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Long-Arm Splinting for Lateral Epicondylitis: A Case Study

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LONG-ARM SPLINTING FOR LATERAL EPICONDYLITIS:

A CASE STUDY

By

Crystal Wolters

THESIS

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ABSTRACT

Lateral epicondylitis is a debilitating condition that has a significantly negative effect on the occupational lives of many people. There appears to be no recognized ideal treatment method for the condition. Long-arm splinting for lateral epicondylitis has not been addressed in the literature. A case study was used to thoroughly describe one participant’s experience with long-arm splinting to treat her lateral epicondylitis. She was interviewed, observed, and measurements were taken of her affected arm’s range of motion and strength. The seven themes which were identified through these methods include a description of how her lateral epicondylitis developed, her description of the treatment used, the condition’s effect on her occupational life, her feelings about the all of the treatment, her perception that the inconveniences of the splint were worth the benefits, how she returned to her occupational performance, and how she applies her belief in the splint.
ACKNOWLEDGEMENTS

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Also, a huge thank you to my parents, sisters, John, and all my family members who provided continuous prayers, support, love and encouragement throughout this process. Ultimately, thank you to my Lord & Savior for His Grace and Guidance.
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CHAPTER 1 INTRODUCTION

Background/Context

Lateral epicondylitis is a common problem in those engaging in repetitive activities, especially those which involve extension of the wrist and metacarpal phalangeal (MP) joints (Boyer & Hastings, 1999). In their review, Borkholder, Hill & Fess (2004) note how researchers are unable to agree on lateral epicondylitis' etiology, inflammation, or degeneration. As cited by Borkholder, Hill & Fess (2004), epicondylitis was first addressed in the literature as tennis elbow by Runge (1873), and its etiology, symptomology and the use of a splint to treat it was first described by Morris (1882). Their definition of epicondylitis as tennis elbow referred to the pain in the elbow experienced by those who often played lawn tennis.

As lateral epicondylitis may be caused by overuse of the tendons, one of the main risk factors for acquiring the condition is the physiological age of the tendons originating at the lateral epicondyle; physiological age referring to the amount the tendon has been used (Nirschl & Ashman, 2004). Those tendons include the extensor carpi radialis brevis (ECRB), which extends the wrist, and the extensor digitorum communis (EDC), which extends the metacarpophalangeal (MP) joints. Nirschl & Pettrone (1979) identified these tendons as those responsible for lateral epicondylitis; and Nirschl & Ashman (2004) confirmed through over 1000 surgical cases that lateral epicondylitis originates from ECRB primarily and EDC secondary. Other risk factors for lateral epicondylitis include clients 35-years or older, high activity levels, demanding activity techniques, and inadequate fitness (Nirschl & Ashman, 2004).
The primary symptoms of lateral epicondylitis are pain and tenderness at the lateral elbow. The condition is usually diagnosed based on a client’s history of dysfunction related to the pain and physical tests which may exacerbate the pain, such as resisted wrist extension (Mani & Gerr, 2000).

As with lateral epicondylitis’ etiology, there is not an agreement on the most effective treatment technique. While even Nirschl & Ashman (2004), who propose surgery to treat the condition, agree that a conservative nonsurgical approach should be attempted first; there is no consensus as to what this method should be. Whilt Trudel, Duley, Zastrow, Kerr, Davidson, & MacDermid’s (2004) identified several effective conservative approaches in their review of rehabilitation for patients with lateral epicondylitis; they were unable to claim one to be so effective that it should be the preferred technique. Borkholder, Hill, & Fess’ (2004) review of the efficacy of various types of splints as treatment techniques was able to provide “early positive” support for the use of splinting to treat lateral epicondylitis. Although, they were unable to provide conclusive support for the use of any type of splinting in treatment of lateral epicondylitis.

Problem Statement

The problem this study addressed was that lateral epicondylitis is a debilitating condition that has a significantly negatively effect on the occupational lives of many people. Further, there was no clearly advantageous treatment technique which allows those with the condition to more fully engage in their occupational life. While long-arm splinting for lateral epicondylitis has only been studied in the context of examining the effectiveness of other techniques, Labelle & Guibert (1997) supported the efficacy of this
technique as they found a statistically significant decrease in pain in all subjects: those in the control (immobilization and placebo) and the experimental (immobilization and non-steroid anti-inflammatory drugs (NSAIDs)) groups. Research was required to describe all aspects of the use of long-arm splinting for lateral epicondylitis.

**Purpose**

The purpose of this case study was to comprehensively describe one participant’s experience with long-arm splinting as a treatment technique for her lateral epicondylitis. The study describes the participant’s ability to engage in her occupational life before wearing the splint, while wearing the splint, and after wearing the splint. The participant’s thoughts and feelings related to wearing the splint are also illustrated. Additionally, the study includes descriptive measures of the participant’s ability to complete a self-identified meaningful activity, range of motion (ROM), and strength tasks with her bilateral upper extremities.

**Research Questions**

In the description of one participant’s experience of having had long-arm splinting to treat her lateral epicondylitis, the following research questions were proposed.

- How did wearing the long-arm splint affect the participant’s ability to engage in her occupational life?
- How did the participant feel and think about wearing the long-arm splint to treat her lateral epicondylitis?
- After wearing the long-arm splint, how was the participant able to complete a self-identified meaningful activity?
Significance of Study

This case study attempts to thoroughly describe one participant's experience of using long-arm splinting to treat her lateral epicondylitis. As Creswell (1998) identifies, case studies have the potential to act as a starting point for future research. The results of this study may narrow down research questions and methodologies for future research on long-arm splinting. This future research may possibly include results which are generalizable to most with lateral epicondylitis. Such research may have the potential to enable clients to manage their lateral epicondylitis and engage in meaningful occupational lives sooner and with less pain.

Definition of Terms

Lateral epicondylitis is defined as a syndrome of overuse of the tendons originating at the lateral epicondyle which is primarily identified by pain at the lateral epicondyle.

Splinting treatment is defined as the conservative treatment technique in which participants wear a volar long-arm splint which immobilizes the elbow at 90 degrees, the wrist in slight extension, and the forearm neutral between pronation and supination. The splint begins distally just proximal to the distal palmar crease and ends proximally just distal to the shoulder joint. The splint is worn full time for four-to-six weeks at which point a weaning program is initiated. The participant may doff the splint daily for short periods of time, such as when engaging in an activity of daily living like bathing. The participant will not have undergone any treatment which aims to strengthen the muscles with the inflamed tendons.
CHAPTER 2 LITERATURE REVIEW

Introduction to Topics of Review

This literature review addresses the following subtopics related to the present study: a general description of lateral epicondylitis' definition and etiology, anatomy, diagnosis and prognosis, the diverse nonsurgical techniques used to treat lateral epicondylitis, and outcome studies of several nonsurgical techniques used to treat lateral epicondylitis. The literature in each subtopic will be presented and briefly examined, the research in each subtopic will be analyzed, and the literature as it relates to the proposed study will be summarized.

Major Related Studies in Topic Areas

General Description of Lateral Epicondylitis

The following works are included in the present review to provide a general description of lateral epicondylitis, including its definition, etiology, anatomy, diagnosis and prognosis.

Definition & Etiology

The reported definitions of lateral epicondylitis vary with what the author believes to be the condition's etiology. As the condition's name implies, Aiello (1997) believes lateral epicondylitis presents with inflammation located at the lateral epicondyle of the humerus caused by singular or multiple tears of the originating extensor tendons. Aiello (1997) reports this definition in her chapter in *Hand rehabilitation: A Practical Guide, 2nd ed.* In the chapter she goes on to describe the purpose, goals, and indications for conservative therapy for lateral epicondylitis. An obvious limitation to Aiello’s (1997)
work is that she does not report any resources, and only give a list of “suggested readings” at the end of her chapter. Aiello’s chapter is included in this review because it demonstrates one of the commonly held perspectives on lateral epicondylitis’ etiology and definition.

Currently, the more commonly held belief is that lateral epicondylitis is secondary to a tendinosis. In their article, Nirschl & Ashman (2004) outline how they believe the condition to be secondary to a degenerative process because after more than one thousand surgeries on lateral epicondylitis, they have never histologically identified inflammatory cells. They view the label “epicondylitis” to be misleading as it implies inflammation is associated with the condition. They argue that this degenerative process may be caused by the overuse and failed healing of the tendons originating at the lateral epicondyle. They present what they see as a more appropriate label for the condition: tendinosis, or diseased tendon.

Many believe that the overuse of the tendons in lateral epicondylitis is associated with repetitive movements of the involved tendons. In their introduction to a review of conservative rehabilitation techniques used with lateral epicondylitis, Trudel et al. (2004) agree that the condition is caused by tendon overuse through repetitive motion; and they define the condition simply as a pain syndrome in the wrist extensor muscles at or near their origin at the lateral epicondyle. While their definition and etiology are easy to understand, by just defining the condition as a pain syndrome they appear to overlook the complexity of lateral epicondylitis’ etiology.

In their review article in which they search for an evidence-based definition and treatment method for lateral epicondylitis, Boyer & Hastings (1999, pp. 481) recognize
this disparity in defining and identifying the condition’s etiology; and simply identified its etiology as “most commonly an idiopathic or a work-related condition.” They reported that no etiology has been “definitively” identified. They analyzed that while most patients present with a repetitive injury, even those presenting with pain after a traumatic blow to the epicondyle may have had an underlying condition that surfaced after the trauma. Boyer Hastings (1999) consolidate these arguments and report that in all likelihood lateral epicondylitis probably has numerous pathoetiologies. Boyer & Hastings’ (2004) central approach is appreciated as one should recognize that there are always interacting factors in any condition’s etiology.

It should also be recognized that when lateral epicondylitis is defined as lateral elbow pain as Trudel et al. (2004) do, the etiology of the pain may be very different. The pain may be secondary to an acute or chronic condition. The acute inflammation may be referred to as tendonitis and the chronic pathology as tendinosis (Nirschl & Ashman, 2004). Although, even with a chronic condition, there may still be inflammation in the lateral elbow (Nirschl & Ashman, 2004). This review will not cover the differential diagnoses that must also be considered in addition to lateral epicondylitis (Nirschl & Ashman, 2004).

Anatomy

There appears to be a greater consensus in the identification of the anatomical areas involved with lateral epicondylitis than its definition and etiology. In all of the searched literature, an agreement appears that lateral epicondylitis involves the extensor tendons that originate at the lateral epicondyle of the humerus. These tendons include the ECRB and the EDC. Nirschl & Ashman (2004) report that through over 1000 surgical
In their review of lateral epicondylitis, they have observed that the ECRB is primarily involved while the EDC is secondarily involved. They note how the involved tendons appeared diseased. They describe how they are white and in their opinion do not necessarily reflect inflammation. It should be considered that this pathoanatomy may not be representative of all cases of lateral epicondylitis; Nirschl estimated in one of his earliest works on lateral epicondylitis that only approximately 4-11% of patients with the condition will require surgical intervention (Nirschl & Pettrone, 1973). Nirschl & Ashman (2004) only recommend surgery after conservative rehabilitation has failed to relieve the symptoms.

Meyer, Pennington, Haines & Dailey (2002) concur in their work that lateral epicondylitis involves primarily the origin of the ECRB as they studied the effect of a forearm support band on forces at the ECRB origin. Meyer et al. (2002) use cadavers to measure the reduction of force at the origin when the band is in place. The results of this study will be discussed further in the current review.

While in agreement that lateral epicondylitis involves the extensor tendons originating at the lateral epicondyle of the humerus, Boyer & Hastings (1999) disagree that the two tendons (ECRB & EDC) may be differentiated in their roles in lateral epicondylitis. In their critical review of the evidence concerning lateral epicondylitis' pathology, anatomy, treatment and other characteristics, Boyer & Hastings (1999) report that the ECRB & EDC origins cannot be anatomically differentiated. They argue that because the EDC origin lies just superficial to and is continuous with the ECRB origin, the two tendons blend together and there is no definable differentiation between them at the lateral epicondyle. They propose it to be impossible to say whether lateral epicondylitis stems from the ECRB or the EDC; although many, as Nirschl & Ashman...

**Diagnosis**

The diagnosis of lateral epicondylitis naturally follows its anatomical involvement. In one of the earlier articles on the condition’s pathology and treatment that is often cited by others, Cyriax (1936) reports that it is diagnosed by the presentation of the patient having pain over the lateral epicondyle which increases with resisted wrist extension. He also reported the pain to increase with wrist extension and forearm pronation or supination. Another situation he found to increase the pain in the lateral epicondyle was gripping with the wrist extended. Cyriax’s (1936) diagnostic techniques and description of the condition appear to have remained valid over time, as this work is often cited in diverse articles relating to lateral epicondylitis. Boyer & Hastings (1999) appear to follow Cyriax’s (1936) lead and support using physical examination as one part in the diagnosis of lateral epicondylitis. In addition to the pain with palpation and pain in different positions, Boyer & Hastings (1999) also encourages questioning patients about what events or factors incite and relieve their pain. They encourage asking the patients about their ability to manipulate and carry objects in positions that may incite pain associated with lateral epicondylitis—the elbow extended or the forearm pronated with the wrist flexed. This questioning may reveal the patient’s greatest source of pain and may also aid in ruling out differential diagnoses which may present similar to lateral epicondylitis.
While Nirschl & Ashman (2004) advocate for the recognition of pain with certain positions and activities, they also identify a continuum of the presence of pain with activity and pain with rest that may help the practitioner know how far the patient’s lateral epicondylitis has progressed. They also state that because lateral epicondylitis frequently affects one’s functional strength, the measurement of grip strength using a dynamometer may be helpful in diagnosing lateral epicondylitis. Nirschl & Ashman (2004) also present using radiography as an instrument in diagnosing lateral epicondylitis as they have found 20% of patients with the condition presenting with tendon calcification or reactive exostosis at the tip of the epicondyle. Again, Nirschl & Ashman’s (2004) data should be considered cautiously as they mainly address chronic lateral epicondylitis.

