Effectiveness of Physiotherapy Exercise on Shoulder's Range of Motion, Strength, Power, and Pain Level among Ischemic Stroke Patients with Hemiplegic Shoulder Pain: A Review

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2020

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by

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Thesis submitted in full fulfilment of the requirements

for the degree of

Masters of Sports Science

SEPTEMBER 2020

ACKNOWLEDGMENT

Firstly, I would like to express my sincere gratitude to Allah, the one and only Almighty God who makes this easy for me. It is my pleasure to acknowledge my supervisor, Dr. Rosniwati Ghafar for the inspiration and knowledge impacted. Her relentless support was instrumental in keeping me focused and beyond what may be expected of a supervisor. My sincere appreciation also goes to my co-supervisors, Dr. Ayu Suzailiana Muhamad, AP. Dr. Ooi Foong Kiew, and Dr. Muhammad Hafiz Hanafi for their unending effort and direction towards achieving a successful dissertation. I am extremely humbled and thankful for their efforts and time. Their wisdom and skills availing to students are exemplary. Thank you.

To my noble family and well-wishers, I would also like to say thanks to you all. I wouldn't have made it without your support via Allah's permission. Thank you all.

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LIST OF ABBREVIATIONS

ASSP	After Stroke Shoulder Pain
BMI	Body Mass Index
CIMT	Constraint-Induced Movement Therapy
HSP	Hemiplegic Shoulder Pain
MT	Mirror Therapy
QOL	Quality of Life
ROM	Range of Motion
UE	Upper Extremities

Keberkesanan Senaman Fisioterapi Terhadap Julat Pergerakan, Kekuatan, Kuasa, Dan Tahap Kesakitan Bahu Dalam Kalangan Pesakit Strok Iskemia Yang Mengalami Kesakitan Bahu Hemiplegik : Satu Ulasan

ABSTRAK

Pengenalan: Strok adalah satu penyakit neurologi yang serius yang mana kebiasannya diirigingi oleh kesakitan bahu hemiplegik. Setakat ini, kajian ke atas keberkesanan senaman fisioterapi terhadap julat pergerakan, kekuatan, kuasa, dan tahap kesakitan bahu dalam kalangan pesakit strok iskemia yang mengalamani bahu hemiplegik adalah terhad. **Objektif:** Membandingkan julat pergerakan, kekuatan, kuasa, dan tahap kesakitan bahu di kalangan pesakit strok iskemia yang mengalami kesakitan bahu hemiplegik sebelum dan selepas megikuti program senaman fisioterapi berdasarkan kajian-kajian terdahulu dari tahun 1990 sehingga 2018. **Kaedah:** Kata kunci seperti strok, kajian terhadap strok, pesakit strok, senaman fisioterapi kepada pesakit strok dan kesakitan bahu hemiplegik digunakan untuk mencari artikel yang berkaitan di atas beberapa platform pencarian. **Hasil Kajian:** 338 artikel telah dijumpai, hanya 24 artikel yang diambilkira untuk diulas. Bedasarkan kajian literatur, adalah dijangkakan, mengikuti program senaman, julat pergerakan, kekuatan dan kuasa kepada kedua-dua bahu akan mengalami peningkatan. Selain itu, tahap kesakitan bahu pula akan menurun. **Kesimpulan:** Kebanyakan preskripsi program senaman dalam kajian literatur mendapati bahawa senaman fisioterapi dapat memperbaiki julat pergerakan, kekuatan, kuasa dan tahap kesakitan bagi pesakit strok yang mengalami kesakitan bahu hemiplegik.

Effectiveness of Physiotherapy Exercise on Shoulder's Range of Motion, Strength, Power, and Pain level among Ischemic Stroke Patients with Hemiplegic Shoulder Pain : A Review

ABSTRACT

Introduction: Stroke is a severe form of neurological diseases which normally accompanied by hemiplegic shoulder pain. To date, studies on the effectiveness of physiotherapy exercise on shoulder's range of motion (ROM), strength, power, and pain level among ischemic stroke patients with hemiplegic shoulder is limited. **Objectives:** To compare shoulder’s ROM, strenght, power and pain among ischemic stroke patients with hemiplegic shoulder pain before and after following 8 weeks of physiotherapy exercise programme based on a review on previous studies from the year of 1990 to 2018. **Methods:** Keywords such as stroke, stroke research, stroke exercise, physiotherapist exercise for stroke and hemiplegic shoulder pain were used to find a related articles over several search platforms. **Results:** 338 articels were found, only 24 articles were included in the review. Based on a review, it was expected that, following exercise programme, ROM, strength, and power of both shoulders will increase. In addition, shoulders’ pain level will decrease. **Conclusion:** Most of the exercise programme prescribed in this review found that physiotherapy exercise improve shoulders’ range of motion, strength, power and pain level in stroke patients with hemiplegic shoulder pain.

