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Effects of kinesio taping on hemiplegic shoulder pain

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Abstract

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Stroke is one of the major disabilities all over the globe. Among people who have suffered stroke, shoulder impairment is one of the challenging issues affecting their quality of life. 12 to 49 percentage of stroke patients are prone to any kind of shoulder problem which leads to shoulder pain. Developing issues in the shoulder always restricts the function of the shoulder and degrading the activities of daily living. Range of motion of the affected shoulder is limited by the prevailing pain and impacts on quality of life of the patient. Kinesio taping is applied over the affected shoulder intending to reduce the pain. The aim of this bachelor's thesis is to identify the effects of kinesio taping in stroke patients with hemiplegic shoulder pain.

A systematic search was conducted in the database of CINHAL, PubMed, ProQuest, and manual search. Determined criteria for inclusion and exclusion were executed. Results were retrieved in accordance with their date of publication from 2013 to 2023.

The results included three systematic reviews, four randomized controlled trials, and one single-group pre-post design pilot feasibility study. Depending on the reviewed articles, kinesio taping reduces hemiplegic shoulder pain.

Application of kinesio taping on hemiplegic shoulder pain could reduce the shoulder pain of the affected side. Hence, it will upgrade the quality of life, range of motion and functional ability of the patient.

Keywords: Hemiplegic shoulder, Kinesio taping, Stroke

Contents

1 Introduction

Stroke is one of the main causes of disability in the world. Impaired upper extremity function is one of a common occurrence, with shoulder issues accounting for the majority of upper extremity complications. Due to its high mobility and decreased stability, the shoulder is prone to a variety of secondary musculoskeletal difficulties following a stroke, including pain, subluxation, and limited joint range of motion. (Kumar, Fernando, Mendoza, and Shah 2021.)

People suffer from stroke due to various aetiologies such as formation of atheroma in large arteries, small vessel disease and cardiogenic embolism (Jensen and Thomalla 2019). According to Hao, Zhang, Li, and Guo (2021) among the secondary complications developed in stroke patients, shoulder pain is one of the typical symptoms seen among the stroke population. 12% to 49% of stroke patients have shoulder pain due to suggestive causes for instance hypotonic muscles, imbalance of soft tissue structures and flaccid paralysis of the upper limb. Shoulder pain is more significant from the first to third month of the incident.

Considerable number of stroke patients are suffering from shoulder pain. While there are many other factors, it should be noted that the patient's geographical location can have a significant impact. The symptoms can be varied depend on the geographical location. Time of the onset is also considered as a major reason for developing shoulder pain. (Zhang et al. 2021.) When the shoulder pain has developed in a stroke patient, it will clearly affect the activities of daily living and make restrictions. The pain could vary from moderate to severe. In stroke rehabilitation the rehabilitator must pay attention to patients who are at risk for developing problems in the shoulder. (Lindgren, Jönsson, Norrving and Lindgren 2007.)

In stroke patients, several changes take place in the shoulder complex of the affected side. The paralysis causes the limitation of the range of motion in the shoulder joint. (Pan et al. 2017.) Shoulder pain in stroke patients could result in

further limitation in the movements. It can affect the quality of life of patients. They find difficulties in sleeping comfortably due to sudden wake up while sleeping and choosing a suitable pain free position. In addition, patients can get depressed and have a reduced quality of life. (Dyer, Mordaunt and Wakeling 2020.)

The purpose of this bachelor's thesis is to identify the effects of kinesio taping for stroke patients having shoulder pain.

2 Background

Hemiplegic shoulder pain affects about one third of stroke patients during their recovery process. Hemiplegic shoulder pain impacts negatively on their quality of life and activity of daily living. The medical practitioners use wide range of interventions for hemiplegic shoulder pain. Understanding regarding the causes and rationale behind the treatment of hemiplegic shoulder pain, assist to implement evidence-based interventions to treat stroke patients with hemiplegic shoulder pain. (Shah et al. 2008.)

2.1 Therapeutic effects of kinesio taping

Kinesio taping has been used in neurological patients to improve joint stability, reduce postural misalignment, support weak structures, activate weak muscles, activate mechanoreceptors, control spasticity, and increase proprioceptive and sensory feedback. Kinesio taping, which is also referred to as neuromuscular, elastic therapeutic taping, kinesthetic, is an adhesive tape that is applied directly onto the skin's surface. (Jr, Nobre and Rocha 2018.)

Usually, the kinesio tape is applied over the muscles to avoid excessive contraction. Kinesio taping is thought to reduce pain and inflammation by enhancing lymphatic and blood flow without restricting range of motion in the affected area. Using this method, the pressure and irritation on the neurosensory receptors that are responsible for pain are released. Additionally,

the tape elevates the skin microscopically, which enhances the lymphatic drainage and lowers inflammation in the affected areas. (Mostafavifar, Wertz and Borchers 2012.)

According to Wang, Li, Sun, and Xu (2022) with the advancing of kinesio taping its application in upper limb rehabilitation is growing. Kinesio taping may be able to provide sensory input from the paretic upper limb at a higher intensity to improve motor function and reduce sensory impairments. This study discovered that kinesio taping had a beneficial effect on proprioception. Muscle activation may improve by elastic stimulation of kinesio taping.

Lin et al. (2021) suggest that activating cutaneous receptors enhances sensorimotor control and increases muscle spindle sensitivity, cutaneous and proprioceptive inputs have distinct functions in sensorimotor integration. There is still limited evidence on how kinesio taping impacts sensorimotor function or how the central nervous system's sensory input is impacted by tape tension.

Krajczy, Bogacz, Luniewski and Szczegielniak (2021) suggest on balance in neurological patients, kinesio taping could encourage functional usage of the upper and lower extremities by easing overstretched muscles, relieving pain, and supporting weak muscles. The application of kinesio taping has been assessed for use in treating stroke patients' shoulder, upper limb, trunk, ankle movements and lower limb (Chen et al. 2022).

Kinesio taping has grown in popularity recently as a rehabilitation tool for hemiplegic patients. Systematic review by Ravichandran et al. (2019) which aimed on various tapes whereas elastic taping, therapeutic strapping, kinesio taping and California Tri-Pull Taping, discovered that taping had a significant impact on stroke patients' pain relief and prevention of shoulder subluxation. This finding was consistent with the beneficial effects of kinesio taping.

