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STUDY 1***

The Influence of a Dynamic Elastic Garment on Musculoskeletal & Respiratory Wellness in Computer Users – *Michael Decker, PHD, Steven J. Narvy, M.D., C. Thomas Vangsness, Jr. M.D.*

https://www.tandfonline.com/doi/full/10.1080/10803548.2016.1182321

STUDY 2***

Scapular Bracing and Alteration of Posture and Muscle Activity in Overhead Athletes With Poor Posture – *University of North Carolina at Chapel Hill, Department Exercise and Sport Science (Athletic Training)*

http://natajournals.org/doi/full/10.4085/1062-6050-48.1.13?=

STUDY 3***

Measuring the Effects of a Posture Shirt on Ergonomic Position at the Dental Chair – *David E. Cohen DDS, Clinical Restorative Sciences, UMKC School of Dentistry, USA*

https://www.google.com/url?q=http://austinpublishinggroup.com/dental-disorders/download.php%3Ffile%3Dfulltext/jdod-v4-id1093.pdf&sa=U&ved=0ahUKEwjn57nes7DaAhVIj1QKHeesAYcQFggFMAA&client=internal-uds-cse&cx=016120555718622698702:xpaictngqdy&usg=AOvVaw2Pu9A3882eQ8cpzvyfJAJA

STUDY 4

The Effects of a Posture Shirt on Throwing Velocity, Throwing Accuracy and Blood Flow in Professional Baseball Pitchers - *Department of Orthopaedic Surgery – Keck School of Medicine USC*

STUDY 5

The Effect of a Postural Enhancing Device on Sub-Acromial and Coracohumeral Distances during Shoulder Abduction: A Bi-Plane Fluoroscopy Imaging Study – *Steadman Phillippon Research Institute Vail, Colorado*

STUDY 6

The Effects of a Posture Shirt on Rotator Cuff Muscle Strength – *Kerlan Jobe Sports Medicine Institute, Los Angeles, CA*

STUDY 7

The Effects of the S3 for Shoulder Pathologies – *Steven Smith, Kerlan Jobe Sports Medicine Institute, Los Angeles, CA*

STUDY 8

The Effects of Anatomic Enhancing Garments on Knee Performance and Injury during Skiing – *University of Denver, Anne Bevington-Director of Health and Safety – Vail Resorts*

STUDY 9

The Effectiveness of a Scapular Brace on Scapular Kinematics in American Society of Shoulder and Elbow Therapists *Uhl TL, K. W., Tripp BL, Spigelman TH, McClelland R*

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POSTURAL FITNESS™

TITLE: The Influence of a Dynamic Elastic Garment on Musculoskeletal & Respiratory Wellness in Computer Users

https://doi.org/10.1080/10803548.2016.1182321

INTRODUCTION

Computer use in the business setting is ubiquitous. Evidence is growing that computers users are at increased risk of developing musculoskeletal disorders. The purpose of this study was to determine the short-term effects of wearing a dynamic elastic garment (Posture Shirt; AlignMed; Santa Ana, CA) on musculoskeletal wellness and health in the computer work place.

MATERIALS AND METHODS

Ninety-five computer users employed at a municipal utility provider volunteered to be prospectively evaluated in the work place. A functional assessment of posture, lung function and strength was performed using a dynamic elastic shirt for four weeks. Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire was given. A training log was kept to track weekly sensations of postural fatigue using a visual analogue scale (VAS).

RESULTS

Postural fatigue and muscular fatigue decreased by 21% and 29%, respectively, and energy level and productivity increased by 20% and 13%, respectively. Lung function (FEV1) improved 2.8% immediately, rising to 3.8% improvement at study completion (p=0.67). Hand strength improved 3.8% immediately, and rose to 5.4% at study completion (p=0.13).

DISCUSSION

The form-fitting fabric and non-stretch neuro-bands within the garment gently pull the shoulders back, which in turn reduces/enhances the anatomical alignment of the spine, scapula, shoulder and arm and improves forward head and shoulder posture.

This prospective study demonstrated a positive impact of this dynamic elastic garment on the short term subjective measures of fatigue and posture, head and shoulder posture, thoracic kyphosis, lung function and grip strength.

CONCLUSION

The dynamic elastic garment had a favorable effect on both subjective and objective measures of workplace ergonomics among occupational computer users in this short-term study.

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TITLE: The Spine and Scapula Stabilizing (S3) Brace Has an Effect on Posture and Muscle Activity in Overhead Athletes with Poor Posture

original research

Scapular Bracing and Alteration of Posture and Muscle Activity in Overhead Athletes With Poor Posture

Ashley K. Cole, MA, ATC*; Melanie L. McGrath, PhD, ATC†; Shana E. Harrington, PhD, MPT‡; Darin A. Padua, PhD, ATC§; Terri J. Rucinski, MA, PT, ATC, CSCSǁ; William E. Prentice, PhD, PT, ATC, FNATA§

Key Points

- Changes occurred in forward shoulder angle and the electromyographic activity of the upper, middle, and lower trapezius muscles when participants wore the scapular-stabilizing brace.
- The compression garment and the tension straps selectively affected posture by reducing forward shoulder angle, but associated electromyographic activity changes were small and do not appear to be influenced by strap tension.
- Scapular bracing appeared to produce beneficial changes in muscular activity and posture in healthy overhead athletes.
- Clinicians might consider using a scapular brace as an adjunct to prerehabilitation and rehabilitation exercises in the athlete with poor posture.

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ABSTRACT

The purpose of this study was to determine whether or not the S3 scapular stabilizing brace corrects the posture of participants with FHRSP. In addition, this study determined whether or not wearing the S3 scapular stabilizing brace has an effect on the muscle activity of participants with FHRSP while performing six scapular stabilization exercises. Posture was measured using a digital camera and Adobe Photoshop to determine both the forward head and rounded shoulder angles. Muscle activity was measure for the upper trapezius, middle trapezius, lower trapezius, and serratus anterior using the average EMG recorded during Y's, T's, W's, shoulder extension, forward flexion, and scapular punches. This study found that there were significant changes in FSA
and upper, middle, and lower trapezii EMG activity caused when wearing the S3 brace compared to not wearing it. However, this study did not find significant differences in the treatment group compared to the sham group for FHRSP or EMG activity in any muscles.

