Spring 4-20-2018

Is dry cupping as effective as a traditional exercise program in reducing shoulder pain in competitive swimmers

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Abstract

Purpose: The purpose of this literature review is to investigate the efficacy of dry cupping as a method for pain reduction in competitive swimmers.

Background: Competitive swimming increased to a member base of over 335,000 in 2015. Elite swimmers can perform between 500-thousand to 1-million arm cycles in each year. The repetitive overhead motion of swimming can lead to overuse injuries over time. During the 2016 Olympics, some swimmers appeared with visible round bruises left by a Traditional Chinese Medicine treatment method of cupping.

Case Description: The patient is a 28-year-old female swimmer who trains with a Masters Swim Team and competes in triathlons. She presented to an orthopedic outpatient clinic with self-diagnosed swimmer's shoulder with a duration of 6 months. The patient had noticed that cupping was being used by elite athletes and inquired as to its efficacy in treating shoulder pain.

Methods: Several databases were searched regarding the use of cupping therapy for the treatment of shoulder pain in swimmers. A review of the current literature revealed that there is low level evidence for the use of cupping in pain reduction but no studies have been conducted on swimmers. In contrast, there was sufficient evidence to suggest that exercise and stretching can have a significant effect on both pain and function of the shoulder in competitive swimmers.

Discussion: Due to the lack of evidence of the use of cupping in swimmers, a decision of its efficacy must be extrapolated from the scarce amount of studies available. Studies have shown that cupping may be able to decrease pain by an average of 20mm on the Visual Analog Scale. This suggests that in the painful shoulder it may be used as an adjunct to exercise therapy but should not replace it as cupping does not address the underlying impairments that swimming induces on the shoulder.

Level of Evidence: 5

Introduction

Competitive swimming is a sport that has increased in popularity over the years with more than 335,000 members registered with USA Swimming in the year 2015 (2015 Membership Demographics, 2016). There are four stokes utilized in competitive swimming: freestyle (or crawl), butterfly, backstroke and breaststroke. Swimmers may specialize in one or many stroke patterns, but a large proportion of the practice is spent on freestyle (Heinlein & Cosgarea, 2010; Matzkin, Suslavich, & Wes, 2016).

Swimmers start high intensity training as young as 8, and elite swimmers over the age of 13 can perform between 0.5 to 1 million arm cycles in a given year (Bak, 2010). Training for the swim season is broken up between long-course training (50-meter pool) in the fall and winter, followed by short-course training (25-meter pool) in the spring (Wymore, Reeve, and Chaput, 2012). Some swimmers train consistently throughout the entire year which can translate to the athletes practicing between 5-7 times per week, and average between 6-10 thousand meters each day (Heinlein & Cosgarea, 2010). This repetitive motion at the shoulder joint with such high intensities may predispose the competitor to overuse injuries. Swimmer's shoulder is a catch-all diagnosis that was termed in the 1970's and has recently been thought to represent multiple pathologies including instability, impingement of the shoulder complex, rotator cuff and biceps tendonitis (Sein et al., 2008). Walker, Gabbe, Wajswelner, Blanch, and Bennell (2012) found shoulder injury rates of competitive swimmers between 23-38% which is consistent with other studies but some have reported incidence rates as high as 87% (Tovin, 2006). Additionally, a recent study involving eleven NCAA swim teams by Wymore, Reeve, and Chaput (2012) found no correlation between swim stroke and incidence of shoulder pain.

The 2016 Olympics introduced a new, albeit old, form of therapy to treat pain ailments as evidenced by the presence of round bruising on many of the competitive swimmers. This form of therapy is known as cupping. Cupping is a type of Traditional Chinese Medicine (TCM) that follows the thought of balancing "*Qi*" (Tham, Lee, & Lu, 2006). Traditional Chinese Medicine considers *Qi* a life force and blockage or stagnation of this can result in disease (Tham, Lee, & Lu, 2006). The disease or ailment is treated by unblocking the stagnant *Qi* though various techniques, one of which is cupping (Tham, Lee, & Lu, 2006). There are many different types of cupping therapy but the most widely used method is dry cupping which is a noninvasive procedure performed with the use of spherical glass cups with a rolled rim varying in size from 25-75mm (Mehta & Dhapte, 2015). Wet cupping differs in that the practitioner makes a small incision at the application site prior to adding the cup causing the patient to bleed (Rozenfeld & Kalichman, 2016).

The general method for cupping involves using the round cup along with negative pressure to form an air-tight contact with the patient that results in a vacuum type effect (Rozenfeld & Kalichman, 2016). The negative pressure in the cup is achieved by swabbing the interior of the cup with a flammable substance (such as alcohol), lighting it, and placing the cup on the patient moments before the flame is extinguished (Rozenfeld & Kalichman, 2016). This induces a negative pressure effect that creates a suction in the cup creating a tensile force on the skin and tissue beneath (Rozenfeld & Kalichman, 2016; Tham, Lee, & Lu, 2006). Cupping has been used to treat various pathologies ranging from neuralgia to stomach aches, although it's primary use is musculoskeletal pain (Rozenfeld & Kalichman, 2016). In theory, cupping is thought to increase circulation, vasodilation, and local metabolism while decreasing systemic blood pressure (Chi et al., 2016). Although the exact mechanism is unknown, the most

comprehensive mechanism thought to explain the effects are what Rozenfeld & Kalichman (2016) call the neural mechanism theory. This theory states that small diameter nerves in the muscles send impulses to the spinal cord which activate various mechanisms in the central nervous system; this in turn activates various chemical transmitters to produce an analgesic type effect (Rozenfeld & Kalichman, 2016).

There is no gold standard in treating swimmer's shoulder but recommendations include conservative treatment with reduction of time in the water, alteration of training patterns (reduce use of hand paddles and kickboards), individualized exercise training that includes stretching and strengthening, and surgery in more severe cases (Bak, 2010; Tovin, 2006). With the extensive coverage of the 2016 Olympics and the introduction of cupping treatment to many of those who were not aware of the treatment until then; this study aims to investigate if dry cupping (DC) is as effective as traditional exercise programs (TEP) in treating the painful shoulder in competitive swimmers.

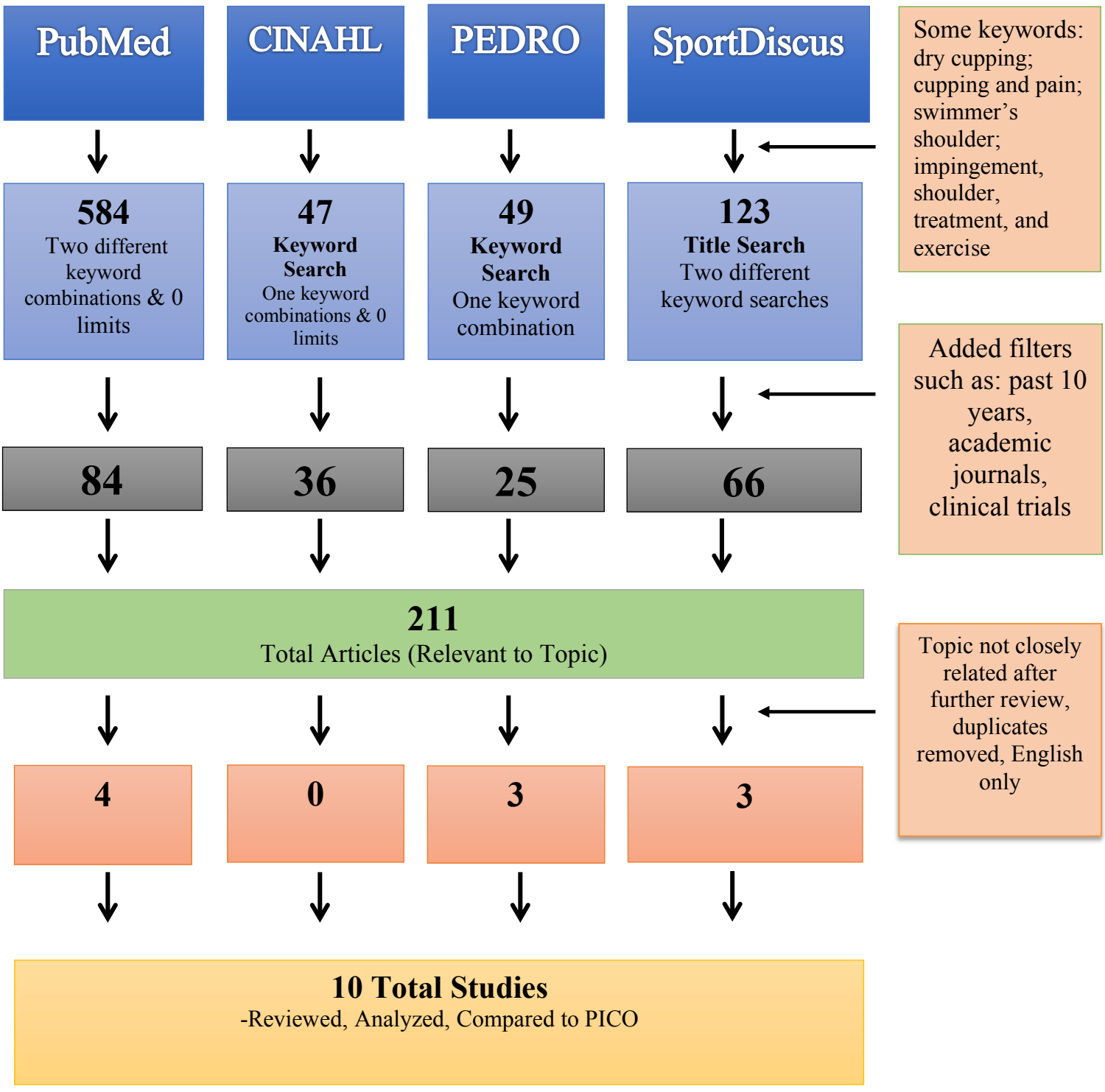
Case Description

The patient leading to the question of this literature review was a 28-year-old female recreational swimmer who occasionally trains with a Master's Swim team and competes in triathlons. She presented to an orthopedic outpatient physical therapy clinic with reports of right shoulder pain that has been present for 6 months and self-diagnosed swimmer's shoulder. Symptoms were exacerbated with increased swim load and subsided with rest, non-steroidal anti-inflammatory medication, and over-the-counter topical analgesics after several days. The patient inquired about alternative treatment ideas that would help with her condition, one of which was dry cupping.

Methods

In conducting the literature review a number of databases were utilized including: PubMed, PEDRO, CINAHL, SPORTDiscus, and Web of Knowledge. Of these databases, searches from CINAHL and Web of Knowledge returned duplicate articles and therefore are not included in the flowchart presented in Figure 1. Search terms included: dry cupping, cupping, pain, shoulder, impingement, treatment, exercise, and swimmer's shoulder. After reviewing the titles and abstracts a total of 10 articles were chosen due to their relevance to the question at hand. These 10 articles were then reviewed, analyzed, and compared to the question. Search breakdown is illustrated in Figure 1: Articles Included and Excluded for Analysis. Article summaries are included in Table 1: Article Summaries and further in Appendix A. Article analysis are included in Appendix B.