2.2 Hemiplegic shoulder pain

Hemiplegic shoulder pain, along with depression, urinary tract infections, and falls, are four most common post-stroke medical complications (Janus-Laszuk, Mirowska-Guzel, Sarzynska-Dlugosz and Czlonkowska 2017). The reported incidence of hemiplegic shoulder pain ranges from 30% to 65%. Within six months of their stroke, nearly one-third of stroke patients experienced shoulder pain. After a stroke, the stroke patients in the chronic stage were found to have a higher prevalence of hemiplegic shoulder pain than in the acute stage. Early hemiplegic shoulder pain manifestation may have a negative impact on the recovery and, ultimately, on quality of life related to health. (Kumar, Turton, Cramp, Smith, and Mccabe C 2020.)

Hemiplegic shoulder pain can be broadly divided into two categories which are mechanical such as shoulder muscle imbalance, subluxation, rotator cuff injury, and altered scapula position and neurological such as spasticity, paralysis, neuropathic pain and altered sensation. (Vasudevan and Browne 2014.) Fifty percent (50%) of stroke patients develop contracture, evaluating all potential contributing factors are necessary for managing the painful shoulder and upper extremity with reduced range of motion (Fitterer, Picelli and Winston 2021).

Only a small number of musculoskeletal specialised tests, such as the hand-behind-head test and modified Neer impingement tests to identify specific tissue lesion, have been administered to stroke patients (Kumar P., Turton A., Cramp, Smith and Mccabe 2020).

2.3 Post stroke shoulder pain

Instability-related joint pain may occur sharply when moving passively or actively. Pulling pain with movement can be caused by atrophic or spastic muscles. Malfunctioning of central nervous system modulation of pain, which can range from dull and aching to sharp and piercing, which can cause abnormal sensitivity to pain. Since hemiplegic shoulder pain has no

pathognomonic association with any particular pain subtype, it is challenging to interpret pain types and other descriptions of the condition. Pain that occurs due to muscles or tendons impinging on one another could also be the result of an upper motor neuron disease such as spasticity. Hyperpathia, allodynia, or sharp pain from a lower motor neuron disorder (axillary neuropathy) can also present similar symptoms related to altered sensation and central sources of pain. To avoid such confusion, the aetiology of hemiplegic shoulder pain is a more reliable classification than the symptoms alone. (Vasudevan and Browne 2014.) Those with left-sided hemiplegia are more likely to experience hemiplegic shoulder pain (Answer and Alghadir 2020).

2.4 Proprioception and kinesio taping

Twenty-two studies were included in meta-analyses which was conducted by Hu et al. in (2019) comparing traditional rehabilitation with kinesio taping on post-stroke balance problems. The results of the study illustrated that kinesio taping was a more efficient recovery method for balance function than conventional rehabilitation. Additionally, they stated that kinesio taping can help stroke patients move more easily and improve their lower limb function. (Hu et al. 2019.) Taping enhanced electromyographic activity and enhanced healthy individuals' perception of their shoulder joint position (Lin, Hung and Yang 2010).

Additionally, during knee extension in proprioception, taping helped healthy individuals, which was linked to decreasing the bilateral stimulation in the cerebellum and cingulate motor area and increase the bilateral stimuli to activate in the primary sensory cortex and primary sensorimotor cortex. As a result, these findings showed that taping can affect neural activation and offer biomechanical support, which enhances shoulder girdle stability. (Burfeind and Chimera 2015.)

A systematic review of stroke patients found insufficient evidence regarding activities of daily living, and that the results of taping on strength, muscle tone,

and pain intensity, range of motion were inconclusive. Therefore, the authors concluded that further investigation is required to confirm the effects of taping on this population. (Grampurohit, Pradhan, Kartin 2015.)

2.5 Other therapeutic options

Various treatment options are used to treat patients with hemiplegic shoulder pain like, drug management, bracing, neuromuscular electrical stimulation, kinesio taping, and use of heat modality. If the shoulder pathology of the hemiplegic patient is suspected as a rotator cuff pathology, it is wiser to use intra-articular/bursal corticosteroid injections. Similarly, it is evident that supra scapular nerve blocking is also a successful intervention in managing hemiplegic shoulder pain. In the same way intra–muscular botulinum injection is as the best treatment in the period between 4th and 24th week. (Musab, Younas and Rathore 2022.)

Shoulder braces are sometimes utilised to manage the pain in particular cases. Although a recent study shows that shoulder braces are beneficial in gait pattern restoration in hemiplegic patterns, it does not add any optimistic or pessimistic impact on the use of braces for reduction of the pain. (Lin et al. 2021.)

Different study clearly shows that elastic dynamic sling would reduce the incident of supraspinatus tendonitis and thus reduce the pain as well. It will improve the upper limb motor functions and activities of daily living in hemiplegic patients. (Kim et al. 2022.)

Another treatment method which clinicians are interested in is Transcutaneous Neuromuscular Electrical Stimulation. Transcutaneous Neuromuscular Electrical Stimulation treatment along with bilateral arm training will improve shoulder pain efficiently. It explains that this reduction of pain would persist for a considerable time duration. (Kim et al. 2022.) Additionally, robotic assisted rehabilitation is one of the upcoming therapies in treating different kinds of issues in hemiplegic patients. One of the articles published in the 21st century

emphasizes the use of robotic therapy to reduce spasticity and as a result reduction of hemiplegic shoulder pain. It further explains that immobility of the hemiplegic shoulder causes an increase in tone and pain. (Serrezuela et al. 2020.)

3 Aim and Method

3.1 Aim

The aim of this bachelor's thesis is to identify the effects of kinesio taping in stroke patients with hemiplegic shoulder pain.

3.2 Search strategies

3.2.1 Inclusion and exclusion criteria

The inclusion and exclusion criteria are presented in below table 1.

Table 1. inclusion and exclusion criteria.