**Prognosis**

As Cyriax (1936) was one of the first to present diagnostic techniques for lateral epicondylitis, he also presents material on the prognosis of those with the condition. He reports that tennis elbow (lateral epicondylitis) resolved with or without treatment in an average of 8-12 months. Along with his diagnostic techniques, this norm presented by Cyriax (1936) has been often cited in the literature on lateral epicondylitis today.

In their attempt to investigate prognostic factors associated with lateral elbow pain (lateral epicondylitis), Hudak, Cole, & Haines (1996) reviewed appropriate studies published in the Institute for Work and Health’s database. In relation to Cyriax’s (1936) 8-12 month resolution claim, they found the studies they reviewed to be methodologically flawed in one way or another. They reported they could not make any comparison to Cyriax’s supposition. Based on their review of forty articles, Huday et al.
(1996) report that prognostic factors in lateral epicondylitis are location of pain and history of recurrence of symptoms. These are thought to follow lateral epicondylitis’ anatomy and diagnosis as the more advanced the condition is, the more different the location of symptoms will be, and the greater chance of recurrence.

In a randomized control trial (RCT), Haahr & Anderson (2003) investigate whether intervention by occupational specialists could enhance the prognosis of lateral epicondylitis compared with treatment usually given in general practice. While the RCT and treatment techniques will be addressed later in this work, the prognostic factors found will be addressed. They found that after one year, 83% of all patients had experienced improvement in their lateral epicondylitis. This may be seen to support Cyriax’s (1936) claim of resolution in 8-12 months. Haahr & Anderson (2003) also found that some factors which related to poorer prognoses include employment in manual jobs, high level of physical strain at work, and high level of pain at baseline. These appear to support the claim that lateral epicondylitis is secondary to repeated mini traumas to the tendons originating at the lateral epicondylitis (Trudel et al., 2004). Throughout the literature on the prognosis of lateral epicondylitis it should be noted that there was a resounding theme that many interpersonal and extra personal tertiary variables had a unique impact on each patient’s prognosis.

**Nonsurgical Treatment Techniques**

There are several techniques presently used to treat lateral epicondylitis. For the scope of the present study, only nonsurgical techniques will be addressed. This subtopic of the present literature review is meant to give an introduction to these techniques and the next subtopic will analyze efficacy studies of such techniques. The nonsurgical
techniques to be discussed include: wait-and-see, splinting, minimal intervention and education techniques, exercise, mobilization and manipulation, NSAIDs, corticosteroid injections, botulinum toxin, glycosaminoglycan polysulfate injection, ultrasound, phonophoresis, iontophoresis, pulsed electromagnetic field, laser, polarized polychromatic non-coherent light (Bioptron light), extracorporal shock wave, and acupuncture.

**Wait-and-See**

Smidt, van der Windt, Assendelft, Devillé, Korthals-de Bos, & Bouter (2002) use a wait-and-see-technique for one of their study’s random assignments for treating lateral epicondylitis. They describe the wait-and-see policy as when a patient visits a family doctor only one time. During the visit, activities that produce pain are discussed and the patient is educated on “practical solutions” such as ergonomics. The patient may also be prescribed a pain medication or an NSAID if necessary. The patient then waits for spontaneous improvement. The only critique of Smidt, van der Windt, Assendelft, Devillé, Korthals-de Bos, Butler’s (2002) definition of a wait-and-see policy is that it may not be mutually exclusive of a technique advocating for the use of NSAIDs.

**Splinting**

Borkholder, Hill, & Fess (2004) cite Morris (1882) as being the first to advocate for any treatment of lateral epicondylitis. Morris recommended splinting. They report that splinting is still one of the main treatment techniques used to address lateral epicondylitis today. Borkholder et al. (2004) identify five types of splints used to treat lateral epicondylitis in their systematic review. The first is the long-arm splint which holds the elbow in 90 degrees flexion, the forearm in neutral and the wrist in neutral.
This splint type will be addressed in the present study. The following types of splints were also identified by Berkholder et al. (2004) and their efficacy will be discussed in the next subtopic of this review: elbow flexion restriction splint; an inelastic nonarticular proximal forearm splint; an elastic nonarticular proximal forearm splint; a nonarticular forearm splint, and a wrist immobilization splint.

**Minimal Intervention and Education Techniques**

Another noninvasive technique is labeled as a minimal intervention and education technique. Using this type of a technique the patient is educated on the factors which may cause or exacerbate their lateral epicondylitis. It is hoped that through education, the patient may be able to adapt a positioning technique that may avoid overloading the tendon which Nirschl & Ashman (2004) identify as a main etiological factor in the development of lateral epicondylitis. Haahr & Anderson (2003) describe a minimal intervention technique used in their randomized trial comparing the minimal intervention with a general approach to treating lateral epicondylitis. The patients in the minimal intervention group were given information about the condition's lack of treatment that significantly-improves its prognosis and were seen by an ergonomist for instructions in a graded exercise program. These patients were also able to use over-the-counter pain medications or elbow braces at their own discretion. Chan, Li, Hung, & Lam (2000) describe another program which utilized a combination of education and home exercise. They measure the efficacy of a standardized clinical program which included education about the condition, training in a home exercise program and a progressive work-hardening program. These minimal intervention education treatment techniques address the nature of lateral epicondylitis- its apparent spontaneous recovery (Cyriax, 1936), and
the value in education of patients so they may avoid the overused tendon which may lead to or exacerbate lateral epicondylitis (Nirschl & Ashman, 2004).

Exercise

Nirschl & Ashman (2004, pp. 598) conclude in their article on lateral epicondylitis that "...the key to successful nonsurgical treatment is rehabilitative resistance exercise with progression of the exercise program." Exercise is encouraged frequently in the literature for the treatment of lateral epicondylitis. Nirschl & Ashman (2004) advocate for an exercise program which will revitalize diseased tendons involved with the condition. In their review of the rehabilitation for patients with lateral epicondylitis, Trudel et al. (2004) describe exercise techniques as those with progressive strengthening exercises aimed at pain reduction and increased grip strength.

Mobilization and Manipulation

More physical techniques which aim at the treatment of lateral epicondylitis include mobilization and manipulation. Again in Trudel et al.'s (2004) review of rehabilitative techniques used with lateral epicondylitis, mobilization and manipulation techniques were identified as being used in the radius and wrist in treating the condition. In their randomized pilot study, Struijs, Damen, Bakker, Blankevoort, Assendelft, & van Dijk (2003) focus on a technique of manipulation of the wrist in which the wrist joint is moved to its endpoints in both extension and flexion. They see it as freeing displaced motion segments, if only short-term, to allow for full participation in activities of daily living (ADL).

Deep Transverse Friction Massage and Cyriax Physiotherapy

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Stasinopoulos & Johnson (2004) describe deep transverse friction massage as originally proposed by Cyriax as part of his therapy for lateral epicondylitis. They report it to include a connective tissue massage applied directly to soft tissue structures like tendons. Stasinopoulos & Johnson (2004) report the massage needs to be located directly over the site of the tendon’s lesion with the amount of friction tolerated by the patient. They cite that the massage must be very localized with the therapist’s fingers and patient’s skin moving together. The massage needs to be applied transversely to the tissue. Deep transverse friction massage was proposed by Cyriax as only part of his physiotherapy. To be considered Cyriax therapy, the massage needs to be followed by manipulation (Stasinopoulos & Johnson, 2004).

**NSAIDs**

In their investigation of NSAID use, Labelle & Guibert (1997) identify the use of oral NSAIDs as one of the most common treatment techniques prescribed for lateral epicondylitis. In their study they believed a NSAID given twice daily for four weeks would significantly impact the patients’ pain and ability to participate in ADL activities. It is thought that the NSAID minimizes the inflammation in the lateral epicondyle. In relation to the definition and etiology of lateral epicondylitis as discussed earlier, those who believe that the condition is degenerative probably would not advocate for or use NSAID with lateral epicondylitis (Nirschl & Ashman, 2004).

**Corticosteroid Injections**

In treating lateral epicondylitis, corticosteroid injections are used to ease pain and increase functional use of the affected extremity (Smidt, Assendelft, van der Windt, Hay, Buchbinder & Bouter, 2002). In their review of the literature on the use of this treatment
technique for lateral epicondylitis, Smidt, Assendelft, van der Windt, Hay, Buchbinder, & Bouter (2002) found no significant difference between the types of steroids used in the injection, nor between the doses or suspensions of the corticosteroid injections. During their RCT, Smidt, van der Windt, Assendelft, Devillé, Bos, & Butler (2002) identify using corticosteroid injections with 1 mL triamcinolone acetonide (10 mg/mL) and 1 mL lidocaine 2 percent. They describe injecting every tender spot until the patient was free of pain during resisted wrist extension.

Botulinum Toxin Injection

During their RCT measuring botulinum toxin injection's effects on lateral epicondylitis, Wong, Hui, Tong, Poon, Yu, & Wong (2005) describe the injections as being administered aimed at the patient's painful point, deeply into the subcutaneous tissue and muscle 1 cm from the lateral epicondyle. They acknowledge that the exact mechanism for relieving pain in those with lateral epicondylitis is largely unknown. Wong et al. (2005) hypothesize it to be because of botulinum toxin's paralytic effects on the extensor tendons forces them to rest for 2-4 months, allowing for their healing. This same line of thinking, that the tendons require rest is a main factor in using a splint which immobilizes the wrist extensor tendons to treat lateral epicondylitis, as the one which will be investigated in the present study.

Glycosaminoglycan Polysulfate Injection

In their review of the evidence of treatment techniques used for lateral epicondylitis, Boyer & Hastings (1999) cover glycosaminoglycan polysulfate injections. Unlike corticosteroid and botulinum toxin injections, glycosaminoglycan polysulfate is described as being injected repeatedly. As with the other injections mentioned, the goal
is to decrease pain, although after his review of the literature on such injections, Bernstein (2001) concludes that there is limited evidence that the injections affect pain in the short or intermediate term.

**Ultrasound and Phonophoresis**

In their review of rehabilitation techniques used for lateral epicondylitis, Trudel et al. (2004) identify ultrasound as a commonly used technique to treat the condition. They note it is used to decrease pain. Michlovitz (2002) identifies ultrasound as a technique which is generated from the conversion of electrical energy to acoustic energy. The applicator or sound head is manipulated over the target area with a coupling agent in-between the two at a selected frequency and intensity. Ultrasound may be used for thermal or nonthermal effects on the targeted tissue. In their article answering the clinical question comparing the use of ultrasound and the use of phonophoresis, Hoppenrath & Ciccone (2006) identified phonophoresis as using ultrasound to transdermally administer medication. They report that with lateral epicondylitis, the coupling agent used may include an anti-inflammatory steroid or NSAID.

**Iontophoresis**

Nirschl, Rodin, Ochiai, & Maartman-Moe (2003) identified iontophoresis as another method used to treat lateral epicondylitis. As identified by Bissell (1999), iontophoresis may be used to transdermally move ionic drugs by using opposing electrical charges. With lateral epicondylitis, the ionic drugs may be used to treat inflammation and therefore pain (Nirschl et al., 2003).

**Pulsed Electromagnetic Field**
In their review of rehabilitation techniques, Trudel et al. (2004) identified pulsed electromagnetic field as yet another treatment technique used to decrease the pain associated with lateral epicondylitis. Michlovitz (2002) identifies the technique as one in which electromagnetic currents are elicited in short bursts to the target area. Its effectiveness will be discussed in the section addressing outcome studies for treatment techniques.

**Rebox Therapy**

Trudel et al. (2004) identified Rebox therapy as a technique used in the treatment of lateral epicondylitis. Rebox therapy is another type of electrical therapy. As opposed to transcutaneous electrical nerve stimulation, another popular type of electrical therapy, the apparatus used for Rebox therapy operates on much lower current. A Rebox apparatus uses between 0 and 300 microA of electricity (Johannsen, Gam, Hauschild, Mathiesen, & Jensen, 1993).

**Laser**

Trudel et al. (2004) also cover the use of laser to treat lateral epicondylitis in their review. Thomas (1993) identifies laser used in therapy as being light amplification produced by emission of radiation which emits intense heat and power at close range. Laser with lateral epicondylitis is again used to treat the pain and weakness associated with lateral epicondylitis. Boyer & Hastings (1999) also mention using laser to treat the condition in their review; and their conclusion on its efficacy will be discussed further in this literature review.

**Polarized polychromatic Non-Coherent Light**
In their study investigating the therapeutic benefits of three treatment techniques used with lateral epicondylitis, Stasinopoulos & Stasinopoulos (2006) identify polarized polychromatic non-coherent light (Bioptron light) as a technique to decrease pain. They used the probe of the light 90 degree angle and 5-10 cm above the target surface. For lateral epicondylitis, the probe was used over the lateral and anterior surfaces of the lateral epicondyle as well as over the muscle bellies of the wrist extensors. The efficacy of this technique will be discussed in the next section of this literature review.

**Extracorporal Shock Wave**

Boyer & Hastings (1999) identify extracorporal shock wave as a treatment technique used for lateral epicondylitis. In studying this technique's efficacy, Pettrone & McCall (2005) identify the treatment as using one treatment each week in which the shock wave is transmitted with 2000 impulses at 0.06 mJ/mm-squared for three weeks. The head of the device is described as being aimed toward the most painful point near the lateral epicondyle. A coupling gel is described as being used; and Pettrone & McCall (2005) report re-focusing the device onto the lateral epicondyle every 200 to 400 impulses.

**Acupuncture**

Acupuncture has been recognized as a treatment used to decrease pain associated with lateral epicondylitis by Boyer & Hastings (1999). Relating to classical acupuncture, Hu (1991) cites the technique as used to reconcile the disharmony between the tendons and blood vessels which is secondary to damage from overexertion. Trudel et al. (2004) note in their review that acupuncture may be used with different “needling” techniques: the classic deep acupuncture and a superficial needling.
Outcome Studies for Treatment Techniques

In this section, outcome studies for conservative treatment techniques of lateral epicondylitis will be critically reviewed. As Boyer & Hastings (1999) point out, there are several nonsurgical treatment techniques for lateral epicondylitis but little evidence that any actually influences the condition. They recognize that most studies that have been published have poor power secondary to small numbers of patients. They also protest that even when the study has a control, the authors do not do compete investigation—lacking a paired analysis. A theme throughout the literature on the efficacy of treatment techniques is that better methodology is needed to be able to better support any of the techniques (Boyer & Hastings, 1999, Trudel et al., 2004). Research on the nonsurgical treatment of lateral epicondylitis will be examined in an order according to its relevance to the present study: from least relevant to most relevant. First, nonsurgical techniques which do not use splinting will be considered, then techniques using splinting will be addressed. Finally, the two studies which used the same type of splint as in the present study will be analyzed.

