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Outpatient Physical Therapy Rehabilitation for a Patient with Wrist Pathology

Amy Svir

Outpatient Physical Therapy Rehabilitation for a Patient with Wrist Pathology

by

Amy Svir

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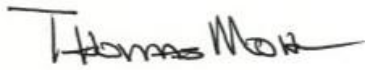
This Scholarly Project, submitted by Amy Svir in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.



(Graduate School Advisor)

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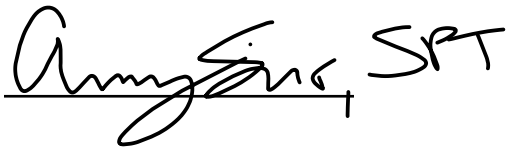
Signature 

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ABSTRACT

Case Description. This case report describes the physical therapy evaluation and intervention for a 14-year-old female with right wrist pathology. The patient presented with increased pain as well as decreased function, decreased active range-of-motion (AROM), decreased passive range-of-motion (PROM), and decreased wrist strength. **Plan of Care and Intervention.** The treatment for this patient was a combination of iontophoresis administration of dexamethasone, manual therapy in the form of instrument-assisted soft tissue mobilization (IASTM) and joint mobilization, and therapeutic exercise. Iontophoresis was used to transfer dexamethasone, an anti-inflammatory medicine, into the affected area. **Outcomes.** After 8 treatment sessions, the patient had decreased pain (0/10) and improved functional ability. She also reached within normal limits AROM, PROM, and strength in the right wrist. At discharge she was very close to functioning the way she did before the injury. **Discussion.** Treatment was developed considering evidence-based articles, current knowledge, and the patient's symptoms. Treatment was altered based on the patient's progression. The improvements made suggest that a combination of iontophoresis, manual therapy, and therapeutic exercise had positive effects on the wrist pathology.

Key words: iontophoresis, dexamethasone, manual therapy, therapeutic exercise

CHAPTER I

BACKGROUND AND PURPOSE

There are numerous diagnoses that may cause pain to the distal posterior forearm/posterior wrist. Possible diagnoses include fractures, soft tissue injuries, and bone contusions. Some of these diagnoses present with very similar symptoms and can be caused by similar events.

Fractures to the wrist can be of any carpal bone. They are commonly caused by a fall on an outstretched hand (FOOSH), a crush or direct blow to the wrist, axial loading from a metacarpal bone, or hyperextension of the wrist.[1] Patients with carpal fractures typically have painful, swollen wrists, tenderness at the wrist, and increased pain with movement of the wrist. X-rays may be the first diagnostic imaging for this condition, but it is very common for carpal bone fractures to be missed on X-rays.[1]

The most commonly fractured carpal bone is the scaphoid. Risk factors for this fracture include participation in high-impact contact sports or involvement in a high-impact traumatic injury, such as a fall or a motor vehicle accident. Symptoms for a scaphoid fracture include wrist pain towards the radial side, pain with thumb movement, reduced hand grip strength, tenderness at the anatomic snuffbox and scaphoid tubercle, and pain with axial pressure to the thumb.[2]

Other fractures causing pain to the wrist other than those found within the carpal bones could occur to the distal radius, the distal ulna, or the distal radioulnar joint. A

distal radius fracture is the most common fracture of the upper extremity and is usually caused by a direct blow, a FOOSH, or a motor vehicle accident. People most likely to obtain this injury are young males involved in high-energy activities and elderly females with osteoporosis. Symptoms of a distal radial fracture are swelling and tenderness over the distal radius.[3] A distal ulnar fracture is commonly caused by the three events that also cause a distal radial fracture. Ulnar fractures account for 44% of all forearm and hand fractures in people living in the United States.[4] Symptoms of this injury can include swelling and tenderness over the ulnar side of the forearm.[4] A distal radioulnar joint fracture (or dislocation) may be caused by a FOOSH most commonly combined with a rotational force. Symptoms of a distal radioulnar joint fracture are pain, swelling, tenderness, and bruising to the central distal dorsal forearm. People with this fracture also may feel increased pain with supination and may have limited forearm and wrist range of motion.[5]

Two dislocations that may cause dorsal wrist pain are lunate dislocations and scapholunate dislocations. A lunate dislocation is when the lunate is shifted anteriorly but the distal radius and capitate maintain normal alignment. This may be caused by a FOOSH or a high-energy trauma. The lunate may appear triangular in a radiograph as a result of its displacement.[6] A scapholunate dissociation occurs when the ligaments holding the scaphoid and lunate together rupture. A FOOSH may result in this injury. It is the most common injury causing instability of the carpal bones.[7] Symptoms of a scapholunate dissociation include a painful, swollen wrist, pain with hand grip, numbness and weakness to where the median nerve distributes, and a positive Watson test.[7]

