2009

Carpal Tunnel Syndrome: An In-Service and Guide on Education and Prevention

Derek Foss
University of North Dakota

Follow this and additional works at: https://commons.und.edu/ot-grad

Part of the Occupational Therapy Commons

Recommended Citation
https://commons.und.edu/ot-grad/65

This Scholarly Project is brought to you for free and open access by the Department of Occupational Therapy at UND Scholarly Commons. It has been accepted for inclusion in Occupational Therapy Capstones by an authorized administrator of UND Scholarly Commons. For more information, please contact zeinebyousif@library.und.edu.
CARPAL TUNNEL SYNDROME: AN IN-SERVICE AND GUIDE ON EDUCATION AND PREVENTION

by

Derek Foss

Advisor: Janet Jedlicka Ph.D., OTR/L

A Scholarly Project
Submitted to the Occupational Therapy Department
of the
University of North Dakota
In partial fulfillment of the requirements
for the degree of
Master's of Occupational Therapy

Grand Forks, North Dakota
August 2009
This Scholarly Project Paper, submitted by Derek Foss in partial fulfillment of the requirement for the Degree of Master's of Occupational Therapy from the University of North Dakota, has been read by the Faculty Advisor under whom the work has been done and is hereby approved.

_______________________________
Faculty Advisor

_______________________________
Date
PERMISSION

<table>
<thead>
<tr>
<th>Title</th>
<th>Carpal Tunnel Syndrome: An In-service and Guide on Education and Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
<td>Occupational Therapy</td>
</tr>
<tr>
<td>Degree</td>
<td>Master's of Occupational Therapy</td>
</tr>
</tbody>
</table>

In presenting this Scholarly Project in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the Department of Occupational Therapy shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my work or, in his/her absence, by the Chairperson of the Department. It is understood that any copying or publication or other use of this Scholarly Project or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and the University of North Dakota in any scholarly use which may be made of any material in my Scholarly Project.

Signature____________________  Date_______
# TABLE OF CONTENTS

**ACKNOWLEDGEMENTS** ............................................................................................ vi

**ABSTRACT** .................................................................................................................. vii

**CHAPTER**

I. **INTRODUCTION** ..................................................................................................... 1

II. **REVIEW OF LITERATURE** .................................................................................. 5

   - Introduction ............................................................................................................. 5
   - Overview ................................................................................................................... 6
   - Causes and Predisposing Factors ............................................................................. 7
   - Prevention .................................................................................................................. 9
   - Conservative Treatment Techniques ..................................................................... 12
   - Surgical Intervention ............................................................................................... 17
   - Costs .......................................................................................................................... 19
   - Conclusion ............................................................................................................... 20

III. **ACTIVITIES/METHODOLOGY** .......................................................................... 21

IV. **PRODUCT SUMMARY** ....................................................................................... 24

V. **SUMMARY** ........................................................................................................... 26

**REFERENCES** ........................................................................................................... 29
<table>
<thead>
<tr>
<th>Appendix</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>(In-service)</td>
<td>36</td>
</tr>
<tr>
<td>B</td>
<td>(Guidebook)</td>
<td>99</td>
</tr>
<tr>
<td>C</td>
<td>(Pre/Post Test)</td>
<td>117</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

I wish to thank everyone in the Occupational Therapy Department at the University of North Dakota. Without your help and guidance this achievement would not have been possible. I would especially like to thank Janet Jedlicka Ph.D., OTR/L who was my advisor for this project. Your belief in my potential and your educated guidance greatly influenced this project and the outcome. Thank you for your help with this project and for your help in all other aspects of my education at the University of North Dakota.
ABSTRACT

Carpal tunnel syndrome (CTS) is common among supermarket employees with a high prevalence among supermarket cashiers. In a study by Davis et. al., (2001) it was found that supermarkets had the highest number of workman's compensation claims regarding CTS in Massachusetts. Of 247 reported cases of CTS in supermarkets 80 involved cashiers. Supermarket cashiers show a 19-60% CTS prevalence rate (Bonfiglioli et al., 2007). No prevention guide designed for supermarket employees was found in the literature; this scholarly project addresses the need for prevention of CTS among supermarket employees.

An extensive literature review was conducted to understand the need for a prevention program. All information gathered came from scholarly journals and text books. This information was used to develop the product. The reading level of the product was kept between 7th and 9th grade to accommodate participants of all education levels.

The product of this scholarly project is an in-service and a supplemental guide book. The causes, predisposing factors, prevention techniques, conservative treatment, and surgical treatment are all covered in the in-service. The guide book is designed to be a supplement to the in-service and has information on prevention as well as examples of how to complete prevention techniques. The goal of this product is to increase the awareness of CTS among supermarket employees and aid in prevention of the disorder among this population.
CHAPTER 1
INTRODUCTION

Carpal tunnel syndrome (CTS) is associated with repetitive motion of the wrist, specifically excessive flexion and extension and gripping and pinching motions (Margolis & Kraus, 1987). This excessive motion causes the median nerve located in the carpal tunnel to become compressed causing several different problems in the median nerve distribution of the hand including: parasthesis and numbness of the thumb and first two and a half digits, abductor pollicis brevis atrophy, hand pain, wrist pain, and overall weakness of the hand (Margolis & Kraus, 1987).

The literature shows that work related carpal tunnel syndrome is a common disorder among supermarket cashiers. This scholarly project focuses on prevention of CTS among supermarket cashiers. Due to the repetitive movements and the forceful exertions associated with working as a supermarket cashier employees are placed at a high risk for developing CTS (Bonfiglioli et al., 2007). Bonfiglioli et al. (2007) found that full-time supermarket cashiers had a 2.3 times increased risk for developing CTS symptoms compared to a control group. The findings suggest that prevention methods that control posture such as workstation changes may reduce the risk of CTS among supermarket cashiers and save money for employers (Harber et al., 1993). This information indicates a need for a prevention...
service directed at the population of supermarket cashiers in the United States.

This scholarly project consists of an in-service conducted by an occupational therapist as well as a prevention guidebook that may be used by the participants of the in-service. The design of the in-service is directed toward supermarket employees with an emphasis on cashiers because of the high risk for the development of CTS symptoms in this population.

The in-service is designed in a lecture format that includes hands-on learning opportunities for prevention methods. A pre-test is given before the start of the lecture to gauge the knowledge of the participants regarding CTS and strategies for increasing this knowledge. The in-service begins with an overview of CTS as well as an explanation of the possible causes and predisposing factors related to the disorder. The in-service then shifts to ways in which to prevent CTS with hands-on learning including instruction in tendon/nerve gliding exercises, soft tissue mobilization, uses of splints, as well as work site modifications and postural changes that can be made. The in-service also includes an explanation of treatment methods that may be prescribed by a physician if prevention is ineffective. The in-service concludes with a summary of the main points and completion of a post-test. The post-test is designed to gauge the knowledge gained from the in-service.

The guidebook includes the prevention methods that were covered in the in-service. It will be provided to the employees as a part of the in-service. The guidebook will be distributed to the employees for use during the in-
service as well as after the in-service has been completed; it is to be a supplement of the in-service. The purpose of the guidebook is to provide a reference that employees can use to further increase their knowledge on the prevention of CTS and steps they can take to avoid CTS.

A biomechanical approach was used in the creation of this in-service and guidebook. A biomechanical approach focuses on decreasing or preventing impairments; it is reductionistic and focuses on correcting an underlying problem (James, 2003). The changes that can be made to posture as well as the exercises provided for prevention stem from the biomechanical perspective due to the goal of correcting a possible problem. The goal of these prevention techniques are to change or modify the movements of the employee as well as make appropriate changes to his/her environment in order to effectively prevent CTS.

