

# Fizjoterapia po zabiegu operacyjnym ręki z zastosowaniem urządzenia do diagnostyki i terapii funkcjonalnej ręki. Studium przypadku

*Physiotherapy after a hand surgery performed with a diagnostic and functional therapy device.  
Case study*

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## Streszczenie:

Wstęp. Fizjoterapia ręki po leczeniu operacyjnym urazowych uszkodzeń ściegien zginaczy palców ręki dotychczas opierała się na wykorzystaniu ustalonych form kinezyterapii wraz z fizykoterapią. Brak jest doniesień na temat kompleksowej fizjoterapii po leczeniu urazowym ściegien, naczyń i nerwów ręki z wykorzystaniem systemu Hand Tutor w fizjoterapii ręki.

Cel pracy. Celem pracy jest przedstawienie kompleksowej fizjoterapii ręki po zabiegu operacyjny i rewizji ściegien z zastosowaniem urządzenia do diagnostyki i terapii funkcjonalnej ręki z Biofeedbackem – Hand Tutor TM.

Materiał i metody badań. Badaniem objęto 42 letniego mężczyznę. Chory po urazie ręki prawej z uszkodzeniem ściegien, tętnicy oraz nerwu łokciowego, operowany w 2012r. W trakcie leczenia doszło do powikłań (stanu zapalnego, obrzęku i zrostów). W leczeniu prowadzono kompleksową fizjoterapię (wykorzystując system do fizjoterapii ręki z Biofeedbackem – Hand Tutor TM).

Wyniki. W badaniu własnym, po zastosowaniu wczesnej, kompleksowej fizjoterapii wraz z wykorzystaniem urządzenia Hand Tutor stwierdzono wygojenie rany pooperacyjnej oraz istotną poprawę funkcji ręki. Wydaje się, że zastosowane procedury fizjoterapeutyczne wpłynęły na skuteczność terapii. Badania końcowe wykazały znaczną poprawę ruchomości pasywnej, aktywnej oraz szybkości ruchów badanej ręki. W badaniach wykazano także zmniejszenie poziomu subiektywnych odczuć bólowych chorego oraz powrót funkcji nerwu łokciowego.

## Słowa kluczowe:

wczesna, kompleksowa fizjoterapia, Hand Tutor, urazowe uszkodzenia ściegien

## Abstract

**Background.** Surgical treatment after fingers flexor tendons' injury requires a consequent physiotherapy of the hand that is based on well-established essential procedures. There are no reports on comprehensive hand physiotherapy treatment after traumatic injuries of the tendons, blood vessels and nerves with an application of the Hand Tutor system in the therapeutic process.

**Aim of the study.** The aim of the study is to present a comprehensive hand physiotherapy after surgery and revision of the tendons with a rehabilitation system with biofeedback - Hand Tutor TM, which is a modern system designed for the therapy of sensory, motor and cognitive disorders of the hand.

**Materials and methods.** The study presents a case of a 42 year-old man. The patient suffered from the injury of a right hand with a significant damage of tendons, artery and ulnar nerve, operated in 2012. Complications after the performed surgery were observed during the recovery (inflammation, swelling and tissue adhesions). In the therapy early comprehensive hand physiotherapy was introduced (with an application of the system for hand physiotherapy with biofeedback - Hand Tutor TM). **Results.** The study shows that introduction of an early, comprehensive physiotherapy together with the Hand Tutor device was successful in terms of the wound healing process and significant improvement in hand function after surgery. It appears that appropriately selected physiotherapy procedures may positively influence the effectiveness of the general therapy. Final results showed significant improvement in passive and active range of motion of the injured hand as well as in the speed of the movements. The study also showed a reduction of the subjective level of the pain and the return of the ulnar nerve function.

## Key words:

early comprehensive physiotherapy; Hand Tutor; traumatic tendon injury

### Background

There is a lack of unified standards for rehabilitation of patients with hand injury. For this group the main goal of physiotherapy is to prevent formation of blood clots, reduce the consequent swelling and tissue adhesions. Early introduction of rehabilitation process to the patients aims in maintaining sufficient muscle strength and ensuring the gradual recovery of lost hand's functions as well as minimizing possible complications. [1, 2, 3, 4, 5, 6].