S3 SCAPULAR STABILIZATION BRACE

The bracing company AlignMed Evidence Based Apparel (EBA) has come out with a new brace designed to correct posture and scapular positioning similar to the theory behind scapular taping. (38) The Scapular Stabilizing System (S3) brace is "a spine and scapula stabilizing brace designed to improve posture, reduce pain, and increase range of motion." The company designed the S3 brace to "trigger the body to correct improper posture by re-educating and re-engineering the musculoskeletal system surrounding the shoulders and spine" as well as signaling the neuroreceptors in the skin to engage in proper posture. The company also states that the S3 brace "addresses and lends instant relief to fatigue and poor spine alignment associated with unnatural body position at the computer." Uhl et al. performed a study on the prototype of the S3 brace and other studies are waiting to be been published. The abstract from this study states that the objective was to evaluate the S3 brace on scapular kinematics at rest and during active arm elevation. Fifteen healthy subjects and 15 subjects with scapular dyskinesis were used in this study. The results found that the brace increased posterior tipping by 3 degrees in the first and last 30 degrees of motion, decreased upward rotation in the dominant arm by 4 degrees at 90 degrees of elevation, while increasing upward rotation in the non-dominant arm by 2 degrees in the first and lat 40 deg of elevation. The S3 also decreased internal rotation by 3.5 degrees during the lowering phase of elevation. The authors concluded that the S3 brace affected the scapular kinematics at rest and in the lower

ranges of motion and that the increased posterior tipping and decreased internal rotation from wearing the brace may assist the scapular muscles in controlling scapular motion.

Forward head rounded shoulder posture causes excessive scapular protraction and acromial depression increasing the potential for impingement and 39 other chronic shoulder injuries. If the S3 brace decreases the shoulder angle this may improve scapular motion by restoring normal posterior tipping, upward rotation, and medial rotation. If the scapula is returned to optimal positioning while wearing the S3 brace then the scapular stabilizers may be more effectively strengthened while performing strengthening exercises. Theoretically, due to improved scapular positioning the lower trapezius, middle trapezius, and serratus anterior activity will increase and upper trapezius activity will decrease. Improved scapular positioning caused by wearing the S3 brace may improve muscular activation of the scapular stabilizers. As a result the scapular stabilizers may be more effectively strengthened while performing strengthening exercises. In conclusion, improving posture will help to decrease the incidence of shoulder pain as well as decreasing the amount of time lost from sports participation and/ or daily activities. This will improve the playing time for overhead athletes as well as the quality of their performance.

SUBJECTS

Males and females between the ages of 18-25 were recruited from the student population at the University of North Carolina at Chapel Hill. Forty subjects were recruited through mass e-mails sent to the student population, through flyers placed around campus, and through exercise and sports science classes. Subjects were included if they currently participated in a NCAA, club, or recreational overhead sport 3-4 days a week for at least 1 hour or more. An overhead sport was defined as baseball, softball, swimming, volleyball, tennis, water polo, javelin, shot put, or discus. Subjects displayed forward head rounded shoulder posture. Subjects (41) were excluded if they had had a shoulder or back injury in the last 6 months, previous history of shoulder or back surgery, are currently performing formal shoulder rehabilitation, had any congenital postural abnormalities, a forward head or rounded shoulder posture less than the specified criteria, and had any prior experience with the S3 brace. The dominant arm (arm they would throw a ball with) was tested for each subject. Subjects were randomly assigned to either the treatment groups or sham group by trained research assistants to allow the principal investigator to remain blinded to group assignment and treatment condition.

STUDY DESIGN

This was a single blind randomized-control study. Each subject was blind to group assignment and brace condition. Subjects were randomly assigned to groups, and measurements were taken both with the brace applied and without for control purposes.

S3 Brace Fitting

The S3 brace was fitted and applied by two trained research assistants according to manufacturer specifications using a two strap method. The research assistants fit all subjects for the correct size. If a subject was in between sizes then he or she tried on both sizes and the research assistants determined which size had the best fit.
Neither the treatment group nor the sham group was educated on the reasons for wearing the S3 brace. Men were shirtless and women wore a sports bra. After putting on and zipping up the S3 brace; both groups tightened the Velcro pads on the waist band so that they were snug, but not uncomfortable. Both groups were instructed to retract and depress the shoulder blades in preparation for strap placement. The treatment group had a small (C) strap applied from the posterior, superior Velcro pad (over the upper trapezius muscle) to the contralateral waist band. This method was repeated for the opposite side. Next, the medium (B) strap was attached from the lateral, superior Velcro pad (over the pectoralis major muscle) to the contralateral waistband Velcro pad inferior to the (C) strap. This method was repeated for the opposite side (Figure 3). The sham group used the same method of applying the brace, but the medium (B) straps were used in place of the short (C) straps and the long (A) straps were used in place of the medium (B) straps. There was a 5 ½ to 6 inch difference between the B and C straps and a 6 inch difference between the A and B straps. Due to this difference in length the straps did not cause retraction, but maintained the look of the brace.

PROCEDURES

Posture

During postural alignment assessment subject's stood 40cm in front of a grid screen with reflective markers placed on the subject's right tragus (ear), right acromion, and 7th cervical vertebrae spinous process (see Figure 2). High resolution digital pictures were then taken in a sagittal plane to determine the plumbline through the C7 spinous process. The primary investigator stood 3m from the grid and the camera was positioned on a tripod. The photos were then uploaded onto a personal computer for postural analysis using Adobe® Photoshop. The photos were then used to calculate the shoulder and head angle of each subject to determine whether or not they were included in the study. Forward head position was defined as having a forward head angle greater than or equal to 46° relative to the vertical line extending from C7 to the line connecting C7 to the tragus.
Rounded shoulder position was described as having a forward shoulder angle of greater than 46or equal to 46° relative to the vertical line extending from C7 to the line connecting C7 to the acromion (Sawyer, 2006; Thigpen, 2006). Postural alignment criteria were based on a study done by Thigpen in which he screened 310 individuals from the university population.

MVIC

A maximal voluntary isometric contraction (MVIC) assessment was performed against manual resistance. Each subject performed one sub-maximal contraction to familiarize themselves with the manual muscle testing position. Subjects performed 3 MVIC's for each muscle (lasting 5 seconds each) with 1 minute rest between each muscle and 30 seconds between each trial. The average EMG amplitude for all of the trials was recorded. The order of the muscles tested was randomized. MVIC's were tested as follows:

Upper trapezius- The subject was seated with arms at his/her sides. The tester stood behind the subject and gave the subject instructions to "shrug the shoulder" which was being tested and "rotate the head in the opposite direction." The tester applied a stabilizing force to the back of the head and a downward force to the acromion for 5 seconds. The subject was then instructed to "relax" (Kendall, 1993).

Middle trapezius- The subject laid in the prone position with the shoulder abducted to 90° and externally rotated. The tester stood at the subject's side and gave the subject instructions to "raise the arm towards the ceiling" while the tester applied a downward force to the proximal end of the brachium for 5 seconds. The subject was then instructed to "relax" (Kendall, 1993).
Lower trapezius- The subject laid in the prone position with the arm raised overhead in line with the lower trapezius muscle fibers. The tester stood at the subject's side and gave the subject instructions to "raise the arm towards the ceiling" while the tester applied a downward force to the proximal end of the brachium for 5 seconds.

The subject was then instructed to "relax" (Kendall, 1993).