Consideration was paid to how adults learn in order to provide the information in a way in which adults would understand. Adults learn well through demonstration with cues from an experienced professional (Fitzgerald, 2006). Demonstration is used in the lecture to convey important prevention techniques. Lecture composes a large part of the in-service. Lecture is an effective means of conveying information to a large number of people at one time, it is also effective in conveying content knowledge (Fitzgerald, 2006).

The following chapters consist of an extensive literature review in Chapter II. A description of the methodology used in developing the products...
in Chapter III. Chapter IV provides a summary of the products with the complete products being found in the appendices. Chapter V provides a summary of the project including limitations and recommendations for implementation of the product and procedures to follow for implementation.
CHAPTER II

REVIEW OF LITERATURE

Introduction

Carpal tunnel syndrome (CTS) is a disorder that affects thousands of Americans every year. In the general population of the United States CTS is seen in 13% with 276 cases for every 100,000 people (Brininger et al., 2007). This is a rather large number for the general population of the United States. CTS is seen in both men and women but is more frequently seen in women, 15.6% compared to 11.3% of men (Brininger et al., 2007). This occurs because of the size of the carpal tunnel. In women the carpal tunnel tends to be smaller thus increasing the risk for pressure buildup in the carpal tunnel and developing CTS.

Carpal tunnel syndrome is most commonly seen in the workplace. Over 13% of repeated trauma work-related disorders are CTS composing an estimated 50% of all medically treated cases of CTS (Davis, Wellman, & Punnett, 2001). Supermarket cashiers have shown a high rate of CTS. This is thought to be stemming from the repetitive movements as well as the forceful exertions associated with their type of work. There is a 19-60% CTS symptom prevalence rate among supermarket cashiers (Bonfiglioli et al., 2007). In a study by Davis et al. (2001), grocery stores had the greatest number of work-related CTS cases reported to workman’s compensation in
Massachusetts between 1992 and 1997; of this group there were 247 CTS cases with 80 of these cases involving the supermarket cashiers. It is thought that the repetitive nature of being a supermarket cashier is what causes CTS. More than 500 items are handled and over 80 bags are filled by supermarket cashiers every hour leading to the cashier lifting more than 6,000 pounds of groceries in a single 8-hour shift (Barnhart & Rosenstock, 1987). The prevalence of CTS among supermarket cashiers is a problem that can be addressed through prevention and proper treatment.

This literature review addresses many different aspects of carpal tunnel syndrome. It begins with an overview of the disorder and moves into the causes and predisposing factors. Treatment and prevention of the disorder are covered including both conservative and surgical interventions. Primary prevention focuses on individuals that are at risk for developing CTS, secondary prevention focuses on conservatively treating the disorder, and tertiary prevention refers to surgical treatments of the later stages of the disorder (Scaffa, Desmond, & Brownson, 2001). Finally, the costs associated with CTS and the various treatments for the disorder are addressed.

**Overview**

Of all the nerve entrapment disorders, carpal tunnel syndrome is the most common (Cooper, 2008). The carpal tunnel is composed of the carpal bones of the wrist (creating the floor) and the transverse carpal ligament (creating the roof); 9 flexor tendons and the median nerve are located in the carpal tunnel (Cooper, 2008).
CTS results from compression of the median nerve at the wrist where it passes through the carpal tunnel with the 9 flexor tendons (Margolis & Kraus, 1987). Swelling of the tendons or thickening of the tendons can build pressure in the carpal tunnel leading to the compression of the median nerve which can lead to sensory limitations in the median nerve distribution (Cooper, 2008).

The median nerve distribution of the hand includes the thumb, index, middle and half of the ring fingers. With compression of the median nerve in the wrist, as in CTS, the patient will exhibit several symptoms including nocturnal paresthesias, numbness/tingling in the median nerve distribution area, pain in the median nerve distribution, sensory deficits in the palm and palmar surface of the thumb, index, middle, and half of the ring finger, atrophy of the thenar eminence leading to motor loss, a positive Phalen’s Test or Tinel’s sign (Armstrong, 2008).

**Causes and Predisposing Factors**

CTS can be caused by only one thing and that is the compression of the median nerve in the wrist. However, there are several different ways in which compression of the median nerve can take place. Compression of the median nerve can occur from swelling of the flexor tendons that share the carpal tunnel with the median nerve, as well as buildup of scar tissue in the wrist from an injury, osteophytes in the carpal tunnel, distal radioulnar joint dislocation, and metabolic disorders (Jacobs & Austin, 2003). Repetitive use of the flexor tendons can result in flexor tenosynovitis causing friction to build
up between the tendons and the median nerve in the carpal tunnel leading to compression of the median nerve (Cooper, 2008).

Several different predisposing factors are identified for CTS. These include but are not limited to obesity, pregnancy, diabetes, rheumatoid arthritis, hypothyroidism, and wrist trauma (Margolis & Kraus, 1987). Female gender is also a predisposing factor because of smaller wrist size in females, with increased risk for females within the age range of 40-60 years of age (Cooper, 2008).

Obesity is one of the leading risk factors for CTS. It also leads to metabolic syndrome which is also a risk factor for the development of CTS (Balci & Utku, 2007). It is thought that the buildup of fat tissue in the carpal tunnel increases the hydrostatic pressure in the carpal tunnel which leads to the compression of the median nerve (Werner, Albers, Franzblau & Armstrong, 1994). It has also been found that obese individuals have a 2.5 times greater chance of developing carpal tunnel syndrome as compared to their slender counterparts (Werner et al., 1994).

Carpal tunnel syndrome is commonly seen during pregnancy. This is thought to be because of increased weight with pregnancy and the local edema in the hands of pregnant women (Finsen & Zeitlmann, 2006). Pregnant women tend to develop edema in their hands, this swelling is thought to increase the pressure inside the carpal tunnel producing symptoms of CTS; these symptoms are reduced or completely disappear after delivery when the swelling disappears (Finsen & Zeitlmann, 2006).
CTS is often seen in patients with diabetes. This is often contributed to confusion with other risk factors, specifically obesity (Balci & Utku, 2007). There is a strong relationship between obesity and Type II diabetes and it is thought that this is why there is a relationship between diabetes and CTS. It was found that patients with diabetes who showed mononeuropathy of the median nerve had a higher body mass index than those who did not have mononeuropathy (Albers, Brown, Sima, & Greene, 1996).

Wrist trauma can lead to CTS for the fact that there can be a buildup of scar tissue in the carpal tunnel as well as inflammation of the flexor tendons that pass through the carpal tunnel which put pressure on the median nerve. There has also been an association between CTS and both hypothyroidism and rheumatoid arthritis. It is not defined exactly why these are associated with CTS but it is believed to be because of metabolic changes that occur with the two disorders which increase the pressure in the carpal tunnel (Balci & Utku, 2007).

Prevention

Primary prevention addresses patients that are at risk for developing a disorder such as CTS and it focuses on limiting the problems that may occur (Scaffa et al., 2001). The focus of primary prevention is to decrease the risk factors associated with a vulnerable population.

Occupational therapy plays an important role in the treatment of CTS after it is diagnosed. Many businesses are using occupational therapists to develop prevention programs regarding CTS (Fenton & Gagnon, 2003).
Occupational therapists are utilized by businesses for ergonomic evaluations such as job site analysis, job modification, and reasonable accommodation recommendations because of their expertise in anthropometrics (physical properties of the body) and ergonomics (Fenton & Gagnon, 2003).

Job site analysis is essential in the development of prevention methods. Workstations at grocery stores vary greatly and a proper job site analysis should be conducted to discover what changes can be made to reduce the risk of CTS. In job site analysis the occupational therapist makes physical measurements with a tape measure, stopwatch, force gauges, and sometimes a video camera, interviews and observations are also utilized (Fenton & Gagnon, 2003). By using these measurements and techniques the therapist can develop a plan to address the risk factors for CTS and can make the appropriate changes for prevention of the disorder.