One of the most common causes of ulnar-sided wrist pain and limited wrist function is a triangular fibrocartilage complex (TFCC) tear. A FOOSH can cause this condition or the TFCC could tear due to natural degenerative changes. People who participate in sports that require repetitive axial loading, rotation, and radial/ulnar deviation, such as golf, tennis, or baseball, have an increased risk for a TFCC tear. People with chronic distal radioulnar joint instability are also at an increased risk. A TFCC tear can be suspected if the patient experienced a recent acute injury, such as a FOOSH, traction or twisting of the wrist or forearm, or an object falling on the wrist that is pronated and extended.[8] This injury is characterized by ulnar sided wrist pain, increased wrist pain with forearm supination and pronation, distal radioulnar joint instability, clicking in the distal radioulnar joint, decreased wrist range of motion, decreased hand grip strength, impaired wrist function, and a positive ulnar fovea sign.[8]

Common soft tissue injuries to the wrist and forearm due to overuse or trauma are forearm splints, forearm exertional compartment syndrome, and intersection syndrome. Forearm splints are a strain from a static contraction. The main symptoms of forearm splints are a dull ache between the extensor muscles of the forearm, weakness of the forearm extensor muscles, and tenderness with palpation of the interosseous membrane and the surrounding tissue.[9] Forearm chronic exertional compartment syndrome may be caused by a muscle avulsion, a distal radial fracture, or a crushing injury.[10] These traumatic injuries create pressure from edema in the fascial compartments, which exceeds perfusion pressure of the muscle.[5] Flexor digitorum profundus, flexor pollicus longus, and pronator quadratus are most susceptible to this injury.[9] This condition presents with swelling and pain that increases as the condition

progresses. Pain is produced from passive stretching and active contraction of the forearm.[5] Finally, intersection syndrome is an overuse syndrome that occurs when the abductor pollicis longus and extensor pollicis brevis muscles cross over the extensor carpi radialis longus and extensor carpi radialis brevis tendons causing rubbing, friction, and inflammation. The patient presents with pain, tenderness, swelling, and redness on the dorsal radial side of the distal forearm as well as crepitus from flexion and extension of the wrist.[9]

Wrist sprains and wrist tendonitis are common injuries. A wrist sprain is most commonly caused by a FOOSH, however any abnormal, forced movement of the wrist can also cause this injury. A wrist sprain is characterized by pain, swelling, and limited range of motion of the wrist. Wrist tendonitis usually occurs from repetitive wrist accelerations and decelerations. The patient may feel pain with active motion or passive stretch. There will also likely be swelling and tenderness over the affected wrist tendon.[10]

There is limited research on bone contusions in the forearm and wrist as a majority of the literature delves into those found within the knee. Bone bruises are defined as bone marrow edema and can happen within any area of the body containing bone marrow, including the forearm and wrist.[11] There are three types of bone bruises; subperiosteal hematoma, interosseous bruise, and subchondral lesion. Subperiosteal hematomas are usually the result of a traumatic blow to the bone, interosseous bruising results from frequent extreme pressure to the bone, and subchondral lesions occur from a crushing injury or a twisting force to the bone.[11,12] Signs of a bone bruise include

swelling and pain near the area of injury as well as limited range of motion of the joint near the injury and pain and stiffness with muscle contraction.[13]

The physical therapy interventions for these diagnoses varies. A possible treatment to decrease pain and inflammation from a wrist injury is the administration of dexamethasone via iontophoresis. Iontophoresis is a noninvasive technique to introduce medication into the body tissues with a direct electrical current.[14] Advantages of using iontophoresis are that it produces little to no patient discomfort and it facilitates the transmission of medication into the body tissue. When compared to topical application of a medication, iontophoresis decreases the amount of time the body needs to absorb the medication and increases the delivery rate. When compared to oral administration, iontophoresis has the advantage because it does not have to be absorbed by the gastrointestinal tract and it concentrates in a specific area. When compared to injection administration of a medication, iontophoresis decreases the risk of skin infection and damage as well as decreases patient discomfort. Furthermore, a key advantage of iontophoresis is it decreases the patient's ability to develop a tolerance for the medication by releasing the medication at both a high and a sustained rate.[14]

