

# Clinical Practice and Effectiveness of Kinesio Taping for Lower Limb Musculoskeletal Disorder: A Systematic Appraisal

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**Abstract:** *Kinesio tape (KT) is a proprietary product that purports to offer a range of benefits in the treatment and prevention of various musculoskeletal conditions. Kinesio taping involves the application of elastic adhesive tape to areas of pain or dysfunction. It has a diverse mechanisms of action including reduction of pain through stimulation of sensory afferents and increased range of motion (ROM) due to enhanced local circulation. Despite a recent increase in its public profile due to use of KT by athletes at major sporting events, the clinical benefits of the intervention remain unclear. The main objective of this Systematic Appraisal (SA) is to review a clinical practice and level of effectiveness of KT application for lower limb musculoskeletal disorders. Electronic databases including Cinahl, Nora, Web of Science, Cochrane and Medline were searched for studies conducted since 2008. The studies were selected on the basis of the research questions and objectives. The list was narrowed down to six studies, of which five were randomised controlled trials and one was a cross-over research design. The studies used baseline data to determine the effectiveness of KT for lower limb musculoskeletal disorders. The results of two studies revealed that KT might be beneficial in rehabilitation for musculoskeletal disorders. The results indicate that KT proved to be a highly promising application for reducing pain when compared with sham and athletic tapes. In one study, while comparing KT with sensory motor training for proprioception, sensory motor training showed better results than KT, but KT was better at reducing pain on a short-term basis. The remaining two studies on ankle sprains reported that KT did not reduce swelling or improve functional performance. Kinesio tape may play a role in reducing short-term pain in lower extremity musculoskeletal disorders, however in future high quality studies that contribute to the evidence base for its use are needed with large datasets.*

**Keyword:** Kinesio tape, clinical, lower limb and musculoskeletal

## 1. Introduction

Musculoskeletal pain is common in among populations globally, in relation to costs in the individual subjects in particular and as a whole, within the society. (Buchbinder et al., 2015). The usual problems facing musculoskeletal pain include the following: low back pain, shoulder pain, neck pain, and knee pain as well as widespread pain.

One of Musculoskeletal disorder (MSD) is lower limb disorder that involves the hip, knee and ankle joint. Lower limb disorders, if not treated on time, will increase the prevalence of musculoskeletal diseases (Khan, and Kurita, 2015). The scholars emphasised the need to conduct further analysis on lower limb disorders, including MSDs of the back and upper limbs. The nature and the level of the problems attributed to MSDs need to be understood to address such issues (Bourne et al., 2014). Nevertheless, the prevalence of MSD is mainly from lower limb disorders but still there are laws, regulations, and guidance as well as instructions for the musculoskeletal health personnel's' backs and upper limbs. However, the feasibility of these applications to the above mentioned personnel's' lower limbs is doubtful (WHO, 2015).

The Kinesio tape (KT) is primarily prioritised to give wide coverage of some advantageous therapy and prevention of different musculoskeletal conditions. However, Dr Chiropactor Kenso Kase invented the KT dated back in

1970s (elastic therapeutic tape) for the treatment of sport injuries and related disorders (Bassett et al., 2010). The KT technique involves the application of elastic adhesive tape to areas of pain or dysfunction. It is assumed that KT normally give support to the muscles with injuries, joints and assists to alleviate the pain by moving the skin up to allow flow of blood and lymph. The KT status was raised during Olympic Games in 2008 when the tape was given to almost 58 countries (Montalvo et al., 2014). The use of Kinesio tape taping was expanded from the therapy of musculoskeletal conditions various clinical applications which include: management of lymphedema (Lawrence, 2009) and neurological condition (Jaraczewska and Long, 2006). Furthermore, some research shows how KT usage in wide range of motion and resulting measures like pain-free range of motion (ROM) among the patient with myofascial shoulder pain (Garcia-Muro et al., 2010) and pain in meralgiaparesthetica patients (Kalichman et al., 2010). The outcomes of this study indicate that the KT is clinically importance with high risk of bias related with different research and their deficient to inform the cause and limit of the outcomes findings to make it clear in clinical practice.

As with other rehabilitation methods, a satisfying outcome can only be achieved if diagnosed accurately. Therefore, prior to KT application, it is important that the physiotherapist make detailed clinical assessment, which comprise clinical history along with a meticulous physical examination, in order to detect possible structure(s) in a

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specific context that may be leading to the clinical presentation of the patient (Morris et al., 2013).

Considering that KT depends on the skin's influence via the tape application, the skin's evaluation should be put into consideration. The experience, knowledge and understanding about KT help in normal orthopaedic evaluation, along with the KT therapeutical application (Kase et al., 2003).

The concept of evidence-based practice (EBP) is proliferating allowing through the physical therapy practice; though there is a reasonable difference to the extent to which EBP is actually applied (Nilsen and Bernhardsson, 2013). Physical therapists (PTs) utilise other methods of treatment with very strong of medium or evidence of effect, but also other techniques with limited evidence or no effect (Walsh and Hurley, 2009). The use of evidence base practice for physical therapy treatment is increasing rapidly, which is serve as a challenging factor for practitioners to use the recent findings based on evidence. In order to overcome the gap that exist between research and the practice as well as to facilitate the uptake of research outcome in the physical therapy practice, evidence-based clinical practice guidelines are primarily trusted and practiced. It however appears that healthcare interventions tend to be patient centred (Csapo and Alegre, 2014).

The policy surrounding KT application centres on the patient (Csapo and Alegre, 2014). KT might relieve pain and may be less costly, as well as increasing work productivity (Bolglia and Boling, 2011). There are no NHS policies in the UK regarding KT, as it is a relatively new treatment method in the UK and there is no official pathway. Kinesio taping association international (KTAI) in the U.S. set a policy about standards for tape application, but not how it is to be used within the health service. The KT is a new method of treating a variety of musculoskeletal injuries, including lymphedema, neurological conditions and others (Chang et al., 2013). KT is not a big company that can conduct or fund research for high quality; however, it is a promising technique which is safe and not comparable to drug therapy (Csapo and Alegre, 2014). There are 10,000 members of Kinesio taping worldwide, and in UK over 800 professionals are being trained annually, according to Kinesio taping association (KTA) (Moore, 2012).

## 2. Justification for systematic appraisal

KT is yielding a lot of important in the treatment and prevention of different musculoskeletal conditions. The KT includes the application of adhesive elastic tape to places of pain or disorder. Different mechanisms of action of KT are numerous, involving decrease of pain through stimulation of sensory afferents (Bassett et al., 2010) and increased range of motion (ROM) due to enhanced local blood circulation (Chang et al., 2013). However, the clinical benefits of the intervention remain unclear irrespective of modern awareness in publically due to the use of KT by sport people at major sporting events such as the Olympics in 2008.

Though there is a well-known and understood base of evidence of elastic therapeutic tape/Kinesio tape, there is a

need to support its application by in undertaking more research on a large scale. This also warrants conducting research on the feasible options for earlier interventions for managing the lower extremity conditions for optimal management and rehabilitation (Hettle et al., 2013).

Clinical decision-making in the previous era has evolve striking issue due to the socio-demography, awareness campaign, education of healthcare beneficiaries, access to information, and advanced technology (Sutherland et al., 2009). For promoting EBP, evidence-based interventions and evidence-based research are required for promoting healthcare services, as they are comparatively better (Jette et al.2006). Moreover, clinicians'roles must be guided by EBP, which is important in a complex healthcare system (Sturesson et al., 2014). The CRD (2008) reiterated that individual healthcare regulations and establishment of policy should be solely based on the available research evidence. To spread the desirable healthcare evidence, systematic reviews are considered as the most advantageous means (Levy and Ellis, 2006). When considering the aims and objectives of the study, the systematic review (SR) and the Systematic Appraisal (SA) are relevant. However, they varied from each other considering the number of reviewed studies, time, and number of study and types of participant involved. While effectiveness of the KT is considered as a new effective intervention for curing lower musculoskeletal patients, there is a limited of evidence and standard of studies. This SA would contribute to add more value in understanding the effectiveness of KT among patients that have a history of lower limb musculoskeletal problems. This Systematic Appraisal will identify the effectiveness of KT in musculoskeletal injuries in lower limbs.

### 2.1 Background of KT (Kinesio Tape)

Taping is now commonly used in the rehabilitation of patients with MSDs, and also in the prevention and treatment of these conditions (Thelen et al. 2008). Kinesio tape has become popular with athletes and sports players as a new therapeutic tool. It was introduced in 1970 by Kenzo Kase, for the healing of soft tissues. The importance of KT has been recognised by professionals for its therapeutic attributes. It can be described as an elastic therapeutic tape employed in the treatment of a number of different injuries (Thelen et al. 2008). The tape is prestretched by 15-25% when it is applied to the backing paper, and can actually be stretched to 120-140% of its original length. When it is applied to the skin, it shrinks back to its upstretched length.

The theory behind how such tape works is that it lifts the skin and facilitates blood and lymph flow. In doing so, it supports injured joints and muscles. It is manufactured from tightly woven elasticised cotton, which makes it both waterproof and hardwearing. It does not need to be accompanied by any drugs or medication; the simple elasticity of the tape brings relief (Chang *et al.*2010).