	Inclusion Criteria	Exclusion Criteria
Publication Date	Articles published from 2013 to 2023	Articles published before 2013
Publication Language	Only articles published in English language	Articles which published in different languages
Method	All type of study methods	Nonrelevant study methods
Content	Using kinesio tape as an intervention to stroke patients who developed	Using kinesio tape for elbow and wrist

	hemiplegic shoulder pain after stroke. In acute, subacute, and chronic stages	Articles using kinesio taping without history of stroke

3.2.2 Data Collection

The data collection begins in September 2023. Electronic databases used, PubMed, CINAHL, ProQuest, and Google Scholar.

The search words used were kinesiology tap*, kinesio tap*, neuromuscular tap*, hemiplegi*, shoulder, and pain. The bachelor thesis included studies published from 2013 to 2023. It will bring the most updated data. These search words are utilised with different combinations in each search engine to have the maximum number of relevant articles.

In PubMed, the search words used were "kinesiology tap*" OR “neuromuscular tap*” OR "kinesio tap*" AND "hemiplegi*" AND "shoulder" AND "pain" as the search words and Boolean operators.

For the search conducted in CINHAL, "kinesiology tap*" OR “neuromuscular tap*” OR "kinesio tap*" AND "hemiplegi*" AND "shoulder" AND "pain" were used as the keywords and Boolean operators.

The ProQuest search was conducted by using different combinations of words. Targeted articles were published in the last 10 years., "kinesio tap*" AND "hemiplegi*" AND "shoulder" AND "pain".

The search words and Boolean operators used were "kinesio tap*" OR "kinesio tap*" OR “neuromuscular tap*” AND "hemiplegi*" AND "shoulder" AND "pain" were used as the Boolean operators and search words in Google Scholar. Time concernment was 2013 to 2023.

3.3 Data extraction

From the included studies, the data were extracted. The two authors discussed and came to an agreement to resolve differences. The figure 1 displays the extraction process of the article.

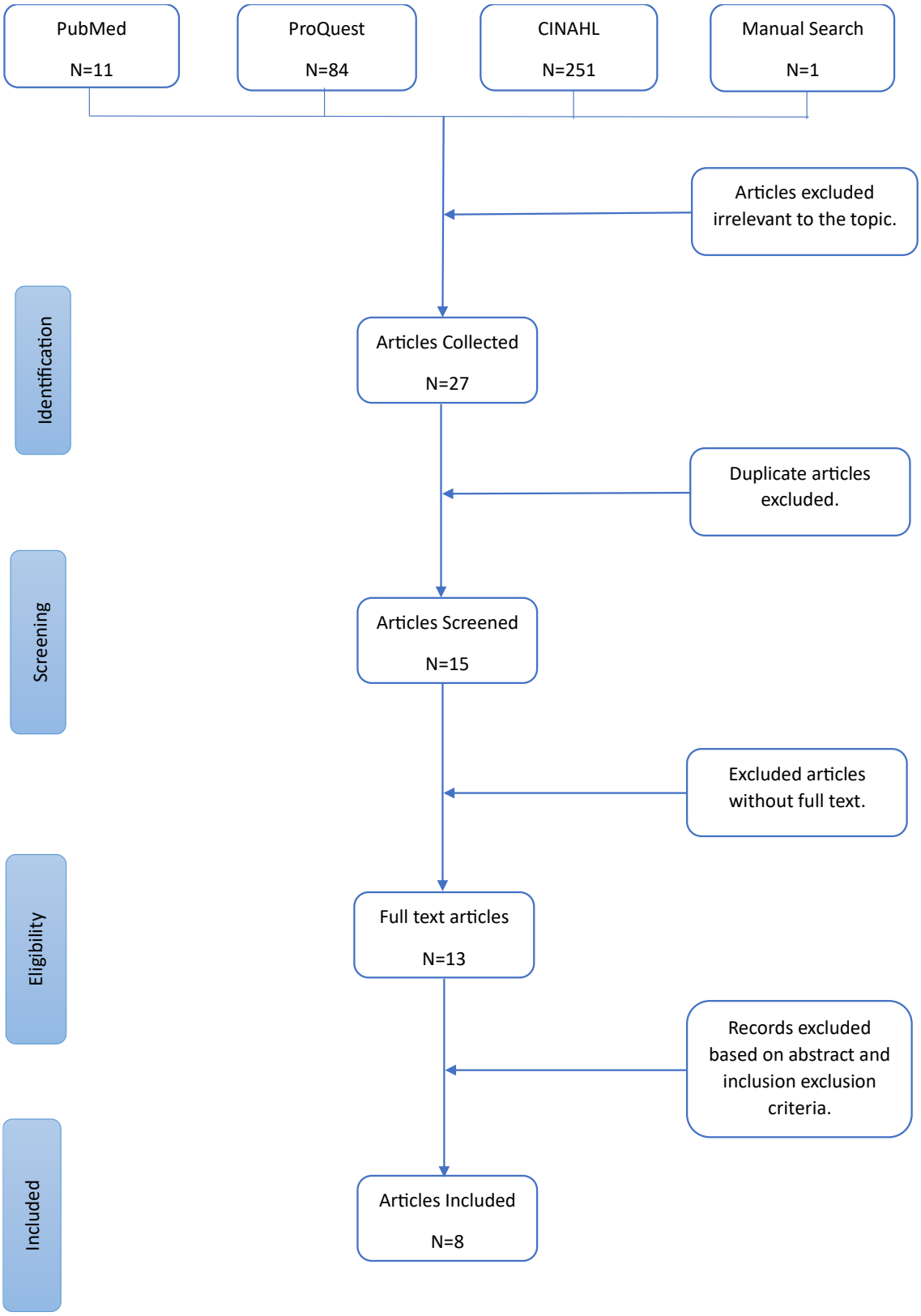

Figure 1.Flow chart

4 Results

347 articles were considered (11 PubMed articles, 84 ProQuest articles, 251 CINAHL articles, 1 from manual search). Based on the headlines and abstract reading, 320 articles were excluded. Twenty-seven articles were screened for any duplications. It was narrowed down to fifteen articles based on full article availability, then 13 available articles were re-examined based on abstracts and inclusion and exclusion criteria. Therefore, 8 articles were chosen to the data extraction stage.

