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JOINT CLINICAL STUDIES ON HAND INJURY REHABILITATION, ESPECIALLY IN CENTERS THAT COMBINE PHYSICAL AND OCCUPATIONAL THERAPISTS TO IMPROVE RANGE OF MOTION AND FUNCTIONAL ABILITY

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ABSTRACT

Hand injuries are among the most common and functionally disabling workplace injuries, affecting range of motion, muscle strength, and occupational performance across a broad range of workers. This narrative review examines the evidence supporting interdisciplinary collaboration between physical therapy (PT) and occupational therapy (OT) as the optimal framework for hand injury rehabilitation. Drawing on epidemiological data, systematic reviews, and meta-analytic findings – including Vásquez-Carrasco and colleagues (2026), who demonstrated significant improvements in motor function, strength, and pain following structured OT interventions – the review finds that integrated PT-OT models provide more comprehensive rehabilitation outcomes than either discipline achieves independently. The complementary expertise of both professions, formalized through the certified hand therapist (CHT) credential, supports coordinated clinical care, work hardening, ergonomic assessment, and return-to-work planning. Alignment with OSHA and NIOSH ergonomic frameworks further reinforces the role of interdisciplinary hand rehabilitation in both injury recovery and recurrence prevention. The evidence consistently supports collaborative, interdisciplinary practice as the standard of care for restoring functional ability in adults with hand injuries.

INTRODUCTION

Workplace hand injuries represent one of the most significant and persistent challenges confronting occupational health, rehabilitation medicine, and clinical practice globally. The hand, with its extraordinary complexity of joints, tendons, ligaments, nerves, and musculature, is both the most frequently used instrument in virtually every occupational setting and, consequently, one of the most vulnerable structures to injury. For working adults, a hand injury is not merely a medical event – it represents a potential disruption of livelihood, independence, and quality of life. As the evidence base in rehabilitation science has matured, there has been growing recognition that optimal recovery from hand injuries requires the combined, coordinated effort of multiple clinical disciplines, most notably physical therapy (PT) and occupational therapy (OT), working within integrated clinical frameworks. This article reviews the epidemiology of hand and upper extremity workplace injuries, the clinical science underpinning rehabilitation protocols, and the emerging body of joint clinical research supporting interdisciplinary collaborative models as the gold standard for restoring range of motion and functional ability in injured workers.

The scale of workplace injury in the United States alone justifies urgent attention to rehabilitation efficacy. According to data from the U.S. Bureau of Labor Statistics Injuries, Illnesses, and Fatalities (IIF) program, 2,488,400 total recordable nonfatal injury and illness cases were reported in private industry in 2024, representing a rate of 2.3 cases per 100 full-time equivalent workers (Bureau of Labor Statistics, 2024). Among cases involving days away from work (DAFW), the median was 8 days in 2024, with 888,100 such cases recorded. Cases involving sprains, strains, and tears – the category most reflective of musculoskeletal injury to the upper extremity and hand – accounted for 568,150 of those DAFW cases. These figures underscore the enormous clinical and economic burden that hand and musculoskeletal injuries place upon workers, employers, health systems, and society at large. Addressing this burden effectively demands not only the resources of individual disciplines, but the integrated deployment of physical and occupational therapy expertise within shared clinical environments.

Epidemiology of Hand Injuries in the Workplace

The hand is disproportionately exposed to the mechanical forces, repetitive motions, and environmental hazards that characterize modern workplaces. Data from the Bureau of Labor Statistics

have consistently demonstrated that injuries to the wrist, hand, and fingers constitute a substantial proportion of all occupational nonfatal injuries and illnesses in the United States (Bureau of Labor Statistics, 2015). The body parts most affected by nonfatal injuries include the upper extremities, and within that category, the hand and wrist remain particularly vulnerable to both acute traumatic events and cumulative trauma disorders. These injuries span a wide spectrum from lacerations and fractures resulting from machinery contact, to the insidious development of musculoskeletal disorders (MSDs) such as carpal tunnel syndrome, tendinitis, trigger finger, and epicondylitis – conditions that develop through sustained exposure to repetitive strain, awkward postures, forceful exertions, and vibration.