Nonsurgical Techniques Which do not Use Splinting

During their critical review of the evidence of lateral epicondylitis’ name, physical examination, diagnostic modalities, pathology, anatomy, operative and nonoperative treatment techniques, and studies on elbow biomechanics relating to tennis elbow, Boyer & Hastings (1999) reviewed several efficacy studies for the nonsurgical treatment of lateral epicondylitis. They reviewed studies concerning acupuncture, extracorporal shock wave therapy, ultrasonography, low-energy laser applied to painful or acupuncture points, steroid injections, glycosaminoglycan polysulfate injection, and
electrical therapy; and concluded none have been shown to have significant positive results on lateral epicondylitis. They reviewed studies on modification of tennis stroke and work activities and reported that while some positive effects were found, they recognized it is usually harder to change the person’s technique than it is to change the activity.

While Boyer & Hastings (2004) argue valid points such as the need for more RCTs in evaluating the efficacy of treatment options for lateral epicondylitis, they also do not support their claims with exhaustive techniques. For example, the reader does not know where or how the cited articles were recovered and if the authors truly performed an exhaustive search for all related research. Boyer & Hastings (1999) never claim to have performed a systematic review. Boyer & Hastings (1999) sufficiently make the reader aware of the need for more research, yet do not appear to recognize the difficulties inherent in performing RCTs, nor how far the research has come in examining the research techniques used with lateral epicondylitis.

Trudel et al. (2004) completed a systematic review of rehabilitation techniques used with patients presenting with lateral epicondylitis. They report searching the Medline, CINAHL, EMBASE, PEDro, and the Cochrane databases for articles dated January 1983 to March 2003 relevant to lateral epicondylitis. They used a search inclusion list of over twenty terms including lateral epicondylitis, tennis elbow, injections, and ultrasound to ensure appropriate studies. From 233 found articles, only 31 met the Trudel et al.’s (2004) quality criteria and were considered. They conclude with at least level 2b evidence, that acupuncture, exercise therapy, manipulations/mobilizations, ultrasound, phonophoresis, Rebox therapy and ionization with diclofenac all show
positive effects decreasing pain and enhancing function for patients with lateral epicondylitis. They also report that there is at least level 2b evidence that laser therapy and pulsed electromagnetic field therapy is ineffective in treating lateral epicondylitis. Trudel et al. (2004, p. 263) note that secondary to the lack of evidence of the relative benefits of the treatment techniques showing positive effects, therapists must choose a treatment plan based partially on “clinical practicalities and expertise”. It is believed that Trudel et al. (2004) did well finding and analyzing the research on the rehabilitation of patients with lateral epicondylitis. Again, they emphasized how more research needs to be done to make any conclusive results of the efficacy of most techniques used with lateral epicondylitis.

Nimgade, Sullivan, & Goldman (2005) also conducted a review of the literature in an attempt to discover the most efficacious treatment technique for lateral epicondylitis. They reviewed thirty controlled trials which addressed the nonsurgical techniques of physiotherapy, steroid injections, rest, splinting, ultrasound and manipulation in treating lateral epicondylitis. They concluded that evidence for rest, splinting, ultrasound and manipulation are all neutral or insufficient. They found steroid injections to relieve symptoms in the short term and active physiotherapy to be efficacious regardless of time frame.

Nimgade et al. (2005) again reiterate the need for more research with better methodology in order to make decisive conclusions on the efficacy of treatment for lateral epicondylitis. In relation to the presently proposed study, beginning evidence will be able to give a better insight into the efficacy of long-arm splinting for lateral epicondylitis.
In their chapter on tennis elbow Nirschl & Ashman (2004) discuss conservative treatment for patients with lateral epicondylitis and report that treatment should enhance the body’s natural healing response to the affected tendons. First, they report pain should be relieved and inflammation controlled through protection, rest, cold, elevation and modalities. Next, tissue healing is encouraged with exercises, conditioning and refraining from abuse. Nirschl & Ashman (2004) next advise for the promotion of general fitness to enhance regional perfusion and to minimize the loss of strength and patients’ negative emotional reactions. Next loads on the affected tendon are controlled by adapting positioning during all activities and possibly using bracing. Nirschl & Ashman (2004) report that if this approach does not provide relief of symptoms, surgical treatment should be used; and they give a set of indications and contraindications for surgery.

While their proposed rehabilitation course appears appropriate and anecdotal to the healing course of the body, it does not appear to follow their claim that lateral epicondylitis stems from a degenerative etiology, as discussed previously in this review. It is questioned why a rehabilitation course should follow “...the natural biological healing response after injury...” (Nirschl & Ashman, 2004, pp. 590) when they claim the condition to be degenerative. Also, they do not back their proposed rehabilitative methods with any research, and certainly not by RCTs.

One study which was not a RCT but did involve measurement of efficacy is Chan et al.’s (2000) clinical pilot to assess the efficacy of a 6-week standardized treatment program for patients with “work-related” lateral epicondylitis. Fifteen female patients with lateral epicondylitis from work were recruited from an outpatient orthopedic clinic and underwent the intervention program which included education, exercises, and work-
hardening protocols. Based on measurements at admission, pre-discharge, and 4th and 12th-week follow-ups, significant improvements were shown in pain intensity, isometric strength and endurance, self-perceived performance competence and self-perceived performance competence. While the power of the study is low secondary to its low numbers of subjects (n=15), it is seen as what the authors judged- a pilot study. Chan et al. (2000) recognize that more research needs to be done with RCTs to determine the efficacy of the standardized program.

Haahr & Anderson (2002) also address a minimal intervention technique in their study. They performed a RCT in which 266 patients with lateral epicondylitis either were in the control group and received treatment "as preferred and agreed upon by the patient and general practitioner" or in the intervention group which received minimal intervention. The intervention group attended an informational meeting about lateral epicondylitis' "favourable prognosis" and the void of a proven treatment technique at an occupational medicine facility, and one meeting with an ergonomist in which they were given instructions in an exercise program and positioning (Haahr & Anderson, 2002, pp. 1217). After one year, Haar & Anderson (2002) claim that 83% of all patients demonstrated improvement in their condition and the intervention was found to have had no advantage. They found poor prognostic factors to be employment in manual jobs, a high level of physical strain at work, and a high level of pain at baseline, high baseline distress and involvement of the patient's dominant arm.

While their study had randomization, Haahr & Anderson's (2002) claim of a control group is questioned. Their control group which underwent different patients' and practitioners' choice of treatment does not seem to be a control. Information is never
given on the different treatment techniques the patients in the control group underwent; and the reader does not know if treatments used in the intervention group were not also used in the control group. For example, as Nirschl & Ashman (2004) do, many believe rehabilitation for lateral epicondylitis includes exercise. Some in the control group may have undergone exercise as an agreed upon technique, yet in the intervention group, graded exercise is a treatment.

Martinez-Silvestrini, Newcomer, Gay, Schaefer, Kortebein & Arendt (2005) studied different types of exercise in treating lateral epicondylitis. They randomly assigned 94 subjects into a stretching, stretching plus concentric strengthening, and stretching plus eccentric strengthening groups. Martinez-Silvestrini et al. (2005) report choosing to study eccentric strengthening because it follows the theory that the tendons involved in lateral epicondylitis are degenerative and can be trained to withstand greater force than that incurred in inciting activities. After 6-weeks, significant gains were made by all three groups, with none showing a statistically significant difference in outcomes measured. Martinez-Silvestrini et al. (2005) note that just as the patients in the eccentric strengthening group did not demonstrate significant differences in improvement, they also did not demonstrate any worsening. While the study was randomized, it should be noted that the last measurement only came after six weeks of baseline and the long-term effects of the eccentric strengthening is still unknown.

Another study which used six weeks after baseline as the last follow-up measure which measured the effectiveness of manipulation of the wrist as a treatment technique was done by Struijs et al. (2003). They randomly assigned 31 patients to receive wrist manipulation, or to receive ultrasound, friction massage, and muscle strengthening and
stretching. At three-weeks, the manipulation group demonstrated significantly more success, and at six-weeks, the same group demonstrated significantly decreased pain than the group treated with ultrasound, friction massage, and muscle strengthening and stretching. Struijs et al. (2003) conclude that wrist manipulation appears to be more affective than ultrasound, friction massage, and muscle strengthening and stretching.

Again, it is noted that a longer follow-up is needed to draw more conclusive results. Also, the conclusion that manipulation is more effective than the treatments used in the control group is questioned; as it is impossible to isolate the treatments in the control group (ultrasound, friction massage, or muscle strengthening and stretching) based on this study which grouped them all together. Wrist manipulation may be more effective than the combination of the other treatments in the control group, but wrist manipulation was never compared to each treatment individually. Although, even that conclusion appears biased as the only times significant differences shown between the two groups were demonstrated were the success rate at three weeks and the pain rating at six weeks. It appears that the rest of the measures which were not significant were not considered when the conclusion was made that wrist manipulation appears more affective than the treatment techniques used in the other group.

Stasinopoulos & Stasinopoulos (2006) investigated the comparative efficacy of three treatment techniques for lateral epicondylitis. They sequentially allocated 75 patients to one of three treatment groups: 1) Cyriax physiotherapy which included ten minutes of deep transverse friction massage immediately followed by elbow manipulation (which was individualized based on the patients’ description of pain during the technique), 2) supervised exercise program of slow progressive eccentric exercises of
wrist extensors and static stretching exercise of ECRB, or 3) polarized polychromatic non-coherent light therapy. All patients were seen three times for four weeks and then evaluated at week 4 (the end of the treatment), week 8, week 16 and week 28. Stasinopoulos & Stasinopoulos (2006) report that while all three groups demonstrated a reduction in pain and improvement in function, the supervised exercise program produced the largest effects in short, intermediate and long term. They suggest it be first considered in treating lateral epicondylitis. While Stasinopoulos & Stasinopoulos (2006) sequentially allocated the patients to the groups, the study lacked true randomization. Also, the study lacked a control group, and the three treatment groups may arguably not be appropriate to compare with each other.

Another study comparing different techniques’ efficacy in treating lateral epicondylitis is Smidt, van der Windt, Assendelft, Devillé, Korthais-de Bos, & Bouter’s (2002) RCT in which 185 patients were randomly assigned to six weeks of treatment with corticosteroid injections, physiotherapy or a wait-and-see policy. They measured the patients’ outcomes before randomization, once during intervention, and at 6, 12, 26, and 56 weeks after the intervention began. After Smidt, van der Windt, Assendelft, Devillé-Korthais-de Bos, & Bouter (2002) found that the injections had a short term advantage but higher long term recurrence rates, and that while the physiotherapy had better results; they were not significant compared with the wait-and-see group. They conclude that patients should be well informed of all techniques’ advantages and disadvantages and may best choose a technique when considering the resources available, as the physiotherapy showed no significant differences than the wait-and-see policy. As in Stasinopoulos & Stasinopoulos (2002), this study has no control group to compare the
different techniques to. Besides critiquing its lack of control, this study is commended for its large subject numbers.

In his review of the use of injection and surgery for patients with chronic pain, Bernstein (2001) addresses the use of local injections in treating chronic pain secondary to lateral epicondylitis. After analyzing one systematic review, one RCT, and one medium quality study, Bernstein (2001) concludes that there is moderate evidence that local triamcinolone injections benefit those with lateral epicondylitis both in the short and intermediate terms, that multiple injections appear to be no more effective than single, and that there is limited evidence that local glycosaminoglycan polysulphate injections control pain in the short and intermediate terms. While the results of this review seem appropriate, the reader is never informed of where the research was gotten.

Wong et al. (2005) investigated the efficacy of another type of injection in the treatment of lateral epicondylitis: botulinum toxin. They used a double-blind approach to randomly allocate 60 patients to receive a single injection of botulinum toxin or a placebo saline injection. The botulinum toxin group demonstrated significantly better pain scores than the placebo group at 4 weeks and 12 weeks; and there were no significant differences in grip strength between the two groups. Wong et al. (2005) reported that 4 patients in the botulinum toxin group had mild paresis of the fingers at four weeks, with one patient's paresis lasting until the 12th week. Wong et al. (2005) conclude that a botulunim toxin injection may improve pain over 3 months but may be associated with finger paresis. While this was a RCT, its power is still low because of low subject numbers. Also, the outcome measures were only recorded to intermediate term of 12 weeks.
In their review evaluating the efficacy of ultrasound for musculoskeletal disorders, van der Windt, van der Heijden, van den Berg, ter Riet, de Winter, & Bouter (1999) evaluated the use of ultrasound in treating lateral epicondylitis. Together, the six reviewed studies, three of which were placebo controlled, demonstrated inconsistent results, with statistically significantly positive results shown in only one study. van der Windt et al. (1999) concluded that there is weak evidence in favor of ultrasound use with lateral epicondylitis, with the proportion of positive studies only 33%. While the analysis of the data appears appropriate, it is questioned why the authors only reviewed six articles on the use of ultrasound with lateral epicondylitis. Once more, the reader is left realizing more quality research is needed to conclusively make any conclusions regarding this treatment technique with lateral epicondylitis.

While Nussbaum & Gabison (1996) do not address lateral epicondylitis directly, they address the effect of different dosages of ultrasound on inflamed tissue. While ultrasound may be used in dosages ranging from 0.1 W/cm2 to 1.5cm2, Nussbaum & Gabison (1996) found positive results using what may be considered low dosages of 0.1 to 0.6 W/cm2. This may introduce another contributing factor in the use of ultrasound to treat lateral epicondylitis.

