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Case Report

Use of rigid tape in conjunction with Kinesio® tape to treat post-stroke shoulder pain: A case report

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1. Introduction

Scapular dyskinesis refers to an abnormal scapula resting position and/or abnormal scapulohumeral rhythm during motion [1,2]. It has been defined as a non-specific response to a painful condition in the shoulder [2]. Soft tissue involvement and muscle weakness resulting in altered muscle activation have been cited as causes of scapular dyskinesis [1,3]. Scapular dyskinesis is determined by clinical observation of prominent bony landmarks on the posterior aspect of the scapula, an examination of the rotation of the scapula, and assessment of the scapulohumeral rhythm during range of motion [1,3]. The association between scapular dyskinesis and shoulder impingement has been extensively studied in non-stroke patients [3–11].

Shoulder pain is a common complication after stroke, affecting nearly one-third of stoke patients [12]. Poor scapula resting position and abnormal scapulohumeral rhythm are considered risk factors in the development of shoulder dysfunction and pain after stroke [13–15]. In stroke patients, shoulder pain is associated with lost or decreased arm function [12]. It has been hypothesized that stroke patients may be unable to compensate for the gravitational pull on the scapula due to hemiparesis [15]. Furthermore, muscle weakness in stroke patients affects the scapulohumeral rhythm during motion and results in the failure of kinematics that traditionally prevent impingement [16]. Another study concluded that the subacromial area of the shoulder in stroke patients is likely a source of pain possibly due to impingement [17]. Therapy interventions in the treatment of patients with subacromial pain traditionally include stretching and strengthening exercises, joint mobilization and manipulation, scapular and proprioceptive training [5,18,19] as well as therapeutic taping with either rigid [20,21] or elastic tape [22–27].

A systematic review examined the efficacy of adhesive taping (elastic or rigid) as an adjunct to physical rehabilitation in post-stroke patients [28]. In the review, only three of the studies that used therapeutic taping on the shoulder were good quality (using the PEDro evidence rating system): one elastic [29] and two rigid [30,31]. The purpose of the taping, in each of the three studies were to prevent shoulder pain and not to treat an underlying condition. The elastic tape study found a trend, though not statistically significant, toward pain reduction and functional improvement in stroke patients [29]. One rigid tape article found a statistically significant increase in pain-free days, and although not statistically significant, a trend towards improved range of motion and function in stroke patients [30]. The other good quality rigid tape article found no statistically significant difference on pain, range of motion, or function, however, the stroke patients that received their taping protocol, did have a trend towards reduced pain and improved arm function [31].

Studies have compared the effectiveness of rigid versus elastic tape in various populations. Both tapes have been found to reduce pain in patients with anterior knee pain and normalize scapular kinematics in patients with shoulder impingement syndrome [32–34]. When comparing the two types of tape, rigid tape demonstrated a statistically significant reduction in the shoulder forward head angle in patients with impingement syndrome when compared to flexible tape [32].

Currently, there are no studies on the combined use of rigid and elastic taping in any population for any purpose. We hypothesized that using both tapes could remediate scapular dyskinesis and pain. Thus, the significance of this clinical case report is that both tapes were used simultaneously, without overlap, for different purposes but with the overall goal of improving scapular and glenohumeral alignment. The purpose of this report is: (1) to

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describe the process of performing a clinical shoulder assessment, (2) explain the rationale and clinical significance behind using two different types of therapeutic tape to treat mechanical related shoulder pain in a post-stroke case and (3) report feasibility using the clinical findings to support assessment-driven interventions and use of therapeutic tape as an adjunct to traditional treatment. Though patient outcomes are shared, this case report makes no claims as to an exact source of pain, or a direct cause and effect relationship between the taping intervention and pain remediation. This case report is meant to offer clinicians insight into the assessment of an impaired shoulder post-stroke, the role that scapular dyskinesis may play in pain, and an impairment-guided treatment approach, completed by rehabilitation professionals. We are suggesting clinicians should consider therapeutic taping – rigid, Kinesio®, or a combination of both – as an adjunct to traditional interventions.

2. Materials and method

2.1. Case description

2.1.1. Acute hospital report

The patient is an 80-year-old male, who sustained a stroke in July of 2016 resulting in right hemiparesis and was living at home with aphasia and right hemiparesis. A headache and worsening ataxia was the reason for admission; there was not a new stroke based on the computed tomography and magnetic resonance imaging. His past medical history includes appendectomy, left knee arthroscopy, hypertension, hyperlipidemia, and a fall with subsequent persistent right anterior shoulder pain at rest and with movement. While at the acute care hospital, the patient also received an x-ray which was negative for fractures. A medical exam ruled out soft tissue injuries and rotator tear and patient was prescribed Voltaren gel (twice daily topical application to the right shoulder) and Tylenol as needed for the pain.