Certain occupational groups carry markedly elevated risk. The Occupational Safety and Health Administration (OSHA) has identified a broad range of high-risk occupations for musculoskeletal disorders, including registered nurses, nursing assistants, firefighters, laborers, material movers, janitors, heavy truck drivers, production workers, plumbers, pipefitters, and maintenance and repair workers (OSHA, 2021). Many of these roles involve precisely the hand-intensive physical demands – gripping, pinching, pushing, pulling, and repetitive fine motor activity – that are associated with upper extremity MSDs. Hart (2005) noted that hand injuries are among the most common serious injuries in emergency settings, reinforcing the acute dimension of this problem alongside its chronic, cumulative character. Given the high incidence rates across multiple industries, the economic costs associated with medical treatment, lost productivity, and workers' compensation claims are substantial, creating a compelling imperative for evidence-based rehabilitation interventions that can return workers to full functional capacity as efficiently as possible.

Musculoskeletal Disorders: Pathophysiology and Clinical Significance

Musculoskeletal disorders affecting the hand, wrist, and forearm arise through a variety of pathological mechanisms, whether acute trauma or chronic overuse. OSHA defines MSDs as conditions that affect the muscles, nerves, blood vessels, ligaments, and tendons, with risk factors including lifting heavy items, bending, reaching overhead, pushing and pulling heavy loads, working in awkward body postures, and performing the same or similar tasks repetitively (OSHA, 2021). Prolonged or repeated exposure to these risk factors elevates the cumulative

load on soft tissue structures, eventually exceeding the tissue's capacity for repair and adaptation.

In the context of hand rehabilitation, the most clinically significant MSDs include carpal tunnel syndrome – a compression neuropathy of the median nerve – tendinitis across multiple tendons of the wrist and hand, trigger finger (stenosing tenosynovitis of the flexor tendon sheath), epicondylitis affecting the lateral or medial elbow, rotator cuff injuries that indirectly impair hand function through kinetic chain dysfunction, and general muscle strains affecting the intrinsic and extrinsic musculature of the hand (OSHA, 2021). These conditions, whether treated conservatively or surgically, ultimately require skilled rehabilitation to restore joint range of motion, tissue flexibility, muscle strength, neuromuscular coordination, and the ability to perform activities of daily living and work tasks.

The consequences of inadequately rehabilitated hand injuries extend well beyond the initial clinical episode. Chronic pain, contracture formation, impaired grip and pinch strength, sensory loss, and psychosocial sequelae including depression and fear-avoidance behavior can develop when rehabilitation is insufficient or poorly coordinated. The systematic review and meta-analysis by Vásquez-Carrasco and colleagues (2026) represents a landmark contribution to the evidence base in this domain, demonstrating that occupational therapy interventions produce statistically and clinically meaningful improvements in motor function, muscle strength, and pain levels among adults with hand injuries. Their findings validate what experienced clinicians have long observed in practice: that structured, goal-directed therapy targeting the functional demands of the individual patient's life and work yields superior outcomes compared to passive approaches.

Occupational Therapy in Hand Injury Rehabilitation

Occupational therapy has historically held a central place in the rehabilitation of hand injuries, particularly in enabling patients to regain the functional abilities needed for participation in meaningful occupations – including work, self-care, and leisure. The philosophical foundation of occupational therapy, which views function through the lens of occupational performance rather than isolated anatomical structures, is uniquely suited to addressing the complex, multi-dimensional recovery needs of the hand-injured worker.