CHAPTER 1

INTRODUCTION

1.1 Background of Review

Ischemic stroke is characterised by the sudden loss of blood circulation to an area of the brain, resulting in a corresponding loss of neurologic function (Maas & Safdieh, 2009). Acute ischemic stroke is caused by thrombotic or embolic occlusion of a cerebral artery and is more common than haemorrhagic stroke. In the past years, a large number of people suffering from strokes have had complications of shoulder pain (Ischemic Stroke, 2019). Up to 70% of patients complained about shoulder pain and it often appears in the first few days. It is a marker of stroke severity, and 75% of patients complain of pain at some time in the first 12 months following a stroke.

The mechanisms for the development of pain are sometimes unclear but, since the attachment of the upper limb to the trunk is muscular rather than directly skeletal, any disruption of muscular action is likely to give biomechanical problems around the shoulder, which can lead to pain (Ward, 2007) Development of a painful shoulder in the stroke patient is a significant and serious problem, because it can limit the patient's ability to reach his or her maximum functional potential. Hemiplegic shoulder pain is associated with a reduced pinch grip and shoulder shrug strength, with abnormal muscle tone, but most importantly, with sensory inattention and sensory loss. Patients with this problem lose movements around the shoulder and, in the context of hypertonia, a typical posture of adduction and internal rotation of the arm is seen.

Several aetiologies of shoulder pain have been identified, such as immobilisation of the upper extremity, trauma to the joint structures, including brachial plexus injuries, and subluxation of the gleno-humeral joint (Andersen, 1985). Knowledge regarding the basic anatomy and kinesiology of the shoulder complex, the various aetiologies of hemiplegic shoulder pain, and the pros and cons of specific treatment techniques is essential for the occupational therapist to evaluate effectively techniques used to treat the patient with hemiplegic shoulder pain. More effective management of this problem will facilitate the patient's ability to reach his or her maximum functional potential.

1.2 Problem Statement

Shoulder pain hinders rehabilitation, is an important contributor to length of hospital stay, and has been associated with depression and decreased quality of life (Pillastrini et al., 2016). Hemiplegic shoulder pain has several aetiologies. Since the cause of the pain is unclear and varies in aetiology, these lead to different approach in treating hemiplegic shoulder pain during rehabilitation. Thus, evaluation of the method used in the rehabilitation process is important for the patients' progress in the recovery process. It can be used to motivate the patients to achieve the same progress as others. However, to date, research on effectiveness of physiotherapy exercise on shoulder's range of motion (ROM), strength and power, and pain among ischemic stroke patients with hemiplegic shoulder pain is scarce.

1.3 Significance of the Study

Through this review, it is hoped that we can understand more about the recovery capability of the shoulders' ROM, strength, power, and pain level following physiotherapy exercise. This finding is important and significant to physiotherapists and doctors to improve the treatment and health care of patients.

1.4 Review questions

1. Is physiotherapy exercise able to improve the shoulder's ROM among ischemic stroke patients with hemiplegic shoulder pain?

2. Is physiotherapy exercise able to improve shoulder's strength and power among ischemic stroke patients with hemiplegic shoulder pain?

3. Is physiotherapy exercise able to improve the shoulder's pain level among ischemic stroke patients with hemiplegic shoulder pain?

1.5 Study Objectives

General objective

To review the effectiveness of physiotherapy exercise on shoulder's ROM, strength and power, and pain level among ischemic stroke patients with hemiplegic shoulder pain.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Stroke is a severe form of neurological disease which is known to be the leading cause of death due to physical damage or incapacity (Mukherjee & Patil, 2011). Nearly 40% of patients with stroke experience functional damage, with 15% to 39% severely disabled (Duncan et al., 2002). Although many stroke patients survive with appropriate emergency care and early treatment following a stroke, they frequently suffer from motor, sensory or cognitive disorders (Choi, Nam, Lee, & Park, 2013). Many of the stroke patients suffered from upper limb motor injury and decreased facility to do necessary activities (Kwakkel, Kollen, van der Grond, & Prevo, 2003; Lawrence et al., 2001). Stroke is linked to shoulder impairments which may cause decontrol in hand leading to difficult coordination in the upper limb (Beebe & Lang, 2008; Mercierand & Bourbonnais, 2004).

Even though a lot of stroke patients survive with the right emergency care and quick treatment after stroke, they often suffer from movement, sensory or mental syndromes (Pillastrini et al., 2016). The painful hemiplegic shoulder is a commonly described shoulder pain after stroke, and specific aetiology of basic pathophysiology is usually unclear (Pillastrini et al., 2016).

