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Outpatient Physical Therapy Management of a Patient with a Work-Related Hand Contusion

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OUTPATIENT PHYSICAL THERAPY MANAGEMENT OF A PATIENT WITH A WORK-RELATED HAND CONTUSION

by

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This Scholarly Project, submitted by Brianne Halstead in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

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Department Physical Therapy

Degree Doctor of Physical Therapy

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Signature Brianne Halstead

Date 9/4/2020

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ABSTRACT

Background and Purpose. Work-related traumatic hand injuries can range from minor cuts or burns to more serious injuries involving man and machine interaction. The hands are a vital part of daily life, and injuries to this area may present significant decreases in functional abilities. Because of the variance in severity and lack in specific research, this injury may pose a unique challenge to physical therapists. **Description.** This case study describes the six-week outpatient physical therapy management of a 58-year-old male who sustained a hand contusion from a work-related injury. The patient presented with decreased strength, decreased range of motion, pain, and swelling in the dorsal right hand. The purpose of this case study is to explain the interventions utilized for the patient and evaluate the outcomes of those interventions. **Intervention.** The treatment of this patient involved education, compression garments, iontophoresis, ultrasound, range of motion exercises, and gentle strengthening exercises. **Outcomes.** Following physical therapy intervention, the patient achieved decreased pain, increased range of motion, and increased strength. The patient reported decreased swelling and increased ability to perform activities of daily living with his hand. **Discussion.** Treatment was based on textbook information for the rehabilitation of hand and finger injuries, available research studies, and the patient's current symptoms. Alteration and progression were based on the patient's response.

CHAPTER I

BACKGROUND AND PURPOSE

Literature reviewed for this case identified that not only is the hand is one of the most commonly injured sites, but it is also one of the most poorly managed in terms of seeking and receiving treatment. A contusion is produced when an external force causes soft tissue structures to be compressed against hard bone, injuring the soft tissue, bone, or both. The hands and phalanges are prone to contusion due to their irregular bony structure and little protective fat or muscle padding.[1] Immediately after a significant injury to the hand, such as a blunt force or crush injury, the hand assumes an intrinsic minus position. This includes flexion at the proximal and distal interphalangeal joints and extension or hyperextension of the metacarpophalangeal joints. Edema then develops on the dorsum of the hand, in the subcutaneous and sub-tendinous spaces impacted by the injury.[2] This course of action can result in significant pain, loss of range of motion, and decrease in ability to engage in activities of daily life. Our hands perform many functions that define us as human beings, including social interaction, self-care, communication, and expression. Due to this strong connection and application in daily life, hand injuries can have a significant psychological impact on the ability to make adjustments and recover from injury.[2,3]

The economic burden of acute hand injuries can be extensive and rise sharply with increased severity. Injuries sustained to the hand and wrist account for 20% of all emergency room presentations. A systematic review found that the median total cost per case was $6,951 in

studies that examined strictly cost of illness and $8,297 in studies that evaluated health economics.[4] It was noted that the individual cost varied greatly depending on many factors, but overall, hand and wrist injuries should be considered a significant burden to both the individual and society.

Medical costs of an injury that occurs on-the-job can be covered by the Workforce Safety and Insurance (WSI) of the state the injury occurred in when the individual files a Workers' Compensation Claim. WSI has adopted the Healthcare Common Procedure Coding System coding requirements from the Centers for Medicare and Medicaid Services (CMS) for the documentation and billing of time-based physical medicine and rehabilitation codes. This requires that a provider must spend 8 or more minutes in direct, face-to-face contact with the patient to bill for a single 15-minute unit.[5] Regulations can vary state to state, but in North Dakota specifically, a patient must be referred to physical therapy by a physician, treatment may not include more than two modalities, and 10 visits are allowed before authorization. If a medical provider verifies that the patient is unable to work, WSI North Dakota also reimburses wages at a rate of ⅔ the pre-injury weekly wage.[6]

While an acute hand contusion is not an injury that is completely preventable, certain risk factors may increase the likelihood of occurrence and should be identified and mitigated by the individual and the occupational setting. Individuals of a working age and the conditions of the workplace are directly involved in risk, including type of labor, specific tasks performed, and heavy equipment or machinery involved. Protective factors include safety training and protective gloves or other safety equipment.[7]

Research on the typical physical therapy treatment of a work-related hand contusion is significantly lacking. Due to the mechanism of injury typically involving a blunt force or

crushing action, ruling out fracture is a necessary first step. The treatment and plan of care varies significantly based on severity of injury and whether surgery and/or immobilization is involved. Early interventions should include a pain-free progression of passive, active-assisted, and active range of motion exercises to assist in edema removal and decrease the risk of contracture.[2]

A systematic review of prognostic factors for return to work following work-related traumatic hand injury identified that increased severity of injury and lower pre-injury income were related to increased time to return to work. The authors speculated that, in general, positions earning a lower income may often involve heavy physical labor or machinery, predisposing them to a more traumatic injury. Other factors such as age, gender, occupation, education, workers' compensation status, treatment related variables, location of injury, and personal factors did not have a significant effect on the length of time to return to work.[8] This is important to acknowledge in dispelling any biases related to a workers' compensation patients or claims.

Services provided by a physical therapist for a patient with a work-related hand contusion begin with a detailed examination to determine treatment options, prognosis, and plan of care. They will utilize methods to decrease pain and inflammation in the acute stage, gentle progression of range of motion and strengthening exercises in the sub-acute and chronic stages, and re-introduction of functional movements related to activities of daily life and return to work requirements. A physical therapist treating a patient with a workers' compensation claim will also work very closely with the referring physician and other members of the healthcare team to ensure the patient is treated as a whole person, rather than a diagnosis, and that requirements for the claim are met.

