Nutritional Considerations for Transgender Patients

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COMMENTARY

Athletic trainers (ATs) serve as a key resource regarding nutritional information for active patient populations. Both in traditional and emerging settings, the ATs role often includes educating patients on proper nutrition, both for enhancing sport performance and maintaining healthy lifestyles. According to the Commission on Accreditation of Athletic Training Education (CAATE) 2020 Standards, ATs must practice in collaboration with other health care and wellness professionals. One vital partnership among health care providers (HCPs) is that of ATs and nutrition professionals. Personalized nutrition, particularly in athletic populations, has been used by dieticians (RD) and nutritionists (unregulated nutrition specialist) in an effort to enhance performance and improve health outcomes.[1] It is imperative for ATs to possess a level of knowledge to appropriately answer patient questions, provide guidance and recommendations, and collaborate with other professionals in this area. Recently, the Joint Position Statement by the American College of Sports Medicine, the Academy of Nutrition and Dietetics, and the Dietitians of Canada, highlighted the importance of developing nutritional interventions that take into consideration the uniqueness of each individual, to improve health outcomes.[2] The recognition and knowledge about unique nutritional considerations for patients is crucial in sports medicine. More importantly, when treating patient in the LGBTQ+ community, ATs and HCPs need to be aware of the contributing factors that can influence nutrient absorption. Athletic trainers have a unique opportunity to be a resource for nutritional-related concerns for this population, and specifically for those who identify as transgender. LGBTQ+ patients face disproportionately high levels of food insecurity, obesity, and disordered eating while also facing barriers to accessing affirming and knowledgeable healthcare providers.[3] The purpose of this commentary is to provide awareness and inform ATs and other HCPs about the unique nutritional considerations for patients who identify as transgender. Further, the commentary will serve as a call to action for ATs and other HCPs to research and develop transgender specific nutritional recommendations as a mechanism to reduce health care disparities for this population.

Transgender individuals are people whose gender identity and/or gender expression differs from what is typically associated with the sex they were assigned at birth.[3] Patients who identify as transgender represent a growing and underserved population in the U.S., and the percentages of the general population that identify as transgender continue to increase.[4] As such, HCPs must become aware of the specific needs of this population. An important piece of transgender health care is the role of nutritional interventions in relation to hormone therapy, mental health and wellness, and chronic illness.

Historically, nutritional principles have been primarily focused on cisgender patients, those whose gender identity aligns with their assigned

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sex at birth.[3] As athletic training and other healthcare professions work towards providing patient-centered and culturally competent care, a foundational level of understanding in transgender health care is vital. As identities within athletic populations become more diverse, ATs must focus efforts on providing holistic healthcare, which may include developing nutritional guidelines

HORMONE THERAPY

In an effort to improve transgender individuals' access to quality nutrition care, it is important to first understand conditions for which this population is most at risk. Oftentimes, those who identify as transgender will undergo hormone therapy, and are at risk for adverse effects.[4] Testosterone therapy for transgender males (Assigned Female at Birth) may lead to weight gain, decreased lean body mass, decrease in lipid mass, increased LDL cholesterol, decreased HDL cholesterol, and increase hemoglobin and hematocrit.[4] Additionally, long-term effects of testosterone may significantly reduce or eliminate the menstrual cycle, impacting iron needs for that patient. For transgender females (Assigned Male at Birth), estrogen therapy may present with weight gain, an increase in HDL cholesterol, a decrease in LDL cholesterol, and increased bone mineral density.[4,5] For transgender adolescents, hormone therapy may impact bone health, where supplementation with calcium and Vitamin D may be warrented.[4] In order to reduce the impact of the negative side effects, ATs may intervene and collaborate with nutritionists and dieticians to implement nutritional interventions that best align with the patients' needs.

In patients taking testosterone therapy, we often see an increase in LDL cholesterol, a cessation of menstruation, weight gain, and increased blood viscosity[13], which may require advising patients to limit saturated fats and address other fatty meals with alternatives to decrease LDLs.[6] Due to the increase in hematocrit and hemoglobin, fluid retention may occur.[7] Monitoring the intake and elimination of liquids may be important when advising appropriate hydration before, during, and after activity. Weight gain, another side effect of testosterone therapy, may be managed by understanding the demands of a patient's activity and advising appropriate weight gain, loss, or maintenance strategies. Transgender patients may also have a decrease or cessation in menstruation, warranting a conversation regarding bone health imperative. Athletic trainers should encourage the increase in calcium and vitamin D with dairy-rich foods, adequate sun light, and if necessary, supplements among this population. For transgender patients prescribed estrogen therapy, weight gain, increases in HDL and decreases in LDL, increases in bone mineral density, as well as cardiovascular side effects are common concerns. In addition to monitoring and encouraging physical activity for patients on estrogen therapy, nutrition interventions can also be implemented into their specific treatment plan to reduce potential cardiovascular pathologies.

A key issue surrounding nutrition assessment of transgender people is that nearly all equations used by dieticians and nutritionists are gendered.[8] Calculating the appropriate amount of nutrients a transgender person needs is multifaceted, as oftentimes transgender people are taking hormones and have modified nutritional needs due to physiological changes, causing inaccuracies in estimating energy expenditure rates. The premise of nutritional needs being calculated solely on gender has also been explored by Rahman and Linsenmeyer.[8] In their study, the authors note differences in gender-specific diet and nutrition related considerations have only compared cisgender heterosexual males vs cisgender heterosexual females.[8] Furthermore, a study by Smalley, et al[8], discussed significant variations in health risk behaviors within each subcategory of sexual orientation, which highlights the need for ATs and other HCPs to further explore the dietary needs of sexual minorities rather than through group membership.[8] Historically, patients who are viewed in a minority group, or a category that is differentiated and often discriminated against, have negative health outcomes and face additional barriers to health care as compared to the majority, further suggesting the need to develop nutritional guidelines that are not limited by the confines of binary gender.

MENTAL HEALTH AND WELLNESS

Additional considerations for transgender patients should also focus on mental health and wellness, and the link between diet and more positive mental health outcomes.[2] The etiology of eating disorders in the transgender population is not clearly delineated, as relationships among sexuality, gender identity, body image, and eating disorders are complex.[8] According to the National Transgender Discrimination Survey, those who are transgender have an increased risk of eating disorders and an increased risk of abusing diet pills because of social norms.[9] This increased prevalence affects transgender females disproportionately compared to transgender males, and is related to feeling the need to meet ideal body standards, emotional trauma from the process of accepting gender identity, and stress from social stigma and discrimination.[10]

Research exists to suggest weight gain is a side effect in the transgender population in those individuals undergoing hormone therapy.[8] Anti-androgen and estrogen therapies cause an increase in body fat, and a decrease in muscle mass.[8] Diemer et al[10] demonstrated a higher rate of self-reported eating disorders, vomiting, use of diet pills, and use of laxatives among transgender college students compared with their cisgender counterparts. In addition, transgender individuals have high rates of binge eating, fasting, and vomiting for weight loss.[10] Differences in health outcomes exist between transgender patients and their cisgender counterparts; however disparities between transgender women and transgender men propose unique considerations for individualized healthcare.[11] These disparities, coupled with the knowledge gap regarding best practices surrounding caloric needs of transitioning individuals, lends to additional barriers for transgender individuals receiving individualized nutritional planning.[10]

CHRONIC ILLNESS

Patients who identify as transgender may be at increased risk of chronic illness, like HIV or Cardiovascular disease, which can impact their specific nutritional if their transition process includes the use or hormone therapies.[12] Human Immunodeficiency Virus (HIV) and cardiovascular disease are two of the conditions most researched within the transgender population; however, other chronic illnesses impact the patients' body, including type 2 diabetes, cancer, obesity, depression, asthma, chronic obstructive pulmonary disease, and chronic kidney disease.[13] The literature suggests that transgender people may be at higher risk for cardiovascular disease due to exposure of oral ethinyl estradiol, a common hormone prescribed to transgender females.[13]

A substantial amount of literature links dietary factors to increased risk of chronic disease.[2,7,9-10] Although this correlation is well documented, there is a gap in knowledge regarding the nutritional needs and interventions to decrease the risk of chronic disease, specifically in the transgender population. Healthcare providers should understand how these illnesses have the potential to affect patients who identify as transgender, and more research should be completed to evaluate what nutritional interventions can aid in the healing process of such diseases.

A need exists for understanding physiological changes within the bodies of patients who identify as transgender. Understanding the impact of hormone therapy, mental health and wellness, and chronic disease are three main influencers to consider when educating and developing individualized nutritional care for patients who identify as transgender.