Roll and Hardison (2017) conducted a systematic review of occupational therapy interventions for

adults with musculoskeletal conditions of the forearm, wrist, and hand, finding evidence supporting the effectiveness of a range of OT interventions including orthotic fabrication, therapeutic exercise, activity modification, and ergonomic training. Similarly, Marik and Roll (2017) examined OT effectiveness for musculoskeletal shoulder conditions, a proximal region whose functional impairment can cascade distally to affect hand use and grip function through kinematic linkage. These reviews confirm that occupational therapists bring specialized knowledge and techniques that are directly applicable to restoring the upper extremity function required for work and daily life.

Dale and colleagues (2002) characterized occupational therapists working in hand therapy as practitioners of holism within a cost-containment environment, highlighting the challenge of delivering comprehensive, patient-centered care under the administrative and financial pressures of modern healthcare systems. Their analysis of OT practice in hand therapy settings emphasized the importance of addressing not only impairment-level deficits in range of motion and strength, but also the activity and participation dimensions of recovery – how well the patient can perform meaningful tasks, maintain productive employment, and engage with their social environment. This holistic orientation distinguishes OT from more reductionist approaches and is a key rationale for integrating OT into multi-disciplinary hand rehabilitation centers.

Keller and colleagues (2016) analyzed thirty years of practice trends in hand therapy, identifying continuity in core interventions – exercise, splinting, edema management, sensory re-education – alongside growing emphasis on prevention, workplace accommodation, and evidence-based practice. Their analysis underscores how hand therapy has evolved from a narrowly clinical enterprise to a broader rehabilitation specialty that interfaces with occupational health, ergonomics, and workplace systems. The certified hand therapist (CHT), a credential awarded by the Hand Therapy Certification Commission (HTCC) to occupational therapists and physical therapists who have demonstrated advanced competency in hand and upper extremity rehabilitation, represents the pinnacle of specialized clinical expertise in this field. As Belyayev and Smith (2022) documented, CHTs play multifaceted roles spanning workplace injury prevention, direct clinical treatment, rehabilitation, and collaboration with occupational safety professionals – a scope that positions them as

natural bridges between the clinical and occupational health domains.

The Role of Physical Therapy

While occupational therapy has traditionally been associated with hand rehabilitation in the United States, physical therapy contributes essential and complementary expertise to the multi-disciplinary team. Physical therapists bring advanced knowledge of musculoskeletal biomechanics, manual therapy, therapeutic exercise programming, electrophysiological modalities, and pain neuroscience that enriches the clinical capabilities of the rehabilitation team. In hand rehabilitation specifically, physical therapists contribute to the assessment and treatment of joint mobility restrictions following fractures or surgical repair, management of scar tissue and adhesions, progressive resistive exercise programs for strengthening intrinsic and extrinsic hand musculature, and neuromuscular re-education following peripheral nerve injuries.

The complementary nature of PT and OT expertise creates synergies that neither discipline alone can fully achieve. Where the physical therapist focuses intensively on restoring the tissue-level and biomechanical substrates of hand function – joint mobility, tissue extensibility, muscular endurance – the occupational therapist contextualizes these gains within the framework of functional task performance, work simulation, adaptive strategies, and psychosocial well-being. When both disciplines operate in coordination within shared clinical environments, the patient benefits from a seamlessly integrated continuum of care that addresses recovery at every level of function.

Interdisciplinary Collaboration: The Clinical and Scientific Case

The movement toward interdisciplinary collaborative models in hand rehabilitation has been driven by both clinical pragmatism and a growing evidence base. Belyayev and Smith (2022) specifically examined the roles of certified hand therapists – who may hold credentials in either OT or PT – in workplace injury prevention and rehabilitation, and emphasized the value of collaboration with occupational safety professionals, including ergonomists, industrial hygienists, and safety officers. Their study highlighted that CHTs who engaged in cross-disciplinary collaboration achieved more comprehensive outcomes for injured workers, particularly in terms of sustainable return-to-work and prevention of re-injury. This finding aligns with

the broader literature on team-based care, which consistently shows that patients managed by coordinated, multi-professional teams experience better functional outcomes, fewer complications, and higher satisfaction than those managed through fragmented, discipline-siloed care pathways.

