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The New View: Clinical Recommendations for Occupational Therapy Treatment for Clients with Lateral Epicondylitis

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THE NEW VIEW: CLINICAL RECOMMENDATIONS FOR OCCUPATIONAL THERAPY TREATMENT FOR CLIENTS WITH LATERAL EPICONDYLITIS

A Scholarly Project

by

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of the

University of North Dakota

for the degree of

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CHAPTER I

INTRODUCTION

The New View: Lateral Epicondylitis

The clinical presentation and associated manifestations of lateral epicondylitis have been extensively researched and documented as this injury has recently been characterized as the “epidemic of the 1990’s” (Clements & Chow, 1993, p. 138). Lateral epicondylitis can often have a chronic course, lasting from several months to a number of years, with intermittent reoccurrences (Clements & Chow, 1993). At worst, it can become a handicap as those who are stricken with the injury are prevented entirely from performing vital occupations (Clements & Chow, 1993).

Lateral epicondylitis is generally characterized by localized and debilitating pain just distal to the lateral epicondyl of the humerus (Bernstein & McGuire, 1999). Most patients, however, will initially complain of diffuse pain commonly located over the lateral aspect of the elbow (Peters & Baker, 2001). In fact, patients often note difficulty holding and lifting even light objects as well as performing simple activities such as turning a doorknob and shaking hands (Clements & Chow, 1993). This is due the associated anatomy and mechanical manner in which the forearm extensor musculature is used to perform such activities. Of the extensor muscles that take origin from the lateral epicondyle, the extensor carpi radialis brevis is the muscle most often involved (Bernstein & McGuire, 1999). The point of attachment of this muscle is approximately 1 cm distal to the lateral epicondyle. The muscle then courses along the dorsal aspect of the forearm to distally attach to the base of the third metacarpal in the hand, therefore mechanically making it an active extensor of the wrist (Bernstein & McGuire, 1999).
This is why pain is most often elicited by resisted wrist extension and forearm rotation (Bernstein & McGuire, 1999; Peters & Baker, 2001).

The keys to diagnosing lateral epicondylitis is the signs and symptoms of pain and palpable tenderness in the previously described anatomical areas (Nirschl, 1992). The associated signs and symptoms usually originate during the physical examination and through the use of provocative maneuvers. “Provocative tests include reproduction of pain in the area of the lateral epicondyle with resisted wrist extension, resisted forearm supination, and resisted long finger extension” (Peters & Baker, 2001, p. 553). Bernstein and McGuire (1999), also suggest that such tests include “both passive and resisted contraction of the involved extensor mass” such as “passively flexing the fingers and wrist with the elbow fully extended or by resisted wrist dorsiflexion while palpating the origin of the extensor carpi radialis brevis” (p. 22). Forced finger flexion should also be included as one of the provocative tests due to the wrist extensors isometrically contracting in order to counterbalance the force of the flexors (Bernstein & McGuire, 1999). The use of a handgrip dynamometer is also required with the aim of determining the extent of lost grip strength as it compares to the uninvolved, healthy side (Peters & Baker, 2001).

The upper extremity injury known as lateral epicondylitis, or "tennis elbow", is a significant challenge confronting occupational therapists. Due to the recent rise in incidences (Clements & Chow, 1993), practicing therapists are now required to understand and identify the associated manifestations and appropriate treatment strategies of this injury. In past years, it was hypothesized that the symptoms associated with lateral epicondylitis were caused by inflammation of the extensor tendons and
New View: Lateral Epicondylitis 3

surrounding tissues. It has been treated, mainly, by means of anti-inflammatory agents, such as corticosteroid injections, non-steroidal anti-inflammatory drugs (NSAIDs), and various other treatment strategies (Peters & Baker, 2001). Although, some of these methods have been proven effective in reducing pain and the acute inflammatory response to the initial injury, they have been relatively ineffective in reducing the development and/or resolution of its manifestations. In contrast to the theory attributing the cause to inflammation, recent research findings have now determined that the symptoms of this injury are linked to microtears of the extensor tendon(s) that lead to a number of degenerative changes, and ultimately result in a decrease in function (Bernstein & McGuire, 1999).

