

DOES TAPING IN ADDITION TO PHYSIOTHERAPY IMPROVE THE OUTCOMES IN SUBACROMIAL IMPINGEMENT SYNDROME? A SYSTEMATIC REVIEW



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ABSTRACT

Background: Taping is used with/ without other interventions for many purposes, especially to manage pain and improve functional activity in patients with shoulder pain. The mechanism of action of taping is still not clear but the most widely accepted theory is mechanical and proprioceptive effects. There is no currently strong consensus regarding the clinical effectiveness of taping, although several taping techniques are commonly used adjunctive treatment for shoulder impingement pathology.

Objectives: To carry out a systematic review in order to determine whether any taping technique in addition physiotherapy care is more effective than physiotherapy care alone in patients with shoulder impingement syndrome.

Search methods: A systematic search of Cochrane Database of Systematic Review, MEDLINE (EBSCO), Physiotherapy Evidence Database (PEDro), CINAHL (EBSCO), PUBMED, AMED, EMBASE (OVID), The Kinesio Kinesio® Taping Method, Kinesio® Tex Tape UK and International websites (www.kinesiotaping.co.uk; www.kinesiotaping.com) was conducted to June 2014.

Selection criteria: Any randomised and non-randomised controlled trials including any taping techniques in addition to any physiotherapy treatments versus sham taping plus physiotherapy or physiotherapy care alone were considered.

Data collection and analysis: Three randomised controlled trials and one non-randomised controlled trial (135 patients) were included. Quality assessment and data extraction were performed by one author. No data were suitable for meta-analysis.

Data were therefore reported as narrative synthesis. The outcome measures were pain, disability and shoulder range of motion.

Main results: Despite the one study (Kaya et al, 2010) that found the taping group to have an effect on reducing pain at one week follow-up, the results were conflicting and weak on the effectiveness of taping as an adjunct therapy for pain management. The addition of taping to exercise therapy, electrotherapy or manual therapy improves disability status significantly in two studies (Kaya et al, 2010; Simsek et al, 2013). However, one study (Miller & Osmotherly, 2009) did not find any significant difference ($p>0.05$) between taping and comparison groups. Two studies (Simsek et al, 2013; Djordjevic et al, 2012) showed that taping group has a significant increase on shoulder flexion. Besides, according to one study (Djordjevic et al, 2012), taping group has also a significant effect on shoulder abduction.

Conclusion: Clinical taping in addition to any physiotherapy interventions (exercise, electrotherapy, manual therapy etc.) might be an optional treatment for curing patients with shoulder impingement syndrome; however we need further robust, placebo controlled and consistent studies to prove whether it is more effective than physiotherapy interventions without taping.

ABBREVIATIONS

CI: Confidence interval

DASH: Disabilities of the arm, shoulder and hand

EBP: Evidence based practice

KT: Kinesiotape/ kinesiotaping

MCID: Minimally clinically importance difference

MMT: Manual muscle test

MWM: Mobilisation with movement

NSAIDS: Nonsteroidal anti-inflammatory drugs

PEDro: Physiotherapy evidence database

RCT(s): Randomised controlled trial(s)

ROM: Range of motion

SAIS: Subacromial impingement syndrome

SIS: Shoulder impingement syndrome

SPADI: Shoulder pain and disability index

TENS: Transcutaneous electrical nerve stimulation

US: Ultrasound

VAS: Visual analogue scale

1 INTRODUCTION & LITERATURE REVIEW

1.1 Shoulder Pain and Shoulder Impingement Syndrome

Amongst the musculoskeletal issues that are most common, shoulder pain is widespread, and is recognised as the second most prevalent form of musculoskeletal pain, with low back pain the only ailment identified more commonly (Michener et al., 2004; Faber et al., 2006). In the United Kingdom, for example, as many as 1 in 5 individuals suffer from shoulder-related problems, with many individuals not seeking medical assistance (Hasvold & Johnsen, 1993).

Of all general practice encounters recorded in the Australian context, 1.2% are owing to shoulder disorder (Bridges-Webb, 1992), whereas in the context of Dutch general practice, on the other hand, this is believed to be around 11.2 patients in every 1,000 (van der Windt et al, 1995). According to Kuru et al. study (2011), shoulder pain has highest pain prevalence %73.6 among the adults in Turkey.

A person's ability to function and work independently can be impacted by shoulder pain, especially amongst the elderly (Chard & Hazleman, 1987; Chakravarty & Webley, 1993). A significant volume of those experiencing shoulder pain do not seek medical assistance, despite the fact that effective treatment could help to reduce time away from work and a lack of independence. As a further point in this regard, it is estimated that the costs incurred in the USA in 2000 when treating shoulder dysfunction amounted to roughly US\$7 billion (Meislin et al, 2005).

Shoulder impingement syndrome, in other words; subacromial impingement syndrome (SAIS), is characterized by pain and functional restrictions, mostly during overhead activities (Michener et al, 2003).

However Jarjavay first described this disease in 1867, then it was known as a peri arthritis humeroscapularis or Duplay disease (Iannotti, 1991). After 1950, lots of clinicians and researcher (Codman, Armstrong, Hammond) used 'Subacromial Impingement Syndrome' and this term has been improved by Neer in 1972 as a "shoulder impingement" and it has widely been used synonym of it because SAIS involves a wide range of structural pathologies of the rotator cuff muscles, head of biceps tendons, subacromial and subdeltoid bursa (Matsen, 1990).

Almost 44 to 60 of patients with shoulder pain are diagnosed with shoulder impingement syndrome (SIS) and the cost of health care for this disorder is variable, as 'several treatment options typically explored before a successful outcome has been achieved' (van der Windt et al, 1995; Vecchio, 1995), therefore differentiating SIS from other diagnosis, whose main symptom is shoulder pain such as glenohumeral osteoarthritis, calcific tendinitis or adhesive capsulitis, is very important for clinicians.

There are several supplementary vascular and mechanical factors play a role of pathology of this disease, such as structural anatomic abnormalities of glenohumeral joint, chronic repetitive overhead movements, ischemia or degeneration of the rotator cuff tendons, kinematic changes of shoulder (Ludewig and Cook, 2000). SIS and rotator cuff disease are increasingly more common in athletes whose sports involve repetitive overhead motions (Tibone & Shaffer, 1995). As shoulder pain characterized by arm elevation and overhead activities, SIS can lead to consequences of functional loss, disability and occupational problems (Michener et al., 2003; Vaz et al, 2000; Ludewig and Cook, 2000).

1.2 Classification of Shoulder Impingement Syndrome

Impingement is clinically classified into various subgroups comprising external, which is sub classified as primary and secondary, and internal (Neer, 1972).

1.2.1 Primary Shoulder Impingement

Abnormalities in the superior body structure of the acromion are believed to be responsible for the compression and encroachment of the subacromial space. In this instance, there may be a curving or flat shape, or hook-like shape, recognised in the acromion; this may be the result of a congenital formation, or otherwise owing to the presence of bony spurs/osteophytes, as recognised when degenerative changes occur (Blukner and Khan, 2011).

1.2.2 Secondary Shoulder Impingement

One further problem inducing infringement into the subacromial space may be identified following acromion excessive angulation, which is much more commonplace amongst younger people. This problem may be secondary to insufficient muscle stabilisation, as well as through the motion of scapula-humeral rhythm. An increase in anterior tilt and internal rotation may subsequently cause the subacromial space to be narrowed, thus meaning greater compressive force is placed on bursa and rotator cuff (Blukner and Khan, 2011).

1.2.3 Internal Impingement

This form of impingement arises predominantly in people who are active in sports, as well as those who partake in repetitive overhead activities, such as throwing, for example. The rotator cuff tendons experience impingement at the undersurface; this

arises against the posterior, superior surface of the glenoid and not the subacromial space. This could arise owing to abduction and external rotation, and repetitive extension, with the issue subsequently becoming pathological should the trauma be repeated (Blukner and Khan, 2011).

1.3 Diagnosis of Shoulder Impingement Syndrome

It is known that there are many problems associated with precisely identifying one particular structure as being the cause of shoulder dysfunction or pain (Lewis, 2009). Some tests, however, can be used in the clinical environment, particularly by physiotherapists, such as Hawkins–Kennedy, Neers, Empty and Full Can Tests. Importantly, however, such shoulder assessment tests are recognised by Lewis (2009) as valuable pain-/symptom-inducing methods; however, it is not likely that any test would compress or stretch only one structure. Importantly, this theory is supported by Michener (2010), who suggests that the aforementioned tests are valuable in ruling out or identifying shoulder impingement with a cut point of 3 out of 5 tests; however, such methods are not—in the scholar’s view—accurate or reliable enough to be used as a method of diagnosis for pain sourcing or individual pathology. In a similar vein, the work of Kelly *et al* (2010), which comprised clinical tests, was not very extensive in its ability to inform a diagnosis with specificity and inconclusive sensitivity when implementing ultrasound scanning as a reference standard. Furthermore, the conclusion was drawn by May *et al.* (2012), following a systematic review comprising 36 different studies, that, although the tests demonstrate acceptable reliability, the evidence to support this statement is lacking.

Moreover, the link between shoulder pain symptoms and radiological imaging is seen to be poor, with the work of Frost *et al.* (1999) stating that 42 patients with shoulder structural pathology showed comparable radiological results following MRI and ultrasound scans when contrasted alongside 31 asymptomatic individuals of the same age. Such a finding implies that the pathological changes reported on imaging might not always be responsible for the symptoms of the individual.

1.4 Management of Shoulder Impingement Syndrome

There are several different treatments for shoulder impingement syndrome and they are commonly categorized into two groups: conservative and surgical treatment.

1.4.1 Conservative Treatment

Researches have shown that shoulder impingement syndrome conservative management has the potential to overcome the issue in around 70% and 90% of all cases (Garofalo *et al.*, 2011; Castagna *et al.*, 2010). The majority of surgeons have a tendency to conduct patient observations for a 6-month period; nonetheless, this may vary depending on a number of individual patient factors. In the case of patients aged 50 years and older, for example, it may be necessary to carry out conservative treatment for a longer period; when dealing with cases of people aged 40 years and younger or athletic cases, who may have experienced rotator cuff injuries and trauma, it may be advisable to carry out surgical intervention as early as possible in order to facilitate repair to a pre-injury degree (Faber *et al.*, 2006; Krishnan *et al.*, 2008). Overall, it is agreed that rehabilitation and physiotherapy programmes should be the first solution for such an ailment (Bang *et al.*, 2000; Faber *et al.*, 2006). On the

other hand, however, Desmeules et al. (2003) state inadequate uniformity in terms of defining, assessing and treating shoulder impingement. Moreover, it was established that, amongst those trials that were well-designed, there was a lack of evidence to support the overall effectiveness and efficiency of physical therapy in the case of shoulder impingement syndrome.

Importantly, in the treatment of pain, there has been the widespread use of Oral Nonsteroidal anti-inflammatory drugs (NSAIDS) and steroid injections; more recently, however, there has also been the adoption of topical NSAIDS, which are available in form gels or patches. Medication and steroid injections in the context of shoulder pain management have been considered in terms of efficiency, with only support established in the short-term and possibly as a first method (van der Windt et al., 1995).

1.4.2 Surgical Treatment

Upon the failure of conservative management centred on relieving symptoms, or when there is the identification of a complete cuff rupture, it may be necessary to implement operative interventions, especially amongst younger patients. When there has been the occurrence of traumatic injury in the rotator cuff, surgery is commonly recognised as achieving better results in terms of shoulder functionality (Hantes et al., 2011). Moreover, arthroscopic surgery seems to be an option of preference owing to its various benefits when compared with open surgery; these are especially important amongst younger or athletic individuals as such an approach allows these individuals to return to pre-injury functionality (Checroun et al., 1998; Gerald et al., 2000; Krishnan et al., 2008).

1.5 Physiotherapy in Shoulder Impingement Syndrome

According to several studies, which have been accepted by a large number of specialist, physiotherapy programs for shoulder pain involves exercises, ice/heat therapy, manual therapy, several electrotherapy techniques, dry needling, and taping (Senbursa et al, 2007; Baltaci, 2003; Hsu et al, 2009; Kalter et al, 2011).

1.5.1 Manual Therapy

Physical therapists widely implement manual therapy, such as in the form of passive joint mobilisation, in order to provide pain management, such as in the case of shoulder pain, alongside the application of other treatment approaches, such as taping and exercise therapy (Greet et al, 1998; Michener et al, 2004). Importantly, MWM (Mobilisation with Movement) is a concept that was first introduced by Brian Mulligan, and is defined as one of the manual therapy approaches where the therapist manually supports a particularly oriented glide to a painful joint, whilst the patient actively carried out the same movement (Mulligan, 1993).

In specific regard to shoulder pain management, mobilisation methods are applied to the shoulder joints, the scapular, the cervicothoracic vertebral column joints, and to the ribs. Moreover, shoulder pain can be managed through the use of passive joint mobilisation through the use of physiological mechanisms, such as inducing hypnoanalgesia (Paungmali et al, 2003; Sterling et al, 2001), or otherwise through mechanical mechanisms, such as restoring normal biomechanical relationships by dealing with associated joint stiffness (Maitland, 2005).

A number of randomised controlled trials have been documented with the objective to assess the application of manual therapy for shoulder impingement treatment. The

conclusion has been drawn by authors Bang & Deyle (2000) that manual therapy in combination with exercise is more beneficial than exercise therapy in isolation. This same view is supported by Conroy & Hayes (1998), who detail a notable improvement in levels of pain following manual therapy, although improvements were recognised in a number of functions and motions across both groups. Furthermore, manual therapy is recognised by Senbursa *et al.* (2007) as being notably superior when contrasted alongside exercise therapy alone, although, once again, both treatment groups did display improvements.

A randomised controlled trial (RCT) conducted by Yiasemides *et al.* (2011) showed no notable differences when comparing manual therapy and exercises/advice. Moreover, comparable results were derived by the work of Kromer *et al.* (2009), with notable improvements identified in the case of both groups, although there was no notable difference between the two interventions. Furthermore, one of the researches involved a placebo, of inactive ultrasound therapy, contrasted with exercise and manual therapy (Bennel *et al.*, 2010). After the 22-week point, the outcome showed significant improvements in shoulder disability and pain in terms of the index score in the case of the manual therapy group; on the other hand, however, no significant improvements were seen across all three groups, thus emphasising improvements when measuring levels of pain and the perceptions of patients concerning successful treatment outcome. Such studies demonstrate the belief that placebo can have a significant and positive impact on the response to treatment displayed by a patient.

1.5.2 Exercise Therapy

There are a number of exercises in clinical practice that can be adopted to treat impingement syndrome, including biceps and deltoid strengthening, postural corrections, rotator-cuff strengthening and scapula stabilisation. An in-depth physical exam is needed, however, prior to exercise being prescribed; this is done in order to assess all dysfunction causative factors that could be responsible for the musculoskeletal system changes (Kibler et al, 2013).

In regard to exercise therapy for shoulder impingement syndrome specifically, it was established through the systematic review of 11 RCTs, as carried out by Kuhn (2009), that pain is significantly reduced and function notably improved amongst those with displaying shoulder impingement symptoms. As a result of the findings, the scholar stated that, despite the need to ensure the application of a 'gold standard' exercise programme, it is also fundamental that individualisation in the clinical setting is also adopted. The exercises evidenced comprise the following:

- Capsular stretches
- Elastic band resisted strengthening exercises
- Press ups
- Rows
- Scapula retractions and scaption exercises
- Side lying external rotations
- Thoracic Spine extensions (Kuhn, 2009).