Hoppenrath & Ciccone (2006) not only address the use of ultrasound, but also of phonophoresis in the treatment of lateral epicondylitis. In an attempt to demonstrate how a clinician bases practice on research evidence, the authors reviewed and analyzed literature in search of evidence that phonophoresis is more effective than ultrasound in reducing pain in lateral epicondylitis. After searching four databases, the authors identified seven articles relating to phonophoresis and lateral epicondylitis. Based on
results of these studies, Hoppenrath & Ciccone (2006) conclude they would not recommend the use of phonophoresis with patients with lateral epicondylitis— they found only one study suggesting it may be useful and no strong evidence in an experimentally designed study which supported its use. This article was effective in demonstrating the process of basing clinical decisions on evidence. Hoppenrath & Ciccone (2006) described their search technique thoroughly and succinctly made recommendations based on the well described research they analyzed.

Nirschl et al. (2003) utilized a randomized, double-blinded and placebo-controlled research methodology in investigating the efficacy of treating lateral epicondylitis with iontophoresis of dexamethasone sodium phosphate. One hundred and ninety-nine patients randomly received either dexamethasone sodium phosphate or a placebo of bacteriostatic sodium chloride six times. After two days after their last treatment session of iontophoresis, the experimental group reported significantly less pain than the control group. However, one month after the last treatment, the experimental and control groups’ pain reports were not significantly different.

Another study which analyzed a nonsurgical treatment technique for lateral epicondylitis is Pettrone & McCall’s (2005) article which addresses the use of extracorporeal shock wave therapy without local anesthesia in patients with chronic lateral epicondylitis. 108 patients were randomly assigned to a treatment group or a placebo group; both of which received three weekly treatments and evaluated at one, four, eight, and 12 weeks. The group which received the extracorporeal shock wave therapy without local anesthesia demonstrated a significant positive difference in pain reduction when compared to the placebo group, and significant improvements in
functional activity scores, activity-specific evaluation and the overall impression of the disease state from the at 12 weeks compared to baseline. While the subject number is sufficient, Petrone & McCall’s (2005) study does not evaluate follow-up measures past three months.

Labelle & Guibert (1997) aimed to investigate the efficacy of another nonsurgical technique: the use of an oral NSAID diclofenac in their RCT. There were 128 patients randomly assigned to be in the control group which was treated with placebo pills, or in the treatment group receiving diclofenac. All patients were also treated with a cast which immobilized the elbow and wrist. The only statistically significant outcome measured between the control and treatment groups was that of pain reduction. The treatment group also experienced a statistically significant increased amount of negative side effects.

Labelle & Guibert (1997) conclude that in light of the limited differences between the two groups and the presence of the side effects, they would not recommend using diclofenac to treat lateral epicondylitis. Their conclusion appears to be based on sound evidence. While the RCT addressing the use of diclofenac did not appear effective in its original intent, all patients (treated with immobilization of the elbow and rest) did demonstrate significant improvements in all areas measured. Labelle & Guibert’s (1997) RCT will be analyzed and discussed further in this literature review when splinting is covered.

Nonsurgical Techniques Which Include Splinting

Borkholder et al. (2004) performed a systematic literature review and investigated eleven RCTs chosen from 98 articles obtained through searches of several databases to
inspect the efficacy of using splinting to treat lateral epicondylitis. The studies addressed five different types of splints, as outlined by the American Society of Hand Therapists (ASHT) Splint Classification. Borkholder et al. (2004) gave each RCT a quality score and organized their analyses of each study's results based on the splint type. As none of the studies they reviewed obtained a perfect quality score, Berkholder et al. (2004) concluded that these RCTs offer early affirmative, but not conclusive, evidence for the use splinting in the treatment of lateral epicondylitis. One of the eleven studies evaluated addressed the efficacy of a technique similar to that which will be addressed in the present study. That individual work (Labelle & Guibert, 1997) will be analyzed in this literature review.

Borkholder et al.'s (2004) review is viewed as an excellent source of evidence for the investigation of the efficacy of using splinting with lateral epicondylitis because of both its strict inclusion criteria and its quality ratings of each study analyzed. Borkholder et al.'s (2004) review was even recognized by Szabo (2006) as being an example of the strong evidence-based resources The Journal of Hand Therapy produces in his address at an annual ASHT meeting. As with all of the research considered thus far, both Borkholder et al. (2004) and the reader end with the recognition that more RCT of excellent methodology need to be performed to provide conclusive evidence backing or refuting the use of splinting with lateral epicondylitis.

Derebery, Devenport, Giang, & Fogarty (2005) completed a retrospective study which addressed the efficacy of splinting treatment for epicondylitis. They analyzed the records of 4614 patients who had filed workers' compensation claims with elbow pain. Derebery et al. (2005) compared the treatment outcomes of the patients who had and who
had not received splinting as a treatment for their elbow pain. They considered splinting to be any restraint to the elbow, forearm, or wrists areas. They included braces, splints, straps and wrap bandages in the splinting condition.

Derebery et al. (2005) conclude that splinting patients with epicondylitis is not advantageous. They cite that patients who had undergone splinting had significantly higher rates of limited duty, treatment duration and medical costs. While Derebery et al’s (2005) sample was large, their conclusions must be considered with caution. By including any type of brace, splint, strap or bandage as a splint, they were unable to analyze differences between the different types of splints. They did not even note any differences in the splints considered in the splinting group so it is not known if a long-arm splint was included in any of the patients. While their results appear significant, it is doubtful that their study’s results are trustworthy because of their consideration of every type of splint strap and brace as being equal.

Struijs, Kerkhoffs, Assendelft, & van Dijk (2004) defined the splint in their study much better. They compared the efficacy of treatment with standard physical therapy (ultrasound, friction massage, and exercise), with a brace worn continuously on the forearm, and treatment including the two. The brace was a counterforce brace which was worn just distal to the elbow. 180 patients were randomly allocated into the three groups and received treatment for six weeks. The results were measured six weeks and one year after randomization. Struijs et al. (2004) reported that 19-21% of patients in all three groups received additional treatment for their symptoms related to lateral epicondylitis. The only outcomes they found which were significant were beneficial results from physical therapy for pain, disability and satisfaction in the short term only, and superior

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inconvenience during daily activities in the brace-only group. While the number of patients in the study is sufficient, the study appears to lack a true control group. Also, with about 20% of all patients receiving additional treatment, the results are questioned to be valid, especially as Struijs et al. (2004) never gave any information on what the additional treatment entailed.

Walther, Kirschner, Koenig, Barthel, & Gohlke (2002) evaluated the biomechanics of three types of braces used with lateral epicondylitis: those with a clasp at the lateral epicondyle, those with a silicone pad on the lateral epicondyle, and those with padding over the wrist extensor muscle bellies in the forearm. Walther et al. (2002) measured the vibration and acceleration of the forearm and elbow of ten skilled tennis players wearing each of the three braces, so a total of ten sets of measurements were taken for each brace type. There were significant differences shown in each brace type’s reduction of vibration and acceleration. The brace with the largest impact was those with pads on the forearm, the next highest reduction was with the brace with pads on the lateral epicondylitis and the least reduction was when the brace with a clasp at the lateral epicondylitis was used.

Walther et al. (2002) concluded that this evidence of braces reducing vibration and acceleration support their use in treating lateral epicondylitis in hopes of reducing a force overload in the wrist extensor muscles. They support the use of the brace with the padding over the extensor bellies to be tried first. While the data certainly is significant, it is questioned how the results are translated into claiming the efficacy of the braces in treatment with lateral epicondylitis. It is questioned how it is know that a reduction in the
vibration and acceleration of the forearm indicate a reduction of load on the extensor
tendons originating at the lateral epicondyle.

In an attempt to demonstrate the reduction of force load on the wrist extensor
tendon by a counterforce brace in treating lateral epicondylitis, Meyer et al. (2002)
investigated loads on the ECRB with a brace applied at different forces in forearms of
four cadavers with the ECRB being distally loaded. Their results identified an increased
effect of the counterforce brace worn at increased force levels, and a decreased effect of
the brace with increased distal loads of the ECRB. Based on these results, Meyer et al.
(2002) recommended the use of a counterforce at a setting of 40 to 50 mmHg during
light-duty activities while also recognizing the need for more definitive research. While
Meyer et al.'s (2002) results are significant, it is again questioned how it is known that
this is an effective treatment for lateral epicondylitis. Also, the results are questioned
concerning inherent difficulties in using cadavers as research subjects: the quality of the
musculoskeletal tissue, and the lack of any interaction with the subjects in order to
identify pain.

In another study examining the effectiveness of braces used to treat lateral
epicondylitis, Wuori, Overend, Kramer, & MacDermind (1998) used a repeated-measures
design with three brace types and fifty patients acting as their own control. The three
brace types were as follows: two manufactured braces for lateral epicondylitis and one
placebo brace prepared with a patella strap worn above the lateral epicondylitis and
therefore out of reach of the ECRB. Wuori et al. (1998) measured pain and pain-free grip
strength for each patient wearing all three brace types within an hour. They reported that
no significant differences were shown in measures of neither pain nor pain-free-grip

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strength for any of the three brace groups. While the statistical analysis of the data appears to be complete, their methodology is certainly questioned. With only five minutes between each brace type during the one hour per-patient testing, it is assumed difficult to be able to differentiate between the effects of the three groups. Wuori et al. (1998) conclude, and the reader concurs, that research needs to be done which investigates the long-term effects of bracing as well as the short-term.

The only studies found searching CINAHL, ProQuest, PubMed, Scopus, and PEDro databases which discusses the efficacy of treating lateral epicondylitis with immobilization of the elbow and wrist, as the present study will, was Labelle & Guibert’s (1997) RCT and Zarezadeh et al.’s (2004) study. Labelle & Guibert (1997) analyzed immobilization’s efficacy indirectly as they formally addressed the efficacy of diclofenac in treating lateral epicondylitis. As previously discussed, Labelle & Guibert (1997) inadvertently measured the efficacy of immobilization as both their control and experimental groups underwent immobilization. The patients in the experimental and control groups had immobilization casting of the affected arm with the elbow maintained in 90 degrees flexion and the forearm and wrist in a neutral position for 14 days and thereafter were instructed to resume ADL while avoiding “at-risk” activities. The experimental group also took the NSAID for 28 days while the control group took a placebo.

Labelle & Guibert (1997) found that all patients of both the experimental group and control groups had significant improvements at 28 weeks after baseline in: maximum pain-free grip strength, maximum grip strength, visual analog pain scale, visual analog
function scale, and the pain-free function scale. The only measure that showed significantly improved results for the experimental group was pain.

Labelle & Guibert (1997, pp. 262) recognized that the use of a NSAID had no clear advantage over the use of immobilization and reported this to be due to three possible factors: “...a placebo affect, the natural tendency of the disease to improve with time and rest, and a possible therapeutic effect of immobilization casting.” This possible therapeutic effect of immobilization will be addressed in the present study. In their systematic review of splinting used with lateral epicondylitis, Borkholder et al. (2004, pp. 185) recognized the need for more research to validate Labelle & Guibert’s (1997) finding of the efficacy of immobilization of the elbow and wrist, “...unfortunately, no other studies using splints in this category were found to further validate these results.” It should be noted that while Labelle & Guibert (1997) used immobilization with casting, the present study will examine immobilization with splinting which will allow daily brief active range of motion (AROM) to avoid contractures of the arm. This is thought to be an advantage of immobilization by splinting.

Zarezadeh et al. (2004) also studied immobilization using long-arm casts. While Zarezadeh et al. (2004) describe the cast only as a “long arm cast splint” which ran from “distal palmar crease to proximal arm” (Zarezadeh, 2004, p. 16) it is unknown if the splint crossed the elbow joint. Zarezadeh et al. (2004) also studied the casting in context of other treatment techniques. As opposed to Labelle & Guibert (1997), they manipulated the casting, with their control group not receiving the casting and their experimental group receiving the casting. All of the subjects in the control and experimental groups received NSAIDs three times daily for ten days and one local
corticosteroid injection. Those in the experimental group wore the splint cast for 21 days. Zarezadeh et al. (2004) measured pain and tenderness during resisted wrist flexion prior to treatment, three weeks, three months and six months after initiation of treatment and found no significant difference between pain in the control and experimental groups.

While Zarezadeh et al. (2004) measured pain for six months after initiation of treatment; there are several limitations to their study. First, the reader is not able to clearly understand the cast splint used in the experimental group as it is just described as running from the distal palmar crease to “proximal arm” (Zarezadeh et al., 2004, p. 16). It remains unclear if the cast splints used are similar to those used by Labelle & Guibert (1997) or the long-arm splint to be used in the proposed study in relation to immobilizing the wrist and elbow. Also significant, Zarezadeh et al. (2004) use pain and tenderness during resisted wrist flexion as their dependent variable when it appears to be understood in the literature that lateral epicondylitis causes pain during resisted wrist extension (Cyriax, 1936, Nirschl & Ashman, 2004, & Boyer & Hastings, 1999). While there still may be pain during wrist flexion for those with lateral epicondylitis, the literature reports lateral epicondylitis to be exacerbated by resisted wrist extension and does not mention resisted wrist flexion (Cyriax, 1936, Nirschl & Ashman, 2004, & Boyer & Hastings, 1999). As has been described in previous sections of this literature review, lateral epicondylitis involves the origins of the extensor tendons ECRB and EDC (Nirschl & Ashman, 2004, Meyer et al., 2002, & Boyer & Hastings, 1999). The short length of time (21 days) that their experimental group wore the cast splints is another limitation to their study. The proposed study’s participants will have worn the splints from 4-6 weeks.
Besides these two significant shortcomings of the study, Zarezadeh et al. (2004) also appears to misunderstand the research they cite. During their literature review, they report that during the past decade long-arm splints have been emphasized as an appropriate treatment method for lateral epicondylitis. Upon review of their cited source, Foley (1993), it is found that the article is a descriptive piece on lateral epicondylitis and does not even mention long-arm splinting as a treatment choice. Foley’s (1993) only mention of splinting at all is the proposition of using a wrist cock-up splint in severe cases to shorten the extensor tendons. Also, Zarezadeh et al. (2004) claims that “recent studies have questioned the value of long arm splints basically because for the associated decrease in elbow range of motion and increased muscle weakness during a minimum treatment period of three weeks” (pp. 15-16) based on a chapter in Greene’s Operative Hand Surgery (Fromimson, 1999). Not only does Zarezadeh (2004) not cite and describe which individual studies have questioned the use of long arm splints, they cite a chapter of a book which describes surgical techniques and never even mentions long arm splinting (Fromimson, 1999).