Serratus anterior- The subject was seated with the arm shoulder flexed between 120° and 130°, with the arm internally rotated. The tester stood beside the subject and gave the subject instructions to "raise the arm towards the ceiling," while the tester applied a downward force to the proximal end of the brachium for 5 seconds.

The subject was then instructed to "relax" (Kendall, 1993).

The S3 Brace
The S3 brace has been designed to improve posture and reduce pain in patients suffering from poor posture and shoulder injuries. It has been found in previous unpublished studies that the S3 brace improves scapular kinematics and rest and in the lower ranges of motion. The designers of the brace state that through a "Velcro strapping system coupled with proprioceptive padding" the brace attempts to restore normal shoulder kinematics. Previous studies have found that exercise may improve scapular kinematics although it is unclear whether scapular positioning is improved. Wang et al found that when patients performed an exercises regimen that included 5 shoulder exercises resting scapular posture did not change and that the scapula showed less superior translation after the exercise program (Wang, McClure, Pratt, & Nobilini, 1999). Ludewig et al found that selective activation of the serratus anterior with minimal activation of the upper trapezius may improve the relative strength of the serratus anterior and improve the balance of these two muscles in patients with shoulder dysfunction (Ludewig, Hoff, Osowski, Meschke, & Rundquist, 2004). It is believed that strengthening the lower trapezius, middle trapezius, and serratus anterior muscles with the scapula in the proper position and a more normal force couple restored would overtime help to restore the force couple in the long run during rehabilitation exercises, sport activity, and everyday movements. Given the findings of this study it can be stated that wearing the brace does cause positive changes in forward shoulder posture and EMG activity of the upper and lower trapezii, however it has not been determined that these changes are a direct result of the strap placement suggested by the AlignMed company. This study does not disprove the claims that the AlignMed Company has made in regards (65) to the effectiveness of the brace, but further studies must be done to

determine whether the changes seen are a result of corrective straps or merely the result of the proprioception caused by wearing a compressive shirt.

Purpose:

The purpose of this study was to determine whether or not the S3 scapular stabilizing brace corrects the posture of participants with FHRSP. In addition, this study determined whether or not wearing the S3 scapular stabilizing brace has an effect on the muscle activity of participants with FHRSP while performing six scapular stabilization exercises. Our results indicate that wearing the brace compared to not wearing the brace had an effect on both posture and EMG; however there was no significant difference between then sham group and the treatment group.

Posture:

It was found that forward head posture was not improved with sham or treatment application of the brace. Although it was hypothesized that the brace would decrease forward head posture this did not occur. Since the S3 brace did not apply any direct force to the head or the cervical spine then it is not surprising that there was no change in FHP. Lewis et al. however, found that scapular taping did improve FHP compared to a placebo tape job when Leukotape was applied from the center of the spine of the scapula to the spinous process of T12 in a diagonal fashion (Lewis, Wright, & Green, 2005). The subjects were asked to retract and depress their scapulas as were our subjects during application of the S3 brace. This 57 difference in these findings cannot be fully explained, but it is possible that the direct application of the Leukotape to the skin may have allowed for a greater change in forward head posture compared to the brace where the attachment of the Velcro pads to a strap that goes over the acromion inside the brace is what retracts the shoulders.
Although FHP was not changed, FSP was significantly decreased when subjects were wearing the brace compared to when they were not wearing the brace. However, there was not significant difference in the sham group compared to the treatment groups, in both groups FSA was decreased when wearing the brace compared to not wearing the brace. This suggests that it may not be the straps that cause the decrease in shoulder angle, but it may be the proprioceptive effects of the brace. Lewis et al. also found that scapular taping in the manner described previously caused a decrease in FSA (Lewis, Wright, & Green, 2005). Again, the tape was applied directly to the skin and this may be more effective than applying the straps to the brace. It is also possible that although the straps used in the sham treatment were 51/2 to 6 inches longer than the treatment straps they may not have been long enough to completely prevent shoulder retraction. Further studies should be done to investigate different brace applications and how they affect FHP and FSP. While the change in FSP may seem small this may be enough to make a difference clinically. Since this wearing the brace one time had positive effects, it is possible that with regular use of the S3 brace this difference would increase and have more of effect overtime. (58)

EMG:

There were no group effects found for EMG meaning that there were no significant differences between the sham group and the treatment group. Condition effects were found for certain muscles during certain exercises, which generally demonstrated that bracing, regardless of group, changed EMG activity. When evaluating EMG in relation to shoulder pathology it has been found that the upper trapezius is overactive while the middle trapezius, lower trapezius, and the serratus anterior are under active. This causes a disruption in the force couple which leads to changes in scapular kinematics. Ultimately these changes in the force couples and in scapular kinematics may lead to chronic shoulder pathologies such as subacromial impingement, associated subacromial bursitis, and rotator cuff or biceps tendonitis (Ludewig, Hoff, Osowski, Meschke, & Rundquist, 2004). Cools et al studied the balance of the trapezius muscles in overhead athletes with impingement syndrome compared to those without impingement syndrome and it was found that patients with impingement syndrome showed significantly higher EMG activity in the upper trapezius of their injured side compared to the dominant side of the control group (Cools, Declercq, Cambier, Mahieu, & Witvrouw, 2007). It was hypothesized that wearing the S3 brace while performing shoulder exercises would decrease the muscle activity of the upper trapezius and increase the muscle activity of the middle trapezius, lower trapezius, and serratus anterior thereby creating a more normal force couple for these muscles.

The S3 Brace

The S3 brace has been designed to improve posture and reduce pain in patients suffering from poor posture and shoulder injuries. It has been found in previous unpublished studies that the S3 brace improves scapular kinematics and rest and in the lower ranges of motion. The designers of the brace state that through a “Velcro strapping system coupled with proprioceptive padding” the brace attempts to restore normal shoulder kinematics. Previous studies have found that exercise may improve scapular kinematics although it is unclear whether scapular positioning is improved. Wang et al found that when patients performed an exercises regimen that included 5 shoulder exercises resting scapular posture did not change and that the scapula showed less superior translation after the exercise program (Wang, McClure, Pratt, & Nobilini, 1999). Ludewig et al found that selective activation of the serratus anterior with minimal activation of the upper trapezius may improve the relative strength of the serratus anterior and improve the balance of these two muscles in patients with shoulder dysfunction (Ludewig, Hoff, Osowski, Meschke, & Rundquist, 2004). It is believed that strengthening the lower trapezius, middle trapezius, and serratus anterior muscles with the scapula in the proper position and a more normal force couple restored would overtime help to restore the force couple in the long run during rehabilitation exercises, sport activity, and everyday movements. Given the findings of this study it can be stated that wearing the brace does cause positive changes in forward shoulder posture and EMG activity of the upper and lower trapezii, however it has not been determined that these changes are a direct result of the strap placement suggested by the AlignMed company. This study does not disprove the claims that the AlignMed Company has made in regards (65) to the effectiveness of the brace, but further studies must be done to determine whether the changes seen are a result of corrective straps or merely the result of the proprioception caused by wearing a compressive shirt.