A systematic review of twenty-four studies comparing the effect of iontophoresis with a placebo was conducted and ten of those studies were pooled for meta-analysis. The results indicated evidence that iontophoresis was effective in treating pain. The heterogeneity between studies was low to moderate.[15] Other research suggests the evidence for the efficacy of iontophoresis in treating inflammatory musculoskeletal conditions is limited and needs more exploration.[16] Gurney and Wascher studied the efficacy of iontophoresis in delivering dexamethasone to the body tissue. They found

that of 16 people who received true iontophoresis, 8 had measurable amounts of dexamethasone after 4 hours, and of 13 people who received dexamethasone without the iontophoresis machine turned on, 1 person had measurable amounts of dexamethasone in their body tissue after 4 hours. This evidence indicates that iontophoresis does facilitate the transmission of dexamethasone into the body tissue.[17]

Another treatment for pain and inflammation from a wrist injury is instrument-assisted soft tissue mobilization (IASTM). Musculoskeletal injury can produce scar tissue that causes muscle tightness and decreased range of motion to the nearby joint. IASTM is used to break down this scar tissue and adhesions by producing an inflammatory response. This in turn provokes the remodeling and healing of the injured tissue.[18] A systematic review of the effectiveness of IASTM examined seven studies and found that a majority of them indicated significant improvements in pain and/or range of motion with the use of IASTM when compared to other conservative treatment strategies.[19]

Many of the diagnoses described above also indicated a loss of range of motion of the wrist joint. Range of motion exercises can be performed to enhance the wrist's range of motion.[20] According to Dutton[20], the benefits of active range of motion exercises include maintaining or improving the elasticity, strength, and endurance of the muscle being exercised, enhancing blood circulation to the joint, and providing sensory awareness of the joint.

CHAPTER II

CASE DESCRIPTION

History, Examination and Evaluation

The patient was a 14-year-old female who came to physical therapy with right wrist pain. This pain was caused by a fall on the ulnar aspect of the right forearm. The patient did see a doctor who gave her a brace and ordered an MRI and two X-rays. The scans showed no abnormalities in the right wrist. The doctor suggested that it could be a possible bone bruise and referred her to physical therapy. The patient rated her pain at initial evaluation of a 5/10 at rest and a 6/10 during activity. She has pain and difficulty with cleaning, writing, and putting weight through her right upper extremity. She wears the brace the doctor gave her throughout most of the day and night. She wishes to reduce her pain and improve her ability to accomplish tasks with her right arm, such as writing in school.

Examination was based on “Dutton’s Orthopaedic Examination, Evaluation, and Intervention”.[21] During the initial evaluation, the patient filled out a functional assessment questionnaire and was tested for tenderness from palpation, AROM, PROM, and strength. The Upper Extremity Functional Index (UEFI) was completed.[22] The patient scored 19/80 indicating 24% maximal function out of 100%. During palpation to the entire right hand, wrist, and forearm, the patient felt tenderness from her medial, posterior, and lateral wrist to the middle of her posterior forearm.

AROM was tested with the patient seated, and with her upper arm placed at her side and her elbow flexed to 90 degrees. The patient's AROM measurements from the initial examination are listed in Table 1. The normal ranges are from Dutton's textbook.[21] All the limited motions in the patient's right upper extremity were limited by pain. The patient reported pain when making a fist, however she exhibited right finger and thumb motions that were within normal limits. All of her left elbow, wrist, and hand motions tested within normal limits.

PROM was tested with patient seated, with her arm placed at her side and with her elbow flexed to 90 degrees. The patient displayed normal end feels in all wrist motions bilaterally, except right supination. The patient had 70 degrees of passive right supination and demonstrated a hard end feel.

The patient's strength was tested with both arms at her side and with the elbows flexed to 90 degrees. All left wrist motions tested 5/5. All right wrist motions, except supination, tested 5/5 with pain. Right supination tested 4/5 with pain.[21]

Table 1. Active Range of Motion Measured at Initial Examination.