Job modification may result from the job site analysis. When a specific group of employees are at risk for developing CTS, such as supermarket cashiers the proper job modifications may prevent more cases of a disorder from occurring (Viikari-Junturea, 1998). Ergonomic considerations, such as mechanization, automation, and work station changes, are typically moderate in their expenses and effective and should be some of the first aspects addressed in prevention of CTS (Viikari-Junturea, 1998).

Prevention of CTS relates closely to the conservative treatments. Many of these conservative treatments can be used in the prevention of CTS before symptoms even occur. Both splinting and tendon and nerve gliding
exercises aid in the prevention of CTS symptoms. The benefits of splinting are covered under conservative treatment techniques later on in this literature review.

Tendon and nerve gliding exercises have been shown to increase the range of motion of the joints as well as reduce the chance of tendons adhering to the fascia, nerve, or other tendons in the carpal tunnel (Baysal et al., 2007). They can be easily taught to a patient and diagrams can be provided for easier completion. These exercises have shown to mobilize the nerve, increase venous return, decrease edema, and decrease pressure in the carpal tunnel (Coppieters & Alshami, 2007). Tendon and nerve gliding exercises are also used in treatment of CTS and are explained further along in this literature review.

Special attention should be paid to posture during work. Carpal tunnel pressure is greatly increased during flexion and extension of the wrist (Brininger et al., 2007). Because of this fact cashiers should take steps to avoid excessive flexion and extension while lifting items over the computer scanner. This may be done through sliding items rather than grasping and lifting items up to be scanned. This posture would be evaluated during the job site analysis and proper recommendations would be made by the occupational therapist.

Rest is essential in preventing CTS and it is commonly used in the control of CTS by employers (Wellman, Davis, Punnett, & Dewey, 2004). In a typical 8 hour shift a supermarket cashier has 30 minutes of paid break time.
Increased breaks from work, as an employer intervention, were reported in 10% of work related CTS cases (Wellman et al., 2004). This also influences work performance because employees/cashiers will not become as fatigued.

In a study by Wellman et al. (2004) it was found that the typical prevention techniques that businesses take are job rotation, job transfer, more breaks, and environmental changes. These techniques typically occur after symptoms are presented; few businesses provide information on the cause and prevention of CTS before symptoms are present. It has been found that workers in service occupation (e.g. grocery store cashiers) are unlikely to receive any prevention interventions or training of causes and prevention of CTS (Wellman et al., 2004).

**Conservative Treatment Techniques**

Several conservative treatments exist for the treatment of CTS. Conservative treatment techniques are considered secondary prevention because they address the disease in early stages and try and slow or stop the disease progression (Scaffa et al., 2001). These treatments include splinting, tendon and nerve gliding exercises, oral therapies, soft tissue mobilization, ultrasound, and steroid injection. Conservative treatment of CTS tends to show temporary symptom relief compared to surgery, but this can be a benefit because of the complications associated with carpal tunnel release surgery (Baysal et al., 2006).

Splinting is one of the most common forms of treatment for patients with CTS; it has been found to be effective in the relief of CTS symptoms in
37% of patients that use splinting (Bland, 2007). Splinting is found to be the most effective when the wrist is placed in a neutral position of 0 degrees and the metacarpophalangeal joints (MCP) in 0-10 degrees of flexion (Brininger et al., 2007). This can be achieved through the use of a customized splint designed specifically for the patient or an over the counter wrist splint. Brininger et al. (2007) compared the use of an over the counter wrist cock-up splint with the use of a customized splint. Their results showed a significant reduction of CTS symptoms in the custom splint group as compared to the over the counter splint, however symptoms were reduced in both groups.

Splinting can be done during the day (diurnal) and at night (nocturnal). Although both forms of splinting have shown effective results there has been documented success for nocturnal splinting. A study evaluating the use of splinting during the sleeping hours showed improved discomfort scores in the hand and wrist with 49% of the participants reporting significant reduction of their symptoms (Werner, Franzblau, & Gell, 2005). Splinting has shown statistically significant results when used with CTS and is often used in conjunction with other conservative treatments such as ultrasound and tendon and nerve gliding exercises (Baysal et al., 2006).

Tendon and nerve gliding exercises are commonly used for the treatment of CTS. The recommended tendon and nerve gliding exercises were developed by Totten and Hunter, (1991) where the fingers are placed in five different positions including straight, hook, fist, table top, and straight fist; the wrist and hand is then placed in six different positions. These positions
are maintained for 5 seconds and should be done 5 times a day and repeated 10 times per session (Baysal et al., 2007). The possible benefits of tendon and nerve gliding exercises are mobilization of the median nerve, venous return facilitation, reduction of edema, and a decrease of the pressure in the carpal tunnel (Coppieters & Alshami, 2007). The purpose of tendon and nerve gliding exercises is to change the length of the nerve bed and cause the nerve to glide around the surrounding structures; this is done through movements of the joints so that the nerve bed is lengthened which increases the strain at the median nerve but movements at the other joints counterbalance this median nerve strain by shortening the nerve bed and decreasing strain (Coppieters & Alshami, 2007). In a study by Rozmaryn et al. (1998) it was found that 71% of patients who did not receive tendon and nerve gliding exercises required CTS surgery while only 43% of patients who received tendon and nerve gliding exercises required CTS surgery. These results are important for the treatment of CTS and the possible avoidance of intrusive surgery.

Oral therapies are used for the treatment of CTS. Oral steroids such as prednisone are commonly used. Oral prednisone is taken on a daily basis with differing doses which are prescribed by a physician (typically 10-20mg) (Chang, Ger Hsieh, & Huang, 2002). Oral steroids have an anti-inflammatory action and can reduce the pressure in the carpal tunnel. Chang et al., (2002) found that in low doses and short term use oral steroids can greatly reduce CTS symptoms but the follow-up was short term so long term effects could
not be assessed. In a controlled trial by Herskovitz, Berger, and Lipton (1995) it was found that using 20 mg of oral prednisone daily for one week and 10 mg of oral prednisone daily for an additional week significantly improved self-reported pain as well as global symptom scale pain, numbness, parasthesis, and nocturnal pain. Improvement is often seen within the first 5 days of treatment but is reduced after the treatment period ends (Herskovitz et al. 1995). It has been shown in the literature that oral steroid use can be an effective treatment for symptoms of CTS but the results are not sustained over time.

Manual therapy such as soft tissue mobilization has shown to be effective in the treatment of carpal tunnel syndrome. The goals of manual therapy are to release tissue adhesions and increase range of motion of the wrist to decrease the pressure in the carpal tunnel (Burke et al., 2007). Manual soft tissue mobilization (STM) as well as the Graston instrument-assisted soft tissue mobilization (GISTM) were evaluated in a study by Burke et al., (2007). STM is done by a professional manipulating the tissue using his/her hands to deeply stretch the tissue and reduce adhesions. GISTM does the same thing as STM but is done through the use of a machine rather than a hands on approach done by the professional. The results of this study showed that both types of manual therapy were effective in the reduction of symptom severity; both types of manual therapy also showed improved grip strength, range of motion, and isometric strength. In all this study showed that manual therapy is an effective treatment for the symptoms of CTS.
Ultrasound is also commonly used in the treatment of CTS. It is believed that the warming effects of ultrasound increase the blood flow of the tissue, increase the metabolism of the tissue, increase tissue regeneration and reduce the inflammation, edema, and pain in the carpal tunnel which decreases the compression of the median nerve (Baysal et al., 2006). There have been few studies that have shown the benefit of ultrasound for the symptoms of CTS but it is commonly used in conjunction with splinting and tendon and nerve gliding exercises (Baysal et al., 2006).