Figure 1: Articles Included and Excluded for Analysis



	Study and Origin	Oxford Level of Evidence	Pedro Score	Purpose of Study	Outcome Measures	Results	Accept Results to Answer PICO Question
1	(Chi et al., 2016) Taiwan	2b	5/10	Effectiveness of cupping therapy in changes of surface skin temperature for relieving chronic neck and shoulder pain	Skin surface temperature, blood pressure, VAS	Intervention group had a significant reduction in both neck and shoulder pain as reported by VAS ($p<0.001$)	Yes
2	(Lauche et al., 2011) Germany	1b	7/10	Effectiveness of 5 dry cupping sessions on chronic non-specific neck pain	VAS, NDI, SF-36, PPT, MDT, VDT	Intervention group had a significant decrease in neck pain at rest ($p=.00002$) and maximal pain related to movement ($p=0.001$) after 5 treatment sessions	Yes
3	(Michalsen et al., 2009) Germany	1b	7/10	Effects of wet cupping on carpal tunnel syndrome	VAS, DASH, NPQ, Levine Questionnaire, SF-36	Intervention group significantly improved in VAS, Levine questionnaire, DASH, and NPQ	No

	Study and Origin	Oxford Level of Evidence	Pedro Score	Purpose of Study	Outcome Measures	Results	Accept Results to Answer PICO Question
4	(Markowski et al., 2014) United States	4	N/A	Investigate effects of cupping therapy on patients experiencing low back pain	VAS, ROM, SLR, PPT	Subjects significantly improved in VAS (p=0.0001), SLR of the left (p=0.043), lumbar flexion ROM (p=0.016), and PPT in 4 points investigated (p,0.007)	Yes
5	(Maenhout, Mahieu, De Muynck, De Wilde, & Cools, 2012) Belgium	2b	6/10	Investigate the addition of heavy load eccentric training to conservative treatment in patients with subacromial impingement	Isometric strength, pain and function (SPADI), self-perceived improvement	Both groups improved significantly on SPADI (p<0.001), no difference between groups All groups improved in isometric strength (p<0.001) regarding abduction at 0deg, 45deg of scapular abduction, external rotation (all p<0.001), and internal rotation (p=0.038)	Yes

	Study and Origin	Oxford Level of Evidence	Pedro Score	Purpose of Study	Outcome Measures	Results	Accept Results to Answer PICO Question
6	(Holmgren, Bjornsson Hallgren, Oberg, Adolfsson, & Johansson, 2012) Sweden	2c	7/10	Investigate whether a specific exercise strategy improves shoulder function and pain versus an unspecific exercise program in patients with subacromial impingement	Constant-Murly, DASH	Intervention group improved Constant-Murley by 24 (19-28 95%CI), DASH 16 (SD 15, 95%CI), EQ-5D significant improvement ($p<0.001$), no significant difference in EQ-VAS between groups	Yes
7	(Tarek Sadek, 2016) Egypt	4	N/A	Investigate effect of TRX suspension training to prevent shoulder pain in young swimmers	Static strength test, passive chest flexibility, active chest flexibility, shoulder mobility, seated medicine ball throw	All variables saw a statistically significant improvement ($p<0.05$)	No

	Study and Origin	Oxford Level of Evidence	Pedro Score	Purpose of Study	Outcome Measures	Results	Accept Results to Answer PICO Question
8	(Başkurt, Başkurt, Gelecek, & Özkan, 2011) Turkey	2b	5/10	Effectiveness of the addition to scapular stabilization exercises to a traditional exercise program in regards pain, ROM, strength, joint position sense, scapular dyskinesis, and quality of life	VAS, strength, joint position sense, lateral scapular slide test, Western Ontario Rotator Cuff Index (WORC)	Both groups significantly improved in regards to pain at rest, during activity, flexion, abduction, IR, ER, rotator cuff strength, and WORC score ($p<0.05$) The scapular stabilization group saw significant increases in trapezius strength, joint position sense, and lateral scapular slide test ($p<0.05$)	Yes

	Study and Origin	Oxford Level of Evidence	Pedro Score	Purpose of Study	Outcome Measures	Results	Accept Results to Answer PICO Question
9	(De Mey, Danneels, Cagnie, & Cools, 2012) Belgium	4	N/A	Investigate the effects of a 6-week exercise program consisting of 4 specific shoulder exercises on pain and function in overhead athletes	SPADI, MVIC of 3 parts of trapezius muscle, muscle ratio of UT vs. MT/LT/SA, muscle activation of UT, MT, LT, SA	SPADI scores decreased by 18.16 ($p<0.001$), MVIC for all trapezius muscles increased (SA MVIC did not), UT/SA ratio decreased but UT/MT and UT/LT did not ($p<0.05$), LT earlier activation than UT ($p<0.001$) and MT ($p<0.001$), SA earlier activation compared to UT and MT ($p<0.001$) and LT ($p=0.046$)	Yes
10	(Kromer, Bie, & Bastiaenen, 2014) Germany	1b	7/10	Effectiveness of manual physiotherapy and exercises versus exercises alone in patients with subacromial impingement syndrome	SPADI, Generic Patient-Specific Scale, FABQ, Pain Catastrophizing Scale, Direct costs, Indirect costs	Both groups significantly improved and no difference between groups at 1 year follow-up for all outcomes measures ($p<0.05$)	Yes

Table 1: Article Summaries

Discussion

The aim of this literature review was to assist a patient in determining if dry cupping is as effective as a traditional exercise program in the reduction of shoulder pain. This intervention has become more popular since professional swimmers competing in the 2016 Olympics appearing with small, round bruises on their shoulders. *The Guardian* reported that internet searches on Google rose 2100% for "circles on Michael Phelps" during the Olympics (Lyons, 2016). Efficacy regarding the effects of dry cupping on the shoulder, especially in an athletic population, is very limited. Therefore, decisions must be made through the extrapolation of information in the available literature. Dry cupping appears to have positive effects regarding pain reduction acutely after treatment but long-term effects could not be established.

Dry cupping intervention

Scholarly articles regarding the efficacy of dry cupping are scarce but those that have been published suggest that this modality may reduce pain in the tested populations. Chi et. al (2016) found that after one session of dry cupping in subjects with self-perceived chronic neck and shoulder pain that dry cupping was effective in reducing pain as shown by a reduction in the Visual Analog Scale (VAS) by 61mm and 59mm for neck and shoulder pain respectively. Lauche et. al (2011) found similar results in pain reduction when investigating the effects of 5-dry cupping sessions over the span of 2-weeks. This study found significant improvements in pain at rest (PR), pain during movement (PM), the Neck Disability Index (NDI) and bodily pain as reported on the SF-36. Both PR and PM were reported using the VAS with average reductions of 19.4mm and 33mm respectively (Lauche et. al, 2011). It should be noted that although the authors were able to find a statistically significant difference in both the VAS and the NDI, they

failed to meet the minimal clinically important difference (MCID) of a 10-point change on the NDI (Lauche et. al, 2011). The failure to meet the MCID requirements of the NDI may be attributed to the omission of addressing the underlying impairments and focusing on the symptom of pain.

Other authors have investigated the pain reducing effects of dry cupping as well. Michalsen et al. (2009) and Markowski et al. (2014) also investigated the effects of cupping on pain due to carpal tunnel syndrome and subacute low back pain respectively. Michalsen et. al (2009) used a wet cupping method, which involves puncturing the skin before the cup is applied. The authors saw positive results regarding pain reduction but due to the use of wet versus dry cupping the study results are weighed very lightly in this research. Similarly, Markowski et al. (2014) found a statistically significant difference regarding pain reduction ($p<0.0001$) in subjects with subacute low pain back. Cao et al. (2014) performed a systematic review and meta-analysis on the acute and chronic effects of cupping therapy on pain management. The authors investigated 16 cupping trials combined to complete 4 meta-analyses. Most of these analyses included wet cupping, but two trials conducted on dry cupping concluded that it significantly reduced pain on the VAS (outcome values not listed) compared to those subjects who were placed on a wait list (Cao et al., 2014). These articles all support the use of dry cupping as a pain management tool in their respective populations suggesting that it that it may useful in others as well.

The MCID for the VAS regarding shoulder pain has not been established and since there is no consensus as to the minimal clinically important difference for the VAS across settings, it is

worth comparing the aforementioned results with studies investigating MCID of the VAS. Lee, Hobden, Stiell, and Wells (2003) found that an MCID of 30mm was necessary to adequately control a patient's pain in an emergency room setting for those experiencing acute pain. In contrast, a 2009 study by Tashjian, Deloach, Porucznik, and Powell reported that a VAS change of 14mm was considered a minimal clinically important difference in patients with rotator cuff disease (Tashjian, Deloach, Porucznik, & Powell, 2009). Considering these findings are specific to rotator cuff pathology, which can be a significant factor in swimmer's shoulder, it is recommended to utilize the 14mm change as the MCID.

There are many theorized explanations for the pain reduction benefits afforded from dry cupping treatment. Chi et. al (2016) stated that some theories include: vasodilation, stimulation of circulation, and increased metabolism. The increase in skin temperature post-treatment is thought to support this assertion but an alternative thought is that high tensile stresses within the cup may cause dilation of the capillaries to the point of rupture (Chi et. al, 2016; Rozenfeld & Kalichman, 2016). Other proposed physiological effects include stretching muscles and the associated connective tissue, collagen synthesis, increased capillary endothelial repair, increased speed of granulation, and angiogenesis (Lauche et al., 2011; Markowski et al., 2014; Mehta & Dhapte, 2015; Rozenfeld & Kalichman, 2016). There is no consensus between authors as to the true physiological effects of dry cupping which leads to the need for more high-quality research into the matter. It should also be noted that a review of systematic reviews performed by Lee, Kim, and Ernst (2011) stated that most of the current reviews have been performed on clinical trials associated with a risk of bias. The authors noted that the systematic reviews were performed on trials that originate from mostly one geographical region (Lee, Kim, & Ernst,

2011). It is not known if this influences the data, there is currently more research coming from different areas of the world that have yielded similar results but still present with the risk of bias. It has proven difficult to devise a suitable sham treatment to compare cupping to as the subject is readily aware of what is commencing during the cupping session. Markowski et. al (2014) utilized a novel approach by standardizing the pressure in the cup utilizing a hand pump during application until 1.6cm of skin was elevated in the cup. By standardizing the pressure in the cup, a sham treatment may be employed by having far less pressure in the cup so the patient is blinded to the treatment. This approach modifies the traditional method of applying the cups, but introduces a new form of control which may improve the quality of the research.