Table 2 display the summary of the results of the chosen publications. This included four randomised controlled trials, three systematic reviews and one single-group pre-post design pilot feasibility study.

Table 2. Results summary.

Authors, Year, and place	Purpose of the study	Method	Participants	Intervention	Result and conclusion
Huang et al. 2017, Taiwan	To identify the effects of kinesio-taping for stroke patients with hemiplegic shoulder pain.	Double-blind, placebo-controlled clinical study	21 stroke patients with 6 months onset.	The study group was divided in to two. Experimental group consist of 11 participants and underwent conventional rehabilitation with therapeutic kinesio taping on the affected shoulder. Rest of which is the control group with 10 members had conventional rehabilitation	Experimental group showed improvements in shoulder pain and disability index and numerical pain compared to the control group. Numerical rating scale and shoulder pain and disability index, two groups did not demonstrate any significant differences among

				treatments with sham kinesio tape on the affected shoulder. Then evaluate various factors such as numerical pain rating scale scores, ultrasound findings, shoulder pain and disability index, and pain free passive range of motion of the affected shoulder, intervention followed for 3-weeks. Pre and post outcome measures were	them in the shoulder. In terms of pain free range of motion, ultrasound findings, numerical rating scale scores, the therapeutic kinesio taping group showed notable improvement in shoulder flexion, external and internal rotation, shoulder pain, disability index comparatively. This suggest kinesio taping is an

				taken. Changes and differences in values were detected by using statistical tests.	alternative treatment option for treating hemiplegic shoulder pain.
Deng, Zhao, Zhang, Xiao and Li 2020, Republic of China	Examination the effectiveness of the kinesio taping for the management of the hemiplegic shoulder pain.	Systematic review and meta-analysis	9 articles. Considered randomised controlled trials in English or Chines in which they used kinesio taping for treating the hemiplegic shoulder pain.	PEDro scale and risk bias tool used separately by two reviewers to evaluate the quality of the articles and risk of bias.	Evidence shows that kinesio taping is benefits to reduce shoulder pain, shoulder subluxation, and improving the activities of daily living. Statistical data proves that kinesio taping is superior to sham kinesio taping or no taping to reduce

					pain in acute, sub-acute or chronic stroke patients.
Kalichman et al. 2016, Israel	To evaluate the short-term effect of kinesio taping for pain and motor function over hemiplegic shoulder.	Single-group pre-post design pilot feasibility study.	11 stroke patients.	In addition to the regular treatment protocol, participants received kinesio taping application. The taping was consisting of one to three strips according to a pre-determined plan, applied over the affected shoulder. Various assessments were conducted such as	The study is showing no significant improvements in the concerned variables. Participants who were lacking active movement in the shoulder did not show any negative induced changes. Two out of four patients showed improvements in visual analogue

				range of motion, visual analogue scale, measuring pain of the shoulder at rest and with movements, active and passive pain free abduction box, and block and Fugl- Meyer upper extremity motor assessment before and after 24 hours.	scale for movement and active abduction range of motion. Six participants with active shoulder movement showed enhancement in active abduction range of motion and four demonstrated improvements in box and block and Fugl- Meyer functional tests. Conversely two patients exhibited reduced functional

					scores. Two patients taping led to increased pain during movements.
Ravichandran et al. 2019, India and Ethiopia	To analyse the efficacy of the hemiplegic shoulder taping for pain and managing the subluxation.	Systematic review of randomised controlled trials.	132 participants were concerned in 8 randomised controlled trials published 2000-2017	Used 4 data bases Google scholar, CINHAL, PEDro and PubMed and articles were searched electronically. The articles were evaluated by the members using Llyod Smith's scale of evidence hierarchy. They used the quality assessment of	All together 132 participants were concerned in 8 randomised controlled trials. Significant effect can be seen in reduction in pain and subluxation of the shoulder joint in hemiplegic patients. This systematic review provides evidence that taping is an

				controlled intervention studies to assess the quality of the randomised controlled trials.	effective method of reducing pain and subluxation in stroke patients.
Yang, Yang , and He 2018, China.	To identify the effect of kinesio taping on hemiplegic shoulder pain, in terms of pain intensity, magnitude of subluxation, muscle activity, and active range of motion.	Randomised control trials.	19 stroke patients with 6 months onset.	All participants received treatment for 5 days consecutively up to a month. electrotherapy, kinesio taping and exercise therapy given as treatments to all. Taping group received kinesio taping with tension	At the baseline there were no significant improvement seen in both experimental and control groups. Kinesio taping group has shown immediate effect after the 1st day of treatment. After 4 weeks of the

				where, control group received kinesio taping without tension on the painful shoulder. Twenty minutes each reserved for electrotherapy and exercise therapy. Taping is kept for 10-12 hours per day.	intervention protocol, the intensity of pain, muscle activity magnitude of subluxation, and active range of motion in shoulder flexion and abduction showed significant improvement. Therefore, authors concluded that kinesio taping can be beneficial in hemiplegic shoulder pain after stroke.

Li, Zheng, He and Zhao 2021, China	To examine the efficacy and safety of kinesio tape in treating hemiplegic shoulder pain.	Systematic review	14 randomised controlled trials with 679 participants.	Treatment group receive therapeutic kinesio taping and other treatment modalities including electrotherapy and exercise therapy. control group receive sham kinesio taping or no taping with exercise therapy and electrotherapy. Kinesio taping applied and left for 15 minutes to 3 days depending on the study. Applied the intervention for	Systematic meta-analysis offered the most recent data supporting the effectiveness of kinesio taping in reducing pain and improving range of motion, and shoulder activities in hemiplegic shoulder patients. The impact of kinesio taping on activities of daily living and quality of life, were not verified in these articles. Therefore, authors conclude