In centers that specifically combine physical and occupational therapists, the organizational architecture supports what Wilkinson and Cowen (2019) described in the context of ergonomics education: a collaborative curriculum that incorporates the expertise of certified hand therapists alongside occupational safety professionals. Their work demonstrated that when CHT expertise is systematically integrated into educational and clinical frameworks, the resulting interdisciplinary dialogue elevates the sophistication of both ergonomic risk assessment and rehabilitation planning. This kind of structural collaboration – where professional boundaries are permeable and expertise flows bidirectionally – is precisely what is needed in rehabilitation centers to achieve optimal patient outcomes.

The evidence from joint clinical studies, while still a developing body of literature, supports several key conclusions about collaborative rehabilitation models. First, structured programs that combine the functional training orientation of occupational therapy with the biomechanical and exercise science expertise of physical therapy produce superior improvements in objective measures of hand function – including grip strength, pinch strength, and active range of motion at the wrist, metacarpophalangeal, proximal interphalangeal, and distal interphalangeal joints – compared to single-discipline programs. Second, programs delivered in integrated settings benefit from enhanced communication between clinicians, enabling real-time adjustment of therapeutic goals as the patient progresses through recovery stages. Third, collaborative models facilitate more comprehensive ergonomic assessment and work hardening components, ensuring that the patient's rehabilitation targets are aligned with the actual physical demands of their occupational role.

Ergonomics, Prevention, and the Rehabilitation Interface

A critical dimension of joint clinical work in hand rehabilitation is the interface between rehabilitation and prevention. OSHA's ergonomics guidelines emphasize that implementing an ergonomic process is effective in reducing the risk of developing MSDs across diverse high-risk industries, and identify

several essential elements: management support, worker involvement, training, problem identification, early symptom reporting, hazard control solutions, and ongoing evaluation of progress (OSHA, 2021). These principles do not merely apply to primary prevention; they are directly relevant to the rehabilitation context, where secondary prevention – preventing recurrence of injury or development of chronic disability – is equally important.

Gainer (2008) traced the historical convergence of ergonomics and occupational therapy, demonstrating that the two fields share common roots in the scientific study of the human-environment interface and the optimization of work task design for human capability. This historical kinship provides a conceptual foundation for the integration of ergonomic principles into OT and PT practice, particularly in hand rehabilitation settings where therapists must consider not only the patient's current clinical status but the biomechanical demands of their anticipated return-to-work environment. The National Institute for Occupational Safety and Health's (NIOSH) foundational Elements of Ergonomics Programs document (1997) provides a framework for this integration, identifying hazard identification, risk assessment, control implementation, and program evaluation as the core components of an effective ergonomic process – components that translate directly into the assessment and treatment planning practices of hand rehabilitation clinicians.

Pitts and colleagues (2021) explored the hand therapist's role in the prevention and management of upper extremity injuries in the modern mass production industrial setting, a context characterized by highly repetitive, force-intensive manual tasks that create sustained MSD risk. Their analysis reinforces the importance of deploying hand therapy expertise proactively within industrial environments, not merely as a reactive clinical response to already-injured workers, but as a prophylactic resource that can identify at-risk workers, modify job tasks, and train workers in ergonomic principles before injuries develop. This preventive dimension of hand therapy practice requires the kind of occupational competency that is cultivated through interdisciplinary training and collaboration.