In the clinic, if this modality is available the final decision to use this modality is made by the patient, however it is the therapist's role to educate the patient with the best possible evidence to allow them to make an informed decision. Recent evidence has revealed that dry cupping can reduce a subject's pain by more than the recommended 14mm on the VAS which suggests that it may be a viable option. The patient should be informed that the studies have not been performed on those specifically experiencing swimmer's shoulder but rather those diagnosed with other pathologies such as neck or back pain. Although evidence is limited, it should be noted that the lack of evidence does not imply that this modality which has been utilized for thousands of years is not effective.

Exercise intervention

Numerous studies over the years have correlated physical therapy exercise intervention with the reduction of shoulder pain and increased function. Exercise intervention focuses on

treating underlying impairments that may be pain symptom generators rather than treating the pain itself. Common impairment findings in the swimming population include: imbalances between internal and external rotators of the shoulder, stiffness in the latissimus dorsi, tight anterior shoulder musculature, a tight posterior glenohumeral joint capsule, and scapular dyskinesis (Batalha, Marmeleira, Garrido, & Silva, 2015; Laudner and Williams, 2013; Madesen et al., 2011; Tovin, 2006). Madsen, Bak, Jensen, and Welter (2011) found that a single swim training session of 100-minutes can induce scapular dyskinesis in competitive swimmers who currently do not experience shoulder pain. This could lead the swimmer to being predisposed to shoulder injury as intensity and training volume increases. Other studies investigating the effect of exercise on shoulder function in the swimming population include an article by De Mey, Danneels, Cagnie, and Cools (2012) which reported 4 specific shoulder exercises and their effect on pain, function, and activation levels in overhead athletes. In this study, it was concluded that the exercises utilized were able to decrease pain and increase function by an average reduction of 18.16 based on the Shoulder Pain and Disability Index (SPADI) (De Mey, Danneels, Cagnie, & Cools, 2012). Combining eccentric exercises with traditional exercises may also assist in addressing impairments induced by swimming. Maenhout, Mahieu, De Muynk, De Wilde, and Cools (2012) reported that combining eccentric training with traditional rotator cuff training reduced pain and increased function as reported by a reduction in SPADI scores of 25 in 12 weeks. The addition of scapular stabilization exercises may also improve pain, function, joint position sense, and scapular dyskinesis (Başkurt Z., Başkurt F., Gelecek, & Özkan, 2011). Strengthening of stabilizers is important as the decreased activation of the serratus anterior coupled with increased upper trapezius activation is seen in those with shoulder pathology (Madsen et al., 2011). This will help maintain the subacromial space during the stroke and

decrease the chance of impingement. Addressing the anterior shoulder musculature, Laudner, Wenig, Selkow, Williams, & Post (2015) conducted a study on female collegiate athletes and concluded that a muscle energy technique performed twice a week in combination with strengthening the posterior musculature resulted in a significantly reduced forward posture of rounded shoulders (Laudner, Wenig, Selkow, Williams, & Post, 2015). Additionally, Holmgren, Bjornsson Hallgren, Oberg, Adolfsson, and Johansson (2012) investigated the effects of a specific shoulder training program versus a generalized exercise program and found specific exercises and stretches to be more effective than a generalized exercise program. This has implications for swimmers as it can be extrapolated that an impairment based program designed by an experienced therapist may be superior to a generic program found elsewhere (i.e. the internet). Finally, Kromer, de Bie, and Bastiaenen (2014) suggested that an exercise program alone without the addition of manual therapy has similar results after one year. This is promising as a swimmer may be supplied an exercise program to fit their needs with minimal use of additional treatment.

In summary, an exercise program focused on correcting impairments found by an experienced physical therapist has been shown to decrease pain and increase function in the swimming population. This involves utilizing the many techniques physical therapists are capable of implementing and teaching the athlete to include: exercises focused on strengthening weak muscles, adding eccentric exercises to traditional exercises, improving endurance of muscles that fatigue easily, stretching adaptively shortened muscle groups, and/or teaching muscle energy techniques that can be applied by a teammate. Although pain is not the primary

focus of the physical therapy intervention, it is probable that it will be resolved once the underlying impairments are addressed.

Conclusion

Although there may be many impairments involved in swimmer's shoulder, pain is typically the focus and debilitating factor to the athlete. The results of this literature review suggest that dry cupping may be a suitable treatment for shoulder pain in competitive swimmers but has not been shown to have long term effects. Therefore, it should be considered only as an adjunct treatment performed by a certified practitioner to decrease pain in conjunction with a focused exercise program to address the underlying impairments to reduce the possibility of future injury.

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26. Tarek Sadek, M. (2016). Effect of TRX suspension training as a prevention program to avoid the shoulder pain for swimmers. *Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health, 16*(2), 222-227.

27. Tashjian, R., Deloach, J., Porucznik, C., & Powell, A. (2009). Minimal clinically important differences (MCID) and patient acceptable symptomatic state (PASS) for visual analog scales (VAS) measuring pain in patients treated for rotator cuff disease. *Journal of Shoulder and Elbow Surgery*, *18*(6), 927-932. http://dx.doi.org/10.1016/j.jse.2009.03.021

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Appendix A: Article Summaries

Chi, L., Lin, L., Chen, C., Wang, S., Lai, H., & Peng, T. (2016). The Effectiveness of Cupping Therapy on Relieving Chronic Neck and Shoulder Pain: A Randomized Controlled Trial. *Evidence-Based Complementary and Alternative Medicine*, *2016*, 1-7. http://dx.doi.org/10.1155/2016/7358918

Level of Evidence: Oxford 2b, PEDRO 5/10

Purpose: To investigate the efficacy of cupping therapy on chronic neck and shoulder pain as well as surface skin temperature in members of the community in Hualien City, Taiwan.

Methods: 60 subjects were randomized in 2 groups of equal size. The intervention group received dry cupping therapy at 3 acupuncture sites: SI 15, GB 21, and LI 15. The cups were administered to the subject's right side and left in place for 10 minutes, removed, and the procedure was then repeated on the subjects left side. The control group received a treatment of "resting" for 20 minutes.

Results: There was a statistically significant increase in skin surface temperatures for all 3 points tested at 5-minutes post-intervention for the treatment group ($p=0.003$, $p=0.003$, $0=0.008$ for SI 15, GB 21, and LI 15 respectively). There was also a statistically significant decrease in systolic blood pressure in the treatment group as well ($p=0.003$). Finally, there was a statistically significant decrease in both neck and shoulder pain per the VAS in the treatment (both $p<0.001$)

Conclusion: The researchers conclude that 10 minutes of dry cupping therapy have statistically significant effects in regards to skin surface temperature, blood pressure, and pain in subjects with non-specific neck and shoulder pain. This study is important has it demonstrates there are possible acute effects to dry cupping therapy regarding increased circulation and pain relief. It is however still unclear as it can be assumed that any treatment is better than no treatment. It is also important to take into account the placebo effect as the subjects were not blinded to the interventions.

Lauche, R., Cramer, H., Choi, K., Rampp, T., Saha, F., Dobos, G., & Musial, F. (2011). The influence of a series of five dry cupping treatments on pain and mechanical thresholds in patients with chronic non-specific neck pain - a randomised controlled pilot study. *BMC Complementary and Alternative Medicine*, *11*(1). http://dx.doi.org/10.1186/1472-6882-11-63

Level of Evidence: Oxford 1b, PEDRO 7/10

Purpose: A pilot study to investigate the effects of a series of 5 dry cupping session on pain relief and mechanical pressure thresholds in subjects with chronic non-specific neck pain.

Methods: Subjects were randomly divided into treatment groups and a wait-list group. Both groups were given pain diaries to diaries and various outcome measures to fill out at baseline assessment and 18-days post-intervention of the treatment group. Once baseline measurements were collected, the treatment group received 5 dry cupping sessions over the course of 2 weeks while the wait list group received no treatment. The wait list group was offered treatment after outcomes measures were collected.

Results: Post-treatment the intervention group had a significant decrease in pain at rest and maximal pain related to movement versus the wait list group. NDI decreased significantly in the treatment group as well but the SF-36 did subscales for physical or mental components revealed no statistical difference between the two groups. Finally, there was a between group difference regarding pain-pressure threshold but not for mechanical-detection threshold or vibration-detection threshold in favor of the treatment group.

Conclusion: The results of this study illustrate that 5 session of dry cupping over a course of 2-weeks may be effective in the reduction of pain in subject with chronic non-specific neck pain. It should be noted that the subjects were not blinded as a sham treatment for cupping has yet to be designed. Placebo effect cannot be ruled out and an MCID of 3cm (30mm) has been referenced by other authors which was not met by the mean but was include in the 95% confidence interval. Therefore, it may effective in treating pain statistically but not clinically.

Michalsen, A., Bock, S., Lüdtke, R., Rampp, T., Baecker, M., & Bachmann, J. et al. (2009). Effects of Traditional Cupping Therapy in Patients with Carpal Tunnel Syndrome: A Randomized Controlled Trial. *The Journal of Pain*, *10*(6), 601-608. http://dx.doi.org/10.1016/j.jpain.2008.12.013

Level of Evidence: Oxford 1b, PEDRO 7/10

Purpose: To investigate the effects of a single wet cupping treatment versus local thermal therapy on pain in subjects presenting with carpal tunnel syndrome

Methods: Subjects were randomized into 2 groups utilizing a non-stratified block-randomization with various lengths. The treatment group received one session of wet cupping which involves puncturing the skin with a 20-gauge microlancet before the cup is administered. The cups were left on for a duration of between 5-10 minutes. The control group had a heating pad placed bilaterally on the patient's shoulders for 15-minutes and acted as the control group as this is a common home therapy in Germany for this pathology. Outcomes measures were taken 7-days post treatment.

Results: There was a statistically significant difference in favor of the treatment group 7-days post treatment regarding pain at rest, numbness, tingling, pain during movement, pain with pressure, Levine CTS Score Symptom Severity, and functional status (DASH) with a $p<0.001$ except the Levine CTS Score Symptom Severity, $p=0.002$.

Conclusion: The subjects treated in this study had a significant reduction in pain and an increase in function one week after receiving a single session of wet cupping. The pain reduction did meet the MCID set forth at 3cm for shoulder patients although this treatment may pose other possible risks as the patient's skin must be punctured. This treatment was compared to using a simple heating pad so the placebo effect should be taken into effect as the patients were not blinded to the treatment they were receiving. Although this study shows a significant increase one week post treatment, further long-term studies should be conducted to verify its efficacy.