Functional outcome or quality of life measurements may be implemented by a physical therapist throughout the process due to the psychological aspects related to hand injury and loss of work. The QuickDASH (Disabilities of the Arm, Shoulder, and Hand) is a questionnaire that has been shown to exhibit high validity and, when utilized, could assist in identifying, intervening, and continually assessing a worker with an upper extremity musculoskeletal disorder.[9] A physical therapist plays a vital role in progressing a patient with a hand contusion from initial injury to returning to enjoyable activities and work, and would find benefit in a tool like this to continually adapt their patient-centered care approach.

The purpose of this case study was to explain the physical therapy interventions utilized for a patient with a work-related hand contusion and evaluate the outcomes of those interventions. This includes a description of the clinical decision-making process and individual factors that affected the plan of care. Due to a significant lack in research for this diagnosis, this case study also aimed to identify further areas of research that should be explored in order to provide the best quality of patient care.

CHAPTER II

CASE DESCRIPTION

Examination, Evaluation and Diagnosis

The patient was a 58-year-old male who complained of dorsal hand and third finger pain and swelling after the handle of a shovel slipped and fell on his hand at work on 10/28/19. He saw a physician on 11/06/19 in which X-Ray images were taken and a referral to physical therapy for evaluation and treatment was made. The physician placed the patient on "Restricted Duty." This involved the patient not performing any hard, repetitive, or prolonged grasping and no lifting greater than 5-8 pounds. The patient works construction, but is a seasonal worker, and at the time of the physical therapy evaluation on 11/07/19, he was finished working for the season.

The patient described pain and swelling between the dorsal 2nd and 3rd metacarpophalangeal (MCP) joints. When moving his hand, he felt a "sharp" 4/10 pain, and at rest, he described a "little ache," with no complete relief of pain. He denied any naturally occurring symptoms of numbness or radiating pain, although he experienced numbness in all five fingers upon wearing a compression glove that was not the right size for his hand. The patient was recommended to discontinue use of this device at that time. Upon questioning, the patient denied any prior history of injury to the area. The clinic was solely based on occupational medicine and utilized an electronic medical record that shielded the clinicians from most of the patient's medical history in an attempt to prevent bias in workers compensation claims. The

patient denied having any other medical conditions or history other than “taking cholesterol medications.”

His current medications included Lipitor, Claritin D, and Aspirin. Lipitor, also known as Atorvastatin or simply a statin drug, has a cholesterol lowering effect. Gastrointestinal side effects are common in patients taking this drug, including abdominal cramps, constipation, diarrhea, or heartburn. Other side effects a physical therapist should be aware of include dizziness, weakness, fatigue, chest pain, peripheral edema, rashes, rhabdomyolysis, arthralgia, myalgia, and hypersensitivity reactions.[10] Claritin D and Aspirin have the risk of similar side effects of the gastrointestinal system, dizziness, weakness, cramping, and a rash. A physical therapist should be aware of the common side effects of these drugs as they may alter treatment and recovery of the patient. The patient also identified allergies to hydrocodone, ibuprofen, naproxen, and oxycodone. These allergies limited the analgesics and, more so, the anti-inflammatory medications the physician may have prescribed to decrease the patient’s swelling and pain. While physical therapy aimed to resolve these symptoms, a combination of rehabilitation and non-opioid medication may have been beneficial, especially in the acute stage.

The patient was right-handed and noted increased pain with any activities of daily living that involved making a fist, grasping, or straightening his fingers. Even with very frequent pain, the patient was able to continue to be independent in his own care and activities, including driving to and from appointments. He lived in a home where snow removal was done for him, and he did not report any other issues with his ability to care for the home. Identifiable behavioral risk factors for this patient included a low fitness level and an endomorphic body type. Because this patient was not returning to work in the near future, his goals were simply to decrease pain and regain function in his right hand.

The patient was an appropriate candidate to receive physical therapy based on the physician's referral and anticipation of improvement with conservative treatment, the North Dakota Workers Safety Insurance regulations, and the patient's agreeable and stable state. An examination plan was created to compare the physical therapy diagnosis to the physician diagnosis, rule in or out differential diagnoses, determine prognostic factors, and determine the appropriate interventions. All of these items would assist in determining the overall plan of care, which would be updated as necessary.

During the history and examination, a review of systems was completed. The only direct complication in relation to this injury was to the musculoskeletal system. No disruption to the integumentary system was present and the patient denied any neurological signs or symptoms. The patient exhibited risk factors for cardiovascular disease that were considered during the course of physical therapy, but due to the specificity of the workers' compensation claim, this was being directly addressed by the patient's primary care physician. There were no apparent complications to the pulmonary, endocrine, or other systems due to this specific injury or that needed to be addressed in physical therapy.

Evaluation was based on Dutton's Orthopedic Examination, Evaluation, and Intervention.[11] Upon observation, minor swelling was noted between the dorsal aspect of the 2nd and 3rd metacarpophalangeal (MCP) joints of the right hand. The patient stated that the swelling had visibly gone down since the initial injury. No visible discoloration or deformity were present, but the patient held the fingers in a flexed position due to pain. With palpation, the only point of tenderness was between the 2nd and 3rd MCP joints of the dorsal right hand. When demonstrating range of motion, the patient was able to achieve full and pain-free active range of motion with elbow flexion, extension, pronation, and supination, all MCP, proximal

interphalangeal (PIP), and distal interphalangeal (DIP) joint motions of all fingers except the third finger on the right hand, and all thumb motions. Limited active range of motion or motions that provoked pain were measured with a goniometer and can be viewed in Table 1. Full passive range of motion was present in all directions, with pain noted only at end range wrist extension. Functionally, the patient was unable to place his right hand flat on the table or bear any weight through the hand due to significant pain.