Because the theory regarding the physiological cause of lateral epicondylitis has now changed, treatment teams, including occupational therapists, need to follow suit. This change should include the implementation of preventative strategies, in combination with traditional conservative interventions including the use of: physical agent modalities, splints and/or external aids, assistive technology/devices, strength training, ergonomic/work-site analysis, and client/employer education. The latter two are becoming more important as work-related injuries constitute the most common cause of developing lateral epicondylitis. Injuries, such as lateral epicondylitis, that are usually associated with work activities or other occupations are also referred to as: cumulative trauma disorders (CTD), work-related injuries (WMSD), overuse injuries, and/or repetitive strain injuries (Jacobs, 1997). Because occupational therapists are specifically trained in the contexts associated with developing this injury, as it often restricts individuals from working and pursuing chosen leisure activities, they must be familiar
with the most appropriate and effective ways of treating the clients affected by lateral epicondylitis as well as begin implementing the suggested preventative methods.

Occupational therapists play a vital role in the treatment, and ultimate prevention, of lateral epicondylitis. Specifically, occupational therapists are educated to address all life activities, and/or contexts, in order to ascertain the most effective means of treating a patient. When addressing cumulative trauma injuries, such as lateral epicondylitis, occupational therapists have the theoretical knowledge required to determine the probable causes of symptom development as well as patient-compatible treatment options. The occupational therapy theory, specifically the Model of Human Occupation (commonly referred to as MOHO) addresses how the person, the activity, and the environment, interact and subsequently affect an individual’s ability to function in meaningful occupations (Kielhofner, 1985). If there is a crisis in one of the areas, such as an injury like lateral epicondylitis, the individual will consequently experience some level of dysfunction. In regards to treating and preventing lateral epicondylitis, occupational therapists can effectively address, through use of this dynamic framework, possible problematic areas and viable treatment options. When using the person-activity-environment model, the occupational therapist uncovers the “person” or client factors; such as poor body mechanics, decreased endurance or pre-existing disease, that could possibly contribute to the development of the injury. The “activity” could include work-specific tasks, leisure pursuits, or self-maintenance activities in which the patient is involved in. And the “environment” includes the space in which the person is required to perform the activities and occupations along with the objects or tools with which they interact. Each of the areas mentioned above are addressed in some fashion through the
following clinical recommendations given to occupational therapy practitioners in chapter III-IV. By using a combination of the occupational therapy theoretical framework, clinical experience, and thorough education, occupational therapists can effectively treat, evaluate, and implement the necessary preventative and conservative treatment measures.
CHAPTER II
REVIEW OF LITERATURE

Physiological Cause

Khan, Cook, Taunton, and Bonar (2000), discussed the latest belief regarding the physiological causes behind lateral epicondylitis in their recent article. They stated that there is an increasing body of evidence that supports the notion that overuse tendon injuries, such as tennis elbow, do not in fact involve inflammation. Khan et al. (2000), also made a key statement saying, “if this notion is correct, then the traditional approach to treating this tendinopathy, as an inflammatory “tendonitis” is likely flawed” (p. 39). They also discussed past researchers who had similar hypotheses regarding the notion that this injury was in fact caused by microtearing and not inflammation, but unfortunately these researchers did not gain enough support at that time to initiate change in the medical community. One such researcher, Perugia with the help of his team in 1986, found “remarkable discrepancy between the terminology generally adopted for these conditions and their histopathologic substratum, which is largely degenerative” (Khan et al., 2000, p. 40). Perugia also found that inflammatory cells were absent in surgical specimens.