After stroke shoulder pain (ASSP) can be well-defined as the musculoskeletal pain in the enfeebled shoulder of hemiplegic persons due to stroke, the medical features of post-stroke shoulder pain vary from slight discomfort to disabling aches, frequently acting as a precursor feature for minor anatomical deformities. This pain is sometimes termed as weakened, continuous or triggered by passive or active mobilisation and is linked with a reduced range of motion and improved disability in events of regular living or care. This can lead to immobility and progressively worsening function. Thus, ASSP interferes with adequate participation in rehabilitation programs (J. A. Lee et al., 2012; Murie-Fernández et al., 2012). On the other hand, it is linked with poorer prognoses and a lot of hospital admission (Allen, Shanahan, & Crotty, 2010). Many reported prevalence of ASSP differs in the literature between 16% and 84% with significant symptomatology in nearly 70% of cases (J. A. Lee et al., 2012). ASSP typically improves in patients with slight or no voluntary movement of the affected upper limb as well as in poorly located ones (Pedreira, Cardoso, & Melo, 2008).

ASSP has been considered an additional risk determinant for the onset of depressed disorders, interfering even more in the individual’s functioning (Dogan et al., 2013). The aetiology of ASSP is still debatable and multifactorial (Liporaci, Mourani, & Riberto, 2019). But some features have been described as causes, such as rotator cuff lesions, glenohumeral dislocation, hand shoulder syndrome, myofascial pain syndrome, spasticity and contractures, and adhesive capsulitis. It also plays a role in the progress of unusual patterns of decreased motor function or spasticity or severe focal atrophy. Usually, the condition develops 2-3 months after the stroke but in some cases it can develop as early as 2 weeks (de Oliveira, de Andrade, Machado, & Teixeira, 2012). Adequate managing of ASSP permits the patient to fully participate in the rehabilitation program in addition to promoting better functional outcomes (Murie-Fernández et al., 2012).

The ideal treatment should start with acceptable prevention instantly post-stroke because once the patient is present with pain, secondary anxiety and overprotection, it can hinder an effective approach (Walsh, 2001). The proper management of ASSP is problematic, and the clinical picture, in addition to the responses following rehabilitation used, is diverse, creating a context in which multidisciplinary approaches tend to present a better result. There is little evidence to date about the obtainable treatments for this condition associated with the presence of trigger points. Trigger points are regions of the body's surface over the muscles that are painful to palpation and reproduce the patients' complaints, and when properly treated, lead to the progress of symptoms.

2.2 Demographic of Stroke and Shoulder Hemiplegia

2.2.1 Global prevalence of stroke

Universally, the prevalence of shoulder pain ranges from 11% to 40% and it was established as an important factor in delaying rehabilitation and increasing the cost of management as well as hospital burden in stroke patients (Khealani & Wasay, 2008). Stroke is a very common disease, particularly in developed countries. The rates of incidence varied between 200 and 600 cases /100,000 citizens/year, depending on the epidemiological studies in different geographical areas (Bejot et al., 2007). This implies that the disease is the second, or even the most common cause of death in most of these countries.

Therefore, with the increase in life expectancy and an aging population, a progressive increase in hospitalisation will occur as a result of stroke (Sayago-Silva, García-López, & Segovia-Cubero, 2013). In addition, throughtout the world, the rates of incidence vary between 200 and 600 cases/100,000 citizens/year, depending on the epidemiological studies in different geographical areas (de Leciñana-Cases, Gil-Núñez, & Díez-Tejedor, 2009; Neyer et al., 2007). In Spain, stroke is the most common cause of death in females and the most or second most common cause of death in males, depending on the different autonomous communities. The mortality rates from stroke in the year 2006 in Spain were 74,657/100,000 (63,675 in men and 85,248 in women) compared to 84,169/100,000 from acute myocardial infarct and other ischemic heart diseases (97,615 in males and 71,096 in females) (Sayago-Silva et al., 2013). In addition, it is the highest cause of incapacity in the adult (up to 53% of patients are left with a grade of dependence) and the second highest cause of dementia (between 30% and 50% of patients have cognitive deterioration after stroke) (Gresham et al., 1998).

This implies a significant consumption of resources during the acute phase (approximately 4% of the health care budget) as well as in the secondary prevention measures or rehabilitation. This does not contain the long-term indirect costs derived from the needed measures to provide care for these dependent patients where, cessation of productive labour not only for the patient but also for the family members who are providing care (Flynn, MacWalter, & Doney, 2008). Stroke is the main cause of disability in most advanced countries (Murie-Fernández et al., 2012), and hemiplegic shoulder pain is a common and distressing consequence of stroke. Nevertheless, it lacks a precise definition, beyond the complaint of pain in the hemiplegic shoulder. The shoulder pain characteristically develops between 2 weeks to several months resulting stroke (Drummond & Wade, 2014).