Markowski, A., Sanford, S., Pikowski, J., Fauvell, D., Cimino, D., & Caplan, S. (2014). A Pilot Study Analyzing the Effects of Chinese Cupping as an Adjunct Treatment for Patients with Subacute Low Back Pain on Relieving Pain, Improving Range of Motion, and Improving Function. *The Journal of Alternative and Complementary Medicine*, *20*(2), 113-117. http://dx.doi.org/10.1089/acm.2012.0769

Level of Evidence: Oxford 4, PEDRO n/a

Purpose: To investigate the effect of dry cupping on subjects on pain, range of motion, and function in subjects with subacute low back pain.

Methods: 21 patients were recruited for this study of which 18 were able to complete it. This was a quasi-experimental study as there was no control group and the subjects were compared between pre- and post-intervention data. Cups were applied to the subject's low back and a hand pump was used to perform the suction. Suction was applied so that 1.5cm of skin was elevated within the cup and the treatment lasted for 10 minutes. Outcome measures used include OSWETRY, VAS, pain-pressure threshold, and range of motion.

Results: There statistically significant improvements for VAS ($p<0.00001$), straight leg raise ROM on the left ($p=0.043$), lumbar flexion ($p=0.016$), and pain-pressure thresholds for the 4 points measures ($p<0.007$).

Conclusion: The results of this study suggest that a single session of dry cupping can have alleviate pain, increase range of motion, and improve function in subjects with subacute low back pain. The authors do not provide any baseline data for any measurements or outcome measures as well as no confidence intervals. Considering the lack of data presented it is therefore recommended that this article not be utilized in decision making as it cannot be determined if the subjects met the minimal clinically important difference for the measures. Also, the small sample size may not be representative a larger population. This should be considered a pilot study and further research should be conducted in which the authors provide the reader with the data.

Maenhout, A., Mahieu, N., De Muynck, M., De Wilde, L., & Cools, A. (2012). Does adding heavy load eccentric training to rehabilitation of patients with unilateral subacromial impingement result in better outcome? A randomized, clinical trial. *Knee Surgery, Sports Traumatology, Arthroscopy*, *21*(5), 1158-1167. http://dx.doi.org/10.1007/s00167-012-2012-8

Level of Evidence: Oxford 2b, PEDRO 6/10

Purpose: To investigate the efficacy of adding heavy load eccentric training to a conservative rehabilitation treatment plan in increasing strength and decreasing pain and dysfunction.

Methods: Both groups performed all exercises at home for 12 weeks while simultaneously attending one physical therapy session lasting 30 minutes for the first 6 weeks, then on session every other week for the last 6 weeks of treatment. The traditional treatment group performed internal and external rotation strengthening exercises with the use of a resistance band. The intervention group performed the same exercises with the addition of performing the eccentric phase of a full can exercise in the scapular plane. All subjects completed a daily log book consisting of exercises performed, pain, and adverse events. Additionally, subjects were requested no to perform any other exercises or seek outside treatments. Pain and function were assessed through the SPADI and isometric strength was measure utilizing a hand-held dynamometer.

Results: Both groups increased isometric strength in regards to abduction at 0deg, 45deg of scapular abduction, external rotation (all $p<0.001$) and internal rotation ($p=0.038$). The treatment group demonstrated an increase in isometric strength of abduction at 90deg ($p<0.001$). No difference between groups regarding SPADI at 12 weeks although both improved ($p<0.001$)

Conclusion: The study demonstrates that the addition of eccentric strengthening to a traditional program may improve strength but has similar outcomes regarding pain and function. This study included minimal exercises that are not typical of common physical therapy practices therefore it should be considered that a preliminary study on the use of eccentrics in rehabilitation.

Holmgren, T., Bjornsson Hallgren, H., Oberg, B., Adolfsson, L., & Johansson, K. (2012). Effect of specific exercise strategy on need for surgery in patients with subacromial impingement syndrome: randomised controlled study. *BMJ*, *344*(feb20 1), e787-e787. http://dx.doi.org/10.1136/bmj.e787

Level of Evidence: Oxford 2b, PEDRO 7/10

Purpose: To investigate if utilizing a specific exercise strategy focusing on both rotator cuff and scapular stabilizers versus unspecific exercises in subjects with subacromial impingement syndrome improves shoulder function and pain as well as decreasing the need for decompression surgical intervention.

Methods: All subjects received a corticosteroid injection at the first visit. 2-weeks after the injection all subjects were introduced to the exercises. All patients followed up with the research therapist once a week for the first 2 weeks and then every other week thereafter for the remainder of the study (7 visits total). The intervention group performed a standardized 6 exercise protocol focusing on the rotator cuff and scapular stabilizers by utilizing weights or elastic band. The control group received 6 unspecific movement exercises for the neck and shoulder with no external load.

Results: There was a significant greater improvement of the intervention group regarding the Constant-Murley score (24pts vs. 9pts in control), global assessment of change ($p<0.001$), as well as a lower proportion of underwent surgery (20% vs. 63% of the control).

Conclusion: This study suggests that exercises specific to rotator cuff and scapular stabilizer function can reduce pain and function versus an unspecific exercise program. It should be noted that the intensity of the programs was different in regards to set, repetition, and load. This should be taken into account when reviewing results. If the unspecific group were given the same intensity (external load, repetitions, and sets) then the outcomes and statistical significance may vary dramatically.

Tarek Sadek, M. (2016). Effect of TRX suspension training as a prevention program to avoid the shoulder pain for swimmers. *Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health, 16*(2), 222-227.

Level of Evidence: Oxford 4, PEDRO N/A

Purpose: To investigate the effects of the TRX suspension trainer on prevention of shoulder pain in young swimmers.

Methods: 10 swimmers from the Ajman club were selected at random. Subjects trained 3 times a week for 8 weeks with a TRX suspension training system. Static strength, active and passive chest flexibility, shoulder mobility, and seated medicine ball throw were measured pre- and post-intervention.

Results: Subjects improved in all outcome measures ($p<0.05$) after the intervention.

Conclusion: The authors conclude that utilization of the TRX suspension trainer improved the swimmer's strength and flexibility of the shoulder. This alone cannot be used to support the hypothesis of the study that inclusion of a TRX program can prevent shoulder pain. This study has several limitations, some of which may be due to translation of the article. First, the authors do not mention how they randomly selected the subjects to participate in the study. Second, there is no mention as to what exercises the subjects performed on the TRX, just simply that they participated in a program. Third, in one paragraph of the article it states that the subjects will participate 3 times a week in training but in another paragraph, it is stated that the training program was offered twice a week. The bottom line is that this article cannot be suggest from the results that it can prevent incidence of shoulder pain in young swimmers. This article can suggest that participating in suspension training multiple time per week may increase strength and flexibility. Specific exercises used should have been reported as well inclusion of pain and function outcome measures.

Başkurt, Z., Başkurt, F., Gelecek, N., & Özkan, M. (2011). The effectiveness of scapular stabilization exercise in the patients with subacromial impingement syndrome. *Journal of Back and Musculoskeletal Rehabilitation*, *24*(3), 173-179. http://dx.doi.org/10.3233/bmr-2011-0291

Level of Evidence: Oxford 2b, PEDRO 5/10

Purpose: To investigate the effectiveness of stretching, strengthening, and scapular stabilization exercises on pain, range of motion, strength, joint position sense, and quality of life in subjects with subacromial impingement syndrome.

Methods: 40 patients were randomized into 2 groups of 20. One group received stretching and strengthening exercises while the intervention group received the same with the addition of scapular stabilization exercises. The standardized exercise protocol consisted of flexibility, strengthening, and Codman exercises. Scapular stabilization exercises added to the intervention group include PNF, scapular clocks, stranding weight shift, double arm balance, scapular depression, wall push-up, and wall slide exercises. Training consisted of 3 sets of 10 repetitions of each exercise performed 3 times per week for 6 weeks. Subjects were progressed to next strongest exercise band once they were able to complete the 3 sets without substantial fatigue or pain.

Results: There was an improvement but no difference between groups regarding any of the outcomes measures with the exception of the 3 parts of the trapezius, serratus anterior, joint position sense, and lateral scapular slide test ($p<0.05$).

Conclusion: These results suggest that the addition of scapular training exercises can improve joint position sense and scapular stability during movements. The clinical significance of this study is that the addition to scapular stabilization exercises has a positive effect on scapular position which is important during movements of the upper extremity.

De Mey, K., Danneels, L., Cagnie, B., & Cools, A. (2012). Scapular Muscle Rehabilitation Exercises in Overhead Athletes with Impingement Symptoms: Effect of a 6-Week Training Program on Muscle Recruitment and Functional Outcome. *The American Journal of Sports Medicine*, *40*(8), 1906-1915. http://dx.doi.org/10.1177/0363546512453297

Level of Evidence: Oxford 4, PEDRO N/A

Purpose: To investigate the effect of 4 previously studied exercises regarding pain, function, and activation levels, and onset timing during shoulder elevation in overhead athletes with impingement symptoms.

Methods: 40 overhead athletes who have had symptoms for at least 3 months completed the trial. None of which had ceased training or contacted the team physician. The subjects underwent 6-weeks of a daily home exercise program consisting of: side-lying forward flexion, side-lying external rotation, prone horizontal abduction with external rotation, and prone extension in a neutral position. Subjects were instructed to perform 3 sets of 10 repetitions with 1 minute of rest in between. Exercises were individualized by 10-rep max testing and a pain level of up to 5 was allowed on the VAS.

Results: SPADI scores decrease significantly ($p<001$) and surpassed the MCID in over half the participants. MVIC values for the 3 parts of the trapezius significantly increased for UT ($p=0.003$), MT ($p=0.026$), and LT ($p=0.003$), but not for serratus anterior ($p=0.285$). There was also an overall decrease in trapezius activation and UT/SA ratio but no changes in UT/MT and UT/LT ratios.

Conclusion: This study suggests that the exercises chosen for their muscle activation ratios may cause improved activation regarding UT/SA but not for the UT/MT and UT/LT. Future studies may find a change in UT/MT and UT/LT ratios as the pre-test ratios of the subjects in this study were already considered low. This is important as these exercises have been shown in EMG studies to have favorable muscle ratios which could help correct muscle imbalances.

Kromer, T., Bie, R., & Bastiaenen, C. (2014). Effectiveness of physiotherapy and costs in patients with clinical signs of shoulder impingement syndrome: One-year follow-up of a randomized controlled trial. *Journal of Rehabilitation Medicine*, *46*(10), 1029-1036. http://dx.doi.org/10.2340/16501977-1867

Level of Evidence: Oxford 1b, PEDRO 7/10

Purpose: To investigate the effects of manual physiotherapy and exercises versus exercises alone in subjects with shoulder impingement syndrome after one year of inclusion in the trial.

Methods: 90 subjects were recruited and randomized into the 2 groups. The intervention group received an individualized exercise program along with individualized manual physiotherapy and the control group received just the individualized exercise program. Participants received 2 treatment sessions a week for 5 weeks and afterwards continued with their home exercise programs for 7 additional weeks.