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Body Tempering and its Effect on Ankle Dorsiflexion and Power

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ABSTRACT

Body Tempering (BT) is a newer myofascial release (MFR) technique that is used by athletes and healthcare professionals. The effects of BT are stated to be similar to foam rolling (FR) and other MFR techniques, but there is minimal research assessing the effects of BT on power and range of motion (ROM). The purpose of this study was to determine the effect of BT on ankle dorsiflexion ROM and power, as well as to compare the effects of BT to traditional FR. Twenty college-aged participants (10 males-10 females) were tested before and after intervention on three measurements of the broad jump (single-leg and double-leg) and weight bearing lunge test. Week one, each participant was randomly assigned to a 30-second treatment (BT or FR) performed on both calves, simultaneously, at a pace of 1 pass every 2 seconds. Week two, the treatment that was not received in session one, was administered. Paired sample t-tests between post-intervention and baseline measurements, as well as BT and FR showed statistically significant differences in FR and BT between pre and post single-leg jump averages for the left leg (FR-Pre: 93.22 cm, Post: 96.77 cm; p = .046) (BT-Pre: 94.53 cm, Post: 100.27 cm; p = .03) and the right leg (FR-Pre: 92.28 cm, Post: 99.38 cm; p= .007) (BT-Pre: 94.22 cm, Post: 99.83 cm; p= .036). Average ROM was only found to be statistically significantly different for BT on the right leg (Pre: 8.32 cm, Post: 8.80 cm; p = .035). There were no statistically significant differences in power (p= .293 -left leg; p= .894 -right leg; p= .362 -bilaterally) or ROM (p= .791 -left leg; p=.825 -right leg) when comparing the BT to FR interventions. When throwing, jumping, and running, single leg power is important, and these techniques could increase muscle performance needed during activity.

Key Phrases

Clinician-rated outcomes, manual techniques, College and University Patient population, body tempering, foam rolling

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INTRODUCTION

Functional movement and power are vital to an athlete's performance, but these qualities can be hampered by myofascial adhesions or decreased ROM of muscle and fascia.[1] To help the body perform at maximum capacity these myofascial adhesions need to be treated or released.[1] MFR is a process by which pressure is applied to tissue, supplying increased blood flow to the area and reducing myofascial adhesions once the pressure is released.[2] Fascia exhibits the phenomenon of thixotropy, in which it becomes more fluid or soft when it is moved or disturbed and more solid when it sits undisturbed.[3] Therefore, MFR allows tissue to relax and become more elastic.[1,4]

There are several MFR techniques, all of which can be divided into two categories: invasive and non-invasive. Invasive techniques include injection therapy and dry needling, and noninvasive techniques include massage, stretching, myofascial release, ischemic bands, Graston, deep tissue massage, neuromuscular therapy, therapeutic ultrasound, and laser.[5] The exertion of mechanical pressure that many of these techniques provide is theorized to decrease myofascial adhesions between tissue layers, improve muscular compliance and decrease muscle stiffness of the muscle fibers.[2] This in turn will be beneficial to performance and mobility. In previous studies, common techniques, such as dry needling,[6] ischemic bands,[7] Graston,[8] deep tissue massage,[9] and FR[1] have been shown to improve performance and mobility.

Body Tempering (BT) is a new, noninvasive tool used to accelerate sport activity performance and recovery by combating soft tissue restrictions similar to the effects of FR.[10] Although the effects of BT have been compared to FR, there is minimal research on the modality because it is so new. The manual provided at The Body Tempering™ certification course states, "While Body Tempering does not have a body of literature to directly support it as a specific method, its biomechanical effects are very similar to spinal/joint mobilizations, FR, Instrument Assisted Soft Tissue Mobilization, and soft tissue mobilization."[10] BT is performed using a heavy metal cylinder placed on the respective muscle(s), which is then passively rolled along the length of that muscle.[10] BT's main technique, Dynamic Tempering, refers to having a clinician roll out the muscle in a manner similar to FR but the device is laid on top of the body, allowing the body to relax instead of having activated musculature like when a patient completes FR their self.[10] With the use of the weighted cylinder and passive movement, it is stated in the manual that trigger points and myofascial adhesions cannot hold up to the BT cylinder like they could with less aggressive methods such as FR.[10]

Despite BT's increasing popularity with athletes in the NFL, NCAA, and Crossfit, there is minimal research available to support its use to improve performance and ROM compared to other MFR techniques.[10] Therefore, the purpose of this study was to examine the BT MFR technique's effectiveness in improving mobility and power. The secondary purpose was to examine the effects of the BT MFR technique compared to FR and a control session (warm-up only).

PARTICIPANTS

Twenty participants completed the study (10 males: 23.20 ± 3.68 years, 179.07 ± 9.06 cm, 86.86 ± 10.66 kg; 10 females: 22.80 ± 1.48 years, 161.8 ± 5.75 cm, 64.37 ± 6.12 kg). Inclusion criteria included male and female recreational athletes, defined as someone who exercises at the CDC recommended levels of 2-3 hrs/week on average, between ages 18-35 years old.[11] Participants were excluded if they had the following: a current lower extremity orthopedic injury, a lower extremity orthopedic injury in the previous six months, osteoporosis with or without unexplained non-traumatic fracture, lymphatic/fluid retention disorders, impaired sensation, COPD/lung pathology, blood pressure/cardiac issues, or rashes/skin deformities including but not limited to open wounds.[10]

Participants were recruited through email, posters, and word of mouth. This study was approved by The Institutional Review Board (IRB) of the XXX and all participants provided consent prior to participating in the study.

OUTCOME MEASURES

Instruments and Measurements

Pre-Participation Demographic Questionnaire

Before participating, each participant completed a questionnaire providing their age, gender, self-reported height and weight, and previous injury history.

Weight Bearing Lunge Test

Participants were in a lunge position (knee on ground) facing a wall without shoes with the test foot and knee perpendicular to a wall.[12] While maintaining this position, participants performed a lunge in which the knee was flexed with the goal of making contact between the anterior knee and the wall while keeping the heel firmly planted on the floor. Valgus and varus collapse were not specifically controlled for, but the PI observed the knees throughout the test to ensure proper motion. The participants continued to move their foot back slowly until their heel could no longer stay in contact with the ground at the same time their knee was touching the wall. [13] According to Bennell et al. (1998), the weight bearing lunge

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test has intra-rater intraclass correlation coefficients (ICC) ranged from 0.97 to 0.98 and the inter-rater ICC value was 0.99.[12] For assessing ankle dorsiflexion these results have excellent reliability.

Broad Jump

A tape measure was laid out on the floor and participants started with their toe on the starting mark. The contralateral leg was positioned with the hip and knee angles at approximating 90 degrees of flexion and their hands were placed on their hips. A single maximal hop was executed without swinging the contralateral leg or removing the hands from the hips. The participants were encouraged to achieve maximal horizontal distance and to land on the same foot without simultaneously placing the opposite foot down for support. Once their landing foot touched down, however, they were free to extend the opposite leg to avoid falling.[14] For double-leg jumps, participants were allowed to use a counter movement jump technique and participants were asked to jump out as far as possible each time. They were to hold the position until the investigator told them to move. Measurements were taken from the back of the heel closest to the starting point and were measured to the closest half centimeter. If the participant did not stabilize after their jump, they were asked to repeat the attempt.

The broad jump is used to measure power output, specifically horizontal power output. The ALPHA Health-Related Fitness Test Battery protocol was followed when administering the test.[15] Markovic et al. (2004) concluded that double CMJ (horizontal) is the most reliable and valid field test for the estimation of explosive power of the lower limbs in physically active men.[16] The single leg horizontal distance test has a high test-retest reliability, with ICC values between 0.88 to 0.96.[17]

Statistical Analysis

Data analysis for this study included descriptive statistics that were calculated for the demographic information and dependent variables. Comparisons were made between the baseline measurements performed before each session and the measurements performed after each intervention, as well as between the measurements assessed after each intervention. These comparisons were performed using a paired-samples T-test with an alpha set to < 0.05. IBM SPSS statistics package 26 was utilized for the analysis.

INTERVENTION

Body Tempering Roller

The BT roller (Forge; Watkinsville, GA) is a large metal cylinder (22.68 kg) used to apply pressure to the identified muscle tissue (**Figure 1**).[18]

Figure 1. BT device used in the study. In this study, a 10 lb. plate was added to each side of the device to make the total weight 50 lbs. (the device itself weighs 30 lbs.).

Foam Roller

The participants used a 15.24 cm x 91.44 cm polyethylene foam roller (Power Systems, high-density foam rollers, Knoxville, TN). The foam roller was a high-density, pre-molded piece of foam in the shape of a cylinder.[19]

Procedures

This study consisted of two separate interventions/sessions, with at least one-week in-between each. The same procedures were followed at each session, and the only thing that changed was the intervention device that was used (i.e., BT-session one and FR-session two, or vice versa)

Participants arrived on the first day and completed the consent form and demographic questionnaire. Once they agreed to participate, participants were randomly assigned to initially participate in either the BT group or the FR group. Each participant began with a general warm up on a bike, pedaling at 60 rpm at a self-selected resistance for 3-4 minutes.[20] Participants then engaged in a 5 min standardized warmup consisting of dynamic mobility (e.g., walking knee lift and lunge walk) and calisthenics (e.g., skipping and jumping jacks) exercises (**Table 1**).[21] After completing the warmup, participants rested for 2 minutes before participating in three baseline measurements of active dorsiflexion (ADF) ROM on each ankle. This was assessed using the weight-bearing lunge test with the participant self-selecting which ankle was assessed first. Unilateral and bilateral broad jump were assessed next, to examine power. Single-leg (unilateral) jumps were performed before the double-leg (bilateral), with each participant self-selecting to start on the right or left.