Nirschl (1992), another well known researcher of this injury, discussed in a 1992 article, his experience with, and examination of pathologic tendons of individuals with lateral epicondylitis. He found that the tendon biopsies often failed to reveal inflammatory cells. However, there was a consistent pattern of change in the cells that was representative of a degenerative process secondary to overuse, fatigue, weakness, and possible avascular changes. Thus, he also shared in the sentiment that the term tendinosis, rather than tendonitis, was a better descriptor of the histopathologic findings.
Many other researchers have now begun to attribute the development of symptoms to degenerative changes and microtrauma. Such researchers include Bernstein and McGuire (1999), who agreed with Nirschl (1992); Khan et al. (2000), by adding, “the problem is not truly an inflammatory condition but rather a tendinopathy, characterized by microtrauma and degeneration” (p. 21). Khan et al. (2000), also, examined surgical biopsy specimens of patients with lateral epicondylitis to arrive at their conclusions. Again, they found that inflammatory changes rarely occurred; rather, pathologic degeneration occurred within the proximal muscles and tendons. They believed that the process begins as a tear of the origin of the extensor carpi radialis brevis muscle, secondary to mechanical overloading and were reflective of repetitive trauma (Bernstein & McGuire, 1999). Their findings allude to the possible chronic course of this injury.

**Cumulative Trauma and Occupation-Related Activity**

This course was clearly described in an article by Noteboom, Cruver, Keller, Kellogg, and Nitz (1994). They too contended that repetitive and cumulative injury produces this condition. The process begins with forceful contractions of the wrist extensor mechanism, often from occupation-related activities, which lead to irritation and partial tearing of the involved structures (Noteboom et al., 1994). The lesions, or microtears, are often repaired by immature granulation tissue that is unable to heal completely secondary to continued use (Noteboom et al., 1994). Noteboom et al. (1994), discovered that often times the onset of pain is gradual and dull initially, failing to alert the individual to the extent of the injury being caused. In fact, they found that pain is not usually present until the injury has already begun to proceed through the initial stages of
healing (i.e., collagen formation) however, as discussed, the injury is unable to progress through all the necessary stages of healing and the vicious tendinosis cycle continues.

Peters and Baker (2001), also share this insight as they found that microtearing stimulates an acute inflammatory cascade, leading to collagen formation. However, attempts at healing were incomplete and subsequent tendon degeneration set up the continual process of tendinosis. They also described the injury histologically, like many of the researchers mentioned previously, as “non-inflammatory, degenerative, and avascular, with evidence of immature disorganized collagen, fibroblasts and avascular components” (Peters & Baker, 2001, p. 552).

Now that the physiological causes are understood, who is at risk of developing this debilitating injury? Clements and Chow (1993), describe those most likely to be stricken with lateral epicondylitis as middle aged people who do activities requiring repetitive wrist and finger extension. These repetitive motions are most often found in many manual labor jobs, office positions, housework, and various hobbies/leisure interests. Because most individuals are required to perform a combination of activities throughout the day, many of them are not cognizant of what they are doing to their bodies: they continue to ignore the pain they experience in order to fulfill their daily occupations. Because these individuals do not “feel” the damage to its fullest extent when the initial injury occurs, they often do not seek medical attention until the pain is affecting their abilities to complete their normal daily activities. Barr and Barbe (2002), made mention of this as they stated, “the time when most clinicians intervene may be too late to reverse some of the pathophysiological and neuroplastic changes that have already
taken place, which can explain why chronic disability is an increasing consequence of lateral epicondylitis and many other CTD’s” (p. 81).
CHAPTER III – IV
PROCEDURES AND FINDINGS

Because the potential for being chronically disabled by this injury is high, it is imperative to determine the occupational causes of this work-related injury and consequently find the best means of prevention and treatment. Tennis elbow, and other CTDs, are thought to be caused, precipitated, and/or aggravated by overuse or overexertion (Ostendorf, Rogers, & Bertsche, 2000). Generally, the risk factors associated with any CTD include awkward postures, force, repetition, duration, contact stressors, vibration, and exposure cold (Ostendorf, Rogers, & Bertsche, 2000). In regards to development of lateral epicondylitis specifically, the overuse or over exertion has been recently found to provoke and/or cause the microscopic tearing of the tendon(s) associated with wrist extension (Ostendorf, Rogers, & Bertsche, 2000). Many of the risk factors described by Ostendorf, Rogers, and Bertsche (2000), are found in many manual labor and computer-based positions, both of which are prevalent occupations in the United States.