### Aim of the study

The aim of the study is to evaluate the comprehensive hand physiotherapy after surgery and revision of the tendon with a device for the diagnosis and functional therapy with biofeedback - Hand Tutor TM.

### Materials and methods

The study presents a case of a 42 year-old man.

Complications after the performed surgery were observed during the recovery (inflammation, swelling and tissue adhesions). Patient also suffered from flexion-extension contracture of the right hand's fingers, traumatic scarring of the palmar fascia and fingers flexor tendons' sheaths II-III-IV-V, as well as traumatic carpal and ulnar syndrome. Additionally, considerable degree of the hand gripping dysfunction was found.



**Figure 1. Palmar side of the injured hand before physiotherapy. Source: private material**



**Figure 2. Flexion of the fingers before physiotherapy. Source: private material**

Before introduction of the physical therapy, the assessment of passive and active range of motion, speed/quality of movement and ability to perform precise movements was conducted. Additionally, subjective level of pain test and tension test of the right ulnar nerve (the Upper Limb Tension Test ULTT 3 by Butler) were studied. These tests were performed regularly in the first, fifth, tenth and eleventh, fifteenth and twentieth day of the treatment.

Both for diagnostic and therapeutic purposes therapists used rehabilitation system with biofeedback – Hand Tutor<sup>TM</sup>, which is a modern system designed for the therapy of sensory, motor and cognitive disorders of the hand. The system consists of an ergonomic wearable glove and dedicated physical therapy rehabilitation software (Medi Tutor<sup>TM</sup>). The Hand Tutor system allows for a range of bio-mechanical evaluation and is an advanced rehabilitation package supporting at the same time the assessment of hand function and treatment of the disorder (Fig.3).



**Figure 3. The system for rehabilitation hand with biofeedback. Source: private material**

Physiotherapy program included:

- LFEF (low frequency electromagnetic field: an intensity of the electromagnetic field 5-7 mT, frequency 20-30 Hz) application on the area of the right hand; after 10 days of rehabilitation introduction of a bio-stimulating laser (3 - 7J / cm<sup>2</sup>) on the area of the wound
- manual therapy OMT Kaltenborn - Evjenth (mobilization of the wrist bones, dorsal and palmar slides within interphalangeal joints)
- neuromobilization of the right ulnar nerve
- diagnosis and therapy of functional right hand with the use of hand rehabilitation system.

Three training programs of Hand Tutor TM were introduced to the patient taking part in the study and each day patient was undergoing one of them:

- Tracking a target (time of therapy: 680 sec.; the task was to maintain a point on a designated, moving path; it was possible to modify the indicators of hand movement during the therapy);
- Catching a basketball (time of therapy: 180 s.; the task was to correctly position a movable basket with hand movements in order to catch a passing ball; it was possible to modify applied degree of difficulty);
- Racing a car (time of therapy: 180s.; the task was to maintain a car on a racetrack with hand movements; program chose defined degree of difficulty depending on the individual level of the wrist and fingers' mobility).

## Results

Analysis of the results on the 10th day showed that presented scheme of hand physiotherapy resulted with improved passive and active range of motions within both the wrist and fingers (Fig. 4). Improvement covered active flexion and extension of the fingers III-V, respectively by approx. 40%, 100% and 10%.

