Kinesio® Taping in Stroke: Improving Functional Use of the Upper Extremity in Hemiplegia

Ewa Jaraczewska and Carol Long

The purpose of this article is to present the Kinesio® taping method used to improve the upper extremity function in the adult with hemiplegia. The article discusses various therapeutic methods used in the treatment of stroke patients to achieve a functional upper extremity. The only taping technique for various upper extremity conditions that has been described in the literature is the athletic taping technique. In this article, some interpretation is offered on proper assessment of the nonfunctional upper extremity, including the emphasis on postural alignment, trunk control, and scapula alignment. The Kinesio® taping method in conjunction with other therapeutic interventions may facilitate or inhibit muscle function, support joint structure, reduce pain, and provide proprioceptive feedback to achieve and maintain preferred body alignment. Restoring trunk and scapula alignment after the stroke is critical in an effective treatment program for the upper extremity in hemiplegia. **Key words:** *functional use, Kinesio® taping, stroke, therapy, upper extremity*

Patients diagnosed with stroke often present with a combination of muscle weakness or muscle imbalance, decreased postural control, muscle spasticity, poor voluntary control, and body malalignment. The ability of the adult with stroke to functionally use the affected arm may be diminished due to all of the above problems. As clinicians, we need to be aware of all the structures affecting patients' ability to reach, hold, and manipulate an object.

Regaining functional use of the upper extremity after a stroke is one of the most challenging tasks for the patient and for the therapist working with the patient. Its result has a significant impact on the individual's physical, psychological, and emotional well-being. There are several, equally important factors contributing to the problem with the functional use of the upper extremity. Thoracic and lumbar spine pathology may affect scapular plane shoulder abduction and muscle force. Poststroke shoulder pain is a relatively early complication affecting the use of the upper extremity within an available range of motion. The correlation between shoulder subluxation and development of the shoulder pain has been reported.[1] When shoulder subluxation occurs, it may inhibit functional recovery by limiting the range of motion.

Impaired or lack of sensation in the hemiplegic upper limb, its spasticity or flaccidity, and the neglect of the hemiplegic arm contribute equally to a nonfunctional upper extremity in the stroke victim.

This article promotes the potential of a Kinesio® taping method, a treatment technique that may be used in restoring the functional use of the upper extremity in hemiplegia.

Review of Therapeutic Methods to Achieve Functional Use of the Upper Extremity

In rehabilitation programs, it is a challenge to find a way to stimulate the sensorimotor system toward regaining normal voluntary movement and upper extremity functional use. Various treatment techniques have been adapted to be used clinically in rehabilitation centers for patients who presented with shoulder subluxation, shoulder pain, and nonfunctional upper extremity due to stroke.

Functional electrical stimulation (FES) applied to shoulder muscles in patients with hemiplegia has shown beneficial effects on mobility and pain

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reduction.[2] Faghri et al.[3] suggest that FES helps in decreasing shoulder pain and subluxation and improves motor function of the upper extremity. Prada and Tallis[4] reported the use of FES to reduce the effect of the hemi neglect. Skin stimulation of the affected forearm was used to draw a patient's attention to his neglected arm.

The protocol for the use of phenol, alcohol, or Botox injections in the management of the focal spasticity has been developed and has been reported to improve the range of motion and the upper extremity function.[5] In another study, Leandri et al.[6] demonstrated that the high-intensity transcutanous electrical stimulation (TENS) was more effective in increasing the range of motion in the hemiplegic upper extremity when compared with the low-intensity TENS.

Bobath approach and other exercise programs have been implemented early after the onset of the stroke to prevent immobility[7] and soft tissue contracture and to alter the muscle tone in order to gain mobility. The goal of most therapy programs is to maintain the affected upper extremity in the best possible aligned position to avoid overstretched soft tissue, edema, and pain. Therapists use and teach proper handling techniques, use an arm trough or tray on a wheelchair, and correctly position the affected upper extremity in bed. Through the exercise program and use of weight-bearing techniques, the therapist attempts to maintain and improve trunk and shoulder alignment to allow the functional use of the upper extremity. Passive range of motion of the upper extremity is often required; however, the overhead exercise pulleys should never be used.[1] The use of the overhead pulley system has been documented to cause pain, impingement, and even rotator cuff rupture.[8] Instead, a range of motion program using bilateral techniques is strongly recommended. Taping can be used as an adjunct during the rehabilitation program to enhance functional recovery by reducing pain, improving alignment, and stimulating or inhibiting muscle function and improving proprioceptive function of the joint structure. Athletic taping has been used in promoting a proximal stability of the scapula. It is suggested that the taping technique affects the resting position of the scapula and assists in maintaining the proximal shoulder girdle stability. A specific taping technique with Leukotape® P was described in the case of impingement of the rotator cuff tendons.[9]

Kinesio® taping is a treatment method used in conjunction with other therapeutic techniques in the treatment of various musculoskeletal and neuromuscular deficits. Kinesio® taping has a long history of use by occupational therapists, physical therapists, athletic trainers, and other trained health professionals to achieve improvement in the treatment of joint sprains and joint instability, soft tissue inflammation, muscle weakness, and pain.