According to the CDC, approximately 800,000 new strokes occur each year in the United States. This number has remained relatively stable over the last 20 years. However, with advancements in health care, mortality rates have started to reduce. There were 133,000 deaths due to stroke in 2008, Closely 20,000 less than in 1998. Regardless, stroke remains the fourth leading cause of death in the United States (Kochanek, Xu, Murphy, Miniño, & Kung, 2011) . However In Australia, shoulder pain presentations are the third most common musculoskeletal reason for presenting to general practice (O'Doherty, Masters, Mitchell, & Yelland, 2007). More than 660,000 Americans survive stroke each year, and it has been noted that approximately half of survivors over the age of 65 will be left with moderate to severe disability (P. Wolf, 1998). One factor that has not only been shown to decrease functional recovery and quality of life (Chae et al., 2007), but also lead to severe disability in many people with stroke is hemiplegic shoulder pain (HSP). Historically, prevalence has varied drastically between studies (from 5% to 84 %). Postulated reasons include disparities in defining shoulder pain and differences in recruitment criteria (Kalichman & Ratmansky, 2011).

Recent population-based studies from New Zealand and Sweden found similar prevalence of 22–23%. The largest study to date of 1,000 patients in a Turkish rehabilitation hospital found a 55% prevalence (Benlidayi & Basaran, 2014). In Spain, the data showed that the incidence of stroke, ranged between 140 and 169 cases/100,000/year in women between 170 and 364 cases/100,000/year in men (Camargo, Bacheschi, & Massaro, 2005). The prevalence increases with age, for instance women > 65 years of age the incidence is 510/100,000/year and in men it is 704/100,000/year (Díaz Guzman, Egido, Abilleira, Barberá, & Gabriel, 2007). These rates increase up to 1,493 and 2,371 in females and males respectively, above 70 years of age. The prevalence of stroke in Spain, among people > 65 years of age is nearly 6% in women and 7% in men. Given the progressively aging Spanish population, it was predicted that, at the current rhythm, there will be 742,500 individuals affected by stroke by the year 2030 and, by the year 2050, the level will reach 1,129,000; a highly significant number, especially when taking into account that half of them will have a certain grade of residual incapacity.

Researchers have shown that HSP reduces participation in the rehabilitation process, leads to poorer recovery of arm function, lowers rates of discharge home and leads to increased length of hospital stay (Maxwell & Nguyen, 2013). HSP is both a prevalent and important problem that remains frustrating to treat for physicians. Due to the diverse range of possible aetiologies, the exact cause of HSP is often obscure, making efficacious treatment similarly as elusive.

2.2.2 Risk factors for hemiplegic shoulder pain in stroke patients

There are many factors that can cause painful hemiplegic shoulder (PHS) to occur. These factors can be characterised as those having to do with the shoulder joint itself or rotator cuff injury (Kijima et al., 2015), or subluxation of the humeral head (De Leciñana et al., 2014), and those related to a neurological disorder, lack of sensation, initial flaccid paralysis, hemi-spatial neglect and spasticity (Benlidayi & Basaran, 2014; Rundquist, Dumit, Hartley, Schultz, & Finley, 2012). Rotator cuff tendinopathy is the most common cause of shoulder pain, with subacromial impingement symptoms which is a common diagnosis for patients who present with a painful shoulder (Virta, 2013).

Due to the wide array of pathologies potentially underlying the development of HSP, the specific aetiology is difficult to assess. It is impossible to treat HSP successfully without first understanding the mechanism of injury or disease. Kalichman and Ratmansky (2011) created a comprehensive narrative review on the aetiology and associated factors of HSP, categorising three precise types of possible pathologic processes: (1) soft-tissue lesions, (2) impaired motor control (specifically muscle tone changes), and (3) altered peripheral and central nervous system activity.

Soft tissue injuries are some of the most common aetiologies of HSP. Included in this classification are rotator cuff tendinopathies and tears, biceps tendinopathy, subacromial and sub deltoid bursitis, adhesive capsulitis and myofascial pain of the shoulder region (Kalichman & Ratmansky, 2011). Several studies over the past two decades have demonstrated a high incidence of impingement syndrome and other rotator cuff pathologies in hemiplegic patients. One study reported that 61 % of patients suffering from HSP in an acute rehabilitation setting had impingement symptoms, while 33% had evidence of a rotator cuff tear (Barlak, Unsal, Kaya, Sahin-Onat, & Ozel, 2009).

In additional, Shah et al. (2008) used MRI to show that 35% of chronic stroke survivors with HSP had a tear of the biceps, rotator cuff or deltoid tendons, while 53% exhibited tendinopathy. Another similar study proposed that such injuries may be due in part to trauma sustained during post-stroke rehabilitation. Najenson, Yacubovich, and Pikielni (1971), noted that rotator cuff tears or tendinopathies could be linked to passive abduction greater than 90^0 or forced abduction without lateral rotation, specifically referring to the use of overhead pulleys. Adhesive capsulitis has been found in as many as 43–77 % of stroke survivors (Kalichman & Ratmansky, 2011) . It should be noted that adhesive capsulitis can be both the cause and effect of HSP. A study by McKenna (2001) reported that HSP may trigger the development of adhesive capsulitis due to immobilisation of the affected limb, disuse atrophy or contracture, but, Snels et al. (2002) observed that adhesive capsulitis during the acute stage is often quite painful (Snels et al., 2002). A detailed history and physical analysis coupled with appropriate imaging help differentiate between these soft tissue injuries. Impaired motor control, more precisely spasticity or flaccidity of the shoulder girdle muscles, has been shown to contribute to HSP.