Corticosteroids are shown to relieve symptoms of CTS. It is thought that corticosteroids (e.g. prednisone, lidocaine, etc.) decrease inflammation around the median nerve and reduce the pressure on the median nerve. It is thought that corticosteroid injection is most effective if the symptoms first occurred within the last year (Habib, Badarny, & Rawashdeh, 2006). The injection is typically placed ulnar to the palmaris longus tendon within 4 cm of the first wrist crease (Habib et al., 2006). In a study by Armstrong, Devor, Borschel, and Contreras (2004) it was found that after 2 weeks the median sensory distal latency of a steroid injection group was significantly improved as well as function and symptom scores as compared to a placebo group. Steroid injection has been found to be a safe and effective treatment relieving the symptoms of CTS (Armstrong et al., 2004). However, steroid injection should be carefully used with diabetic patients because it can have a negative effect on the glucose and insulin levels of patients (Habib et al., 2006).
Surgical Intervention

There are several different surgical techniques designed to relieve the symptoms of CTS; these include traditional open carpal tunnel release, minimally invasive carpal tunnel release, and endoscopic procedures (Lorgelly, Dias, Bradley, & Burke, 2005). These treatments are shown to be effective in relieving CTS symptoms in 75-99% of cases (Burke et al., 2007). Surgical interventions can be considered tertiary prevention because they address the disease in the later stages and try to limit the problems associated with the disorder (Scaffa et al., 2001).

The most commonly used surgical treatment for CTS is the traditional open carpal tunnel release (Ferdinand & MacLean, 2002). Traditional open carpal tunnel release surgery consists of an incision being made ulnar to the thenar crease and distal to the Kaplan oblique line and proximal to the distal wrist crease 3-4 cm; the transverse carpal ligament superficial palmar fascia are then split (Trumble, Diao, Abrams, & Gilbert-Anderson, 2002). There has been debate to the complications associated with open carpal tunnel release and whether it is the most effective form of surgery. The main problems associated with open carpal tunnel release are it has a high frequency of a sensitive scar which is commonly hypertrophic and it involves a slower recovery after operation as compared to less invasive treatment (Jugovac et al., 2002). In spite of these complications open carpal tunnel release shows that it is safe and has a predictable outcome and the amount of associated complications is rather low (Ferdinand et al., 2002).
Minimally invasive carpal tunnel release such as limited palmar incision has shown to be effective in the reduction of CTS symptoms. In a study by Jugovac et al. (2002) it was shown that this approach was as effective in postoperative electrophysiological findings as the control group which underwent open carpal tunnel release. Because of these findings it appears that limited palmar incision is an effective less invasive technique for the reduction of CTS symptoms (Jugovac et al. 2002).

There are two forms of endoscopic carpal tunnel release these include single-portal and twin-portal. They are both believed to reduce scar tenderness and allow for patients to return to work more quickly (Trumble et al., 2002).

Single-portal carpal tunnel release consists of a 1 cm incision at the distal wrist crease in the volar wrist, scissors are then used to make a flap in the flexor retinaculum, a device (Agee device) is inserted and a blade elevates and is drawn out to release the transverse carpal ligament (Trumble et al., 2002). In the study by Trumble et al. (2002) they found that patients that had the single-portal carpal tunnel release showed improved function and relief of symptoms compared to a control group that underwent open carpal tunnel release. Carpal tunnel release is common and a study by Benson et al. (2006) discovered that endoscopic carpal tunnel release is not more likely than open carpal tunnel release to cause tendon, artery, or nerve damage.

The twin-portal carpal tunnel release consists of two incisions that are each 1 cm long one at a proximal and one at a distal portion with the
transverse carpal ligament being split from distal to proximal (Atroshi et al., 2006). There are more complications associated with this endoscopic technique compared to the single-portal technique, however, endoscopic surgery results in decreased scar pain as well as activity limitation in the early weeks after surgery compared to open carpal tunnel release (Atroshi et al., 2006). Both forms of endoscopic release cost more than open release but it is believed that this is made up for with earlier returns to work and activities of daily living (Trumble et al., 2002).

Costs

There are many costs associated with CTS. The cost of carpal tunnel release surgery in the United States exceeds $2 billion every year (Brininger et al., 2007). Workman's compensation claims are high for CTS among grocery store cashiers with a rate of 105 claims for every 10,000 workers in Massachusetts (Davis et al., 2001). The costs for businesses regarding workman's compensation claims of CTS are high but through the literature review process specific dollar amounts were not found. Preventative measures are typically moderately priced and should be the option considered first because of the possible benefits (Viikari-Juntura, 1998). Specific costs in time lost from work because of CTS vary across occupations depending on how much an employee earns in a year as well as the amount of time lost from work.
Conclusion

After conducting this literature review there has been shown the need for preventative measures for CTS. The literature has shown a high frequency of CTS among supermarket employees with the number being highest among cashiers. There was no identified program for the prevention of CTS in this population in the literature. Based on the findings of the literature there is a need for an in-service and guide book regarding prevention techniques for carpal tunnel syndrome for use with supermarket employees. This project is designed to provide supermarket cashiers with the necessary education to avoid the complications that come with the development of CTS.

Chapter III describes the process used in the development of the in-service and guide book on the prevention of CTS. It also covers how the project relates to the literature, how the information for this in-service and guidebook was gathered, and an overall description of the product. Both the in-service and the guide book were developed using current literature and adult learning principles.
CHAPTER III

ACTIVITIES/METHODOLOGY

An extensive literature review was the first step in the development of this scholarly project. The review of literature included causes of carpal tunnel syndrome (CTS), treatment of CTS, and methods used to prevent CTS. The literature was exclusively gathered from scholarly journals and textbooks.

The information used in the in-service was gathered through several different scholarly journals and texts. Through searching PubMed the articles were located. These articles were obtained online and in text at the Harley E. French Library at the University of North Dakota. Current textbooks and articles regarding carpal tunnel syndrome, adult education, and principles of patient education were used to develop the in-service. The articles were all obtained from scholarly sources. The texts were used for general information about CTS as well as information on patient education and ways to properly instruct adults. Adults learn better through hands on learning and example rather than strict lecture therefore there are several hands on learning opportunities provided during the in-service (Fitzgerald, 2006). Hands on learning techniques included demonstration and practice of tendon/nerve gliding exercises and soft tissue mobilization techniques. All information provided in the in-service was cited from the original source in the PowerPoint
slides. When creating the in-service the reading level of the population was considered. The goal was to keep the reading level around 6th to 8th grade and to avoid medical jargon so the cashier population would better understand the information provided. The in-service is at a 9th grade reading level because in the explanation of certain treatment techniques and surgeries some medical jargon could not be avoided. The reading levels of both the in-service and guidebook were calculated using the Flesch-Kincaid grade level tool in Microsoft Word.

The in-service is designed as a PowerPoint presentation that has breaks put in as well as opportunities for hands on learning and instruction. The information on CTS, the causes, predisposing factors, and types of treatment were gathered from journals and text books. The information gathered was adapted for use in an in-service and converted into language that the lay person could understand. Objectives for learning were also developed based on the information gathered from the reading and literature review.

Prevention techniques were gathered through scholarly journals that explain the benefits including articles on splinting, tendon/nerve gliding, soft tissue mobilization, and job site modification. Images were created by the author of the scholarly project as well as through the use of a digital camera with the author being the subject photographed. Tendon/nerve gliding techniques as well as soft tissue mobilization techniques were shown through digital pictures with instruction on how to complete them provided in the in-service and guide book. All other images were created by the author.
After the in-service was completed the guide book on prevention was developed. It is based of the prevention techniques described in the in-service. Information in the guide book was designed to correlate with the in-service and be a resource for the participants. It provided handouts on tendon/nerve gliding exercises and soft tissue mobilization techniques. The guide book is designed to be a supplement to the in-service and a resource for employees to use to review key information learned during the in-service. The guidebook is at a 7th grade reading level making it simple to understand.

The tools used to assess the effectiveness of the in-service were a pre-test and a post-test. The pre-test and post-test are based on the information provided during the in-service. The pre-test is designed to assess the knowledge of the employees regarding CTS and the post-test is designed to assess what the employees have learned from the in-service.