Schreuer and colleagues (2009) documented the role of occupational therapists as mediators in the workplace accommodation process, facilitating dialogue between injured workers and employers to identify and implement modifications that support

safe return to work. This mediating function underscores the importance of OT competency in workplace communication and employer engagement – a competency that is complemented, in collaborative clinical settings, by the physical therapist's expertise in functional capacity evaluation and work task simulation. Coole and colleagues (2014) found that occupational therapists treating people with musculoskeletal conditions frequently needed to communicate complex clinical information to employers to facilitate appropriate workplace accommodations, but that barriers including limited employer responsiveness and time constraints sometimes impeded this process. These findings highlight the need for institutional support within rehabilitation centers to enable cross-sectoral communication, and suggest that interdisciplinary teams are better positioned to navigate these challenges than individual clinicians working in isolation.

Outcomes of Joint Rehabilitation: Range of Motion and Functional Ability

The primary clinical outcomes targeted in hand injury rehabilitation are restoration of range of motion (ROM) across the affected joints and improvement in functional ability – the capacity to perform meaningful tasks with the injured hand. These outcomes are closely interrelated: adequate ROM is a necessary but not sufficient condition for functional performance, which also requires adequate strength, coordination, sensory discrimination, pain control, and cognitive-motor integration.

The meta-analytic evidence provided by Vásquez-Carrasco and colleagues (2026) demonstrates that occupational therapy interventions produce significant gains in motor function and muscle strength, as well as meaningful reductions in pain, in adults with hand injuries. These are precisely the outcome domains most relevant to restoring functional ability for work and daily living. The effect sizes reported in their meta-analysis, while variable across intervention types and hand injury diagnoses, provide clinicians with a quantitative framework for setting realistic recovery expectations and designing therapeutic programs with sufficient intensity and specificity to achieve meaningful outcomes.

When physical and occupational therapists collaborate in joint clinical studies and shared practice environments, the capacity to measure and track outcomes is enhanced by the diversity of assessment tools and clinical perspectives brought to the evaluation process. Physical therapists contribute

proficiency in goniometric ROM measurement, dynamometric grip and pinch strength testing, and standardized functional mobility assessments. Occupational therapists contribute expertise in performance-based outcome measures such as the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, the Patient-Rated Wrist Evaluation (PRWE), and observational assessments of occupational performance. Together, this multi-dimensional assessment approach captures the full spectrum of recovery, from the tissue and joint level through to the activity and participation levels of the International Classification of Functioning, Disability and Health (ICF) framework.

The work simulation component of rehabilitation – designed to bridge the gap between clinic-based gains and real-world occupational performance – is particularly well-suited to collaborative delivery. Physical therapists can design and supervise progressive exercise and activity programs that replicate the strength and endurance demands of the patient's job, while occupational therapists can introduce work simulation stations that replicate the tool-use, assembly, or keyboard tasks of the patient's specific occupation, ensuring that the patient's regained motor skills are practiced and consolidated in functionally relevant contexts before return to work. This integrated approach to work hardening is a defining feature of the most successful joint rehabilitation models.

Training, Education, and Professional Development

The development of genuinely integrated interdisciplinary practice in hand rehabilitation requires not only organizational will but deliberate attention to professional education and training. Wilkinson and Cowen (2019) proposed a collaborative curriculum model that explicitly incorporates the expertise of certified hand therapists into ergonomics education, arguing that the complementary knowledge bases of CHTs and ergonomics professionals create richer educational experiences than either discipline can provide alone. This curricular integration at the training level has implications for how future clinicians conceptualize their professional roles: graduates educated within collaborative frameworks are better prepared to function as team members, to communicate across disciplinary boundaries, and to draw on the expertise of colleagues in addressing complex clinical problems.

Belyayev and Smith (2022) found that CHTs who had received formal or informal training in occupational

safety principles were more effective collaborators with safety professionals and more likely to engage in preventive activities at the worksite level. This finding suggests that continuing education programs for both OTs and PTs working in hand rehabilitation should incorporate ergonomics content, occupational safety principles, and communication skills for employer engagement – not merely to expand the individual clinician's scope of competency, but to strengthen the foundation for effective interdisciplinary teamwork.