The benefits of taping include improving and inhibiting muscle activity repositioning of joints; prevention of injury and enhanced proprioception. There are conflicting reports on its effectiveness; however it is still used widely in therapeutic interventions

### 3. Properties of the Kinesio Tape

This SA focuses on a particular tape, Kinesio Tex. It is an adhesive, elastic tape and it mimics certain properties of human skin such as flexibility, thickness and weight.

The tape's wave pattern is linked to its adhesive properties, which allow the tape to shrink back, a key feature of the tape and its efficacy (Kase, 2003). The tape is breathable, which helps to prevent allergies arising from its use (Thelen et al. 2008). As mentioned previously, the tape can be stretched to around 120-140% of its initial length, so the therapist can vary the amount of tension applied and manage the effects on the patient (Lee & Yoo, 2011). The backing paper of the Kinesio Tex tape has a pre-tension level, so when it is applied the tension should be around 10-15% (Parreira et al. 2014).

Kase and William (2003) reported on the different parts of Kinesio tape and how they are used in its application. The tape has an end and a base, and the therapist needs to know both the tension and position that the type needs to be applied in for each limb/body/skin position, as altering these will alter the effects that the tape has on the patient.

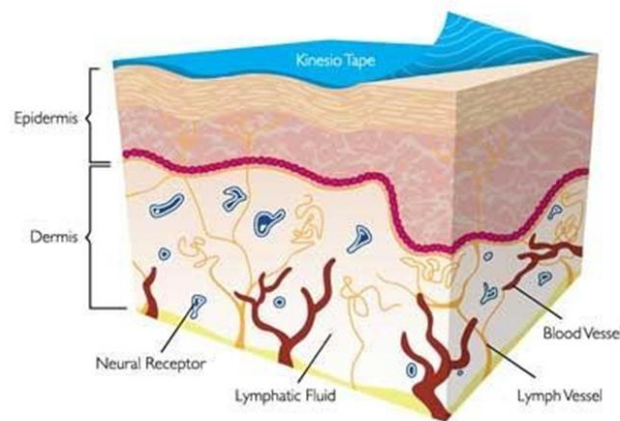
When the tape is applied to the skin, its recoil effect can be seen. The theory is that when the tape is applied, it stretches the tissues underneath. These tissues remain under the base in the direction of anchor (Parreira et al. 2014).

Thelen et al. (2008) gave an explanation of the types of cut and different tensions that can be used with the tape. Different effects are generated by the application of the tape, but it is not easy to study its mechanical effects on skin in vivo, because of the skin's superficial layers.

Kinesio Tape still allows patients full range of movement and thus enhances the individual's functionality (Campolo et al. 2013). The principle objective of utilising the tape is the generation of an afferent stimulus on the skin which enhances many functions, for example muscular, lymphatic, articular, and the central nervous system (CNS). It also alters the perspective of the treatment from mechanical perspective to neurophysiologic (Kase et al. 2003). By comparison, another tape, McConnell taping, acts purely mechanically and therefore does not allow full range of movement (Campolo et al. 2013).

Overall, human skin accounts for 16% of body weight and its total area is around 2m<sup>2</sup>. Skin is an organ with well-established functions such as a physical barrier, immune protection, and the regulation of body temperature (Shimizu, 2007).

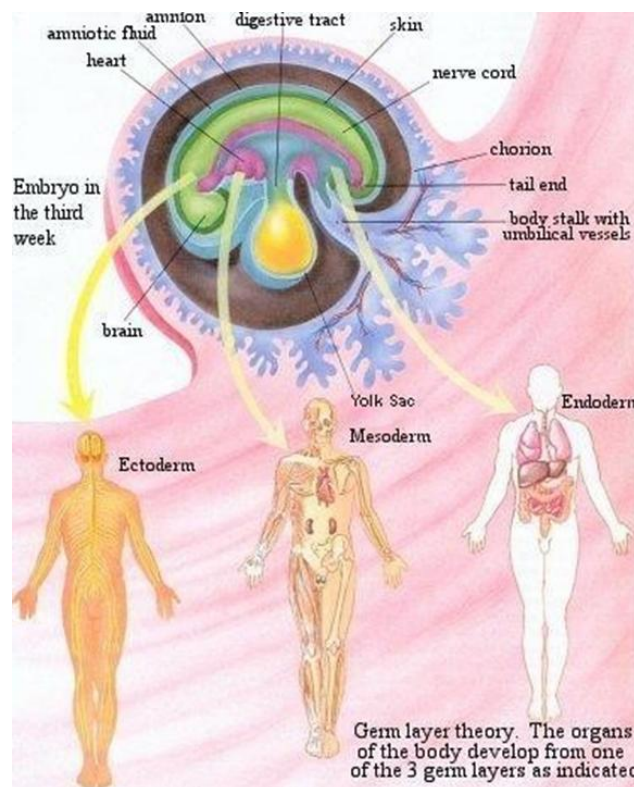
Furthermore, skin can potentially influence the human body's perceptions and motor scheme. It has established through research that skin receptors are important in the modulation of pain right throughout the activation of descending inhibitory pathways, and they receive and alter several types of incentives such as mechanical, chemical and related to temperature. With KT, skin receptors are activated by the stretching stimulus which is caused by the application of the tape (Lumpkin et al. 2010).



**Figure 1:** Representation of layers of the skin with the possible mechanical effect of the Kinesio Tex Tape, generating a lifting effect

Source: *Footballmedicine.net*

A study of the embryologic stage reveals the relationship between the central nervous system and the epidermis. The three embryologic layers (ectoderm, mesoderm and endoderm) are created from three types of cells, which will be differentiated in the various body tissues. The central and peripheral nervous system, alongside the epidermis, are differentiated from the same embryologic layer, the ectoderm (Schoenwolf et al. 2014). This key fact illustrates the close relationship between the epidermis and the central nervous system, and explains how each one can influence the other. In the case of CT, it highlights the potential that the skin has to affect other tissues, through the modulation of the central nervous system (Kase, 2003).



**Figure 2:** Embryologic Layers representation: notice that ectoderm and the neural systems differentiate from the same layer, the skin.

Source: *Football Medicine.Net*



As skin has receptors that are part of the transfer system of stimuli to the central nervous system, it can be seen that it has an active role in the body's reaction to any treatments applied to the skin.

#### **4. Lower limbs disorder And Physiotherapy roles**

Lower limb musculoskeletal disorders (LLD) can result in two kinds of traumas: acute trauma and cumulative (overuse) trauma. It is important to be able to differentiate between the two in cases where excessive loads have been placed upon the body, above the normal tolerance levels of the body structures (muscles, ligaments, tendons and bone). Cumulative trauma is seen when there is a disproportionate load on body structures, which results in their failure. The tolerance of the body structures is decreased by repetitive movements which leads to 'wear and tear'. Other factors can be involved in LLD, such as an incorrect posture, leverage action and muscular load

With regard to the sufferers of these injuries, Akesson et al. (1999) found acute and overuse injuries in military personnel, athletes, and industrial workers claimed that there were more injuries among military populations and athletes than among occupational groups study found 123 cases of overuse injuries and 115 cases of acute injuries in a sample of 8644 military recruits.

Cherry et al. (2001) noted that 82% workers showed the signs of MOSS (Musculoskeletal occupational surveillance scheme). The period of study was 1997-2000, and the types of injuries reported were from overuse or repetitive movements, rather than being acute. Bruchall carried out a literature review in 1995 for studies related to occupational knee disorders and he also reported many workers with overuse injuries. There therefore seems to be a need for employers or government to provide guidance on how to avoid LLD injuries. Such injuries can have a large impact on the workplace, society and the individual. The employer and industry suffer due to the lost hours of work, hospitalisation may be required and the employee, as well as suffering from the injury itself, can find other parts of the body affected, and treatment may negatively impact on their quality of life (Chen et al. 2007, Jensen 2008).

Physiotherapists decide whether or not to apply Kinesio Taping, and they know how to apply it and which joint or muscle to apply it to; they also decide on the level of stretch to be applied. Different levels of tension will result in different levels of traction and response. According to the Kinesio Taping Method manual, the traction facilitates elevation of the epidermis which lessens the pressure on the mechanoreceptors (below the dermis). This in turn decreases the nociceptive stimuli (Coker, 2012).

If the tape is applied with a lighter tension, this results in decompression in the tissues, and recoil and lifting of the skin. In theory, this enlarges the space in the tissues underneath and improves fluid circulation. These techniques with lighter tension are best suited to acute injuries where inflammation is important; they reduce pain in tissues caused by the inflammatory response (e.g. oedema) (Kase, et

al. 2003). An application technique with a stronger recoil effect may result in a greater degree of skin stretch and consequently it will have a more powerful effect on afferent receptors related with pain modulation mechanisms. From the patient's point of view, this would lessen their perception of the pain.