The following chapter (Chapter IV) provides an overview of the product including the purpose of the product and explanation of both the in-service and the guide book. The content covered in both the in-service and guide book are explained in Chapter IV along with how the in-service may be conducted.
CHAPTER IV

PRODUCT SUMMARY

The purpose of this project was to develop a program for preventing carpal tunnel syndrome (CTS) among supermarket cashiers. The goal is to reduce the number of workman’s compensation claims in a specific supermarket as well as reduce the chances of employees developing CTS.

This project consists of two parts. First, an in-service is conducted. Included in this in-service is information regarding CTS among supermarket cashiers, what CTS is and how one develops CTS. Information on prevention techniques for CTS is the bulk of the in-service. The in-service also includes current conservative and surgical treatments for CTS. The in-service is designed to be completed in a two hour session but may be split into 2 one hour sessions to better meet learner or employer needs. It must be conducted by a registered occupational therapist so information can be accurately conveyed to the participants. The focus of the in-service is the population of supermarket cashiers who have been shown to be at high risk for developing CTS. Second is the guidebook. This guidebook includes prevention methods that an employee and employer can take to reduce the risk of CTS in the workplace. The guidebook is designed to be a supplement to the in-service. It is distributed to the employees before the beginning of the in-service and can be used as a reference while covering prevention during
the in-service. This guidebook includes information on proper posture, the importance of rest, possible work station changes, tendon/nerve gliding exercises with images, soft tissue mobilization techniques, and splinting information. The goal of this guidebook is to supplement the in-service and provide employees with a tool for preventing CTS.

This project is designed from a biomechanical perspective. Changes made to posture as well as work station changes stem from a biomechanical approach. Exercises are demonstrated during the in-service and are also be included in the guidebook. These exercises are biomechanical in nature.

The goals of these prevention techniques are to change or modify the movements of the employee as well as make appropriate changes to his/her environment in order to effectively prevent CTS.

The complete product is located in the appendices. Appendix A includes the in-service/PowerPoint presentation and lecture notes, appendix B includes the guidebook, and appendix C is the pre/post tests designed to gauge the knowledge gained from the in-service.
CHAPTER V

SUMMARY

The purpose of this project was to develop an effective way to inform supermarket employees, with an emphasis on supermarket cashiers, about carpal tunnel syndrome (CTS) and ways to prevent it. The goal of this project was to decrease the incidence of CTS among supermarket cashiers decreasing workman's compensation claims and time lost to pain and surgical intervention involved with the disorder.

This project included an in-service designed to involve the participants. Hands on learning as well as lecture format were used in the in-service. To supplement the in-service a guidebook was created for use by the participants during the in-service and may be kept for reference after the in-service has been conducted. This guidebook focuses on prevention and has images of tendon/nerve gliding exercises with specific directions provided.

Several different factors can influence the effectiveness of this intervention. The employees should all be present for the in-service to show its full potential. If all employees are not included in this in-service then the employer may not see the benefits of the in-service. Also the in-service must engage the employees and be meaningful in order to have positive outcomes. The goal of this in-service and guidebook is to prevent CTS from occurring in supermarkets with emphasis on the supermarket cashier population. There
must be cooperation between the employees as well as the employer in order to gain the maximum benefit of this in-service. One of the main limitations of this project is the ability for the business to complete recommended prevention techniques. The supermarket needs to be willing to take the appropriate steps in prevention for this project to be effective. Work station changes as well as accommodations for the employees may be done by the business, but are not a requirement.

This project is designed to be conducted by a registered occupational therapist and implemented by the employer. An employer is not required to provide prevention methods to its employees and it is the decision of the business whether or not they wish to implement this in-service (Wellman et. al. 2004). There are associated costs with this in-service and it is the decision of the business to allow this in-service to be conducted within its facility. These costs include time, materials used, handouts, and a certified occupational therapist to conduct the in-service. An occupational therapist that is capable of conducting this in-service should approach the business and propose the project. If the business is willing the in-service will be delivered and effectiveness can be measured.

Product usefulness will be measured by the use of a pre-test before the in-service and a post-test after the in-service has been delivered. These are designed to indicate the knowledge gained by the participants during the in-service.
The literature showed no prevention program regarding supermarket employees. This project is designed to address this through the skills of a registered occupational therapist. This project was designed to provide business owners and supermarket employees with a resource to prevent CTS in the workplace.

Prior to marketing and implementing the program on a large scale, it is recommended that the program be piloted with two grocery stores. Piloting of the program will allow the author to make modifications based on participant feedback thus refining the program. Both managers and employees will be asked for feedback on specific strengths of the program and areas that would benefit from additional content/learning activities. In addition, using a follow up survey 6 months after the in-service was conducted could be used to document the outcomes of the in-service.
REFERENCES


APPENDIX A

CARPAL TUNNEL SYNDROME IN-SERVICE – IN-SERVICE
Carpal Tunnel Syndrome
What Can Someone Do

Derek Foss MOTS
Part I – Introduction to Carpal Tunnel Syndrome

- This section will cover:
  - Prevalence of carpal tunnel syndrome.
  - What the carpal tunnel is composed of.
  - Causes of carpal tunnel syndrome.
  - Predisposing factors of carpal tunnel syndrome.
What Should I Learn From This?

Learning Objectives

- At the end of this section participants will be able to:
  - Describe what Carpal tunnel syndrome (CTS) is.
  - Identify what causes CTS.
  - Describe CTS risk factors.
  - Identify strategies to active in prevention of CTS symptoms.
How Common Is Carpal Tunnel Syndrome?

- Carpal Tunnel Syndrome (CTS) is seen in 13% of the US population (Brininger et al., 2007).
- 15.6% of women are affected by CTS (Brininger, et al., 2007).
- 11.3% of men are affected by CTS (Brininger, et al., 2007).

13% of work related trauma disorders are CTS (Davis, Wellman, & Punnett, 2001).

50% of all medically treated CTS cases are work related. (Davis et al., 2001).
What about Cashiers?

- 19-60% prevalence of CTS symptoms among supermarket cashiers (Bonfiglioli et al., 2007).
- Grocery stores have the highest number of workman's compensation claims regarding CTS according to a Massachusetts study (Davis et al., 2001).

Supermarket cashiers have forceful movements of the hands relating to their work which may be the cause of CTS.

Ask for examples of work duties that the cashiers participate in and how they may contribute to CTS.
What is the Carpal Tunnel?

- The carpal tunnel is a narrow space in the wrist through which 9 flexor tendons and the median nerve pass to enter the hand.
- The base of the carpal tunnel is formed by the carpal bones of the wrist and the roof is formed by the transverse carpal ligament.
- Pressure build-up in this space causes compression of the median nerve leading to CTS symptoms.
- (Cooper, 2008).

The carpal tunnel is at high risk for females because of a more narrow space. Carpal tunnel pressure buildup can be caused by swelling, fat buildup, and injury.
This is the carpal tunnel if you cut straight through the wrist.
It contains nine tendons and the median nerve.
The roof is the transverse carpal ligament and the floor is the carpal bones.
What Causes CTS?

- The main cause of CTS is a buildup of pressure in the carpal tunnel.
- Pressure buildup can be caused by several different factors:
  - Swelling of the flexor tendons.
  - Scar tissue in the carpal tunnel.
  - Bone spurs in the carpal tunnel.
  - Dislocation of the wrist.
  - Metabolic disorders.
- (Cooper, 2008); (Jacobs & Austin, 2003).

Flexor tendons can swell from overuse as well as injury.
Scar tissue can develop from surgery or a hand/wrist injury such as a break.
Osteophytes or bone spurs develop because of arthritis.
Metabolic disorders can change the chemical interactions in the body resulting in various changes to the joints.
What are the Predisposing Factors?