A systematic review was carried out by Desmeules *et al.* (2003), arguing that there is a lack of evidence to support the use of exercise in regard to SIS; however, the suggestion made that exercise may be better than the application of placebo,

acromioplasty or no intervention at all. On the other hand, however, there has been some evidence to show that exercise therapy may be valuable amongst those with rotator cuff dysfunction (Green et al, 2003).

1.5.3 Electrotherapy

A number of different methods have been applied in consideration to shoulder impingement syndrome treatments, such as cryotherapy, laser, local heat, transcutaneous electrical nerve stimulation (TENS) and ultrasound (US), amongst others. Importantly, the most widely used methods for controlling pain are US and TENS.

1.5.3.1 *Ultrasound*

US, in its therapeutic form, has been adopted in relation to a number of different inflammatory and subacute traumatic conditions, as well as for scar and excessive fibrous tissue, chronic rheumatoid conditions, and for pain relief (Low & Ann, 2000).

A trial was carried out comprising 145 individuals, with the findings of the study showing that bipolar interferential current is no more advantageous in its usage when compared with placebo in specific regard to general (mixed population) shoulder disorders, with such use centred on the complete recovery or at least significant improvement in pain in the short- or long-term (6 weeks–12 months (van der Heijden, 1999).

Nonetheless, one trial, which examined the impacts associated with iontoferesis of acetic acid, combined with ultrasound (Petron, 1997), established no notable benefits in calcific tendinitis. Moreover, when examining the impacts of ultrasound in rotator cuff tendinitis or general shoulder pain, no evidence identifies an impact.

Notably, a pooled analysis, comprising three individual trials examining the impacts of ultrasound on short-term effects (van der Heijden, 1999; Ebenbichler, 1999; Berry, 1980), displayed small but nonetheless significant advantages when compared with placebo.

1.5.3.2 TENS

TENS has been utilised widely as a way of controlling pain and it has been widely used to be an effective means of modulating pain (Shehab & Adam, 2000).

A number of studies have demonstrated that TENS is a reusable, safe and simple approach to controlling pain in the case of a number of conditions (Johnson et al, 1992), and has a number of positive analgesic impacts (Carroll, 1996). Nonetheless, in terms of whether or not the use of TENS is beneficial for non-specific shoulder pain as part of a day-to-day physical rehabilitation programme, there is a lack of evidence to prove this one way or another (Albright et al, 2001).

Research on the overall effectiveness of TENS and US, as well as cold application and exercise, in an effort to reduce periarticular shoulder pain, has been carried out by Shebab and Adam (2000), who note that both modalities are efficient with the utilisation of US, thus achieving improved results and accordingly enhancing motion range.

1.5.4 Therapeutic taping

Taping is used with/ without other interventions for many purposes, especially to manage pain and improve functional activity in patients with shoulder pain (Kalter et al, 2011). There are many different types of taping techniques, such as rigid taping and kinesiotopeing. Kinesiotopeing, also known as kinesiology taping (KT), is a brand

of kinaesthetic tape whose material is latex free and quick drying tape so that it mimics the qualities of human skin through its thickness and flexibility. By means of this, it can help the muscles and lymphatic systems (Kase, 2003).

However Thelen et al (2008) reported that KT did not show significant improvement for reducing pain and improving functions when compared with sham taping application in patient with shoulder impingement. According to Cools et al (2002), McConnell taping, a specific technique has a greater effect on reducing pain and improving shoulder range of motion (ROM) but there is not a significant improvement on the electromyographic activities of the taped muscles. Alexander et al also tried to explore whether or not taping facilitates trapezius muscle and they chose one of the most popular applications, which is the placement of tape from the medial end of the scapula to the lower thoracic spine (Alexander et al, 2003). They observed trapezius reflex after application to investigate whether taping affects muscle activity. On the contrary, the results showed that taping inhibits its reflex. However, Hsu et al (2009) found that taping has a greater improvement in both lower trapezius activity and scapular movement in the baseball player with impingement syndrome.

1.6 Mechanism of Proposed Effects of Taping

Despite the fact that various scholars believe that taping only has an impact on mechanical stabilisation (Gerrard, 1998; Ernst et al, 1999), taping is widely implemented in relation to the proprioceptive mechanism besides mechanism effects (Kneeshaw, 2002). Hume & Gerrard (1998) also assumed that taping has a positive psychological effect. In specific consideration to the psychological domain, receiving attention demonstrated a clear placebo effect; however, consciousness is also

heightened as a result of the applied tape sensation. Accordingly, there is much debate in the literature as to whether or not taping induces a notable contribution amongst patients, as well as whether or not the proposed mechanisms are valid (Refshauge et al, 2000; Ernst et al, 1999; Alt et al, 1999; Powers et al, 1997; McNair et al, 1996).

1.6.1 Biomechanical Effects:

The mechanical effects are centred on to repositioning the joints in an effort to achieve joint stabilisation, thus providing a splint or changing length-tension relationships so as to generate the necessary motor pattern or musculoskeletal posture (Gerrard, 1998; Kibler, 1998). Dr. Kase, the creator of kinesiotape, explains that these elastic tapes, which are similar with skin, can increase blood circulation and movement because it lifts the skin and increases subcutaneous interstitial space. Increased circulation and movement leads to reduce inflammation in other words, it leads to cool in that area. In this way, reducing pain, improving performance, re-education of neuromuscular system, preventing injuries, acceleration of tissue healing and blood circulation are aimed with KT (Kase et al, 2003).

1.6.2 Proprioceptive Effects:

Murray (2001) presented a mechanism to describe KT and its capacity to cause an increase in proprioception through greater stimulation to cutaneous mechanoreceptors. There is not much known concerning the potential proprioceptive effects of KT; nonetheless, it is considered that there is a facilitatory effect of cutaneous mechanoreceptors, as shown by a number of researches analysing the impacts of linen-backed adhesive athletic tape (Murray, 2001).

Stretching the skin and applying pressure is also recognised as stimulating cutaneous mechanoreceptors, with the stretching sensation recognised as potentially signalling joint movement or joint position (Grigg, 1994). Moreover, it has been stated that cutaneous mechanoreceptors may be useful in identifying joint position and movement stemming from the stretching of the skin at extremes of motion, such as in the case of joint mechanoreceptors (Riemann and Lephart, 2002).

It is also stated by some scholars (Parkhurst & Burnett, 1994; Perlau et al, 1995; McNair et al, 1995) that, as a result of taping, neuromuscular functions are impacted, with the statement made that proprioceptive inputs to central nervous system increase owing to the skin traction or the tape pressure, which means alignment correction is witnessed throughout the course of dynamic movements. Moreover, further evidence suggests that taping has an influence on the relative onset of muscle activity (Morrissey, 2000). In this regard, there is the application of tape in such a way that there is minimal tension, during which time the body part is positioned or held in the right way. Within a particular period of time and with adequate repetition and feedback, there is the learning of these patterns as learned elements of the motor engrams for given movements.

1.7 The Outcome Measurement in Shoulder Impingement Syndrome

There has been much attention directed towards patient-based outcome measures in assessing orthopaedic problems treatment, such as in the cases of rotator cuff ailments and impingement syndrome (Keller, 1993). Importantly, these outcome measurements are discussed below.

1.7.1 Pain

Visual analogue scales (VAS) can be defined as patient-based outcome scales, which facilitate symptoms to be assessed in relation to the scale-associated questions. VASs have been adopted with the aim of assessing levels of pain across various ailments (Richards et al., 1994). When responding to a particular VAS item, subjects detail their own level of agreement concerning particular statements; they do so by detailing a position along an on-going line between two points, such as 10 (very severe pain) and 0 (no pain), for example (Reips & Funke, 2008). A VAS sample can be seen in Appendix 1.

1.7.2 Shoulder Range of Motion (ROM)

Shoulder mobility assessment can be carried out through various tools, such as goniometry, inclinometry, linear measures and visual observations, amongst others (Clarkson, 2005). All of the joints have a normal range of motion, which can be identified in terms of degrees. Importantly, such ROMs are commonly measured through use of inclinometers and goniometers.

1.7.3 Universal goniometer

This tool has been widely implemented owing to its inexpensiveness and portability (Gajdosik & Bohannon, 1987; Laupattarakasem et al., 1990). Nonetheless, goniometry is known to encompass one notable drawback, which is that it is necessary for a clinician to use both hands in order to ensure stabilisation of the extremity; this can mean error can arise when utilising the tool (Gajdosik & Bohannon, 1987).

1.7.4 Inclinator

This measure provides another functional, feasible solution, and involves consideration to constant gravity as a point of reference for evaluating joint mobility, as noted by various researchers (Bovens et al., 1990; de Jong et al., 2007; Laupattarakasem et al., 1990). Digital inclinometers are recognised as having various positive attributes, including being lightweight and portable, and require training comparable to goniometry (Kolber et al., 2011).

1.7.5 Disability

There are a number of available measures for establishing symptoms and calculating shoulder function:

1.7.5.1 Disabilities of the Arm, Shoulder and Hand questionnaire (DASH)

The DASH, in addition to its more condensed version, is the most widely utilised and best-tested tool for evaluating shoulder functionality. The DASH may be described as a 30-item questionnaire centred on assessing symptoms and overall physical function (Jette et al., 1994), with each item comprising a five-response option. Scoring is carried out through summarising the circled responses and subtracting 30; this is recognised as anchoring the score with a base of 30, which is necessary owing to the fact that the response scale spans 1–5, and needs to be changed to a 0–4 equivalent. Subsequently, the figure is then divided by 12 in order to achieve the possible score out of 100 for DASH function/symptoms. Moreover, on the DASH, a higher score shows a worse degree of disability (Beaton et al., 2001).

A DASH sample can be seen in Appendix 2.

1.7.5.2 Shoulder, Pain, Arm, Disability Index (SPADI)

The SPADI was developed in mind of assessing the disability and pain associated with shoulder pathology, and can be defined as a self-administered index comprising 13 individual items, which together may be assigned to two subscales, namely disability and pain. Importantly, items are rated with the use of a VAS. In order to derive a score (out of 100), all items are rated, with each subscale summed and transformed. The two subscales are considered in order to provide a mean, with a lower score presenting lower levels of disability and/or impairment (Roach et al., 1991).

A DASH sample can be seen in Appendix 3.

1.7.6 Muscle Strength

1.7.6.1 Manual muscle test

The evaluation of muscle performance in line with clinical practice provides manual muscle tests (MMTs), which may be widely implemented by physical therapists (Kendal et al., 1993; Hislop et al., 1995). Importantly, the MMT is carried out with an examiner applying force to the individual in the contrasting direction to the tested muscle's action. Subsequently, there is the grading of the muscle with the use of an original grading scale, notably spanning 0–5 (Kendal et al., 1993; Hislop et al., 1995).

1.7.6.2 Dynamometer

Dynamometers, some of which are handheld, have become more widely utilised and recognised as a valuable tool for measuring muscle force production in the clinical environment, with such measures recognised as potentially linked with isokinetic strength scores (Reed et al., 1993; Top & Mikesky, 1994). Despite the various benefits established through the use of a handheld dynamometer, such as its portability and lack of attachments necessary when measuring both lower and upper muscle groups, it remains that there is one key drawback, which is the tool's reliability, which rests on the examiner's strength and their own capacity to maintain the testing position whilst simultaneously holding against the patient's own resisting force (Wikholm & Bohannon, 1991).

1.8 Rationale for Review

As a novice physiotherapist in musculoskeletal service, I have had lots of experience with patients suffering from shoulder pain in this short time and most of them diagnosed with shoulder impingement syndrome. Regarding my experience in Turkey, shoulder problems have been chronic because of inappropriate diagnosis and treatment methods, therefore shoulder pain becomes one of most interesting area both clinicians and patients in Turkey. General physiotherapy care, such as electrotherapy and home exercises, have been used as a primary health care setting by many physiotherapists because there are not enough clinicians and clinic for patients so they usually choose these techniques to care as much possible patient as in a short time. Moreover, after significant positive results of taping, it has been a really popular and promising technique in Turkey as well as many countries. So

much so, people can apply taping, called " pain tape " in the pharmacy, on their own by reading instruction manuals. Besides excess demand, it is a quick method to apply; as a consequence many physiotherapists have begun to use taping on their patients in the clinics. Taping is usually combined with physiotherapy care in Turkey and many patients and clinicians believe that taping contribute to physiotherapy to fix problems and decrease pain levels, however there is not enough evidence to prove that.

Moreover, there is not sufficient research to explore clinical effectiveness of taping techniques in addition physiotherapy care. It seems that majority of studies just conducted clinical effectiveness of KT, a type of elastic taping technique, in patients any musculoskeletal disorders. Firstly, there is a big gap in the literature about clinical effectiveness of taping method in particular disorders. Secondly, the most of taping methods were selected as KT methods in these studies, however many physiotherapist use taping techniques in combination with other physiotherapy interventions. Thirdly, there is no consensus on whether it is an effective method to improve symptoms in patients with shoulder pain.

For these reasons, I decided to focus on such specific area and build my question to answer whether using taping in combination with physiotherapy care improve symptoms particularly for patients with shoulder impingement syndrome.

1.9 Aim and Objectives

This systematic review aimed to critically appraise and synthesize the available evidence on the effectiveness of clinical taping in addition to physiotherapy care in

patients with shoulder impingement syndrome. The outcomes of interest pain, disability and ROM. The research question which aimed to answer is: "Is any type of taping technique in addition to usual physiotherapy care more effective than usual physiotherapy care without taping in patients with shoulder impingement syndrome?"

The objectives were to:

- I. Critically review the literature on the effectiveness of clinical taping combined with physiotherapy in the management of shoulder impingement syndrome
- II. Undertake a modified systematic review of randomized controlled trials (RCTs) and pseudo RCTs that investigated the role of clinical taping plus physiotherapy and specifically answer the question below:
 - Is clinical taping and physiotherapy an effective method for pain management, improving shoulder ROM and functional status in patients with shoulder impingement syndrome?
 - Is clinical taping plus physiotherapy superior to physiotherapy care alone for improvement symptoms in patients with shoulder impingement syndrome?
 - Are there any differences between taping techniques (rigid or elastic taping) to improve symptoms?
- III. Reflect on how findings of systematic review will impact clinical practice
- IV. Make recommendation based on the findings of the systematic review.

2 METHODOLOGY

This chapter focuses on the methodology employed in carrying out this modified systematic review. It starts with an introduction and discussion of the role of systematic reviews in evidence based practice. This followed by the justification for scope of the review, the review question, the protocol and the methodology of the review.

2.1 Introduction

In accordance with the requirement of the school of Health Science of the University of Nottingham, this dissertation will be modified systematic review as it will have only one reviewer.

2.2 Systematic Review in Evidence Based Practice

Evidence-based practice (EBP) may be defined as the mixing of the most valuable and best available research alongside clinical expertise in relation to patient culture, characteristics and preferences. This approach is recognised as having a profound and fundamental impact on the way in which the disability and rehabilitation field is evolving, with construct evidence-based practice recognised as the preferred approach for professionals providing those with disabilities with services.

