confirmed that the addition of ergotherapy to the early rehabilitation program resulted in an improvement in hand grip strength, which could be important for rehabilitation, no evidence of functional improvement was found. This suggests that adding ergotherapy to standard physiotherapy would be indicated for patients with low or severely reduced hand grip strength after the immobilization period, but not for others.[15] In our study, it is compatible with the literature as the grip strength parameter was more significant in the group that underwent ergotherapy.

One of the limitations of our study is less patient number. Another is the selection of patients in a wide age range. Future comparative studies can determine the most effective treatment combination and treatment process for metacarpal fractures in the postoperative period for functional recovery.

Conclusion

Three weeks of combined physical therapy and ergotherapy for surgically treated metacarpal fractures within 8–16 weeks post-operatively had a lower DASH score, a better Milliken score, and a higher efficacy in grip strength compared to physiotherapy alone.

Disclosures

Ethics Committee Approval: This study was approved by Department of Orthopaedics and Traumatology, University of Health Sciences, Fatih Sultan Mehmet Training and Research Hospital Ethics Committee (Date: 25/06/2020, Number: 2020/46).

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Conflict of Interest: None declared.

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