				3 days to 8 weeks. Kinesio tape tension in given 10% to 100% targeting supraspinatus, deltoid, brachii and trapezius muscles.	that more studies with high number of participants are needed in future.
Yu et al. 2016, Taiwan	To evaluate the effects of kinesio taping on upper extremity functional outcomes, pain associated with hemiplegic shoulders, and shoulder soft tissue injury prevention in subacute stroke	Randomised, double-blind controlled trial.	44 stroke patients with 3 months onset.	23 participants received 1 hour each physical and occupational therapy and sham kinesio taping for 5 days a week. Twenty-one participants in experimental group received the same	The statistical data has demonstrated no significant improvement in post intervention 3 weeks. Experimental group and control group result remain same. Authors conclude that

	patients undergoing hemiplegic shoulder rehabilitation.			with therapeutic kinesio taping. Kinesio taping applied for 3 weeks on every other day.	therapeutic kinesio taping could restrict the development of hemiplegic shoulder pain in subacute stroke patients compare to chronic stroke patients.
Pillastrini et al. 2015, Italy	The aim of the study is to examine the changes in pain, the range of motion and spasticity in people with hemiplegic shoulder pain.	Randomised controlled trial	31 stroke patients	Participants divided in to two groups 16 and 15 each. Both experimental group and control group received standard physiotherapy program for 45	Authors revealed that there was no marked improvement in control group where only the experimental group have shown improvement in

				minute for four weeks. Only experimental group received neuromuscular taping.	shoulder range of motion and decrease in pain demonstrated in outcome measures. Therefore, authors conclude that kinesio taping is benefited in hemiplegic shoulder pain.

Huang et al. (2017) completed the study indenting to evaluate the effect of kinesio taping for patients with hemiplegic shoulder pain. The study was a double-blind placebo-controlled clinical study. This study included 30 participants at the beginning and selected 21 patients who had a diagnosis as a unilateral ischemic or haemorrhagic stroke which was confirmed after computerised tomography or magnetic resonance imaging. The selected population was having the onset less than 6 months before the discharge and having shoulder pain in the hemiplegic side. Importantly all the eligible participants were able to communicate well and were free of cognitive dysfunctions. Others were excluded based on having a history of surgical procedure or pain in the hemiplegic shoulder. Similarly, wounds, skin problems, infections in the affected shoulder joint, having experience of using kinesio taping, history of allergies to kinesio tape were considered as reasons for the exclusion. The group was separated into two subgroups using a randomised table of numbers generated by a computer and created by a third party who did not enrol in any of the processes. Eleven people were assigned to the treatment group rest of the participants were in control group. At the beginning and 3 weeks after the treatment, patients were assessed by a physician who did not act as a member of the research team. In the kinesio taping group, tape was applied by a certified physiotherapist who did not get involved in the rehabilitation process or the study. Bicep muscle, deltoid muscle and supraspinatus muscles were taped. It was significant to note that tape application was crossing the shoulder joint and tension was applied. In the control group, the sham kinesio tape was introduced, and it was applied over the skin without any tension. Similarly, it did not cover the joint. The concerned muscles were the same. A total of 6 tape applications were done throughout the duration. Despite the kinesio tape applications, patients underwent a normal rehabilitation process, and therapists were advised not to talk about or be concerned about the tape application. The pain was assessed by using an eleven-point numerical rating scale. In both groups, shoulder pain before and after was evaluated in resting position and while performing the movements. The second outcome measure utilised the Shoulder Pain and Disability Index. Finally, ultrasound imaging of the shoulder joint was performed by an

experienced physiatrist. The physiatrist evaluated the musculo-tendon pathology and sub-acromial distance as the measurements. Pain free passive range of motion of flexion, abduction, extension, adduction, external rotation, and internal rotation were measured using a digital goniometer. Statistical data were analysed using the Statistical Package for the Social Sciences. There was no difference noticed in statistical or demographic data among the two groups. similarly, ultrasound imaging showed no comparison among them in terms of subacromial distance before and after the treatments. According to the numerical pain scale, there was a significant effect depicted in the kinesio taping group. Although the degree of pain free range of motion was not significantly divided among the two groups, an improvement was seen in the kinesio tape group in the movements of flexions, external rotation, and internal rotation. Limited sample size and the limited duration of the follow ups are considered as the limitations of this study. This study concludes that kinesio tape application for 3 weeks on hemiplegic shoulders would reduce shoulder pain and improve the range of motion of flexion, external rotation, and internal rotation. Therefore, kinesio tape could be an alternative treatment for hemiplegic shoulder pain.

Deng et al. (2020) examined the effectiveness of the kinesio taping for treating the hemiplegic shoulder pain. Systematic review and meta-analysis were published in 2020. The selected randomised controlled trials were included patients over 18 years of age. Methodology describes that the researchers compared kinesio taping with sham taping. Physiotherapy treatments were provided to both groups. Another requirement for the inclusion criteria was to include at least motor function of the upper limb, magnitude of the shoulder subluxation, activities of daily living and as outcome measures. Crossover trials, quasi-randomised control trials, review articles, nonrandomised controlled trials, case reports, conference abstracts, trials with incomplete data and low-quality studies were excluded. Studies with patients having shoulder pain due to other neurological causes were excluded as well. In addition, studies which used rigid tape or inelastic tape were considered as inappropriate articles for the study. If a study was carried out in combination with multiple treatment modalities, such

study was also neglected. Two independent readers selected the articles and reviewed them based on title, abstract and the full article. The PEDro scale was utilised and used to assess the quality. Randomised controlled trial deviation risk assessment tool in the Cochrane Handbook was considered to assess the bias risk. Statistical information was analysed using the Review Manager. Out of 270 articles, 9 were used for this study. Kinesio tape application revealed moderate level of evidence to reduce patient's pain when comparing with the other options or sham tapes. Kinesio taping does not significantly improve the motor function of the affected limb but kinesio taping is moderately accountable for reducing shoulder subluxation in the hemiplegic patients. According to the results, the use of kinesio taping in improving activity of daily living are resulted lower. The study stressed that kinesio taping plays a vital role in decreasing shoulder pain in stroke patients. The results suggest that kinesio taping is beneficial in reducing shoulder subluxation, improving motor functions of the upper limb, and improving the activities of daily living.