In sub-acute stages of injury, or when an athlete is returning to training, they may wish to have a higher proprioceptive awareness in order to improve muscle/tendon/joints functions. In this case, the tape would be applied at a higher tension (Kase, 2003). The therapist also uses clinical reasoning development during the rehabilitation process, as combined with a thorough assessment; it enables the therapist to determine the most beneficial treatment for that patient (McCarthy, 2010). Campolo et al. (2013) emphasised the correlation between the effectiveness of the tape and an initial assessment of the patient. The therapist must make a thorough assessment of the pain experienced by the patient, and then must also be familiar with the correct procedure and methods of taping. The tape's application can make a big difference to how effective it is.

#### **5. Outcome Measurement and KT Effectiveness**

KT is currently used in a number of different clinical settings, and it offers a good range of flexibility, being able to be applied to any joint or muscle. The suggested benefits of KT include a lessening of pain, an improved blood and lymphatic circulation, a realignment of joints and alteration in the recruitment activity patterns of the muscles that are being treated. Despite the worldwide use of KT in clinical practice, the evidence on its efficacy is hard to find, or contradictory. Four Systematic Reviews have assessed the effect of KT on specified outcomes in various populations. Williams et al. assessed the effectiveness of KT in the prevention and treatment of sports injuries. Bassett et al (2011) and Mostafavifar et al (2012) evaluated the effects of KT in a sample of individuals with musculoskeletal conditions. Morris et al (2013) broadened the focus to include other fields such as neurological and lymphatic conditions.

#### **6. Conflict of Evidence**

So far, the literature in this field has shown contradictory or poor evidence of the benefits of KT. There have been a number of studies carried out in the last twenty years on the effect of Kinesio Taping in cases of MSDs, however many are of low quality or are biased, and hence the evidence is by no means literature conclusive from a scientific point of view (Mostafavifar et al. 2012; Morris et al. 2013; Parreira et al. 2014). The majority of the studies that found no effect of KT created a bias because they used healthy subjects in their sample, so the KTT method was used to reestablish homeostasis and not to enhance the body's capabilities (Viegas, 2014).

More positive outcomes were reported when individuals with symptoms of injury were used. The most commonly reported beneficial effects of KT were improved pain

threshold, inflammation, functional capabilities, lymphatic circulation, and rate of tissue healing, and a faster recovery rate (Nadali, et al. 2014).

While there have been three studies that investigated the effect of KT on vertical jump performance, only one of them used a sample of individuals with symptoms of injury, and it was the only study out of the three to report beneficial effects of KT (Nakajima & Baldrige, 2013; Nunes, et al. 2013; Nadali et al., 2014). Nadali et al. (2014) studied vertical jump performance in a sample of individuals who had undergone anterior cruciate ligament (ACL) reconstruction. They reported that there was a significant improvement in the jump scores of the group applying KT, compared to the group using sham tape and the control group. It was suggested that the effects shown in the KT group were due to a rise in RF activity through the RF application.

In addition, KTT, compared to the McConnell taping technique, has been shown to be more comfortable and to provide longer-lasting effects during functional tasks. The theory put forward by researchers has been that KT is effective due to the stimulation of cutaneous mechanoreceptors and improved afferent feedback to the central nervous system, which reduces the perception of pain.

Another study investigated ankle proprioception and made a comparison between KT and a non-elastic sports taping; no benefits were reported for the KT. However, the same problem occurred, in that only healthy subjects were used in the sample (Briem et al. 2011).

Tsai et al.'s (2010) study examined the effect of KT application with fifty two patients with plantar fasciitis. The tape was started to be applied after one week, and the patients experienced significantly less pain than the control group. There was also evidence of reduced thickness of the plantar fascia at the insertion site. Bae et al. (2014) reported that applying KT before muscle-damage inducing exercise succeeded in lessening the pain connected to delayed onset muscular soreness (DOMS), in comparison to sham tape.

The KT Method is intended to return tissue's/body's homeostasis, not to enhance tissue's/body's performance/skills. It is therefore specifically intended to interact positively with an injured or dysfunctional body structure (Kase, 2003). However, a large number of healthy subjects are used in a significant number of studies, revealing that many researchers do not fully understand the concept they are attempting to test, as KT is not intended to be used on healthy subjects, or to provide benefits to healthy subjects (Viegas, 2014). Healthy subjects should be compared with patients suffering from knee or joint pain in order to measure the differences between knee or joint pain with a control group. The actual difference made by KT would be better judged by comparing KT with other taping techniques.

All of the above points to the fact that professionals play an important role in addressing issues such as knee or joint pain, as they can better judge how and when to apply KT. There is however little information in the literature about

different types of tapes or taping techniques, which might limit its application. It is true however that small difference in application can make a big difference to the outcome. Physical Therapists and researchers must therefore be familiar with all the different brands of tape and their different properties. A different technique is required for KT or MT, so if researchers have full knowledge of different tapes and how to apply them correctly, they may obtain positive results for Kinesio Taping. It is important also to verify the authenticity of the tape being used as there are copies of KT that look very similar, and if these are used, misleading results may be obtained, as Kinesio Tex Tape is completely unlike other tapes.

## 7. Methodology

### Evidence-based practice (EBP)

Evidence-based practice (EBP) materialised in 1980 in medicine and consequently is recognised by healthcare professionals in areas like pharmacy for its reliability and its capacity to assist with effective decision making. EBP can be applied in practice and enables practitioners to ask patients introspective questions, in order to improve healthcare.

EBP takes the patient into account together with the expert's knowledge to provide a treatment, which applies a problem-solving approach. (Melnyk et al., 2005). Nevertheless, it has taken time for this particular method to find favour and to be used in everyday practice due to reasons such as environmental factors and intra-personal relationships (Melnyk et al., 2011).

It should be noted that the current definition of EBP is that it is a method whereby healthcare professionals use their knowledge, circumstances and preferences together with the patient's values to apply evidence driven decisions (Rubin and Bellamy, 2012). In addition, they use the knowledge they have in relation to services, local resources, community and the capacity of the agency. However, evidence should not be the only process used to make decisions in practice. This is because the intervention must also be convenient for the community.

Healthcare professionals frequently rely on evidence to answer questions they are unable to answer, for instance how an intervention is provided for a patient, the type of intervention to be put into action, and furthermore, other issues that may affect the utilisation of the chosen intervention. Therefore, EBP is a method that many healthcare professionals use to guide and improve their practice, even if they might consider other methods whilst working with the patient.

### Systematic Appraisals and Evidence-Based Practice

A Systematic Appraisal (SA) examines and considers other research articles. As a result, it goes on to present a review of the results using scientific methodology and then finishes with a research article which is of a high standard. At present, health policies are based on information pulled together from Systematic Appraisal of other appropriate literature. For that reason, the appraisal of individual literature is not adequate enough, as it has to be based on some relevant evidence. It should also be pointed out that

SAs have a significant role for healthcare professionals, as they have a tendency to shape practice guidelines (Khan et al., 2011). Nevertheless, it is worth recognising that not all SAs are of a high standard and can be given critical reviews. Therefore, it is crucial that health professionals have a deeper understanding of the SAs prior to applying it in their field of work.

A SA is performed using a number of methods, such as obtaining pertinent research articles via the internet, journals, inter-library loans, user friendly software for metaanalysis, etc. In doing so, researchers employ current high quality reviews to assist with practice and apply guidelines. Nevertheless, at times, the literature is of poor quality or cannot be found; thus, it is appropriate to pose questions to a specialist in the field, assess the primary studies which are available and perform a SA.

The most appropriate methodology to support a SA and a method that is supported by an assortment of healthcare professionals is evidence-based research, which has become more imperative in practice over the last twenty to thirty years. Moreover, SAs also enlightens professionals through evidence-based practice. Thus, the importance of having a good review is essential as it enables healthcare professionals to gain knowledge and be informed. As a result, it is important that researchers have a good understanding of the underlying philosophy of the study they are undertaking. It is also important to note that SAs play an essential role in informing health policy makers to create and implement policies in healthcare setting.

#### **Strengths and Limitations of Systematic Appraisal**

The strength of a Systematic Appraisal is the ability to bring together and create data from widespread sources which are combined to prepare an appropriate conclusion to answer the research question (Armstrong et al., 2010c). Furthermore, it is believed that SAs reduce bias; the use of methodology in the research is logical and can also be justified, can be applied to individuals or people in varying situations and can be applied to different research questions. Moreover, it can also be used by policy makers to assist with and improve practice and interventions (Garside et al., 2013).

One of the disadvantages of a SA is that the methodology has its own limitations which might mean that the data cannot be applied to other population groups. Furthermore, there are other weaknesses with this method, for instance publication bias which can lead to incorrect information regarding interventions. Language bias also plays a significant role in limiting the dependability of a SA, whereas the results of a SA can be uncertain or incorrect because of the biased sample, which is demonstrated in the research articles that were selected. Further biases that confirm a weakness of the study are particular study designs, reporting bias, bias in the studies which were selected, and finally, differences amongst the studies.

## **8. Results**

While offering the results above of six primary studies, the results are divided into two main parts, wherein the details of the critically analysed versions can be seen

comparatively. However, each study is judged individually and major themes are focused on.

#### **Characteristics of SA studies**

In all six primary papers a quantitative approach was adopted to collect data, but there are differences across the primary study in terms of word limits for each paper. It could be possible that the some details of the sampling process, data collection, and methods are not included; however, the journals are rated very high academically.