Flaccidity may lead to shoulder joint instability and subluxation, which in turn can cause significant soft tissue and nerve dysfunction including peripheral nerve compression, adhesive changes in associated tendons, and traction injuries to the brachial plexus (Maxwell & Nguyen, 2013). Nevertheless, it seems intuitive that these pathologic changes would cause pain, the precise relationship between shoulder subluxation and HSP remains unclear. Increased tone of the muscles responsible for scapular movement that may also result in abnormal scapulohumeral rhythm and lead to impingement of the rotator cuff or other structures in the subacromial space (O'Sullivan, Schmitz, & Fulk, 2019). Additional researches support this finding empirically. One found that patients experienced pain reduction and improvement in range of motion after phenol motor point blocks were performed on the subscapularis muscle, while another found reductions in reported pain scores with surgical release of muscular contractures in the shoulder girdle (Maxwell & Nguyen, 2013).

Altered peripheral and central nervous activity may also contribute to HSP. However, this connotation remains ambiguous. Researchers have suggested that peripheral nerve entrapment, central sensitisation and central post stroke pain all play a role in HSP, though studies remain incongruent and inconclusive (Maxwell & Nguyen, 2013).

2.2.3 Recommended Exercise for Hemiplegic Shoulder Pain

After a stroke patient is categorised in stable condition, exercise will be prescribed by the physicians, which is usually 6 months after the stroke attack. The exercise in the rehabilitation center usually comprises of the following exercises:

- **Isometric shoulder external rotation:** Stand in a doorway with your elbow bent 90 degrees and the back of the wrist on your injured side pressed against the door frame. Try to press your hand outward into the door frame. Hold for 5 seconds. Do 2 sets of 15.
- **Isometric shoulder internal rotation:** Stand in a doorway with your elbow bent 90 degrees and the front of the wrist on your injured side pressed against the door frame. Try to press your palm into the door frame. Hold for 5 seconds. Do 2 sets of 15.
- **Isometric shoulder adduction:** With a pillow between your chest and your arms, squeeze the pillow with your arms and hold 5 seconds. Do 2 sets of 15.
- **Isometric shoulder flexion:** Stand facing a wall with the elbow on your injured side bent 90 degrees and held close to your body. Press your fist forward against the wall. Hold this for 5 seconds, then rest. Do 2 sets of 15.

- **Isometric shoulder extension:** Stand facing away from the wall with the elbow on your injured side touching the wall. Press the back of your elbow into the wall and hold for 5 seconds. Rest. Do 2 sets of 15.
- **Isometric shoulder abduction:** Stand with your injured side next to the wall and your elbow bent 90 degrees. Press the side of your arm into the wall as if you were trying to lift it. Hold for 5 seconds. Rest. Do 2 sets of 15.
- **Shoulder flexion:** Stand with your arms hanging down at your sides. Keep your arms straight and lift them in front of you and up over your head as far as you can reach. Hold this position for 5 seconds and then bring your arms back down in front of you and to your sides. Do 2 sets of 15.
- **Shoulder extension:** Stand with your arms at your sides. Move the arm on your injured side back, keeping the arm straight. Hold this position for 5 seconds. Return to the starting position and repeat 10 times.
- **Shoulder abduction:** Stand with your arms at your sides. Bring your arms up, out to the side, and toward the ceiling. Hold for 5 seconds. Return to the starting position. Repeat 10 times.
- **Active elbow flexion and extension:** Gently bring the palm of the hand on your injured side up toward your shoulder, bending your elbow as much as you can. Then straighten your elbow as far as you can. Repeat 15 times. Do 2 sets of 15.

As these exercises become easier, weight will be added to hand to give some resistance.

- **Resisted shoulder internal rotation:** Stand sideways next to a door with your injured arm closest to the door. Tie a knot in the end of the tubing and shut the knot in the door at waist level. Hold the other end of the tubing with the hand of your injured arm. Bend the elbow of your injured arm 90 degrees. Keeping your elbow in at your side, rotate your forearm across your body and then slowly back to the starting position. Make sure you keep your forearm parallel to the floor. Do 2 sets of 8 to 12.
- **Resisted shoulder external rotation:** Stand sideways next to a door with your injured arm farther from the door. Tie a knot in the end of the tubing and shut the knot in the door at waist level. Hold the other end of the tubing with the hand of your injured arm. Rest the hand of your injured arm across your stomach. Keeping your elbow in at your side, rotate your arm outward and away from your waist. Slowly return your arm to the starting position. Make sure you keep your elbow bent 90 degrees and your forearm parallel to the floor. Repeat 10 times. Build up to 2 sets of 15.