Results: Both groups improved significantly in SPADI scores and sub0scores for pain and function, as well as improvements in the Generic Patient Specific Scale though there was no difference between groups (p=0.38). 87% of total participants saw a 30% improvement on SPADI compared to baseline and 81% saw a 50% or more improvement.

Conclusion: This study suggests that at a 1-year follow-up there is no difference between groups when given either manual physiotherapy in addition to an individualized exercise program versus those who received and individualized exercise program alone. Both groups saw significant improvements over the course a year but one cannot rule out the spontaneous healing that can occur during this time. One conclusion that may be inferred from this study is that a patient who is considering surgical intervention may want to wait at least one year before making the decision if they participate in an individualized exercise program.

Appendix B: Article Analyses

Chi, L., Lin, L., Chen, C., Wang, S., Lai, H., & Peng, T. (2016). The Effectiveness of Cupping Therapy on Relieving Chronic Neck and Shoulder Pain: A Randomized Controlled Trial. *Evidence-Based Complementary and Alternative Medicine*, *2016*, 1-7. http://dx.doi.org/10.1155/2016/7358918

Level of Evidence: Oxford 2b, PEDRO 5/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	Yes, the purpose is stated clearly in both the abstract and introduction. The purpose of this study was to investigate the effectiveness of cupping therapy on both changes in skin temperature and the ability to relieve chronic neck and shoulder pain.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study	There is limited research regarding the skin temperature changes that cupping therapy can induce as well as its efficacy for pain modulation utilizing acupuncture points.

Does the research design have internal validity?	
Appraisal Criterion	***Reader's Comments***
➢ **Discuss possible threats to internal validity in the research design. Include:** ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry** ➢ **Statistical Regression**	There are no possible internal validity concerns regarding assignment, attrition, instrumentation, statistical regression to the mean, or testing. A possible threat may have been compensatory rivalry as there was no mention if the groups were treated at separate times. If the control group was aware of the intervention they could have reported false information and vice versa.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
1. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes, subjects were assigned groups randomly and informed of their group through a sealed envelope which was sequence coded before the study began.
2. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?**	The demographics that were reported were similar at the start of the trial. Both groups were similar in gender, skin temperature, blood pressure, and VAS scores.
3. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes, the subjects would have been able to know by the treatment they received. The control group just received 20 minutes of rest versus the intervention group receiving 20 minute of cupping therapy. Potential consequences include compensatory rivalry, diffusion of treatment, as well as increase reports of efficacy of the treatment group.
4. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	No, the authors sate that the researchers and participants both were unaware of assignments prior to the start of the study.
5. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the groups were both managed equally apart from the independent variable.
6. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research?	Yes, the follow-up time was 5 minute intervals and the investigators were able to gather the information they needed. There

a. If not, what are the potential consequences of this knowledge for the study's results?	was no report of long-term outcomes so this study should be taken with a grain of salt.
7. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	No, 2 of the subjects were excluded from the study because they had ingested analgesics prior to starting. The authors did not state what they did with the data but a power analysis conducted prior to study revealed that they had enough participants to minimize possibility of error.
8. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	The authors did not state if they performed an intention to treat analysis but all patients were analyzed in the groups to which they were assigned.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***

9. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences? With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI**	Statistical findings reveal that there were significant differences between the control and experimental groups regarding skin surface temperature at the SI 15 ($p<0.01$), GB 21 ($p<0.01$), and LI 15 ($p<0.01$) points from baseline to final measurement. There were no significant differences ($p<0.117$) between groups regarding blood pressure from baseline to final measurement. There was a significant difference ($p<0.001$) between groups regarding the VAS of both shoulder and neck pain in favor of the treatment group
10. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	The statistical findings indicate that there was a significant decrease in pain (VAS) after a 20-minute session of cupping therapy regarding neck and shoulder pain.
11. Do these findings exceed a minimally important difference? **a. If not, will you still use this evidence?**	Yes, there was a mean reduction in VAS of 5.9 in the intervention group. A MCID of 3cm has been estimated based on a study by Tashjian et al (2009) regarding rotator cuff disease.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
12. Does this intervention sound appropriate for use (available, affordable) in your clinical setting?	The intervention sounds appropriate for short term pain reduction but was not validated for long term pain modulation.
13. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	Yes, the subjects included must be working 40 hours per week, have 3 months or longer of neck and shoulder pain, and a VAS of at least 3.
14. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	Yes, the reduction is pain and relatively safe intervention sound as if they would be worth a try for the patient. The only barrier would be cost depending on where the patient seeks treatment.
15. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes, the patient is interested in the treatment due to its popularity garnered during the Olympics.

16. Are there any threats to external validity in this study?	There are not

What is the bottom line?

The bottom line from this article is that a 20-minute session of cupping therapy was effective in reducing pain as reported on the VAS in participants who worked at least 40 hours a week and were suffering from neck and shoulder pain.

Lauche, R., Cramer, H., Choi, K., Rampp, T., Saha, F., Dobos, G., & Musial, F. (2011). The influence of a series of five dry cupping treatments on pain and mechanical thresholds in patients with chronic non-specific neck pain - a randomised controlled pilot study. *BMC Complementary and Alternative Medicine*, *11*(1). http://dx.doi.org/10.1186/1472-6882-11-63

Level of Evidence: Oxford 1b, PEDRO 7/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	Yes, the purpose is stated clearly in both the abstract and introduction. The purpose of this study was to investigate if the application of 5 dry cupping treatments is effective in alleviating chronic non-specific neck pain.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study	Yes, there was sufficient background information given. There are limited high quality studies regarding the efficacy of cupping therapy and its effect on chronic non-specific neck pain. As well as those patients who seek an alternative to conventional therapeutic modalities such as physical therapy, medicinal and or injection therapies.

Does the research design have internal validity?	
Appraisal Criterion	***Reader's Comments***
➢ **Discuss possible threats to internal validity in the research design. Include:** ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry** ➢ **Statistical Regression**	Compensatory rivalry may be a validity error associated with this article. Those in the control group were wait-listed and did not receive treatment. They were not blinded and aware of their group assignment once the trial began. This could have ramifications of the subjects seeking alternative means of treatment without the knowledge of the assessors.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
17. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes, subjects randomly assigned by utilizing sequentially numbered envelopes. The envelopes were prepared by the study coordinator but the authors point out that the coordinator was not involved in the treatment or measurements of the study.
18. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?**	There were no significant differences between the treatment and control group.
19. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes, the subjects were aware to the grouping as one group received treatment whereas the "control" group was put on a waitlist for 2 weeks. This could have negative effects on the study as the control group could report symptoms worse than they are or not report improvements over the waiting period in order to obtain the treatment once their time had arrived.
20. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	The study does not indicate whether or not the investigators knew prior to the allocation.
21. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the groups were both managed equally apart from the independent variable.
22. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research?	Yes, the follow-up time of 2 weeks allowed for the accumulation effects of the treatment

a. If not, what are the potential consequences of this knowledge for the study's results?	to take place. It should be noted that no long-term data was acquired.
23. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	No, 3 subjects in the treatment group and 1 subject from the control group withdrew prior to starting the study and no data was collected or any of them. One subject from the treatment group withdrew due to worsening symptoms. The last observational data from this subject was carried forward for analysis.
24. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes, the subjects were analyzed in the groups to which they were assigned.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***

25. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences? With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI**	Pain at rest -22.5mm (p=0.00002, CI -31.9 - -13.1) on VAS Maximal pain at movement -18.8mm (p=0.01, CI -32.0 to 5.6) NDI -6.3% (p=0.0002, CI -10.2 - -2.4) All CI are 95%
26. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	These findings suggest that 5 sessions of dry cupping may decrease pain in those with chronic non-specific neck pain.
27. Do these findings exceed a minimally important difference? **a. If not, will you still use this evidence?**	The confidence interval of pain at rest and pain at maximal movement cross the 3cm mark of a MCID. The mean was below the MCID so the treatment may be an option based on patient beliefs.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
28. Does this intervention sound appropriate for use (available, affordable) in your clinical setting?	The intervention would not be performed in the clinic but used as an adjunct along with therapy hopefully.
29. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	There was a wide range of ages included in this study, the mean was a bit older than my patient.
30. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	Yes, the reduction is pain and relatively safe intervention sound as if they would be worth a try for the patient. The only barrier would be cost depending on where the patient seeks treatment.
31. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes, the patient is interested in the treatment due to its popularity garnered during the Olympics.

32. Are there any threats to external validity in this study?	There are no visible external validity threats.

What is the bottom line?

The bottom line from this article is that 5 sessions of dry cupping over a 2 weeks' period may be able to reduce the patients pain significantly with the possibility of it reaching a MCID set at 3cm.

Michalsen, A., Bock, S., Lüdtke, R., Rampp, T., Baecker, M., & Bachmann, J. et al. (2009). Effects of Traditional Cupping Therapy in Patients with Carpal Tunnel Syndrome: A Randomized Controlled Trial. *The Journal of Pain*, *10*(6), 601-608. http://dx.doi.org/10.1016/j.jpain.2008.12.013

Level of Evidence: Oxford 1b, PEDRO 7/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	Yes, the purpose is stated clearly in both the abstract and introduction. The purpose of this study was to investigate if the effectiveness of a single wet cupping therapy versus heat application in subjects with carpal tunnel syndrome.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study	Yes, there is enough background information given to allow the reader to understand the pathology and why the trial is being conducted. According the author who sites a few other trials, conservative management of carpal tunnel syndrome can be considered less than satisfactory and surgical decompression results in a good outcome in 75% of cases. So, the author proposes to investigate this alternative method of treatment.