Kalichman et al. (2016) discussed the effects of kinesio tape application on hemiplegic shoulder pain and motor ability in their study which was carried out as a single-group pre–post design pilot feasibility study. They included patients with the first incident of stroke who then had developed shoulder pain. Positive results in hand- behind- neck test and Neer's test were included into the inclusion criteria. They omitted the patients if they were in any other interventional clinical trials were less than 18 years of age had difficulties in communication or had a history of severe health problems in addition to the stroke. Based on the inclusion and exclusion criteria they recruited 11 post-stroke patients who were hospitalised in the Department of Neurology C, Loewenstein Rehabilitation Hospital, Raanana, Israel. Despite the study, participants were engaged in normal rehabilitation programs. The intervention was applied by a physiotherapist experienced on kinesio taping was done according to the technique described in Jaraczewska and Long (2006) detailed paper on kinesio taping in stroke rehabilitation and Kase et al. (1998) kinesio taping manual. This application was done according to a pre-defined algorithm. The muscles involved in kinesio taping were erector spinae, lower trapezius,

anterior and posterior deltoid and all the applications were done with minimal tension (20%). Visual analogue scale was used for determining the pain at rest and pain with arm movements. In addition, passive pain-free abduction range of motion and active pain-free abduction range of motion were measured. Fugl-Meyer upper extremity motor assessment, box and blocks, and upper extremity motor assessment and shoulder subluxation grade were used as the outcome measures. The outcome measure tools were used before applying the kinesio tape and 24 hours after the application to evaluate the progress. One patient was complaining about worsening symptoms after the kinesio tape application, and it was removed. The results show no significant difference among the variables being evaluated before and after the tape application. Two out of four of the participants did not have the active range of motion depicted improvement in the visual analogue scale and active abduction range of motion. The remaining 6 participants who had active movements in their affected shoulders showed some progress. Five of them had improvements in their active abduction range of motion. Only four of them showed improvements in their functional tests but two of them inversely showed negative results of their functional tests. Two of them were having increased pain during the movements after the kinesio tape application. This study reveals that short term kinesio tape application does not have the effect of reducing the pain in the hemiplegic shoulder pain. It does not impact on improvement of the range of motion in the shoulder or shoulder functions.

The systematic review done by Ravichandran et al. (2019) expressed the effectiveness of taping in hemiplegia. The search was completed by using the databases, CINAHL, Google scholar, PubMed, PEDro. Stroke, hemiplegia, shoulder, taping, strapping, kinesio tape and subluxation were the search words used by the team. The authors reviewed the relevant articles which were published from 2000 to 2017. Three reviewers performed the selection of the articles, and the articles were ranked according to the hierarchical system of Lloyd-Smith. Pain assessment, Shoulder subluxation, Fugl Meyer assessment of the upper extremity, modified Ashworth scale, motor assessment scale and range of motion of the shoulder were considered as the outcome measures

discussed in the articles. As the principal summary measures, shoulder subluxation was taken into consideration as the predictors of the outcome and taping as therapeutic intervention. At the beginning 100 articles were filtered, and later 8 randomised controlled trials were finalised for the use. Among the 8 articles, 5 have reported about the proper randomisation and only 4 articles had clearly concealed the allocation process. Only 2 articles found double blinded and the rest of them were single blinded. Five articles had blinded outcome assessors. All 8 articles were reported to be eligible in terms of completeness. After analysing the results, it was noted that 7 randomised controlled trials provided evidence that taping is effective in stroke patients. It was suggested that taping should be used as a therapeutic intervention for the management of the hemiplegic shoulder, and they suggested that it could be a definite intervention for reducing hemiplegic shoulder pain and subluxation.

Yang et al. (2018) double blind placebo control clinical trial included nineteen participants diagnosed with stroke for the first time. In this study the inclusion criteria included participants above thirty years old diagnosed with stroke in the past six months and with hemiplegic shoulder pain. Participants could perform shoulder flexion and abduction for more than ten degrees but less than ninety degrees. Researchers excluded participants who had cancer, hypertension, heart disease or any skin conditions on the affected side. In addition, participants with tape allergies, shoulder fracture, sprains, subluxation, previous history of stroke and participants who had intra-articular steroid injection in the past four weeks were excluded from the study. Participants were divided into two groups using randomisation. The experimental group and the control group first received electrotherapy followed by kinesio taping and exercise programs. The experimental group received kinesio taping on every other day for four consecutive weeks, whereas the control group received a placebo kinesio taping application on their affected shoulders. The session continued for about 4 weeks, 5 days each week. Electrotherapy was applied for 20 minutes and electrodes were placed over anterior and posterior sides of the shoulder. 5cm width kinesio taping was used in this study. The taping activated the neuromuscular function of the body. The researchers targeted deltoid, teres

minor muscles and supraspinatus. The facilitation technique was applied on the muscle. Researchers used kinesio taping which varied from 15 – 70% tension on different muscles. Researchers observed that there were no significant changes at the beginning of the treatment. During the follow up no side effects were identified. Immediately after the treatment, experimental groups had showed decreased pain intensity compared to the baseline. After 4 weeks, post observation outcome measures revealed that there was significant improvement on pain reduction in the experimental group who had therapeutic kinesio taping on the affected side. Therefore, researchers conclude that kinesio taping was beneficial in reducing pain, subluxation, muscle activity and increasing active range of motion in hemiplegic shoulder pain patients.

Li et al. (2021) systematic review on kinesio taping in hemiplegic shoulder pain reviewed articles on Web of Science, Embase, MEDLINE, Cochrane Library, Science Direct, Wiley, Springer, Karger, PEDro, Scopus and CNKI, VIP. All articles were published before 13th of December 2020. Authors had created a study selection criterion upon four conditions. First condition was that the participants had to be diagnosed with ischemic or haemorrhagic stroke by computerised tomography or magnetic resonance imaging and clinically diagnosed with hemiplegic shoulder pain. In the second condition, the treatment group used therapeutic kinesio taping, while the control group used sham taping or no kinesio taping at all. Numerical pain rating scale, Visual Analog Scale were used as outcome measures for pain. Day to day activities were assessed using Shoulder Pain and Disability Index, Barthel Index and modified Barthel Index, Action Research Arm test, quality of life and adverse events. The systematic review examined only the randomised controlled trials which were in Chinese or English. Articles involving participants with different types of shoulder injuries were not included. Interventions with complex treatment which did not mention any effect on kinesio taping were excluded. The quality assessment was done according to the Physiotherapy Evidence Database scale. The reviewers chose articles based on a score of six or above. This concluded that articles were high quality. Initially 272 articles were included in the study and after considering the abstract and careful screening, only 14