Future Research:

Future research should investigate different the brace applications described by the bracing company and how they affect FHRSP and EMG activity. Future research should compare different strap applications to just wearing the compression shirt portion of the brace without the straps applied. This was not done in this study in an effort to blind the primary researcher to the group that the subject was in. Future research should also evaluate different exercises which may better engage the specified muscles such as the push up plus for the serratus anterior. Future research should investigate the cumulative effects of wearing the brace while performing exercises to determine whether or not changes continue to occur. This could be done through an intervention program lasting several weeks I which the subjects wear the brace while performing various daily or weekly rehab exercises. Not only would this better help to determine the long-term effects of the brace, but it would further help to determine clinical significance since this is the manner in which the brace would be used clinically rather than wearing it just once (68) and expecting large changes. It would also be useful to include a survey in future research to determine whether the patient feels that the brace is improving posture, the comfort level of the brace, whether the brace felt different after exercises compared to before. This would be especially useful in studies comparing a treatment group to a sham group as this one did to determine if patients feel they are receiving a treatment and how that affects results. Further investigation should be done to determine whether or not it is the strap application or the proprioceptive effects of the brace that caused changes in the FSA and muscle activity for the upper, middle, and lower trapezii.

Conclusion:

In conclusion, this study found that there were significant changes in FSA and upper, middle, and lower trapezii EMG activity caused when wearing the S3 brace compared to not wearing it. However, this study did not find significant differences in the treatment group compared to the sham group for FHRSP or EMG activity in any muscles. This indicates that the specific strap application may not be the cause (or at least not the sole cause) of the changes in posture and EMG activity. This is not to say that use of the brace is ineffective or unwarranted, but future studies should be performed to further determine the effectiveness of the brace in improving posture and EMG activity.

TITLE: Measuring the Effects of a Posture Shirt of Ergonomic Positioning at the Dental Chair

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Research Article

Measuring the Effects of a Posture Shirt on Ergonomic Positioning at the Dental Chair

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Abstract

There are numerous studies verifying the correlation between poor posture and musculoskeletal disorders in dentistry (MSDs). The purpose of this study was to determine the short-term effects of wearing an elastomeric garment (Posture Shirt®; AlignMed, USA) and clinician posture. The scope is specific to the back, shoulders, head and neck. Methods and Materials: six subjects were videotaped performing an identical restorative procedure wearing a fitted tee shirt and subsequently one week later in a posture shirt after wearing the posture shirt during the previous week. Their posture wear time during the week was logged. The video data initially and after wearing the posture shirt was analyzed with portions of Branson's Posture Assessment Instrument (BPAI). Results: Benefits were not significant when evaluating all planes of movement (transverse, frontal and sagittal). One of the six subjects improved from harmful to acceptable (16.6%). In the sagittal plane only, four of the six subjects improved from compromised to acceptable (66.6%). Conclusion: It is hoped this research will inform the dental practitioner of an option that may improve their back to front posture for trunk, shoulders, head and neck when performing dental treatment.

Keywords: Ergonomics; BPAI; Dentistry; MSD

Introduction

There have been few studies on the effects of posture shirt wear with positive ergonomics and musculoskeletal pain relief. The Influence of a Dynamic Elastic Garment on Musculoskeletal and Respiratory Wellness in Computer Use by Decker, Gomas, Narvy and Vangsness [1] is the only published literature that touches on the subject. There have been no studies on posture shirt effectiveness in the dental field to date.

The most prevalent regions for pain in dentists have been shown to be the back (36.3- 60.1%) and neck (19.8-85%) [2,3]. Several studies have indicated that back, neck as well as shoulder pain as major problems among dentists. Finsen et al. (1997) [4] reported 65%; and Chowanadisai et al. (2000) [5] reported 78%.

Musculoskeletal disorders (MSDs) are a major cause of early retirement among dentists [6].

*Musculoskeletal disorders (29.5%)

*Cardiovascular disease (21.2%)

*Neurotic symptoms (16.5%)

*Tumors (7.6%)

*Diseases of the nervous system (6.1%)

Dentistry requires strong endurance of the shoulder girdle stabilizing muscles for strength and range of arm motion. The middle and lower trapezius muscles supply the majority of this support. However, they tend to fatigue quickly when the clinician works with their head in a forward position and have a rounded upper back.

When these muscles tire, the upper trapezius, scapula and upper rhomboids must then compensate and become overworked and tight, resulting in a decreased blood supply and oxygenation to these tissues (Figure 1).

"Continual work in front of and below the operator's eye level leads to a forward head and rounded shoulder posture. This can cause weakening and elongation of the stabilizer muscles of the shoulder blades (middle and lower trapezius, rhomboid and serratus anterior muscles). As a result, the shoulder blades tend to move away from the spine, leading to rounded shoulder posture. Meanwhile, anterior "mover" muscles (scalene, sternocleidomastoid and pectoralis) become short and tight, pulling the head forward" [7].

Posture affects the ability of the dental clinician to reach, hold, and use equipment. It also influences how long the task can be performed without suffering adverse health effects. Over 3 time, any position will eventually become fatiguing and may lead to MSDs. An MSD is characterized by presence of discomfort, disability or persistent pain in the joints, muscles, tendons, and other soft parts, caused or aggravated by repeated movements and prolonged awkward or forced body postures [7]. It is also important to note that the weight of the head greatly increases as it tilts forward, placing increased neck stress on Cl-C7 [8] (Table 1).

For dentists to perform effectively, they need to have a posture position that allows them to achieve optimum access, visibility, comfort, and control at all times [9].

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RESEARCH HYPOTHESIS

To determine the short-term effects of wearing the Posture Shirt " with subjective assessments of posture, including head, neck, Shoulder and back. It is a garment with an anatomic matrix of bands, panels and seams, collectively referred to as NeuroBands". The company describes the shirt as wearable therapy to retrain muscles and improve muscle tone, performance, posture, poise and reduce pain.

Table 1:

Position	Neutral	15°	30°	45°	60 °	90°
Force To Cervical Spine	10-12lbs.	27lbs.	40lbs.	49lbs.	60lbs.	Not Measurable
The weight seen by the spine increases when flexing the neck at varying degrees. An adult head weighs 10-12 pounds in the neutral position. As the head tilts forward the forces seen by the neck surges to 27 pounds at 15 degrees, 40 pounds at 30 degrees, 49 pounds at 45 degrees and 60 pounds at 60 degrees.						