It is widely help that EBP needs to involve a mixture of the most current and best research evidence, as well as relevant stakeholder views, and clinical and

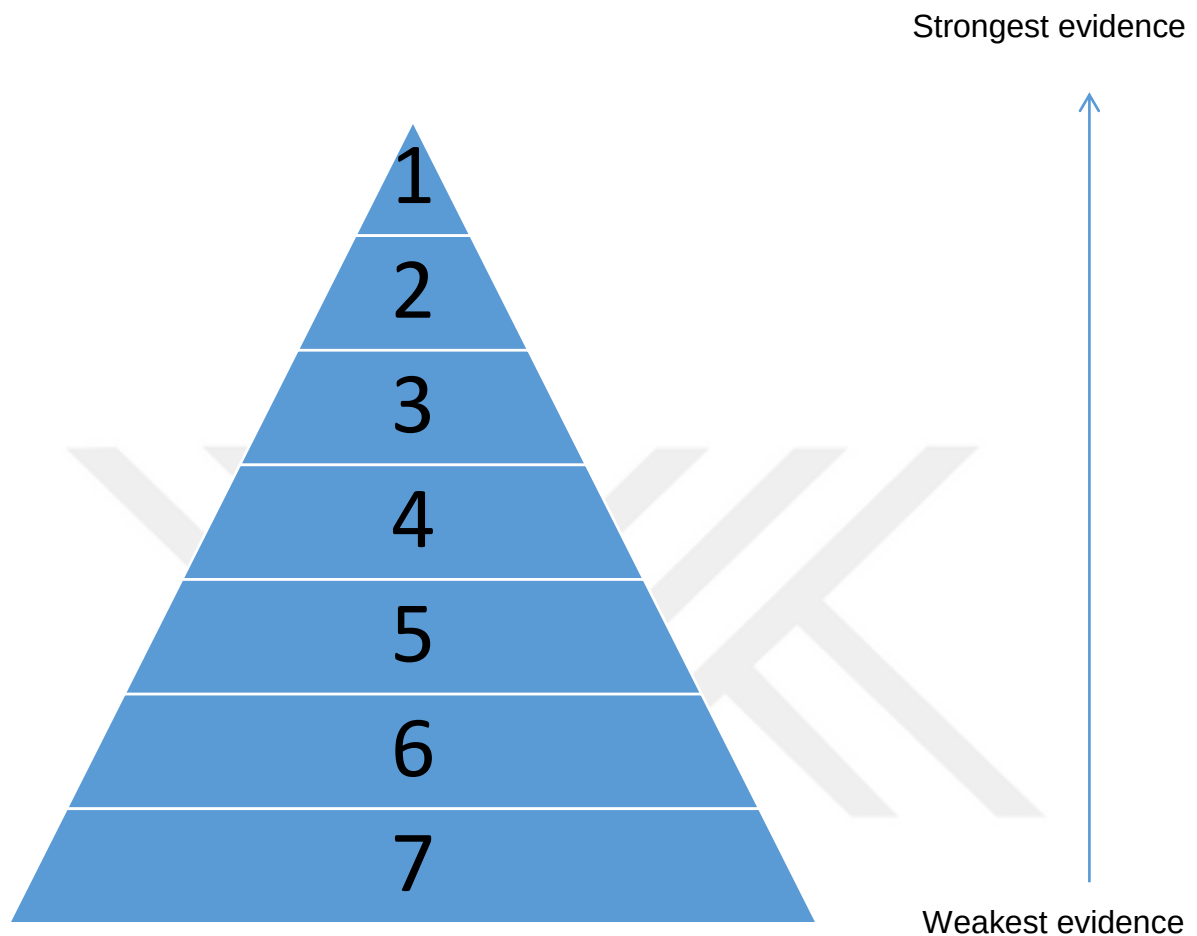
educational expertise when making the best possible decisions for a specific type of consumer (Law, 2002; Straus et al, 2005; Schlosser, 2003; Raghavendra, 2004).

Importantly, there is the need of multiple researches; these are synthesised in an effort to provide valid findings that can either reject or validate an approach. Accordingly, systematic reviews specifically those making use of meta-analyses are recognised as higher ranking than non-systematic reviews and individual studies on hierarchies of the treatment evidence in medicine (Schlosser & Raghavendra, 2004). Furthermore, systematic reviews can also be applied in an effort to extract important data relating to development efforts and the quality of such.

Despite there still being a number of existing databases considering what is classified as best evidence, the conclusions drawn following the completion of systematic reviews of randomised control trials are recognised as delivering the best EBP-related evidence (Guyatt *and Rennie*, 2002; Fineout-Overholt *et al*, 2005)

(Figure 1 illustrates a pictorial representation of the evidence hierarchy).

Figure 1: Hierarchy of evidence



1. Systematic reviews and meta-analyses
2. Randomised controlled trials with definitive results (confidence intervals that do not overlap the threshold clinically significant effect)
3. Randomised controlled trials with non-definitive results (a point estimate that suggests a clinically significant effect but with confidence intervals overlapping the threshold for this effect)
4. Cohort studies
5. Case-control studies
6. Cross sectional surveys
7. Case reports

2.3 The review question

By considering the qualities of a well-designed question, it has been developed below:

Is any type of taping technique in addition to usual physiotherapy care more effective than usual physiotherapy care without taping in patients with shoulder impingement syndrome?

The question is broken down based on the mnemonic PICO, and shown in table 1.

Table 1: PICO Characteristics of the Review Question

Participants	Adults with shoulder impingement syndrome
Intervention	Any taping technique in addition to usual physiotherapy care
Comparison	Usual physiotherapy care with/without sham taping.
Outcomes	Pain, Shoulder ROM and disability

2.4 Justification of Methodology

The choice of the design of this study is a systematic review including RCTs and non-randomized controlled trials. As I mentioned in section 2.2, systematic reviews, are the strongest and most trustworthy evidence in the literature to evaluate effectiveness of any interventions because of using strategies to avoid bias and random error secondary source of reviews of literature to evaluate and summarise primary research studies (Cook et al, 1997). RCTs are gold standard for primary research especially to compare two interventions (Begg et al, 1996). This study aimed to understand whether taping in addition physiotherapy is more effective than physiotherapy care without taping in patients with shoulder impingement syndrome in this study, therefore randomized controlled trials were chosen in this study and physiotherapy care without taping or with sham taping were control groups. Therefore, among the several methods to answer research question, systematic review of randomized and pseudo randomized controlled trials was selected the best design because of justifications mentioned above.

Pain was selected as a primary outcome measure in this review because pain is one of the primary interests to patients, clinicians and third party payers (Turk et al, 2008).

2.5 Systematic Review Protocol

Similar to an empirical research proposal, a systematic review protocol is a detailed written plan prepared in advance (Higgins and Green, 2008). It explicitly sets out the

methodology for the review and defines the scope of the study. The protocol for this modified systematic review can be seen in appendix 4.

2.6 Inclusion and Exclusion Criteria

Studies were included if the following criteria were fulfilled:

2.6.1 Type of Studies

Randomized and pseudo randomized controlled trials, which are published in English or Turkish, were included in this study.

2.6.2 Types of Participants

Studies over 18, with shoulder pain and restricted ROM who referred by an general practitioner, orthopedic surgeon, physicians or physiotherapist and diagnosed any shoulder impingement related disorders (SIS or rotator cuff lesions) regarding physical examinations, shoulder impingement tests, radiography or MRI images, were included in this study.

2.6.3 Types of Intervention

All participants received any usual physiotherapy care (e.g. manual therapy, exercise, soft tissue massage, cold or heat therapy, US or any electrotherapy methods). In addition to usual physiotherapy care, any rigid or elastic taping methods are applied by experienced physiotherapists as a treatment group. Usual physiotherapy care alone or sham taping applications in addition to routine physiotherapy care were comparison group.

2.6.4 Types of Outcome Measures

This study focused on the following outcomes: pain level, pain free ROM and functional activity and the primary outcomes of interest were pain level in this review. There were no restrictions on working to any specific outcome measures.

2.6.5 Exclusion Criteria

Patients excluded if they were diagnosed with any other shoulder dysfunctions (e.g. frozen shoulder, capsulitis-type disorders, full thickness of rotator cuff disease), have any shoulder post-surgery conditions, fracture or dislocation of affected shoulder, cervical problems accompanied by radicular symptoms, steroid injection into or around shoulder in the past 3 months, poor or fragile skin condition and any systematic diseases (e.g. rheumatoid arthritis).

2.7 Identification of studies

2.7.1 Search methods for identification of studies

In this review, Medline search strategy was chosen as the main search strategy. Compared with other search strategies such as original Cochrane strategy, Medline is more comprehensive method because of sensitivity to possibly relevant studies and limiting of irrelevant trial (Robinson and Dickersin, 2002).

Search terms used in databases were shoulder impingement syndrome, rotator cuff, subacromial impingement, shoulder tendinopathy, shoulder pain, shoulder instability, physical therapy, physiotherapy, exercise, musculoskeletal manipulations, chiropractic, manual therapy, manipulative medicine, manipulative therapy,

electrotherapy, electric stimulation therapy, acupuncture, dry needling, athletic tape, strapping, taping, kinesiotaping.

To conduct more sensitive search, this terms were also used the following database: Cochrane Database of Systematic Review, MEDLINE (EBSCO), Physiotherapy Evidence Database (PEDro), CINAHL (EBSCO), PUBMED, AMED, EMBASE (OVID).

There is no limit on the publication date and these studies were conducted to June 2014.

The detailed search strategies are also illustrated in the appendix 5 for each database.

2.7.2 Searching other resources

The Kinesio Kinesio® Taping Method and Kinesio® Tex Tape UK and International websites (www.kinesiotaping.co.uk; www.kinesiotaping.com) were searched for additional relevant research not identified by the mainstream search engines.

I also used a Turkish official database (<https://tez.yok.gov.tr/UlusalTezMerkezi>), which collects all of theses of master's and doctorate studies .

2.7.3 Selection of studies

Since this is a modified systematic review, only one reviewer evaluated the titles and abstracts for relevance to the systematic review's purpose. The same eligibility criteria were applied to all the titles and abstracts identified during the search. The selection of studies was comprised two steps. In the first step, titles and abstracts of studies were screened and irrelevant studies were removed. Potentially relevant full

text studies were obtained to further evaluate regarding inclusion criteria in the second step. A few studies were excluded after reading their full texts. Such studies and reasons for their exclusion are presented in appendix 6.

2.8 Data Extraction and Analysis

2.8.1 Data Extraction

Relevant data was extracted from each study by using standardised data extraction form that contained:

- bibliographic data (authors, years of publication)
- study characteristics (aim of studies, study design, sample size)
- aim of the studies
- characteristics of participants (gender, age, symptoms characteristics)
- description of the intervention (both intervention and control groups)
- follow-up intervals
- outcomes assessed
- results

2.8.2 Quality Assessment

The quality assessment of the studies was conducted using Physiotherapy Evidence Database (PEDro) and JBI Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MASARI) critical appraisal tools.

PEDro scale is a checklist of yes/no questions to appraise studies regarding allocation bias, blinding and adequacy of follow up (Moseley et al, 2002).

Although critical appraisal was done by one reviewer, all studies were also assessed by JBI-MASaRI appraisal tool in order to achieve more reliable assessment. The JBI-MASaRI appraisal tool which has also developed a standard checklist to appraise RCT or experimental study designs is also very common tool among health professionals.

2.8.3 Data Synthesis

The amount of the individual studies did not allow the results to be combined through meta-analysis therefore, the results were described narratively.

As no studies reported difference between means and medians from the baseline, I calculated by subtraction baseline from final value. I also calculate standard deviation for mean difference using a formula according to Cochrane Handbook for Systematic Review (Higgins, 2011).

In this review, cohen d and %95 CI were also reported via a calculator on Campbell Collaboration website (Campbellcollaboration.org, 2014).

These results are also interpreted according to Yatana's interpretation table (2014), which is illustrated in table 2.

Table 2: Interpretation of CI and effect size

CI includes the zero	The absolute value of the effect size	The range of CI	Implication
No	small	small	The effect apparently exists, but we are also sure that the effect is small.
	small	large	This is unlikely to happen.
	large	small	The effect apparently exists, and we are sure that the effect is large.
	large	large	The effect apparently exists and may be large, but we are not sure about the real size of the effect.
Yes	small	small	We are sure that the effect is small, but not sure whether the effect really exists.
	small	large	We are not sure whether the effect exists. We thus need more data.
	large	small	This is unlikely to happen.
	large	large	We are not sure whether the effect exists. We thus need more data.

2.8.4 Missing Data

There were two studies (Kaya et al., 2010; Miller & Osmotherly, 2009) reported results using median and interquartile range and they did not report neither Z score nor Cohen's d score. I contacted to the authors to get data. Kaya et al (2010) supplied the means and standard deviations of the results, whereas Miller & Osmotherly (2009) did not reply my e-mail. Therefore, in the results section, I used the median differences from baseline regarding clinically effectiveness for each group and also reported p value for statistically differences.

3 RESULTS

The findings of this systematic review are presented in this chapter. This includes the result of the search strategy, an overview of the included studies, quality assessment of each of the studies, and a narrative synthesis of the results.