articles were taken into consideration. The duration of the treatment varied from 3 days to 8 weeks, and the tape was left in place for 15 minutes to 3 days. The five-centimetre tape was divided into Y, X, or W shapes or left uncut. The target muscles were the biceps brachii, supraspinatus, deltoid, and trapezius. Kinesio taping tensions ranged from 10% to 100%. The sham kinesio taping was applied without tension. The therapeutic options included electrotherapy, and physical therapy with passive and active assistance and active exercises. 570 participants were included in 11 randomised controlled trials which showed significant results in pain reduction. Results were compared to the therapeutic kinesio taping and sham kinesio taping groups. Begg's and Egger's tests confirmed the funnel plot's visual symmetry and suggested that there was no publication bias. Authors concluded that kinesio taping benefits in relieving hemiplegic shoulder pain.

Huang et al. (2017) double-blind randomised controlled trial included 290 participants initially, but only 49 participants were diagnosed with subacute hemiplegic shoulder pain. During the follow up of the study, only 44 participants completed the study. Forty-four participants were randomly assigned into experimental and control groups. The following criteria had to be met in order to be considered for inclusion: unilateral hemiplegia, no history of stroke within the previous three months, and impaired hemiplegic shoulder function as determined by the Brunnstrom motor stages I, II, III, and IV. The following were considered exclusion criteria: a history of injury or pain in the shoulder within the previous year, systemic neuromuscular diseases, cognitive impairment that would impede study participation and significant heart or lung malfunction or other medical conditions that would impede daily activities or physical examination. All participants received conventional inpatient rehabilitation that included active strengthening exercise along with stretching and balance training. Experimental groups received therapeutic kinesio taping whereas control groups received sham kinesio taping. Application was done for 3 weeks. Taping was applied every three days, with the exception of one day. Therapeutic kinesio taping was applied on deltoid tuberosity, along the medial border of the scapular. Sham kinesio taping was applied on the clavicular angle

along with the inferior angle of the scapular. Other tape was applied along the triceps brachii. Pre – post outcome measures were assessed. Quality of life was assessed with a modified Barthel index. Range of motion was assessed by goniometry. Spasticity was evaluated by a modified Ashworth scale. Shoulder subluxation measured by placing the middle and index finger between acromion process and humeral head. Fugl Meyer assessment was used for the upper extremity functions. After the outcome measures, researchers showed that there were no significant changes found after 3 weeks of the intervention. Only significant changes were found in the experimental group. Shoulder flexion increased compared to the control group. The numerical pain scale remains unchanged in both groups. In conclusion, therapeutic kinesio taping may prevent, the development of the hemiplegic shoulder pain and improve the pain-free shoulder flexion. In subacute stroke patients, standard inpatient rehabilitation using a 3-week therapeutic and sham kinesio taping showed unchanged improvement in upper extremity function, everyday activities, and quality of life without additional shoulder soft tissue damage.

Pillastrini et al. (2015) article included 53 participants after screening. Considering the inclusion criteria, 21 participants were excluded. 32 were included to the meta-analysis. One participant could not follow up. Spasticity was present above or equal to 1 according to the modified Ashworth scale in all participants. Each participant had a diagnosis of hemiplegic shoulder pain. Patients who used muscle relaxation, had a history of shoulder surgery, or had received a botulinum toxin injection into their shoulder within the last six months were also excluded, as were participants whose arms were flaccid had thermoalgesic sensitivity, or who exhibited any form of mental inability. Both experimental and control groups received four standard physiotherapy training programs for 45 minutes which focused on the shoulder girdle and upper limb. Scapulothoracic and glenohumeral joints were mobilised to reduce the restriction along with muscle group stretching. The experimental group received neuromuscular taping technique on affected hemiplegic shoulders. Researchers focused on pectoralis major, deltoid and supraspinatus muscles. The muscles were positioned at a stretched position when applying kinesio tape. The

therapist did not create additional tension to the kinesio tape. To guarantee the best possible neuromuscular taping application, the experimental group's participants received four applications total, spaced about five days apart. The researchers suggested applying the kinesio taping on pectoralis major muscle since it is evident that it is the most affected muscle by spasticity. The protocol was applied for four weeks. Visual analog scale was used to assess the pain intensity. A goniometer is used to assess the range of motion. Data was analysed using statistical package for the social science software. According to the results authors did not find comparable changes in the control group whereas the experimental group showed significant improvement shoulder flexion and abduction and pain reduction compared to the baseline data. There was minimal change in pain at the after-treatment outcome measure and during the follow-up. Four weeks later, the experimental group's minimal detectable change scores on the Visual Analog scale were significantly high, measuring more than 4.5 cm. This change exceeded the 2.0 cm minimal clinically significant difference, and researchers found that pain reduction was clinically significant in relation to this result. The authors noted that although there had been improvements in shoulder flexion and abduction of more than 24.8 degrees and 25.1 degrees, respectively, they were unable to declare that these data indicated a clinically significant improvement because the literature has not specified a specific value for the minimally important difference in shoulder range of motion in stroke subjects. Researchers concluded that neuromuscular taping technique using kinesio tape in treating patients with hemiplegic shoulder pain, improved shoulder function and reduced hemiplegic shoulder pain.

5 Discussion

This bachelor’s thesis evaluated eight articles. This included four randomised controlled trials, three systematic reviews and one single-group pre-post design pilot feasibility study. After evaluating all the articles, comparative results on reducing pain, improving range of motion, muscle activity and activity of daily living were shown. Primarily this bachelor’s thesis analysed the usage of kinesio taping on hemiplegic shoulder pain of stroke patients. The secondarily analysed

components were shoulder range of motion, muscle activity, magnitude of shoulder subluxation, spasticity, and activity of daily living. Seven studies included two groups, where one study was done as a single-group pre-post design pilot feasibility study. Experimental and control group studies included one group with therapeutic kinesio taping and the other with sham kinesio taping or no taping application. This bachelor's thesis is focused on how kinesio taping application benefits neurological patients. An article was published by Grampurohit et al. (2015) on evidence about the use of kinesio taping with neurological disorders. This literature review analysed five standard articles to provide information on how kinesio taping affect neurological conditions. It evaluated the effectiveness of adhesive taping as a supplement to physical rehabilitation in a systematic review. They found preliminary evidence in the area of body structure and function supporting the use of kinesio taping at the shoulder to extend the number of days without pain following a stroke.