Table 1. Standardized warm-up

Exercises	Sets	Yards
Jog	1	30
Backpedal	1	30
Skip	1	30
Quad Stretch Walk/Knee Hug Walk	1	15/15
Fwd Lunge/Bkwd Lunge	1	15/15
Shuffle Right/Left	1	15/15
RDL Walk/Straight Leg March	1	15/15
High Knees/ Butt Kickers	1	15/15
Carioca Right/Left	1	15/15
Sprint	1	30

Depending on the group each participant was assigned to either a 30 second BT treatment or a 30 second FR treatment was, then, applied to the triceps surae muscle group.[2,21-23] The treatment was performed at a pace of one pass every 2 seconds (4 seconds for a complete cycle).[10,24] Participants reported for a second session at least one week after the first in order to complete the other intervention. All treatments were held at approximately the same time of day and participants were instructed to maintain their normal exercise routine. The PI attended each treatment session and performed all BT interventions. During the BT intervention, participants laid prone on a soft surface (**Figure 2**).[25] The PI rolled a cylinder proximally and distally on both triceps surae muscle group, simultaneously, for approximately 30 seconds.[1,2,10,26,27] Those participating in the FR intervention rolled both triceps surae muscle group at the same time for 30 seconds at the same tempo as the BT group.[24] After the treatment period, each participant rested for 1 min and then the PI reassessed the double- and single-leg broad jump and ankle dorsiflexion.

Figure 2. Application of BT Device

The participants tested both the broad jump (double and single legs) and ankle dorsiflexion three times,[28] and the best score and the averages were recorded.

RESULTS

Paired sample t-tests were used to compare post-intervention and baseline measurements, as well as BT to FR. Detailed results can be found in **Tables 2-5**. Statistically significant differences ($p \leq .05$) were found between pre- and post-FR single leg jump averages for the left leg (Pre: 93.22 ± 23.32 cm, Post: 96.77 ± 20.54 cm; $p = .046$) and the right leg (Pre: 92.28 ± 22.81 cm, Post: 99.38 ± 22.52 cm; $p = .007$). Statistically significant differences were also found between pre- and post-BT single leg jump averages for the left leg (Pre: 94.53 ± 21.65 cm, Post: 100.27 ± 19.79 cm; $p = .03$) and the right leg (Pre: 94.22 ± 20.74 cm, Post: 99.83 ± 19.48 cm; $p = .036$). Average ROM was only found to be statistically significantly different for BT on the right leg (Pre: 8.32 ± 3.08 cm, Post: 8.80 ± 3.20 cm; $p = .035$), which 19 of the 20 participants indicated was their dominant leg. There were no statistically significant differences in power or ROM when comparing the BT to FR interventions.

DISCUSSION

The purpose of this study was to determine the effect of BT on ankle dorsiflexion and power. The secondary purpose was to compare the effects of BT to traditional FR. The results of our study showed statistically significant improvement in the unilateral jump on the left and right leg after both BT and FR. These results are important for those who participate in many sports that require a participant to have single leg explosiveness to accomplish a task successfully, including running, throwing, and jumping. That explosiveness is known as the word power. With power being defined as work over time,[29] the quicker the athlete can move a certain distance, the more powerful they are. The ability for the athlete to produce more power could lead to greater success in their competitive arena, thus making these results intriguing for the athlete.

Although our study resulted in statistically significant differences in single-leg jumps, no statistically significant differences were found between the results of the baseline measurements and either intervention for the double-leg jump. Aligning with the double-leg results from our study, in a systematic review assessing effects of self-MFR, Beardsley et al. (2015) found all but two of the reviewed documents to show no changes in double leg performance measures after a session of self-MFR.[22] It has been shown in research that the mechanical output per leg is less in two-leg jumps than in one-leg jumps, and thus has been given the name bilateral deficit.[30] This same effect can be seen in our study as the patients saw statistically significant increase in their single leg jump, but there was no statistically significant changes when looking at the double-leg jump.

In terms of ADF ROM, only the pre-intervention to post-intervention of BT on the right limb showed statistically significant difference. In the MacDonald et al. (2013) study, they found an increase in ROM in both limbs two and ten minutes after completing the treatment session after rolling both limbs individually.[1] Our results may have been different due to rolling both limbs at the same time. In the Skarabot et al. (2015) study, they assessed FR by itself, and compared it to FR plus a static stretching intervention. FR by itself resulted in no increase in ROM, while the combination showed a statistically significant increase.[23]

Nineteen of the twenty participants in our study stated that the right leg was their dominant leg. The lack of ROM on the dominant leg due to increased usage may have allowed for greater improvement compared to the less used non-

Table 2: Pre- and Post-Measurements for Average Jumping Distance (mean ± SD)

Intervention			Pre-Measurement (cm)	Post-Measurement (cm)	p-value
Foam Rolling	Left	Avg	93.22± 23.32	96.77 ± 20.54	0.046*
		Longest	101.35 ± 24.90	102.35 ± 20.42	0.628
	Right	Avg	92.28± 22.81	99.38 ± 22.53	0.007*
		Longest	99.45 ± 22.962	103.60 ± 22.86	0.137
	Both	Avg	184.77 ± 33.92	180.98 ± 35.17	0.464
		Longest	189.50 ± 34.32	186.73 ± 36.27	0.586
Body Tempering	Left	Avg	94.53 ± 21.65	100.27 ± 19.79	0.030*
		Longest	101.13 ± 21.42	105.98 ± 21.25	0.069
	Right	Avg	94.22 ± 20.74	99.83 ± 19.48	0.036*
		Longest	101.53 ± 20.49	105.78 ± 17.72	0.130
	Both	Avg	187.38 ± 34.28	186.41 ± 36.24	0.497
		Longest	192.78 ± 34.31	191.63 ± 35.55	0.489

*=significant finding ($P < 0.05$)

Table 3: Post Intervention measurement comparison (FR and BT) (mean ± SD)

Intervention		FR (cm)	BT (cm)	p-value
Avg Jump Distance	Left	96.767 ± 20.540	100.267 ± 19.790	0.293
	Right	99.375 ± 22.525	99.833 ± 19.481	0.894
	Both	180.975 ± 35.165	186.408 ± 36.242	0.362
Longest Jump Distance	Left	102.350 ± 20.415	105.975 ± 21.249	0.334
	Right	103.600 ± 22.857	105.775 ± 17.720	0.533
	Both	186.725 ± 36.274	191.625 ± 35.554	0.414

Table 4: Pre- and Post-Measurements for ROM (mean ± SD)

Intervention		Pre-Measurement (cm)	Post-Measurement (cm)	p-value
Foam Rolling	Left	8.567 ± 3.122	8.833 ± 2.974	0.069
	Right	8.325 ± 3.011	8.725 ± 2.909	0.073
Body Tempering	Left	8.517 ± 2.918	8.930 ± 3.113	0.079
	Right	8.321 ± 3.078	8.800 ± 3.201	0.035*

*=significant finding ($P < 0.05$)

Table 5: Post Intervention ROM comparison (FR and BT) (mean ± SD)

Intervention		FR (cm)	BT (cm)	p-value
ROM	Left	8.833 ± 2.974	8.930 ± 3.113	0.791
	Right	8.725 ± 2.909	8.800 ± 3.201	0.825

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dominant leg. In a previous study on frequency of injury in soccer athletes, it was shown there was no difference in ROM between either leg, but the dominant (shooting leg) was more likely to get injured.[31] Because this leg is more dynamic in use, it is injured more often. During the injury process, tissue goes through a remodeling phase which can be extremely prolonged, and even when finished, it might not heal correctly or align the best possible way.[32] The participants could have had previous injuries, past the six month criteria, that affected the tissue in their dominant leg. This tissue healing could have caused an underlying deficit that the BT device aided upon intervention. Because the non-dominant side was uninjured and there was no underlying deficit there was no improvement that could be seen whether that was with the BT or the FR.

FR the calves consists of a lot of upper body and core strength, as the participant needs to hold themselves in a proper position throughout the duration of the treatment. This ability, or lack thereof, can change the amount of force the participant has on the intended tissue. Because this study was completed on the general population and not athletes, many of the participants struggled to complete a treatment session for 30 seconds due to lack of strength. This lack of ability to hold oneself up to provide force into the calf could have caused a lack of change in the tissue when FR. This would explain why ADF ROM was statistically significantly different in the dominant leg while BT, but not while FR.