3.1 Selection of studies

The database search produced a total of 62 studies. After screening the articles by title and abstract, and after deleting duplicates, 36 abstract remained and reviewed, and 9 of these had a high probability of relevance. The full articles of these were then retrieved and assessed for inclusion, except the study by Wang SS et al (2001). This study could not be retrieved despite contacting to the author to get the article. The abstract of this paper can be seen in appendix 7. After full text articles assessment for eligibility, 4 studies met the inclusion criteria, and made up the systematic review. The flow chart of the search process is provided in figure 2

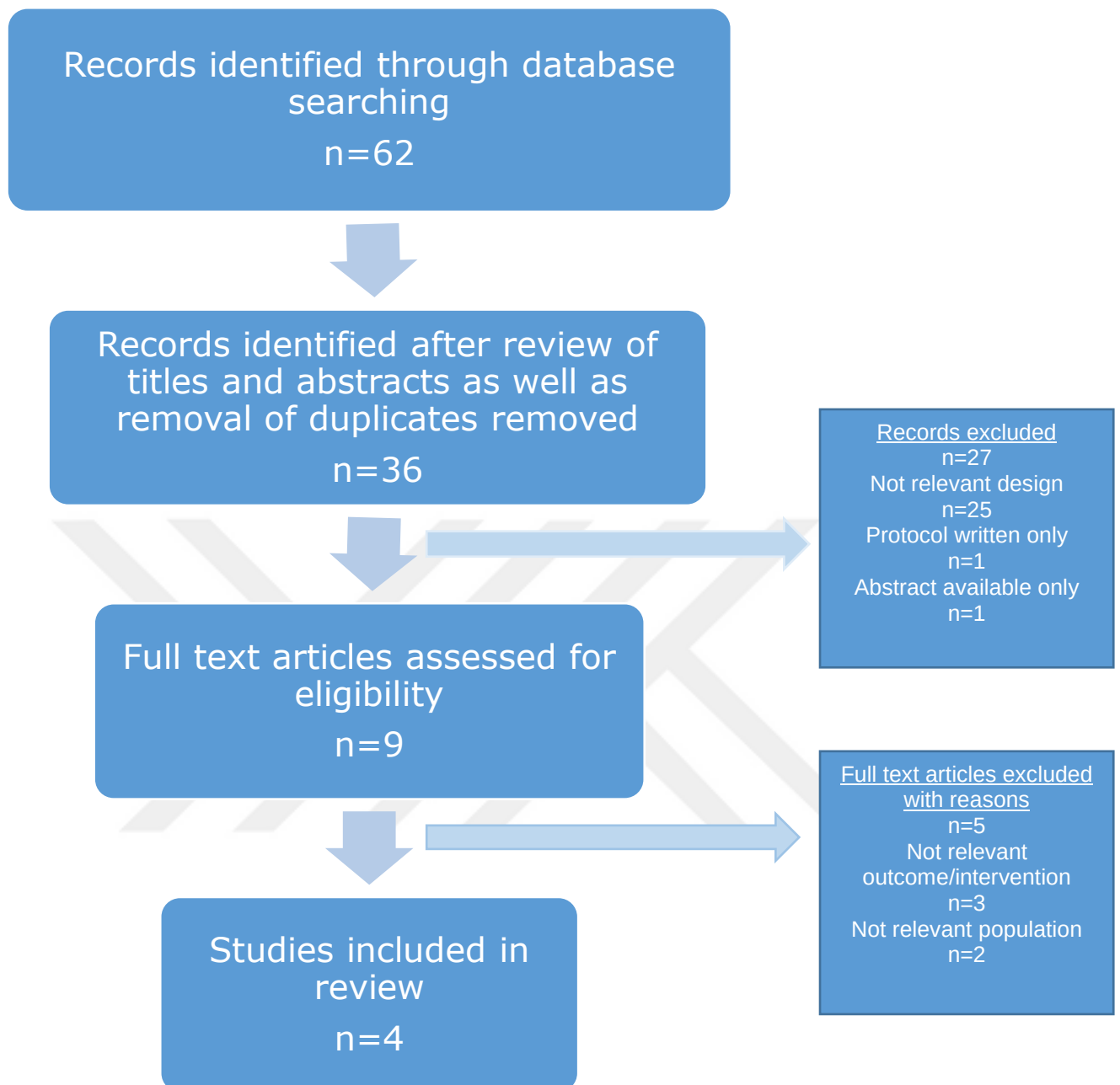


Figure 2: Flow chart of study selection

3.2 Description of included Studies

The 4 studies included in this review were 3 of these published RCTs and 1 of these controlled trial by the electronic database search. Characteristics of included studies are provided in table 3.

3.2.1 Participants of included studies

A total of 135 participants were enrolled in the included studies. Participants were male and female adults with an age of 18 to 79. All studies have similar mean age. All studies chose their participants based on shoulder impingement tests by Hawkins, Neer and Kennedy. Their main complaints were shoulder pain and painful or/and restricted ROM in the shoulder and the limited daily living activities .Duration of symptoms are also specified except one (Simsek et al., 2013). A detailed description of the population is given in table 3.

3.2.2 Location of included studies

The studies were conducted in three different countries: Turkey (Kaya et al., 2010; Simsek et al., 2013), Australia (Miller& Osmotherly, 2009) and Serbia (Djordjevic et al., 2012). All the studies recruited participants from physical therapy departments.

3.2.3 Intervention and comparisons

The included studies compared KT or rigid taping in addition physiotherapy interventions to either a sham tape in addition physiotherapy care or physiotherapy care without taping. Three of studies (Kaya et al, 2010; Simsek et al, 2013; Djordjevic et al, 2012) used KT as a taping technique and one study (Miller et al, 2009) used a scapular rigid taping technique. Two of studies (Simsek et al, 2013;

Djordjevic et al 2012) used only supervised exercise program as a physiotherapy care. There was only one study (Simsek et al, 2013) which used sham taping as a comparison.

The combination and comparison interventions can also be seen table 3.



Table 3: Overview of included studies

<i>Study</i>	<i>Aim</i>	<i>Population</i>	<i>Intervention/comparison</i>	<i>Follow up</i>	<i>Outcomes</i>
Miller & Osmotherly, 2009	To investigate the short-term effect of taping on people presenting with sub-acromial impingement syndrome	N=22 Taping group n=10 mean age:62 Pt only group n=12 mean age:54.5 Duration of symptoms: Taping: 16 weeks Pt only group: 17 weeks	Group 1 received scapular (rigid) taping (six sessions) plus routine physiotherapy (soft tissue massage, joint mobilisation and exercise) Group 2 received routine physiotherapy without taping.	7 th and 42th day after treatment	Primary outcomes: function (SPADI); secondary outcomes: pain (VAS) and ROM (goniometer)
Kaya et al., 2010	To determine and compare the efficacy of kinesiotape and physical therapy in patients with SIS.	N=55 KT group n=30 mean age:56.2 PT group n=25 mean age:59.5 Duration of symptoms: KT group: 6.3 months, PT group: 7 months	Group 1 received a standardized kinesiotape (three sessions) in addition to the home exercise program. Group 2 received a dail of physiotherapy program (ultrasound, tens, hotpack) in addition to the same home exercise program.	7 th and 14 th day after treatment	Primary outcomes: function (DASH); secondary outcomes: pain at rest, at night and by movement (VAS)
Djordjevic et al., 2012	To compare the efficacy of MWM and KT with supervised exercise program in patients either with rotator cuff lesion or SIS	N=20 Taping+ MWM group n=10 mean age: 51.80 Exercise only n=10 mean age: 54.10 Duration of symptoms: taping+ MWM : 4.7 months, exercise only: 4.8 months	Group 1 received MWM plus KT (two sessions) whereas group 2 received supervised exercise program only.	5 th and 10 th day after treatment	Pain free active ROM (goniometer)

Simsek et al., 2013	To determine and compare the efficacy of kinesiotape and physical therapy in patients with SIS	N=38 KT group n=19 mean age: 48 Sham tape group n=19 mean age:53	Group 1 received the therapeutic kinesiotape (four sessions) in addition to supervised exercise program, whereas group 2 received sham tape plus the same exercise program.	5 th and 12 th day after treatment	Pain (VAS), function (DASH), ROM (goniometer) and muscle strength (dynamometer)
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3.3 Excluded studies

Details of the studies excluded after reviewing their full text articles can be seen in appendix 6.

3.4 Outcome Measures

The primary outcome of interest was pain and the secondary outcome measures were function status/ disability, ROM and muscle strength.

3.4.1 Pain

Three studies included in this systematic used VAS to measure pain intensity. Two of these studies (Kaya et al, 2010; Simsek et al, 2013) measured pain severity at night, at rest and by movement, whereas one study (Miller& Osmotherly, 2009) measured pain severity during active flexion and abduction of shoulder. This study also measured pain severity with SPADI questionnaire. Minimal clinically important difference (MCID) defined 3 cm. on a 10 cm. VAS measuring pain for patients shoulder pain (Tashjian et al, 2009)

3.4.2 Functional status/ disability

Three studies assessed the perceived level of disability as a result of shoulder pain and/or painful, restricted shoulder ROM. The DASH is used by the two of these studies (Kaya et al, 2010; Simsek et al 2013) and one study (Miller & Osmotherly, 2009) used the SPADI for disability as well. The MCID for DASH has been reported 10.2 points, whereas it is 13.2 points for SPADI (Schmitt and Di Fabio, 2004).

3.4.3 Range of Motion

Three studies measured active pain free shoulder flexion/elevation and abduction ROM.

Two of these studies (Djordjevic et al, 2012; Simsek et al, 2013) used conventional goniometer and one study (Miller & Osmotherly, 2009) used digital inclinometer to conduct ROM measurement. The MCID for ROM of shoulder elevation measured with goniometer has been found 8 degrees, whereas it has been found 9 degrees with digital inclinometer (Kolber et al, 2011).

3.4.4 Muscle strength

There is only one study (Simsek et al, 2013) assessed muscle strength of shoulder muscle using dynamometer. They measured shoulder flexors, extensors, abductors, external rotators and internal rotators of shoulder joint. As they just did not measure specific muscle strength test, there is no study about MCID value for muscle strength. Therefore analysing of these data is not going to be possible regarding clinically importance.

3.5 Quality Assessment

The methodological quality of the studies was assessed two different tools: PEDro and JBI-MAStARI. The results accorded a yes, no and each yes was counted as one and no counted as zero. The maximum score was 8 out of 11 for PEDro whereas it was 9 out of 10 for JBI. Low quality was as meeting less than five criteria for each one. Both appraisal tools showed only one study (Kaye et al, 2010) was deemed as being low quality because it did not meet more than 5 criteria.

There is no study which met the criteria about blinding subject and there is only one study met the criteria about concealment allocation.

The mean methodological quality of all studies is 7.5 for PEDro out of eleven whereas it is 7.75 out of ten for JBI MASTaRI.

All studies showed higher quality when they were assessed by JBI MASTaRI.

Results of the methodological quality scorings for included studies are shown in table 4-5.

Table 4: Scoring of the methodological quality of included studies using JBI MASTaRI

Study	1. <i>Was the assignment to treatment groups truly random?</i>	2. <i>Were participants blinded to treatment allocation?</i>	3. <i>Was allocation to treatment groups concealed from the allocator?</i>	4. <i>Were the outcomes of people who withdrew described and included in the analysis?</i>	5. <i>Were those assessing the outcomes blind to the treatment allocation?</i>	6. <i>Were control and treatment groups comparable at entry?</i>	7. <i>Were groups treated identically other than for the named interventions?</i>	8. <i>Were outcome measured in the same way for all groups?</i>	9. <i>Were outcomes Measured In a reliable way?</i>	10. <i>Was appropriate statistical analysis used?</i>	Total
Miller & Osmotherly, 2009	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	9
Kaya et al., 2010	N	N	N	Y	N	Y	Y	Y	Y	N	5
Djordjevic et al., 2012	Y	N	Y	Y	Y	N	Y	Y	Y	Y	8
Simsek et al., 2013	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	9

Table 5: Scoring of the methodological quality of included studies using PEDro

<i>Study</i>	<i>1. Eligibility criteria</i>	<i>2. Random allocation</i>	<i>3. Concealed allocation</i>	<i>4. Baseline comparability</i>	<i>5. Blinding subject</i>	<i>6. Blinding therapist</i>	<i>7. Blinding assessor</i>	<i>8. Outcome Data> 85%</i>	<i>9. Intention to treat</i>	<i>10. Between Group results</i>	<i>11. Point measure/ measures of variability</i>	<i>PEDro score</i>
Miller & Osmotherly, 2009	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y	8
Kaya et al., 2010	Y	N	N	Y	N	N	N	Y	Y	Y	N	5
Djordjevic et al., 2012	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	8
Simsek et al., 2013	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	9

Table 6: RESULTS

STUDY/OUTCOME MEASURE	TIME	PAIN AT REST <i>Mean (SD or 95%CI)</i>				PAIN AT ACTIVITY <i>Mean (SD or 95%CI)</i>				PAIN AT NIGHT <i>Mean (SD or 95%CI)</i>			
		GROUP 1 Therapeutic KT+ Exercise	GROUP 2 Sham taping+ Exercise	P value	Effect Size (d/%95 CI)	GROUP 1 Therapeutic KT+ Exercise	GROUP 2 Sham taping+ Exercise	P value	Effect size (d/%95 CI)	GROUP 1 Therapeutic KT+ Exercise	GROUP 2 Sham taping+ Exercise	P value	Effect size (d/%95 CI)
Simsek et al., 2013 VAS(cm)	Baseline	2.74(2.73)	3.21(2.92)	0.644		7.12(2.21)	7.96(1.25)	0.370		6.23(3.42)	6.74(3.03)	0.624	
	5 th day	1.74(2.06)	2.61(2.72)	0.563		4.87(2.29)	6.71(1.68)	0.010*		3.36(2.83)	5.38(3.35)	0.065	
	difference 5 th day	1.00 (1.64)	0.6 (1.79)			2.25 (2.02)	1.25 (1.01)		d= 0.63 (-0.02,1.27)	2.87 (2.05)	1.36 (2.04)		
	12 th day	1.43(2.22)	2.65(2.67)	0.116		4.32(2.64)	6.28(1.93)	0.009*		2.37(3.19)	4.82(2.95)	0.018*	
	difference 12 th day	1.31 (1.63)	0.56 (1.78)			2.80 (1.58)	1.68 (1.191)		d= 0.8 (0.13,1.46)	3.86 (2.16)	1.92 (1.89)		d= 0.95 (0.28,1.62)
		PAIN AT REST <i>Mean (SD or 95%CI)</i>				PAIN ON MOVEMENT <i>Mean (SD or 95%CI)</i>				PAIN AT NIGHT <i>Mean (SD or 95%CI)</i>			
Kaya et al., 2011 VAS(mm)	TIME	GROUP 1 KT + Exercise n=30	GROUP 2 PT+ Exercise n=25	P value	Effect size	GROUP 1 KT + Exercise n=30	GROUP 2 PT+ Exercise n=25	P value	Effect size	GROUP 1 KT + Exercise n=30	GROUP 2 PT+ Exercise n=25	P value	Effect size
	Baseline	42 (29.49)	54 (28.43)	0.445		83 (17.74)	86 (17.55)	0.445		72 (28.83)	74.40 (28.73)	0.451	
	7 th day	24 (23.57)	48.8 (26.35)	0.001*		43.83 (23.18)	67.6 (17.62)	0.001*		36.67 (26.69)	59.20 (25.31)	0.01*	
	difference 7 th day	18 (17.69)	5.2 (17.43)		d= 0.72 (0.18, 1.27)	39.17 (13.93)	18.4 (10.44)		d= 0.22 (-0.31, 0.75)	35.33 (17.67)	15.2 (17.39)		d= 1.13 (0.56, 1.70)
	14 th day	16.33 (20.92)	25.6 (22.92)	0.218		33.50 (23.16)	40.40 (22.81)	0.218		21 (24.54)	32 (24.66)	0.07	
	difference 14 the day	25.67 (17.89)	28.4 (17.05)			49.5 (13.91)	45.6 (13.70)			51 (17.63)	42.4 (17.3)		
Miller & Osmotherly, 2009 VAS(mm)	TIME	Group 1 Taping+ PT n=10	Group 2 PT only n=12	P value	Effect size	Group 1 Taping+ PT N=10	Group 2 PT only N=12	P value	Effect size	Group 1 Taping+ PT N=10	Group 2 PT only N=12	P value	Effect size
	Baseline	85.5/ 76-124	86.5/ 62.5-120	0.58		25/ 11-46	32/ 14-58.5	0.69		54.6/ 43.6-69.1	60/ 32.7-67.3	0.74	
	14 th day	16.5/ 5-36	56/ 32.5-67	0.09		15.5/ 5-24	38.5/ 4.5-51.5	0.45		20.9/ 16.34-32.57	40.9/ 15.4-64.6	0.28	
	difference 14 th day	69	30.5		No Data (ND)	9.5	-6.5		(ND)	33.7	19.1		(ND)
	42th day	9/ 5-14	10/ 2-66	0.45		13.5/ 5-32	6/ 4-26	0.76		18.2/ 1.8-25.5	20/ 0-60	0.76	
	difference 42th day	76.5	76.5		(ND)	11.5	26		(ND)	36.4	40		(ND)
		PAIN AT ABDUCTION <i>Median /IRQ</i>				PAIN AT FLEXION <i>Median /IRQ</i>				SPADI <i>Pain score Median/IRQ</i>			