Grip strength was assessed with a hand dynamometer with the elbow at 90 degrees to assess loss of strength and function. In 2020, a meta-analysis concluded that hand grip strength assessment had "excellent" reliability (ICC 0.95; 95% CI, 0.93-0.97; I^2=28%) and "very strong" validity scores in relation to other tools or a computerized grip strength assessment (correlation coefficient r=0.86).[12] A variety of emerging tools exist for assessing strength of the pinch motion. Research shows that there are strong intra-class correlations for both key and tripod (3pt) pinch positions, and high inter-instrument reliability between the three varieties of tools used, especially in the symptomatic patient population (ICC >0.90; 95% CI).[13] Pinch strength in the key and 3pt positions was assessed with a mechanical pinch gauge with the elbow at 90 degrees. Grip and pinch strength results can be viewed in Table 2.

Table 1.
Initial Wrist and Finger Active Range of Motion (In Degrees).

	Right	Left
Wrist Flexion	62	62
Wrist Extension	65 (5-6/10 pain)	75
Wrist Radial Deviation	22	35
Wrist Ulnar Deviation	30	42
3rd Finger MCP Flexion	65 (pain)	95
3rd Finger PIP Flexion	85 (pain)	90
3rd Finger DIP Flexion	68 (pain)	80
Finger Abduction	WNL (pain)	WNL
Finger Adduction	WNL (pain at end range)	WNL
3rd Finger Extension	Not assessed due to pain - could not achieve 0 degrees of extension	20 degrees hyperextension

Table 2.
Initial Grip and Pinch Strength (In Pounds).

	Right	Left
Power Grip	44 (8-9/10 pain)	112
Key Pinch	9 (6-7/10 pain)	24
3pt Pinch (Tripod)	6	17

Strength was assessed with manual muscle testing in various positions as indicated in the referred textbook.[11] For strength testing of the wrist, the patient was seated with their elbow at 90 degrees, forearm resting comfortably on the table, and wrist hanging off the end of the table. For the hand and finger strength testing, the position was the same, with the alteration of the hand being placed on the table. Wrist extension, flexion, radial deviation, ulnar deviation, pronation, and supination were all 5/5 strength, with 8-9/10 pain noted with wrist extension and flexion.

Flexion of the 3rd MCP, PIP, and DIP were all 4/5 with pain. Extension of the 3rd finger was 4+/5 in the limited range of motion. Fracture was ruled out with a negative finger percussion/compression test that involved axial compression to the distal phalanx. Acute fracture or other osseous injury had also been ruled out by an initial x-ray ordered by the physician and taken on 11/06/19. The compression test has a sensitivity of 0.673 and a specificity of 0.875, and can be beneficial in the case that an acute fracture is not yet visible on the initial x-ray.[14] Other special testing was not completed at the time of initial evaluation due to pain and no indication of other injuries.

Initial evaluation data indicated that the patient likely suffered a contusion to the area of the 2nd and 3rd MCP joints of the right dorsal hand, involving the 3rd extensor digitorum tendon. The injury to this area resulted in problems that included significant pain, increased inflammation, decreased range of motion, decreased strength, and overall loss of functional abilities in the right, dominant hand of the patient. This was consistent with the physician's diagnosis. The ICD-10 code relevant to this encounter was S60.221A Contusion of right hand, initial encounter.[15] To analyze the diagnosis further by relating the patient's condition to existing impairments, activity limitations, participation restrictions, and other positive or negative factors, the International Classification of Functioning Model (ICF) was utilized. (Appendix 1)

Prognosis and Plan of Care

While the patient was able to remain independent after the injury, his symptoms limited him from utilizing the right hand in many of his daily functions, including tasks such as opening a jar, twisting a doorknob, pinching objects, and placing his hand flat to bear weight in the right upper extremity. The patient was done working construction for the season, but had he still been

in season, would not have been able to perform necessary work duties under the physician's restrictions. While some rest time is beneficial to decrease acute symptoms, a concurrent loss can result from either under-utilization or over-utilization of the injured extremity. There is no evidence that indicates a recommended amount of rest time or expected recovery time for a patient with a hand contusion. Patient education on self-limitation according to pain was provided, which was intended to increase patient comfort and function, while also attempting to decrease the chronicity of the injury.

The patient's optimal level of functional improvement included a full return of strength, range of motion, and functional ability of the right hand, with no remnants of pain or swelling. Goals to achieve optimal improvement for this patient included decreasing pain, decreasing inflammation, increasing range of motion, and increasing strength (grip, pinch, and manual). The full list of documented goals can be viewed in Table 3. These goals were made to improve the patient's activities of daily living, functional hand and finger mobility, and ability to return to work duties when the season resumes.

Because there was no fracture or visible trauma to the skin, and the patient had increased healing time due to his work schedule, it was expected that the patient would be able to make a full recovery. The goals made were reflective of this expectation (Table 3). The plan of care addressed the patient's impairments and activity limitations through the use of stockinette compression garments, therapeutic exercise, iontophoresis, ultrasound, and education. The plan was also subject to change based on the physician's orders and the requirements of the workers compensation claim. Overall, the focus of physical therapy was centralized around the patient's goals, preferences, responses, and recovery process.

Table 3.
Short-Term and Long-Term Goals

Short Term Goals	Following PT intervention, the patient will be able to decrease pain to 2/10 when performing active ROM of the R hand to be able to decrease the risk of exacerbation of symptoms with activities of daily living. *To be met in 2 weeks.*
	Following PT intervention, the patient will be able to increase power grip strength to 50% of the L side in order to increase ability to grasp and hold onto tools related to construction work. *To be met in 2-4 weeks.*
Long Term Goals	Following PT intervention, the patient will be able to perform full pain-free range of motion of the wrist and fingers in order to perform all activities of daily living. *To be met in 4-6 weeks.*
	Following PT intervention, the patient will be able to increase grip strength to WNL as compared bilaterally to grasp and hold onto tools related to construction work. *To be met in 4-6 weeks.*
	Following PT intervention, the patient will be able to increase pinch strength to WNL as compared bilaterally to be able to process and complete construction related paperwork. *To be met in 4-6 weeks.*

CHAPTER III
INTERVENTION

The patient was seen 1-2 times per week for 30-minute sessions over a period of 6 weeks. Treatment was based on intervention strategies for hand injuries found in Dutton's Orthopedic Examination, Evaluation, and Intervention, and the patient's current symptoms and responses.[11] Initial intervention focused on decreasing the patient's symptoms of pain and swelling, with intention to progress to improving range of motion, strength, and overall function as symptoms resided.