Critical Analysis of Studies in Topic Areas

General Description of Lateral Epicondylitis

Definition and Etiology

While most appear to agree that lateral epicondylitis entails pain over the lateral epicondyle of the humerus which is exacerbated with resisted wrist extension (Nirschl & Ashman, 2004, Struijs et al., 2004, Struijs et al., 2003, Haahr & Anderson, 2003, Trudel et al., 2004, & Boyer & Hastings, 1999), not all agree upon its etiology. Some see it to be caused by inflammation of the wrist extensor tendons inserting at the lateral
epicondyle, as its name implies (Aiello, 1997); while others view it as a degenerative
process of the overused wrist extensor tendons (Nirschl & Ashman, 2004).

Again it is recognized that each patient with lateral epicondylitis will be different
and may be in the acute or chronic phase of the disease. Those supporting an etiology of
inflammation may be more inclined to consider those with acute lateral epicondylitis and
those supporting the degenerative etiology appear to be more inclined to consider those
conclusion that most likely every case of lateral epicondylitis has multiple
pathoetiologies is appreciated. Throughout the very dissimilar claims of etiological
causes of the condition, the wrist extensor tendon's overuse appears to be a unifying
theme. Those believing it to be degenerative label it out rightly as being caused by the
overuse of the said tendons (Nirschl & Ashman, 2004); while those believing it to stem
from inflammation indicate rest to decrease the inflammation to the tired tendons (Aiello,
1997).

Anatomy

Again, the tendons which are thought to be overused with lateral epicondylitis are
the extensor tendons originating at the lateral epicondyle, namely the ECRB and EDC.
While many believe the ECRB to be more involved (Nirschl & Ashman, 2004, Meyer et
al., 2002), Boyer & Hastings (1999) claim it impossible to lay more blame on the ECRB
than the EDC based on the inability to differentiate ECRB and EDC at their origin on the
lateral epicondyle. Based on the anatomy, if one wanted to give rest to the overused
tendons, both the elbow and wrist need to be rested.

Diagnosis
The diagnosis of lateral epicondylitis also has been shown to be based on its anatomy. Most appear to agree that it is diagnosed by using a physical examination identifying pain in the lateral epicondylitis, especially with resisted extension of the wrist (Cyriax, 1936, Nirschl & Ashman, 2004, & Boyer & Hastings, 1999). Boyer & Hastings (1999) also considered it important to obtain a history of the pain—what initiates it, exacerbates it, and what relieves it. This historical perspective may give practitioners additional information in teaching individual patients unique adaptations to be made to daily activities.

Prognosis

In support of Cyriax’s (1936) claim of spontaneous resolution of lateral epicondylitis in 8-12 months, a small RCT showed that in both treatment conditions, 83% of all patients with lateral epicondylitis experienced an improvement in symptoms in one year (Haahn & Anderson, 2003). Haahr & Anderson (2003) also identified factors related to poorer prognoses: employment in manual jobs, high level of physical strain at work, and high level of pain at baseline. All of these negative prognostic factors are believed to be related to an overworking of the overused tendons.

Diverse Nonsurgical Techniques

The review of the research revealed many diverse nonsurgical techniques used to treat lateral epicondylitis. Many approaches were not very intrusive, such as the wait-and-see (Smidt, van der Windt, Assendelft, Devillé, Korthals-de Bos, & Bouter, 2002) and the minimal intervention with education (Haahr & Anderson, 2003, Chan et al., 2000) techniques. There are also techniques which are minimally intrusive: splinting (Borkholder et al., 2004), exercise (Nirschl & Ashman, 2004), and manipulation and
mobilization (Struijs et al., 2003). Many approaches are also seen as being somewhat intrusive: NSAIDs (Labelle & Guibert, 1997), corticosteroid injections (Smidt, Assendelft, van der Windt, Hay, Buchbinder, & Bouter, 2002), botulinum toxin injections (Wong et al., 2005), glycosaminoglycan polysulfate injection (Boyer & Hastings, 1999), ultrasound and phonophoresis (Hoppenrath & Ciccone, 2006), pulsed electromagnetic field (Trudel et al., 2004), laser (Trudel et al., 2004), polarized polychromatic non-coherent light (Stasinopoulos & Stasinopoulos, 2006), extracorporeal shock wave (Pettrone & McCall, 2005), acupuncture (Boyer & Hastings, 1999), and Rebox therapy (Trudel et al., 2004).

Throughout the literature, there is the aforementioned theme of the need for more efficacy research on all techniques used. Boyer & Hastings (1999, pp. 481) recognized this need when they reported that,

"...most, if not all, common nonoperative therapeutic modalities used for the treatment of tennis elbow (lateral epicondylitis) are unproven at best or costly and time-consuming at worst."

The following section will address the efficacy studies done on the mentioned treatment techniques.

Outcome Studies of Several Treatment Techniques

Throughout the efficacy studies of the several treatment techniques for lateral epicondylitis, this lack of methodologically sound research is recognized as most authors reported that more RCTs need to be done in order to make conclusive conclusions on the treatment of lateral epicondylitis. Based on the research analyzed and described in previous sections, the following have not been found to be supported by evidence as a treatment method for lateral epicondylitis: laser therapy (Vasseljen, 1992, &
Krasheninnikoff, Ellitsgaard, Rogvi-Hansen, Zeuthen, Harder, Larsen, & Gaardho, 1994), pulsed electromagnetic field therapy (Devereaux, Hazleman, & Thomas, 1985), steroid injections (Price, Sinclair, Heinrich, & Gibson, 1991), glycosaminoglycan polysulfate injections (Akermark, Crone, Elsasser, & Forsskahl, 1995, Bernstein, 2001). While these techniques have not been backed by evidence it is recognized that many of them continue to be used to treat lateral epicondylitis (Boyer & Hastings, 1999).

The following techniques have had mixed efficacy results, with some authors reporting early positive results and some authors reporting them as ineffective in treating lateral epicondylitis: acupuncture (Molsberger & Hille, 1994, & Fink, Wolkernstein, Luennemann, Gutenbrunner, Gehrke, & Karste, 2002), extracorporeal shock wave therapy (Rompe, Hopf, Kullmer, Heine, Burger & Nafe, 1996, & Pettrone & McCall, 2005), ultrasound (Boyer & Hastings, 1999, Trudel et al., 2004, & van der Windt et al., 1999), phonophoresis (Hoppenrath & Ciccone, 2006, & Trudel et al., 2004), iontophoresis (Nirschl et al., 2003) and oral NSAID use (Labelle & Guibert, 1997).

These are the techniques that may especially need further examination, especially for the therapists whom back their worth with testimonial and anecdotal evidence.

The following techniques have been found to have beginning positive support of their efficacy in treating lateral epicondylitis effectively: alteration of tennis stroke or work technique (Blackwell & Cole, 1994), manipulations/mobilizations (Struijs et al., 2003, & Stasinopoulos & Stasinopoulos, 2006), Rebox therapy (Johannsen, Gam, Hauschild, Mathiesen, & Jensen, 1993), minimal intervention (Chan et al., 2000), exercise (Martinez-Silvestrini et al., 2005, & Stasinopoulos & Stasinopoulos, 2006), polarized polychromatic non-coherent light (Stasinopoulos & Stasinopoulos, 2006),
triamcinolone injections (Bernstein, 2001), botulinum toxin injections (Wong et al., 2005), all six types of splints reviewed in a systematic review (Borkholder et al., 2004), cross friction bracing (Walther et al., 2002), and splinting with the elbow and wrist stabilized (Labelle & Guibert, 1997).

While there are several options of nonsurgical treatment techniques for lateral epicondylitis that are backed, at least in the beginning stages, by evidence, each patient’s unique disease process and occupational life is emphasized as being one of the important factors in deciding which treatment technique to use. As Boyer & Hastings (1999) note, each individual patient may have several pathoetiologies relating to his or her lateral epicondylitis which affects his or her engagement in daily occupations. Cowdry (2006) recognizes that with each of the diverse patients with lateral epicondylitis all that is explicitly known is that they have debilitating elbow pain. He calls for a continual intense professional dialogue addressing the treatment of lateral epicondylitis. Part of this dialogue will be summarized next.

**Summary of Literature as it Relates to Proposed Study**

This review of the current literature partly in search of the best method to assist individuals with lateral epicondylitis in returning to full engagement in their lives has provided a configuration for the present investigation of a treatment technique for the condition. Concerning lateral epicondylitis’ definition and etiology, there is a chasm between those who believe lateral epicondylitis is secondary to inflammation and those who believe it to be secondary to degeneration. There does appear to be a consensus that the condition is secondary to overused tendons; and this begs for a treatment which will
rest the involved tendons. The negative prognostic factors once more suggest a treatment technique in which the tendons are rested.

The literature appears to support the assumption that the affected tendons involved in lateral epicondylitis need rest. Along with this supposition, the lack of conclusive evidence for one treatment approach over another surfaces the need to return to the basics of lateral epicondylitis and develop an intervention based on its etiology, anatomy, and prognostic factors. This gives support to the treatment of rest for the tendons.

The present study will investigate a treatment technique which applies this principle of providing rest for the affected extensor tendons, and addresses a technique similar to the technique discussed in the RCT by Labelle & Guibert (1997). Their findings concluded that patients whose elbows and wrists were immobilized for 14 days demonstrated significant long-term improvements in maximum pain-free grip strength, maximum grip strength, reduction in pain as measured by a visual analog pain scale, increase in function as measured by a visual analog function scale, and an increase in pain-free function as measured by the pain-free function scale. These early positive results regarding using immobilization to treat lateral epicondylitis invite further research to investigate this technique of resting the tendons through immobilization.

While Zarezadeh et al. (2004) also investigated using a long-arm cast to treat lateral epicondylitis, the severe methodological flaws limit their results which claim no significant differences in pain between those who had worn and those who had not worn the cast splints. Zarezadeh et al. (2004) does not describe the cast well enough so that is may be positively identified as crossing the wrist and elbow. Also, they measured pain
during wrist flexion, when wrist extension has been shown to exacerbate pain associated with lateral epicondyritis (Cyriax, 1936, Nirschl & Ashman, 2004, & Boyer & Hastings, 1999). Zarezadeh et al. (2004) also only had their experimental group wear the cast splints for 21 days, as opposed to the 4-6 weeks required for rest of the tendons of the participants in the proposed study. And as described earlier in this literature review, Zarezadeh et al. (2004) also claimed things in their literature review that were not shown by the sources they cited. All combined, their results appear insufficient to make any claims about using long-arm splinting with lateral epicondyritis. Their work further supports descriptive research into the phenomenon of using long-arm splinting to treat lateral epicondyritis.

The main difference between the splint type of that used in Labelle & Guibert’s (1997) trial, and assumedly in Zarezadeh et al. (2004), and the splint used in the present study is that the present study will describe use of a long-arm splint which immobilizes the wrist and elbow, while Labelle & Guibert (1997) and Zarezadeh et al. (2004) investigated the use of a cast immobilizing the joints. The splint is thought to be advantageous to the cast because it allows for daily short doffing of the splint to allow for gentle AROM to prevent muscle contractures and possible stiffness.

Based on this literature review, it is recognized that a treatment technique which allows the overused tendons involved in lateral epicondyritis to rest needed to be investigated. It was believed that a case study is the best method to do so. A case study may provide the most in depth point-of-view of a phenomenon (Creswell, 1998). A case study may address how wearing the long-arm splint affects a participant’s occupational
life, how a participant thinks and feels about wearing the splint, and how wearing the splint has affected her ability to perform a meaningful activity.
CHAPTER 3 METHODOLOGY

Study Design and Rationale for Selection

A case study design was used to investigate the use of long-arm splinting to treat one participant's lateral epicondylitis and the response of that participant to wearing the long-arm splint. This approach was considered advantageous because it may be able to give the most comprehensive description of the use of long-arm splinting and the perception of the participant to wearing the long-arm splint. Case studies have been established as an effective means to describe a phenomenon in the social sciences (Creswell, 1998). The level of research of this study is descriptive. The aim of this study was to describe using long-arm splints to treat lateral epicondylitis and to describe the participant's reaction to wearing the long-arm splint. This was completed by an interview, observation and measurements of the participant's upper extremities.

Participants and Context of Study

A sample of convenience was used in the present study. Dr. Donald Condit, a hand surgeon in Grand Rapids, Michigan, chose a client of his who underwent treatment of her lateral epicondylitis with long-arm splinting based on the following inclusion criteria. The participant must:

- Be wearing or have worn a volar long arm splint which immobilizes the elbow at 90 degrees, the wrist in slight extension, and the forearm neutral between pronation and supination
- Be wearing or have worn the splint continuously, except for daily doffing to perform ADL, for 4-6 weeks
• Not have undergone any strengthening treatment for her lateral epicondylitis.

After obtaining her consent, the participant, S., was interviewed and observed simulating an activity by the primary investigator in Dr. Condit's office. The primary investigator also completed ROM measurements of the participant's bilateral elbows, wrists and MP joints, and strength measurements of the participant's bilateral grip strength. While the primary investigator was planning on reviewing S.' chart, there was no data to be reviewed, as the chart was no longer available in Dr. Condit's office. Studying one participant who had worn a long-arm splint gave the researcher an in-depth look at using long-arm splinting in treatment for lateral epicondylitis.

Instrumentation Along With Validity and Reliability

The primary investigator interviewed the participant. The interview enabled the primary investigator to learn of the effect of wearing the long-arm splint on the participant's ability to engage in her daily life. The interview also provided insight into how the participant felt and thought about wearing the long-arm splint.