The purpose of this section is to critically analyse and explain the process of the findings for each primary peer reviewed paper and their features. The designs for all studies are not the same but differ; this is because of the study's situation or place. For example, where total knee replacement occurs, it refers to randomisation, while a laboratory experiment probably limits the options. There is no doubt that in all six studies, the followings aspects have been applied to justify the results: sampling process, research design, ethical issues, data collection and extraction methodology; however, some of these do not explain every detail of their process. This is due to requirements for a particular journal article. However, each primary study discusses details of the experimentation.

#### **Study design and methodology**

In all studies researchers used a quantitative approach to collect data. It seems that in all six studies S1-S6, randomised control designs were selected to collect data. It appears that the design among the six studies varies, but most significantly, randomised control design is used. The researchers accessed nearly more than five hundred subjects and found the sample in S2. This procedure provides a strong foundation to express the un-biased results. However, the main purpose of the research is to get to know the efficacy/performance/reliability of the KT application and what difference, the patients/practitioners have noted during the application of KT. These six primary studies report the importance of KT, what differences there are and if it is accepted by the field professionals. The data collected on various aspects suggests that KT is safer than other techniques. The six chosen studies all have descriptive data along with analytical data, to provide the best possible answer to the research question among the individual studies.

#### **Data collection**

The data collection process of the six primary studies only gauged the application of KT in different subjects during different scenarios. The interventions were provided during different stages, especially where tools were used to collect data. The data was then collected for ROM Goniometer; for pain, they used Laitinen's by pain indicator questionnaire. Also, KT and control groups introduced poll continuing information about life style to evaluate the effectiveness of physiotherapy in S1. In S2, knee pain intensity was measured by numerical pain rating scale (NPRS), ROM by Goniometer. For oedema, the dynamics and leg circumference measurements were done with tape before surgery and afterwards were done in four standardised points of the limb. While data in S3 was gathered for the primary outcome for peak isokinetic, quadriceps torque was

measured by an isokinetic dynamometer, while secondary outcome pain was measured by a Visual analogue scale (FAS). For pain, a visual scale was used to measure knee pain, while proprioception was measured by isokinetic dynamometer. Functional disability levels were measured by an arthritis impact scale in S4, whereas in S5 swelling was measured by volumetry, perimetry, and relative volumetry and two analyses of the difference in volume and perimetry between ankles of each participant

In S6, functional performance for athletes with ankle sprain was measured by (Hopping test by Amanda et al, Single Limb Hurdle Test, Standing Heel Rise test, Vertical Jump

Test, The Star Excursion Balance Test [SEBT] and Kinesthetic Ability Trainer [KAT] Test) were used to quantify agility, endurance, balance, and coordination.

### Approaches to analysis

The data was analysed through different statistical packages. For example, the first primary study, where the data was analysed through an ANOVA test, was performed using non parametric tests as well as Wilcoxon, including Kruskal-Wallis. In S6, one way ANOVA's were performed, but it seems as though the researchers only adopted a single method which was one way ANOVA. The researcher could have used a different approach, where different KT tapes could be used to see the differences. The researchers could divide different tapes with varied cuts and then could test the results through different statistical packages. However, most differently, during the third primary study multivariate analysis of variance was conducted to compare groups, which were formed through random selection. However, during S4, the data was analysed using SPSS for Windows, version 18.0 (SPSS, Inc., Chicago, IL). Statistical significance was set at  $P = 0.05$ . In study 5, analysis of Variance (ANOVA) linear mixed models were used to compare the effect of Kinesio Taping on swelling between the groups, whereas in S3, statistical analysis was performed using the Statistical Package for Social Science (SPSS version 10.5, SPSS Inc., Chicago, IL). If we look at the data analysis, there are only studies that applied SPSS in S3 and S4, whereas in the rest of the primary studies the statistical analysis differs, but still all the researchers tested the data through packages.

### Ethics

Accordingly, this Systematic Appraisal Review noted that prior to starting research, the researchers obtained informed consent in all six studies. However, some information is missing and this could be due to the word limits for the publishing research papers. In study 1, the research was done on ambulatory patients in the John Paul II Western Hospital in Grodzisk Mazowiecki. The researchers might not have obtained ethical approval. In study 2, ethical approval was obtained through the local ethical committee. Similarly, in study 3 the researchers obtained consent from the subjects

and got this approved from the ethical committee of M. S. Ramaiah Hospital and Medical College before the commencement of this study, which was conducted according to the Declaration of Helsinki. Most significantly, the researchers obtained a registration number: CTRI/2013/03/003486. In S4, approval from the ethical committee of the Faculty of Physical Therapy, Cairo University, was obtained. In S5, it appears that ethical approval either was obtained or was not, but it was not mentioned. However, the study was conducted at Clínica Escola de Fisioterapia of Universidade do Estado de Santa Catarina and at the participants' training sites in Brazil. In S6 ethical approval from the Ethics Committee in Scientific Research Centre at University was obtained and written informed consent was also taken from all participants.

### KT Method Application

In all six primary studies, the researchers reported that they had applied KT in different ways upon different patients/subjects/participants for different outcomes and different purposes. Particularly in S 2, the researchers mentioned clear purposes, such as lymphatic correction; while in S 4, mechanical correction and facilitation for the subject during KT application was reported. In the rest of the studies, the researchers did not clearly mention the purposes of the KT application.

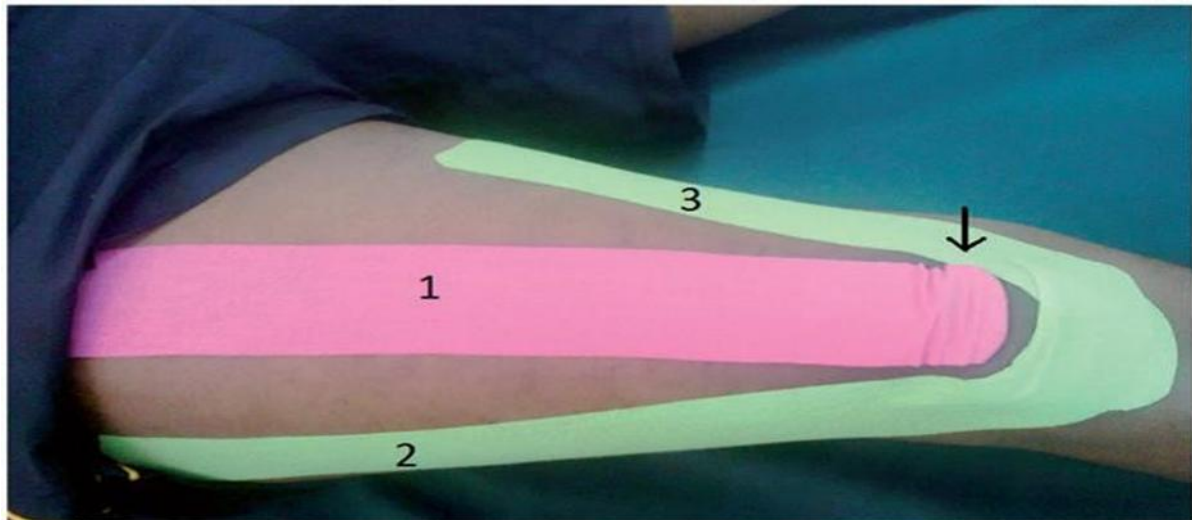
In the direction of KT application, the researchers used proximal to distal direction in S 1, 3 and 5. While in S 2 and 4, they used direction of KT application from origin to insertion muscles.

In reference to the degree of KT application, in S1, 15 to 50% was used and then 75 to 100% was used to achieve a different target. In S2, the KT degree of tension was moderate – approximately 50%, and in S3 it was 50-75%. In S4 the degree of tension was 25%, 25% and 50% respectively, while in S5, the degree of KT application was 20%. Finally, for S6, the degree was 25%. Regarding cuts of KT: in S1 and 2, the Y shape cut was used, plus in study, they added the I cut shape to meet the needs of the studies; in S3, 3 strips of the I cut shape were used; in S4, three cuts of the Y shape were used, Y and I; in study 5, the researchers used four strips of the fan shape to target the joints; in S6, there it is not clear which shape was used. It is important to mention that KT practitioners in study 2 and 6 were certified in KT application. Also, only S3 showed the importance of physiological effects of KT, which is convulsion.