STUDY/OUTCOME MEASURE	FUNCTION Mean (SD or 95%CI)								
Simsek et al., 2013 DASH	TIME	GROUP 1 Therapeutic KT+ Exercise	GROUP 2 Sham taping+ Exercise	P value	Effect size (d/%95 CI)				
	Baseline	46.15(19.83)	52.69(16.42)	0.246					
	5 th day	30.14(17.77)	48.05(18.59)	0.004*					
	difference 5 th day	16.01 (12.01)	4.64 (11.26)		d= 0.975 (0.30,1.64)				
	12 th day	25.14(14.35)	47.10(17.87)	0.001*					
	difference 12 th day	21.01 (11.99)	5.59 (10.93)		d= 1.34 (0.6, 2.04)				
	FUNCTION Mean (SD or 95%CI)								
Kaya et al., 2011 DASH	TIME	GROUP 1 KT + Exercise n=30	GROUP 2 PT+ Exercise n=25	P value	Effect size				
	Baseline	58.63 (16.48)	56.56 (17.75)	0.691					
	7 th day	(ND)	(ND)	(ND)					
	difference 7 th day	(ND)	(ND)	(ND)	(ND)				
	14 th day	25.53 (17.28)	33.04 (16.72)	0.027*					
	difference 14 th day	33.1 (10.70)	23.52 (10.94)		d= 0.88 (0.33, 1.44)				
	SHOULDER DISABILITY Median /IRQ			TOTAL Median /IRQ					
Miller & Osmotherly, 2009 SPADI	TIME	Group 1 Taping+ PT	Group 2 PT only	P value	Effect size	Group 1 Taping+ PT N=10	Group 2 PT only N=12	P value	Effect size
	Baseline	36.9/ 23.4-60.2 n=10	50.0/ 21.6-63.6 n=12	0.67		47.7/ 39.4-62.8 n=10	54.4/ 27.2-65.1 n=12	0.90	
	14 th day	20.5/ 10.2-29.6 n=6	42.6/ 4.6-55.1 n=12	0.92		18.4/ 16.0-31.10 n=6	41.5/ 12.36-54.3 n=12	0.60	
	difference 14 th day	16.4	7.4		(ND)	29.3	12.9		(ND)
	42th day	8.5/ 1.1-27.3 n=6	12.5/ 0-51.1 n=11	0.72		13.1/ 2.1-33.6	19.7/ 0-59 n=11	0.76	
	difference 42th day	28.4	37.5		(ND)	34.6	34.7		(ND)

STUDY/OUTCOME MEASURE		ACTIVE ABDUCTION ROM Mean (SD or 95%CI)				ACTIVE FLEXION ROM Mean (SD or 95%CI)			
		GROUP 1 Therapeutic KT+ Exercise	GROUP 2 Sham taping+ Exercise	P value	Effect size	GROUP 1 Therapeutic KT+ Exercise	GROUP 2 Therapeutic KT+ Exercise	P value	Effect size
Simsek et al., 2013 ROM (degrees)	TIME								
	Baseline	129.50(34.07)	147.26(30.74)	0.061		143.42(29.63)	166.68(20.23)	0.002*	
	5 th day	145.68(28.62)	155.26(24.14)	0.234		157.63(22.01)	171.58(15.88)	0.002*	
	difference 5 th day	16.3 (20.48)	8.00 (18.45)			14.21 (17.85)	4.9 (12.14)		d= 0.6 (-0.04,1.26)
	12 th day	158.95(22.14)	160.58(21.44)	0.863		165.68(19.45)	172.59(12.72)	0.040*	
	difference 12 th day	29.5 (20.96)	13.54 (18.71)			22.26 (18.27)	5.91 (12.62)		d=1.04 (0.36,1.71)
		ACTIVE ABDUCTION ROM Mean (SD or 95%CI)				ACTIVE FLEXION ROM Mean (SD or 95%CI)			
Djordjevic et al., 2012 ROM (degrees)	TIME	GROUP 1 KT + Exercise n=30	GROUP 2 PT+ Exercise n=25	P value	Effect size	GROUP 1 KT + Exercise n=30	GROUP 2 PT+ Exercise n=25	P value	Effect size
	Baseline	53(21)	46(14.28)	0.163		53(28.48)	69(14.63)	0.015*	
	5 th day	112(46.69)	47.5(15.21)	0.0001*		105(41.10)	72(17.35)	0.0005*	
	difference 5 th day	59.0 (32.43)	1.5 (9.37)		d= 2.31 (1.63,3.00)	52.0 (25.04)	3.0 (10.44)		d=2.47 (1.76,3.17)
	10 th day	170(17.89)	60.5(15.72)	0.0001*		166(20.59)	86(21.89)	0.0001*	
	difference 10 th day	117.0 (12.64)	14.5 (9.58)		d=9.02 (7.25,10.79)	113.0 (17.22)	17.0 (13.44)		d=6.14 (4.88,7.41)
		ACTIVE ABDUCTION ROM Median /IRQ				ACTIVE FLEXION ROM Median /IRQ			
Miller & Osmotherly, 2009 ROM (degrees)	TIME	Group 1 Taping+ PT n=10	Group 2 PT only n=12	P value	Effect size	GROUP 1 Taping+ PT N=10	GROUP 2 PT only N=12	P value	Effect size
	Baseline	85.5/ 76-124	86.5/ 62.5-120	0.58		131/ 124-138	126.5/ 98.5-140	0.45	
	14 th day	122.5/ 113-134	120/ 72-144	0.93		129/ 122-134	129/ 118-147	0.96	
	difference 14 th day	37.0	33.5			-2	2.5		
	42th day	129/ 116-136	127/ 77-147	0.84		143.5/ 130-152	150/ 136-155	0.96	
	difference 42th day	43.5	40.5			12.5	23.5		

STUDY/OUTCOME MEASURE	<u>MUSCLE STRENGTH of Shoulder Flexion</u>					<u>MUSCLE STRENGTH of Shoulder Extension</u>				<u>MUSCLE STRENGTH of Shoulder Abduction</u>				<u>MUSCLE STRENGTH of Shoulder External Rotation</u>				<u>MUSCLE STRENGTH of Shoulder Internal Rotation</u>			
	Time	GROUP 1 Therapeutic KT+ Exercise	GROUP 2 Sham taping+ Exercise	P value	Effect size	GROUP 1 Therapeutic KT+ Exercise	GROUP 2 Therapeutic KT+ Exercise	P value	Effect size	GROUP 1 Therapeutic KT+ Exercise	GROUP 2 Sham taping+ Exercise	P value	Effect size	GROUP 1 Therapeutic KT+ Exercise	GROUP 2 Therapeutic KT+ Exercise	P value	Effect size	GROUP 1 Therapeutic KT+ Exercise	GROUP 2 Sham taping+ Exercise	P value	Effect size
Simsek et al., 2013 Dynamometer (kilogram-force)	Baseline	8.74 (2.62)	7.53 (3.16)	0.032*		7.74 (2.62)	7.58 (3.32)	0.544		5.32 (2.81)	4.68 (2.66)	0.563		5.68 (2.81)	5.47 (3.04)	0.665		6.21 (2.80)	5.37 (2.94)	0.246	
	5 th day	10.21 (3.11)	8.42 (3.09)	0.05*		9.21 (3.88)	8.11 (3.34)	0.418		6.21 (2.89)	5.26 (2.18)	0.191		7.42 (3.08)	5.95 (2.39)	0.130		7.79 (3.19)	6.37 (3.25)	0.096	
	difference 5 th day	1.47	0.89			1.47	0.53			0.89	0.58			1.74	0.48			1.58	1.00		
	12 th day	11.21 (3.37)	8.42 (3.15)	0.005*		10.05 (4.23)	8.21 (3.10)	0.123		6.89 (2.42)	5.47 (2.14)	0.053		8.16 (3.35)	5.95 (2.30)	0.003*		8.79 (3.82)	6.42 (3.10)	0.053	
	difference 12 th day	2.47 (2.02)	0.8 (1.99)		d=0.7 (0.13, 1.44)	2.31	0.63			1.57	0.79			2.48 (2.02)	0.48 (1.82)		d=1.04 (0.36, 1.71)	2.58	1.05		

SD: standard deviation; IRQ: interquartile range; Group 1: experimental group; Group 2: comparison group; KT: kinesiotape; PT: physiotherapy care; VAS: visual analog scale; DASH: disabilities arm, shoulder and hand questionnaire SPADI: shoulder pain and disability index ROM: range of motion

*Clinically Relevant: VAS: 3 cm or 30 mm, DASH: 10.2 points, SPADI: 13.2, ROM:8° (goniometer), 9°(inclinometer), MUSCLE STRENGTH:-

**Statistically Relevant: p<0.05

3.6 Effects of Interventions and Data Analysis

The amount of studies included in this review is only four. Although there are four studies in this review, pain, function and shoulder ROM were not measured in all studies. The table 5 shows all data for each different measurement and it is seen that all measurement were performed in varying contexts, such as pain at shoulder flexion versus pain at rest. It is also appear that all outcome assessments were done at different time intervals following the intervention. Consequently, data could not be collapsed across studies for meta-analysis. Therefore, a narrative synthesis was carried out to describe and compare findings.

3.6.1 Pain Analysis

3.6.1.1 *Pain at rest*

There are two studies (Kaya et al, 2010; Simsek et al, 2013) investigated analgesic effect of taping regarding pain at rest. Simsek et al (2013) compared KT with exercise therapy to exercise therapy with sham taping. In their study, there was no significant difference between groups at 5th day ($p=0.563$) and 12th day ($p=0.116$). Kaya et al (2010) compared KT with exercise therapy to electrotherapy with exercise therapy. In their study, taping group showed significant improvement at 7th day ($p=0.001$, $d=0.72$ %95 CI (0.18, 1.27)) in comparison with electrotherapy with exercise therapy, however the control group showed surprisingly better results than taping groups at 14th day.

3.6.1.2 *Pain at night*

Two studies (Kaya et al, 2010; Simsek et al, 2013) computed data for the effect of taping on pain at night. In the Simsek et al, (2013) study, there were no clinically and

statistically difference between groups at 5th day ($p=0.065$), although taping group showed significant difference at 12th day ($p= 0.018$, $d=0.95$, %95 CI (0.28, 1.62)) compared with sham group. According to effect size, the effect apparently exists and may be large; we are not sure about the real size of the effect as the range of CI is large. Kaya et al (2010) reported that taping group showed clinically relevant difference both at 5th day (35.33 mm) and 14th day (51 mm), although there was only significant difference at 7th day ($p=0.001$, $d= 1.13$ %95 CI (0.56, 1.70)) between groups. However the taping group has the huge effect size, we are not sure about the real size of the effect as the range of CI is large.

3.6.1.3 Pain on movement

Three studies (Miller & Osmotherly, 2009; Kaya et al., 2010; Simsek et al, 2013) reported results about pain level at movement. In the Simsek et al, (2013) study, taping groups showed statistically significant reduction of pain level in comparison with sham taping both at the 5th day ($p=0.010$, $d=0.63$, %95 CI (-0.4, 0.87)) and 12th day ($p=0.009$, $d=0.8$, %95 CI (0.13, 1.46)). In the Kaya et al., (2010) study, taping group was clinically relevant within group change from baseline both at 7th day (39.17 mm) and 14th day (49.5 mm), although there was only significant difference in the taping group at 7th day ($p=0.01$, $d= 0.22$ %95 CI (-0.31, 0.31)). Miller & Osmotherly (2009) compared scapular taping with routine physiotherapy to routine physiotherapy without taping and assessed shoulder pain during shoulder flexion and abduction. The taping groups had clinically relevant difference from baseline both at 14th day (69 mm) and 42th day (30.5 mm) for pain during abduction although; there were no clinically relevant difference for pain during flexion. Besides, there was no statistically difference at all inter-groups ($p> 0.05$).

3.6.1.4 Pain score reported by SPADI

Miller & Osmotherly (2009) also reported pain score using SPADI. According to SPADI score, there were no statistically difference between taping and comparison groups ($p=0.28$ at 14th day, $p=0.76$ at 42th day), although taping groups showed clinically relevant reduction at 14th day (33.7 mm) and at 42th day (36.4mm).

Summary: Despite the one study (Kaya et al, 2010) that found the taping group to have an effect on reducing pain at one week follow-up, the results were conflicting and weak on the effectiveness of taping as an adjunct therapy for pain management.

3.6.2 Disability Analysis

3.6.2.1 Dash questionnaire

There are two studies (Kaya et al, 2010; Simsek et al, 2013) assessed disability using Dash questionnaire. According to Simsek et al (2013), therapeutic taping group showed significant difference ($p=0.004$, $d= 0.97$ %95 CI (0.3, 1.64)) and the effect apparently exists and may be large, but we are not sure about the real size of the effect in comparison with sham taping group at 5th day. At 12th day, the results were similar to 5th day. The taping group showed relevant improvement ($p= 0.001$, $d= 1.34$ %95 CI (0.6, 2.04) in comparison with sham taping group. Similarly, In the Kaya et al, (2010) study, the results taping groups showed significant difference from baseline at 14th day ($p=0.027$, $d= 0.88$ %95 CI (0.33, 1.44)) but we are not sure about the real size of effect owing to the large range of % 95 CI. They did not measure Dash score at 7th day.

3.6.2.2 SPADI

Miller & Osmotherly (2009) reported disability score using SPADI. However they did not find any statistically difference between groups regarding disability score neither at 14th ($p=0.92$) nor 42th day ($p=0.72$), the taping groups showed clinically significant reduction both at 14th day (16.4) and 42th day (28.4).

For total SPADI score, there was no difference between taping in addition physiotherapy group and physiotherapy group alone at 14th day ($p=0.60$) and 42th day ($p=0.76$).

Summary: The addition of taping to exercise therapy, electrotherapy or manual therapy improves disability status significantly in two studies (Kaya et al, 2010; Simsek et al, 2013). However, one study (Miller & Osmotherly, 2009) did not find any significant difference ($p>0.05$) between taping and comparison groups.

3.6.3 Shoulder Range of Motion Analysis

3.6.3.1 Abduction

There are three studies investigated the effect of taping on ROM of shoulder abduction (Miller & Osmotherly, 2009; Djordjevic et al, 2012; Simsek et al, 2013).

In the Simsek et al, (2013) study, taping groups showed clinically relevant difference from baseline both at 5th day (16.3°) and 12th day (29.5°), although there were no significant difference neither at 5th day ($p=0.583$) nor at 12th day ($p=0.863$) between therapeutic and sham taping groups.

Djordjevic et al (2012) compared taping in addition to MWM to exercise therapy and they found that taping groups showed significantly improvements both at 5th day

($p < 0.0001$, $d = 2.31$; %95CI (1.63, 3.00)) and 10th day ($p = 0.0001$, $d = 9.02$; %95 CI (7.25, 10.79)) from the baseline but we are not sure about the real size of the effect due to the huge range of %95 CI.