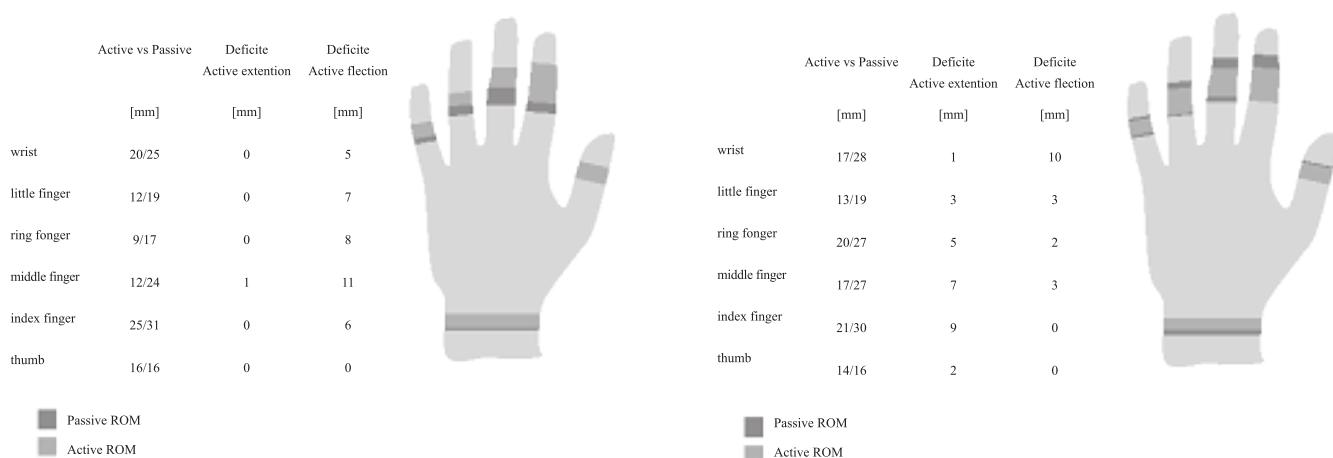


Figure 4. Analysis of the hand movements before introduction of the therapy and on the 10th day of physiotherapy

In the course of the comprehensive physiotherapy, process of undisturbed wound healing was observed (Fig. 5, 6, 7). Also, after the completion of the physical therapy, a significant improvement in hand function was noted (Fig. 9, 10). Analysis of the results on the 20th day of the treatment showed improvement of passive and active movements of the wrist and fingers III-V by 45%, 100%, 200% and 50%. Additionally, a significant increase of the maximum frequency of the hand movements was discovered.



**Figure 5** Palmar side of the injured hand on 11th day of the comprehensive physiotherapy. Source: private material



**Figure 6.** Palmar side of the hand after the completion of the comprehensive physiotherapy. Source: private material

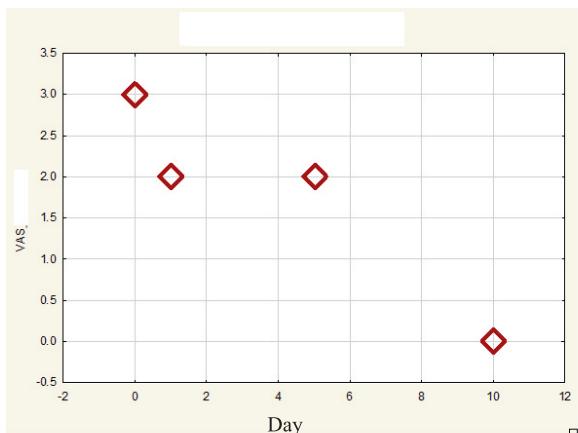


Figure 7. Fingers' flexion after the completion of the comprehensive physiotherapy. Source: private material

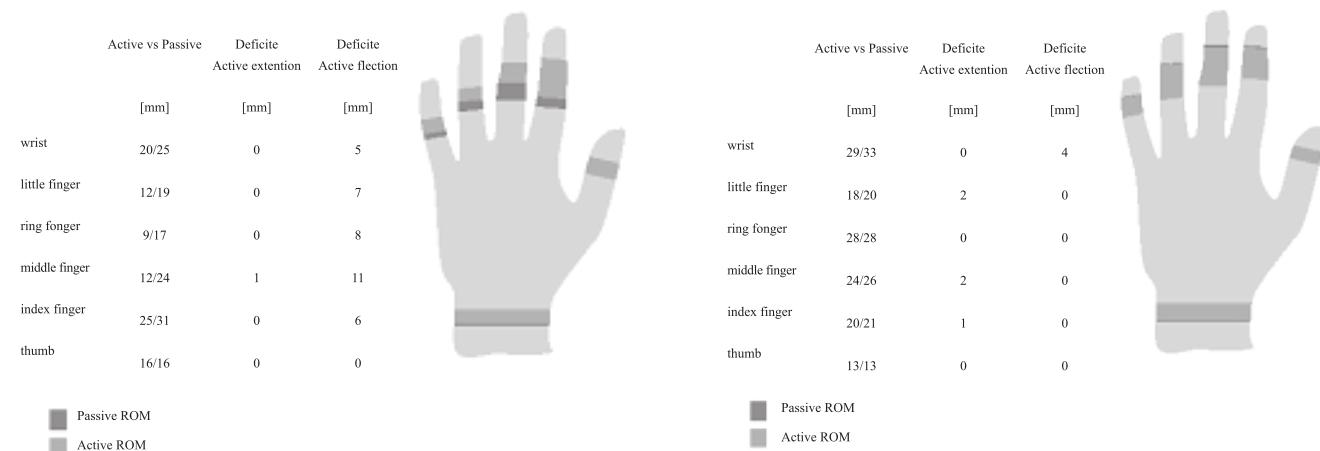
Table 1. The results of the subjective level of pain test and voltage tests of the ulnar nerve