**Figure 4:** Application KT for quadriceps femoris with supporting proprioception. Source: Dariusz et al., (2012)



**Figure 5:** The above figure shows the application of therapeutic KT. The three tapes applied in sequence are numbered as 1, 2 and 3 respectively. The black arrow indicates the “convolutions” created as a result of the tape application. Source: Anandkumar et al., (2014)

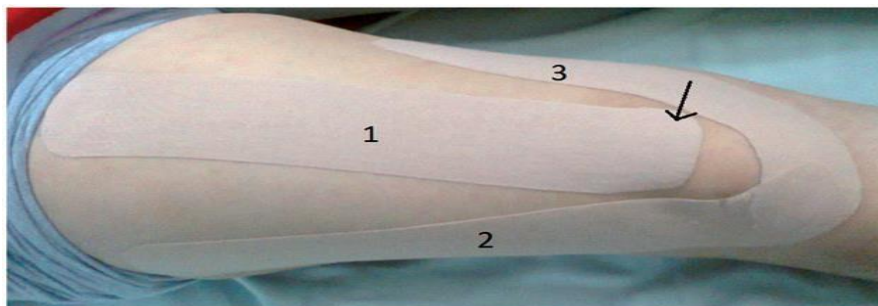
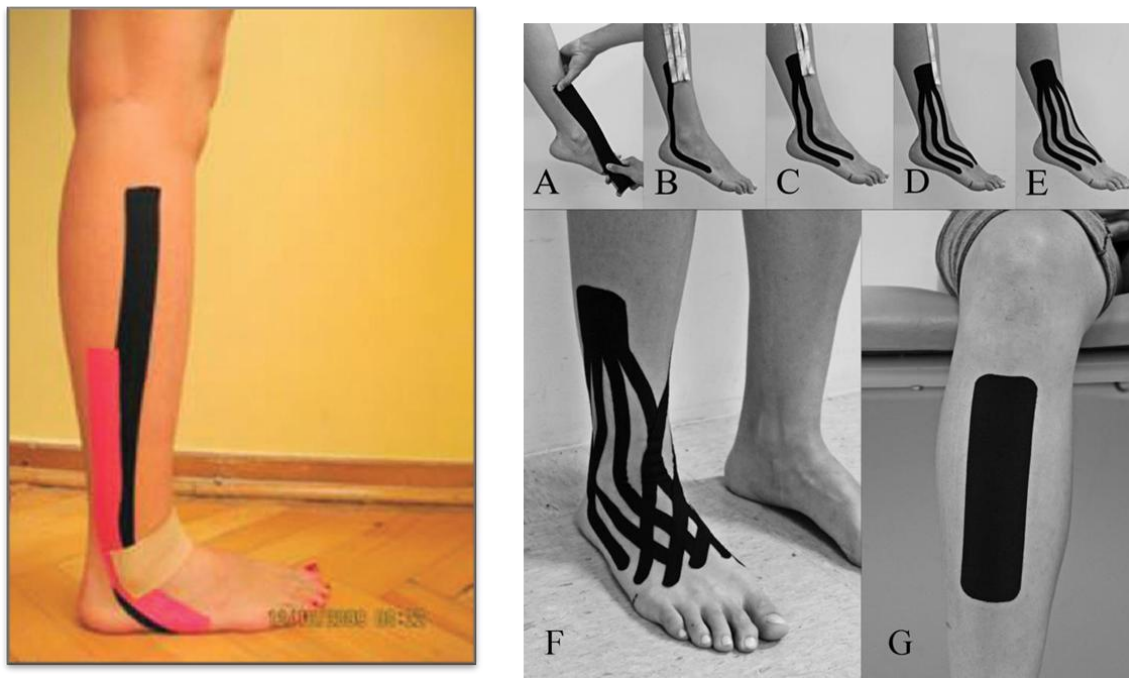


Figure 6. The above figure shows the application of sham KT. The three tapes applied in sequence are numbered as 1, 2 and 3 respectively. The black arrow indicates the absence of “convolutions” in the sham tape in contrast to therapeutic KT application. Source: Anandkumar et al., (2014)





**Figure 7:** Kinesio Taping application for S6. A – how the Kinesio Taping was measured and cut; B – application of 1st strip; C – application of 2nd strip; D – application of 3rd strip; E – application of 4th strip; F – full Kinesio Taping application; G – application to the control group. Source: Bicici et al., (2012)

## 9. Location of injury at lower limb

**A: Knee Joint:** state findings regarding pathology, outcome, comparison, the rehabilitation process and effectiveness of KT.

When we focus on the tables above, it can be seen that four of the studies about knee joint showed different pathology. For example, S1 and S2 focused on knee meniscus injury and total knee replacement. Both of these studies had a rehabilitation process and follow up for twenty eight days. In comparison, S1 and S2 had similar rehabilitation protocol compared to the control group. Outcome measurements in S1 and S2 were pain, oedema and range of motion in early processes of rehabilitation. KT's clinical effectiveness showed a positive effect in S1 and S2 studies. In S1, age is the limitation, as the age range is twenty to forty one years. In addition, more women were recruited compared to men, it appears that this is also one of the limitations, as it would restrict to generalise results. Lastly, there is short period of follow up, and in S2, there is lack of a placebo control group.

S3 and S4 examined the effect of KT in the same pathology, which is OA. In S3, KT was compared to sham KT, while in S4; there were three groups, as the participants received sensorymotor training and one traditional exercise programme. In the study outcomes, S3 focused on the primary outcome, which was peak isokinetic quadriceps torque, where the secondary outcome was pain during climbing stairs. In S4, proprioception acuity and functional activities including pain was measured. The KT effectiveness in S3 was improving isokinetic quadriceps torque and decreasing pain in OA. In S4, pain levels were significantly improved in the Kinesio taping group. A significant improvement was found among the trainers of sensorymotor for proprioception acuity and functional

activity. Time taken in measuring isokinetic quadriceps torque differs, from  $90^0$  to  $120^0$  per second, which forms implications for future research. In S4, the age range is thirty to fifty, but as age groups above fifty were not included this limits the results for generalisation. In addition, the age ranges was from forty to sixty years in S3, while in S4, the age of the subjects ranged from thirty to fifty years. Hence, in both studies, age is the limitation. In S5, the stage of injury is acute and the KT wearing time is three to five days so that the tape holds elasticity property. Lastly, the subjects were athletes only because they had faster metabolism compared non-athletes. In S6, the sample size is small and all subjects were females, which limits the study exposure.

### **B: Ankle Joint**

In this part of the data extraction, two studies are regarding ankle joints. S5 and S6 have the same pathology as ankle sprain at different stages, such as acute and chronic. Different participants were used in S5, whereas athletes and basketball players were used in the sixth study. When comparing the studies, KT was compared to sham tape and in S6 athletic tape was compared to that of KT. In the outcome measurements, swelling in S5 and functional performance in S6 was observed. KT showed a negative response in both the studies. In S5, the stage of injury is acute, KT wearing time is three to five days so that the tape can retain its elasticity and lastly, the subjects were athletes only because they had a faster metabolism compared non-athletes. In S6, the sample size is small and all subjects were females, which limits the study exposure.

## 10. Discussion

**Internal validity, construct validity and external validity**  
 While conducting quantitative research, internal validity is highly important to understand during the selection of the

subjects. Some argues that ethically biased data collection cannot address the research question. The concept of bias has also been supported by Delgado, if the subjects are not selected through randomisation the outcome might be biased. The novice researcher ensured that the studies in this SA were randomised and control design was applied. RCTs minimise the risks of bias during data collection. Therefore, it is argued that the data in six primary research studies are reliable.

Researchers discussed external validity in terms of generalisation. The findings suggest that the results of all six studies can be generalised in another area or population but within a similar context. However, it might not be possible when the sample size is small. The statistical analysis is another point to justify external validity. The subjects recruited in all six primary research studies were liable to KT application. A very clear question arises as to whether or not a proper clinical approach was undertaken. Logically, it seems that a clinical approach was used and hence the subjects were asked to wear or put on KT for overcoming outcome measurement in lower limb muscle skeletal disorders. The evidence of KT effectiveness for lower limb MSDs is emerging. Furthermore, the results of controlled randomised trials in SA are not sufficient in terms of the clinical decision making factor. The hierarchy of evidence for questions about the effectiveness of an intervention or treatment according to are listed in Figure 8:



Figure 8: shows systematic reviews of randomised control trials

Source: Physical Therapy.Net

The SA included six primary studies, five of which were RCTs with single and double blinds assessors, while one primary study was a cross over design. RCTs are considered highly reliable for the clinical intervention of KT application. The primary research study of AnandKumar et al (2015) probably used the best research design, as pre-test and post-test might fit in with the KT application evaluation. Bicici et al (2012) used a crossover design that might not address the needs of the research outcome. Furthermore, Figure 8 above shows that SA comprises of high elements in the pyramid. All six primary studies were conducted in

developing countries, where health services are not that good compared to developed countries. The evidence generated from the six primary studies might not be replicable, especially in developed countries, but it can be generalised in the similar context.

#### SA process and its identified limitation

The SA identified a range of critical and analytical challenges encountered across the secondary research. The most difficult challenge was to notice the difference between SR and SA. However, this concept was cleared when accessing literature concerns about the use of KT among the population. CRD (2008) maintained and reported that SRs are conducted by a team comprised of inter-related specialists of the subject. The best SRs account for the inputs for all team members. However, it takes time to complete a SR, which can range from nine to twenty four months. This is unlike this present secondary research, which was conducted by an individual researcher alone. However, during SAs, primary research articles were accessed from databases electronically, while during this research, the researcher accessed more than 500 research papers. But, due to the quality, reliability and other factors only six studies could be accepted for SA analysis. The selection of six to twelve primary studies might be another limitation, although CRD (2008) argued that more primary studies during SA can be better to build the argument about one particular research question.