According to Miller & Osmotherly (2009) study, however both taping and comparison groups showed clinically significant difference from baseline both at 14th day (37°) and 42th day (43.5°), there was no significant difference inter-groups at 14th ($p = 0.93$) and 42th days ($p = 0.84$).

3.6.3.2 Flexion

All three studies mentioned above also assessed ROM of shoulder flexion. In Simsek et al, (2013) study we are not sure whether the effect exists from baseline at 5th day ($p = 0.002$, $d = 0.6$; %95 CI (-0.04, 1.26)), although at 12th day the effect apparently exists and may be large, but we are not sure about the real size of the effect ($p = 0.04$, $d = 1.04$; %95 CI (0.36, 1.71)) in comparison with sham group.

In the Djordjevic et al, (2012) study, the results were similar to Simsek et al study. They reported that taping group was significantly effective than comparison group at 5th day ($p = 0.0005$, $d = 2.47$; %95 CI (1.76, 3.17)) and 10th day ($p = 0.0001$, $d = 6.14$; %95 CI (4.88, 7.41)) but we are not sure about the real size of the effect.

Miller & Osmotherly (2009) found no statistically difference between groups ($p = 0.96$), although taping groups showed only clinically relevant difference from baseline at 42th day (12.5°).

Summary: Two studies (Simsek et al, 2013; Djordjevic et al, 2012) showed that taping group has a significant increase on shoulder flexion. Besides, according to

one study (Djordjevic et al, 2012), taping group has also a significant effect on shoulder abduction.

3.6.4 Muscle Strength

Simsek et al (2013) also investigated the effect of taping in addition to exercise therapy on muscle strength. They measured shoulder flexion, extension, abduction, external rotation and internal rotation using dynamometer. According to their study, there were significant improvements in shoulder flexor muscles strength at the 12th day ($p= 0.05$, $d=0.78$; %95 CI (0.13, 1.44)) and in shoulder external rotator muscles strength at 12th day ($p=0.003$, $d=1.04$; %95 CI (0.36, 1.71)).

4 DISCUSSION

4.1 Discussion of Main Findings

This review is aimed towards critically appraising and synthesising the available evidence on the overall effectiveness of clinical taping, in addition to physiotherapy care amongst patients with shoulder impingement syndrome. Despite the popularity of using taping techniques in shoulder rehabilitation, generally, there is a recognised inadequacy concerning design when evaluating the effectiveness of clinical taping, in addition to physiotherapy care in specific conditions.

Four trials of taping, in addition to physiotherapy care, were identified. All studies were conducted during the last 5 years. With the exception of one study (Kaye et al., 2010), which adopts a non-randomised controlled trial, the quality score of the studies are above 8, which means that they can be considered high-quality studies. A greater degree of quality and a larger number of publications amongst clinical trials, on the other hand, is recognised as encouraging owing to the fact that it may be a reflection of greater interest in evidence-based practice and clinical research. Patient blinding and allocation concealment were the most common weaknesses, which are able to reduce the quality of the studies in terms of assessment tools. There was only one study (Simsek et al., 2013) that conducted a double blinded trial using sham taping. In the view of Karanicolas et al (2010), should subjects not be blinded, group assignment knowledge could have an impact on the ways in which they behave during the trial, as well as their general responses to subjective outcome measures.

Moreover, in 2008, a research utilised a sample of 146 meta-analyses, subsequently drawing the conclusion that the findings of RCTs with unclear or insufficient

allocation concealment were likely to be biased towards advantageous outcomes, but only if RCT outcomes were not objective but rather were subjective (Wood et al., 2008).

Two trials combined taping with only exercise therapy, whereas one trial, on the other hand, combined it with MWM, and the other combined it with manual therapy and exercise therapy. Due to the variety of the outcome measurements, comparison and treatment groups, a meta-analysis combining the results from all the trials was not feasible. Variations that precluded the literature meta-analysis included variable patient demography (acute, chronic, or mixed groups), different sizes of groups, various periods of treatment, and various periods of follow-up. The suggestion has been made through the guidelines (Alderson & Green, 2002; Gherzi, 2005), as well as across various literature publications (Akobeng, 2005), that both clinical and statistical heterogeneity need to be recognised at the very lowest prior to the completion of meta-analysis. Therefore, as opposed to meta-analysis, a narrative data synthesis was reported in the results section.

Two different approaches were adopted for analysing the results owing to missing data. Three trials (Djordjevic et al., 2009; Kaya et al., 2010; Simsek et al., 2013) reported their data using means and standard deviation. As mean differences from the baseline and standard deviation could be calculated, the effect sizes were also reported for these studies in this review. Notably, effect size which may be defined as the scale of difference between groups may be described as providing a more valuable and accurate prediction of the effects of treatment than when compared with P values alone. Importantly, in consideration to the four critical elements involved in treatment effects interpretation, Cohen's d is regarded as being most

valuable for evaluating the overall magnitude of effects (McGough & Faraone, 2009). Furthermore, effects of various treatments can be established through the use of both the calculation of a 95% Confidence Interval (CI) surrounding the Cohen's d score, which can prove useful (McGough & Faraone, 2009). Another trial (Miller & Osmotherly, 2009) reports that data using median but not z score are not adequate in calculating the effect sizes for these two studies. The results of a randomised trial can be achieved through reporting changes from baseline, with reporting detailing clinically relevant terms directly accessible not only to clinicians but also to patients (Kaiser, 1989). Median changes and p values were only reported in an effort to analyse the results, although this could mean the weakening of data synthesis. In the view of John Tukey notably, one of the founders of modern statistical methods the use of such robust approaches is not important in terms of which is used, but rather that such approaches are adopted generally (Huber, 2002).

Three studies (Miller & Osmotherly, 2009; Kaya et al., 2010; Simsek et al., 2013) investigated the effectiveness of taping on pain and function in addition to physiotherapy, ranging from two to six sessions over a period of five days to six weeks. All three studies demonstrated that taping groups have some improvements on pain and function. After reporting effect sizes, the study of Simsek et al. (2013) induced the largest the magnitude of effects on pain and function; they used exercise therapy, which is defined by Hughston and Riivald. Such exercises are recommended within the domain of the functional rehabilitation of SIS, and aim to achieve scapular stabilisation and distal mobility (Skirven et al., 2011). However, Kaya et al. (2010) and Djordjevic et al. (2009) adopted non-specific exercise programmes (ROM, stretching and strengthening exercises) without stabilisation exercise in their trials. According to Schmitt & Synder (1999), a specific exercise

strategy, focusing on strengthening eccentric exercises for rotator cuff and concentric/eccentric exercises for the scapula stabilisers, is superior when compared alongside non-specific exercise programmes (ROM and strengthening exercises), especially when centred on reducing pain and improving shoulder function amongst patients with persistent sub-acromial impingement syndrome. This might explain why the work of Simsek et al. (2013) has shown the largest effect size between three studies in its efforts to reduce shoulder pain and improve function. On the other hand, the 95% CI existed zero and the range of 95% CI were large, thus meaning that the real effects are questionable in the works of both Simsek et al (2013) and Kaya et al. (2010).

Miller & Osmotherly (2009) assessed pain level during abduction and flexion using VAS and for movement pain level. Taping groups showed clinically relevant reduction of pain level from the baseline (69 mm at 14th day and 76.5 mm at 42th day) during abduction, however the reduction was considerable smaller than during flexion (9.5 mm at 14th day and 11.5 mm at 42th day). One possible reason for small improvements might be owing to smaller baseline pain score during flexion. According to their results, there was no statistical difference between groups ($p>0.05$); however, this p value analysis does not provide enough information for real effect size. They also assessed pain level according to SPADI, and found that clinically relevant results, both at 14th day (33.7) and 42nd day (36.4) in the taping groups. As shown through their findings, effects magnitude was seen to decrease on the 42nd day when compared with that achieved on the 14th day. Moreover, with the application of the scapular taping during the first two-week period, the decrease could be rationalised by leaving taping after two weeks, which could highlight the presence of taping effectiveness. Nonetheless, it could also be stated that any taping

effects are short-term, with the choice to adopt taping in the clinic potentially centred on particular short-term targets considered throughout the rehabilitation process. Similarly, Kaya et al (2013) found no significant difference between two groups at the second week ($p=0.218$ for rest and activity pain, $p=0.07$ for pain at movement), however taping groups showed significant improvements at the first week ($p<0.01$). Importantly, this could further support the results of Alexander et al. (2003), who recognise that the impacts on trapezius muscles were not witnessed in the long-term following the removal of the tape. On the other hand, however, there are not enough specific studies centred on assessing the long-term of taping in the literature, thus meaning there is a need to further examine studies to ensure a detailed analysis about mid- and long-term effectiveness.

Miller & Osmotherly's trial (2009) was also the only study that adopted a rigid taping method as an intervention method, meaning this could allow us to compare their study with other studies, such as in terms of whether or not different taping methods are considered important for the size of effects. Unfortunately, however, the researcher was not able to draw a comparison owing to missing data. The only clear implication between two different taping methods is that the rigid taping could be more prone to skin reactions, as the only side effects and skin reactions were seen in the study of Miller & Osmotherly (2009). Importantly, 4 people of 10 in the taping group were withdrawn from the study by the researchers. They claimed that one possible reason for the high rate of skin reaction in their study could be related to age (mean age 57.9), which could make them more prone to fragile skin and skin reactions. Besides, the most taping sessions (six) were applied in their study, which could also accelerate skin reactions. Similar to these studies, there are many case studies in which the side effects of taping were reported, such as in the case study of

Schmitt & Synder (1999), who experienced skin reaction to the prolonged use of tape, causing the technique to be discontinued in this case. Ackermann et al. (2002) also reported various negative effects, observing that rigid and correctional taping techniques are not comfortable, with this type of taping restricting shoulder movement; however, Kneeshaw (2001) explained various precautions and instructions, such as the use of a hypoallergenic adhesive barrier gel, which can reduce these side effects; using rigid taping methods could have high risks on skin reactions and other adverse effects.

Three trials (Miller & Osmotherly, 2009; Djordjevic et al., 2012; Simsek et al., 2013) assessed the effectiveness of taping as an adjunct treatment on active shoulder ROM, with all studies reporting improvements in shoulder flexion and abduction ROM, although the impact associated with taping across various motion ranges continues to be unclear owing to low volume of researches carried out on various joints, as well as their conflicting findings. One relevant and robust study (Thelen et al., 2008), which notably used KT as a main intervention, compared with sham taping in patients with shoulder impingement syndrome, established that the therapeutic KT group showed immediate improvement in pain-free shoulder abduction (mean SD increase, 16.9° 23.2°; $p = 0.005$) following tape application. However, differences between groups in shoulder flexion and scapular plane elevation were not established. In a comparable vein, Hsu et al. (2009) examined the impacts of KT on shoulder kinematics amongst baseball players with shoulder impingement syndrome. In this regard, the KT group was found to achieve statistically significant improvements in scapular orientations when contrasted alongside the placebo group for posterior tilt at 30° and 60° of humeral elevation; however, none of the other measures adopted, such as upward rotation and internal

rotation at any range of scapular orientations or displacements, were recognised as statistically significant. As these two studies used only KT as their key interventions, this was excluded from the review. However, in this review, Djordjevic et al. (2012) found that the KT group had significantly better results, achieving huge effect sizes both for flexion ($d=2.47$ 95%CI (1.76,3.17) at 5th day; $d= 6.14$ 95%CI (4.88, 7.41) at 10th day) and abduction ($d=2.31$; 95%CI (1.63,3.00) at 5th day; $d=9.02$; 95% CI (7.25,10.79) 10th day). Nonetheless, there are several methodological flaws in their study: first of all, as they compared MWM with KT with exercise therapy, they established dramatic difference between groups. Importantly, the study would have been more robust and would have allowed the effects of the two treatments to be isolated if they had adopted a comparison group with only MWM and or MWM with sham taping application. Secondly, the sample size was small (10 for each group), which could reduce the overall accuracy of the study. Thirdly, in the comparison group, they also did not use specific shoulder exercise, such as in the cases of Kaya et al. (2010) and Djordjevic et al. (2009); this could reduce the effectiveness of exercise therapy for shoulder dysfunctions. However, Teys et al. (2008) carried out a stronger research, establishing similar positive results in taping groups. It was found that an application of the shoulder MWM in line with tape achieved statistically significant improvements ($p< 0.001$; 18.8° , 95% CI (7.3, 30.4)) when reviewing shoulder abduction ROM, which was maintained for a period of 7 days amongst patients with anterior shoulder pain when compared with the MWM only group.

One of the greatest weaknesses was recognised as the lack of placebo controlled groups in this review. There was only one study (Hacer et al., 2013) that adopted sham taping groups to eliminate placebo effects on taping; however, significant improvements in both therapeutic and placebo groups were witnessed, with the

therapeutic groups superior to sham taping groups. Irrespective of the wealth of studies in the area of placebos, it remains that there has been little challenge in this domain concerning the area of sport, performance and taping (Stedje et al., 2012), with very few researches, such as that of Simsek et al. (2013), for example, seeking to examine the overall efficacy associated with taping as a placebo, assuming the outcome is a result of a placebo effect. There are also various studies (Wilson et al., 2003; Christou, 2004; Castro-Sanchez et al., 2012) that have been recognised as inducing strong placebo effects of taping. In regard to such considerations, various writers (Turner et al, 1994; Mengshoel, 2000; Simmonds, 2000) have posed the view that the placebo effect is an actual, measurable impact that may be associated with particular mechanisms and which, in the clinical domain, could be recognised as suitable in terms of improving the overall efficiency of active-therapy on physiological mechanisms by further impacting psychological and cognitive mechanisms. Nonetheless, placebo effects should be clarified in the primary researches considering ethical and scientific aspects. Mengshoel (2000) states that, when considering the fact that the objective of physiotherapy modality is to examine efficiency from influencing pathogenic mechanisms, placebo-controlled researches may be seen to adopt a suitable framework.

In conclusion, when treating patients with shoulder impingement syndrome, the combination of therapeutic taping with routine physiotherapy always improves symptoms, and it seems to be superior to physiotherapy care alone. Despite the fact that its effectiveness is not strong and clear due to the lack of real controls group, the uncertainty of placebo effects and the large range of 95% CI in the studies included in this review.

4.1 Comparison with Similar Studies

There is no systematic review that has, thus far, been conducted relating to exploring effectiveness taping techniques with the use of combined physiotherapy care in patients with shoulder impingement syndrome. After reviewing databases, which are written in Section 3.7.1, there are five systematic reviews relating to the effectiveness of KT amongst patients with various pathologies.

Bassett et al. (2010) conducted a systematic review of three studies, which are focused on the efficacy of KT for musculoskeletal conditions (two shoulder impingement syndrome and acute whiplash associated disorders). According their studies, KT showed no significant clinical effects on patients with musculoskeletal disorders when compared with sham taping methods. Similarly, Mostafikar et al. (2012) identified is insufficient evidence to indicate the effectiveness of KT in musculoskeletal disorders.

Another systematic review was carried out by Williams et al. (2012). The aim of their study was centred on evaluating the effectiveness of KT in the treatment and prevention of sport injuries. Importantly, only two of studies have been conducted on patients with shoulder impingement syndrome. The subjects of the remaining studies were a healthy population in an effort to understand whether or not taping prevents sports injuries. They concluded that kinesiotape could have a small beneficial effect on the range of motion and strength of an injured area; however, there was no substantial evidence to support the use of KT in making improvements in terms of pain, proprioception and muscle activity.

