

Efficacy of occupational therapy and effective factors in rehabilitation of injured flexor tendons after repair: A Review article

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Abstract:

Hand tendon injuries have significant negative effect on patients' daily routine and recreational activities by causing dysfunction of hand and this reduces the quality of life. Based on the researches, this issue has a high prevalence. Researchers suggest different causes for this problem, including traumatic injury, motor vehicle injuries, combat injuries and occupational ones. Rehabilitation of flexor tendons after their repair is challenging for health providers, since they should maintain the balance between protecting the repaired tissue and providing enough tendon gliding to prevent from contracture and adhesion. Hand rehab programs should be accessible for patients to minimize the chance adhesion and maximize the function. During past two decades, surgical interventions, especially regarding second zone of hand, has improved significantly and this has led to better outcome. Small incisions in these surgeries prevent the tissue from edema. Furthermore, the sutures should be resistant enough to remain intact in rehabilitation sessions.

Keywords: *flexor tendon repair, occupational therapy, tendon adhesion*

Background and Objective

Tendon injuries of the hand can substantially impair an individual's capacity to perform daily activities, fulfill professional responsibilities, and engage in recreational pursuits. Such impairments can profoundly

affect overall quality of life, as the ability to participate in meaningful activities is closely linked to hand function.¹

Research indicates a notable prevalence of these injuries; for instance, Stewart and

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colleagues have reported that tendon injuries constitute one-third of all admissions to hospitals in South Africa.² The etiology of these injuries is diverse, with traumatic events—including altercations, traffic accidents, and workplace injuries—being the predominant causes.³

Surgical intervention is frequently required to repair damaged flexor tendons; however, the success of these repairs is contingent upon several physiological and biomechanical factors. Key variables influencing outcomes following tendon repair include the patient's age, the specific location of the injury, the strength and technique employed during the repair, and the quality of postoperative rehabilitation.

Specialized hand rehabilitation is critical for minimizing adhesions and promoting functional recovery; therefore, it is imperative that such interventions are readily accessible to patients.⁴⁻⁶ Numerous studies have underscored the significance of timely attendance and referral to postoperative therapy sessions, as these factors markedly influence the functional recovery of repaired tendons.⁷

Over the past two decades, techniques for repairing flexor tendons, particularly in Zone II, have evolved considerably to prevent postoperative adhesions and improve functional outcomes. Surgical methods have increasingly prioritized the utilization of smaller incisions to minimize edema. Furthermore, the suturing technique employed must provide sufficient resistance while facilitating tendon gliding during rehabilitation.⁸

One study has identified that the most effective repair technique involves the reconstruction of tendon structures, the tendon sheath, the pulley system, and the surrounding subcutaneous soft tissue in the affected area. The cruciate repair method is preferred, as it establishes a robust foundation for initiating an early active rehabilitation protocol. Additionally, the release of the sheath and pulley system creates optimal conditions for improved gliding of the injured flexor tendon, thereby enhancing recovery outcomes.⁹

The paramount significance of tendon gliding in the postoperative phase following tendon repair surgery has been extensively documented in a multitude of studies. It is evident that effective postoperative rehabilitation is equally critical to the restoration of hand functionality as the surgical intervention itself. A variety of rehabilitation protocols for flexor tendon repair have been proposed, highlighting the necessity of selecting the most appropriate approach, which should be administered by a qualified therapist to achieve optimal therapeutic outcomes. Hand rehabilitation specialists play a vital role in enhancing functional capabilities and improving the quality of life for individuals who have sustained upper limb injuries.⁸ Occupational therapists, in particular, constitute an integral part of the rehabilitation team, possessing specialized training to assist patients with upper extremity injuries and to actively engage them throughout the recovery process. Through close collaboration with patients, occupational therapists assess their unique needs and limitations. Following comprehensive evaluations, these therapists provide targeted interventions designed to enhance patients' abilities and promote functional independence. While the primary objective of occupational therapy is to immerse patients in meaningful and purposeful activities, the attainment of this objective necessitates the implementation of specific techniques and activities that focus on enhancing physical structure and function.⁹⁻¹¹

Recent years have witnessed a considerable increase in research investigating the role of occupational therapy in hand rehabilitation following flexor tendon repair. The present study aims to review these findings, with the intention of summarizing the roles and responsibilities of occupational therapists. Furthermore, this study seeks to identify the most effective rehabilitation protocols and other factors that may influence the functional recovery of patients following flexor tendon injuries.