- Obesity
- Metabolic syndrome
- Diabetes
- Pregnancy
- (Margolis & Kraus, 1987).

Fat tissue builds up in the carpal tunnel in obese individuals.

Metabolic syndrome causes changes in the chemical makeup of the person increasing chances of pressure buildup.

Diabetes is thought to increase the chances of CTS symptoms but it is related to obesity.

Edema from pregnancy can cause increased pressure in the carpal tunnel but symptoms tend to disappear after pregnancy.
Predisposing Factors Continued...

- Trauma to the wrist:
  - Scar tissue buildup and flexor tendon swelling.
- Hypothyroidism:
  - Metabolic changes.
- Rheumatoid arthritis:
  - Changes in the wrist joint.
- ((Margolis & Kraus, 1987).

Hypothyroidism is an underactive thyroid gland. This can lead to a reduction in important hormones which can cause joint pain and stiffness.

Rheumatoid arthritis can cause compression of the wrist when the immune system attacks the joints.
Why Obesity?

- Obese individuals are 2.5 times more likely to develop CTS than other individuals (Werner, Albers, Franzblau, & Armstrong, 1994).
- Buildup of fat tissue in the carpal tunnel increases pressure.

Obesity is one of the leading predisposing factors for CTS.
Why Obesity

- This increased pressure from the fat tissue compresses the median nerve (Werner et al., 1994).
- Metabolic syndrome and diabetes are thought to be related to CTS because of a common association with obesity (Albers, Brown, Sima, & Greene, 1996).
Why Pregnancy?

- Weight is increased with pregnancy.
- Hand and wrist swelling.
- This swelling is thought to increase the pressure in the carpal tunnel.
- After giving birth CTS symptoms tend to disappear.
- (Finsen & Zeitlmann, 2006).

Ask if anyone experienced symptoms when they were pregnant.
Part II – Prevention of CTS

- This section will cover:
  - Posture and rest
  - Ergonomics/work station optimization
  - Tendon/nerve gliding exercises
  - Splinting
What Should I Learn From This?

Learning Objectives:

- At the end of this section participants will be able to:
  - Describe and demonstrate proper posture while checking groceries.
  - Describe the role rest plays in decreasing pressure in the carpal tunnel.
  - Identify possible workplace modifications.
What Should I Learn From This?

Learning Objectives

- At the end of this section participants will be able to:
  - Demonstrate how to use tendon/nerve gliding exercises.
  - Describe the benefits of soft tissue mobilization.
  - Describe the benefits of splinting for preventing CTS.
Posture

- Excessive bending of the wrist increases the pressure in the carpal tunnel (Brininger et al., 2007).
- Repetitive movement also causes pressure to buildup in the carpal tunnel.

Both flexion and extension as well as repetitive motion is part of being a supermarket cashier.
These seem unavoidable but can be avoided in simple ways.
Posture

- Techniques to avoid flexion/extension
  - Try sliding items across scanner.
  - Avoid grasping and lifting items.
  - Use two hands for heavier items.
  - Try to keep wrist straight or in a neutral position.
- (Wellman et al., 2004)

These are simple techniques a cashier can use to avoid building pressure in the carpal tunnel.

With these simple modifications carpal tunnel pressure can be reduced.
Posture

- NOW IT'S TIME TO PRACTICE!!!

Set up a table approximately the same height as a cashier's workstation
Have a variety of items that the participants can try to handle with the new posture techniques they just learned
Demonstrate for them first and then allow them time to practice
Rest

- Rest can decrease the pressure in the carpal tunnel.
- Shorter more frequent rest breaks are a benefit and are commonly used by employers (Wellman, Davis, Punnett, & Dewey, 2004).

Rest allows swelling that develops on tendons in the carpal tunnel to be reduced.

More rest breaks are seen as an employer intervention for CTS in 10% of businesses.

Rather than taking one long break employees should take shorter more frequent breaks to relieve their wrists.
Work Station Optimization

- After analysis many work station changes may be considered.
- In 57% of cases work station changes are seen among businesses (Wellman et al., 2004).
- Work station changes may prevent more cases of CTS from being seen in a business (Viikari-Junturea, 1998).

Work station changes are common among businesses
They are not as common in the service industry such as in supermarket cashiers
This is because of difficulty in changing the environment and keeping productivity up
Work Station Optimization

Possible changes to the workplace

- Use of conveyor belts.
- Use of a hand scanner to avoid grasping items.
- Seated work station.
- Front facing work station rather than right handed side scan.
- Customer grocery unload rather than cashier grocery unload work stations.

More changes can be made through a job site analysis because all grocery stores are different

Each cashier is different and stature should be considered

Workstations where the cashier or customer unloads the grocery cart

Proper work station analysis should be done by a qualified occupational therapist for proper work station optimization
Tendon & Nerve Gliding Exercises

- These are simple stretching techniques.
- They are easily learned using diagrams or pictures.
- Tendon & nerve gliding exercises consist of 6 different stretches (Totten & Hunter, 1994).
- Can be done on work breaks or free time

Each stretch should be held for 10 seconds and done several times a day.
If you have an extra 5-10 minutes during a slow time at work or when you are at home watching TV try doing some stretches.
These stretches are easily learned and can be done quickly.
These stretches will not change daily routines because they can be done during free time.
Tendon & Nerve Gliding Exercises

- Tendon & nerve gliding exercises show:
  - Increased movement in the wrist joints.
  - Reduction in tendons sticking to surrounding tissues.
  - Reduce swelling of the tendons.
  - Move the median nerve.

- (Baysal et al., 2007); (Coppieters & Alshami, 2007).
Tendon & Nerve Gliding Exercises

- NOW IT'S TIME FOR PRACTICE!!!!!
Stretch #1

Wrist in neutral position
Fingers and Thumb flexed
Demonstrate and then have participants complete stretch for 10 seconds (do this for all stretches)
Stretch #2

Wrist in neutral
Fingers and thumb extended
Extend wrist and fingers
Keep thumb in a neutral position
Stretch #4

Extend the wrist, fingers, and thumb
Wrist, fingers, and thumb extended like in the previous stretch
Supinate the wrist (move toward the body)
Stretch #6

This is the same stretch as before but the participant should put some gentle stretch on the thumb with the other hand.
Splinting

- Splinting is a common treatment method for CTS.
- Splinting reduced symptoms of CTS in 49% in a study by Werner, Franzblau, and Gell, (2005).
- It can also be used as a preventative method.
- Use of a splint before the onset of symptoms may eliminate the chances of developing CTS.

Splinting will be covered later in the treatment section but may also be used in prevention of CTS.
Part III – Treatment of CTS

This section will cover:
- Conservative Treatment Interventions
  - Steroid Injection
  - Oral Therapy
  - Splinting
  - Ultrasound
  - Soft-tissue Mobilization
Part III - Treatment

- This section will cover:
  - Surgical Treatment Interventions
    - Open Carpal Tunnel Release
    - Minimally Invasive Carpal Tunnel Release
    - Endoscopic Carpal Tunnel Release
What Should I Learn From This?

Learning Objectives:
- By the end of this section participants will be able to:
  - Identify how conservative treatment methods work from a medical perspective.
  - Identify from a medical perspective how surgical treatments work.
What Should I Learn From This?

Learning Objectives:
- By the end of this section participants will be able to:
  - Describe how these medical interventions are used to treat carpal tunnel syndrome.
  - Describe how these medical interventions can benefit as well as hold back a supermarket cashier.
Conservative Treatment

- Steroid Injection
  - Steroid injections are thought to decrease pressure in the carpal tunnel by decreasing swelling.
  - Symptoms of carpal tunnel syndrome show significant improvement within two weeks following injection (Armstrong, Devor, Borschel, & Contreras, 2004).

Benefits from steroid injection are thought to be best if symptoms of CTS have occurred within the last year.