2.1.2. Inpatient rehabilitation facility (IRF) report

This reported pain continued after admission to the IRF. The pain was significantly impacting his functional abilities and causing emotional distress. The first step the inpatient team took was to refer the patient for a facility-specific upper quadrant assessment. This is a comprehensive examination/evaluation of the scapula and shoulder, led by an occupational therapist and physical therapist. This evaluation is a specific protocol that the hospital has developed to ensure objective measures are used and then documented.

2.2. Clinical findings and explanation of tests performed with case

2.2.1. Pain assessment

The Numeric Pain Rating Scale is standard evaluation for post stroke pain among other groups [35]. At the start of care, the patient reported a 5 out of 10 on the Numeric Pain Rating Scale in his right shoulder at rest and reported that the pain worsened with active movement. No number was quantified with active movement, but the patient's behaviors alluded to intense pain.

2.2.2. Visual observation without movement

A visual anatomical inspection was completed with the patient in short sitting at the edge of a mat table. At rest, he exhibited a Type II right scapula based on Kibler's Scapular Dyskinesis Classification System with a prominent medial border [1,10]. Furthermore, the affected scapula appeared abducted. Mild non-pitting edema was observed to the patient's right upper chest in the area of the pectorals when compared with the left side.

2.2.3. Scapula/Shoulder testing of right Upper extremity

The tests included in this part of the exam are consistent with those recommended in the literature for identifying scapular positioning, kinematics and strength [1–3,10].

- Scapulohumeral rhythm is assessed by looking for smooth, coordinated movement of the scapula during shoulder flexion [3]. The patient was noted to exhibit upward rotation of the inferior angle of the scapula simultaneously with the initiation of shoulder flexion, indicating scapular hypermobility and abnormal scapulohumeral rhythm.
- The lateral scapula slide test is performed with arms at side and provides quantitative assessment of scapular stabilizer strength [3]. The examiner measures the distance from the inferior angle to the nearest spinous process. For this patient, there was a difference from the right and left scapula of 4 in. (right) versus 3.5 in. (left).
- Active range of motion for shoulder flexion and abduction is 0–180 degrees in healthy adults This patient displayed active range of motion for shoulder elevation of 0–110 degrees.
- Proximal strength was assessed via manual muscle testing as a hand-held dynamometer was not available [10]. The patient exhibited 3+/5 strength, which indicates ability to hold position with slight resistance.
- Subluxation is an assessment of the subacromial space by palpation [16]. In this patient, subluxation was absent.

2.2.4. Manual correction

- The scapular assistance test requires the examiner to assist the patient's scapula with their hand into upward rotation as the patient elevates their arm [1–3]. This patient did not exhibit a change in pain during this test and the scapula moved appropriately with manual assistance from the examiner. Thus, the test was negative.
- The scapular retraction test requires the examiner to manually reposition the scapular into retraction and posterior tilting during arm elevation [1–3]. If pain is eliminated with manual correction of the scapula during passive and active arm elevation, this test is positive. This patient scored positively on this test.

2.2.5. Soft tissue shortening and muscle length observations

- Pectoralis minor muscle length is assessed by measuring the distance between the mat table and a patient's acromion process in a relaxed supine position. This patient exhibited no difference in distance from left to right indicating symmetrical pectoralis minor muscle length.
- Pectoralis major muscle length is measured via observation of shoulder external rotation range of motion in 90 degrees of abduction. This patient exhibited limited range of motion in addition to complaints of the same anterior shoulder pain during the movement.
- Subscapularis muscle length was noted to be shortened on the right for this patient as evidenced by limited shoulder external rotation at 30 degrees abduction (scapular plane) and complaints of shoulder pain.

2.2.6. Impingement testing

Scapular dyskinesis in impingement is defined as a loss of upward rotation, scapular internal rotation, and anterior tip of the scapula [3]. We were unable to formally perform impingement tests due to pain. However, we suspected impingement based on clinical examination and subjective reports of pain exacerbated with movement, particularly shoulder elevation $\geq$ 90 degrees.

2.3. Treatment ideas and explanation of treated case

To address the scapular dyskinesis with suspected underlying subacromial impingement we recommended the following: (1) Soft tissue massage and lengthening of the internal rotators (i.e. pectoralis major, subscapularis), (2) scapula mobilization, (3) conservative proximal strengthening exercises, (4) thermotherapy and (5) therapeutic taping for scapular stability and edema/soft tissue dysfunction. These treatment ideas are based on the literature [18–34,36–39,42]. For the purposes of this case, we will only provide details on therapeutic taping because of its non-conventional use.