AREA	CRITERIA
Trunk (Front to back to back angulation)	A: <20 degrees 1 Point; C: >20-<45 degrees 2 Points; H: >45 3 Points
Trunk (Side to side angulation)	A: <20 degrees 1 Point; C: >20-<45 degrees 2 Points; H: >45 3 Points
Trunk (Rotation between planes)	A: <20 degrees 1 Point; C: >20-<45 degrees 2 Points; H: >45 3 Points
Shoulder Assessment	A: Relaxed 1 Point; C: Slumped Forward 2 Points
	A: Level with trunk 1 Point; C: One or both elevated above line of trunk 2 Points

A: ACCEPTABLE C: COMPROMISED H: HARMFUL

Table 2: Modified Branson's Posture Assessment Instrument.

Figure 2: Tee Shirt – Back.

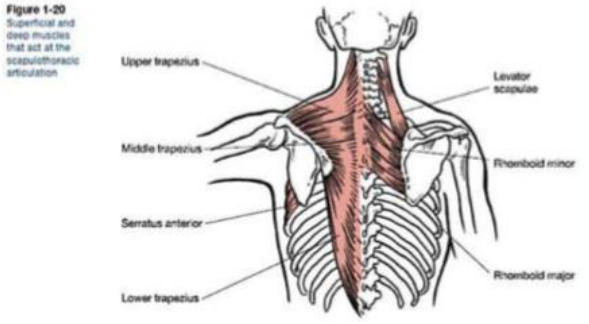

Figure 1: American Council on Exercise, May 2017.

Figure 3: Posture Shirt – Back.

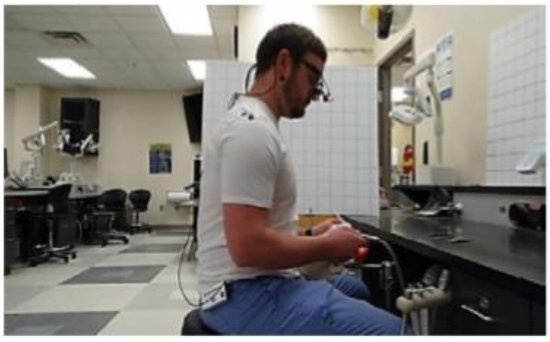

Figure 4: Tee Shirt – Back.

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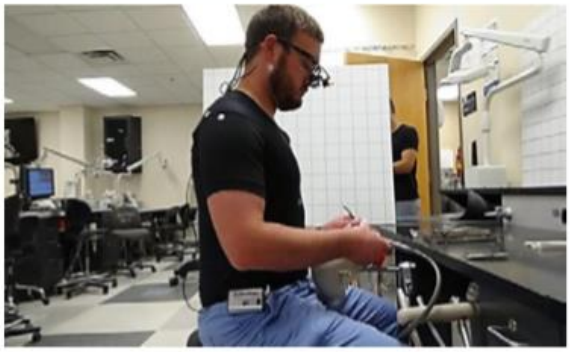

Figure 5: Posture Shirt – Side.

Figure 6: Posture Shirt –Side with angulation measurements.

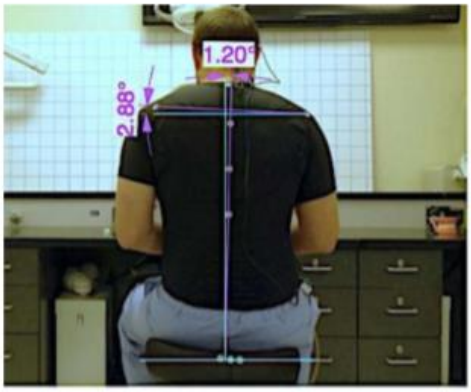

Figure 7: Posture Shirt - Back with angulation measurements.

Table 3:

TOTAL POINTS BPAI :	ACCEPTABLE: <18,	COMPROMISED : 19-30,	HARMFUL 31-48
SUBJECT SCORE	TEE SHIRT (TS)	POSTURE SHIRT (PS)	REDUCTION IN
1300	25 (C)	21 (C)	16.00%
1301	31 (H)	18 (A)	42.00%
1302	33 (H)	21 (C)	36.40%
1303	24 (C)	21 (C)	12.50%
1304	24 (C)	21 (C)	12.50%
1305	29 (C)	20 (C)	31.00%

Results

Table 4:

TOTAL POINTS BPAI :	ACCEPTABLE: <=9	COMPROMISED : 10-18,	HARMFUL 19-30
SUBJECT REDUCTION IN SCORE	TEE SHIRT (TS)	POSTURE	SHIRT (PS)
1300	14 (C)	12 (C)	14.30%
1301	17 (C)	9 (A)	47.10%
1302	18 (C)	12 (C)	33.40%
1303	11 (C)	9 (A)	18.20%
1304	12 (C)	9 (A)	25.00%
1305	13 (C)	9 (A)	30.80%

METHODS AND MATERIALS

Participants: The pool of participants for the feasibility study consisted of three third and three fourth year predoctoral dental students at the UMKC School of Dentistry. Exclusion criteria for subjects included those with congenital musculoskeletal disorder, rheumatoid arthritis, past history of MS surgeries, and current pregnancy. The protocol for the study was approved by an institutional review board (IRB 16-327)

Visit 1: A dental school simulation of laboratory work station was utilized for the study. The subjects were given a size appropriate white tee shirt. They adjusted the operator's stool and typodont head to a a comfortable working position. Colored Velcro dots were used to mark the right tragus of the ear. On the tee shirt, the dots were placed at the apex of the right and left deltoid muscles, spine of the scapula adjacent to the deltoids C7, T6, and L3 vertebrae.

Velcro dots marked the Dr.'s stool horizontally (Figure2,4). The subjects then performed a mesiolingual CI II composite operative preparation procedure on the maxillary right central incisor on a typodont head affixed to a stand. Subjects who normally wore loupes in the clinic were asked to wear them. Subjects were videotaped and photographed from the back and side over a five minute time period from the commencement of the tooth preparation. Posture measurements still photos were captured at intervals of 0, l, 3 and 5 minutes during the 5-minute recording span.

The neck, trunk and shoulders were measured at variance from neutral posture. Vectorworks'' was utilized for angulation measurements derived from the video and still photography captured during each session.

The subjects then changed into their size appropriate Posture Shirts •. Colored Velcro dots were then used to mark the right tragus of the ear. On the posture shirt, the dots were placed at the apex of the right and left deltoid muscles, spine of the scapula adjacent to the deltoids, C7, T6, Tl2 and L3 vertebrae (Figure 3,5). The subjects were instructed to wear the posture shirt• daily during dental school- related activities for the next seven days.

They were dispensed a wear log and asked to record the hours and days the shirt was worn and to bring the log with them to their next scheduled visit. They were asked to wear the shirts a minimum of 6 hours per day for 4 days.