Concerning the participant's present pain, she was asked to rate the pain on a 0-10 pain scale. The 0-10 pain scale is widely used in the clinic and Breivik, Björnsson, & Skovlund (2000) have shown that it is comparably sensitive as a 100-mm visual analog scale. Lundeberg, Lund, Dahlin, Borg, Gustafsson, Sandin, Rosén, Kowalski, & Eriksson (2001) not only show the numeric rating scale to be as sensitive as the visual analog scale, they also show it to be as reliable as the visual analog scale.

Lastly, the interview allowed the participant to describe why she thought she wore the long-arm splint. The interview questions' validity and reliability was
established through input from both clinicians familiar with the use of long-arm splints to treat lateral epicondylitis and clinicians familiar with qualitative research.

The final question of the interview was one in which the participant described a meaningful activity that has been impacted by her lateral epicondylitis and by wearing the long-arm splint. She simulated the activity of wiping a countertop. This provided the primary investigator an opportunity to view how the long-arm splint has affected participation of meaningful activities for the participant. While the participant narrated the activity during the interview, direct observation provided a unique perspective of how the splint has affected the participant’s occupational life.

Finally, the primary investigator measured the participant’s bilateral elbow, wrist and MP ROM, and also grip strength. Based on the biomechanical frame of reference, these measurements may provide insight into the foundations of ROM and strength which account for the ability to engage in occupations (Hagedorn, 2001). The ROM was measured using a goniometer, and the grip strength was measured with a dynamometer, as proposed to be the preferred methods by the American Society of Hand Therapists (1999).

Procedures

After notification of approval from Grand Valley State University’s Human Research Review Committee, Dr. Condit directed his office staff to contact the client he chose who met the inclusion criteria. After the participant agreed to be involved in the study, the office staff contacted the primary researcher and gave her the contact information of the chosen participant so that she could contact her.
On the date of the interview, the participant first read and signed the informed consent form (Appendix A). The primary investigator interviewed the participant. The interview was audiotaped, as outlined in the informed consent form (Appendix A), and the primary investigator took notes on the interview protocol form (Appendix B). The participant then simulated the meaningful activity of wiping a countertop, an activity which she reported had been affected by her lateral epicondylitis and by wearing the long-arm splint. The primary investigator took notes on the observation data form (Appendix C). The participant’s ROM of the elbow, wrist and MP joints, and grip strength were then measured. This data was recorded on the ROM and strength data form (Appendix D). The primary investigator was also planning on collecting data from the medical chart and the therapy chart. However, these charts were not made available to the primary investigator.

Data Analysis Plan

The data describing the experience of the participant wearing the long-arm splint the data was analyzed using methods introduced by Stake (1995). The audiotape of the interview was transcribed and read through several times to understand the participant’s responses as a whole before attempting to analyze them (Creswell, 1998). As proposed by Stake (1995), the data was then analyzed in terms of categorical aggregation, direct interpretation, patterns and naturalistic generalizations. Data concerning the results of the observation, and ROM and strength measurements was included during the development of the themes of the analysis. Overall, the case was described, the themes were classified, and they were interpreted to draw conclusions which became apparent.
CHAPTER 4 RESULTS

The results of the interview, observation, and measurements will now be addressed. The participant, a 42 y.o. female, S., met with the primary investigator at Dr. Condit’s office, in a treatment room. The interview took approximately 26 minutes, the observation took approximately three minutes, and the measurements took approximately six minutes. The results from the interview will be discussed first, followed by those of the observation, and measurements.

Themes in Interview

Throughout the interview, S.’ replies implied seven themes. The themes describe how her lateral epicondylitis developed, both the long-arm splinting treatment and other treatment techniques she underwent for her lateral epicondylitis, the impact having lateral epicondylitis had on her occupational performance, S.’ thoughts and feelings about wearing the long-arm splint, how the participant believes the results of wearing the long-arm splint are worth the inconveniences, how she slowly returned to her previous occupational performance level and continues to rest her elbow, and how she described applying her belief in the splint by returning to wear the splint when she had pain in her elbow and recommending the splint to a friend who has lateral epicondylitis.

How the Lateral Epicondylitis Developed

The first theme which became apparent regards how S.’ lateral epicondylitis began. She reported how active she is in her activities of daily living, vocational, and leisure occupations. S. reported she keeps busy as a mother, doing all of the yard and house work, and also working as a nurse. She recalled she was carrying many boxes
during a family move when she first felt pain in her elbow. S. stated how she thinks the pain in her elbow was secondary to overuse of her right upper extremity, and how it seemed not to be horrible at first, but progressed through stages. The evidence for this first theme is included in Table 1.

Table 1

Participant’s Perception of How Her Lateral Epicondylitis Developed

<table>
<thead>
<tr>
<th>Area of Response</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active lifestyle</td>
<td>“...I do all the outside work in the house. So I do all the yard work; I am constantly outside doing stuff. We don’t have lawn service and we have two houses. So I’m the one, so... Garden, all that kind of stuff. If it needs to be painted I paint it...”</td>
</tr>
<tr>
<td></td>
<td>“…cooking dinner for five people...”</td>
</tr>
<tr>
<td></td>
<td>“…fold the laundry...”</td>
</tr>
<tr>
<td></td>
<td>“…I’m just a patient...and a nurse...”</td>
</tr>
<tr>
<td></td>
<td>“…I waterski...I golf...I ski...I kayak...I lift weights...I went to DisneyWorld...”</td>
</tr>
<tr>
<td>Activity engaging in when pain began</td>
<td>“...we were moving, so I was carrying lots of boxes and carrying lots of items...”</td>
</tr>
<tr>
<td>Development in stages</td>
<td>“...it wasn’t like, okay now I have the pain and this day I still have the pain. Someday I had the pains and then I didn’t have the pain. Then it would go into a chronic phase...”</td>
</tr>
</tbody>
</table>

Long-Arm Splint Wearing Schedule and Other Treatment Techniques

Besides discussing how her lateral epicondylitis developed secondary to her active lifestyle, S. also highlighted her wearing schedule of the long-arm splint and which other treatment techniques were used to address her lateral epicondylitis. She reported wearing the splint almost all the time for about five or six months. She reported doffing the splint for short breaks for ADL like bathing. She also reported that she received other treatment techniques to treat her lateral epicondylitis. She described how she stretched her arm, received two cortisone injections, ultrasound treatment, iontophoresis treatment,
heat packs, and a saline patch treatment for her lateral epicondylitis. The data from the interview which supports this second theme is presented in Table 2.

Table 2

<table>
<thead>
<tr>
<th>Response Area</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splint was a dorsal long-arm splint</td>
<td>“Dorsal, yeah. And then it kind of sat right here.” (palpating palm)</td>
</tr>
<tr>
<td>Wearing schedule</td>
<td>“...then I just wore it all the time...”</td>
</tr>
<tr>
<td></td>
<td>“...most of the time I wore it. When it was bad, all day, all night.”</td>
</tr>
<tr>
<td></td>
<td>“I think a couple of months...five to six months...”</td>
</tr>
<tr>
<td>Other treatment techniques</td>
<td>“...stretching basically, and I think they did the iontophore...”</td>
</tr>
<tr>
<td></td>
<td>“...Yup, two cortisone. And...I think they did some heat...”</td>
</tr>
<tr>
<td></td>
<td>“...like a patch where they injected something...they put like a saline injection on it and then I kept it on...”</td>
</tr>
<tr>
<td></td>
<td>“Yup, ultrasound...”</td>
</tr>
</tbody>
</table>

Effect of Her Lateral Epicondylitis on Her Occupational Performance

In addition to describing the treatment she had undergone, another theme which emerged from the interview was that S.’ lateral epicondylitis greatly impacted her occupational performance. She described how there were times when even light duty activities like drinking coffee and writing induced pain. She illustrated how she utilized compensatory strategies like relying mainly on her non-dominant left hand, and having her family do things for her. S. described how she continued to do the “necessary” things like cooking for her family, and she quit performing occupations that she perceived unnecessary to complete, such as playing tennis. The results which support this theme are presented in Table 3.
Table 3

<table>
<thead>
<tr>
<th>Response Area</th>
<th>Response</th>
</tr>
</thead>
</table>
| Pain affected her occupational     | • "Like the next day I’d be like, “Augh, this feels really bad today.”
   performance                        | • "...because I just pulled a big bunch of weeds out of the backyard. So it was more like, “How much do you want to suffer the next day?”
                                           | • "...I even got to the point where to pick up a coffee cup was just, you know, excruciating."
                                           | • "I got to the point too, where writing was really hard."
| Compensatory techniques used        | • "...I ended up using my left hand."
                                           | • "...so I just wanted to protect it."
                                           | • "And a lot of times I would say, ‘would you pull this pot off’ or have someone else fold the laundry.”
                                           | • "...I’d pick up pots really slowly, or I’d have someone pull them off the stove for me.”
                                           | • "...maybe I vacuum like twice a week, so I probably would go down to once a week and not vacuum so much.”
| Continued to complete               | • "Yeah, yah know, you just kind of had to do it. You just did it.”
   necessary occupations              | • "Well, I’d do it, but I’d do the activity or item, but I’d suffer, like the next day...”
                                           | • "...cooking dinner for five people...”
                                           | • "...I would put my long-arm-splint on and just mow the grass...”
                                           | • "...pulling stuff out of the dryer...”
                                           | • "... I would do it. I would just make it work some other way.”
                                           | • "...I didn’t stop, ‘cause I can’t.”
                                           | • "...I did water-ski. And I did ski with it though.”
                                           | • "I mean, I did all that, I just modified things, or do it left-handed.
                                           | • "...I did everything, even still...”
| Did not complete unnecessary        | • "...I wouldn’t do the leisure stuff.”
   occupations                        | • "Yeah, I have given up my leisure stuff I guess. But not all of it. Like I could live with kayaking with my long-arm-splint on.”
                                           | • "...I didn’t golf, very well.”
                                           | • "...I have not played tennis at all.”
                                           | • "...I mean, I just did the stuff.”
                                           | • "...I work out a lot...and I didn’t do any of that. I just did lower extremity and not upper...so I just, it was totally just, rest it.”

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Participant’s Feelings About the Long-Arm Splint in Relation to Other Treatment Techniques

After addressing how her lateral epicondylitis developed, was treated, and affected her occupational life, S. addressed what she thought and felt about wearing the long-arm splint, especially in relation to the other treatment techniques used. Overall, she “…loved…” the long-arm splint. S. reported perceiving it to be more effective in reducing her pain than any of the other treatment techniques. She described how she felt it worked because it rested her arm, while some other techniques, like the ultrasound and iontophoresis, irritated her arm. The data supporting this theme is found in Table 4.

Decreased Pain Worth the Inconveniences

Related to S.’ belief that the long-arm splint was more effective than any other treatment because it rested her arm, during the interview she also described how she believed that the decreased pain was worth the inconveniences related to wearing the splint. Throughout the interview, she reported how the size of the splint made it inconvenient to wear at times. She described not wanting to wear it during formal events. S. also spoke of how her forearms appeared atrophied after she was done wearing the splint. Although, as will be discussed in the next theme, she reported that she believes that she has fully regained the lost strength. The supporting data for this theme is found in Table 5.
Table 4

Feelings about the Long-Arm Splint in Relation to Other Treatment Techniques

<table>
<thead>
<tr>
<th>Response Area</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoughts and feeling related to the effectiveness</td>
<td>“...oh, I asked for it.”</td>
</tr>
<tr>
<td>of the long-arm splint</td>
<td>“I loved it.”</td>
</tr>
<tr>
<td></td>
<td>“I think that’s what helped me.”</td>
</tr>
<tr>
<td></td>
<td>“Yeah, you could tell (it was improving). It was just resting things, yah know?”</td>
</tr>
<tr>
<td></td>
<td>“So she doesn’t get rid of it or something, ‘cause it’s my friend!” (Participant spoke of needing to get the splint from someone she loaned it to)</td>
</tr>
<tr>
<td></td>
<td>“I think right away.” (How long before she noticed the pain improved after donning the splint.)</td>
</tr>
<tr>
<td></td>
<td>“...ooh...about a one…” (current pain level)</td>
</tr>
<tr>
<td>Belief that long-arm splint rested her arm</td>
<td>“I said, “I need to just rest.” I could tell my whole arm was inflamed, yah know?”</td>
</tr>
<tr>
<td></td>
<td>“And it felt like my whole muscles could relax because I was in that frame, yah know?”</td>
</tr>
<tr>
<td></td>
<td>“...it just makes that hand, be in position and relax…”</td>
</tr>
<tr>
<td></td>
<td>“You have tendonitis; it’s an inflammation- so rest it.”</td>
</tr>
<tr>
<td></td>
<td>“...it supported when my arm felt heavy and very weak. And intensely inflamed I guess.”</td>
</tr>
<tr>
<td></td>
<td>“...I just, I don’t want it to get bumped, smashed, I don’t want it to, so this will hold it in place…”</td>
</tr>
<tr>
<td></td>
<td>“...it was just resting things, yah know?”</td>
</tr>
<tr>
<td></td>
<td>“...the rest of the arm was still supported, but kind of relaxed.”</td>
</tr>
<tr>
<td></td>
<td>“...supportive I guess is just the best way to explain it. It’s like your muscles weren’t workin’ as hard to just keep the arm in place or something.”</td>
</tr>
<tr>
<td>Reaction to other treatment techniques</td>
<td>“I think I could have avoided- if I just had gotten in a long-arm-splint, I think I could have avoided the two cortisone shots, and I think this... (implying the patch) I don’t know if that did anything. I think if I just had put that on- I mean that’s the way I feel.”</td>
</tr>
<tr>
<td></td>
<td>“And some, like the ultrasound and the iontosphere, I felt like those did nothing.”</td>
</tr>
<tr>
<td></td>
<td>“...some of that other, I just felt like it was irritating, I just felt like it was stirring it up, yah know?”</td>
</tr>
</tbody>
</table>
Table 5

Decrease in pain well worth the bothers of wearing the splint

<table>
<thead>
<tr>
<th>Response Area</th>
<th>Response</th>
</tr>
</thead>
</table>
| Clumsiness of Long-Arm Splint | “It got in the way, but I felt like it was…” (worth it)  
“…like trying to fix dinner, ya know, that kind of thing”  
“…trying to um, driving a little bit, was a pain in the butt-trying to turn the wheel.”  
“…”Um…let’s see, I went to Disney World on the rides, that was kind of a pain! (laughs) Yeah, fun, I just thought, “I’m goin’, I don’t care. …but when you go down a roller coaster, you can’t hang on as well (laughter).  
“If it got really bad in the way I’d take it off. But most of the time I wore it. When it was bad, all day, all night.” Was it worth it? “Yeah, oh yeah. But it was really nice to be able to take it off to shower. Run that hot water around it, my arm. But I wanted it right back on when I was done.”  
Didn’t wear during fancy, black-tie events, “I would not wear that- ‘cause then you have ten million questions. But I would just hold my arm tight (simulates) … not, to dress up with it was kinda hard. So I didn’t do it in a dress up situation. But if I’m just in jeans and a tee-shirts when I’m at home, then I just wore it all the time” |
| Decreased strength | “Oh, huge. Yeah. This was one really weak hand. And you could almost see atrophy in it. Yah know, not totally, but … I mean, I just felt like it was really weak.”  
It was still worth it though? “Yeah, I mean it had to rest…”  
“… it took me a long time because this hand was so weak. So I ended up still being very left handed.”  
“Yeah, I think I have my strength back.” |

Return to Previous Occupational Performance and Persistent Rest of the Affected Arm

S. described how the inconveniences of wearing the long-arm splint were well worth it because of her ability to return to pain-free occupational performance. She described how she slowly returned to doing the things she had given up. She also reported she had realized that maybe she needed to rest, in addition to her elbow. She
reported doing things differently now, in an attempt to avoid re-injuring her elbow. The data supporting this theme is presented in Table 6.