In addition, duration is the limitation that sometimes misleads the researchers about their SAs. However, time constraints can be better managed through timetables, where one has to apply already agreed principles of SAs. The researchers have to follow the inclusion and exclusion criteria for selecting primary research studies. It can be seen in this SA that initially many studies were accessed from data bases, but after applying inclusion and exclusion criteria, the researcher ended up with six primary studies emphasised that SA about same research design might close the gaps of inclusion criteria, as cross sectional studies create doubts to finally infer the results. Particularly during this SA, the researcher faced issues in selecting primary studies, such as research questions, objectives and mismatching of research design.

#### KT Method Application

Since this SA refers to KT application, it is a pre-requisite to present some information which could be focused on in all peer reviews of the six primary research studies. The individual analysis of the six studies focuses on the bottom line requirements, such as preparation of skin, position of the injured place, tension, the direction and the time of use. In KT application, the tape is cut in different shapes, which are shown as —YI, —II, —XI, —fanI, —webI (modified —fanI) and —donutI shapes. However, cutting tape totally depends upon the size of the affected muscle and type or kind of treatment needed. It is important to recognise that different cuts of tape are used to facilitate or inhibit effects of pain, swelling, biomechanical correction, lymphatic drainage (both —fanI and —webI), focused oedema or specific area (sports) (Kase 2003). It is also important to know that the affected area's skin must be dry and the use of oils or lotions is strictly prohibited prior to application of

KT. While removing the protective sheet of the adhesive, practitioners should use minimal contact to preserve the adhesive capacity. This means that the adhesive protection shouldn't be absolutely removed. The KT must reproduce the positioning of the therapist's hands on the patient. The base of the tape must be positioned five cm below the origin or above the insertion, with no tension, so that the patient feels comfort. KT should not be stretched, if so, its effect will be reduced. This therefore suggests that the balance of tension is the best way to apply KT when treating patients (Kase 2003).

The tension is graded in terms of percentage, such as no tension 0%, very light 0-15%, light 15-25%, moderate 50%, intense 75% and full tension 100%. In a situation where the patients have weak muscles, many researchers have recommended that KT should be applied from the origin to the insertion at 25-50% (Kase, 2003).

KT application in the above scenarios should last for 3-5 days. However, a patient will feel that the tape has fully adhered in approximately twenty minutes (Kase 2003). KT applications are practiced on the recommendations of KenzoKase's book (Kase 2003). Therefore, proper assessment for each case depends highly on clinical reasoning, such as signs and symptoms (aetiology) of lower limb MSDs to achieve desirable goals in different stages of injuries. Also, the direction of taping, the degree of tension and target tissues are all attributes to good results of taping application. This SA found that there are varieties clinical methods used in different MSDs in the lower limbs.

A finding of this SA revealed that KT tape's application is due to a lack of standardisation, as clinical method applications were not fully followed in the six primary research studies. As was discussed before in this SA, this technique definitely requires a proper assessment in order to achieve the best results with the taping application, considering the individual needs of each case. However, researchers prepare to use a standardised taping application, and try to understand its effect on subjects'outcomes (Campolo, et al. 2013).

However, this SA analysis indicated that the practitioners did not have full knowledge about the application of KT. Two of the studies show that KT was applied by certified practitioners and rest of the studies did not mention the certified practitioners. Therefore, the application of KT might affect the outcomes of the measurement of KT application, while decision making plays a pivotal role in selecting clinical therapeutic method of KT. This demonstrates the importance of a meticulous assessment prior to choosing and applying the KT.

In this SA, the researchers used facilitation action or inhibition action to obtain the effectiveness of KT. However, MSDs have different pathological clinical pictures that might lead to different applications of KT to fit the outcome. This shows that the practitioner of KT is only concerned with the clinical aspect rather than the real aetiology. For instance, a researcher who studied the effect of KT on the management applied for facilitation, whereas there are many

other causes that might lead to (PFS) and need different KT techniques to achieve the desired goal of the practitioner.

Furthermore, only Anandkuma et al (2014) used inhibitive action, which might be suitable for the OA. Results of their study concluded with convulsion, which is the main point of consideration in KT application for inhibiting muscle relaxation. Their findings conformed to that of Parreira et al. (2013). Also, they compared the two KT approaches in patients with chronic nonspecific low back pain.

Moreover, skin preparation might play an important in clinical practice in KT, as the findings of this SA state that only one study paid attention toward skin preparation. The rest of the studies did not pay any attention about skin percussion. This might lead towards influence of KT application outcome, according to the KT application manual book. Also, direction of tension is reported in these SA findings, but this needs to be proven scientifically, as it leads to facilitation or a inhibition microceptorsone study conducted by Vered et al. (2015), wherein the researchers concluded that KT direction might not strengthen/relax the muscles.

It is worthy to note that the accuracy of KT tension application is subject from one individual to another, based on their respective strength in pulling in and out of the tape. This is an argumentative issue which might affect the result of KT application practices

#### **KT's Effectiveness at the site of injury**

All six primary studies in this SA were heterogeneous; in terms of participant population, outcome variables assessed the methods of KT application. This makes direct quantitative comparison of the therapeutic efficacy of KT difficult.

Kinesio Taping research has deep methodological, internal and external validity limitations. Considering the ambiguous outcomes regarding evidence and clinical practice in the use of KT, it is important to discuss why this may be happening, as well as suggesting what could be improved in future research regarding KT application (Morris et al. 2013).

Highly designed research studies can help to measure the effectiveness of KT. In the findings of this SA, all six primary research papers differ in research design. For instance, it is important to focus on the work of Anandkumar et al. (2015), as they selected pre-test and post-test subjects and used randomised control design, which might be suitable to measure the effectiveness of KT in patients suffering from OA. Their approach probably appears to measure the effectiveness of KT over a long scale of further treatment, while on the other hand, Bicici et al (2012) used cross over research design that limits to measure the KT effectiveness.

Musculoskeletal pain affects all genders and populations in this SA; the researchers selected samples varying in age, participant background and gender. The age range in four of the studies covers meniscal injury, total knee replacement and OA, but did not cover all suspected patients who might have MSDs. In addition, there is contradiction in suggesting further treatment. Also, it can be noticed that in some of the



studies, such as S1, S2, and S4, the range of follow up times was four to eight weeks, while in S3; the only comparison was made between KT and sham KT with no further follow up. However, all pathological conditions had signs and symptoms that might change according to the stage of injury. Therefore, for this reason there is need to increase the time of follow up to evaluate the signs and symptoms of each musculoskeletal disorder. It depends upon the physiology of the healing process at each stage of injury and adaptation to KT application.

Furthermore, the results of S1 showed KT response along with isometric and active resistance exercises. The researchers did not find twenty eight days as enough time for rehabilitation. This therefore suggests extension of rehabilitation as a follow up.

Groups were homogenous in S2, where KT applications were tolerated other than by two patients. In terms of outcome measurements, post-operative pain was less in KT applied patients and similarly, oedema was less intense compared to the control group. Regarding the active range of motion, initially during rehabilitation there was a similar response, but at the end of rehabilitation a significant difference was noted in the KT group. Though the results of S2 were quite promising, this was perhaps the only study in the SA where an aged population was targeted.

In S3, researchers noted peak isokinetic quadriceps torque (concentric and eccentric at 90 per second and 120 per second). They set Standardised Stair Climbing Task (SSCT) and pain experienced during the SSCT (measured using the Visual Analogue Scale (VAS) as secondary outcome measures. The subjects were the patients of Knee OA. The results suggest KT significantly improved the concentric and eccentric quadriceps torque production in knee OA at angular velocities of 90 and 120 per second respectively. These results disagree with (Lins et al, 2012, wherein they did not find an effect of KT on isokinetic quadriceps torque. However, the researchers in their study argued that it might be that the subjects in those studies were healthy, while in the S3, the subjects were the patients of musculoskeletal knee pain. This SA therefore notices that while testing KT with other modalities, the subjects should have had pain, especially musculoskeletal. Also, KT application time should be at least 30 minutes to achieve the activation of the glue. This improves the performance of the muscle according to principles of KT (Kase, 2003). In some of the studies, Lins et al.2012) it was reported that the gap was less than ten minutes to check the quadriceps torque production. It is likely that this time was enough to activate the glue. In S4, the patients with OA were introduced to test kinesio taping and sensory-motor training on pain intensity, proprioceptive acuity and functional disability. The results indicated that patients in sensory motor significantly improved compared to the KT group. However, pain as an outcome measurement was reduced significantly in the kineseo tape.