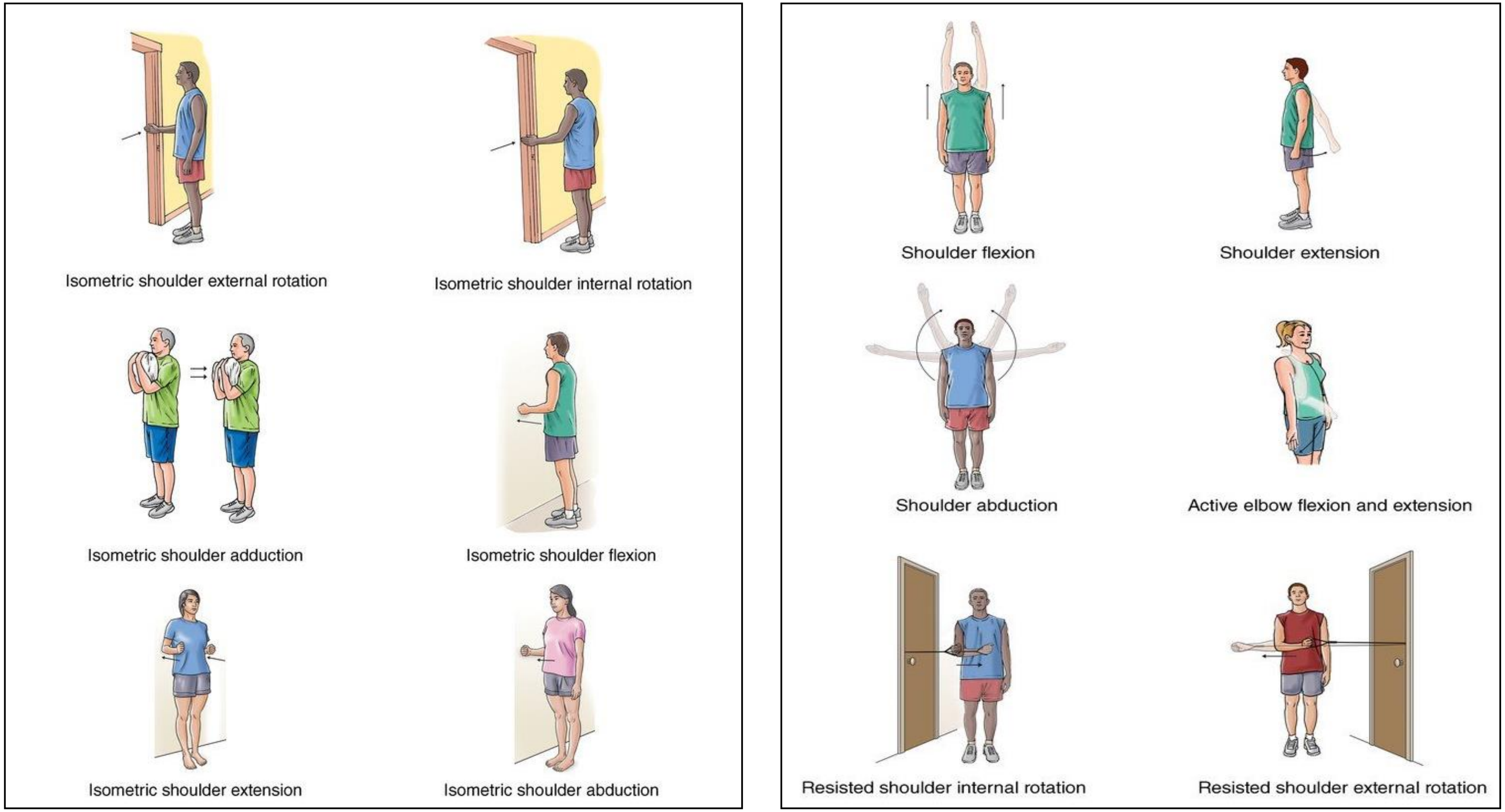

Figure 2.1: Physiotherapy exercise

CHAPTER 3

METHODS

3.1 Introduction

After the exercise is prescribed to the patient, the evaluation of the exercise usually will be carried out to measure the range of motion, strength and power of the effected side and pain level of the patients. This is carried out in different ways and reported in various ways in the previous studies. Several equipment were suggested for measuring the effectiveness of the exercise such as Dr. Ganiometer, isokinetic dynamomoter and pain scale for the research in the rehabilitation center.

3.2 Review Methods

Several keywords were used to collect the article from the year 1990 to 2018. The keywords including stroke patients, exercise for stroke patients, research on the stroke patients and hemiplegic shoulder pain. These keywords were used to find the articles over google platform, google scholars and library database. All related articles were skimmed through the abstract to view the content of the article. The articles that were within the scope of the review were selected.

CHAPTER 4

STUDY RESULTS

4.1 Introduction

This chapter presents the results of the review based on the keywords used over the search platforms.