Week one

The first week involved only the patient's initial evaluation session. After determining that the patient's complaints were likely the result of a contusion to the dorsal hand and acute fracture was ruled out, treatment of iontophoresis was chosen. Research has shown that iontophoresis may be used for pain and inflammation, polarized substances are more easily transferred through tissues with this method, and iontophoresis increases the tissue penetration of steroids.[16, 17] The patient had very localized swelling and pain that "fit" under the iontophoresis patch, which also aided in this choice. Iontophoresis with 1.5 mL Dexamethasone Sodium Phosphate (4mg/ml) was applied by placing the medicated patch over the space between the 2nd and 3rd MCP joints on the right dorsal hand, while the dispersive electrode was placed on the proximal medial forearm. The dose was set at 80 mAmp/min with a tolerated intensity of 2.5 mAmps, for a treatment length of 32 minutes.

The patient was educated on the importance of continuing rest, compression, and elevation to decrease the localized swelling. Recommendations for ice were held due to the patient reporting that it increased his pain. The patient presented with a compression glove that he stated made the tips of his fingers go numb after a few minutes of wearing it. At this physical therapy appointment, he was provided with a Tubigrip size D compression sleeve and a finger sleeve to wear instead of the compression glove.

The patient was also given "Six Pack" hand exercises and basic wrist range of motion to begin as tolerated as a home exercise program with the goal of keeping the joints moving to increase flow of fluid out of the area and maintain accessible mobility. The hand exercises included ten repetitions in a pain-free range of motion of tabletop position (MCP flexion, PIP and DIP extension), PIP and DIP flexion, finger abduction and adduction, opposition of thumb to all fingers, and finger extension (see Appendix 2). In 2018, a randomized control trial evaluated the effect of interdisciplinary care, extensive patient education, and intervention on grip strength in patients with osteoarthritis (OA) of the hand, utilizing the same "Six Pack" hand exercises and theraputty exercises utilized in this case.[18] Osteoarthritis may involve pain, swelling, stiffness, tenderness, loss of range of motion, reduction of grip strength, difficulties when performing tasks of everyday life, loss of productive work time, and a decreased ability to perform manual activities.[19] While the patient in this case was not diagnosed with osteoarthritis, he did experience many of these symptoms and, therefore, could experience similar results to those in this trial. The researchers found that the hand exercises, along with education and interdisciplinary care, resulted in a statistically significant improvement in grip strength.[18] The wrist movements for general range of motion maintenance and to improve the proximal movement of swelling were performed with the patients elbow at 90 degrees, forearm resting

comfortably on a table, and wrist hanging off the end of the table. They included ten repetitions of flexion, extension, radial deviation, ulnar deviation, pronation, supination, and circumduction in a pain-free range of motion.

Week Two

The second week's interventions involved two treatment sessions where gentle active and passive hand and wrist range of motion and "Six Pack" exercises were continued, along with introducing a peach (lightest resistance) theratubing for wrist flexion, extension, radial deviation, and ulnar deviation, stress ball squeezes, and isolated finger extension against gravity. The patient was also given the lightest resistance theraputty, an instruction sheet, and verbal instruction and demonstration for home use. This week, the patient progressed to being able to lay his hand and fingers flat on the table and increased his 3rd finger flexion range of motion by 15 degrees at the MCP, 7 degrees at the PIP, and 17 degrees at the DIP, although he still rated pain from 2-4/10 with mild activity (Table 4).

Ultrasound was utilized this week to decrease pain and increase tissue extensibility. Ultrasound is used to facilitate healing and range of motion, treat joint contractures, pain, and inflammation, and moderate scar formation in hand injuries.[16] Animal studies have also shown some indication that ultrasound alone or in combination with cryotherapy reduces oxidative muscle stress and increases tissue repair after musculoskeletal contusion.[20,21] The first session involved only the dorsal aspect of the 3rd MCP joint and proximal phalanx. The parameters used were a frequency of 3.3 MHz, Continuous-100% Duty Cycle, intensity of 1.0 W/cm 2, and a treatment time of 8 minutes. The parameters for the second ultrasound session were the same, except for increasing the time to 10 minutes to include the palmar side of the 3rd proximal phalanx of the right hand due to reports of pain in that area.

Week Three

The third week's interventions involved increasing the patient's wrist exercises to ten repetitions with orange Theratubing (next resistance level), adding ten repetitions of finger abduction and adduction with a hand web, a red flexbar for twisting motions, and pronation and supination with a 2-pound weight. This week, the patient's power grip strength increased by 20 pounds, key pinch increased by 9 pounds with 3-4/10 pain, and 3-pt pinch increased by 5 pounds with 1-2/10 pain (Table 4). Based on a discussion with the patient about the perceived effectiveness of previous treatments, an intervention of either ultrasound or iontophoresis was presented as an option. The patient felt iontophoresis was giving him the most pain relief, so 1.5 mL of Dexamethasone Sodium Phosphate (4mg/ml) was applied to the dorsal aspect of the right hand between the 2nd and 3rd MCP joints to decrease pain and inflammation. The dose was 80 mAmp/min and intensity tolerated was 2.1 mAmps, for a treatment time of 38 minutes.

Week Four

The fourth week's interventions involved decreasing the strengthening exercises per order of the physician, as the patient was still having some pain with movement. Only the "Six Pack" hand exercises, ball squeezes, and third finger extension were continued this week. Iontophoresis was applied, with placement of the medicated patch horizontally over the 2nd through 3rd MCP joints of the right dorsal hand, rather than vertically between them. With this placement, the patient was able to tolerate an intensity of 4.0 mAmp at a dose of 80 mA/min for a total treatment time of 20 minutes.