A potential limitation of this study is that the weight used for the BT device was not able to be adjusted because we were testing with just fifty pounds. It is stated in the BT manual that a high pain level should be achieved to see benefits.[10] To ensure consistency in the study, we used one weight the entire time. Changing the weights out based on individual pain scale might have elicited different results. A second potential limitation of this study is the participants ability FR ability, and therefore force applied, was linked to their strength and being able to hold themselves up. Many of these participants did not have the strength to hold themselves up and complete a 30 second treatment session, causing a lack of force into the foam roller, and therefore affecting the results. A third potential limitation is the sample size. While the power of the study was met, this is still considered a small number of participants. Including more participants would increase the strength of this study. A fourth, and final, limitation is that only the triceps surae group had the intervention completed on it. Jumping was tested during this study and jumping requires more than just the triceps surae group (i.e., quadriceps, hamstrings, hip flexors, and extensors). If all the lower extremity musculature was worked on, then the jumping data could have been different. Future studies should focus on the number of treatments per session. Only one treatment was completed per session, and the participants expressed that they did not feel much different before or after the intervention. Increasing the number of treatments per session could elicit a greater benefit or even a benefit that was not seen during the singular treatment. In the study, participants, also, often mentioned, “oh, it’s already done.” This indicated that the length of the treatment might change outcomes for the athlete and is something that can be focused on. Throughout the literature on FR there is varying lengths of treatment that are executed, usually thirty seconds to two minutes.[22] While there are a few studies that show changes under thirty seconds, there is a general consensus that one should spend thirty seconds of treatment time when FR.[2,22,23] After two minutes there seemed to be detrimental effects in one study.[21] While this study looked at thirty second treatment lengths there is time to play with while still staying under that two min period. Using that lengthened time period is something that can be examined to see if greater effects are seen when BT. Throughout the study, pain was assessed during treatment for safety purposes, but led to another idea. One participant said BT was significantly more painful than it was for the other participants; they then stated they felt a lot better and "looser" in their calves (which the others did not state). The individual data for this participant made significant improvements from pre intervention to post intervention for BT; comparing it to FR makes it even more apparent. Assessing the difference in pain level between the amount of weight on the BT device might elicit an interesting connection between pain and benefit for the athlete.

CONCLUSION/CLINICAL APPLICATION

Athletes, coaches, and clinicians should understand the effects these treatments will have and determine if they will benefit the subsequent performance individually. In this study, BT and FR both showed an improvement in power development in individual legs, but not when the double leg jump was completed. Single-leg power is used when competing in many athletic events (throwing, jumping, running) and applying BT or FR pre-contest could increase muscle performance needed during activity. Both techniques were comparative in the effects on power and dorsiflexion ROM, thus showing while both techniques worked, one may not be better than the other. Using this information, athletes preparing for power-type movements could benefit from BT or FR. Although an increase in power was noted in both techniques, only an increase in ADF ROM was recorded in the R leg while BT. While there was some benefit to ROM, it is inconclusive whether it would have a real benefit to the athlete pre-activity. With the aforementioned stated, BT is a passive technique and could be more appealing to the athlete than FR (active technique), thus motivating them to complete these myofascial activation activities. Giving the athlete another option to incorporate into their routine could lead to their success and good health, which in the end is what all clinicians and coaches want to see for the individual. On top of that, there were no detrimental effects noted in this study, leaving the athlete the freedom to use these techniques before activity, without fear of harm to their subsequent performance.

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Graston Technique® Combined with Therapeutic Intervention as an Alternative Treatment for a Grade III UCL Thumb Sprain: A Disablement Model Case Study

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ABSTRACT

Nonoperative measures have been shown to have positive effects on thumb ulnar collateral ligament (UCL) sprains considered less than complete. This case presents evidence supporting Graston Technique® (GT) plus therapeutic exercise in order to decrease pain and stiffness in a collegiate football athlete who sustained a grade III UCL sprain. The results showed that there was a reduction in pain level above the minimal clinically importance difference, and ROM improved throughout the three-week intervention. The findings of this case study provide minimal support for an alternative treatment to reduce pain and stiffness in a grade III UCL sprain, with further research needed.

Key Phrases
College and university patient population, patient-reported outcomes, therapeutic exercise

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INTRODUCTION

The term Skier's Thumb refers to the acute mechanism of injury associated with the ulnar collateral ligament (UCL) of the first metacarpophalangeal (MCP) joint.[1,2] The term Gamekeeper's thumb, similar in nature, is characterized by chronic repetitive stresses placed on the same joint.[1,2] For this case study, Skier's thumb is a more accurate representation of the injury in question. Injury to the thumb MCP joint is considered common in athletics.[3] According to a study conducted by Werner et al, 63% of isolated UCL sprains examined on a single NFL team required surgical intervention.[3] Surgery is a common treatment method for grade III thumb UCL sprains while non-operative treatment is vastly accepted for grades I and II.[4] Yet, a systematic review indicated that there is no consensus regarding surgical indications for thumb UCL injuries.[5] A previous investigation of non-operative intervention for UCL injuries has shown favorable results, including patient satisfaction and grip strength.[6] Additionally, treatment of canine grade III ligamentous injury has suggested that conservative treatment with early mobilization has improved tensile strength compared to surgical treatment with immobilization.[7]

Non-surgical conservative treatment of a UCL injury includes a recommended early immobilization of the injured MCP joint followed by therapeutic intervention.[8] Early immobilization aims to protect the injured joint by restricting motion.[9] The duration of immobilization is a fine balance between too long, which may lead to joint stiffness, and too short, which may not allow sufficient healing time.[8] Although joint protection through immobilization is necessary, motion loss and/or muscle atrophy can occur at its expense.[9] Suggested immobilization time ranges from 3 to 12 weeks, but the outcomes associated with such extended immobilization are unknown.[8,10] The treatment principles which allow motion while concurrently avoiding additional injury are sought after because of its evidenced support in decreasing pain and inflammation throughout the healing process.[9]

Instrument assisted soft tissue mobilization (IASTM) has been found to cause physiological changes and acts as an enhancement to the healing process of ligaments via significant increase in proportion of blood vessels and fibroblastic activity.[11-13] It has also been shown to improve collagen formation in injured ligaments of rodent models.[13] The current case study specifically addresses the proliferative phase of healing, where collagen formation occurs. At approximately 3 days following an injury, injured soft tissue begins to repair and regenerate and continues over the next 3 to 6 weeks.[14] Over several weeks, angiogenesis, fibroplasia, generation of new epithelial tissue and wound contraction occur, as the damaged cells at the site of injury are replaced with scar tissue.[14] As the new collagen tissue matrix is forming, the new blood supply is supporting the tissue with nutrients, resulting in the formation of a vascularized bulk of immature connective tissue.[14] The developing tissue includes type I and type III collagen; type III being especially significant because of its power to form cross-links that provide stabilization to the healing tissue.[14] Instrument assisted soft tissue mobilization can be considered controlled local microtrauma, causing local inflammation in the tissue in an effort to support the healing process. Multiple treatments of IASTM have been shown to increase tissue perfusion when initiated one week following injury of a ligament.[12] Additionally, IASTM combined with rehabilitation exercises has been suggested as an alternative to surgical intervention.[12,13] The Graston Technique ® (GT) is a form of IASTM and is widely used across medical rehabilitation professions such as athletic training, physical therapy, and occupational therapy. The Graston Technique® uses stainless steel instruments specifically designed to apply controlled forces to muscles, tendons, and ligaments of the body.[12,13] The aim of completing GT and therapeutic exercise in the current case study was to improve the limitations reported in a grade III thumb UCL sprain.

PATIENT INFORMATION

The patient was an 18-year-old male NAIA collegiate football athlete who presented to the athletic training facility with pain and swelling in his right thumb. Mechanism of injury (MOI): the patient reached across his body to deflect an incoming pass, the football hit his open palm and hyper-abducted his first MCP joint of the right hand. Otherwise, the patient was considered healthy and free from injury. The uniqueness of this case has two parts. The first aspect of uniqueness is that the injury sustained was diagnosed as a grade III sprain, and surgery was not recommended by the referred hand specialist. Conservative rehabilitation for the injury immediately began and continued during the three weeks prior to seeing the hand specialist. Upon evaluation, the specialist recommended that all treatment be ceased, and the patient be placed in a thumb spica splint throughout the day and allowed to return to sport. A removable hard cast was provided for practice and game competition. The second portion of uniqueness concerns the treatment provided in this case study, as the use of GT combined conservative rehabilitation for treatment of a grade III thumb UCL sprain is the first report to our knowledge.