Method of Article Search

This review study thoroughly utilized several databases, including PubMed, Google Scholar, Science Direct, and Cochrane, to identify pertinent articles in English. Additionally, Iranian literature was reviewed utilizing the MAGIRAN and SID databases. The review encompasses articles published on the role of occupational therapy in the rehabilitation of individuals with flexor tendon injuries, without imposing any temporal restrictions. Keyword searches for English language databases included terms such as "Occupational Therapy," "Hand Therapy," "Flexor Tendon Repair," and "Rehabilitation." Conversely, Persian keywords such as "rehabilitation of the hand," "occupational therapy," and "flexor tendon repair" were employed in the Persian databases. Ultimately, relevant articles were selected and analyzed to furnish a comprehensive overview of the current understanding of occupational therapy within this domain.

Findings

A substantial body of literature comprising over 100 articles delineates the interventions administered by hand rehabilitation specialists, particularly occupational therapists, for upper extremity disorders. The predominant emphasis of these studies has been on patient education as well as the design and fabrication of orthoses. Additionally, several articles have reported on the application of activity-based exercises aimed at enhancing the functionality of the injured hand. Since one of the primary objectives of occupational therapy is to improve hand function across diverse functional domains and daily activities, the integration of exercises derived from daily tasks is instrumental in achieving this aim. A systematic review conducted by Takata and Weed has documented a notable increase in research output over the past decade, thereby underscoring the vital role of occupational therapists and hand rehabilitation specialists in the realm of rehabilitation following tendon injury repairs. They emphasized that these specialists play a pivotal role in administering motion exercises, prescribing

and fabricating splints and orthoses, as well as performing sequential range of motion assessments.^{12,13}

Hardison and Roll performed a systematic review that scrutinized specialized occupational therapy interventions for the hand over an eight-year period. Their findings highlighted the critical contributions of occupational therapists in the rehabilitation of individuals afflicted with a diverse array of hand and upper extremity conditions. Articles focusing on rehabilitation subsequent to flexor tendon repair have identified optimal postoperative protocols. Specifically, their study found that the implementation of an early active protocol yielded good to excellent functional outcomes in 94% of patients.¹² Furthermore, additional reports indicated a remarkably low incidence of tendon rupture—only 2.3%—among programs that concurrently combined the Duran and Kleinert protocols. Separate analyses disclosed re-rupture rates of 4.1% for the early active protocol, 3.8% for the Duran protocol, and 7.1% for the Kleinert protocol.¹⁴

In Iran, two pivotal studies have been conducted regarding rehabilitation following flexor tendon repair. One of these studies aimed to identify the most effective rehabilitation protocol. Farzad and colleagues compared early active rehabilitation to controlled passive rehabilitation within a cohort of 50 patients who suffered zone 2 injuries, all of whom underwent the 4-strand (Locked Cruciate) repair technique. The extent of adhesion was evaluated utilizing the Strickland and Buck-Gramcko criteria. Results based on the Strickland criteria indicated that the active group achieved outcomes of 44% excellent, 36% good, 20% moderate, and no weak results, whereas the passive group demonstrated 8% excellent, 32% good, 44% moderate, and 16.5% weak outcomes. According to the Buck-Gramcko criteria, the active group yielded 12% excellent, 40% good, 32% moderate, and 16% weak results, in contrast to the passive group's 4% excellent, 12% good, 24% moderate, and 60% weak outcomes. The assessment of Total

Active Motion for evaluating tendon gliding revealed an average of 2.150 in the active group, compared to 4.116 in the controlled passive group, thereby suggesting superior tendon gliding in the active cohort.¹⁵

Flexor tendons are especially susceptible to secondary adhesions due to specific biomechanical factors, rendering the timing of rehabilitation exercises post-tendon repair a significant challenge for occupational therapists. Another Iranian study further accentuated the critical importance of early referral following tendon repair. This study involved 57 patients with zone 2 flexor injuries who underwent 4-strand tendon repair and were referred to specialized hand therapy post-surgery. After eight weeks of rehabilitative treatment, the range of motion in the finger joints, proximal interphalangeal joint flexion contracture, and flexion gap were assessed. The outcomes revealed a significant correlation between the duration from injury to surgery and the range of joint motion, signifying that repairs conducted within ten days post-injury resulted in more favorable functional outcomes. Moreover, the study highlighted that shorter referral times to therapy (less than one week post-surgery) were associated with greater improvements in joint range of motion.^{15,16}

In a systematic review published in 2019, a comprehensive examination of studies addressing rehabilitation protocols following flexor tendon repairs was conducted.