Table 6

<table>
<thead>
<tr>
<th>Response Area</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to occupational</td>
<td>“I kinda had to slowly work my way back up. Like I slowly started lifting weights again…”</td>
</tr>
<tr>
<td>performance</td>
<td>“I'm back to playing golf, that's not a big deal. I'm not playing tennis yet, though. And I haven't really, I probably need to go back and try. But…”</td>
</tr>
<tr>
<td></td>
<td>“…I do push ups, yah know, I do overheads…”</td>
</tr>
<tr>
<td></td>
<td>“…I'm water-skiing, I'm snow-skiing, I'm, yah know…”</td>
</tr>
<tr>
<td>Recognition of the need to</td>
<td>“Like I did this sorta thing, where I'd protect my elbow next to my body. For a while, that's kinda how I started out. And then slowly I'd bring it back out, yah know?”</td>
</tr>
<tr>
<td>continue to rest</td>
<td>“…or I'd be pullin’, I'd pull, anything. I'm sure I had bad positioning, and that was part, so I learned to pull closer to my body and that kind of thing.”</td>
</tr>
<tr>
<td>elbow</td>
<td>“…I'm almost afraid to...aggravate things?”</td>
</tr>
<tr>
<td></td>
<td>“…yeah, you feel like you put this much time into it, yah know?”</td>
</tr>
</tbody>
</table>

Application of Belief in How Well Splint Works

In light of the previous theme of how well S. believed the long-arm splint worked, the next theme addresses how she applies this belief. The participant reported that two or three times she has returned to wearing the long-arm splint when the pain in her elbow returned. She also reported she has recommended the splint to a friend who has lateral elbow pain, and that the friend actually still has the splint. She describes how she needs to get the splint back from her friend, as she perceives the splint as also being a friend to her. Table 7 includes the data supporting this theme.
Table 7

Application of Belief in how Well Splint Works

<table>
<thead>
<tr>
<th>Response Area</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to Wearing Splint</td>
<td>“Oh, I’d go right back to it. I have gone back to it...3 or 4 times...”</td>
</tr>
<tr>
<td>Advocating About Splint to Friends</td>
<td>“In fact, I let my friend down the street, she’s got it. And I said, “Do you want my splint?””</td>
</tr>
<tr>
<td></td>
<td>“I’d say try it, forsure. Yeah, my friend’s got it right now. I should go get it from her actually.”</td>
</tr>
<tr>
<td></td>
<td>“I said, “just put it in there and see.”... I just said, “Why don’t you try it and see.””</td>
</tr>
</tbody>
</table>

Observation

The meaningful occupation which S. identified as having been impacted by her lateral epicondylitis was wiping the countertop with a rag. S. described how all cleaning tasks, and especially wiping the countertop and stovetop were impacted by having lateral epicondylitis. She simulated wiping the countertop by wiping the tabletop in the treatment room. S. used only her affected right arm to simulate wiping, without using her left arm to assist. Her facial expression did not change during the simulation, and S. continued to speak to the primary investigator without her voice’s tone or amplitude changing. The simulation did not appear difficult for the participant to complete. No other unanticipated observations occurred during S.’ simulation of wiping a countertop.

Measurements

ROM and strength measurements for S.’ bilateral elbows, wrists, and MP joints will now be discussed. The ROM data was obtained using a goniometer. For her right elbow, S. showed extension and flexion of 10 degrees, and 125 degrees. Her left elbow demonstrated extension and flexion of 10 degrees and 130 degrees. Her right wrist demonstrated extension and flexion of 65 degrees and 80 degrees; while her left wrist
demonstrated extension and flexion of 70 degrees and 75 degrees. Her right MP joints demonstrated hyperextension between 20 and 30 degrees and flexion between 65 to 95 degrees. Her left MP joints demonstrated hyperextension between 15 and 25 degrees and flexion between 92 and 100 degrees.

S.' grip strength was obtained using a dynamometer. Her average right gross grip strength measured by a dynamometer was 60 pounds and her average left grip strength was 62.33 pounds.
CHAPTER 5 DISCUSSION

The results of the interview, observation, and measurements will be addressed here under the previously identified themes. While the themes were originally used to identify the results of the interview, it is thought that the result of the observation and measurements will be best addressed under inclusion with the themes. How each of the themes may be applied to occupational therapy, and how the themes answer the research questions are also discussed. Limitations of the present study are also addressed, and recommendations for further research are made.

S.'s Belief of how Her Lateral Epicondylitis Developed

The first theme presented from the results of the interview and observation is how S. perceived her lateral epicondylitis to have developed secondary to her active lifestyle. She discussed all of the housework, yard work, vocational, exercise and leisure activities which make up her active lifestyle which she perceived to contribute to her lateral epicondylitis. Haahr & Anderson (2003) affirm this suspicion, as they identify high physical strain as a risk factor in acquiring lateral epicondylitis. As will be discussed further, S. appeared to have made gains over her busy lifestyle when she reported she is attempting to use her arms differently in her occupational performance and when she discussed that maybe she needed to rest in addition to resting her arm with the long-arm splint.

This information may be especially important to occupational therapists engaging with clients who are very active. As S. appears to have done, an occupational therapist may assist a client in figuring out the best way he or she may use his or her body most
effectively, most safely, and with the least amount of energy in order to avoid cumulative trauma injuries like lateral epicondylitis (Harlowe, 2001). This case study may be utilized to illustrate what may happen if and when one overuses part of his or her body.

Recognizing that a client may initiate activity modification for himself or herself, as S. does, may be meaningful for occupational therapists. Especially when engaging with clients with cumulative trauma injuries, such as lateral epicondylitis, a common goal may be for the client to recognize when he or she needs to modify an occupation. As Harlowe (2001) advocates, a therapist may work with a client to find a perfect-fit modification to a meaningful activity. This may be done especially well when the therapist recognizes and uses modification techniques the client is already addressing. This may prove to be an optimum approach to engage a client in the sought after client-driven and client-centered rehabilitation (AOTA, 2002).

**Long-Arm Splint Wearing Schedule and Other Treatment Techniques**

S.’ splint was dorsal and not volar as the initial inclusion requirements entailed. However, because the most important aspect of the long-arm splint is the rest of the tendons, it is presumed that a dorsal long-arm splint will reflect the same results that a volar long-arms splint would. As S. discussed, the splint “...broke off a few times...” In personal communication on October 4, 2006 with a therapist who regularly utilizes long-arm splints to treat lateral epicondylitis, J. Biese reported that she had changed to forming the long-arm splint in a volar approach after she had experienced clients breaking the splint, as S. reported doing. J. Biese reported that a volar or dorsal approach does not appear to make any difference on the effectiveness of the long-arm splint.
While the design of the splint is not that specified by the inclusion criteria, the wearing schedule appears to be congruent with that outlined in the inclusion criteria. S. reported wearing the splint full-time except for a daily break to perform ADL. Although S. did report doffing the splint for "black-tie" events, she also demonstrated how she would not use the arm while the splint was doffed, and how she held the arm next to her body. This wearing schedule is thought to be necessary to adequately allow the involved upper extremity to rest, while still permitting limited ROM activities. The schedule follows the beginning promising results Labelle & Guibert (1997) found with long-arm casts, while allowing brief ROM.

S. reported wearing the long-arm splint for approximately five to six months. This is well above the inclusion criteria of four to six weeks. This disparity may be apparent for several reasons. First, the difference may be secondary to individual differences. J. Biese reported on November 6, 2006 in a personal communication that while four to six weeks is normative, some individuals may require more time in the splint if their lateral epicondylitis is further advanced. The disparity may also be secondary to recall bias. Although, Caughlin (1990) reports that recall bias is greater in participants who have a poorer recall in general, which is not apparent in S. It is thought to be most likely that S. wore the splint longer because her affected arm needed more rest.

Besides wearing the long-arm splint most of the time for five to six months, S. also reported on several other treatment techniques she underwent in treatment of her lateral epicondylitis. Her report of the treatment beginning with stretching appears to be representative of many clients whose lateral epicondylitis is being treated with stretching.
Martinez-Silvestrini et al. (2005) results support the use of stretching, as all of their participants made significant gains stretching as the constant variable. Stretching may loosen the tendons enough to decrease some of the inflammation without adding to its wear as exercises may. Martinez-Silvestrini et al. (2005) found in the same study that adding strengthening exercises to a client's treatment did not improve the effectiveness of therapy. This appears to be harmonious with the idea that the irritated tendon needs to rest.

Besides the stretching, iontophoresis and ultrasound were also used in an attempt to decrease the pain in S.' elbow. Nirschl et al. (2003) have shown iontophoresis to have only a short-term effect on pain reduction for lateral epicondylitis; and Nimgade, Sullivan, & Goldman (2005) have found that the evidence for the use of ultrasound with clients with lateral epicondylitis is insufficient. S.' results affirm these authors in that she thought they felt they had done "...nothing..." for her pain.

The next technique which S. did not feel to be effective was the cortisone injections. Her belief of the ineffectiveness is supported by the results of Price et al. (1991). They found that steroid injections in general, including hydrocortisone, did not have any long-term pain reduction effects. They also found that skin atrophy occurred more often with a hydrocortisone injection than with the two other types of injections.

In addition to stretching, iontophoresis, and the cortisone injections, S. reported that heat was used to treat her lateral epicondylitis. Although she did report she enjoyed moving her arm under the warm water in the shower, she also described how happy she was to put her long-arm splint back on. This reflects the necessity to move the elbow and wrist during ADL, while maintaining the position most of the time in the splint.
The final treatment approach S. mentioned as receiving for her lateral epicondylitis was a saline patch. Personal conversation with J. Biese on November 6, 2006 revealed that using a patch with either saline or nitroglycerine on it is a treatment approach which is developing for lateral epicondylitis. Currently, there is nothing which describes this approach in the literature. The use of this approach appears to affirm Boyer & Hasting’s (1999) claim that most treatment used for lateral epicondylitis is not adequately justified through research. The diversity of approaches used to treat S.’ lateral epicondylitis affirms Boyer & Hasting’s (1999) frustration of no clear-cut ideal treatment for lateral epicondylitis. This confirms the need to research different treatment approaches.

S.’ Lateral Epicondylitis Greatly Affected her Occupational Performance

This need for research regarding an effective treatment approach is especially vital when considering the great effect lateral epicondylitis has on one’s occupational performance. S.’ report that her lateral epicondylitis affected her occupational performance is not surprising. The impact of this physiological injury on the rest of S.’ life aligns with Neuman’s (1995) systems theory. According to the American Occupational Therapy Association (AOTA) (2002), Neuman’s (1995) theory should be one of the main foundations of an occupational therapist’s perspective. According to the theory, each person’s subsystems interact to compose one’s occupational life. Only the physiological, psychological, sociocultural, developmental and spiritual systems combined are able to make a person what he or she is. According to the theory, it should be no surprise that S.’ lateral epicondylitis, or a problem in her physiological system,
affected the rest of the systems and ultimately, her occupational performance (Neuman, 1995).

S. reported that her occupational performance was affected by the lateral epicondylitis, and also that she used several compensatory strategies to manage the effect. This was demonstrated during the observation when S. discussed how she used her left arm to wipe the counter when she had pain from her lateral epicondylitis. The use of compensatory strategies becomes necessary when a client is unable to perform a task in its usual manner. Occupational therapists attempt to engage clients in the use of such strategies, and S.' therapists may have given her suggestions on how to avoid using her affected arm, so that it could rest (AOTA, 2002).

This is another important concept S. demonstrates which occupational therapists need to be aware of. When engaging in client-centered practice, it is vital that the therapist addresses and possibly uses the compensatory strategies the client is demonstrating (AOTA, 2002). As Harlowe (2001) describes, compensatory strategies which conserve energy and protect and rest a joint or body part are at times necessary. These strategies may enable a client to more fully engage in his or her occupational life. From the results of this case study, it appears that in the case of those with lateral epicondylitis, compensatory strategies which rest the affected arm may be meaningful.

In reaction to her lateral epicondylitis affecting her occupational life, S. reported that she continued to complete only necessary occupations, and did not attempt to complete others. This information may be useful for a therapist who is engaging with a client who has lateral epicondylitis. Recognizing the necessity to set priorities and only address what is meaningful is one way to engage in client-centered therapy. Sumison &
Law (2006) found that power and choice are two key elements of client-centered care. When engaging with a client similar to S., who recognizes and addresses only what is important to him or her; a therapist may best be able to shape treatment in a client-centered approach. Again, the therapist should address and utilize the lead that the client is giving him or her.