Ergonomic Assessments and Education

Research has just recently begun to support the use of ergonomic assessments and client education in the treatment and prevention of cumulative trauma disorders. It is now confirmed that determining what activities accelerate the onset or probability of developing an injury, such as lateral epicondylitis, is of utmost importance to the medical community at large. Although many occupations and activities can hasten the onset of lateral epicondylitis, the symptoms of lateral epicondylitis usually arise while performing job functions, as they are most often the activities in which people repeatedly perform for
an extended amount of time. In the study by Noteboom et al. (1994), an inventory of individuals diagnosed with CTDs and the causes of their respective injury was taken. They found that lateral epicondylitis was most commonly associated with work-related activities, ranging from 35-64% of all diagnosed CTD cases. This is an important statistic for those treating these injuries to consider, as the prevalence of CTDs is on the rise, not the decline. It is even more daunting to find that all workers, no matter the occupation are at risk of this debilitating injury. In fact, Ostendorf, Rogers, and Bertsche (2000), determined that the occurrence of CTDs, as found in both light and heavy industries, has potential of affecting both men and women equally, and is seen in every occupation and business. Many business owners could attest to the implications these injuries have, not only on their workers, but also on the business itself.

Ostendorf, Rogers, and Bertsche (2000), describe implications of CTD. These injuries account for $1 of every $3 spent on workers' compensation costs; more than $15 to $20 billion annually in direct costs as medical expenses and indemnity. But even more surprising is that indirectly these injuries account for up to $60 billion in total annual costs. These indirect costs include absenteeism, retraining injured workers and new employees, decreased productivity and quality, and poor employee morale. These statistics only solidify the need for implementing preventative treatment strategies. One such strategy, ergonomic analysis, has been proven effective in identifying areas of concern regarding the possible reasons for developing a CTD while performing work duties.

Many times awkward positions, repetition, and/or static postures can be the precursors to microtrauma that cause lateral epicondylitis symptoms. Such findings are
discussed in *Ergonomics for Therapists*. Jacobs (1997), states that repetitive force applied to the same muscle groups, joint, or tendon cause soft tissue microtears and trauma, such as those associated with lateral epicondylitis. Noteboom et al. (1994); Ostendorf, Rogers, and Bertsche (2000); Bernstein and McGuire, (1999); Clements and Chow (1993), all reference the occupational causes including repetitive use and cumulative trauma in regards to developing lateral epicondylitis. Therefore, identifying the activities, tools, and environments that pose as problems for the possible development of the injury is essential. The process of identifying these areas is better known today as work-site or ergonomic analysis.

Ostendorf, Rogers, and Bertsche (2000), defined work-site analysis as “a method of finding and eliminating tools, work habits, and conditions which may contribute to CTD occurrences” (p. 21). As previously mentioned, lateral epicondylitis begins gradually as the microtrauma goes relatively unnoticed by the person stricken with the injury. Therefore, utilizing work site analyses with new and/or existing employees is key in preventing the onset of severe symptoms and subsequent chronic disability. An occupational therapist can uncover what areas or functions of the job could cause, or are currently causing, the development of symptoms. According to Ostendorf, Rogers, and Bertsche (2000), ergonomic analysis begins by identifying departments or particular jobs with increased numbers of CTD occurrence. After areas of the work environment are identified as problematic, the evaluator determines, through use of an ergonomic assessment, how the work duties influence the worker. The influences assessed in during the ergonomic assessment include; physiologic response to physically demanding work; environmental stressors; complex psychomotor assembly tasks; and visual
monitoring tasks (Ostendorf, Rogers, & Bertsche, 2000). These steps lead the therapist in identifying the risk factors, including the work environment and if applicable, the tools required to perform job tasks. When specifically addressing the manifestations of lateral epicondylitis, ergonomic analysis aims at determining which tasks and/or tools may be likely to cause increased stress on the wrist extensors (Noteboom et al., 1994). When these tasks and/or tools are found, the therapist then focuses on ways to reduce the stress placed on the worker by designing tasks within the workers capacities and needs (Ostendorf, Rogers, & Bertsche, 2000). These changes are implemented through job modification.