Motion	**R**	**L**	**Normal Ranges**
Wrist Extension	46º	69º	70-90º
Wrist Flexion	60º	75º	80-90º
Ulnar Deviation	22º	42º	30-45º
Radial Deviation	15º	28º	15º
Pronation	92º	100º	75-90º
Supination	43º	95º	85-90º

The examination test results indicated limited right wrist AROM, PROM and strength. The patient reported right wrist tenderness with palpation. The patient's functional assessment score indicated that she can only function about 24% out of 100%. Five goals were developed for the patient based on her evaluation and functional assessment score. The goals were as follows: 1) at the end of the physical therapy intervention the patient would have reduced pain to less than 2/10 during rest and activity, 2) increased right wrist AROM to match the left wrist, 3) increased right supination PROM to match the left side, 4) increased right wrist strength in all motions to 5/5 with no pain, and 5) increased UEFI to at least 90% maximal function.

CHAPTER III.

PLAN OF CARE AND INTERVENTION

The patient was to be seen in physical therapy two times per week. The combination of manual therapy, therapeutic exercise, and iontophoresis administration of dexamethasone was used during the first 5 treatment sessions and were administered in that order. Treatment session interventions varied during the next 3 sessions.

A hot pack was applied to the anterior and posterior right wrist for 10 minutes prior to starting the manual therapy intervention. IASTM was performed to the patient's medial, posterior, and lateral distal forearm for the first 6 treatments to loosen the tissue, promote blood flow, and facilitate healing by reducing pain and improving function.[19] Radio-ulnar joint mobilizations grades III and IV were performed during the 6th and 7th treatments to help increase right wrist supination.

A home exercise program was given during the initial evaluation. Exercise was included with the other interventions during all the outpatient physical therapy sessions. The physical therapy exercises started with AROM for right wrist flexion and extension, radial and ulnar deviation, and supination and pronation. Resistive exercises were gradually added and were progressed with a red TheraBand during the 4th treatment and a green TheraBand during the 7th treatment session. Along with these exercises, handgrip squeezes were incorporated during the 3rd treatment using a 6-pound

handgrip. Those same exercises were continued at home throughout the rest of the physical therapy visits. A supination stretch using the left hand to twist the right forearm into supination was added during the 6th treatment to further increase right supination. All the strengthening exercises included a set of 10 repetitions with a 5 second hold during each repetition. The strengthening exercises were gradually progressed to 20 repetitions per set. The stretching exercises were to be completed a set of 3 repetitions with 15 second holds during each repetition. All exercises were to be performed two times per day.

Dexamethasone was administered via iontophoresis for the first 5 treatment sessions to reduce swelling and pain in the patient's right wrist. A medium sized electrode with 2 cc's of dexamethasone was applied to the patient's posterior distal forearm. The reason to use a medium sized electrode was because the treatment area was too broad for a small electrode and the patient's arm was too small for a large electrode. Two cc's of medication was used because the commercially produced medium sized electrode indicated that 2 cc's was the recommended amount. The ground electrode was applied to the patient's anterior proximal forearm to allow enough separation between the two electrodes to prevent burns. The dose of medication delivered during treatment was measured as 80 mA/min. A typical iontophoretic medication delivery dose according to Scifers and Prentice is between 0 and 80 mA/min.[23] In order to follow the milliamperes-minutes equation, (mA-min = mA x min), the current intensity was set to 4 mA and the treatment duration was 20 minutes. Scifers and Prentice also indicate that recommended current amplitudes be between 1 and 4

mA and recommended treatment durations be between 10 and 40 minutes.[23] A cold pack was applied on top of the active electrode for the purpose of patient comfort.

CHAPTER IV

OUTCOMES

The patient was seen for 8 treatment sessions. During the last session, she was re-evaluated, which consisted of her filling out the UEFI again and being tested for tenderness from palpation, AROM, PROM, and strength. The results of the re-evaluation showed improvements compared to the initial evaluation. The patient reported 0/10 pain in the right wrist during rest and activity. She filled out the UEFI a second time and scored 73/80 indicating 91% maximal function. This was a 54-point increase from when it was completed on initial evaluation. The patient reported no tenderness with palpation to any area on the wrist. AROM was tested with the patient seated, arm at side and elbow flexed to 90 degrees as in the initial examination.

The AROM at discharge is shown in Table 2. PROM was tested with the patient seated, arm at side and elbow flexed to 90 degrees as in the initial examination. Since PROM of right wrist was normal in all motions except supination at initial evaluation, only supination was tested during the last physical therapy session. The patient showed full PROM in right supination with a normal end-feel. Strength was tested with the arm at her side and with the elbow flexed to 90 degrees. All right wrist motions tested 5/5 with no pain.

Table 2. AROM at Discharge.