**S.’ Feelings about the Long-Arm Splint in Relation to Other Treatment Techniques**

While there is no research which supports why S. loved her long-arm splint so much, this response appears to align with the belief that lateral epicondylitis is a true “itis”. Even S. replied during the interview, “...it’s an inflammation- so rest it.” It appears that S. herself, and this study, support the idea that the extensor tendons are inflamed and need rest. S. repeatedly reported that she liked the splint because it rested her arm and gave her more support. For S., it appears to be true that her arm did need the rest. In sharp contrast to her favorable reaction to wearing the splint, S. reported that the other treatment techniques didn’t really do anything, and some even irritated her elbow more. Her frustration again appears to echo Boyer & Hastings (1999, p. 481) when they discuss how the nonsurgical treatment techniques used are “…unproved at best, or costly and time-consuming at worst.”

While the research does not presently paint a clear picture of what treatment technique to utilize when engaging with a client with lateral epicondylitis, this case study highlights the importance of respecting the client’s opinion. This again is an example of how to maintain client-centered practice (AOTA, 2002). S. obviously did not feel that the other treatments were effective, and she initiated finding a different choice. While most clients may not be this proactive, therapists need to be aware of and follow a client’s lead.
in an ambiguous situation, at least until more research is done which calls for an obviously chosen treatment choice for lateral epicondylitis.

**Decreased Pain worth the Inconveniences**

While S. did report loving the long-arm splint, she also reported it was inconvenient at times. Particularly, its size and shape made it difficult to wear during formal events. Although, repeatedly S. confirmed she thought it was worth it and she described how she believed that the most important factor was her decreased pain. Also, S. continued to maintain her active lifestyle while wearing the splint. She reported wearing it and engaging in vigorous activities like kayaking, riding roller coasters, and mowing her lawn. S. again set her priorities; and the decreased pain was worth the clumsiness of the splint.

In addition to the splint’s awkwardness at times, S. described how her right arm appeared to lose strength and almost appear atrophied. This is a weakness of wearing the splint; although S. reported it did not take long for her to recover her strength. The measurements of grip strength taken in Dr. Condit’s office, with her right grip being 60 pounds and her left grip being 62.3 pounds appear to be close to the norms for her age group of 62.2 for the right hand and 56.6 for the left (Mathiowetz, Kashman, Volland, Weber, Dowe, & Rogers, 1985). While S.’ left grip is still slightly stronger, it must be remembered that S. repeatedly stated, “…it was worth it…”

In agreement with AOTA’s Practice Framework (2002), by using a client-centered approach here, the treatment may be considered effective. S. reported that the most important aspect was that her pain was decreased; and it was. She also repeatedly described how she felt like the decrease in the pain was well worth the clumsiness and
loss of strength. Occupational therapists may again use this data to address how they engage with clients who have lateral epicondylitis. They should assist the client in identifying priorities, such as decrease in pain, as it appears was S.’ priority. This may be done through many client-centered assessments, such as the Canadian Occupational Performance Measure, in which the client rates perceived importance of occupational performance problems (Law, Baptiste, Carswell, McCall, Polatajko, & Pollock, 2005).

Return to Previous Occupational Performance and Persistent Rest of the Affected Arm.

In addition to S.’ relief of her pain, she also reported an increased ability to return to her pain-free occupational performance when she was done wearing the long-arm splint. She simulated a meaningful occupation which she was unable to do without pain before she wore the splint. While she simulated wiping a table she used only her affected arm, demonstrated no pain behaviors, no complaints of pain, nor did she assist her right hand with the left. S. also demonstrated ROM scores which were within normal limits for her elbow, wrist and MPs which may attribute to her occupational performance (Pedretti, 2001).

While the measurements of S.’ ROM and strength may not appear to directly affect her ability to engage in an occupation, as Neuman (1995) points out, her physiological system interacts with her psychological, sociocultural, developmental and spiritual systems to enable occupational performance. As the biomechanical frame of reference alludes to, ROM and strength within normal limits are basic tenets which need to be present before occupational performance may occur (Pedretti, 2001). Partially because S. ROM is currently within normal limits, she reported she is able to do all of her meaningful activities without pain now, in exclusion of playing tennis.
S. recognizes that she probably could return to play, but does not want to re-injure her arm. This may even be considered advantageous to S.; because she is more aware of how she should be protecting and resting her elbow. S. reported she is more aware of how she does need to protect her elbow by modifying how she performs certain activities. S. again unknowingly demonstrates one of the ultimate goals of occupational therapy. She recognized a need, and utilized compensatory strategies which were meaningful to her in order to most successfully engage in her meaningful occupations (AOTA, 2002).

**Application of Belief in how Well Splint Works**

Once S. no longer needed to utilize the compensatory techniques, and she had completed her splint wearing, she applied her belief of the long-arm splint’s efficacy by wearing the splint again when the pain in her elbow returned. She believed it helped her initially, and when the pain returned, she believed it would help her again. She also demonstrated her belief in the splint’s effectiveness through educating her friend with lateral epicondylitis about the splint. She even let her friend borrow the splint and was concerned that her friend still had it.

In client-centered practice, the therapist will acknowledge a client’s reports as valid (Sumsion & Law, 2006). A client’s reports should always be considered valid. As the client is the primary focus of treatment, his or her opinion should be of utmost value to the therapist attempting to engage in client-centered practice (Sumison & Law, 2006). This valid report of S.’ regarding her belief in how well the splint works should be addressed with more research on the efficacy of using a long-arm splint to treat lateral epicondylitis.
Research Questions

The first research question, How did wearing the long-arm splint affect the participant’s ability to engage in his or her occupational life? is adequately answered by the results from this case study. The discussed themes highlight how S. believed the long-arm splint to be the most effective treatment for her lateral epicondylitis. It appears that essentially, she believed it to be the treatment which lead her to return to her previous pain-free occupational performance.

The next question, How did the participant feel and think about wearing the long-arm splint to treat her lateral epicondylitis? also appears to be adequately covered by the results of this case study. The themes covered how she loved wearing the long-arm splint and how she believed it to be the most effective treatment for her lateral epicondylitis. She also demonstrated these thoughts and feelings when she reported returning to wearing the long-arm splint when her elbow pain returns and loaning the splint to a friend who had elbow pain.

The results also sufficiently answer the final research question, After wearing the long-arm splint, how was the participant able to complete a self-identified meaningful activity? As previously discussed, S. simulated wiping a countertop with a rag. She appeared to have no difficulty or discomfort related to the activity; and she was able to complete the simulation without compensating or using her left hand. Again, these results show an affirmative answer to the research question, as she was able to complete a self-identified meaningful activity.
Limitations

Many limitations are recognized in the present study. The main limitation is that it is descriptive and no variables were manipulated to show cause and effect. Unlike a randomized controlled trial, the data may not be used to make any conclusions regarding the use of long-arm splinting in treatment of lateral epicondylitis. Related, the single case study makes generalizability of the conclusions unfeasible.

Also, it may have been difficult for S. to recall how she felt about the details regarding her lateral epicondylitis and wearing the splint because so much time has passed. She may not have been able to recall how she felt, and filled in the details with what she thinks was the appropriate answer. This recall bias may affect the validity of the current study.

Another limitation is that the primary investigator did not have access to the hand therapy charts. The hand therapy charts would have provided more valid data regarding how S. felt, and reacted to the lateral epicondylitis and splint because it was measured at the exact time she was feeling that way. Future research conducted should have access to the therapy charts and account for this limitation.

Finally, some of the interview questions appear to have been vague to S. The questions regarding a percentage of how able she was able to complete occupations may have been unclear. Several attempts of clarification were required in order for S. to understand what was meant by the questions.

Recommendations

Considering the limitations inherent with a case study, future research appears to be necessary that would increase the ability to generalize the results found. While the
results of the apparent effectiveness of the long-arm splint in treating S.' lateral epicondylitis are valuable to literature, they are not applicable to others with lateral epicondylitis. Following this case study’s results, a retrospective approach may be utilized to study the effectiveness of using the long-arm splint on reducing participants’ pain. The background data from this study, including the participant’s belief in the effectiveness of the long-arm splint may be used to support results found in a retrospective study with larger participant numbers. If the said approach produces results which again support the efficacy of long-arm splinting, research in which variables are manipulated and controlled should be completed. Finally, a RCT that highlights long-arm splints utilized in the treatment of lateral epicondylitis is ideal.

Specifically, this study’s results may be important in shaping future research. The seven themes found may impact how researchers view lateral epicondylitis. This one case may support and lead to further research on the idea that lateral epicondylitis involves tendons which need to rest. Also, the results may enlighten those who believe that no clients would ever enjoy or comply with wearing a long-arm splint full time for an extended amount of time. The results may also inspire research which investigates the relationship between a client’s perception of the treatment technique and the technique’s effectiveness.
REFERENCES


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APPENDIX A

Informed Consent Form

You are invited to participate in a research study entitled "Long-Arm Splinting for Lateral Epicondylitis: A Case Study". The purpose of this study is to describe how the splinting of your elbow and wrist to treat your lateral epicondylitis affected your ability to participate in occupations, or meaningful activities, how wearing the splint made you think and feel, and how you are able to complete meaningful activities since you have worn the splint. The study is being conducted through the Grand Valley State University Occupational Therapy program. Crystal Wolters is the primary investigator for the study.

After agreeing to participate in the study you will be interviewed by Crystal Wolters in Dr. Condit's office. The interview will be audiotaped. You will also be observed completing an activity to see how you use your arms, and Crystal Wolters will take measurements to record the strength and mobility of your arms. Crystal Wolters will also review your chart in Dr. Condit's office.

The following are possible risks of participating in this study:

- Discomfort of talking about a difficult period in your life associated with your tennis elbow.

The following are possible benefits of participating in this study:

- Mental and/or emotional closure from discussing your difficulties and/or experiences associated with your tennis elbow.
- While you will not receive any direct benefits, your participation may further knowledge of the treatment of lateral epicondylitis and may benefit those with the condition in the future.

There will be no cost to you to participate in this study. You also will not be compensated or paid to be in this study.

The information you provide in this study will remain confidential. Your identity will not be disclosed without written consent in any publications resulting from this research study.

Participation in this study is completely voluntary, and you may withdraw at anytime. If you withdraw, your withdrawal will have no effect on your care by Dr. Condit.

If you have any questions about the study you may contact Crystal Wolters at (616) 886-4446. The chair of the thesis committee is Nancy J. Powell, Ph.D. If you have any questions about human subjects rights you may contact Paul Reitemeier, Chair of Human Research Review Committee at Grand Valley State University at (616) 331-3417.
I acknowledge that I have read and understand the above information and that I agree to participate in this study. I hereby authorize the researchers to report the results of this study to scientific literature. I have been informed that my name will not be identified and that all information that I have provided will remain confidential.

(Participant’s Signature) ________________ (Date) ________________
APPENDIX B

Interview Protocol
“Long-Arm Splinting for Lateral Epicondylitis: A Case Study”

Date: ______
Time: ______

1. Please describe when you first noticed the pain in your elbow.__________

2. What were you doing when you first noticed the pain?__________

3. Please describe your ability to engage in your daily life when your pain first began.____________________________________________________________

   a. In terms of a percentage (100%, 75%, etc.), how able were you to engage in your daily life then? __________________________________________

Please describe your ability to complete your work or productive activities when the pain first began________________________________________________

   b. In terms of a percentage (100%, 75%, etc.), how able were you to complete your work or productive activities then?____________________

4. Please describe your ability to complete your leisure activities when your pain first began________________________________________________

   a. In terms of a percentage (100%, 75%, etc.), how able were you to complete your leisure activities? ________________________________

5. Please describe how your lateral epicondylitis was first treated.__________

6. Besides the long-arm splint, what other treatment have you undergone for your lateral epicondylitis?________________________________________________

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7. What kind of an effect do you think wearing the long-arm splint has had on your lateral epicondylitis?

8. Please complete this sentence: I wear/wore the splint because it:

9. What did you think when the idea was first brought up about wearing the long-arm splint?

10. How do/did you like wearing the splint?

11. Do/did you follow the therapist’s recommendations of wearing the splint? Please describe your wearing schedule.

12. How long did you wear the splint for (days, months)?

13. From 0 to 10, with 0 being no pain and 10 being the worst pain you’ve ever had, what number would you give to the pain in your elbow right now?

14. Do you think wearing the splint has had/had any effect on your pain?

15. If you had a friend who just found out he or she had lateral epicondylitis and he or she asked you about wearing a long-arm splint for it, what would you tell him or her?

16. If the pain in your elbow came back, how would you feel about wearing your splint again?

IF PARTICIPANT IS COMPLETED WITH THE SPLINTING, ASK 18-20

17. Please describe your ability to engage in your daily life after you were done with the splinting.

   a. In terms of a percentage (100%, 75%, etc.), how able were you to engage in your daily life at that time?
18. Please describe your ability to complete your work activities when you were done with the splinting

a. In terms of a percentage (100%, 75%, etc.), how able were you to complete your work or productive activities at that time? __________

19. Please describe your ability to complete your leisure activities when you were done wearing the splint

a. In terms of a percentage (100%, 75%, etc.), how able were you to complete your leisure activities at that time? ______________

20. Is there anything else you’d like to add about your experience of wearing the long-arm splint to treat your lateral epicondylitis? ____________________________

(Thank participant! Assure him or her of confidentiality!)
APPENDIX C

Observation Data Form

Meaningful activity _______________________________________________________

1. How much does participant use affected arm? _____________________________

2. Does participant use affected arm to assist other arm or as primary arm during
   the activity? _________________________________________________________

3. What is the participant’s facial expression? _____________________________

4. What does the participant say? _______________________________________

5. What appears to be difficult for the participant? _________________________

6. What appears to be easier for the participant? ___________________________

7. What else is noticed concerning the affected arm? _______________________

8. Other unanticipated observations: _____________________________________
APPENDIX D

ROM & Strength Data Form

<table>
<thead>
<tr>
<th></th>
<th>Elbow</th>
<th>Wrist</th>
<th>MP</th>
</tr>
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<tr>
<td>Dynamometer Grip Strength</td>
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