Does the research design have internal validity?	
Appraisal Criterion	***Reader's Comments***
➢ **Discuss possible threats to internal validity in the research design. Include:** ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry**	Statistical regression towards the mean is a possible error. At baseline, there is a wide variety of VAS scores of both the intervention and the control groups. This can lend to misleading outcomes as some with very high VAS scores and improve enough to skew the data for all. Instrumentation errors may have occurred as well. In this study, the assessors utilized manual mechanical suction techniques. There was no mention of standardization of how

➢ **Statistical Regression**	much suction to apply to the cups. This could lead to varying outcomes between subjects.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
33. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes, subjects were randomized in a nonstratified block-randomization with varying block lengths. When the subjects were enrolled after meeting inclusion criteria, the study physician opened the lowest numbered envelope to reveal the group assignment.
34. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?**	The author states that there were no significant differences between the treatment and control group but there is no statistical data given in the table where the baseline data is listed.
35. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes, the subjects were aware of which group they were assigned but it is unclear if the groups knew whether they were the control or intervention. The control group received heat therapy as there is no sham treatment for wet cupping.
36. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	The investigators did not know who was being assigned to which group before the allocation. They were blinded of randomization but not once the treatment had started.
37. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the groups were both managed equally apart from the independent variable.
38. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research?	Yes, the follow-up time of 7 days was exactly what the researchers intended but they state that longer term effects should be investigated in the future.

a. If not, what are the potential consequences of this knowledge for the study's results?	
39. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	Yes, all subjects recruited were able to finish the study.
40. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes, the subjects were analyzed in the groups to which they were assigned.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***

41. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences? With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI**	Group differences in VAS at 7 days 1. Pain at rest -22.9 (CI -35.5; -10.5) 2. Numbness -28.8 (CI -42.5; -15.1) 3. Tingling -25.2 (-37.8, -12.6) 4. Painful movement -32.4 (-45.5; -19.3) 5. Pain with pressure -26.5 (-38.2; -14.7) 6. P<0.001 with 95% CI for all values above DASH group difference -11.1 (CI -17.1; -5.1) NPQ group difference -12.6 (CI -18.8; -6.4)
42. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	These findings are suggestive that a single wet cupping session can have a significant effect on pain in patients with carpal tunnel.
43. Do these findings exceed a minimally important difference? **a. If not, will you still use this evidence?**	The study does meet the MCID of 3cm set forth for this study for the VAS as well as a difference of approximately 11 points on the DASH can be considered clinically important.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
44. Does this intervention sound appropriate for use (available, affordable) in your clinical setting?	This intervention would not be appropriate in a physical therapy clinic given that a needle is used to puncture the skin and is not within the PT scope of practice.
45. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	The study subjects are not similar in age to the patient. The mean age is 30 years older than the patient for which this research is being conducted. Also, the subjects are experiencing carpal tunnel syndrome whereas the patient in question is experiencing shoulder pain.
46. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	No, the benefits of this study may meet the MCID but the risks of puncturing the skin may increase the risk of negative side effects of treatment.
47. Does the intervention fit within your patient/client's stated values or expectations?	No, the patient had inquired about dry cupping and this study involves wet cupping.

a. If not, what will you do now?	It was included as to be able to find the best possible method of treatment.
48. Are there any threats to external validity in this study?	There are no visible external validity threats.

What is the bottom line?

The bottom line from this article is a single session of wet cupping treatment had a significant effect in reducing pain symptoms in subjects with carpal tunnel for 7 days' post treatment.

Markowski, A., Sanford, S., Pikowski, J., Fauvell, D., Cimino, D., & Caplan, S. (2014). A Pilot Study Analyzing the Effects of Chinese Cupping as an Adjunct Treatment for Patients with Subacute Low Back Pain on Relieving Pain, Improving Range of Motion, and Improving Function. *The Journal of Alternative and Complementary Medicine*, *20*(2), 113-117. http://dx.doi.org/10.1089/acm.2012.0769

Level of Evidence: Oxford 4, PEDRO n/a

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	Yes, the purpose of this study is to investigate the effectiveness of using cupping to reduce low back pain.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study	Yes, there is sufficient background evidence presented with an emphasis of the need of a multidisciplinary approach to treat low back pain. The authors highlight how many of the traditional methods of treating low back pain can be costly and some, such as surgical interventions, can be ineffective. The authors state that cupping is a cheap and relatively quick method that can be introduced as an adjunct to modulate pain.

Does the research design have internal validity?	
Appraisal Criterion	***Reader's Comments***
➢ **Discuss possible threats to internal validity in the research design. Include:** ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry**	Assignment validity is a concern as there was no control group. Patients were compared versus their baseline. Attrition – 4 subjects withdrew, 3 due to time constraints and 1 due to adverse reaction to the treatment. Data for these patients were not included in final analysis.

➢ **Statistical Regression**	

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
49. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	No, this is a pilot study so there was no control group. There was also no mention as how the assessors recruited the subjects involved in the study. This opens the door for potential bias violations and undermines the efficacy of the study.
50. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?**	N/A. Only one group in the quasi-experimental, pilot designed study.
51. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes, the subjects were aware to the grouping as there was only group allocated for treatment. This can lead the patients to overestimate their improvements when reporting in outcome measures in order to appease the assessors.
52. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	The investigators were aware as there was only one group. This non-blinding gives the investigators a chance to recruit those who they think will have positive results in the study versus those who will not.
53. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge for the study's results?**	N/A
54. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research?	Unknown, the investigators do not reveal when the outcome measures were obtained after the treatment. It is assumed that the outcomes were taken immediately after the

a. If not, what are the potential consequences of this knowledge for the study's results?	treatment, although it cannot be known for sure. This leads to an unknown in the effects of the treatment other than acutely after treatment (assumedly).
55. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	No, 3 subjects withdrew from the study due to time constraints and 1 subject withdrew due to an adverse reaction to the treatment. The cupping therapy exacerbated her low back pain to the point that she could not stand straight up after treatment. Her post intervention measurements were not collected. This leads to inaccurate post intervention measurements as it excludes negative effects of the treatment.
56. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	No, the subject that experienced adverse effects did not have her post intervention measurements collected. The exclusion of this data can lead to an exaggerated positive treatment effect as the negative effects experienced by this subject were omitted.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***

57. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences? With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI**	VAS score ($p<0.0001$) SLR ROM on the left ($p=0.043$) Increased lumbar flexion ROM ($p=0.016$) PPTS at 4 points collected ($p<0.007$) Confidence intervals are not listed
58. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	These initial findings suggest that cupping may have a positive impact on low back pain but the omission of reported values is startling.
59. Do these findings exceed a minimally important difference? **a. If not, will you still use this evidence?**	No, the authors do not list any data to reference what the initial and post intervention VAS scores were, just that they were statistically significant.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
60. Does this intervention sound appropriate for use (available, affordable) in your clinical setting?	The intervention sounds appropriate due to other research but not recommended due to lack of information provided in the study.
61. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	No, the range of ages in this study was 33-56 with a mean age of 40. Also, patients participating in a study due to low back pain rather than shoulder pain experienced by the patient in this paper.
62. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	Not enough information presented in this paper to conclusively make a recommendation.
63. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes, the patient is interested in the treatment but is not recommended due to low quality of this study.
64. Are there any threats to external validity in this study?	This study is subject to examiner bias as no concrete numbers were given regarding subject scores on VAS. Also, the small

	sample size may not be representative a larger population.

What is the bottom line?

The bottom line from this article is this is a preliminary study and should not be used to make clinical judgments. This study finds that there may be a link between cupping and improving VAS, ROM, and PPT but further research is required.

Maenhout, A., Mahieu, N., De Muynck, M., De Wilde, L., & Cools, A. (2012). Does adding heavy load eccentric training to rehabilitation of patients with unilateral subacromial impingement result in better outcome? A randomized, clinical trial. *Knee Surgery, Sports Traumatology, Arthroscopy*, *21*(5), 1158-1167. http://dx.doi.org/10.1007/s00167-012-2012-8

Level of Evidence: Oxford 2b, PEDRO 6/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	Yes, the purpose is stated clearly in both the abstract and introduction. The purpose of this study was to investigate the effects of heavy load eccentric training to conservative treatment of patients with subacromial impingement.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study	Yes, the authors give relevant background information to include that the reasoning for adding eccentric loading is that it has been shown to increase tendon repair in the Achilles and patellar tendons. Also, that 3 other studies have investigated the effect of eccentric training but due to the small sample sizes it is still not clear whether the addition of eccentric training is superior to traditional training.

Does the research design have internal validity?	
Appraisal Criterion	***Reader's Comments***
➢ **Discuss possible threats to internal validity in the research design. Include:** ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry**	There was a high attrition rate but the study was able to analyze 85% of the subjects at week 6 and 82% at week 12. The authors used intention to treat and analyzed the last known data in the group. Assignment – patients were randomized into groups but were not stratified for gender. This left the intervention group with more males than females as well as a higher baseline measurement for strength. The authors do note that they adjusted for this in their statistical analysis.

➢ **Statistical Regression**	Compensatory rivalry – the subjects all participated in physical therapy sessions throughout the study. It is not known or stated whether or not the subjects were treated at different times so as to make sure they were not able to converse and figure out if they were in the treatment or control group. If a subject were able to find out they were in the control group, they could increase the intensity of their exercises to compensate and skew the final results of the study.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
65. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	The subjects were randomized although the authors do not state how the process occurred.
66. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?**	There were no significant differences between the treatment and control group. The authors state that there was so significant difference between the groups although a p-value is not listed.
67. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	The subjects were unaware which group they were assigned.
68. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	The study does not indicate whether or not the investigators knew prior to the allocation. The authors state that once baseline characteristics were taken, the patients were randomly assigned to the treatment or control group.

69. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the groups were both managed equally apart from the independent variable.
70. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the follow-up time of both 6 and 12 weeks substantial enough to see if changes were made and also are in line with clinical practice.
71. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	No, 85% of the subjects were able to provide data at 6 weeks and 82% of the subjects at week 12. The intervention group started with 31 subjects and ended with 28, whereas the control group started with 30 and ended with 22 at week 12.
72. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes, the subjects were analyzed in the groups to which they were assigned and last recorded data was carried forward.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***

73. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences? With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI**	The treatment and control group both saw a statistically significant increase in isometric strength regarding: abduction @ 0deg, 45deg of scapular abduction, and external and internal rotation. All p-values < 0.001 with the exception of internal rotation p=0.038. Isometric strength at 90deg abduction was significantly increased in the treatment group (p<0.001) versus the control at 12 weeks. Both groups significantly improved in pain and function as measured with the SPADI by week 12 (p<0.001)
74. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	These findings suggest that both traditional treatment and eccentric treatment can reduce pain and improve function of patients with a diagnosis of subacromial impingement. It also suggests that eccentric training did not result in better outcomes regarding pain and function but was able increase isometric strength measured at 90deg shoulder abduction by 15%.
75. Do these findings exceed a minimally important difference? **a. If not, will you still use this evidence?**	Yes, the authors state that 85% of the subjects in the intervention and 89% of the control group reduced their SPADI scores by a minimum of 10 points which has been previously reported a clinically important.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
76. Does this intervention sound appropriate for use (available, affordable) in your clinical setting?	Yes, the intervention sounds appropriate for the clinic and to prescribe as part of a HEP as long as it is within the patients stated values and beliefs.
77. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	The subjects are a little older than my patient but she would fall within one standard deviation of the mean. There were more female participants overall in the study.
78. Do the potential benefits outweigh the potential risks using this	Yes, the potential to repair possibly damaged tendon tissue is a benefit and adding eccentric

intervention with your patient/client?	training into the program would not be difficult.
79. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes, the patient already exercises in the gym a few times a week herself and she has expressed interest in adding a few extra shoulder specific exercises.
80. Are there any threats to external validity in this study?	There were no seen threats to external validity as the patients participated in their own homes and were seen in clinic as well. This is in line with current outpatient clinical practice.

What is the bottom line?