Week Five

The fifth week's interventions involved continuing with only the range of motion exercises and the ball squeezes. Isolated 3rd finger extension was too painful for the patient, so passive range of motion in this direction was utilized instead within a pain free range. The patient reported a small scab where the iontophoresis had been placed the previous week, but had no associated complaints. Through conversation with the patient, it was decided that this week ultrasound would be used in the same parameters as previous sessions. Treatment was centralized over the dorsal 3rd MCP joint and the dorsal proximal phalanx of that finger with a frequency of 3.3 MHz, Continuous-100% Duty Cycle, intensity of 1.0 W/cm 2, and a treatment time of 8 minutes. Towards the end of the week, the patient's pain was down to a 1-2/10, and he felt he was only limited by a few degrees at the end range of motion, which was confirmed with goniometric measurements (Table 4).

Table 4 Intermediate Measurements

	Week 2		Week 3	Week 4	Week 5
Wrist Extension	65° (1-2/10 pain)	73°	77° (3/10 pain)	-	-
3rd Finger Flexion (MCP)	73° (6/10 pain)	80° (3/10 pain)	76° (2/10 pain)	-	80° (pain)
3rd Finger Flexion (PIP)	90° ("mild" pain)	92° (4/10 pain)	88°	-	85°
3rd Finger Flexion (DIP)	75° (pain in PIP)	84° (pain in MCP)	85° (1/10 pain)	-	85°
Power Grip Strength	-	-	64#	-	-
Key Pinch Strength	-	-	18# (3-4/10 pain)	-	-
3pt Pinch Strength	-	-	11# (1-2/10 pain)	-	-

A dashed line (-) indicates that the measurement indicated was not taken that week
Pain was only present if listed. If no pain scale was listed, pain was recorded as a 0/10.

Week Six

The sixth week's interventions involved continuing the range of motion exercises, ball squeezes, and passive third finger extension. Ten repetitions of light weight bearing of the hand on a table with the elbow at 90 degrees were added. This week, the patient was reassessed utilizing the same techniques as the initial evaluation. In general, the patient improved in strength and range of motion, but still showed a moderate strength deficit with power grip and 3-pt pinch. On 12/12/19, the patient had a follow up appointment with his physician regarding his status. The physician recommended discontinuing physical therapy and his home exercise program. If the patient's symptoms should again increase, his claim could be reopened, and treatment would resume.

CHAPTER IV
OUTCOMES AT DISCHARGE

Over a period of six weeks, this patient made improvements in pain, manual strength, and range of motion. This was achieved by initially focusing on inflammation and pain relief, progressing to range of motion and simple strengthening exercises as tolerated, and alternating ultrasound and iontophoresis treatments. Objective and subjective outcome measures, including pain rating, range of motion, and strength, were utilized to assess the effectiveness of physical therapy intervention. The patient was reassessed often throughout the six weeks to continually monitor progress. Initial and final information can be seen in Tables 5 and 6. In addition, manual strength was reassessed with manual muscle testing. Wrist extension, flexion, radial deviation, ulnar deviation, pronation, and supination were all 5/5 strength, with no reported pain. Flexion and extension of all joints of the third finger were 5/5 with 3-4/10 pain.

Table 5.
Initial and Final Grip and Pinch Strength (in Pounds).

	Initial Evaluation		Final Evaluation	
	Right	Left	Right	Left
Power Grip	44 (8-9/10 pain)	112	60 (3-4/10 pain)	118
Key Pinch	9 (6-7/10 pain)	24	20	24
3pt Pinch	6	17	11 (3-4/10 pain)	25

Table 6.
Initial and Final Wrist and Finger Range of Motion (in Degrees).

	Initial Evaluation		Final Evaluation	
	Right	Left	Right	Left
Wrist Flexion	62	62	62	62
Wrist Extension	65 (5-6/10 pain)	75	68	73
Wrist Radial Deviation	22	35	31	35
Wrist Ulnar Deviation	30	42	39	42
3rd Finger MCP Flexion	65 (pain)	95	85	92
3rd Finger PIP Flexion	85 (pain)	90	92	92
3rd Finger DIP Flexion	68 (pain)	80	90	90
Finger Abduction	WNL (pain)	WNL	WNL "stiffness"	WNL
Finger Adduction	WNL (pain at end range)	WNL	WNL	WNL
3rd Finger Extension	Not assessed due to pain - could not achieve 0 degrees of extension	20 (hyperextension)	2 (hyperextension) (4/10 pain)	20 (hyper-extension)

Many of the goals set were met or improved by the time of the final physician appointment. Because of the proximity of disciplines within the clinic, interprofessional care and discussion was a daily practice; therefore, all members of the team were aware of the patient's progress. It was decided at this appointment that physical therapy care would be discontinued at

that time but could resume if the patient regressed. During the final session of physical therapy, right wrist and finger range of motion improved to within 5 degrees of the L side. Pain with range of motion was only experienced in the hyperextension range of finger extension. This allowed the patient to flatten his hand on a surface and bear some weight through his right upper extremity. All manual muscle testing of the wrist and fingers was graded as 5/5 (3/10 pain with 3rd finger flexion and extension). Power and 3pt Grip Strength were limited by approximately 50% with 3-4/10 pain. While the long-term goal was not achieved, reduction from previous pain with these motions allowed the patient improved comfort with gripping activities of daily living such as turning a doorknob and opening a jar.

The patient reported compliance with the portion of the home exercise program that included basic hand range of motion, but was non-compliant with the theraputty. This may have further increased strength of the intrinsic muscles of the hand and improved his prognosis. He tolerated the intervention and treatment process well, reporting few cases of soreness and a small scab from iontophoresis. No other adverse events occurred during the course of treatment.