Job modifications involve reducing or limiting repetitive stress and use of harmful utensils, such as vibratory tools, as well as strenuous activity in general (Peters & Baker, 2001). Peters and Baker (2001), mentioned the benefits of job modifications by stating that laborers benefit from; decreasing repetitive stress, limiting the use of certain tools, using alternative methods to complete job tasks, and periodically changing jobs/tasks throughout the workday. Job modifications, ideally based on the information gained during the analysis, should include: implementing alternative tools to reduce force load on the wrist extensors, eliminate abnormal postures/positions, and modifying the workstation (i.e. height of work station, seating systems, etc.) The latter two areas pose severe problems in the development of lateral epicondylitis. In fact, Ostendorf, Rogers, and Bertsche (2000), report that CTD’s are significantly associated with poorly designed workstations and equipment within the context of the work environment. Jacobs (1997), also stated that modifying the work environment to suit the worker’s performance requirements as well as their personal capacities is important in CTD intervention. One
recommended preventative strategy, the use of assistive technology devices, could allow
the worker to perform essential job functions while maintaining physiologically safe
positions and postures. Ideal postures usually include those that allow the body to remain
in a neutral position while performing activities. Jacobs (1997), defines neutral
positioning as having: head, neck, and trunk aligned at mid-line; head upright; shoulders
retracted and relaxed; upper arms relaxed at side of body; elbows flexed to approximately
90 degrees; forearms not completely pronated, preferably close to mid-line; and wrists
aligned with forearms with minimal ulnar or radial deviation and minimal flexion or
extension.

Use of Assistive Technology

Assistive technology (AT) devices support other preventative and conservative
strategies by promoting neutral positioning of the upper extremity, specifically the wrist,
forearm, and elbow, while performing work duties. Thus, AT devices eliminate or
reduce risk factors that contribute to the microtrauma associated with lateral epicondylitis
symptom development. Because assistive technology devices can be used in a number of
settings and serve a number of functions, they are an effective preventative tool to use
while performing work duties and other daily occupations. Even though it is a relatively
novel idea, the benefits of applying AT devices into the various environments and/or
occupations can be immediately observed. As previously mentioned, Ostendorf, Rogers,
and Bertsche’s (2000), stated that a majority of the risk factors associated with
developing lateral epicondylitis were found in computer-based and manual labor
positions. In fact, Jacobs (1997), cites “the number of computer keyboard workers with
CTD is as much as 12 times the number of non-keyboard users with CTD. And among
keyboard users, the prevalence of CTD is as high as 60%” (p. 240). Knowing this, it is imperative to begin AT intervention with jobs including computer and manual labor activities.

A number of studies suggest that keyboard tasks expose the user to a number of risk factors associated with the development of CTD. Not only are these tasks performed for an extended amount of time, but they also involve simultaneous presence of two or more risk factors, further increasing the risk of developing a CTD such as lateral epicondylitis (Jacobs, 1997). Jacobs (1997), discusses assistive technology devices that could be useful, specifically in the area of data entry and other computer-based positions, in reducing the traumatic effect of the associated risk factors. Useful devices include: ergonomic/alternative keyboards, voice recognition programs, word prediction programs, and one handed typing techniques. All of these devices and techniques aim at reducing risk factors such as awkward positioning. In the case of computer based positions and lateral epicondylitis, an example could include the use of an alternative keyboard to reduce the extent of ulnar deviation during computer activities.

Jacobs (1997), discusses one study in which ulnar deviation of the wrist in excess of 20 degrees was observed in keyboard users who suffered from serious upper extremity symptoms. In the same study, after implementation of an alternative or split keyboard, ulnar deviation of the wrist was observed to decrease to within 5 degrees of a neutral position. This is only one example of the benefits of applying AT devices into the work environment. Body position and keyboard use, are not of course, the only causes of trauma leading to lateral epicondylitis. Results of this study also indicated that workplace design, including the workstation setup (i.e. height of computer monitor, distance to reach
computer mouse, and height of keyboard in relation to neutral body position), associated furniture, and hours of computer operation were also important risk factors contributing to symptoms. The information gained from this study supports the need for ergonomic assessments and job modifications in positions requiring computer input or data entry activities. It is recommended that split keyboards, as well as other devices including voice recognition programs, alternative input devices (i.e. track balls, headpointing devices, etc), and keyboard mounting devices are implemented after an extensive work-site analysis has identified the environmental, occupational, and client factors that expose the worker to potentially harmful risk factors.