The bottom line from this article is that adding eccentric training to a traditional shoulder rehabilitation program has the potential to increase strength but it is still not understood if it helps with tendon repair as has been shown in the Achilles and patellar tendons.

Holmgren, T., Bjornsson Hallgren, H., Oberg, B., Adolfsson, L., & Johansson, K. (2012). Effect of specific exercise strategy on need for surgery in patients with subacromial impingement syndrome: randomised controlled study. *BMJ*, *344*(feb20 1), e787-e787. http://dx.doi.org/10.1136/bmj.e787

Level of Evidence: Oxford 2b, PEDRO 7/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	Yes, the purpose is stated clearly in both the abstract and introduction. The purpose of this study was to evaluate whether a specific exercise program yielded better results than a generic exercise program in patients with subacromial impingement.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study	Yes, the authors state how the incidence rate of subacromial decompression has risen in Sweden. This coupled with the findings that conservative measures have similar outcomes and challenges whether surgery is a good alternative. The authors then go on to lay out a specific and focused exercise regimen needs to be established and whether it can help reduce the need for surgical interventions.

Does the research design have internal validity?	
Appraisal Criterion	***Reader's Comments***
➢ **Discuss possible threats to internal validity in the research design. Include:** ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry**	Statistical regression to the mean – there was a very large variability between duration of pain between patients. In the treatment group, there was a mean of 24 months but a range of 6-120; likewise, in the control group there was a mean of 12 months with a range of 6-156 months. There were no statistics given as to whether or not there were statistical differences of the groups at baseline. Maturation – all subjects both control and intervention were given a corticosteroid

➢ **Statistical Regression**	injection prior to beginning the study. We are unable to know whether the injection had a significant effect on any of the subject's recovery or not. Compensatory equalization of treatments – the physical therapist treating the patients during their weekly visits was not blinded to the group allocation. This leaves room for bias in the therapist giving extra time/treatment to those in the control group so as to maximize their outcomes.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
81. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes. A physical therapist prepared a random sequence before the study with equal numbers in each group. Allocation was performed at the first visit with the physical therapist after the subjects were evaluated by the orthopedic surgeon (assessor of the study)
82. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?**	The authors state that there were no differences between groups at baseline but no statistics are given to validate this statement.
83. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	The subjects were unaware which group they were assigned.
84. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	The investigators were not aware of who was assigned to each group prior to the allocation.

85. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the groups were both managed equally apart from the independent variable.
86. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the follow-up time of 12 weeks was sufficient and chosen as it's applicability to clinical practice.
87. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	No, 4 subjects from the control group and 1 subject from the intervention group were unable to complete the study. These subjects withdrew after enrolling but prior to beginning the study so their data was excluded.
88. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes, the subjects were analyzed in the groups to which they were assigned.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***

89. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences? With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI**	Constant-Murley score – mean difference of 15 between groups (8.5-20.6 95%CI) Mean change in score in specific exercise group was 24 (19-28 95%CI) DASH – mean score of 8 (2.3-13.7 95%CI) between groups. VAS – mean difference between groups 20 (-30.9 - -7.2) for pain at night, no significant difference for pain at rest or during activity. Health related quality of life significantly higher in specific exercise group ($p<0.001$)
90. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	The statistical findings are odd as p-values are not listed for many of the outcomes. The authors state that there was a significant difference. It is assumed that the authors are basing this off a statement in which the authors said, "82 patients to detect a mean 10-point difference between groups with a variability of 16 points (B=0.80, two sided a=0.05)" That being said, it seems odd that p-values are listed for some outcomes and not others.
91. Do these findings exceed a minimally important difference? **a. If not, will you still use this evidence?**	A quick search at rehabmeasures.org reveals that the MCID for the DASH was not met at the average but is included in the confidence interval. The MCID for the Constant score that is being used in this paper is 10. So, the intervention group was able to meet the MCID whereas the control group did not.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
92. Does this intervention sound appropriate for use (available, affordable) in your clinical setting?	Yes, the intervention sounds appropriate for the clinic and to prescribe as part of a HEP as long as it is within the patients stated values and beliefs.
93. Are the study subjects similar to your patient/ client?	The subjects are on average older than my patient and the symptom duration is quite a bit longer. The intervention may still be

a. If not, how different? Can you use this intervention in spite of the differences?	applicable as exercise in general has been shown to be effective, and a more specific program may be even more beneficial a younger population as well.
94. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	Yes, there seems to be no apparent risks with implementing this program with my patient.
95. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes, the patient already exercises in the gym a few times a week herself and she has expressed interest in adding a few extra shoulder specific exercises.
96. Are there any threats to external validity in this study?	There are a few threats to external validity. The physical therapist who treated the patients was not blinded to the group assignments. Also, the participants of the study were recruited from a single facility and were on a surgical wait list, this may not be generalizable to a less severely involved patient and may not be good a representation of the population. Another threat to external validity is the omission of p-values for a lot of the statistical analyses given in the results. The authors state that there were significant differences without provided the statistics to back it up. Finally, the groups were given different intensities of exercise programs (load, repetitions, and sets), this may have an effect on outcomes as the treatment group not only had different exercises but a higher intensity as well.

What is the bottom line?

The bottom line from this article is that a specific exercise program focusing on both rotator cuff musculature and scapular stabilizers is more effective than a generalized exercise treatment method.

Tarek Sadek, M. (2016). Effect of TRX suspension training as a prevention program to avoid the shoulder pain for swimmers. *Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health, 16*(2), 222-227.

Level of Evidence: Oxford 4, PEDRO N/A

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	Yes, the purpose is listed only in the abstract but may have been omitted from the body of the paper due to translation issues. The purpose of this study was to investigate if the use of a TRX suspension trainer is an effective was to prevent shoulder pain in young swimmers.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study	Yes, the author gives a good background on both the suspension training systems as well as swimmer's shoulder and the muscle groups involved. The authors justification for this article is the high incidence of shoulder pain in swimmers of all levels, from novice to elite. Other than this the author does not state any other justification but it could have been lost in translation as the article has many grammatical errors.

Does the research design have internal validity?	
Appraisal Criterion	***Reader's Comments***
➢ **Discuss possible threats to internal validity in the research design. Include:** ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry**	Assignment – this a cohort study so there is no control group. The subjects are compared to their baseline so there is no way to know that the improvements are due solely to the intervention. Attrition – the author states that 10 subjects were obtained from the Ajman club but does not state if they all completed the study or not. Instrumentation – the author does not state what instruments were used to take

➢ **Statistical Regression**	measurements of the flexibility of the swimmers. Also, there is no mention as to the units that are used to measure. So, there are number displayed in a chart but the reader must assume that length measurements are in millimeters and strength measurements are in kilograms.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
97. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	No this is a cohort study and the subjects were measured pre- and post-intervention.
98. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?**	N/A
99. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	The subjects were aware to their group as there was only one group in this study.
100. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	There is no mention if the investigators
101. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this**	N/A

knowledge for the study's results?	
102. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the follow-up time of 8 weeks was sufficient enough to see significant changes and is in line with standard clinical practice.
103. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	There is no mention as to how many subjects finished the study. Only that 10 subjects were randomly picked from the Ajman club.
104. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes, the subjects were analyzed against the pre- intervention measurements.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***

105. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences? With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI**	Subjects significantly improved in static strength, passive chest flexibility, active chest flexibility test, shoulder mobility, seated medicine ball throw. The author does not list the p-values associated with each of these but states in the methodology section that a $p<0.05$ would be considered significant.
106. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	The statistical significance illustrates that the participation in a suspension training program may be able to increase strength and mobility in young swimmers. This has implications for my patient as the age is more similar than in other studies.
107. Do these findings exceed a minimally important difference? **a. If not, will you still use this evidence?**	There is no mention of an MCID considered for strength and mobility training for swimmers in this article.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
108. Does this intervention sound appropriate for use (available, affordable) in your clinical setting?	Yes, suspension trainers are being used in many outpatient orthopedic clinics currently and are a good cheap alternative to personal home exercise equipment if the patient chooses to obtain it.
109. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	The subjects closer in age to my patient in this study than others that I have looked at. The mean age is 20 years and my patient is 28. No other characteristics are given in regards to how much swimming and/or land based training the subjects performed prior or during the study.
110. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	The potential benefits do outweigh the risks as there are no apparent risks that are foreseen utilizing this treatment method.

111. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes, the patient has stated that she has a home TRX suspension trainer and also utilizes one at the gym facility she works out at as well.
112. Are there any threats to external validity in this study?	There are a few external validity threats with this research. The omission of what tools were used to measure and no units listed leaves the reader wanting. The reader cannot confidently extrapolate this data to a patient with the same expected results but due to the low risks it may still be feasible. Also, there is no mention as to which exercises the subjects performed, so there is no way for the reader to reproduce those exercises with their patient. The reader must extrapolate that the suspension trainer had a positive effect and come up with exercises on their own in hopes of achieving the same results.

What is the bottom line?

The bottom line from this article is that TRX suspension may have a positive effect on flexibility and strength but the data is not listed in a manner that it can be confidently extrapolated from the study. This could be due to translational issues as the study was conducted in Egypt and there seem to be many grammatical errors throughout the article.

Başkurt, Z., Başkurt, F., Gelecek, N., & Özkan, M. (2011). The effectiveness of scapular stabilization exercise in the patients with subacromial impingement syndrome. *Journal of Back and Musculoskeletal Rehabilitation*, *24*(3), 173-179. http://dx.doi.org/10.3233/bmr-2011-0291

Level of Evidence: Oxford 2b, PEDRO 5/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	Yes, the purpose is listed in both the abstract and introduction. The purpose of this study was to investigate the effectiveness of stretching and strengthening exercise, and scapular stabilization exercises on shoulder pain, ROM, strength, joint position sense, and quality of life in subjects with subacromial impingement syndrome.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study	Yes, the author gives relevant background information regarding shoulder pain and dysfunction. The author states that there have been many studies investigating the importance of these stretches and exercises but none that has looked at the superiority of them.