VISIT 2: The subjects returned wearing their pre-marked Posture Shirt . They then performed the same procedure as Visit 1 - a mesio- lingual CI II composite operative preparation procedure on the maxillary right central incisor on a typodont head affixed to a stand. Subjects were video taped from the back and side over a five minute time period from the commencement of the tooth preparation. Still photos were captured at 0, 1, 3 and 5 minutes.

Once the angulation measurements were derived (Figure 6, 7), a modified Branson's Posture Assessment Instrument(BPAI) [10] was utilized to calculate the point totals for the head/neck, shoulders and trunk for each subject (Table 2). The hips, head/neck side to side as well as rotation between planes and wrist were omitted due to lack of relevance to areas of the elastomeric shirt that are measurable.

RESULTS

Utilizing the modified BPAI for the Trunk, Shoulders and Head/Neck in the Sagittal, Frontal and Transverse Planes for the 6 subjects, one subject improved from Harmful to Acceptable (16.6%), one from Harmful to Compromised and the other four remained Compromised, with decreases in BPAI numerical score. The average percent improvement, regardless of BPAI criteria score was 25.07 % (Table 3).

Since the Posture Shirt • did not appear to significantly improve the BPAI criteria for Trunk Side to Side, Rotation Between Planes and Shoulders Level with Trunk, a second analysis was performed utilizing only the Sagittal Plane for movement: Trunk (Front to Back), Head/ Neck (Front to Back) and Shoulders (Relaxed or Slumped Forward). Four of the 6 subjects (66.6%) improved from Compromised to Acceptable. The average percent improvement, regardless of BPAI criteria score was 23.0 % (Table 4).

The six subject's average wear of the Posture Shirt • was 5.66 days totaling 42.46 hours with 6.07 hours of wear per day.

CONCLUSION

With heavily booked schedules, complex dental procedures and patient management issues, it is easy to overlook proper clinician positioning. It would appear that wearing the Posture Shirt • shows promise in improving a dentist's posture for trunk, shoulders, head and neck in the sagittal plane when performing dental restorative procedures. This elastomeric garment shows potential in having positive results for operator's posture, comfort and career longevity. It is a passive method to activate, reprogram and provide a more neutral muscular posture. This can lead to improved quality for patient treatment, a healthier way to practice, and potentially lessen future musculoskeletal issues. A pilot study with a larger subject pool over a greater length of time is recommended to further substantiate findings.

TITLE: The Effects of a Posture Shirt on Throwing Velocity, Throwing Accuracy and Blood Flow in Professional Baseball Pitchers: A Pilot Study

INTRODUCTION

- Tight-fitting, high-tech fabric "compression garments" and "performance apparel" are popular among athletes but have little research validation
- Preliminary research suggests that benefits of such garments are sport-specific rather than global improvements in performance.
- Elite baseball pitchers and similar overhead athletes, could potentially see benefits from an emerging technology using touch and tension on muscle tissue to facilitate performance and recovery in lieu of compression on the skin
- Specialized garments that mount anatomic specific elastomeric bands within a form-fitting garment to facilitate good posture.

RESULTS

- Increase in velocity of 1.47 miles per hour attributable to the PS (p=.079)
- Pitchers tended to show improvements in throwing accuracy with the posture shirt (p=.147).
- PS did not decrease accuracy (p=.147)
- The PS significantly affected many vascular measurements
- Brachial artery diameter and flow velocity both increased with the PS by approximately 3.3% (p<.001 and p=.02, respectively).

SUMMARY

- 1500 pitches
  - 750 with posture shirt
  - 750 without posture shirt
- Improved velocity
- Improved accuracy
- Statistically improved vascular blood flow
- Statistical significance between PS and the control shirt was obtained in small sample size suggests vascular physiology of the pitching motion is profoundly altered with PS.
- The results demonstrate that the posture shirt increased average pitch velocity within a group of elite baseball pitchers.
- The effect was greatest in the first inning.
- Pitchers tended to show improvements in throwing accuracy with the posture shirt.

CONCLUSION

- Pitch velocity was improved with the posture shirt
- Pilot study demonstrates that a form-fitting posture shirt significantly affected blood flow characteristics in the pitching arm.
- The question to be determined is value in the effectiveness and stamina of a major league pitcher.

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TITLE: The Effect of a Postural Enhancing Device on Sub-Acromial and Coracohumeral Distances during Shoulder Abduction: A Bi-Plane Fluoroscopy Imaging Study

ABSTRACT

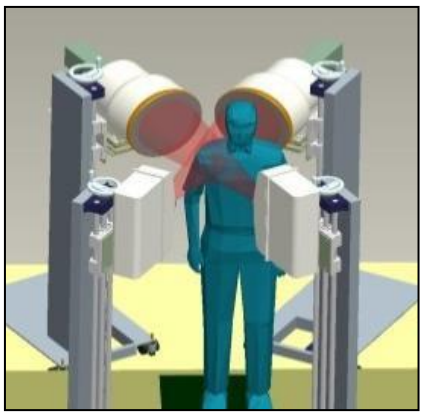
Soft tissue impingement of the shoulder occurs in two critical areas; the subacromial space and coracohumeral space, areas often associated with shoulder dysfunction, pain and injury. Impingement has been described in several different anatomic locations and can be affected by gleno-humeral positioning. Sub-acromial and sub-coracoid impingement have been described as possible sources of pain and dysfunction in overhead athletes or as a result of repetitive motion stress and postural dysfunction. A postural enhancing device (PED) may alter glenohumeral positioning subsequently having an effect on impingement patterns. The purpose of this study was to determine the effect of a PED on the sub-acromial and coracohumeral space in healthy subjects during shoulder abduction and adduction.

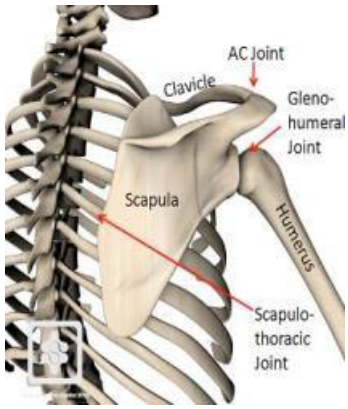
METHODS

Five males, who had full shoulder range of motion and strength and no prior surgery in their tested shoulders participated in this study. After informed consent, the participants obtained a shoulder CT and performed shoulder abduction with and without a PED (Posture Shirt, AlignMed Inc, Santa Ana, CA) while being filmed in a dynamic biplane fluoroscopy system. 3D models of each shoulder were generated and the minimum sub-acromial and coracohumeral distances were measured (accuracy<1mm) at 0, 45, 90, 135 and 180° of shoulder abduction with and without a PED. These distances were contrasted with a 2-way repeated measures ANOVA and Bonferroni post-hoc tests (p=0.05).