Client factors are those that are inherent to the individual and could include poor muscle tone, anatomical abnormalities, and other diseases, such as diabetes or cancer that can influence the body’s ability to function normally. Client factors can play an important role in the possible development of lateral epicondylitis or any other CTD. Strength, endurance, individual physiology, and body mechanics are all examples of external and client factors that affect injury development and/or prevention. Body mechanics are most often rectified in the ergonomic assessment and job modification. However, implementing assistive devices such as the split keyboard can also foster proper positioning. An individual’s capacity to perform their work duties, in regards to their own physiology, is more difficult to change. Just the pure nature of some activities, such as data entry that requires repetitive movements, predisposes individuals to injury. Pair these activities with an individual who is deconditioned or is in the initial stages of microtrauma and a more severe injury is probable. Job modification programs can assist by altering the work environment and tasks as much as possible to inhibit abnormal body
postures, positions, and motions but sometimes fall short in completely inhibiting force loads on the extensor tendons which cause the initial microtrauma.

**Splints and Braces**

Other assistive devices or external aids, such as splints and braces, aid in relieving the mechanical load placed on the associated extensor musculature and tendons, specifically the extensor carpi radialis brevis, while performing work duties and various other occupations. Clements and Chow (1993), in their recent study state “the use of splints, in particular, is a widely accepted treatment for lateral epicondylitis. Splints are designed to reduce the stresses on the common forearm extensor muscle origin and provide physiological rest to the area during healing” (p. 138). As mentioned previously the onset of lateral epicondylitis begins with an initial injury that fails to heal. As the individual continues to use the extremity, the vicious cycle of injury and failed healing continues. Although splints are most often prescribed after the onset of symptoms, individuals who perform repetitive tasks that put mechanical load on the forearm musculature could benefit from early implementation of splinting and may prove effective in preventing over exertion in the first place. For example, Bernstein and McGuire (1999), found that forearm splints that hold the wrist in 30 degrees of extension, relax the extensor carpi radialis brevis, the most common tendon associated with lateral epicondylitis. Khan et al. (2000), also mention the benefits of de-loading splints and braces as they concur that tendinosis results from excessive load on the extensor mechanism. They report that braces and supports that attenuate load through the tendon prove beneficial to the individual.
Most often, a lateral counterforce splint is prescribed to an individual suffering from lateral epicondylitis symptoms and offers pain relief while performing various activities. A lateral counterforce brace is a band several centimeters wide that is placed around the upper part of the forearm and provides counterforce to the forearm musculature. In a recent study, Clements and Chow (1993), investigated this specific type of splint and stated that the lateral counterforce design decreases the capacity of the muscles to contract. This in turn decreases the stress on the area of pathology at the origin of the muscles (Clements & Chow, 1993). In this same study, 10 individuals who had jobs that required repetitive handling activities were put into an experimental group. The experimental group received splints and physiotherapy (assessment, ultrasound, ice and stretching and strengthening exercises, 3x/week). The control group received only physiotherapy. The results of the study established that the experimental group demonstrated a significantly greater improvement in pain (p=0.05) and grip strength (p=0.025) of the affected arm in contrast to those who received just physiotherapy (Clements & Chow, 1993). The experimental group also showed greater improvement in function but this did not reach a level of significance. This research study illustrated that, in conjunction with other interventions, splints and braces can offer vital mechanical support to the injured tendons and tissues working to significantly decrease pain and increasing the individual’s ability to successfully perform work duties. Like other assistive technology devices, splints and braces offer customized benefits in a multitude of environments. Clements and Chow’s (1993), research also alludes to other interventions that are recommended in treating and preventing lateral epicondylitis. These interventions include the use of physical agent modalities and strength training.
Physical Agent Modalities and Strengthening