A recent systematic review (Morris et al., 2013) on the 'clinical effectiveness of kinesiotaping' was carried out with the aim of establishing the overall clinical

effectiveness of KT in patients with any musculoskeletal conditions (such as low back pain, neck pain, shoulder pain, etc.), breast-cancer-related lymphedema and stroke with muscle spasticity. The authors found that KT is no more clinically effective than placebo taping techniques (Morris et al., 2013). Similarly, Kalron & Bar-sela (2013) assessed the effects of therapeutic KT on pain and the disability of participants suffering from musculoskeletal, neurological and lymphatic pathologies. As was established through their research, KT was recognised as efficient in facilitating short-term pain; importantly, however, no conclusions could be drawn, in direct regard to key, valid evidence, that this application is effective on most movement disorders within a wide range of pathologic disabilities.

All studies discussed above point out the requirements of further homogenous, well-designed and high-qualified studies due to the conflicting results of existing studies and the insufficiency of relevant primary researches. However, the results of this modified review have shown different results than in existing reviews. Accordingly, the strength of evidence of the results cannot be described as similarly robust.

4.2 Potential Bias and Limitations

When carrying out a modified systematic review, there is potential bias identifiable in the fact that the review process is conducted by only one reviewer. In this vein, it should be noted that manual errors are commonly incorporated in the case of search strategy, studies selection, appraisal of quality, and data gathering and analysis approaches owing to the fact that there is much dependence directed towards the reviewer's own interpretation skills and judgement. Furthermore, in this review, the quality evaluation instrument sought to optimally establish a balance between the

risk of bias and the methodology. This is the first time such an instrument has been applied, although its validity and reliability are yet to be established.

Another limitation of this review is the missing of one potentially relevant study (Wang et al., 2001). The absence of the statistical data of one study (Miller & Osmotherly, 2009) is also another potential flaw in the data synthesis section.

4.3 Strength of the Review

This review is the first attempt at conducting a homogenous review relating to the effectiveness of taping specifically amongst patients suffering with shoulder impingement. The intervention groups were selected as taping in addition to any physiotherapy modality in accordance with clinical practice. This review also provides a concise literature background relating to shoulder impingement syndrome and the physiotherapy interventions associated with such.

As there was only one reviewer in the processing of carrying out this review, two different quality assessment tools were used in an effort to achieve a more reliable appraisal.

In the results sections, the effect sizes and 95% CI were reported to provide better estimates of treatment effects and in the analysis of such effects, although none of these studies reported them.

5 CONCLUSION AND IMPLICATIONS FOR RESEARCH AND CLINICAL PRACTICE

This chapter concludes the systematic review. It consolidates the discussion in relation to the aims and objectives stated at the beginning of the study. Implications for clinical practice and recommendations for the future investigations are also made.

This modified systematic review of the literature has fulfilled the various aims and objectives outlined at the onset of the study. A critical appraisal of the literature was carried out in relation to the shoulder impingement syndrome, with the main physiotherapy modalities for curing it—especially clinical taping and the mechanism by which taping might achieve its effects—also discussed. This has been followed by the outcome measurement used in shoulder impingement syndrome, and a discussion relating to the role of systematic reviews in EBP. Subsequently, an outline of the methodology employed in this review was provided, with a comprehensive quality appraisal surrounding the included RCTs carried out in an effort to investigate the evidence of the effectiveness of taping in terms of pain, disability and shoulder ROM.

Despite the one study (Kaya et al, 2010) that found the taping group to have an effect on reducing pain at one week follow-up, the results were conflicting and weak on the effectiveness of taping as an adjunct therapy for pain management. The addition of taping to exercise therapy, electrotherapy or manual therapy improves disability status significantly in two studies (Kaya et al, 2010; Simsek et al, 2013). However, one study (Miller & Osmotherly, 2009) did not find any significant difference ($p>0.05$) between taping and comparison groups. Two studies (Simsek et al, 2013; Djordjevic et al, 2012) showed that taping group has a significant increase

on shoulder flexion. Besides, according to one study (Djordjevic et al, 2012), taping group has also a significant effect on shoulder abduction.

To sum up, this review demonstrates that clinical taping, in addition to any physiotherapy interventions (exercise, electrotherapy, manual therapy, etc.), might prove to be an optional treatment for curing patients with shoulder impingement syndrome; however, further robust, placebo-controlled and consistent studies are needed in order to prove whether it is more effective than physiotherapy interventions without taping.

5.1 Implications for research and clinical practice

Whether or not taping should be used in physiotherapy programmes cannot be answered with the data available at present. In the literature, there is a notably large gap regarding the overall effectiveness of taping in specific pathology. This is the first attempt to assess the effectiveness of taping using as an adjunct therapy for management shoulder impingement syndrome. Although data suggest various benefits associated with aspects of pain management, disability and the range of motion in management several pathologies, the results are not firm due to the low quality of these studies; more specifically, non-existing real controlled or placebo-controlled groups. Patient-blinding and reporting outcome measurement with effect sizes and 95% CI should also be taken into consideration in future trials. Similarly, well-designed studies are also needed concerning the effectiveness of taping in other specific pathologies in the future.

The evidence from this review shows that taping might help to improve symptoms when adding to physiotherapy interventions; therefore, clinicians could consider using taping as an adjunct treatment for patients with shoulder impingement syndrome.

5.2 Reflection

The decision was made by the researcher to enrol in an MSc programme at the University of Nottingham with the aim of broadening knowledge and understanding of practice in physiotherapy science. The decision to conduct a systematic review, specifically examining the adjunct benefit of taping, was closely linked to the researcher's personal interest. As taping had been used in a clinical practice setting, in spite of poor evidence, there was a recognised need to explore the effectiveness of taping. Before this course and systematic review process, taping sounded 'a magic modality' owing to improvements on patients. This mind-set changed slightly when the researcher came across literature that investigated the efficacy of clinical taping. As a result, various studies were found to show conflict concerning the efficacy of taping, and it was then recognised as encompassing much amongst physiotherapists. Therefore, a need was highlighted to further investigate robust studies, which need to be homogenous and involve real control groups with the aim of establishing the real clinical effects of taping.

However, a wealth of systematic reviews was read prior to commencing the MSc programme; the researcher was unaware of the rigorous process involved in conducting one. During this task, critical thinking and evaluation were found to be fundamental, which provided a review the literature from a scientific perspective. The

researcher also came to realise that statistical knowledge was critical during this process, and that the researcher was lacking: since, the researcher has become able understand and interpret basic statistical terms, and also learnt that p value is not adequate for detailed analysis when seeking to establish the effectiveness of treatments, whereas the effect size and 95% coincidence intervals provide a better estimate. This will definitely help in future academic life.

Overall, the researcher remains doubtful concerning the real effectiveness of taping. Accordingly, current literature and developments relating to taping should be followed. Moreover, reference to systematic reviews should be carried out as the first port of call when evidence is needed in clinical practice.

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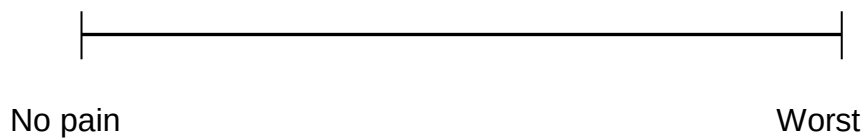


7 APPENDIXES:

Appendix1: Visual Analogue Scale (10cm) (VAS)

Patient Name: _____ Date: _____

What is the level or intensity of pain you are currently experiencing?



Appendix 2: Disabilities of the Arm, Shoulder and Hand

2

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

ACTIVITIES	No Difficulty	Mild Difficulty	Moderate Difficulty	Severe Difficulty	Unable
1. Open a tight or new jar	1	2	3	4	5
2. Write	1	2	3	4	5
3. Turn a key	1	2	3	4	5
4. Prepare a meal	1	2	3	4	5
5. Push open a heavy door	1	2	3	4	5
6. Place an object on a shelf above your head	1	2	3	4	5

7. Do heavy household chores (e.g. wash walls or floors)	1	2	3	4	5
8. Garden or do yard work	1	2	3	4	5
9. Make a bed	1	2	3	4	5
10. Carry a shopping bag or briefcase	1	2	3	4	5
11. Carry a heavy object (over 10 lbs.)	1	2	3	4	5
12. Change a lightbulb overhead	1	2	3	4	5
13. Wash or blow dry your hair	1	2	3	4	5
14. Wash your back	1	2	3	4	5
15. Put on a pullover sweater	1	2	3	4	5
16. Use a knife to cut food	1	2	3	4	5
17. Recreational activities which require little effort (e.g. card	1	2	3	4	5

playing, knitting)					
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g. golf, hammering, tennis)	1	2	3	4	5
19. Recreational activities in which you move your arm freely (e.g. playing Frisbee, badminton)	1	2	3	4	5
20. Manage transportation needs (getting from one place to another)	1	2	3	4	5
21. Sexual activities	1	2	3	4	5
TOTAL					

DISABILITIES OF THE ARM, SHOULDER, AND HAND

Questions	Not at all	Slightly	Moderately	Quite a bit	Extremely
22. During the past week, <i>to what extent</i> has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbors or groups? (circle number)	1	2	3	4	5

Questions	Not at all	Slightly	Moderately	Quite a bit	Extremely
23. During the past week, were you limited in your or other regular activities as a result of your arm, shoulder, or hand problem? (circle number)	1	2	3	4	5

Please rate the severity of the following symptoms in the last week. (Circle number)

	None	Mild	Moderate	Severe	Extreme
24. Arm, shoulder or hand pain.	1	2	3	4	5
25. Arm, shoulder or hand pain when you performed any specific activity.	1	2	3	4	5
26. Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5
27. Weakness in your arm, shoulder or hand.	1	2	3	4	5
28. Stiffness in your arm, shoulder or hand.	1	2	3	4	5

Questions	No Difficulty	Mild Difficulty	Moderate Difficulty	Severe Difficulty	So Much Difficulty
					I

					Can't sleep
29. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? (circle number)	1	2	3	4	5



Questions	Strongly Disagree	Disagree	Neither Agree Nor	Agree	Strongly Agree
-----------	--------------------------	----------	-----------------------------	-------	-----------------------

			Disagree		
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem. (circle number)	1	2	3	4	5
TOTAL					

FORMULA



(RAW SCORE - 30) = DASH

12

* American Academy of Orthopedic Surgeons/Council of Musculoskeletal Specialty Societies/Institute for Work and Health Outcomes data Collection Package May

1997 Version 2.0

Appendix 3: Shoulder Pain and Disability Index

Name: _____ Date: _____

Items listed by scale.

Pain scale: 0-10 numeric, where 0 = “no pain at all”, and 10 = “worst pain imaginable”

On a scale of 0-10, How severe is your pain:

1. At its worst?
2. When lying on the involved side?
3. Reaching for something on a high shelf?
4. Touching the back of your neck?
5. Pushing with the involved arm

Disability scale: 0-10 numeric where 0 = “no difficulty”, and 10 = “so difficult it required help”

On a scale of 0-10, How much difficulty do you have:

1. Washing your hair?
2. Washing your back?
3. Putting on an undershirt or pullover sweater?
4. Putting on a shirt that buttons down the front?
5. Putting on your pants?
6. Placing an object on a high shelf?
7. Carrying a heavy object of 10 pounds?
8. Removing something from your back pocket?

*Roach KE, Budiman-Mak E, Songsirdej N, Lertratanakul Y. Development of a shoulder pain and disability index. Arthritis Care Res 1991;4:143-9.

Appendix 4: Research Protocol

Background

Shoulder dysfunctions are a common problem among the general populations. It is the second most prevalent musculoskeletal pain, preceded only by low back pain (Michener et al 2004, Faber et al 2006). Considering all patient with shoulder dysfunctions, almost half of them are diagnosed with shoulder impingement syndrome or often termed subacromial impingement syndrome (van der Windt et al, 1995; Vecchio 1995) . The major symptom is extreme pain on the shoulder area, so such pain can lead to restrict range of motion and functional activities (Vas, 2005).

There are several different treatments for shoulder impingement syndrome and most of them are conservative methods. Patients with shoulder impingement syndrome are usually treated by physiotherapist. However usual physiotherapy care (e.g. manual therapy, exercise, ultrasound, electrotherapy, heat and ice therapy are most common modality for many physiotherapist, taping techniques are used promisingly by many physiotherapists (Senbursa et al, 2007; Baltaci, 2013; Hsu et al, 2008; Kalter et al, 2011). Taping techniques could be applied in a various ways with an elastic or rigid tape to reduce pain and improve functional activity. However, generally accepted the action mechanism of taping is related mechanical supporting during the movement, some researchers mentioned the proprioceptive effects of taping but the mechanism of taping is still unclear (Morrissey 2000; Kneeshaw 2002).

However some of clinicians are using taping techniques or other physiotherapy care alone, many of them combine those two interventions. Considering outcomes of existing studies, there is no consensus on whether it is an effective method to improve symptoms in patients with shoulder pain. Moreover, there is not sufficient research to explore clinical effectiveness of taping techniques in addition physiotherapy care. There are just three systematic reviews in the literature and the aim of all studies is to explore clinical effectiveness of kinesiotaping, a type of elastic taping technique, in patients any musculoskeletal disorders. The primary aim of this study is to determine whether any taping technique in addition physiotherapy care is more effective than physiotherapy care alone in patients with shoulder impingement syndrome.

Methods

Types of Studies

Randomized controlled trials, which are published in English or Turkish, are included in this study.

Types of Participants

Patients over 80, with shoulder pain and restricted range of motion who referred by an general practitioner, orthopedic surgeon , physicians or physiotherapist and diagnosed any shoulder impingement related disorders (subacromial impingement syndrome or rotator cuff lesions) regarding physical examinations , shoulder impingement tests, radiography or MRI images, will be included in this study. Patients will be excluded if they are diagnosed with any other shoulder dysfunctions (e.g. frozen shoulder, capsulitis-type disorders, full thickness of rotator cuff disease), have any shoulder post-surgery conditions or any systematic diseases (e.g. rheumatoid arthritis) .

Types of Intervention

All participants will be received any usual physiotherapy care (e.g. manual therapy, exercise, soft tissue massage, cold or heat therapy, ultrasound or any electrotherapy methods). In addition to usual physiotherapy care, any rigid or elastic taping methods are applied by experienced physiotherapists as a treatment group. I accepted as a comparator usual physiotherapy care alone or sham taping applications in addition to routine physiotherapy care.

Types of Outcome measure

This study focus on the following outcomes: pain level, pain free range of motion and functional activity and there are no restrictions on working to any specific outcome measures.

Search methods for identification of studies

A good search strategy should be a highly sensitive and specific, it means it is able to identify all the relevant studies and exclude irrelevant studies about the research question. In this study Medline search strategy is chosen. Compared with other search strategies such as original Cochrane strategy, Medline is more comprehensive method because of sensitivity to possibly relevant studies and limiting of irrelevant trial (Robinson and Dickersin, 2002).

Cochrane Database of Systematic Review, MEDLINE (EBSCO), Physiotherapy Evidence Database (PEDro), CINAHL (EBSCO), PUBMED, EMBASE (OVID) are defined as electronic search databases. There is no limit on the publication date and this study will be conducted to January 2014.