In S5, KT was used to reduce swelling in ankle sprain, because the creators of KT claimed that KT stimulates the re- absorption of the interstitial liquid via the lymphatic system, which is because of a decrease in pressure in the skin layer (epidermis). Its effect can be also seen in the

lymphatic vessels and this consequently increases the lumen of these vessels. The response of KT was not seen because of acute swelling in S5, while in another study conducted by Aguilar-Ferra'ndiz et al. (2014) the subjects suffered from chronic pain. In addition, they reported that KT decreases extracellular liquid in subjects with chronic venous insufficiency. Especially with chronic venous insufficiency, swelling could be the cause of hydrostatic pressure changes, which this lowers protein levels. In S5, the subjects were having acute ankle sprains with the active inflammatory process and had higher levels of protein. This therefore dictates that effects of KT on swelling were limited because of the stage of injury. In S6, the results were based upon three group measurements, such as athletic tape, placebo taping and KT tape. The results demonstrated that three of the levels showed significant differences, but KT application results were better where the P value was 0.000. It appears that the decrease in the number of heels might be due to planter flexion ROM of the ankle. In the study, Kinesio Tex Tape showed a higher numbers of heel rises than athletic tape. There were non-significant differences in heel rises between KT-none-tape and KT -placebo. It means this may be proprioceptive feedback, which was also investigated by where the effect of placebo taping was ambiguous.

#### **Discussion in the light of research questions and objectives**

The SA was designed in two main themes: the KT application methods and effectiveness of KT at the site of injury of lower limbs MSDs. To undertake a Systematic Appraisal for evaluating clinical practice and the level of effectiveness of KT application for these SA findings, it has been noted that therapeutic KT methods play an important role for obtaining results as per assessments. In addition to this, practitioners prior to proceeding in tape application should focus upon the assessment of patients suffering from lower limb injuries. Clinical reasoning for KT application is also highly important, because this helps in choosing the right kind of KT application. Consequently, decision making of choosing the right application for certain cases depends scientific reasoning to lead the methods of application.

Clinical effectiveness of a KT application depends upon high quality of research design. In this SA, clinical effectiveness might be affected by different factors, such as research design, sampling, participants, the rehabilitation process and stages of injury (acute to chronic). It is discussed that MSDs had an effect at different ages and gender of varying pathologies during the healing process. It is important to mention that the findings of this SA reveal that research design should be selected very carefully, as it might mislead the final results. Moreover, MSDs occur among all ages and genders, including the backgrounds of the subjects. The recruitments of subjects is a crucial, as the variation in ages, gender and background can affect the results as well. Due to the lack of knowledge, training and skills of practitioners, this might lead to effect on the measuring of KT application for lower limb MSDs.

Now, it is highly important to present arguments about research questions and how the questions were addressed in the six studies. In S1, where the researchers found that KT

application showed improvements of the range of joint motion and reduction of oedema, the objectives and research questions in this SA was met. This was because of twenty eight days of rehabilitation programmes and the lowering of pain, which proves the efficacy of KT on one hand and sets out the application of KT in the future.

In S2 especially, the aim was to see the effect of KT reduces pain in the subjects. We know that all subjects underwent total knee replacement surgery and then KT was applied to reduce the pain. The study results envisage reduction in pain compared to others. This therefore points out that the research question in this SA was addressed. However in other studies, the effect of KT has shown differences, especially where KT was compared to sham KT. In S3, the application of therapeutic KT effectively improved isokinetic quadriceps, SSCT and reduced pain. This simply covers clinical assessment as well as the application of KT with difference in improvement of knee OA. It means this study also supports the objectives and research question in this SA.

Therapeutic KT is effective in improving isokinetic quadriceps torque, SSCT and reducing pain in knee osteoarthritis. In S4, sensorimotor was compared to KT, and sensorimotor with training showed higher performance than KT. This study does not fall within the objectives and research questions in this SA. This is because of the fact that training regarding KT application was not considered. In S5, the aim was to see if the Kinesio taping stimulates the lymphatic system. The results show the ineffectiveness of decreasing acute swelling in ankle sprain in the subjects who were athletes. This is not in line with the objectives in this SA. In S6, athletic and Kinesio tapes were applied to the patients' chronic sprains of the ankle. The results suggest that the Kinesio tapes did not show any negative effect compared to athletic tape. However, the purposes of this study are different than application of KT with a pre-determined outcome. This study does not address the objectives and the research question.

However, this is the first SA that evaluated KT therapeutic application and investigated the KT effectiveness of lower limb MSDs. All six RCTs studies met the criteria of inclusion. All six peer review research papers included subjects with meniscal injuries, total knee replacement, OAs and ankle sprains. Of the six primary studies that included KT as additional modality in rehabilitation process, the results of two studies revealed that KT might be beneficial in rehabilitation for musculoskeletal cases. The results also suggest that in other studies in this SA KT proved to be a highly promising application in reducing pain when compared with sham and athletic tapes. In one study, while comparing KT with sensory motor training for proprioception, sensory motor showed better results than KT, but KT was better in reducing pain in the short term.

In the two studies that included ankle sprains, KT did not show an improvement in reducing swelling and functional performance. It is likely that researchers might choose clinical procedures not suitable for the stage of injury. Moreover, sampling, the background of subjects and research design methods appear not to be high quality.

However, the quality of evidence is graded low to moderate, including conflicting results, as well as a lack of participants with backgrounds and variation in ages that might occur in MSDs. Above all, there was insufficient evidence to support KT as clinical practice for treating lower limb in MSDs over other modalities. This suggests that more high-quality research with long-term outcomes is required. The findings of all six studies supports the KT application, however, there is need to conduct more studies comparing KT with other tapes.

## 11. Conclusion

Musculoskeletal disorders continue to be a serious public health problem in among the general populations. Generally, MDSs are caused by injuries, age and other factors. The findings from this SA demonstrate that the contributory factors are diverse in patients who are suffering from injuries such as knee injury, ankle sprains and OA. The people can become disabled, such as athletes, football players and others, where old age is the most significant factor that makes people disabled and such patients need the attention of health services.

## 12. Gaps in the evidence and implication for future research

It appears that clinical reasoning and decision making during the assessment process for patients suffering from MSD pain is an important skill for physiotherapists who are applying KT methods. Lack of training regarding the application of KT is probably considered as gap. It might be possible that increased training towards KT application is one of the key factors for PT to practice based on evidence. In addition, early assessments at the hospital suggest levels might be a leading gap. Furthermore, the patients' attitudes and behaviours are also a gap that restricts the clinical application of KT.

The selection of respondents is the most serious gap, as in all six studies, the subjects were not homogenous; perhaps just one study claimed homogeneity. This SA noted that sample size among the studies varies. This therefore suggests that large samples might close the gaps regarding research in KT application. In addition, age differences between the subjects might be the reason that KT in few of the studies did not show significant results. However, training can close these gaps with reference to skill scarcity and professionalism.

During the search of literature for this appraisal, it was found that most of the studies were carried out globally, but less in the developing countries. This SA shows that studies were conducted in six different countries, where the small sample might be another gap due to lack of resources, most imminently funds. It has been noted that because of a scarcity of funds, it is not possible to recruit more participants with different backgrounds, age ranges, genders etc to meet the requirement of research.