RESULTS

Coracohumeral distance was influenced by the PED ($F_{1,4}$=8.1, p=0.047) but not by the position of shoulder abduction ($F_{4,16}$=2.1, p=0.132). Coracohumeral distance was on average 13% greater with the PED (PED, 10.0 ± 0.7 mm; No PED, 8.9 ± 0.8 mm). Sub-acromial distance was influenced by the PED ($F_{1,4}$=10.1, p=0.034) and by the position of shoulder abduction ($F_{4,16}$=16.8, p<0.001). Sub-acromial distance was on average 29% greater with the PED (PED, 3.7 ± 1.2 mm; No PED, 2.9 ± 1.1 mm). Compared to the arm at the side, the sub-acromial space was smaller at 90, 135 and 180° of abduction during both PED conditions (all p<.05).





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TITLE: The Effects Of A Posture Shirt® On Rotator Cuff Muscle Strength

ABSTRACT

The shoulder does not function in isolation. All functions of shoulder strength, velocity, and balance are related to scapula position and rhythm. The Shoulder/Scapula is a link in a kinetic chain and a weakness in the chain affects the energy, force, and velocity that are generated. Manufacturers of sports performance apparel make enhancement claims of improved circulation, clearance of blood lactate, reduced muscle oscillation, augmented proprioception and enhanced body mechanics. The purpose of the study was to determine if the application of a form fitting garment with specific tensile properties (Posture Shirt®, AlignMed Inc., Santa Ana, CA) designed to enhance scapular positioning would result in demonstrable improvements to rotator cuff strength compared with a commercial compression shirts or no shirt at all.

METHODS

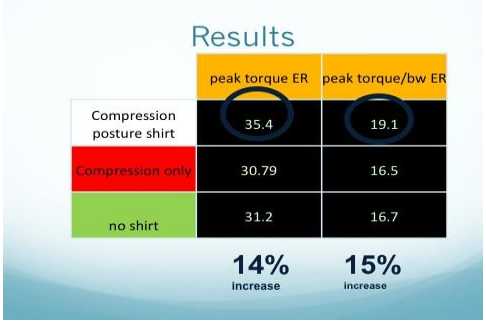
1. Investigational Review Board (IRB) approval
2. 14 male subjects, 24-44yo (32.5 mean). Recruitment through male clinic employees
3. Only dominant, uninjured shoulders tested
4. No prior shoulder, elbow, cervical spine surgery
5. Each subject endured three separate Biodex test sessions done in random order. Fatigue controlled by 3 days of rest between sessions
6. Strength tests measuring standard isokinetic outcome measures were recorded using a Biodex® System 3 isometric testing unit at the Kerlan-Jobe Sports Medicine Clinic, Los Angeles, CA.

RESULTS

Most testing parameters showed some differences between all three shirts
No statistical difference between the No Shirt and Under Armour® compression shirt alone. The Posture Shirt outperformed in shoulder strength when compared side by side to No Shirt and a popular compression garment (Under Amour®). Greatest differences were measured in peak torques in external rotation.

CONCLUSION

A form fitting Posture Shirt with variable elastic tension showed a measurable difference in comparable testing with No Shirt and a Compression Shirt. We conclude that the compressive component of sports garments would do little to alter peak shoulder strength, whereas a Posture Shirt garment that enhances scapular positioning has a beneficial effect. Further testing essential to corroborate findings.



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TITLE: **The Effects of the S3 for Shoulder Pathologies**

S3 EFFECTIVE FOR SHOULDER PATHOLOGIES

-Dr. Steven Smith

Introduction:

Scapular function and its role in shoulder biomechanics has gained increased notoriety in the pathogenesis of shoulder dysfunction over the past years. Both static and dynamic aspects of shoulder motion depend on a properly functioning and positioned scapula. In particular, undo strain is placed on the rotator cuff with dysynchronous scapular motion.

The spine/scapula stabilizer system, S3 (AlignMed, Inc. Santa Ana, CA), is designed to help restore normal shoulder kinematics. The S3 attempts to achieve this objective with a Velcro strapping system coupled with proprioceptive padding and mesh vest to allow biofeedback to patients. This neural feedback, along with the vest's innate postural support, could potentially emphasize proper shoulder muscular mechanics. Uhl, Kibler, et al. evaluated the immediate dynamic effects of shoulder rotation in this brace system and found decreased internal rotation and increased posterior tilt of the scapula in 10 normal subjects[1,9], but the measurement of strength with and without the brace has not been studied. Thus, the purpose of this study is to measure internal and external shoulder strength in subjects with normal shoulders with and without the S3 brace.

Materials and Methods:

The investigation was approved by our institutional review board. Informed consent was received from the subjects. The study design consisted of fourteen males (24-40 years, mean 32.5 years) without a previous history of shoulder, elbow, or cervical spine surgery, discomfort, or weakness. A Biodex dynamometer 7 was used to record data in an isokinetic resistance mode. A physical therapist experienced with the Biodex was used.

Results:

At both testing speeds the means for Peak Torque and Peak Torque to Body Weight increased significantly for internal and external rotation. At 180 deg/sec, internal rotation peak torque increased from 42.2 to 53.7 ft-lbs ($p = .0003$). External rotation peak torque at 180 deg/sec increased from 29.8 to 36.07 ft-lbs ($p = .006$). At 300 deg/sec, internal rotation peak torque increased from 37.2 to 48.5 ft-lbs ($p = .005$) and external rotation peak torque increased from 27.1 to 34.7 ft-lbs with the use of the brace ($p = .007$). When peak torque was normalized to body weight, the same pattern of significance was seen.

TITLE: The Effects of Anatomic Enhancing Garments on Knee Performance and Injury During Skiing

DISCUSSION

There are nearly 30 million individuals engaged in downhill skiing in the United States every year. Injury rates currently range between 3.7 and 9.1 injuries per 1000 skier days, and there has been a well-documented increase in the number of trauma cases and fatalities associated with this sport (Langran & Selvaraj, 2002; Rossi et al., 2003). Significant technological improvements in bindings and boots over the past decade have surpassed advances in knee support and traumatic knee injuries are at a higher rate now than 20 years ago (Pecina 2002). The human musculoskeletal system is a sensitive and complex process that involves both motor and sensory processes; these functions are reduced with the onset of fatigue. The need for injury prevention technology is compounded by the fact that the majority of traumatic lower extremity injuries are due to muscular fatigue and performance errors rather than equipment issues (Girardi et al., 2010). Normal equilibrium is defined as the ability to maintain the center of body mass over its core support, or dynamic postural stabilization. During skiing, dynamic posture is critical for optimal performance. If one body segment or link in the kinetic chain is out of sync, movement efficiency is reduced thereby commencing early fatigue and the probability for injury. Postural inefficiencies thereby render the joints and the upper body more susceptible to damaging stresses. Hence technology that would influence dynamic posture would reduce muscle fatigue and strain on joints and could prove an effective approach to ski injury prevention.