This analysis revealed that Place and Hold exercises yielded superior movement outcomes in comparison to passive motion protocols, such as the Kleinert and Modified Kleinert protocols, particularly for patients repaired using techniques involving 2 to 6 strands. Notably, among patients aged over 30 who underwent two-strand tendon repairs, those engaged in the True Active protocol demonstrated a greater range of motion than those treated with passive motion approaches.¹⁷

A separate cross-sectional study conducted in the United Kingdom investigated the most effective rehabilitation protocols for repairs in Zones 1 and 2 of the flexor tendons. This research involved

collaboration among 35 specialized hand centers, which implemented 52 distinct treatment protocols. The study assessed three splinting programs, with all participating centers employing early motion initiatives. The splints utilized included the long dorsal block splint (DBS), the short dorsal block splint, and the Relative Motion Flexion splint.

The findings indicated that a definitive optimal rehabilitation approach following tendon repair remains elusive. Factors such as the fabrication and prescription of splints, adherence to exercise programs outside of clinical settings, and short-term movement restrictions imposed on patients can contribute to increased financial burdens and exacerbate social constraints. Consequently, the authors recommended further studies to elucidate optimal rehabilitation protocols.⁶

Beyond hand injuries, social and economic factors can significantly influence surgical outcomes. A retrospective study conducted by a consortium of occupational therapists and physicians analyzed the impact of social deprivation and timely access to hand rehabilitation services on the range of motion in patients who underwent flexor tendon repairs in Zones 1 to 3. The researchers posited that social and economic barriers might restrict individuals' access to essential postoperative rehabilitation services. Economic obstacles included low income and insufficient financial capacity to cover rehabilitation sessions. This study examined data from 2016 to 2020, involving 109 patients assessed using the Strickland scale to evaluate range of motion, in conjunction with the Area Deprivation Index to measure levels of deprivation. Results indicated that several factors—including the number of treatment sessions attended, degree of social deprivation, educational background, location of the injury (with particular emphasis on Zone 2 flexor injuries), and patient age—significantly influenced range of motion and functional recovery post-surgery. Specifically, financial constraints, distance to specialized hand rehabilitation facilities, and various social conditions impeded consistent attendance at

therapy sessions, potentially hindering recovery. Ultimately, the study concluded that despite the advancements in surgical techniques and rehabilitation protocols, achieving positive treatment outcomes is unlikely if individuals lack access to adequate postoperative rehabilitation services.¹⁸

Discussion and Conclusion

In summary, the existing body of research underscores the essential role of occupational therapists in the treatment of upper extremity disorders, specifically in the rehabilitation of flexor tendons post-surgery. Occupational therapists can collaborate effectively with surgeons to enhance patients' hand function by providing structured activity-based exercises, fabricating and supplying splints, and offering tailored consultations. The timing of surgery and referral to occupational therapy significantly influence improvements in joint range of motion after flexor tendon surgery, with the Active protocol demonstrating

particular efficacy among current rehabilitation strategies.

However, as highlighted in numerous articles, further research is warranted to definitively identify the optimal rehabilitation treatment protocol.

It is important to acknowledge that successful recovery following flexor tendon injuries encompasses more than surgical intervention and effective rehabilitation measures. Economic and social challenges—such as inadequate insurance coverage for rehabilitation costs, difficulties in fabricating orthoses and splints, lack of employer support for attending therapy sessions, and patients' non-compliance with prescribed exercises—can significantly impact therapeutic progress. Therefore, to optimize treatment outcomes and enhance patient satisfaction and quality of life for individuals with these injuries, it is imperative to address these systemic issues.

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