A clinometric functional outcome measure was not utilized for the patient in this case study. One assessment that could have been provided is the shortened version of the Disabilities of the Arm, Shoulder, and Hand questionnaire, known as the QuickDASH. This assessment has shown to have strong validity in workers with upper extremity musculoskeletal disorders, with the added ability to differentiate severity of injury.[22] This assessment also has a specific module related to work, increasing its applicability to this patient. In general, this assessment has also been found to have excellent test/retest reliability and a minimal clinically important difference of ten points for patients with upper extremity musculoskeletal conditions.[9,23]

Overall, the patient felt that he was progressing with the physical therapy intervention he was provided. At times, he did explain frustration with continued pain and length of prognosis. The patient had not previously experienced an injury to the hand and originally underestimated the severity of his injury in relation to his function. Education on self-limitation according to symptoms was helpful in overcoming this mindset. Although the patient experienced both positive and negative feelings regarding his injury process, in general, it appeared that the patient was satisfied with the care he received in physical therapy. In this case, the benefits of regaining hand function delivered by physical therapy outweighed the cost to the patient.

CHAPTER V
DISCUSSION

Overall, this patient with a work-related hand contusion made significant gains in some areas, while still needing improvement in others to return to his full previous function. After the ninth physical therapy visit, the patient had a follow-up appointment with the physician, who decided to discontinue physical therapy and the patient's home exercise program at that time. The patient was currently out of work for the season, allowing him extra time to heal, but it will remain unknown if continued physical therapy would have benefitted the patient's functional abilities.

There are currently no other studies that evaluate a patient with a work-related hand contusion. Work-related traumatic hand injuries can range from minor cuts/burns to more serious injuries involving man and machine interaction. While this patient's diagnosis, by definition, falls under traumatic hand injury, many of those cases involve a significant crushing force, degloving mechanism, extensive surgery, amputation, or additional splints and devices. This case study provides a look into a patient with a "less-traumatic" hand injury that exhibited substantially decreased function. Additional research is indicated to provide a framework for treatment in these less severe, but still debilitating cases.

Reflective Practice

Communication with this patient proved to be difficult because he lacked the ability or desire to describe his injury, symptoms, and functional issues in detail. My questions were often

met with an “I don’t know” or a simple grunt, even when asked in a variety of ways or using demonstration to assist. In retrospect, I may have had more success utilizing questions with direct and specific examples, rather than open-ended questions. While this could have limited the patient’s responses, I may have received more answers that dictated the treatment process or goals. In the subjective history portion, I would specifically have asked more questions about his limitations in function and daily tasks to gauge a better idea of his home life, since he was not currently working.

The examination procedure would not have changed, as the initial injury was very irritable, and I do not believe the patient would have benefitted from an array of other tests. Because of the very specific location of pain between the 2nd and 3rd MCP joint of the right hand and the mechanism of a shovel falling on this area, the only major differential diagnosis to rule out was a fracture. This was ordered by the physician and interpreted to be negative prior to the initial physical therapy visit. Physical therapy examination confirmed this finding as a fracture may not have been visible on the initial imaging. The examination procedure focused more on the patient’s range of motion and strength, which were more applicable to his function.

For the plan of care, it may have been beneficial to progress slower through the exercises used for the patient. Although he continued to make small improvements throughout each visit, the physician still felt there was a need to back off and simply perform range of motion. This affected my practice by wondering if too much was added in the initial stages. After this recommended change, my practice was also affected by feeling limited in the variety of exercises I could utilize, leaving me to continue the same exercises for the last five sessions. As far as the use of iontophoresis and ultrasound to decrease pain, initiate the healing process, and increase

tissue extensibility, I maintain that I would educate the patient on both modalities, continually assess their effectiveness, and allow his choice to dictate which he preferred.

I would not have sought out a different discipline at the beginning of the episode of patient care, however, as the patient was still experiencing pain at the six-week mark, I may have considered a referral at this point. I think that both receiving an MRI and visiting a hand specialist may have benefitted this patient's long-term recovery. Near the end of my time with the patient, his remaining pain seemed to originate from the soft tissue, mainly the flexor and extensor tendons of the third finger on the right hand. On the dorsal portion of the patient's hand, where the shovel impacted him, also lies a retinaculum that holds the extensor tendon in place. An MRI would be able to discriminate any injury to the tendons or retinaculum that could have altered the patient's plan of care. A hand specialist may have been required if surgical intervention or injection was warranted. A barrier to the referral process is that the patient was under Workers Safety Insurance, which is particular on what they will cover. In order to make referrals out to other disciplines or for additional imaging that would be covered by this insurance, it would have to be documented and proven that extensive conservative treatment had failed.