A number of studies have been done to determine the effectiveness of physical agent modalities, such as ultrasound and high volt galvanic stimulation, in treating lateral epicondylitis symptoms (Clements & Chow, 1993; Noteboom et al., 1994; Khan et al., 2000). Clements and Chow (1993), suggest treatments including exercises, manipulations, ultrasound, change of movement patterns, and splints and braces, to name a few. The use of strengthening programs has been researched extensively and commonly utilized in many treatment programs (Khan et al., 2000; Noteboom et al., 1994; Nirschl, 1992; Peters & Baker, 2001). In fact, most conservative intervention plans include strengthening routines; however they are most often implemented in the latter stages of treatment. Now that the physiological cause of this injury is understood it is recommended that exercise and physical agent modalities be applied early on in order to assist the damaged tendon proceed through the proper tissue healing processes.

Physical agent modalities are used to optimize collagen production and maturation so that the tendon achieves the necessary tensile strength for normal functioning (Khan et al., 2000). The pathologic process, as discussed earlier, begins as a tear in the origin of the extensor carpi radialis brevis secondary to mechanical overloading (Bernstein & McGuire, 1999). Overloading and continued use cause repeated microtrauma that attempts to repair itself by immature granulation tissue or collagen formation (Noteboom et al., 1994). Khan et al. (2000), call to attention the importance of this knowledge and stress the importance of appropriate treatment for this possibly debilitating injury. They stated in their recent article that, “physicians must shift their perspective and acknowledge that tendinosis is the pathology being treated in most
cases and that treatment needs to combat collagen breakdown rather than inflammation.”
(Khan et al., 2000, p. 39) Khan et al. (2000), also state that “collagen production is probably the key cellular phenomenon that determines recovery from tendinosis” (p. 41).

One way to accomplish the objective of treating collagen breakdown is to assist the injured tendon(s) progress through the necessary stages of healing. Overall, physical agent modalities, paired with strengthening exercises, promote alignment and synthesis of healthy collagen (Khan et al., 2000; Noteboom et al., 1994). During the acute stages of the injury, when tissue healing is interrupted, it is important to also promote increased circulation to the area. Noteboom et al. (1994); Khan et al. (2000); Nirschl (1992), all suggested that high volt galvanic stimulation and ultrasound assist in tissue healing by increasing blood flow, decreasing pain, and activating collagen growth. In laboratory settings, high volt galvanic stimulation has been found to stimulate collagen synthesis (Khan et al., 2000) and pulsed ultrasound has also been found to aid in tissue healing, increasing circulation, and decreasing localized inflammation secondary to the acute inflammatory response (Clements & Chow, 1993). Other modalities that assist with treatment of lateral epicondylitis include transverse friction massage, iontophoresis, and cold modalities (Noteboom et al., 1994). Transverse or deep friction massage is often used by therapists to prevent random binding of newly formed collagen (Noteboom et al., 1994). Transverse friction massage assists the collagen position itself in a cross or matrix formation that is usually seen in healing collagen (Noteboom et al., 1994). The use and benefits of iontophoresis in the treatment of lateral epicondylitis are controversial. However, due to its anti-inflammatory indications, iontophoresis has been demonstrated to help decrease the acute inflammation during the acute stages of the injury (Khan et al.,
Finally cold modalities, such as ice massage, ease pain through their analgesic effects as well as decrease acute inflammation. Secondary to ice, high volt galvanic stimulation, is the most recommended modality to use with patients suffering from lateral epicondylitis symptoms (Nirschl, 1992).