Article by Kalichman et al. in (2016) concluded that kinesio taping is not effective for treating hemiplegic shoulder pain. Although different results are described by table 2, almost every study supported the idea that application of kinesio taping reduced hemiplegic shoulder pain. Articles conveyed that the range of motion of the hemiplegic shoulder was improved by using kinesio taping as well (Huang et al. 2017; Yang, Yang, and He 2018; Li, Zheng, He and Zhao 2021; Kalichman et al. 2016; Yu et al. 2016; Pillastrini et al. 2015). The effect on shoulder subluxation was discussed clearly by two randomised controlled trials and they were concluded with two different results (Huang et al. 2017; Yang, Yang, and He 2018). The intervention was conducted within a short period of time. Therefore, these results could be modulated by this fact. Even though this idea was not supported by Ravichandran et al. (2018), effects of pain were also not discussed. It was concluded that hemiplegic shoulder pain was decreased by kinesio taping in the six articles which were included in this bachelor's thesis (Huang et al. 2017; Deng, Zhao, Zhang, Xiao, and Li 2020; Ravichandran et al. 2019; Yang, Yang, and He 2018; Li, Zheng, He and Zhao 2021; Pillastrini et al. 2015). Whereas one article Yu et al. (2016) found that there was no significant improvement in reducing pain among hemiplegic

shoulder pain patients, in both experimental and control groups. However, three weeks after treatments, kinesio taping or sham taping groups demonstrated a notable prevention of future pain development. Additionally, this article concluded that significant improvement in pain free shoulder flexion among the experimental group compared to the control group. Article by Kalichman et al. in (2016) showed no short-term effects of kinesio taping. Time of onset was impacted by the results achieved by each of them. Kinesio taping was much more effective for shoulder pain in chronic hemiplegic patients than acute or sub - acute patients, according to the results published by Leong et al. (2016) in their randomised controlled trial study.

The effectiveness of kinesio taping for hemiplegic shoulder subluxation was discussed by Deng et al. (2020), Ravichandran et al. (2019) and Yang et al. (2018). These three studies showed a positive effect of kinesio taping for shoulder subluxation in patients with hemiplegic shoulder pain. Another study by Huang et al. (2017) showed no effects by kinesio taping in shoulder subluxation. Application of kinesio taping differs depending on the purpose of using it. Pain, injury prevention, performance build up application can be different to one another. Therefore, such applications were strictly maintained to avoid any side effects. (Andryskova and Lee 2020.) Although, the kinesio taping application was different to each other, most of the articles have described the type of application descriptively. All articles followed the basic principles of kinesio taping application. According to Andryskova and Lee (2020) studies, one fundamental guideline for taping is to avoid stretching the origin and insertion of the kinesio taping. It is necessary to apply the tape to the skin within 2-3 centimeters of both the beginning and ending points without stretching it, to prevent skin issues and treatment discontinuation. This principle was followed by all articles.

The majority of studies included in this bachelor thesis utilised kinesio taping which targeted specific muscles. Deltoid muscle was taped in five studies and supraspinatus muscle was taped in four out of five articles. In addition, pectoralis major muscle was taped in the study carried out by Pillastrini et al.

(2015). Teres minor was specially taped in the randomised controlled trial completed by Yang et al. (2018). In the study by Kalichman et al. (2016), additionally erector spinae and lower trapezius muscles were taped. In addition to the deltoid and supraspinatus muscles, bicep muscle was taped and evaluated by Huang et al. (2017). Application of the tape was done with specific tensions.

According to Pillastrini et al. (2015) the researchers used kinesio taping on pectoralis major muscle because this muscle is the most affected muscles by spasticity after stroke, but current evidence does not support this fact. (Huang, Liang, Pong, Leong, and Tseng 2010.) Supportive conclusions were made by six out of eight articles highlighting the positive effect of kinesio taping on improving the range of motion in hemiplegic shoulder. Ultrasound scanning was used to analyse the effect of kinesio taping for the subluxation in hemiplegic shoulder in the study conducted by Huang et al. (2017). Internal rotation, external rotation and flexion are observed to be improved though abduction did not improve. At the same time, shoulder pain and disability index were resulted positively in this study. (Huang et al. 2017.)

Subluxation of the shoulder affects during the flaccid stage of the stroke. Subluxation occurs mostly inferiorly at the glenohumeral joint. This is because of the gravitational pull and failure of passive restraints which helps to stabilise the glenohumeral joint. This could lead to a soft tissue damage. Shoulder subluxation and pain relationship cannot be proved. (Ravichandran at al. 2019.) Study conducted by Deng et al. (2020) the motor function and activities of daily living were improved by applying kinesio taping. Restriction of joint movements, facilitating muscle activation, sensory stimulation and aligning of fascial tissues were also improved by kinesio taping.

According to Kalichman et al. (2016), kinesio taping improved the abduction of the hemiplegic shoulder and also the motor ability of the upper limb. Evidence for the improvement of the motor ability of the muscle activity was provided by the study conducted by Yang et al. (2018). At the same time, improvements in

all the movements in the paralysed shoulder were elaborated generally. Regaining good range of motion in shoulder flexion of the hemiplegic shoulder was discussed by Leong et al. (2016) in their systematic review and positive results for the improvements in quality of life, activities of daily living and shoulder functions were highlighted. Range of motion was measured by two therapists to avoid false results. This was only used by the study of Pillastrini et al. (2015).

This bachelor's thesis evaluated eight articles which were relevant to the topic. This is an open topic for future bachelor's thesis to find a more accurate method for kinesio taping applications to manage hemiplegic shoulder pain. Another suggestion for a bachelor's thesis topic is to compare kinesio taping as a standalone intervention with other forms of treatment modalities. Most of the articles added a positive impact on kinesio taping which is used in physiotherapy and occupational therapy fields.

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