## References

- [1] Aguilar-Ferrández, et al. (2014) A randomized controlled trial of a mixed Kinesio taping–compression technique on venous symptoms, pain, peripheral venous flow, clinical severity and overall health status in postmenopausal women with chronic venous insufficiency, *Clinical Rehabilitation*, Vol 28(1) pp. 69–81
- [2] Anandkumar, S. Sudarshan, S. and Nagpal, P. (2014) Efficacy of kinesio taping on isokinetic quadriceps torque in knee osteoarthritis: a double blinded randomised controlled study, *Physiotherapy Theory Pract*, 2014; 30(6): 375–383
- [3] Armstrong, C.S. Jagolinzer, A.D. and Larcker, D.F. (2010) Performance-based incentives for internal monitors. Working Paper, Stanford University
- [4] Bae, S.-H. Lee, Y.-S. Kim, G.-D. & Kim, K.-Y. (2014). A quantitative evaluation of delayed onset muscular soreness according to application of kinesio taping. *Advanced Science and Technology Letters*, 47, pp. 387-390.
- [5] Bassett, K. Lingman, S. and Ellis, R. (2010). The use and treatment efficacy of kinaesthetic taping for musculoskeletal conditions: a systematic review. *N Z J Physiotherapy*; 38:56-62.
- [6] Bicici, S. Nihan Karatas, N. and Baltaci, G. (2012) Effect of athletic taping and Kinsiotaping® on measurements of functional performance basketball players for inversion ankle sprains *The International Journal of Sports Physical Therapy* | Volume 7, Number 2 | April | Page 1
- [7] Bolgla, L.A. and Boling, S.M.C. (2011) An update for the conservative management of patellofemoral pain syndrome: a systematic review of the literature from 2000 to 2010. *Int J Sports Phys Ther*. 6(2):112-125
- [8] Bourne, A. M. Whittle, S. L. Richards, B. L. Maher, C. G. & Buchbinder, R. (2014) the scope, funding and publication of musculoskeletal clinical trials performed in Australia. *Med. J. Aust.* 200, pp.88–91.
- [9] Briem, K. Eythorsdottir, H. Magnúsdóttir, R. G. Pálmarsson, R. Rúnarsdottir, T. & Sveinsson, T. (2011) Effects of kinesio tape compared with nonelastic sports tape and the untaped ankle during a sudden inversion perturbation in male athletes. *Journal of Orthopaedic & Sports Physical Therapy*, 41 (5), pp. 328-335.
- [10] Buchbinder, R. Maher, C. and Harris, I.A. (2015) Setting the research agenda for *Nat Rev Rheumatol*.
- [11] Campolo, M. Babu, J. Dmochowska, K. Scariah, S. & Varughese, J. (2013). A comparison of two taping techniques (Kinesio and McConnell) and their effect on anterior knee pain during functional activities. *The International Journal of Sports Physical Therapy*, 8 (2), pp. 105-110
- [12] Chang, H.Y. Cheng, S.C. Lin, C.C. et al. (2013) the effectiveness of Kinesio taping for athletes with medial elbow epicondylar tendinopathy. *Int Journal of Sports Med*; 34:1003–6.
- [13] Cherry, N.M. Meyer, J.D. Chen, Y. Holt, D.L. and McDonald, J.C. (2001). The reported incidence of work-related musculoskeletal disease in the UK: MOSS 1997-2000 *Occupational Medicine*, 51, 7, 450-455
- [14] Corrigan, P. and Nye, A. (2012) Pennine MSK Partnership A case study of an Integrating Pathway Hub (IPH) —Prime Contractor/ Right Care Case Book.
- [15] Csapo, R. and Alegre, L.M. (2014) Effects of Kinesio taping on skeletal muscle strength, a meta-analysis of current evidence. *J Sci Med Sport*; 18:450-456
- [16] Garcia-Muro, F. Rodriguez-Fernandez, A.L. and Herrero-de-Lucas, A. (2010) Treatment of myofascial pain in the shoulder with Kinesio taping. A case report. *Manual Therapy* 15: 292–295
- [17] Garside J et al (2013) A concept analysis of competency and its transition in nursing. *Nurse Education Today*; 33: 5, 541-545.
- [18] Gonzalez-Iglesias, J. Fernandez-de-Las-Penas, C. and Cleland, J.A. (2009) Shortterm effects of cervical Kinesio taping on pain and cervical range of motion in patients with acute whiplash injury: a randomized clinical trial. *J Orthop Sports Physiotherapy*; 39:515–21.
- [19] Hettle, D. Linton, L. Baker, J.S. and Donoghue, O. (2013). The Effect of Kinesiotaping on Functional Performance in Chronic Ankle Instability - Preliminary Study. *Clin Res Foot Ankle* 1:105. doi: 10.4172/2329-910X.1000105
- [20] Jaraczewska, E. and Long, C. (2006) Kinesio taping in stroke: Improving functional use of the upper extremity in hemiplegia. *Topics in Stroke Rehabilitation* 13: 31–41
- [21] Jette, D.U. Ardleigh, K. Chandler, K. and McShea, L. (2006) Decision-making ability of physical therapists: physical therapy intervention or medical referral *Physical Therapy*; Dec;86(12):1619-29.
- [22] Kase, K. Wallis, J. & Kase, T. (2003) Clinical therapeutic applications of the Kinesio Taping Method. NM: Kinesio Taping Association.
- [23] Kase, K. Wallis, J. and Kase, T. (2003) Clinical Therapeutic Applications of the Kinesio Taping Method, 2nd edn. Tokyo, Ken Ikai Co. Ltd
- [24] Khan, M.T.I. and T. Kurita. T. (2015) EMG Signals for Co-Activations of Major Lower Limb Muscles in Knee Joint Dynamics. *Biomedical Science and Engineering*. Vol. 3, No. 1, 2015, pp 9-14. <http://pubs.sciepub.com/bse/3/1/3>
- [25] Lawrence, S. (2009) Innovations in the management of chronic oedema. *British Journal of Community Nursing* 14: S14–S21
- [26] Lee, J.-H. & Yoo, W.-G. (2011) Treatment of chronic Achilles tendon pain by Kinesio Taping in an amateur badminton player. *Physical Therapy in Sport*. pp. 1-5.
- [27] Levy, Y. and Ellis, T. J. (2006). A Systems Approach to Conduct an Effective Literature Review in Support of Information Systems Research. *Informing Science*, 9, 181.
- [28] Lins (2012) Kinesio Taping does not alter neuromuscular performance of femoral quadriceps or lower limb function in healthy subjects: Randomized, blind, controlled, clinical trial, *Manual Therapy*, 1-5
- [29] Lumpkin, E. A. Marshall, K. L. & Nelson, A. M. (2010) The cell biology of touch. *The Journal of Cell Biology*, 191, pp. 237-248.
- [30] McCarthy, C. (2010) Combined Movement Theory. Churchill Livingstone.



- [31] Melnyk, B.M. and Fineout-Overholt, E. (2005) Transforming healthcare from the inside out: advancing evidence based practice in the 21st century. *Journal of Professional Nursing*; 21: 6, 335-344
- [32] Montalvo, A.M. Cara, E.L. and Myer, G.D. (2014) Effect of kinesiology taping on pain in individuals with musculoskeletal injuries: systematic review and meta-analysis. *Phys Sportsmed*; 42: 48-57.
- [33] Moore, R. (2012) What is the current evidence for the use of Kinesio Tape. A
- [34] Literature Review, Available on [www.sporttax.net/back-issue-c-22.html](http://www.sporttax.net/back-issue-c-22.html).
- [35] Morris, D. Jones, D. Ryan, H. & Ryan, C. G. (2013). The clinical effects of Kinesio Tex Taping: A systematic review. *Physiotherapy Theory and Practice*, 29 (4), pp. 259-270.
- [36] Mostafavifar, M. Wertz, J. & Borchers, J. (2012) A systematic review of the effectiveness of Kinesio Taping for musculoskeletal injury. *The Physician and Sportsmedicine*, 40 (4), pp. 33-40.
- [37] Nadali, S. Khabazan, M. A. Aryamanesh, A. S. Hoseleh, A. Khabazan, M. H. & Bakhshizadeh, A. (2014) Effect of kinesio taping on vertical jump after ACL reconstruction. *International Journal of Sport Studies*, 4 (6), pp. 653-658.
- [38] Nakajima, M. & Baldrige, C. (2013). The effect of kinesio tape on vertical jump and dynamic postural control. *The International Journal of Sports Physical Therapy*, 8 (4), pp. 393-406.
- [39] Nilsen, P. and Bernhardsson, S. (2013). Towards evidence-based physiotherapy - research challenges and needs, *Journal of Physiotherapy*, (59), 3, 143-144.
- [40] Nunes, G.S. Vargas, V.Z. Wageck, B. Haupenthal, D.P.d.S, da Luz, C.M. Noronha, M. (2015) Kinesio Taping does not decrease swelling in acute, lateral ankle sprain of athletes: a randomised trial, *Journal of Physiotherapy* 61 (2015) 28- 32
- [41] Parreira, P. Costa, L. Junior, L. Lopes, A. & Costa, L. (2014) Current evidence does not support the use of Kinesio Taping in clinical practice: a systematic review. *Journal of Physiotherapy*, 60, pp. 31-39.
- [42] Rubin, A. and Bellamy, J (2012) *Practitioner's Guide Using Research for Evidence Practice*, John Wiley and Sons, Inc
- [43] Shimizu, H. (2007) Chapter 1 – Skin Structure and Function. In H. Shimizu, *Shimizu's Textbook of Dermatology* (pp. 1-11). Nakayama Shoten
- [44] Stureson, M. Edlund, C. Falkdal, A.H. and Bernspång, B. (2014) Healthcare encounters and return to work: a qualitative study on sick-listed patients' experiences, *Primary Healthcare Research & Development*: 15: 464-475
- [45] Sutherland, J.M. Fisher, E.S. and Skinner, J.S. (2009) Getting Past Denial. *The High Cost of Healthcare in the United States*, *N Engl J Med*: 361; 13
- [46] Tacconelli, E (2010) Systematic reviews: CRD's guidance for undertaking reviews in health care, *Infectious Diseases*, Vol, 10, No: 4
- [47] Thelen, M. D. Dauber, J. A., & Stoneman, P. D. (2008). The clinical efficacy of Kinesio Tape for shoulder pain: A randomized, double-blinded, clinical trial. *Journal of Orthopaedic & Sports Physical Therapy*. 38 (7), pp. 389-395.
- [48] Tsai, C.-T. Chang, W.-D. & Lee, J.-P. (2010) Effects of short-term treatment with kinesiotaping for plantar fasciitis. *Journal of Musculoskeletal Pain*. 18 (1), pp. 71-80.
- [49] Vered, E., (2015) Influence of kinesio tape application direction on peak force of biceps brachii muscle:
- [50] Viegas, A. (2014). An utilização de kinesio tape em condições músculo-esqueléticas – Revisão da literatura. *Revista Portuguesa de Fisioterapia no Desporto*, 7 (2), pp. 15-25.
- [51] Walsh N.E. and Hurley, M.V. (2009) Evidence based guidelines and current practice for physiotherapy management of knee osteoarthritis. *Musculoskeletal Care*. Mar; 7(1):4556.
- [52] Wieseler, B. McGauran, N. Kerekes, M.F. And Thomas Kaiser, T. (2012) Access to regulatory data from the European Medicines Agency: the times they are a-changing, *Bio Med Central*
- [53] World Health Organisation, (2015) Engaging for Health Eleventh General Programme of Work, 2006-2015 A Global Health Agenda. Available at: <http://www.who.int/management/AGlobalHealthAgenda.pdf>.