4.2 Results

338 articles were found. Only the articles published from the year of 1990 to 2018 were selected for the review. After reading the abstract, only 24 articles were suitable for the review. The 24 articles were listed in the Table 4.1, main findings are summarised in the last column.

Table 4.1: Previous studies on the effects of various types of exercise in stroke patients with HSP from Year 1990-2018

No	Author/ year	Title	study population	N	Methods	Main Findings	Summary of Findings
1	(Partridge, Edwards, Mee, & Van Langenberghe, 1990)	Hemiplegic shoulder pain: a study of two methods physiotherapy Treatment for hemiplegic shoulder pain in stroke patient	Stroke patients	65	Patients were assessed before and after a four-week period of physiotherapy treatment by either cryotherapy or the Bobath approach.	Pain severity at rest and on movement were significantly reduced after four weeks physiotherapy $p < .05$ (Wilcoxon) Pain, before and after: 26% against 19% for severity of pain on movement, and 79% against 67% at rest ROM before and after bobath approach for passive movement was .60(.24) vs .64(.22) while active movement was .28(.38) vs .30(.37) respectively ROM before and after cryotherapy approach for passive movement was	There was significant improvement in shoulder pain and ROM after the therapy. Physiotherapy have a role to play in the treatment of hemiplegic shoulder pain but the impact of the different physiotherapy method requires further studies

						.57(.29) vs .57(.28) while active movement was .18(.28) vs .26(.33) respectively The proportion of patients who reported improved pain after the 4-weeks' physiotherapy treatment was greater.	
2	(Ada, Dean, Morris, Simpson, & Katrak, 2010)	Supportive devices for preventing and treating subluxation of the shoulder in stroke	Stroke patients	126	Four trials of a randomised, a quasi-randomised or randomised controlled trials, where physiotherapy intervention was supportive devices for which subluxation, pain, function and contracture were measured. Both groups underwent 2 sessions lasting 30 min daily, 5 days a week for 4 weeks Two independent reviewers examined the identified studies which were assessed for methodological quality and	No significant differences between groups at baseline in the (1) supportive devices versus no supportive devices or (2) two supportive devices. Three trials showed that strapping effectively delay the onset of pain (weighted mean difference(WMD) by 14days, 95% C.I 9.7 to 17.8), but not effective enough in reducing pain severity in the shoulder joint function (WMD 0.8,95% CI- 1.5 to 3.1), as well as on the degree of contracture (WMD-1.4 degrees,	Shoulder strapping application was found to be effective in delaying the onset of pain by 14 days in 3 trials However, one result from another high quality trial showed no difference in pain between strapping and no strapping after six weeks of intervention

					analysed as (1) supportive devices versus no supportive devices or (2) two supportive devices.	95% CI-10.9 to 8.1) at the shoulder	
3	De Jong et al., 2006	Repeated Measurements of Arm Joint Passive Range of Motion After Stroke: Interobserver Reliability and Sources of Variation	Stroke patients with severe upper limb paresis	19	Experimental group n = 9,Control group n = 10 Patients were randomly selected to undergo routine rehabilitation or rehabilitation plus a prescribed positioning procedure (during 5 weeks, twice daily during 0.5 h) with the arm positioned at maximum shoulder abduction and shoulder external rotation, with the elbow extended and forearm supine. Factors evaluated were as follows: passive range of motion, and at 5 and 10 weeks of treatment	There were no significant differences between the groups on any of the outcomes At 5 weeks, doctors observed a loss of passive range of motion in both groups, although the losses were less pronounced in the experimental group for 3 out of 5 measurements: -Shoulder external rotation (−19 vs. −18; P = .37) -Shoulder flexion (−23 vs −29; P = .29) -Shoulder abduction (−5.3 vs. −23; P = .042) -Elbow extension (0.6 vs −4; P = .84) -Forearm supination (−11 vs. −3; P = .69)	There were no significant differences between the groups on any of the other outcomes though the experimental group had slightly better outcome after the physio-therapy intervention, better pain quality and improved subluxation outcome than the control groups
4	(Park, Chang, Kim, & An,	The effects of Mirror Therapy (MT) with	Stroke patients	30	2 groups: Experimental group (EG): Controlled group (CG)	Post-treatment: No significant differences between	There was improvement in the UE pain and