2.3.1. Details on therapeutic taping

We applied therapeutic tape using two treatment techniques – rigid and elastic. The patient's skin was cleansed with alcohol swabs in preparation for tape application. First, the rigid tape was applied with a method based on previous techniques used for winging and subacrominal impingement, in which the tape plays the role of the scapular stabilizers and holds scapula in a retracted position [21,32,36,37]. This technique was selected based on the positive scapula reposition test noted during the upper quadrant assessment. A protective base tape layer was applied to protect the skin (Coverall®) followed by a rigid corrective tape layer (McConnell®) to realign the scapula, anchored on the patient's right anterior deltoid and attached in a diagonal direction to the thoracic spine to facilitate external rotation and scapula retraction (Fig. 1). Next, elastic therapeutic tape – Kinesio® Tape – was applied with methods chosen based on patient-specific impairments (i.e. soft tissue shortening) and with techniques consistent with the guidelines developed by Dr. Kenzo Kase [38]. Standard 2-inch beige Kinesio® Tex tape was utilized. A Y-strip refers to a piece of tape that has been cut partially down the middle to produce 2 tails at one end of the tape. An I-strip is an intact piece of 2-inch tape. For this case, inhibition of the right pectoralis major was completed using one Y-strip applied from distal attachment (bicipital groove of the humerus) to proximal attachments (anterior border of medial half of clavicle and anterior surface of distal sternum) (Fig. 2). Paper-off tension of 15–25% was applied to the base of the tape with the patient's right shoulder positioned in horizontal abduction and external rotation to his tolerance [38]. For purpose of space correction (lifting) to limit pain and edema, one I-strip was applied over anterior chest to area of palpable soft tissue tightness with 35–50% tension on the base of the tape with the patient's shoulder externally rotated and horizontally abducted

Fig. 1. Rigid tape application example.

Fig. 2. Kinesio® Tape Application with Rigid Tape example.

totolerance [38]. The amount of tension applied to tape was estimated based upon the average roll of Kinesio Tex Tape being reported to stretch up to 35% of its resting length (i.e. a 10-inch piece of tape can stretch up to 13.5 in. maximally - therefore, 15–25% tension results in a piece of tape stretched to approximately 10.5 to 10.9 in.) [38]. The same taping protocol was utilized each time the Kinesio® tape was applied.

3. Theory/ calculation

The theory behind rigid taping is that the tape acts to normalize the motion of the shoulder and scapula until the proper strength and balance has been restored [39]. The theory behind and therapeutic effects of the Kinesio Taping® Method, are based upon the specific design of Kinesio Tex® Tape (i.e. its stretch capabilities, thickness, and degree of adhesion) and the unique application techniques described by Kase et al. [38] This tape mimics the quality of human skin and is meant to replicate the effects a practitioner's hands can have during manual therapy techniques. It has a lifting effect on the skin which is thought to aid in lymphatic and blood flow [38]. The tape may provide mechanical support to impact joint stability and movement biomechanics and stimulate skin receptors to alter muscle activity [38].

4. Outcomes

A table is provided to share the daily documentation of the treatment interventions, active range of motion and pain levels for this case (Table 1). The patient exhibited only positive subjective reports. For example, he reported during the occupational and physical therapy sessions on day 9: "My shoulder is no longer a problem". In this case, our interventions produced no adverse events and appeared to assist the patient in achieving both his personal goals and goals for therapy, including pain-free functional use of his arm. These outcomes, a reduction in pain and increase in range of motion, however positive, cannot be attributed to any one intervention provided and were likely the result of a multimodal plan of care.

5. Discussion

Our case report has successfully outlined the process of performing a clinical shoulder assessment on a stroke survivor, has explained the rationale for using both rigid and Kinesio® tape to treat shoulder pain and has reported clinical outcomes to

Table 1
Documentation of Treatment, Pain and Shoulder Active Range of Motion by Day (No therapy services provided on Day 5).