DIFFERENTIAL DIAGNOSIS AND EVALUATION

The patient was initially evaluated the same day of injury by the athletic training staff, which included the head athletic trainer and athletic training student. Upon inspection of the hand there was moderate swelling and mild bruising along the thenar eminence and point tenderness in the first MCP joint. There were no symptoms of numbness or tingling and no obvious deformities noted. The patient had no previous history of hand injuries. The patient reported that his thumb felt "stiff and as if it was throbbing." A decrease in flexion, extension, and abduction due to pain was

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observed of the patient's active range of motion (AROM). The assessment of passive range of motion (PROM) showed a decrease in flexion and abduction. The strength deficits that were observed in grip, flexion, extension, abduction and adduction were observed and confirmed through subjective bilateral comparison. Manual muscle tests (MMTs) were attempted but unable to be completed due to pain. Joint laxity was discovered through a valgus stress test of the first metacarpophalangeal joint. Special tests exhibited negative results in tap/percussion test, tuning fork, and varus stress test. The patient was believed to have sustained a moderate to severe sprain of the UCL in the first MCP joint. The patient was placed in a wrist and thumb soft splint for immobilization for approximately 5 days until he was able to see the team physician. No rehabilitation took place during this time, other than the application of cold modalities via ice tub or ice bag. The recommendation to the patient was that the splint was only removed when necessary (i.e., showers and therapeutic treatment) but otherwise worn day and night. The patient was referred to the team physician who confirmed the findings of the athletic trainer and athletic training student. The team physician recommended that the patient continue with splinting and provided a referral to a hand specialist. The patient continued to wear the soft thumb splint until his appointment with the hand specialist. Sport participation had ceased since the time of initial evaluation by the athletic trainer. Non-steroidal anti-inflammatory drugs (ibuprofen) was suggested on an as-needed basis for pain. During this time, there were no restrictions noted by the team physician for controlled rehabilitation of the hand.

BODY STRUCTURE AND FUNCTION

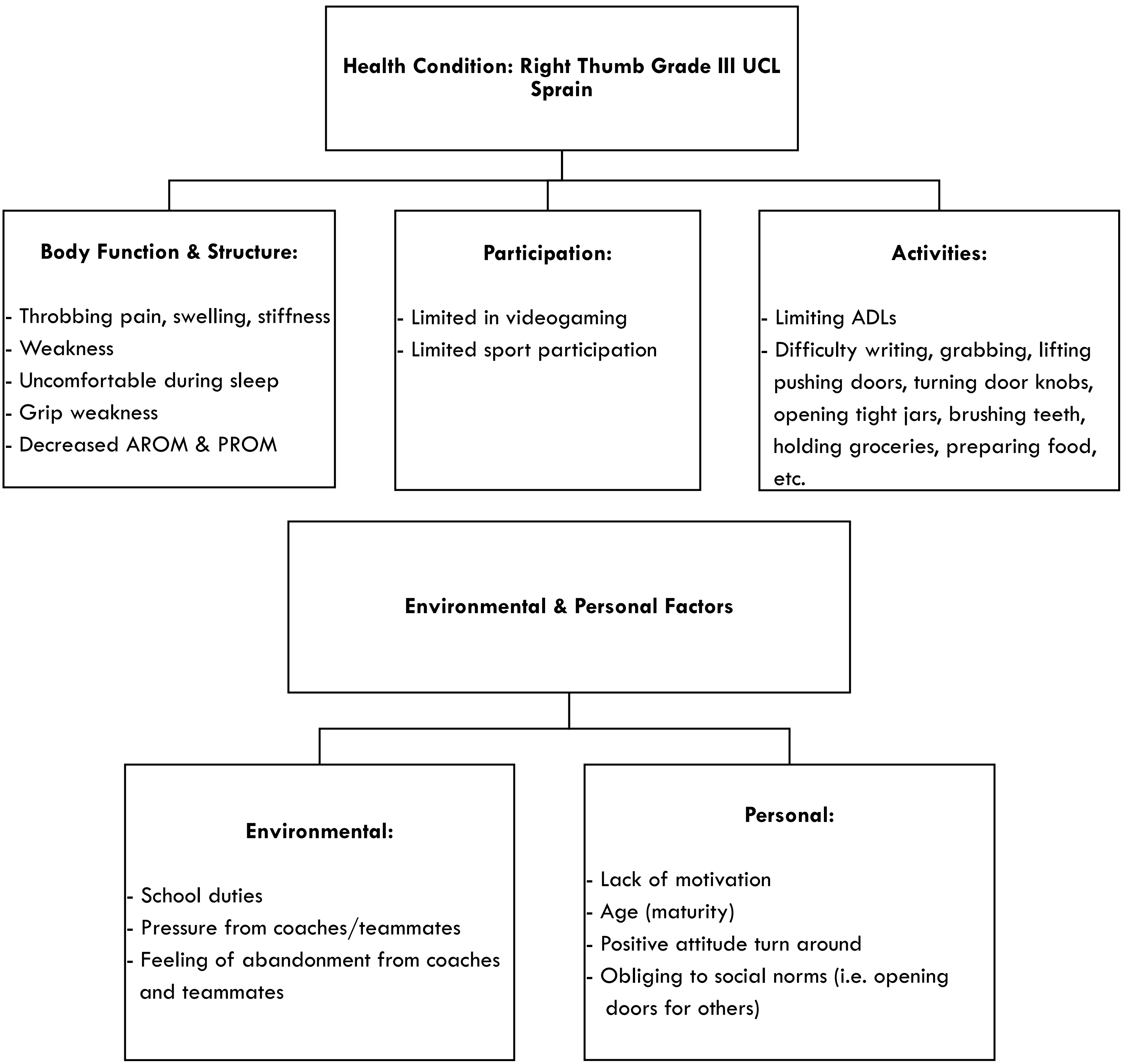
The patient identified as right hand dominant and reported limitation in activities of daily living (ADLs), social leisure, and sport participation. The patient reported severe difficulty turning doorknobs, opening jars, writing, gripping a toothbrush, lifting weights, gripping a video game controller, shaking someone's hand, and catching a football. The impact of the injury on the patient is illustrated using the International Classification of Functioning, Disability and Health (ICF) Disablement Model[15] in Figure 1.

ACTIVITY AND PARTICIPATION

The athletic training staff, team physician, and patient agreed that the patient would not engage in football practice until evaluated and cleared by the orthopedic hand specialist. Additionally, the patient was not participating in any other physical activity involving the use of his right hand. However, the patient was able to continue cardiovascular exercise in the athletic training facility and allowed to participate in conditioning with his team. At school, he reported and inability to write legibly and effectively type notes on his computer without restriction or pain. The patient explained on multiple occasions that he did not feel as if he could function properly in everyday life because anything involving his right hand was limited.

Socially, there were moments where the patient felt excluded from leisure activities because he could not participate with his friends. During rehabilitation, the athletic training staff would ask about the patient's life outside of football. He admitted there were moments he felt dispirited while hanging with friends because it often revolved around playing videogames. Given the injury to his thumb, holding a console controller was difficult. The athletic training staff saw the importance of treating the whole person and assisted the patient with psychosocial coping strategies of conversation and positive affirmation. The athletic training staff and patient began to use daily tasks/results as an opportunity to help discover and appreciate the small victories of rehabilitation (i.e., decrease in pain, stiffness).

Figure 1: Disablement model: Impact of Injury



ENVIRONMENTAL AND PERSONAL FACTORS

Regarding psychosocial considerations of the injury, the patient had reported that he felt indirect pressure and feelings of abandonment from his

coaches and teammates because he could no longer actively participate in practices or games. There was a lack of motivation because he felt his worth was dependent on football. Since the patient was without football and was limited in daily activities, he was hesitant to begin rehabilitation. After completing one full week of treatment, the patient's perceived pain improved. These results gave the patient hope, as he reported that he felt more motivated to continue the process and work hard in rehabilitation. This psychosocial finding was similar to a systematic review which noted that patient compliance may improve with decreased pain achieved through IASTM.[16] The patient began to slowly participate in everyday activities and noted feeling less extrinsic pressures.

INTERVENTION

The treatment for the first week included immobilization and cryotherapy to manage pain and swelling until he was seen by the team physician. Once evaluated by the team physician, the patient was allowed to begin conservative hand therapy until he was seen by the hand specialist, approximately three weeks later. Duri ng this time, the patient reported to the athletic training facility five days per week. The intervention included GT and therapeutic interventions to address ROM and strength deficits. The Graston Technique® was selected as an intervention based on previous work which demonstrated improved range of motion of the thumb after eight sessions of combined GT and active release therapy during immobilization.[17] In the current case, GT was administered by two providers certified in GT (head athletic trainer and athletic training student) two times per week with at least 48 hours in between application, and therapeutic exercise was performed at every appointment. This method of combining daily exercise with GT twice per week is consistent with a previous reported case of subacute lumbar injury.[18]

The Graston Technique® requires the treatment area be heated with either a modality or with a warm-up of the soft tissue before application of the technique, followed by treatment with therapeutic exercises after treatment.[19] For this treatment, the patient performed 10 minutes of heating (paraffin bath: in an extended position, his hand was dipped 7 times with a 3 second hold in wax before the next dip) prior to GT. The intervention was administered for 10 minutes, using the GT2 and GT6 instruments. The treatment time selected is consistent with previous work where GT was applied to an acute ankle injury for 10 minutes.[20] There are several strokes that require distinctive techniques; in the present case, brushing and scooping were the two strokes that were used. Brushing requires a brush stroke motion up and down, similar to the stroke of painting. Scooping requires a motion in a U-shaped pattern, similar to scooping ice cream. Following GT, therapeutic exercises were instructed and performed. The patient began with soft putty for 10 minutes (hand motions included pinching, squeezing, pulling, rolling, and smashing) in order to restore abductor pollicis longus, abductor pollicis brevis, and flexor pollicis brevis strength, followed by an additional 15 minutes of wrist and hand strengthening exercises (grip, finger flexion, finger extension, wrist flexion, wrist extension, ulnar deviation, and radial deviation). The same exercises were completed on days when GT was not performed in order to continue strengthening the wrist and hand.