Training in the early identification of MSD symptoms is another area where joint clinical education adds value. OSHA emphasizes that early reporting of MSD symptoms can accelerate job assessment and improvement processes, preventing the progression of symptoms and reducing lost-time claims (OSHA, 2021). Rehabilitation clinicians – particularly those working in settings with close ties to industrial employers – can play an important role in educating workers about early symptom recognition and the importance of timely reporting, and in establishing clinical pathways that enable rapid assessment and early intervention when symptoms are first reported.

Challenges and Future Directions

Despite the compelling clinical rationale and growing evidence base for interdisciplinary hand rehabilitation, significant challenges remain in translating collaborative models from exemplary centers to mainstream practice. Administrative and reimbursement structures in many healthcare systems do not easily accommodate co-treatment by PT and OT, creating financial disincentives for the shared clinical encounters that are the hallmark of true interdisciplinary care. Scope of practice concerns, professional identity dynamics, and historical hierarchies between disciplines can also impede effective collaboration, even in settings where organizational commitment to the interdisciplinary model exists.

Future research in joint clinical studies on hand rehabilitation should prioritize several areas. Rigorous comparative effectiveness research comparing interdisciplinary collaborative models with single-discipline programs is needed to generate the level of evidence required to influence health policy and reimbursement decisions. Longer-term follow-up studies are needed to examine whether the functional gains achieved through collaborative rehabilitation are sustained over time and translate into durable improvements in work participation. Research examining the cost-effectiveness of collaborative rehabilitation models

– accounting for both clinical outcomes and downstream costs including re-injury, chronic disability, and lost productivity – would strengthen the economic case for organizational investment in joint clinical programs.

There is also a need for research examining the specific mechanisms through which interdisciplinary collaboration produces superior outcomes, whether through more comprehensive assessment, more sophisticated treatment planning, enhanced patient engagement, or other pathways. Understanding these mechanisms would enable the targeted refinement of collaborative models to maximize their impact. Additionally, the integration of ergonomics into joint rehabilitation programs warrants further investigation, particularly in terms of how workplace-specific ergonomic assessment and modification can be systematically incorporated into the rehabilitation process across diverse industry sectors.

CONCLUSION

Hand injuries represent a pervasive and clinically complex occupational health challenge, with hundreds of thousands of workers affected annually in the United States alone, as documented by the Bureau of Labor Statistics (2024, 2015). The rehabilitation of these injuries demands a level of clinical sophistication that is best achieved through the combined expertise of physical and occupational therapists operating in integrated, collaborative clinical environments. The evidence reviewed in this article – spanning epidemiological data, systematic reviews, meta-analyses, qualitative studies of clinical practice, and policy frameworks from OSHA and

NIOSH – converges on a consistent message: interdisciplinary collaboration is not merely beneficial but essential for achieving optimal restoration of range of motion and functional ability in adults with hand injuries.

The meta-analytic findings of Vásquez-Carrasco and colleagues (2026) provide rigorous quantitative evidence that occupational therapy interventions meaningfully improve motor function, strength, and pain outcomes in this population. The work of Belyayev and Smith (2022) documents the broader systemic role of certified hand therapists in bridging clinical rehabilitation and workplace injury prevention. The OSHA ergonomics framework (2021) and the NIOSH elements of ergonomics programs (1997) provide the conceptual infrastructure for integrating preventive ergonomic principles into rehabilitation practice. Together, these sources articulate a vision of hand rehabilitation that is simultaneously grounded in clinical excellence, anchored in occupational science, and oriented toward sustainable return to work and prevention of recurrence.

Realizing this vision requires continued investment in joint clinical research, interdisciplinary training and education, organizational models that support collaborative practice, and health policy frameworks that recognize and reimburse the value of team-based care. Centers that combine physical and occupational therapists in the service of hand injury rehabilitation represent the cutting edge of this field, and the clinical and research programs they generate will chart the course for evidence-based hand rehabilitation practice in the years ahead.

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