Injection is placed within 4 cm of the wrist crease toward the hand.
Conservative Treatment

- Oral Therapy
  - Oral steroids have shown effectiveness in the reduction of swelling within the carpal tunnel.
  - Prescribed oral steroids are taken daily for the effect to take place (Chang, Ger Hsieh, & Huang, 2002).
  - Improvement is usually seen within 5 days but lessens when the oral therapy ends (Herskovitz, Berger, & Lipton, 1995).

Short term use of oral steroids show an improvement in symptoms of CTS. Steroids should be used with caution in diabetic patients because it can have a negative impact on insulin and glucose levels.
Splinting is effective in the treatment of CTS symptoms in 37% of participants (Bland, 2007). The wrist is typically splinted in a straight position with no bending of the wrist. Splinting is often used with other treatment and prevention techniques.

Splinting can be done nocturnally and during the day.
Custom splints are more effective than over the counter splints but both are effective.
Splinting is a cost effective way to treat CTS.
Conservative Treatment

- Splinting:
  - Splinting can be done during the day or at night.
  - Splints are designed to be comfortable and position the wrist in a straight position.
  - (Brininger et al., 2007)

Splinting the wrist and MCP joints (first knuckles) keeps the lumbrical muscles from moving into the carpal tunnel during flexion of the MCP joints. This has been shown to be the most effective but commonly only the wrist is splinted in neutral position.
Splinting

- A person can buy a splint over the counter or have a custom splint made by an Occupational Therapist.
- Splinting at night has been shown to be effective in reducing symptoms of CTS.
- (Brininger et al., 2007)
This is a custom wrist immobilization splint. It is common in the treatment of carpal tunnel syndrome and would be effective in prevention if used at night when it would not bother the daily activities of the person. Custom splints are fairly expensive but their benefits are supported in literature (Brininger et al., 2007).
This is an example of an over the counter splint. This splint can be purchased at many locations such as Target and Wal Mart. It costs less than a custom splint but has been shown to be less effective (Brininger et al., 2007). Typical costs are between 5 and 15 dollars.
Conservative Treatment

- **Ultrasound**
  - Ultrasound has a warming effect on the tissue in the carpal tunnel.
  - It is commonly used in with splinting.
  - Ultrasound increases the blood flow to the wrist and reduces pressure in the carpal tunnel.

The heat is thought to increase blood flow and decrease edema in the tissue reducing pressure in the carpal tunnel.
Conservative Treatment

- **Soft-tissue Mobilization**
  - Designed to break down scar tissue.
  - Designed to break down restrictions in the underlying tissue in the wrist.
  - Hands are used to apply deep pressure on the tissues.
  - (Burke et al., 2007).

Should be done by a physician or qualified occupational or physical therapist but techniques can be learned

Stretches scar tissue, tight muscle bands and connective tissue

Both hands are typically used
Conservative Treatment

- **Soft-tissue Mobilization**
  - The participant should have his/her forearm, wrist, and hand relaxed on a table.
  - Deep pressure is applied with the fingers to the affected area of the wrist.
  - Treatment is typically done 2 times a week by a qualified clinician.
  - Self administered techniques can be learned.
  - (Burke et al., 2007).

After this slide demonstrate soft tissue mobilization techniques
Instruct during the demonstration how they can do soft tissue mobilization on themselves
Surgical Treatment

- These complications are possible in all forms of CTS surgery.
  - Complications:
    - Major nerve injury
    - Finger (digital) nerve injury
    - Tendon injury
    - Scar sensitivity
  - Complications are not very common but may occur
  - (Benson et. al., 2006)
Surgical Treatment

- Open Carpal Tunnel Release
  - Most common type of carpal tunnel release surgery (Ferdinand & MacLean, 2002).
  - This surgery involves a complete cut of the transverse carpal ligament which is the top of the carpal tunnel.
  - It is an invasive surgery with chance for complications.

This technique has a high incidence of scar pain
Involves a slow recovery
It is considered safe with a small amount of complications
Surgical Treatment

- Open Carpal Tunnel Release
  - The purpose is to relieve the pressure in the carpal tunnel.
  - The cut is about 4 cm in length.
  - Everything from the skin to the ligament is cut completely.
  - Improvement is seen at about 4 weeks and slowly gets better.
  - (Trumble, Diao, Abrams, Gilbert-Anderson, 2002)

More invasive than other approaches
Few complications but long recovery time
Surgical Treatment

- Minimally Invasive Carpal Tunnel Release
  - Surgery consists of a small incision in the palm.
  - Less invasive than Open Carpal Tunnel Release.
  - Shown to be effective when compared to Open Carpal Tunnel Release (Jugovac et al. 2002).

Less recovery time than open carpal tunnel release
Smaller chance of complications because of smaller incision
Surgical Treatment

- Minimally Invasive Carpal Tunnel Release
  - Small incision is made at one end of the ligament and the ligament is cut.
  - The other half of the ligament is cut under the skin using a microscope.
  - The incision is half the size as in open carpal tunnel release.

2 cm incision rather than 4 cm in open carpal tunnel release
Surgical Treatment

- Endoscopic Carpal Tunnel Release
  - Single-Portal Release
    - Reduces scar tenderness
    - Allows faster recovery
  - Twin-Portal Release
    - Reduces scar tenderness
    - Allows faster recovery
- Both techniques show improvement after 2 weeks.
- (Trumble et. al., 2002)
Surgical Treatment

- Single-Portal Release
  - Consists of a 1 cm cut at the wrist crease.
  - A device is inserted to cut the transverse carpal ligament below the skin.
  - This device helps reduce scarring.
  - Has shown improved function after surgery compared to Open Carpal Tunnel Release.
  - (Trumble et al., 2002)

Less invasive than open carpal tunnel release
Less chance of scar sensitivity
Results are similar to open carpal tunnel release with less complications
Surgical Treatment

- Twin-Portal Release
  - Two 1 cm cuts are made at each end of the transverse carpal ligament.
  - Shows decreased scar pain and less limited activity after surgery compared to Open Carpal Tunnel Release.
  - Similar to the technique used in the single portal release where a device under the skin cuts the ligament.
  - (Atroshi, Larsson, Ornstein, Hofer, Johnsson, & Ranstam, 2006).

More chance of complications compared to single-portal
Both endoscopic release techniques cost more than open carpal tunnel release
Earlier returns to daily living activities are associated with endoscopic release
Part IV - Summary

Throughout this in-service we covered many different things.
- What the carpal tunnel is
- What causes carpal tunnel syndrome
- Predisposing factors
- Prevention techniques
- Treatment techniques
Summary

- Employees can take an active role in prevention of CTS.
- Prevention of CTS is simple and can be done with limited effort.
- Treatment of CTS is effective but often limits employees.
- CTS is a common problem in supermarkets but steps can be taken to prevent it.
Conclusion

- The participants of this in-service will now complete a post-test that is similar to the pre-test you completed before this in-service began.
- The answers to this test will be given to you after completion and collection.
- The information gathered from these tests is confidential and used to determine the effectiveness of this program.
REFERENCES


Jugovac, I., Brugic, N., Micovic, V., Radolovic-Prenc, L., Uravic, M.,
Golubovic, V., et al., (2002). Carpal tunnel release by limited palmar
incision vs traditional open technique: Randomized controlled trial.
_Croatian Medical Journal._ 43(1), 33-36.
Margolis, W., & Kraus, J. F., (1987). The prevalence of carpal tunnel
syndrome symptoms in female supermarket checkers. _Journal of
Occupational Medicine._ 29(12), 953-956.
nerve gliding in thoracic outlet syndrome and carpal tunnel syndrome.
_Hand Clinics_, 7(3), 505-520.
Single-portal endoscopic carpal tunnel release compared with open
release: A prospective, randomized trial. _The Journal of Bone and Joint
Surgery._ 84(7), 1107-1115.
for prevention and treatment. _Clinical Orthopaedics and Related
Research._ 351, 39-43.
tunnel syndrome (WR-CTS) in Massachusetts, 1992-1997: Source of
WR-CTS, outcomes, and employer intervention practices. _The
American Journal of Industrial Medicine._ 45, 139-152.