Approximately three weeks after seeing the team physician and completing the intervention of GT and therapeutic exercise, the patient was evaluated by the hand specialist who determined that the soft thumb splint was not rigid enough for immobilization during ADL's. The recommended plan of care was that the patient continuously wears a rigid splint for immobilization and rehabilitation should cease. The specialist created a different rigid removable cast for football activities, and the patient was allowed to participate in football activities contingent upon wearing the removeable cast during practice and game competition.

OUTCOMES

Throughout the treatment process, the chief complaints were pain and stiffness of the right thumb. The patient's pain was monitored using the Numeric Pain Rating Scale (NPRS).[21,22] The tool has been found valid (r = 0.94, 95% CI = 0.93-0.95) in assessing acute pain.[23] The rating of stiffness, although subjective in nature, was attempted to be captured through ROM testing. Given the patient's concerns with his ability to function, the outcome measure of Quick Disabilities of Arm, Shoulder, and Hand (QuickDASH) was completed by the patient. The QuickDASH is an assessment tool used to measure functional ability and symptoms in individuals with any musculoskeletal disorder of the upper extremity.[24] No other patient-reported outcome measures were used by the athletic training staff.

NPRS: Pain was measured weekly using the NPRS. The patient was asked to rate his current, best, and worse state of pain within a 24-hour period on a scale from 0 (no pain) to 10 (worst pain imaginable). The three numbers were added together, and an average was calculated (sum of pain rating divided by number of ratings).[21,22] For example, in the initial evaluation the patient reported a current pain rating of 6, best pain rating of 0, and a worse pain rating of 8 within a 24-hour period; 6 + 0 + 8 divided by 3 = 4.67 average. The NPRS categorizes pain as either mild (score of 1-4), moderate (5-6), or severe (7-10).[25] Previous work has demonstrated that the minimal clinically importance difference (MCID) is a reduction of one point.[26] During the first week of intervention the patient's NPRS score was 4.67, and week two's average was 2.67. During the third week of the intervention the NPRS score was 1.33, which remained unchanged the following week when the therapeutic intervention was discontinued per the hand specialist's recommendation.

ROM: Range of motion measurements during the 3-week GT and therapeutic intervention period are displayed in **Table 1**. Flexion measurements were taken using three landmarks: distal arm was positioned dorsal midline of proximal phalanx, center point was positioned dorsal aspect of MCP, and proximal arm was positioned dorsal midline of metacarpal. Abduction measurements were taken using 3 landmarks: distal arm was positioned lateral midline of first metacarpal, center point was positioned lateral aspect of radial styloid, and proximal arm was positioned lateral midline of second metacarpal. Thumb opposition was assessed through visual observation by the athletic training staff. The tip of the thumb was observed attempting to touch the MCP joint on the palmar side of the involved hand. During the initial week of treatment, the patient was unable to complete thumb opposition to his 4th and 5th MCP joints. At

Table 1: Weekly ROM Measurements of Patient's Right Thumb

ROM	Week 1	Week 2	Week 3
Flexion	35°	40°	46°
Abduction	50°	55°	58°
*Opposition (visual)	Able 2-3	Able 2-4	Able 2-5

*Ability to successfully complete opposition to MCP joint of digits 2-5.

the conclusion of week three, the patient could successfully complete opposition by touching his thumb to MCP joint. Measurements were not completed following the cessation of GT and therapeutic exercise. Although, it is important to note that the patient reported an increase in stiffness within the weeks following cessation of therapeutic intervention.

Quick DASH: This assessment was used to assess the patient's ability to perform ADLs and sport specific activities. The QuickDASH consists of 11 items of ADL and 4 items in each of the optional work or sports/performing arts modules. Each item is rated on a scale from 1 (no difficulty) to 5 (unable), and the overall scoring ranges from 0 (no disability) to 100 (most severe disability).[24] The patient first completed the QuickDASH with sport module upon initial evaluation with the athletic training staff. The work module portion of the quick DASH was not included because the patient was not employed. The outcome measure was completed every 1 to 2 weeks. Prior to the intervention of GT and therapeutic exercise the patient scored 50/100 in ADLs and 75/100 in the sport module. Overall scores decreased throughout the intervention and continued to decrease after the intervention was halted. By the end of week 7, the patient scored 0/100 in both ADL and the sport module.

DISCUSSION

Medical providers share a desire to help improve the quality of life of individuals in need. The option of conservative intervention is increasing as patients consider the factors which play a role in deciding surgical versus non-surgical interventions. There are various reasons one might choose conservative treatment over surgery. These reasons include, but are not limited to, financial stability, health insurance coverage, mental fears/adaptations, physical risks, and loss of time of work/sport. Additionally, similar outcomes have been reported when examining conservative versus surgical treatment of both partial and full thickness ligamentous tears.[12] The current case study provides an example of a potential beneficial non-operative treatment option that warrants further exploration. Specifically, the results of the treatment option of GT combined with therapeutic exercise suggest an effectiveness in decreasing the patient's perceived pain and stiffness following a grade III thumb UCL sprain. Historically, chief complaints of a grade III thumb UCL sprain are pain, decreased ROM, and instability.[27] It should be noted that instability was not a symptom reported by the patient in the current case. The Graston Technique® combined with therapeutic exercise was chosen as the treatment of choice in this case study to address both pain and stiffness. The results of this case study suggest an improvement of two of the three common chief complaints, both pain and ROM. Our findings showed that there was a reduction in pain level each week above the minimal clinically importance difference. Additionally, ROM improved each week, and opposition was restored to normal after the three-week intervention. It should be noted that in addition to the GT and therapeutic exercise, the patient was instructed to wear a soft splint continuously, which may have been a factor in the outcomes. It is speculated splinting would decrease pain by protecting the joint from further disruption. Interestingly, the primary reason for immobilizing acute soft-tissue injuries was for pain relief, while loss of motion was cited as the main reason to not immobilize, according to more than two-thirds of physicians polled.[9] It is speculated that since GT and supervised therapeutic exercise was being completed once a day, ROM was able to be improved despite immobilization. Our findings are consistent with a previous literature review which reported that IASTM decreases pain as well as improves range of motion in acute injuries.[28] It is theorized that the ability of IASTM to assist in healing of ligamentous injury is due to its effects on collagen, including maturation and remodeling, through localized blood flow.[12,13,29] Scar tissue is thought to impede mobility and therefore oxygen supply to the injured area.[28] Through the controlled repetitive microtrauma elicited by GT, a reinitiating of the inflammatory process may have led to enhanced tissue perfusion,[12] which in turn allowed for fibroblastic proliferation.[28] Tissue perfusion followed directly with therapeutic exercise may have played a role in the ability of the joint to reach improved ROM. This may be a reason why it is recommended that stretching and strengthening exercises are recommended to immediately follow the application of GT.[19]

The results established from the Quick-DASH presented noteworthy information. The patient reported an initial 50-75% disability to 0% in the ADL and sport module, respectively, over a period of six weeks. We suggest two main reasons why there was such a dramatic change in scores. One theory is that the treatment decreased pain, which allowed him to participate in more activities, aiding in an improved level of physical function. It was evident that pain was diminishing throughout the intervention; however, when treatment was terminated the level of disability continued to drop. It is possible that the patient felt less disabled due to the allowance of sport participation by the hand specialist, which would explain the continued improvement in scores after the intervention was terminated.

Although there were promising scores in disability index, ROM, and pain ratings in favor of GT and therapeutic exercise, there are limitations that need to be addressed. First, it would have been helpful to continue measuring ROM once the intervention ceased to determine if the initial improvements were temporary. The authors acknowledge that the termination of the intervention may have played a role in the overall healing process, and the hand specialist's judgement to cease treatment is unknown to have helped or hindered the outcome measures. The goniometric assessment could have also been measured by a second clinician to assist in accuracy – intra-rater reliability may have played a role in this case. Additionally, a second measurement tool besides ROM could have been used to assess the patient report of stiffness. Lastly, the addition of a psychosocial patient-rated outcome measure may have been helpful in indicating a reason for the decrease in disability score. It is believed that multiple extrinsic and intrinsic factors may have played a key role in the improvements seen, and future investigations should consider adding a psychosocial outcome measure when the QuickDASH is used.