	Day 1	Day 2	Day 3	Day 4	Day 6	Day 7	Day 8	Day 9
Interventions	UQA completed	• Moist heat • Scapula mobs • Soft tissue mobs • Rigid tape application • Kinesio® Tape application[A/B]	• Shoulder girdle stretching • Cross friction massage to pecs • Gravity-eliminated shoulder girdle strengthening/ AROM with manual facilitation of scapulohumeral rhythm	Rigid and elastic tape removed	• Rigid tape re-application • Kinesio® Tape re-application[A/B] and application[C]	Shoulder girdle stretching	Shoulder girdle stretching	Rigid and elastic tape removed
Pain	5/10 right shoulder	5/10 right shoulder pre-treatment 0/10 post-treatment	2/10 right shoulder pre-treatment Post-treatment shoulder pain "better", "barely any"	2/10 right shoulder pre-treatment and post-treatment	2/10 right shoulder 7/10 right rib cage	4/10 right shoulder	No numeric rating for shoulder pain	0/10 right shoulder Patient reports "my shoulder is no longer a problem"
AROM	90° flexion	110° flexion	N/A	N/A	110° flexion pre-treatment; 120° flexion post-treatment	N/A	N/A	140° flexion

provide information for the consideration of the use of therapeutic tape as an adjunct to traditional treatment. Regardless of the source of the patient's pain, which was not able to be completely isolated by the medical team, therapeutic interventions chosen were driven by physical assessment findings and sought to address the impairments found: abnormal scapulohumeral motion, poor scapula position, soft tissue shortening, and muscle weakness. Even though the patient did fall, these impairments are consistent with scapular dyskinesis seen in patients with post stroke shoulder pain [13–16]. And although we do not know if the taping itself made a direct impact on the patient's improvements, we do know that it was a feasible treatment option based on the absence of adverse effects and the positive subjective reports, improvement in active range of motion, and decrease in pain levels.

Like Niessen et al [15], we found an increase in scapular lateral rotation and a decrease in glenohumeral mobility. Additionally, our patient exhibited a reduction in shoulder external rotation, consistent with findings from multiple post-stroke shoulder pain sources [14,15,40]. The scapula retraction/reposition test, which was positive in this report, has been linked to impingement and often demonstrates scapula and glenohumeral involvement [1,10,41]. The stable base during the test is believed to reduce pain and increase rotator cuff strength [10,41]. Miller & Osmotherly used rigid tape based on common dysfunctions of winging and downward rotation in individuals with shoulder impingement symptoms and found a strong trend towards reduced pain which was consistent with our results [21]. They found that the role of taping was most effective early in the treatment process. Similarly, another study using rigid tape concluded that early recognition and rapid intervention are needed to improve function in individuals with impingement [36]. These studies support why we completed our clinical examination and used this technique. Our report can support the option to consider this adjunct treatment technique, for stroke survivors in an acute rehabilitation setting.

6. Conclusion

This case report's findings are important not only to frontline clinicians but to researchers as well. As aforementioned, the volume of literature examining the use of therapeutic taping in the treatment of scapular dyskinesis within the stroke population is limited but is seen frequently in the treatment of impingement syndrome. Strongly designed studies are lacking overall regarding the neuromuscular, musculoskeletal, and sensory therapeutic effects of both rigid and Kinesio® taping and especially when applied simultaneously. Thus, the purpose of using the rigid tape in this case report was to mimic the role of the manual facilitation used in the scapula retraction test, in attempt to eliminate pain. Given the relationship between glenohumeral mobility, scapular dyskinesis, and shoulder pain, Kinesio® tape was also utilized for its potential to address soft tissue imbalances, decrease pain, and facilitate the healing process. Kinesio® tape was applied to decrease pain and provide a relaxing stimulus to soft tissue structures, namely to the pectoralis major, a large and dominant shoulder internal rotator.

The combination of both taping techniques may have contributed to the improvement of pain and shoulder external rotation found after interventions, and. this outcome is consistent with those of Thelen et al [27], Frazier et al [42], and Shakeri et al [25]. However, true experimental research is needed specific to this population to thoroughly understand the role of therapeutic taping as an adjunct tool to standard therapeutic interventions and the effectiveness of using rigid and Kinesio® Tape in conjunction with one another. Thus, the exploration of the combined use of rigid and elastic taping in this case report will add to the current body of research on therapeutic taping and will hopefully encourage more strongly designed studies, because we realize the limitations of this report. These specific studies are needed to directly explore the effectiveness of using rigid and Kinesio® taping in conjunction with one another.

As clinicians, we are responsible for providing evidence-based care but also for utilizing any interventions at our disposal that may improve a patient's quality of life. We feel that the collaboration between disciplines (occupational and physical therapy) and integration of multiple treatment interventions in this case after interpretation of upper quadrant assessment findings were key factors in the patient's overall outcome. However, again because this is not a research study, further work is necessary to determine factual evidence.

We strongly recommend comprehensive shoulder evaluations should be performed on all stroke patients in inpatient rehabilitation settings. Clinicians should consider trying rigid and elastic tape, applied separately or simultaneously, to promote normal scapula and glenohumeral positioning and kinematics for individuals with post-stroke shoulder pain. However, therapeutic taping

should be used as an adjunct to traditional physical rehabilitation methods.

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Declarations of interest

None.

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