APPENDIX B

CARPAL TUNNEL SYNDROME IN-SERVICE – GUIDE BOOK
Carpal Tunnel Syndrome
A Guide for Prevention

Created by Derek Foss OTS
Table of Contents

* Overview 3
* Section I – Posture and Rest 4
* Section II – Work Station Optimization 5
* Section III – Tendon and Nerve Gliding Exercises 6-9
* Section IV – Splinting 10-12
* Section V – Soft - Tissue Mobilization 13
* References 14-15
* Note Pages
Overview

Prevention of carpal tunnel syndrome (CTS) is often overlooked. Prevention of CTS can help a person avoid the problems in daily life and the expenses that come with CTS. The following guidebook describes ways in which to prevent CTS and how people can use prevention to help themselves.

The image on the front of this guidebook is a picture of the carpal tunnel if you cut directly down through the wrist. It shows everything that passes through the carpal tunnel and how the carpal bones and ligament create the floor and ceiling of the carpal tunnel.

As seen in the diagram the carpal tunnel has many structures passing through it. There are nine tendons along with the median nerve. This is a narrow space and the many structures in the carpal tunnel make compression of the nerve common.

CTS is seen when the median nerve (shown on the diagram) is compressed. This can happen through swelling of the surrounding tendons, build-up of scar tissue in the carpal tunnel from an injury, fat build-up in the carpal tunnel, and swelling of the surrounding tissue because of over use.
Section I - Posture and Rest

Posture:

* Repetitive motion of the wrist increases the pressure in the carpal tunnel.
* Often bending at the wrist is the main cause of increased pressure.
* These are common while working as a supermarket cashier.

Proper Posture:

* Use two hands to handle heavy items.
* Slide items across scanner rather than grasping and lifting them.
* Focus on keeping wrist in a straight position.
* Try not to reach with bent wrists.

Rest:

* Rest decreases pressure in the wrist.
* Swelling of the tendons is reduced with rest.
* Frequent rest breaks are a common employer intervention (10% of cases).
* Employees might benefit from shorter breaks more often to relieve pressure in the carpal tunnel.
* Rest time can be used to complete tendon/nerve gliding exercises to stretch the tissue in the carpal tunnel (techniques will be covered further along in guidebook).
* (Wellman et al., 2004).
Section II - Work Station Optimization

Work Station Changes:

* Changes to the work station may be recommended by the occupational therapist.
* In 57% of businesses work station changes are seen when dealing with CTS.
* Work station changes may prevent more cases of CTS from being seen in a business.
* Work station changes are different between supermarkets.

Possible changes:

* Install conveyor belts to reduce reaching.
* Use a hand held scanner to avoid grasping and lifting items.
* Front-facing work station rather than right hand grasp and scan stations.
* Customer-unload rather than cashier-unload work stations.
* Seated work station.
* Consider size (height) of cashier when changing the work station.
* (Wellman et al., 2004); (Viikari-Juntura, 1998).
Section III - Tendon and Nerve Gliding Exercises

Benefits:

* Simple stretching techniques.
* Consist of 6 different stretches that can be done several times a day for a 10 second stretch (Totten & Hunter, 1994).
* Increase movement in the wrist.
* Keeps tendons from sticking to other tissues in the wrist.
* Moves the median nerve.
* Decreases swelling in the wrist.
* (Baysal et al., 2007); (Coppieters & Alshami, 2007).

Exercises:

Stretch #1

Keep wrist in a straight position and bend the fingers and thumb into a fist.
Stretch #2

Keep the wrist straight and open the hand straight up.

Stretch #3

Bend the wrist back and keep the fingers and thumb straight.
Stretch #4

Bend the wrist back with fingers straight and open the thumb.

Stretch #5

Do the same as last stretch but turn the forearm toward you.
Stretch #6

Do the same as the last stretch but place some light pressure on the thumb.
Section IV - Splinting

Benefits:

* Common treatment for CTS.
* Splinting showed a reduction of CTS symptoms by 49% in a study by Werner, Franzblau, and Gell, (2005).
* Can also be used as a preventative method.
* Over the counter splints are typically reasonably priced.
* A custom splint is made by an Occupational Therapist if over the counter splint does not work.
* Has been shown in several studies to be an effective treatment method.

How to use:

* Can be used during the day or at night.
* Places the wrist in a straight position.
* Splinting at night has shown to be a good treatment and should be an effective preventative method.
* Splints can be custom made or purchased at a retail store.
* Custom splints are more expensive but show greater benefits.
* (Brininger et al., 2007).
Examples:

**Custom Splint:**

* This type of splint places the wrist in a straight position and is commonly made to treat CTS.
* May be effective in the prevention of CTS if used before the start of symptoms.
* This is an example of a custom splint that would be made by an Occupational Therapist.
Over the Counter Splint:

* This is an example of an over the counter splint.

* It also places the wrist in a straight position and gives support to the wrist.
Section V - Soft-Tissue Mobilization

Benefits:

* Designed to break down scar tissue.
* Causes increased blood flow to the area.
* Breaks down scar tissue in the wrist.
* Use with an injury to the wrist to decrease the risk of developing CTS because of scar tissue or swelling.

How:

* Physician referral for treatment.
* Typically done by a clinician (physician, occupational therapist, or physical therapist) using both hands.
* Can complete on self using one hand.
* Use fingers to apply pressure to the wrist.
* May feel uncomfortable while performing the stretch but will ease when the restriction is reduced.
* (Burke et al., 2007).
Intended Use of this Guidebook

This guidebook is intended for use by supermarket employees that participated in an in-service on carpal tunnel syndrome presented by an occupational therapist. It is to be used as a resource to aid in the prevention of CTS.

References


gliding in thoracic outlet syndrome and carpal tunnel syndrome. *Hand Clinics*, 7(3), 505-520.


APPENDIX C

CARPAL TUNNEL SYNDROME IN-SERVICE – PRE/POST TEST
Carpal Tunnel Syndrome Pre/Post Test

1. Carpal tunnel syndrome (CTS) results from a buildup of pressure in the carpal tunnel.
   a. True
   b. False

2. All of these are potential causes of CTS except: __________.
   a. Bone spurs
   b. Swelling of the tendons
   c. Scar tissue
   d. Rotator cuff injury

3. Obesity is one of the main predisposing factors for CTS.
   a. True
   b. False

4. If a woman develops CTS while pregnant the symptoms tend to never go away.
   a. True
   b. False

5. Trying to keep the wrist in a straight position while working may prevent CTS.
   a. True
   b. False
6. One long break is better for prevention of CTS than short more frequent breaks.
   a. True
   b. False

7. Tendon/nerve gliding exercises are a preventative method for CTS.
   a. True
   b. False

8. Tendon/nerve gliding exercises should be done several times a day and each stretch should be held for 10 seconds.
   a. True
   b. False

9. Splinting can be used as both a treatment and prevention technique for CTS.
   a. True
   b. False

10. The following are all examples of conservative treatment for CTS except:
    a. Steroid Injection
    b. Oral Steroids
    c. Splinting
    d. Soft-tissue Mobilization
    e. Ultrasound
    f. Electrical Stimulation
11. The following are examples of CTS surgery except: __________.

a. Open Carpal Tunnel Release

b. Minimally Invasive Carpal Tunnel Release

c. Complete Cut Carpal Tunnel Release

d. Endoscopic Carpal Tunnel Release
Answer Key

1. true
2. rotator cuff injury
3. true
4. false
5. true
6. false
7. true
8. true
9. true
10. electric stimulation
11. complete cut carpal tunnel release