CLINICAL BOTTOM LINE

The findings suggested in this case study demonstrate that GT combined with therapeutic exercise and soft splinting may be beneficial to patient-reported limitations of a grade III thumb UCL sprain. This case study found that there were improvements in pain and ROM of the affected joint during a three-week intervention. Future research should investigate the effectiveness of initiating GT and therapeutic exercise at various time points of immobilization of thumb UCL sprains.

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Comparison of the Closed Shoulder Reduction Techniques: An Evidence-to-Practice Review

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ABSTRACT

The shoulder joint is one of the most dislocated joints in the body. It does not have substantial bony support which allows for a large range of motion. Shoulder joints most commonly dislocate anteriorly, and less often dislocate posteriorly and inferiorly. There is a myriad of ways to reduce a shoulder dislocation including closed and open techniques. The purpose of this evidence-to-practice review is to summarize which closed shoulder reduction techniques are most effective and apply those results to an athletic training setting. The authors of this guiding systematic review studied multiple articles that compared different closed shoulder reduction techniques on the following criteria: pain experienced by the patient, ease of technique for clinician (time to reduce the shoulder joint), success rate, and complication rates. The authors chose to include randomized control trials, prospective studies, and retrospective studies. The literature revealed that the scapular manipulation technique had the best outcomes in all the criteria, however, every patient that had a shoulder dislocation that was reduced using that method also had intravenous analgesics. The Fast, Reliable, and Safe (FARES) method was found to be the third most successful and least painful during relocation and was often used without intravenous analgesics. Based on rate of success and patient comfort during reduction, the FARES method is the best option, suggesting that it should be taught to healthcare providers more often. Depending on the state practice act and physician oversight, athletic trainers who are allowed to reduce dislocations should be informed and educated on how to properly reduce and also allow for the best possible outcome and comfort for the patient.

Key Phrases
General Medical Interventions, Clinic and Hospital Patient Population

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SUMMARY

CLINICAL PROBLEM AND QUESTION

Shoulder dislocations account for over 50% of joint dislocations, making it the most commonly dislocated joint of the body.[1,2] In the United States, glenohumeral dislocations occur at a rate of 23.9 per 100,000 person-years, of which 95% occur in an anterior dislocation.[2,3] These injuries can cause a lot of pain for the patient, and improper relocation of the joint may cause complications such as tears of the biceps tendon, deep vein thrombosis, and iatrogenic fractures, and other neurological impairments.[2] Of the shoulder dislocations that presented to emergency departments in the United States between 2002-2006, 48.3% of them occurred during sport or recreation, and most of those occurring in sport or recreation occurred in males (86.7%).[4] Shoulder instability is often a result of a dislocation; an epidemiologic study of athletes at three universities demonstrated that football had the highest prevalence of shoulder instability at 29.3% of cases, followed by basketball, and wrestling.[5] The same study found that the most common type of instability was an occasional, traumatic anterior dislocations, and the majority of shoulder dislocations and instability were traumatic in nature.[5] The National Athletic Trainers' Association (NATA) does not recommend reduction by an athletic trainer if the shoulder joint has dislocated posteriorly or if a fracture is suspected.[1] Posterior dislocations account for approximately 1-5% of all glenohumeral dislocations and are not common in athletics.[1,2] The glenohumeral joint is the most commonly dislocated joint specifically in athletes competing in contact or collision sports.[1]

There are multiple ways that a clinician can choose to relocate a shoulder, all with varying levels of pain experienced by the patient, ease of technique for the clinician (time to reduce the joint), success rate, and complication rates. In this guiding systematic review, ease of the reduction technique for the clinician was determined by the time the technique took to reduce the dislocation.[2] Typically, the method chosen is a result of the provider's knowledge, comfort in performing, or guidance from a collaborating physician. Athletic trainers may come across an acute shoulder dislocation in the athletics setting, particularly in contact or collision sports. With the update to the 2020 Commission on Accreditation of Athletic Training Education (CAATE) Standards, specifically Standard 70 stating that students must learn how to manage emergent conditions such as reductions of dislocations, more athletic trainers will be educated on those techniques. But this, does mean that there are many athletic trainers who are already certified and practicing without that knowledge, unless they have been instructed outside of their primary education.[6] We believe there is a need for certified athletic trainers who were not taught these techniques to be knowledgeable on techniques to properly reduce joint dislocations to ensure improved patient outcomes. Athletic trainers also often work in rural areas, where oftentimes emergency personnel can take a long time to arrive. This knowledge of how to properly reduce a shoulder dislocation may save one of their patients a lengthy ride in an EMS truck and would also save the patient and their families money as the average cost of a closed shoulder dislocation is $2,200.[7] Research has explored various individual techniques in reduction but has not compared the techniques to each other. The purpose of this article was to summarize what the systematic review states and compare what the literature indicates about closed reduction techniques in anterior shoulder dislocations, and determine which technique had the best score in each of the previously mentioned categories of pain experienced by the patient, ease of technique for the clinician (time to reduce the shoulder joint), success rate, and complication rates.

SUMMARY OF LITERATURE

The authors of this guiding article identified 2099 different studies. From that search, articles were included if they focused on shoulder reduction techniques written in English, German, Dutch, and Arabic. Exclusion criteria included open reposition techniques and case reports, systematic reviews, meta-analyses, animal/cadaver/in vitro studies, biomechanical reports, letters to editors, and instructional courses. Additionally, each article that was reviewed was graded and given a modified Coleman Methodology score, which assessed the included articles' methodology on a scale of 0-90.[2] A modified Coleman Methodology score of less than 50 was considered poor, between 50-64 was fair, between 65-79 was good, and between 80-90 was excellent.[2] The Coleman Methodology score is a tool used by researchers to determine if a study's methods and outcomes are considered to be of high or low quality, specifically for studies involving orthopedic injuries, surgeries, and rehabilitations; the authors of this systematic comparison modified it for their specific study.[2] Any study that was given a score of less than 50 points was also excluded from the review. The article list was further narrowed down to 13 articles (9 randomized control trials, 2 retrospective studies, 2 prospective non-randomized comparative studies). Once each article was selected, a comparison was done looking at reduction success, mean reduction time, mean hospital stays, pain, and complications.

SUMMARY OF INTERVENTIONS

The systematic review identified 23 different closed shoulder reduction techniques. However, only 10 reduction techniques were included from the 13 articles selected for the systematic comparison because the other techniques did not meet inclusion criteria or have not been researched. These techniques were then categorized into two groups: traditional and non-traditional. **Table 1** provides the list of traditional and non-traditional techniques that were included in this systematic comparison. Table 2 provides the complete list of 10 reduction techniques including the name, procedure of each reduction technique, is accompanied by a photo demonstration of how each technique should be performed. There were three non-traditional techniques (Boss-Holzach-Matter, Bokor-Billmann, and Aufmesser's techniques) that were mentioned but not examined in the guiding review article, and for that reason are not in Table 2. However, due to the uniqueness of the methods, we have provided brief instructions on the methods. To perform the Boss-Holzach-Matter reduction technique, the patient sits with their hands around the knee on the same side of the affected shoulder, leans back, puts their neck into hyperextension, and shrugs the shoulders anteriorly creating a method of self-reduction.[8] The Bokor-Billmann technique involves the practitioner holding the patient's wrist in one hand, and their elbow in the other, the elbow is flexed to 90 degrees, followed by flexing the glenohumeral joint to 90 degrees, then the shoulder is adducted completely, and then an internal rotation pressure in applied until reduction is felt at about 30 degrees.[9] For the Aufmesser's method, the patient is supine, the clinician holds the patient's hand and fixes their acromion, applies traction to the arm while maintaining eye contact with instructions to relax, and if necessary the clinician's trunk can be used as a fulcrum to provide extra force.[10]

SUMMARY OF OUTCOMES

Best clinical practice, in this case, was defined by which techniques had the best scores in the following categories: pain experienced by the patient, ease of technique for clinician, success rate, and complication rates. Pain levels were determined using the Visual Analogue Scale (VAS) with a score between 1-10, with 1 being the least amount of pain and 10 being the greatest amount of pain.[2] Ease of technique was based on the length of time it took to complete the reduction; a reduction with a lower time was considered easier to perform.[2] The success rate was determined by the percentage of reductions that were completed without further intervention, like having to proceed into an open reduction.[2] Complication risks were determined by any condition that followed and was associated with the reduction such as fracture, deep vein thrombosis, and neuropraxia.[2] The aim of this guiding systematic comparison was to determine which closed reduction technique is the best in terms of success rate, ease of technique, complications, and patient reported pain.[2]

FINDINGS AND CLINICAL IMPLICATIONS

This guiding systematic comparison sought to determine which relocation technique was the most effective, efficient, least painful, and had the fewest complications for a patient with a shoulder dislocation. There are many techniques and maneuvers that a clinician needs to consider, along with their own comfort and experience with each. When looking at each article, there were some varying values for each outcome.