	2015)	tasks on Upper Extremity (UE) function and self-care in stroke patients			(1:1). The MT composed of 8 tasks administered 5days/week for 6 weeks for the EG while the control CG performed the same 8 tasks but with the non-reflecting side of the mirror. (functional tasks) 1. Reach to press switch. 2. Reach to grasp cone. 3. Grasp a small bean bag. 4. Grasp a cup. 5. Lift a plastic bottle. 6.Lift a cup 7. Put coins in the hole of money box. 8. Pick up and place stones on palm.	groups at baseline in the Manual Function Test (MFT) and Functional Independence Measure (FIM) self-care scores ($p<0.05$). Both groups showed a significant improvement post-intervention. Comparison of the changes in the MFT and FIM self-care scores from baseline to 6 weeks between groups showed significant improvement in the MT group ($p<0.05$). Functional outcome measured by MFT for the paralysed upper limb and FIM for self-care performance indicated more functional motor improvement among the EG than the CG Before and after therapy: MFT for EG before was 25.6 ± 12.4 and after was 49 ± 16.9 while MFT for CG before was 26 ± 10.9 and after	function in the experimental group in scores than in the control after the 6weeks physiotherapy application

						was 37±11.4 FIM for EG before was 17.1±5.9 and after was 24±5.7 while MFT for CG before was 17.3±6.4 and after was 20.0±5.0	
5	(Penina Langhu, 2018)	Effectiveness of Mirror Therapy containing functional tasks on UE motor functions among patients with stroke	Stroke patients	60	2 groups: Experimental group EG: Controlled group CG (1:1) MT contains functional tasks administered for 30 minutes/day and 7 times/week for two weeks for the EG while the CG received routine care. Patients were taught how to do the tasks on the first day. Simple tasks like flexion, extension, counting fingers were given for 3 days and followed by the complex tasks like picking up a coin, drawing a shape were given for 3 days.	Post-treatment outcomes showed a statistically significant results (P<0.001) showing that the MT comparing to the CG was found effective in improving the motor function, sensation, passive joint motion and joint pain of the UE among patients with stroke who are hemiplegic and has hemiparesis without any side effects	Mirror physiotherapy was associated with improved pain control and immediate motor functional outcome, assessed with the Fugl Meyer assessment (FMA), in patients with stroke.
6	(Seok, Kim, Jang, Lee, &	Effect of MT on Recovery of Upper	Stroke patients	40	2 groups: Experimental group EG : Controlled group CG (1:1)	Post-treatment results indicated that the MT group had significant	Mirror physiotherapy used as a treatment technique

	Kim, 2010)	Limb Function, pain and Strength in Sub-acute Hemiplegia after Stroke			The EG had MT done in addition to normal therapy for the affected limb for 30 minutes 5 days/week for 4 weeks while there was no additional therapy for CG 5 different movements of shoulder and fingers was done, each 6 minutes.	improvements in UE ROM, MMT, grasp and lateral pinch force of grip strength test and pain ($P < 0.05$), compared to control group that were on normal care Improvement in MFT was more evident in MT group ($P < 0.05$). MMT for EG before was 24.9±12.1 and after was 28.2±11.7 while MMT for CG before was 24.1±9.6 and after was 26.3±9.4 MFT for EG before was 11.6±10.6 and after was 17.6±10.5 while MFT for CG before was 16.7±8.6 and after was 17.9±8.9	for improving upper limb function and strength for hemiplegia shoulder pain was positive
7	(Yoon et al., 2014)	Effect of Constraint-Induced Movement physiotherapy and MT for Patients with Subacute Stroke	Stroke patients	17	2 groups: (1:1) 1. CIMT combined with MT group and CIMT only group. Patients wore a specially designed orthosis to suppress the motion of the unaffected UE for two weeks.	Post two weeks of treatment: Both CIMT groups with and without MT showed higher improvement ($p<0.05$) than the control group, in most of function-al assessments and pain control for hemiplegic UE.	There were significant improvements in all of the assessing parameters: the box and block test, 9-hole Pegboard test, and grip strength test between the CIMT combined with

					MT was performed for 30 minutes/day for 5 days/week, for 2 weeks and no palliative rehabilitation therapy given. 2. Control group received additional self-exercise to substitute for MT as well as the hospital routine palliative rehabilitation therapy Both groups received conventional occupational therapy for 40 minutes/day for the same period.	The CIMT combined with MT group showed higher improvement than CIMT only group in box and block test, 9-hole Pegboard test, and grip strength, which represent fine motor functions of the UE Wolf motor function test comparison of assessment at baseline and after physiotherapy in CIMT without MT before was 33.75±22.51 and after was 51.50±18.25 while for CIMT-only before was 40.44±21.16 and after was 45.67±21.35 while for the CG before was 29.56+27.43 and after was 28.33+26.71 Assessment in all three groups ($p < 0.05$)	mirror therapy group and the CIMT only group and the control groups except in Fugl-Meyer
8	(Paik, Lee, Lee, Park, & Oh, 2017)	Effect of MT and electrical stimulation on UE function in stroke with hemiplegic patient: Pilot study	Stroke patients	8	All patients were treated with MT and neuromuscular electrical stimulation 5 days/week for 4 weeks. Participants qualified for the	The before and after physiotherapy intervention, Fugl Meyer assessment FMA showed significant UE improvement from 29.5 ± 12.4 to 36.5 ± 15.5 ($p<0.05$).	Physiotherapy using mirror therapy and NMES showed a positive result in restoring shoulder function in stroke patients.