Does the research design have internal validity?	
Appraisal Criterion	***Reader's Comments***
➢ **Discuss possible threats to internal validity in the research design. Include:** ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry** ➢ **Statistical Regression**	Assignment – the author states that the randomization process was performed using a simple random table but no mention as how the table was used. Compensatory equalization of treatments – the assessors were not blinded which could lead a potential bias involving giving more treatment to the control group. Compensatory rivalry – there is no mention as to if the participants were blinded. This could lead to the control group exercising more or looking up other exercises to compensate for their lack of scapular stabilization exercises.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
113. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes, the author states that a simple random table was utilized.
114. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?**	The baseline measurements of age, weight, height, and BMI were all similar at the beginning of the study. There were also no significant differences between groups regarding VAS, ROM, joint position sense, lateral scapular slide test, and Western Ontario Rotator Cuff Index. There were significant differences in strength of the supraspinatus and lower trapezius in favor of the intervention group.
115. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	The study does not state that the subjects were blinded so it is assumed that the subjects were aware of which group they were assigned.
116. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	The investigators were not aware of who was being assigned to each group prior to allocation but they were not blinded throughout the study. This could lead to compensatory equalization of treatment bias.
117. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this**	Yes, each group received the same treatment with the exception of the intervention of scapular stabilization exercises.

knowledge for the study's results?	
118. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the follow-up time of 6 weeks was sufficient enough to make measureable changes and is closely in line with clinical practice. Long-term outcomes would be good to investigate later to see if the control group would eventually make the same improvements.
119. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	Yes, all 40 participants completed the study.
120. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes, the subjects were analyzed in the group to which they were assigned.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***

121. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences? With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI**	Subjects of both groups improved significantly in pain at rest, pain during activity, flexion, abduction, internal rotation, external rotation, and WORC scores, strength of rotator cuff muscles ($p<0.05$). Strength of scapular stabilization muscles and joint position sense increased significantly in the intervention group versus the control group ($p<0.05$)
122. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	These statistics illustrate that the addition of scapular stabilization exercises significantly increases strength in the 3 parts of the trapezius, as well as joint position sense and the lateral scapular slide test. This means that the addition of scapular stabilization exercises can strengthen the muscles in question but doesn't have a superior outcome on pain necessarily.
123. Do these findings exceed a minimally important difference? **a. If not, will you still use this evidence?**	Yes, the VAS MCID that I have set forth for my patient is 3 which was achieved in both groups.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
124. Does this intervention sound appropriate for use (available, affordable) in your clinical setting?	Yes, the addition of scapular stabilization exercises is necessary in swimmers to minimize incidence of dysfunction.
125. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	Like other studies reviewed, the subjects in this article are a bit older than my patient as well as quite a bit heavier.
126. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	The potential benefits do outweigh the risks as there are no apparent risks that are foreseen utilizing this treatment method.

127. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes, the patient already participates in an exercise program but is needing something more specific to focus on her dysfunctions.
128. Are there any threats to external validity in this study?	The fact that the assessors were not blinded during the study limits the validity of the study. It cannot be known whether or not the assessors compensated the control group because their lack of intervention. It cannot also be known whether or not those in the control group were aware they were not receiving certain exercises and then went out on their own and included more to compensate. Lastly, the study had the participants in the clinic 3 times a week for exercises, this is not typically feasible with patients are they do not come in more than twice a week in an outpatient setting.

What is the bottom line?

The bottom line from this article is that the addition of scapular stabilization exercises such as PNF patterns to shoulder rehabilitation can increase joint position sense and strength of the 3 parts of the trapezius. There was however no significant difference between pain, ROM, and rotator cuff strength between the traditional exercise group and the group with the addition of scapular stabilization exercises.

De Mey, K., Danneels, L., Cagnie, B., & Cools, A. (2012). Scapular Muscle Rehabilitation Exercises in Overhead Athletes with Impingement Symptoms: Effect of a 6-Week Training Program on Muscle Recruitment and Functional Outcome. *The American Journal of Sports Medicine*, *40*(8), 1906-1915. http://dx.doi.org/10.1177/0363546512453297

Level of Evidence: Oxford 4, PEDRO N/A

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	Yes, the purpose of this study was to investigate the effects of 4 exercises utilized in rehabilitation of overhead athletes on pain function. Exercises include side-lying external rotation, side-lying forward flexion, prone horizontal abduction with external rotation, and prone extension in neutral position.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study	Yes, the author gives relevant background information regarding subacromial impingement syndrome. The author highlights that patients with SIS can often display with hyperactive upper trapezius activation coupled with reduced middle and lower trapezius and serratus anterior activation. These 4 exercises have been shown to have increased middle and lower trapezius and serratus anterior activation while minimizing upper trapezius activation. This study takes those exercises one step further and now investigates if utilizing those exercises in SIS patients can reduce pain and improve shoulder function.

Does the research design have internal validity?	
Appraisal Criterion	***Reader's Comments***
➢ **Discuss possible threats to internal validity in the research design. Include:** ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation**	Assignment – no control group due to this being a prospective case series. This can lead to investigator bias but was chosen for this study as overhead athletes with impingement symptoms are a very specific group. Maturation – the lack of a control group leads the study unable to rule out if the improvements made were due to the

➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry** ➢ **Statistical Regression**	intervention or the subject spontaneously improving over time. Attrition – 7 subjects were unable to complete the study, this is 15% of the subjects and was accounted for when recruiting. Instrumentation – conducting EMG studies over a period of time has its limitations as it needs to be calibrated to the subjects MVIC each time. The authors were able to take this into account and had a high ICC for the study but never the less is still a possible limitation.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
129. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	No this was a prospective case series design so there was only one group. The individuals were analyzed pre- and post-testing.
130. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?**	Everyone in the study was an overhead athlete experiencing subacromial impingement symptoms (along with other inclusion/exclusion criteria). Other subject demographics were given such as age and hours per week participating in sport as well.
131. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Due to the design, all subjects were aware they were part of a treatment group.
132. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this**	Yes, there was only one group. As the outcome measures were obtained by a non-blinded assessor, the study attempted to minimize bias by blinding the investigators to the pre-test results.

knowledge for the study's results?	
133. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, each group received the same treatment.
134. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the follow-up time of 6 weeks was chosen in this study as they referenced an article in which the most significant improvement was to be expected within this time frame.
135. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	No, of the 47 participants who began the study, 7 dropped out due to various reasons.
136. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes, there is no mention what was done with the data for the 7 who dropped out of the study but it is assumed that it was not used in calculations as the statistics measured pre-post subject changes.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***

137. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences? With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI**	SPADI scores decreased significantly from 29.86 (17.03) to 11.7 (13.78) with a $p<0.001$ UT/SA ratio significantly decreased but UT/MT and UT/LT ratios did not change ($p<0.05$)
138. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	These findings illustrate that the 4 exercises were able to change activation levels of the muscles and improve pain and function (SPADI) in overhead athletes with impingement symptoms.
139. Do these findings exceed a minimally important difference? **a. If not, will you still use this evidence?**	Yes, the authors reference articles that range the MCID from 8-13.2 on the SPADI.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
140. Does this intervention sound appropriate for use (available, affordable) in your clinical setting?	Yes, a few of these exercises are common in rehabilitation setting already. This study confirms that they can alter activation ratios and decrease pain.
141. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	Yes, the subjects in this study are similar in age and activity level to my patient.
142. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	The potential benefits do outweigh the risks as there are no apparent risks that are foreseen utilizing this treatment method.
143. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes, the patient already participates in an exercise program but is needing something more specific to focus on her dysfunctions.

144. Are there any threats to external validity in this study?	There are no threats to external validity recognized in this article. All subjects were still participating in sport during the trial which is to be expected to a patient in an outpatient setting seeking physical therapy as well.

What is the bottom line?

The bottom line from this article is that the 4 exercises investigated in this study have the potential to reduce pain and improve function in overhead athletes experiencing mild subacromial impingement symptoms. The exercises were also able to change activation levels of scapular muscles but not able to change the timing of activation regarding elevation of the arm in the scapular plane.

Kromer, T., Bie, R., & Bastiaenen, C. (2014). Effectiveness of physiotherapy and costs in patients with clinical signs of shoulder impingement syndrome: One-year follow-up of a randomized controlled trial. *Journal of Rehabilitation Medicine*, *46*(10), 1029-1036. http://dx.doi.org/10.2340/16501977-1867

Level of Evidence: Oxford 1b, PEDRO 7/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	Yes, the purpose is stated clearly under the subheading of "Aims of the study" The purpose of this study was 2-fold. 1. Investigate the effects of an individualized manual physical therapy plan on pain and functioning as compared to an individualized exercise protocol 2. Compared the costs of the two interventions both directly and indirectly
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study	Yes, the authors give relevant background on subacromial impingement syndrome and how most of the systematic reviews on the subject highlight the need for more high quality RCTs in order to help make a decision on the efficacy of physical therapy interventions. Therefore, the authors designed an RCT with sufficient level of evidence to assist in making a clinical decision

Does the research design have internal validity?	
Appraisal Criterion	***Reader's Comments***
➢ **Discuss possible threats to internal validity in the research design. Include:** ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry**	Maturation – the follow-up was one year after treatment had started. With this long of a follow-up period it is unsure how many subjects improved spontaneously or directly due to the intervention.

➢ **Statistical Regression**	

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
145. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes, after subjects were screened to meet the eligibility criteria they were divided into groups using blocks of 6 by way of central randomization through the internet.
146. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?**	The subjects were similar at the start of the trial for most of the demographic characteristics taken with the exception of sport hours per week, overall duration of symptoms, total FABQ, and FABQ activity subscale.
147. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	The subjects were unaware which group they were assigned.
148. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	The investigators were not aware of who was assigned to each group prior to the allocation.
149. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the groups were both managed equally apart from the independent variable.

150. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the follow-up time of 1 year was sufficient to answer the question but it cannot be known for sure how much of the improvements were due to spontaneous healing rather than the intervention as both the groups significantly improved over the course of a year.
151. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	No, 4 subjects from the intervention group and 1 subject from the control group were unable to complete the trial. Data from those who failed to follow-up was carried forward and analyzed in the final statistics.
152. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes, the subjects were analyzed in the groups to which they were assigned.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***

153. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences? With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI**	SPADI, the subscores, and the GPSS scores significantly improved for both groups but there was no difference between groups.
154. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	This statistics suggest that there is no difference in outcomes between patients who receive individualized manual physical therapy versus those who receive an individualized exercise physical therapy plan
155. Do these findings exceed a minimally important difference? **a. If not, will you still use this evidence?**	Yes, the authors set forth an MCID for the SPADI of 11 points based on a referenced article in the trial.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
156. Does this intervention sound appropriate for use (available, affordable) in your clinical setting?	Yes, the intervention of exercise would be appropriate to use for this patient.
157. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	The subjects are somewhat similar in regards to working hours and activity level, but the subjects in the trial are on average older than the patient.
158. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	Yes, there seems to be no apparent risks with implementing this program with my patient.
159. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes, the patient already exercises in the gym a few times a week herself and she has expressed interest in adding a few extra shoulder specific exercises.

160. Are there any threats to external validity in this study?	There are a few threats to external validity. Due to the long follow-up, there is no way to know if the patients spontaneously improved in shoulder function or if it was due to the intervention. The intervention group received 10 treatments over 5 weeks, and were on their own from there. The control group received exercises from the start – so after 5 weeks both the groups were doing the same thing. This could attribute to why the outcomes were similar after a 1 year follow up.

What is the bottom line?

The bottom line from this article is that after 1 year, outcomes are similar in subjects who received individualized manual physical therapy versus those who received and individualized exercise plan.