STUDY PARTICIPANTS

1) 30 ski professional from Vail Resorts

2) Majority of the participants were skiers that taught skiing

3) The Participants had knees that were on average below normalfunctioning

4) 20% of the Participants had knee arthritis

5) All participants were provided knee support tights and an EBA® Posture Shirt (Evidence Based Apparel, Santa Ana, CA www.alignmed.com).

INVESTIGATIVE TOOLS

Three standardized questionnaires, the IKDC, WOMAC and VAS, were electronically administered via email over three consecutive weeks of skiing (week 1, 2, 3), and at the end of the season while wearing or not wearing the knee support tights and Posture Shirt.

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METHOD

IKDC. The IKDC is a knee specific, self-evaluation questionnaire consisting of 18 questions with scores ranging from 0 (poor function) to 100 (excellent function). This validated form (Higgins et al., 2007) was used to describe the general knee status of the participants prior to testing.

WOMAC. The WOMAC is a self-evaluation questionnaire used to measure dysfunction and pain of the lower extremities by assessing 17 functional activities, five pain related activities and two stiffness categories (Bellamy et al., 1988). The WOMAC has been shown to be a robust measurement tool for assessing therapeutic interventions that are intended to enhance knee function; hence this questionnaire was administered for the first 3 consecutive weeks of testing and at the end of the season.

VAS. The participants were assessed for fatigue, pain and stiffness with a 15 cm visual analogue scale (VAS). Electronically, this scale consisted of 15 circles where the participant selected a circle that best answered the personal sensations experienced during a particular time period. The VAS provided a quantitative metric of muscle fatigue during and after skiing; as well as knee pain and stiffness induced from a normal week skiing. This questionnaire was also administered for the first 3 consecutive weeks of testing and at the end of the season.

SUMMARY OF RESULTS

1. Knee Pain, Stiffness and Fatigue were improved when skiing with the EBA® Garments with Neuroband Technology.
2. Improvements in Knee Pain, Stiffness and Fatigue were Greatest when Skiing with both the EBA Knee Support Tights and Posture Shirt®
3. Knee Pain, Stiffness and Fatigue show potential for dramatic long term Improvements for the participants with Knee Arthritis
4. Standard Compression Garments were Inferior to the Anatomical Garments during Skiing
5. Knee Injuries Were Reduced by 43% at Vail Resorts for the 2010-2011 Season and may translate into a Savings of Greater than $1.48 million.

Compared to the 2009-2010 ski season, total body injuries were reduced by 10% in the 2010- 2011 ski season. Further, injuries to the legs, and particularly the knees were reduced by 28% and 43%, respectively. In the Knee Support Tights and EBA Posture Shirt Study none of the participants reported that they were injured. Statistically, it is likely that these garments contributed to the reduction in the total injuries for Vail Resorts Ski Instructors.

CONCLUSION:
In conclusion, skiing with the Knee Support tights and the EBA Posture shirt dramatically enhanced knee function, pain and stiffness during skiing. These effects were immediate and continued to improve throughout the last two months of the ski season. Concurrently, lower and upper body injuries requiring medical attention and lost time from work were reduced compared to the previous season at Vail Resorts. Collectively, these data are interpreted to indicate that dynamic posture awareness and support was provided by the anatomical garments and promoted joint alignment with balanced knee joint stress.

Additionally, 10% of the participants reported to normally wear compression tights while skiing. For this subgroup, we measured the baseline values of fatigue, knee stiffness and pain when skiing with compression garments; and determined how these variables changed in the short term and long term while skiing with the anatomical garments. Although muscular recovery after skiing was comparable between garments, the anatomical garments were far superior during skiing performance. These results indicate that the form fit of the anatomical garments surpassed the effects of those wearing compression garments alone and therefore suggest that the NeuroBand™ touch and tension technology was primarily responsible for enhanced skeletal alignment, muscular coordination, and body awareness. Skiing with the knee support tights and Posture Shirt and Knee Support System may be an easy and cost effective remedy to ski injury prevention and a means to promote skiing for populations with knee arthritis.

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TITLE: The Effectiveness Of A Scapular Brace On Scapular Kinematics. In American Society of Shoulder and Elbow Therapists

OBJECTIVES

Initial conservative treatment of common shoulder injuries focuses on correcting posture and establishing scapular neuromuscular control. This study evaluated a new Spine and Scapula Stabilizing brace (S3) on scapula kinematics at rest and during active arm elevation.

METHODS

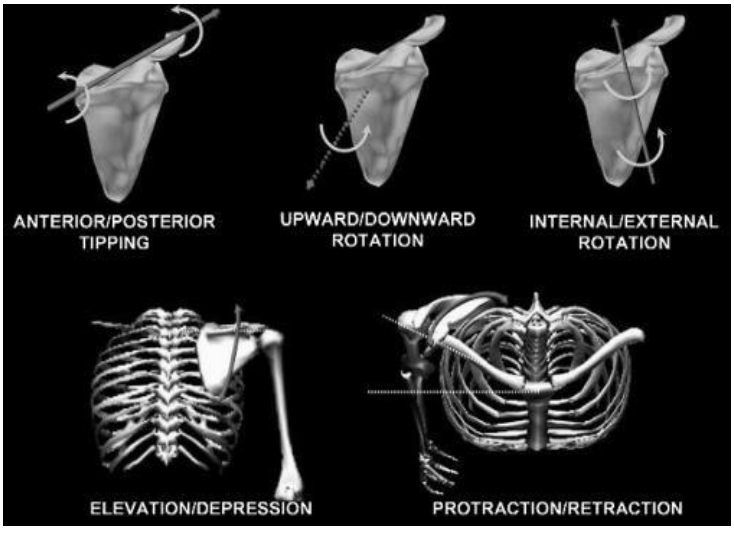
30 volunteers (age 31 ± 10 years, ht 1.7 ± .08 m, mass 75 ± 14 kg), fifteen injured subjects with scapular dyskinesis and fifteen healthy subjects took part in the study.

RESULTS

Repeated measure ANOVAs revealed that during resting posture scapular Posterior Tilt (PT) increased significantly by 4 degrees and UR increased by 2 degrees while wearing the brace. Evaluation of the S3 effect during active elevation revealed that the S3 significantly increased PT by 3 degrees in the first and last 30 degrees of elevation ($P < 0.05$). The brace decreased UR in the dominant arm by 4 degrees at 90 degrees of elevation, while increasing UR in the non-dominant arm by 2 degrees in the first and last 40 degrees of elevation ($P < 0.05$). The S3 also decreased IR by 3.5 degrees during the lowering phase of elevation ($P < 0.05$).

CONCLUSIONS

This is the first evidence that a garment may affect scapular kinematics at rest and during motion. The primary affect appears to be in the lower ranges of motion. The increased PT and decreased IR from wearing the brace may assist the scapular muscles in controlling scapular motion. Future research needs to address benefits to patients with shoulder pathologies and those at risk for developing injuries.



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