MOTION	R	L	Normal Ranges
Wrist Extension	70º	69º	70-90º
Wrist Flexion	70º	75º	80-90º
Ulnar Deviation	42º	42º	30-45º
Radial Deviation	24º	28º	15º
Pronation	90º	100º	75-90º
Supination	85º	95º	85-90º

CHAPTER V

DISCUSSION

Based on the results of the re-evaluation, it was apparent that the patient made great improvements since the initial evaluation. Her pain decreased from 5-6/10 to 0/10. Her right wrist AROM increased in all motions to be within 10 degrees of the left. They also fall within published normal ranges.[21] Her right forearm supination increased in PROM as well. Right supination strength increased to 5/5 with no pain. All other motions tested as 5/5 with no pain. According to her functional assessment, she indicated that she was currently at 91% of her maximal function. She reported that she stopped wearing the brace. These results indicate that the goals developed at initial evaluation were met and the patient was ready for discharge. They also provide evidence that iontophoresis combined with IASTM and therapeutic exercise reduced pain and improved functional ability for this patient with a wrist pathology.

Limitations

There were a few limitations to this study. One limitation is that it wasn't known how compliant the patient was with her home exercise program, which may have affected the results. Another limitation was that the tenderness was tested through therapist palpation and cannot be measured precisely. An additional limitation is treatment sessions showed variation towards the end. Radio-ulnar joint mobilizations were incorporated to increase PROM in supination. Iontophoresis was stopped after the

5th treatment. Also, manual therapy was stopped after the 6th treatment. The combination of iontophoresis, IASTM, and therapeutic exercise worked for this particular patient, but future studies should research the effects of iontophoresis and therapeutic exercise, iontophoresis and IASTM, or just IASTM and therapeutic exercise in the treatment of wrist pathology.

Reflective Practice

With future wrist pathology patients that present similar to this case, it would be beneficial to ask more history questions to obtain information about whether the patient had injured this area before, how much pain he/she experienced when the incident happened and how that had changed between then and the initial physical therapy evaluation, and the mechanics of the fall that caused the injury. With this information, it can be better pictured how the injury happened and what structures may be affected.

For examination, it would be beneficial to perform more special tests. Testing for ligamentous instability in the wrist, TFCC instability, and distal radioulnar joint instability would be helpful to determine any ligamentous injury. Testing specific forearm muscles would also be useful to determine where specifically there is weakness and pain. It is also necessary to assess grip strength during the initial evaluation instead of later in the sessions in order to establish a baseline and record progress. These tests would help focus the patient's goals and the plan of care. If the patient hasn't already had imaging, the results from the special tests would be used to determine if he/she would need imaging or not.

The plan of care created for this patient seemed to work well since she experienced reduced pain and increased functional ability within 5 weeks of attending

physical therapy. For this reason, the plan of care for future patients would only change if the results of the special tests described above indicated an additional or a different pathology.

Further evidence for the treatment of bone bruises, especially those of the wrist as well as the efficacy of iontophoresis administration of dexamethasone is needed. There is also limited research for the use of iontophoresis on the posterior distal forearm. If future evidence is found that iontophoresis is not effective in the treatment of bone bruises, future plan of cares for patients with bone bruises should be adjusted to not include iontophoresis.

This patient did well with physical therapy and did not need to be referred to any other disciplines. The patient already saw an MD and had imaging performed. Future similar patients may be referred for examination from an MD and imaging if physical therapy treatment does not reduce the patients' pain or increase their functional ability.

The total number of visits this patient attended was 8 and the total cost for the physical therapy care was $539.25. This cost is reasonable since insurance paid $2,157.00 for the therapy. Other costs to the patient include gas money for driving to the clinic and time taken away to attend the physical therapy sessions. The patient had to miss school to attend therapy and her parents had to miss work to take her to therapy. Despite the costs, the patient did benefit from physical therapy. Physical therapy outcomes included increased right wrist ROM and strength, increased ability to perform functional activities, and reduced pain in the right wrist. As a result, the benefits outweighed the costs because without therapy, the patient may have taken much longer to heal or may have maintained her symptoms. Reducing costs for this patient would

not have been feasible because all the interventions charged for each visit were necessary in treating her injury.

This case has influenced my professional development goals in a couple of ways. First of all, in the future I now plan to get certified in IASTM or Graston to further my skills in performing soft tissue mobilization so I may deliver the intervention more effectively. I also plan to keep up to date with current research on the efficacy of iontophoresis to determine whether I want to use it with my future patients or not. This case provided me with great learning experience and knowledge I can apply to future patients.

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