The highest values for successful reduction **(Table 1**) were the scapular manipulation (97%), the traction-countertraction (95%), the FARES method (92%), the Spaso technique (92%), and the external rotation maneuver (91%).2 The Stimson's technique was least likely to facilitate a successful reduction (28%).[2] Scapular manipulation was the quickest (mean time 1.75 min), while the Stimson's

Table 1: Reduction Techniques

Techniques	Reduction Style	Pain Experienced by Patient (VAS 1-10)	Time to Reduce Shoulder (Minutes)	Success Rate (%)	Complications
Kocher Maneuver	Traditional	4.68 ± 2.00	4.19 ± 1.25	85	1
Spaso Technique	Traditional	4.69 ± 1.26	2.65 ± 0.59	92	0
External Rotation Technique	Traditional	3.39 ± 0.40	3.06 ± 0.28	91	0
Milch Maneuver	Traditional	5.28 ± 0.54	4.29 ± 0.14	80	0
Chair Method	Traditional	4.00 ± 0.60	3.00 ± 0.30	78	0
Traction-Countertraction	Traditional	4.75 ± 0.55	6.05 ± 2.49	95	0
Scapular Manipulation	Traditional	1.47 ± 0.44	1.75 ± 0.38	97	0
Stimson's Technique	Traditional	5.30 ± 0.14	8.84 ± 0.30	28	0
Hippocratic Maneuver	Traditional	4.88 ± 0.54	5.55 ± 0.39	73	0
Fast, Reliable, and Safe (FARES) Method	Non-Traditional	1.59 ± 0.46	2.24 ± 0.27	92	0

technique took the longest (mean time 8.84 min).[2] Only three studies looked at mean hospital stay.

Shoulders reduced with the Milch maneuver had the shortest hospital stay (35 min), followed by those who were treated with scapular manipulation (92.4 min), the Oxford Chair (141 min), and the traction-countertraction maneuver (320.4 min).[2]

For patient experienced pain, the scapular manipulation technique tends to be the least painful during the reduction (VAS=1.47 during reduction), followed by the FARES method (VAS=1.59 during reduction).[2] The Stimson's method (VAS=5.30; SD 0.14) and the Milch method (VAS=5.28) tend to be the most painful.[2] Only one study reported a complication which occurred during implementation of the Kocher reduction technique, which was a fracture of the humeral neck.[2] The authors of this systematic comparison also specifically mention that the Kocher method has previously been associated with a rupture of the pectoral muscles or humeral fractures and that the Hippocratic method has been associated with transient neuropraxia of the brachial nerve.[2]

Evidence in this review identified that the FARES method had the best outcomes without any analgesic use reported.[2] The scapular manipulation technique had a lower patient pain rating during relocation, but all patients receiving that technique on their dislocation were also given intravenous analgesics. It is evident that the scapular manipulation technique and FARES maneuver had the lowest amounts of pain during reduction and these two techniques also exhibited some of the highest rates of reduction success. The FARES method is new and considered non-traditional compared to the scapular manipulation technique, but clearly shows promising outcomes in patient pain and reduction success.[2]

However, there are many limitations to this systematic comparison that need to be addressed. Practitioner experience and bias were not examined, as some may be more likely to choose one method over another based-on patient characteristics or their own comfort and education in reduction. This analysis was done using studies that took place in the hospital setting, and therefore does not consider the hospital protocols, which could particularly influence the outcome of length of hospital stay. Furthermore, many methods used accompanying analgesics or anesthetics and it was not determined if the use of these had been determined by hospital protocol, physician order, or upon patient request. The authors concluded that the techniques that also used analgesics or anesthesia generally had higher rates of successful reduction; it makes sense that a person in less pain would also have less muscle guarding, allowing for a better chance at a successful reduction. Along with the risks associated with closed reduction of a shoulder dislocation, the use of analgesics or anesthesia comes with its own set of concerns that affect patient comfort, such as vomiting and respiratory distress.[2]

This is relevant to athletic trainers because, depending on the standing orders from the team physician or laws of the state in which they are practicing, the athletic trainer may be in a situation in which they are called on to relocate a shoulder and knowledge of which technique to use is important for best patient outcomes. Joint relocation has become part of the 2020 CAATE Standards, leaving many athletic trainers who have already completed their education without this training. We believe that education on these shoulder reduction techniques should be taught to athletic trainers who are already certified; it may be possible to do so at either at a conference or as a professional development course, as this is likely where many athletic trainers can gather for education. However, an online class, while more attainable, may not be the best option as techniques like this require firsthand practice. Based on the findings of the guiding systematic comparison and our own clinical analysis, we believe that the FARES method is the most clinically applicable for athletic trainers while also being cautious of patient comfort. The FARES method is simple and does not require intravenous analgesics, which some athletic trainers are not allowed to provide based on state practice acts and physician oversight. In our experience, athletic trainers may come across an acute shoulder dislocation in the athletics setting, particularly in contact or collision sports.

CLINICAL BOTTOM LINE

There are several techniques to reduce a shoulder dislocation. Choosing which technique to use depends on clinician training, access to extraneous assistance such as intravenous analgesics, the direction of dislocation, and the setting that the clinician is providing care. According to this review, the FARES technique was the most successful, least painful, and quickest when the use of intravenous analgesics was not available.[2] Although the scapular manipulation method of reduction had the best results across all categories, all patients were treated with intravenous analgesics, which is not readily available in many athletic training settings. Also, athletic trainers are often not able to provide the intravenous analgesics so additional assistance may be required and is not always an option. The other techniques are valid but are not as effective based on the criteria. We believe that athletic trainers need more access to education on joint reduction techniques. Further research should include dislocation reductions involving athletic trainers and their prehospital care in a variety of patients that reflect an athletic trainers' patient population.

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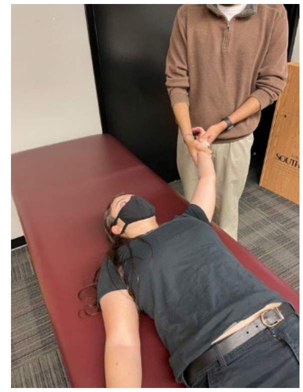
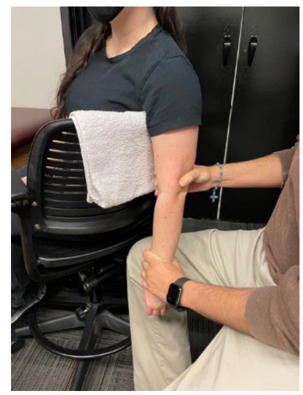
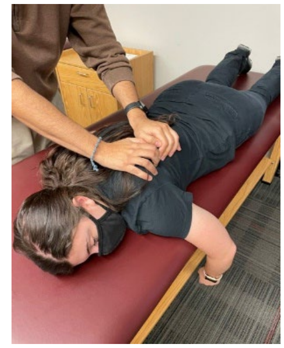
Table 2: How to perform each reduction technique included in systematic comparison

Technique Name	Performance Process	Photo of Technique
1. Kocher Maneuver	1. Patient is supine, arm adducted, and elbow flexed to 90 degrees 2. Clinician externally rotates arm until resistance is felt 3. Clinician flexes arm in external rotation 4. Clinician returns to adducted position	
2. Spaso Technique	1. Patient is supine, shoulder flexed to 90 degrees 2. Clinician pulls traction 3. Clinician externally rotates shoulder while maintaining traction until relocation is felt	
3. External Rotation Technique	1. Patient is supine with arm adducted and elbow flexed to 90 degrees each 2. Clinician flexes shoulder to 20 degrees 3. Clinician moves shoulder into external rotation until reduction is felt	

4. Milch Maneuver	1. Patient is supine 2. Clinician holds arm at the wrist 3. Clinician abducts and externally rotates arm until relocation is felt	
5. Chair Method	1. Patient's axilla is placed over back of a chair 2. Clinician holds arm from wrist and elbow 3. Clinician pulls downward traction until relocation occurs	
6. Traction-Countertraction	1. Patient lies supine with a sheet or belt around thorax and around contralateral side of affected shoulder and clinician 2. Patient elbow and shoulder are each flexed to 90 degrees 3. Clinician applies traction 4. Typically requires two clinicians	

7. Scapular Manipulation

1. Patient is prone with shoulder hanging off the table at 90 degrees of flexion
2. Patient holds weight in hand to provide traction
3. Clinician rotates scapula medially



8. Stimson's Technique

1. Patient is prone
2. Arm hangs off edge of the table
3. Manual or weighted traction is placed on the hanging arm
4. Held for 10-20 min until shoulder relocates

9. Hippocratic Maneuver

1. Patient is supine
2. Clinician places foot into injured side axilla
3. Traction is applied while arm is abducted to 30 degrees

10. Fast, Reliable, and Safe (FARES) Method

1. Patient is supine
2. Clinician holds arm at the wrist
3. Clinician slowly abducts the arm while providing constant traction and oscillation