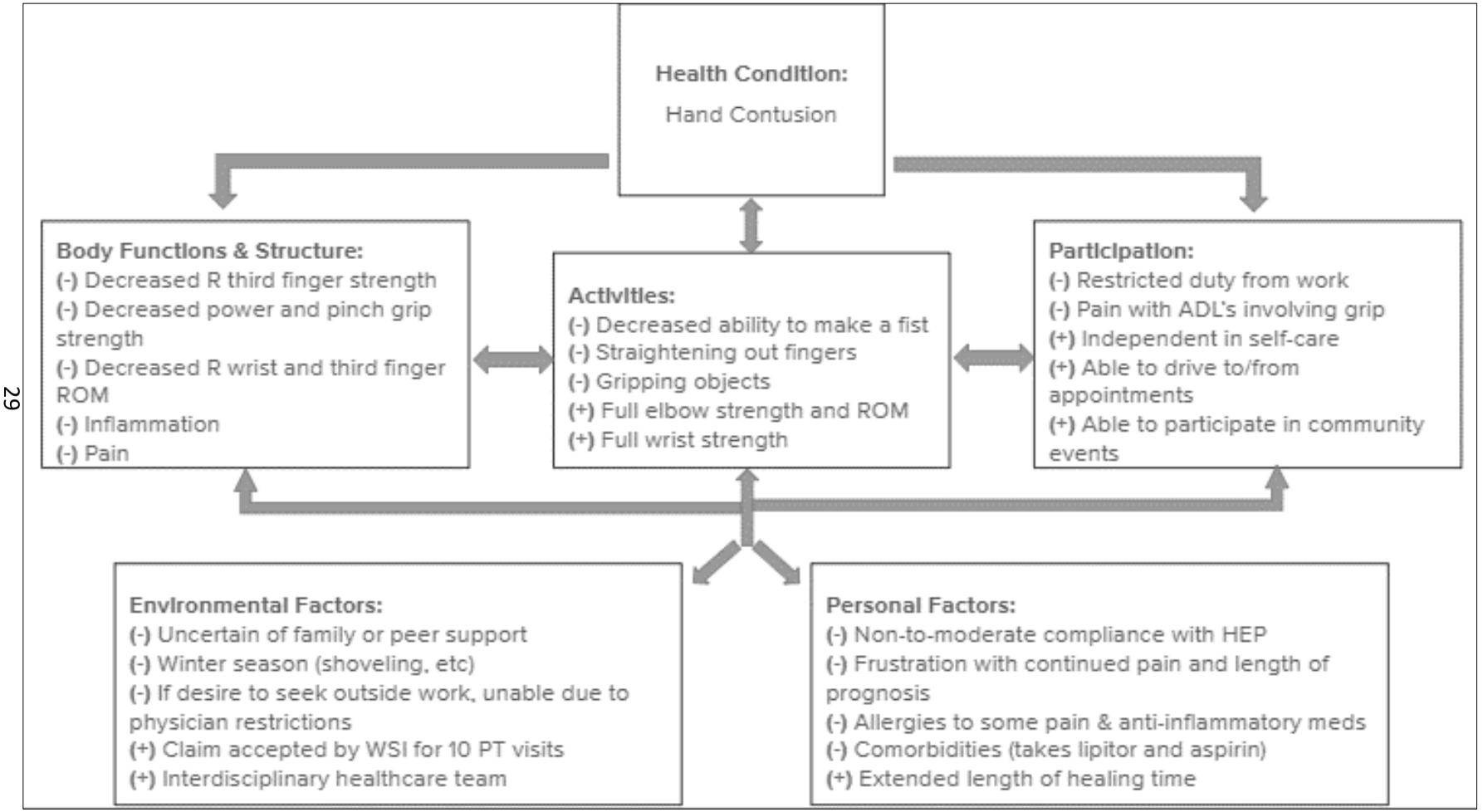
While the main differential diagnosis in this case was fracture, which was ruled out prior to the first physical therapy visit, the diagnosis of "hand contusion" is extremely broad and would benefit from additional definition to rule out various structures that could be injured. Further evidence in differentiating between contusion of bone, tendon, or connective tissue structures is warranted to better individualize and increase efficiency of treatment. Knowledge of this differentiation may have altered the intervention and overall plan of care.

Because this patient's injury occurred while he was working construction, a Worker's Compensation claim was filed and approved, and the total cost of care was covered by Workers Safety Insurance (WSI). The patient was finished working construction for the season, and not working any other jobs, meaning that he was not losing any wages as a result of his injury and the physician-placed restrictions. The total cost of physical therapy care billed to WSI amounted to $448.97, or around $50 per visit. This cost is reasonable based on the fact that hands are vital to our function, and skilled therapy can prevent long term disability and lost wages. At the time the physician discontinued physical therapy care, the patient had regained nearly all range of motion and moderately increased his strength. Outcomes would have likely continued to improve if physical therapy was continued, and further prepared this patient for return to his occupation when the season resumed. If the patient did not have allergies to medications, over-the-counter anti-inflammatory medications could have been utilized to assist in decreasing swelling and pain per physician instruction. Had the patient not had increased discomfort with application of ice, this may have been an additional treatment for swelling and pain. These alternate forms of treatment may have decreased the need for more expensive modalities used in physical therapy such as ultrasound and iontophoresis. In this case, choices in treatment based on cost were limited due to individual patient factors. An algorithm on the decision-making process for this patient's examination, intervention, and plan of care can be viewed in Appendix 3.

This case has taught me the importance of advocating for the best care for your patient. In this setting, the course of a workers' compensation claim was largely dictated by the physician. Those in the profession of physical therapy continue to push for more autonomy in practice, which made it difficult at times to sit back and watch the physician make vital calls, such as ending physical therapy without consulting the healthcare team. In continuing my education

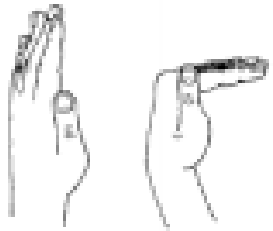
through clinical rotations and the start of my career in physical therapy, my goal is to take as many opportunities as I can to increase my confidence in practicing autonomously, while taking into account and utilizing the strengths of the healthcare team. When many disciplines come together to provide what's best for the individual patient, successful outcomes follow.

APPENDIX 1


Health Condition:
Hand Contusion
Body Functions & Structure:
(-) Decreased R third finger strength
(-) Decreased power and pinch grip strength
(-) Decreased R wrist and third finger ROM
(-) Inflammation
(-) Pain
Activities:
(-) Decreased ability to make a fist
(-) Straightening out fingers
(-) Gripping objects
(+) Full elbow strength and ROM
(+) Full wrist strength
Participation:
(-) Restricted duty from work
(-) Pain with ADL's involving grip
(+) Independent in self-care
(+) Able to drive to/from appointments
(+) Able to participate in community events
Environmental Factors:
(-) Uncertain of family or peer support
(-) Winter season (shoveling, etc)
(-) If desire to seek outside work, unable due to physician restrictions
(+) Claim accepted by WSI for 10 PT visits
(+) Interdisciplinary healthcare team
Personal Factors:
(-) Non-to-moderate compliance with HEP
(-) Frustration with continued pain and length of prognosis
(-) Allergies to some pain & anti-inflammatory meds
(-) Comorbidities (takes lipitor and aspirin)
(+) Extended length of healing time

APPENDIX 2

Six Pack Active Hand Exercises

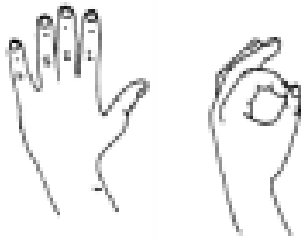


1) **Imaginary Tabletop.** Make a tabletop with your fingers by keeping your wrists and your fingers straight. Bend only at the knuckles.