Day of therapy	Result
0	Pain scale 5 (VAS) Tension test of the right ulnar nerve (ULTT 3): P(+++)
1	Pain scale: 4 (VAS) Tension test of the right ulnar nerve (ULTT 3): P(+++)
5	Pain scale: 3 (VAS) Tension test of the right ulnar nerve (ULTT 3): P(+++)
10	Pain scale: 3 (VAS) Tension test of the right ulnar nerve (ULTT 3): P(++)
11	Pain scale: 2 (VAS) Tension test of the right ulnar nerve (ULTT 3): P(++)
15	Pain scale: 2 (VAS) Tension test of the right ulnar nerve (ULTT 3): P(+)
20	Pain scale: 0 (VAS) Tension test of the right ulnar nerve (ULTT 3): P(-)

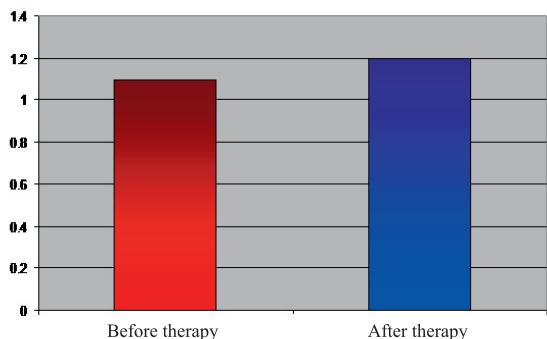
Final test showed normal function of the right ulnar nerve (Test voltage (ULTT 3): P (-) (Tab. 1) and total pain relief (Fig. 8).



**Figure 8. Results of the subjective level of pain test on the 10th and 20th day of the therapy**



**Ryc.9.Analiza ruchów ręki w przed i po zakończeniu fizjoterapii**  
**Figure 9. Analysis of the hand's movements before and after the therapy**



**Ryc.10. Results of the maximum frequency of the hand movements before and after the therapy**

Surgical treatment after fingers flexor tendons' injury requires a consequent physiotherapy of the hand that is based on well-established essential procedures. There are no reports on comprehensive hand physiotherapy treatment after traumatic injuries of the tendons, blood vessels and nerves with an application of the Hand Tutor system in the therapeutic process.

In the literature only a few reports concerning the applicability of the Hand Tutor system in hand physiotherapy can be found [10, 11]. In our previous studies we have focused on the evaluation of the impact of elastic therapeutic tape's application on the final effects of physiotherapy in patients with Colles' fracture treated conservatively. The research demonstrated the efficacy of therapy with elastic therapeutic tape and hand rehabilitation system of biofeedback – Hand Tutor TM. The observed results indicated the possibility of using the physiotherapy Hand Tutor system with some wider application.

The study shows that introduction of an early, comprehensive physiotherapy together with the Hand Tutor device was successful in terms of the wound healing process and significant improvement in hand function after surgery. It appears that appropriately selected physiotherapy procedures may positively influence the effectiveness of the general therapy. Final results showed significant improvement in passive and active range of motion of the injured hand as well as in the speed of the movements. The study also showed a reduction of the subjective level of the pain and the return of the ulnar nerve function.

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### Conclusions

Device for the diagnosis and functional hand therapy with biofeedback -Hand Tutor TM- enables therapists a holistic functional assessment, designed treatment programs tailored to the patients' needs and constant supervision over the process of physiotherapy of a hand. It seems that only a comprehensive program of physiotherapy covering simultaneously the clinical condition's challenges and individual abilities of the patient allows hand function's return. The improvement resulting from the usage of the device for the diagnosis and functional therapy with biofeedback – Hand Tutor TM- can lead to optimization of hand physiotherapy. Nevertheless, the credibility of the applied therapy, evaluation of its effects and standardization procedure requires further research on broader material.

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