Overall, Nirschl (1992), states that the goals of tissue healing should follow the sequence of: “rehabilitative exercise, high-volt electrical stimulation, central aerobics and general conditioning exercise, and absence from abuse” (p. 858). Although patients should be encouraged to not overuse the extremity during the acute healing stages, avoidance of pain does not necessitate complete immobilization or withdrawal from normal activities (Noteboom et al., 2000). In fact, controlled stresses are important for the appropriate alignment of the connective tissue as it heals (Noteboom et al., 2000). This emphasizes the importance of establishing an exercise or strengthening program early on in treatment. Range of motion (ROM) and light exercise should be used in conjunction with physical agent modalities. Noteboom et al. (2000), suggests that “exercise programs should be started early in the treatment to assist with appropriate tissue remodeling” (p. 363). Khan et al. (2000), also mention the importance of early exercise as they state that “eccentric strengthening programs result in tendon strengthening by stimulating mechanoreceptors in tenocytes to produce collagen, and thus help reverse the tendinosis cycle” (p. 41). They support this statement by reporting clinical research results that “loading the tendon improves collagen alignment and stimulates collagen cross-linkage formation, both of which improve tensile strength” (p. 41). Strengthening programs that are initiated early in the healing process should include
exercises that are light in resistance and with a high number of repetitions in order to avoid symptom aggravation (Noteboom et al., 2000).

The research by Khan et al. (2000), also suggest that establishing a routine strengthening program, favorably before the onset of symptoms, could, in fact, prevent the injury from occurring. Job specific exercises are also a must when working with an individual who developed, or is at risk for developing symptoms while performing work duties. Job specific strengthening programs should be personalized by using the specific job duties performed by the worker. This type of strengthening program should aim at improving the worker’s strength and endurance in order to decrease their susceptibility to developing the microtrauma associated with lateral epicondylitis symptoms (Peters & Baker, 2001). Again, the specific skills or duties performed by the worker should be identified within the ergonomic and work site assessments by the occupational therapist.

Many times occupational therapists will begin a treatment program by instructing the patient on forearm and upper extremity stretches to perform at work and while performing home activities. Passive and active-assisted stretches of the wrist extensors are usually recommended during the acute healing stages (Noteboom et al., 2000). Stretches that lengthen the forearm extensors are also used to increase the flexibility of the extensor group and should be continued throughout therapy.
CHAPTER V
SUMMARY

It is important to note that many of the preventative strategies presented in research and this paper are not only preventative measures, but are also effective post-onset of symptoms, as they effectively treat the causes of lateral epicondylitis. First and foremost, work site analysis or an ergonomic assessment should be completed. Although work site analysis is fundamental in treating and preventing lateral epicondylitis it in itself cannot fully treat the injury.

Occupational therapist are educated in the areas associated with this injury, in regards to ergonomic and work site analyses, and have the fundamental knowledge required to address the risk factors, determine abnormal patterns of movement, educate clients, recommend additional and/or changes in equipment, and provide additional interventions. These additional interventions include the use of: physical agent modalities, splints and/or external aids, assistive technology/devices, and strength training.

After an ergonomic assessment has been completed, recommendations should include the implementation of assistive technology devices such as split keyboards, alternative input devices, and software programs. These devices offer relief to the user by decreasing possible contributing risk factors. Braces and splints are other forms of assistive technology that have, in the past, proved their efficacy in relieving symptoms. They too allow the individual to complete work and other daily occupations with as little pain as possible, as well as promote rest to the injured and healing tendon.
Although rest to the injured tendon(s) is important, early implementation of an exercise program is a necessity. Encouraging light, pain free exercise is important in the healing process by stimulating collagen synthesis, increasing tensile strength, increasing circulation to the injured area, and overall preventing recurrence by conditioning the body to endure normal work, leisure, and self care activities.

Physical agent modalities also play an important role in tissue healing. Ultrasound, high volt galvanic stimulation, cold, iontophoresis, and transverse friction massage all aid in collagen synthesis, tissue alignment, pain management, and acute inflammation control. Although the use of certain modalities (such as iontophoresis and ultrasound) is still controversial, the benefits of their use cannot be disregarded specifically now that the physiologic causes of this injury are understood.

Because this injury is reaching “epidemic proportions”, (Clements & Chow, 1993, pg. 138) prevention is essential. A combination of the described interventions can offer the best solution to treating and preventing the microtrauma leading to lateral epicondylitis. Due the recent acknowledgement of the true physiological cause behind lateral epicondylitis, further research on the effectiveness of preventing this injury via implementing the recommended combination of treatments, as well as other methods of prevention, is needed. As an occupational therapist, it is imperative to understand the underlying causes and know how to effectively treat and ultimately prevent this disabling injury.
REFERENCES