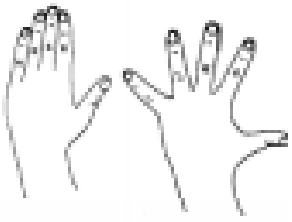
2) **Knuckle Bend**. Keep your knuckles and wrist straight. Bend and straighten your fingers.

3) **Make a Fist.** Make a fist, being sure each joint is bending as much as possible.

4) Straighten your fingers as much as possible

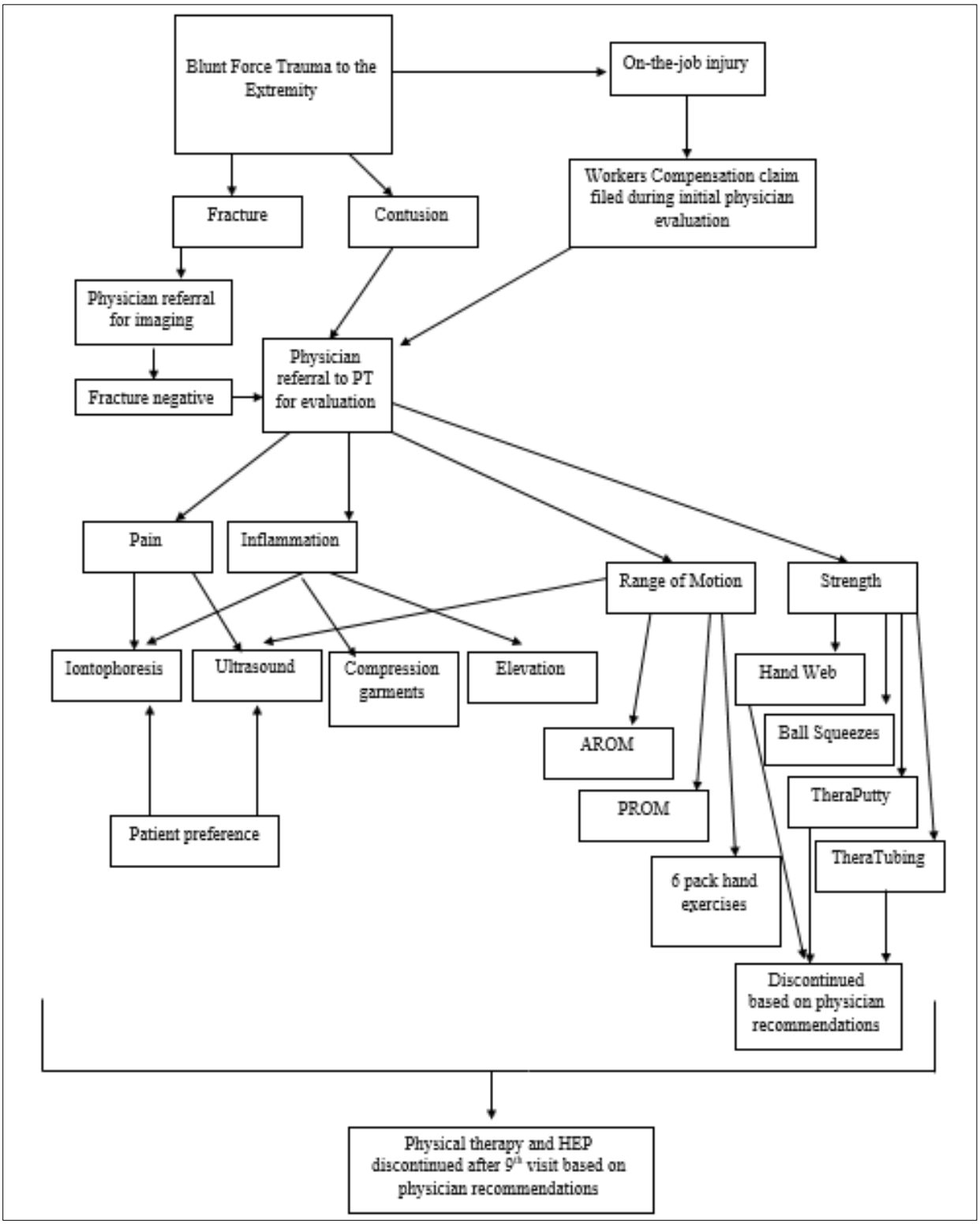


5) **Make "O's".** Make an "O" by touching your thumb to your fingertips, one at a time. Open your hand wide after touching each finger.



6) **Table Spread.** Rest your hand on the table with the palm down. Spread your fingers wide apart and bring them together again.

APPENDIX 3


Blunt Force Trauma to the Extremity
On-the-job injury
Workers Compensation claim filed during initial physician evaluation
Fracture
Contusion
Physician referral for imaging
Fracture negative
Physician referral to PT for evaluation
Pain
Inflammation
Range of Motion
Strength
Iontophoresis
Ultrasound
Compression garments
Elevation
Hand Web
Ball Squeezes
AROM
TheraPutty
PROM
TheraTubing
6 pack hand exercises
Patient preference
Discontinued based on physician recommendations
Physical therapy and HEP discontinued after 9th visit based on physician recommendations

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