Search terms, which is used in Medline, are illustrated on the figure 1. All database searches will be based on this strategy but adapted to individual databases as necessary.

Searching other resources

I will browse the reference list of all eligible studies, text books in order to identify additional relevant studies.

The Kinesio Kinesio® Taping Method and Kinesio® Tex Tape UK and International websites (www.kinesiotaping.co.uk; www.kinesiotaping.com) will also searched for additional relevant research not identified by the mainstream search engines.

I will also use a Turkish official database (<https://tez.yok.gov.tr/UlusalTezMerkezi>), which collects all of theses of master's and doctorate studies.

Fig.1 Search Strategy

Search Terms

1 randomized controlled trial.pt.

2 controlled clinical trial.pt.

3 randomized.ab.

4 placebo.ab

5 clinical trial as topic.sh.

6 randomly.ab.

7 trial.ti.

8 1 or 2 or 3 or 4 or 5 or 6 or 7

9 exp animals/ not humans.sh.

10 8 not 9

11 shoulder pain/

12 shoulder impingement/

13 subacromial impingement/

14 rotator cuff.ti,ab.

15 11 or 12 or 13 or 14

16 exp physiotherapy

17 exercis*.mp.

- 18 exp exercise therapy/
- 19 exp manual therapy/
- 20 exp manipulative medicine/
- 21 16 or 17 or 18 or 19 or 20
- 22 tap*.mp.
- 23 exp taping/
- 24 exp kinesio/
- 25 exp kinesiotope/
- 26 22 or 23 or 24 or 25
- 27 10 and 15 and 21 and 26
- 28 Limit age 16 and over

Data Collection and Analysis

Selection of studies

The selection of studies will be comprised two steps. In the first step, titles and abstracts of studies will be screened and irrelevant studies will be removed. Potentially relevant full text studies will be obtained to further evaluate regarding inclusion criteria in the second step.

Data extraction and management

I will extract relevant data from each studies by using standardised data extraction form that will contain:

- bibliographic data (authors, journal, years of publication, country)
- study characteristics (aim of studies, study design, sample size)
- characteristics of participants (gender, age, symptoms characteristics)
- description of the intervention (both intervention and control groups), number of treatment sessions, duration of each sessions)
- outcomes assessed
- study results
- adverse events

Assessment of risk of bias in included studies

I will conduct the risk of bias assessment for randomized controlled trial using Physiotherapy Evidence Database (PEDro). Critical appraisal is an assessment of the benefits and strengths of research against its flaws and weaknesses. Systematic review can allow more objective appraisal of evidence than other studies and contribute to answer research question confidently. Although taping is really controversial issue among the experts, there is not enough studies to evaluate existing trials and reports. PEDro scale is a checklist of yes/no questions to appraise studies regarding allocation bias, blinding and adequacy of follow up (Moseley et al, 1999). According to many researchers, PEDro scale is more comprehensive than Jedro scales to assess randomized controlled trials (Bhogal et al, 2005). Moreover, it is not just to assess risk of bias, but also to make an overall assess of the methodological quality. For these reason, in this study relevant studies will be appraised by PEDro scale.

Measures of the treatment effect

There are several outcome measure to assess pain level (VAS or numerical rating scale (RTS)), condition of functional activities (Shoulder and hand questionnaires (DASH) or shoulder pain and disability index (SPADI)) and pain free range of motion (Conventional goniometer or digital inclinometer). Therefore, if different measurement are used, the standardised mean difference (SMD) will be used to quantify measure of treatment effect, however if the same scale is used, the weighted mean difference (WMD) will be used. Effect size and 95 % confidence interval (CI) will be used as a measure of treatment effects.

Units of analysis issues

The results will be grouped according to following study characteristics :

1) Control group

a) Usual physiotherapy care alone

b) Manual therapy alone

c) Exercise alone

d) Any physiotherapy intervention with sham or placebo taping

2) Outcome Measure

a) Pain

b) Pain free range of motion

c) Functional status

3) Timing of follow-up

a) At the end of sessions

b) After first week

c) After two weeks

Dealing with missing data

I will first request any missing data from the authors by e-mail. . In the event that the original authors cannot be contacted, or are unable to supply missing data such as standard deviation is missing, I'll try to calculate them from confidence intervals or any existing data of the same study.

Assessment of heterogeneity

The assessment of heterogeneity will be based on duration and types of disorders. For studies judged as clinically homogeneous, I will test statistical heterogeneity with the Q test (Chi-statistic) and I². Clinically, due to many different taping techniques, assessment of heterogeneity of type interventions will not conduct properly.

Assessment of reporting bias

I will use funnel plots in order to determine possible publication biases. Symmetrical plots are interpreted that no publication bias exists.

Data synthesis

Studies will be combined using qualitative best evidence synthesis. Where possible, extracted data will be grouped according to intervention (kinesiotaping or rigid taping in combination with exercise, manual therapy or other usual physiotherapy care) and outcome (pain, range of motion, functional status) and the differences between groups will be presented as the mean difference and 95% confidence intervals.

Subgroups analysis and investigation of heterogeneity

I will undertake subgroups analyses, where data allows, for:

-usual physiotherapy with elastic taping

-usual physiotherapy with rigid taping

Sensitivity analysis

Where sufficient data allows, I will compare analyses including and excluding trials at high of bias in order to determine impact of risk of bias on estimates if treatment effects.

Appendix 5: Database Search Strategies

Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R)
<1946 to Present>

Search Strategy:

- 1 randomized controlled trial.pt. (372783)
- 2 Controlled Clinical Trial/ (88303)
- 3 placebo.mp. (158620)
- 4 Clinical Trials as Topic/ (169745)
- 5 randomly.mp. (212484)
- 6 trial.mp. (855756)
- 7 randomi#ed.mp. (581253)
- 8 1 or 2 or 3 or 4 or 5 or 6 or 7 (1213761)
- 9 Shoulder Impingement Syndrome/ (1237)
- 10 Rotator Cuff/ (4842)
- 11 subacromial impingement.mp. (441)

- 12 shoulder tendinopathy.mp. (5)
- 13 Shoulder Pain/ (2810)
- 14 shoulder instability.mp. (1285)
- 15 9 or 10 or 11 or 12 or 13 or 14 (9111)
- 16 Physical Therapy Modalities/ (27707)
- 17 physiotherapy.mp. (11465)
- 18 exercis*.mp. (254048)
- 19 Musculoskeletal Manipulations/ (903)
- 20 Manipulation, Orthopedic/ or Manipulation, Chiropractic/ (4137)
- 21 manual therapy.mp. (1112)
- 22 manipulative medicine.mp. (72)
- 23 manipulative therapy.mp. (564)
- 24 Electric Stimulation Therapy/ (16772)
- 25 electrotherapy.mp. (1704)
- 26 Acupuncture Therapy/ (11648)
- 27 dry needling.mp. (130)
- 28 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 (314230)
- 29 Athletic Tape/ (103)

- 30 strapping.mp. (288)
- 31 taping.mp. (987)
- 32 kinesiotaping.mp. (12)
- 33 tap*.mp. (70237)
- 34 29 or 30 or 31 or 32 or 33 (70492)
- 35 8 and 15 and 28 and 34 (10)

Embase <1974 to 2014 Week 18>

Search Strategy:

- 1 randomized controlled trial.pt. (0)
- 2 Controlled Clinical Trial/ (384246)
- 3 placebo.mp. (327643)
- 4 Clinical Trials as Topic/ (40222)
- 5 randomly.mp. (261383)
- 6 trial.mp. (1258685)
- 7 randomi#ed.mp. (640346)
- 8 1 or 2 or 3 or 4 or 5 or 6 or 7 (1646497)

- 9 Shoulder Impingement Syndrome/ (1603)
- 10 Rotator Cuff/ (3821)
- 11 subacromial impingement.mp. (549)
- 12 shoulder tendinopathy.mp. (6)
- 13 Shoulder Pain/ (9329)
- 14 shoulder instability.mp. (1612)
- 15 9 or 10 or 11 or 12 or 13 or 14 (15006)
- 16 Physical Therapy Modalities/ (52399)
- 17 physiotherapy.mp. (59312)
- 18 exercis*.mp. (343463)
- 19 Musculoskeletal Manipulations/ (8561)
- 20 Manipulation, Orthopedic/ or Manipulation, Chiropractic/ (5438)
- 21 manual therapy.mp. (1713)
- 22 manipulative medicine.mp. (8625)
- 23 manipulative therapy.mp. (651)
- 24 Electric Stimulation Therapy/ (10691)
- 25 electrotherapy.mp. (1550)
- 26 Acupuncture Therapy/ (28287)

- 27 dry needling.mp. (201)
- 28 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 (437123)
- 29 Athletic Tape/ (66)
- 30 strapping.mp. (362)
- 31 taping.mp. (1270)
- 32 kinesiotaping.mp. (42)
- 33 tap*.mp. (88539)
- 34 29 or 30 or 31 or 32 or 33 (88871)
- 35 8 and 15 and 28 and 34 (16)

Database: AMED (Allied and Complementary Medicine) <1985 to May 2014>

Search Strategy:

- 1 randomized controlled trial.pt. (2931)
- 2 Controlled Clinical Trial/ (0)
- 3 placebo.mp. (2481)
- 4 Clinical Trials as Topic/ (0)

- 5 randomly.mp. (4505)
- 6 trial.mp. (8052)
- 7 randomi#ed.mp. (9381)
- 8 1 or 2 or 3 or 4 or 5 or 6 or 7 (16169)
- 9 Shoulder Impingement Syndrome/ (105)
- 10 Rotator Cuff/ (313)
- 11 subacromial impingement.mp. (64)
- 12 shoulder tendinopathy.mp. (3)
- 13 Shoulder Pain/ (268)
- 14 shoulder instability.mp. (120)
- 15 9 or 10 or 11 or 12 or 13 or 14 (780)
- 16 Physical Therapy Modalities/ (3847)
- 17 physiotherapy.mp. (11407)
- 18 exercis*.mp. (20851)
- 19 Musculoskeletal Manipulations/ (86)
- 20 Manipulation, Orthopedic/ or Manipulation, Chiropractic/ (778)
- 21 manual therapy.mp. (567)
- 22 manipulative medicine.mp. (45)

- 23 manipulative therapy.mp. (299)
- 24 Electric Stimulation Therapy/ (0)
- 25 electrotherapy.mp. (908)
- 26 Acupuncture Therapy/ (4814)
- 27 dry needling.mp. (39)
- 28 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 (39916)
- 29 Athletic Tape/ (45)
- 30 strapping.mp. (42)
- 31 taping.mp. (301)
- 32 kinesiotaping.mp. (7)
- 33 tap*.mp. (1348)
- 34 29 or 30 or 31 or 32 or 33 (1383)
- 35 8 and 15 and 28 and 34 (2)

Database: CINAHL Plus with Full Text

Search	
Terms	Search Options
S5	(((MH "Taping and Strapping") OR (MH "Tapes") OR (MH "Athletic Tape")) OR kinesiotaping) AND (S1 AND S2 AND S3 AND S4)
S4	((MH "Taping and Strapping") OR (MH "Tapes") OR (MH "Athletic Tape")) OR kinesiotaping
S3	(MH "Manual Therapy") OR (Physical Therapy Modalities OR physiotherapy) OR exercis* OR (Musculoskeletal Manipulations OR manipulative medicine OR manipulative therapy) OR (Electric Stimulation Therapy OR electrotherapy) OR (Acupuncture OR dry needling)
S2	((MH "Shoulder Impingement Syndrome") OR (MH "Shoulder Pain") OR (MH "Shoulder Instability, Multidirectional") OR (MH "Shoulder Instability, Posterior") OR (MH "Shoulder Instability, Anterior")) OR rotator cuff OR subacromial impingement OR shoulder tendinopathy
S1	((MH "Randomized Controlled Trials") OR (MH "Clinical Trials")) OR randomi#ed OR placebo OR clinical trials as topic OR trial OR randomly AND Shoulder impingement syndrome OR rotator cuff OR subacromial impingement OR shoulder tendinopathy OR shoulder pain OR shoulder instability

Appendix 6: Excluded Studies

<u>Excluded Studies :</u>	<u>Reason:</u>
Does taping influence electromyographic muscle activity in the scapular rotators in healthy shoulders?	Not relevant outcomes measurement
Cools AM, Witvrouw EE, Danneels LA, Cambier DC. Manual therapy 2008, 7(3), 154-162	Not relevant populationgroup
The clinical efficacy of kinesio tape for shoulder pain: a randomized, double-blinded, clinical trial.	Not relevant intervention/ comparison group
Thelen, Mark D., James A. Dauber, and Paul D. Stoneman. <i>Journal of orthopaedic & sports physical therapy</i> 2008; 389-395.	(kt only against sham taping only)
The immediate effect of scapular taping on surface of electromyographic activity of the scapular rotators in swimmers with subacromial impingement symptoms.	Not relevant outcomes measurement
Smith MJ; Sparkes V. Physical Therapy in Sport (PHYS THER SPORT), 2006 Nov; 7 (4): 171	Not relevant intervention/ comparison group
One-week time course of the effects of Mulligan's Mobilisation with Movement and taping in painful shoulders.	Not relevant population group
Teys P, Bisset L, CollinsN, Coombes B, Vicenzino B <i>Manual therapy</i> 2013, 18(5), 372-377	

Appendix 7: The Abstract of Missed Study

The effect of the McConnell shoulder taping technique on people with anterior shoulder pain

Author: Wang SS, Olson SL, Hanten WP, Etnyre BR.

Year: 2001

Summary: This study was to investigate the effect of the McConnell shoulder taping in people with anterior shoulder pain. There were two phases in this study. In phase one, the purposes were to determine the immediate effect of the taping on (1) activity of the upper and lower trapezius and the infraspinatus muscles during shoulder scaption; (2) pain level during shoulder scaption and (3) range of shoulder scaption (ROM). In phase two, the purposes were to determine the effect of a six-week course of the taping combined with an exercise program as compared to the effect of an exercise program only on (1) ROM and (2) pain level and functional status. In phase one, twenty-three subjects and twenty-four shoulders were accepted for the study. Surface electromyography (EMG) was used to detect muscle activity. A standard goniometer was used to determine ROM and a visual analogue scale (VAS) was used to measure pain level. The EMG data, ROM measurements and VAS pain scores were collected from each subject under the taping and no taping conditions on the sameday. Results revealed no difference in EMG data between the

two conditions. Results showed improved VAS pain scores and ROM with the taping condition. In phase two, twenty-three subjects and twenty-four shoulders were accepted for the study. The Shoulder Pain And Disability Index (SPADI) was used to determine subjects' pain level and functional status. Twelve subjects in the exercise only group performed a specific exercise program for six weeks. Twelve subjects in the exercise with taping group were taped daily for the first two weeks and performed the same exercise program for six weeks. SPADI scores and ROM measurements were collected on four different days. Results revealed no difference in SPADI scores or ROM between the two groups.

Results indicated the McConnell shoulder taping technique may be beneficial for temporary pain relief and an increase in ROM when treating people with anterior shoulder pain. However, the taping technique may not add any effect to the exercise program. Therefore, it may not be cost-effective to introduce the taping technique for people with anterior shoulder pain.