The elastic quality of the Kinesio® Tex Tape, if used and applied properly, may help to support or inhibit muscle function, support joint structure, reduce soft tissue inflammation, and reduce pain. It can provide feedback to the muscles to maintain preferred postural alignment.

Kinesio® Tex Tape has an effect on sensorimotor and proprioceptive systems, as seen in its benefit in the treatment of various neurological conditions, including shoulder subluxation following a stroke. No information exists, however, on the effectiveness of Kinesio® taping in conjunction with other therapeutic activities to facilitate improvement in restoring functional use of the upper extremity in hemiplegia.

Yasukawa studied the results of the Kinesio® taping application in improving upper extremity control and function in the acute pediatric rehabilitation setting.[10] Based on a clinical evaluation, Kinesio® Tex Tape was applied to facilitate a functional upright position of the trunk, to assist with positioning the shoulder in neutral alignment, and to provide palmar stability and arch support for the involved hand. Yasukawa concludes that the use of the Kinesio® taping method appeared to have improved purposeful movement and provided needed stability of the shoulder and hand.[10] Yasukawa et al. found that the application of the Kinesio® Tex Tape provided the proper body alignment to allow performance of reach, grasp, release, and manipulation tasks.

This article attempts to review the important factors in restoring the upper extremity function following a stroke. Presented factors were chosen based on the literature review and the clinical experience of a physical therapist and an occupa-

tional therapist certified in the Kinesio® taping method.

Functional Anatomy and Kinesiology of the Upper Extremity: Thoracic and Lumbar Spine Perspective

The thoracic spine has three roles related to upper extremity function. It supports and stabilizes the rib cage that provides housing and allows movement of the scapula. Its articulating vertebral facets allow full range of extension and flexion of the thoracic spine to assist with shoulder elevation and depression. The thoracic spine provides support for the lumbar spine and together they construct the upright column that stabilizes the upper extremity in relation to the trunk.

It is apparent that without a stable supporting central point the muscles of the upper limbs would not be effective in their function.

The thoracic spine flexion and extension range of motion is limited by the attachment of the rib cage. Axial rotation is, however, relatively wide-ranging, exceeding that of the lumbar spine. It allows the upper extremity to perform a variety of functional tasks.

The lumbar spine has a wide range of flexion and extension because there are no ribs attached to it. However, there is only little motion in the individual facet joints of the lumbar spine. Major motion of lumbar spine flexion depends on the available range of motion in the hip joint, and its stability depends on a strong action of the abdominal muscles.

In summary, for the upper extremity to perform its functional tasks, the trunk needs to be held upright and needs to be able to move freely from one stable position to another either against the pull of the gravity or despite its pull.

Two groups of muscles are responsible for trunk control. There are back extensors posteriorly and abdominal muscle anteriorly. Back extensors that surround the vertebral column provide a flexible support for the trunk. Many of these muscles function as the “guy-ropes” supporting the upright pole. While producing a variable tension on the spine during different activities in sitting or standing, they allow the entire trunk or its segments to deviate in any direction and still provide the stability required for the function performed.

An important function of the trunk musculature is to fixate the thorax, lumbar spine, and pelvis to stabilize the proximal attachment of the shoulder muscles when the arm is moving. Specific electromyographic study of the trunk muscles demonstrates that manual resistance to shoulder extension and adduction will activate abdominal muscles; with the arms placed over head and lifted, the back extensors will contract.[11]

When the upper extremity performs its functional activity, it requires efficient function of the abdominal muscles to maintain and achieve a desired movement. For the abdominal muscles to act efficiently, they need a stable thorax. With increased thoracic kyphosis, the insertion and origin of the obliques is approximated, therefore the muscles cannot function in full capacity. It is important to mention that an excessive kyphotic position of the thoracic spine caused by poor posture, muscle weakness, or muscle imbalance will cause a compression of the rib cage. Such compression will reduce the volume of the lungs and cause the patient to fatigue easily.

When evaluating the upper extremity function, one has to include postural assessment. Alignment of the cervical, thoracic, and lumbar spine influences scapular position and the overall upper extremity function.

During the shoulder abduction, scapulohumeral rhythm determines the range and the quality of the movement. It is further concluded that the extension of the thoracic spine is necessary for a full range of motion of the shoulder.[12]

It is known that increased thoracic kyphosis tends to abduct the scapula and downwardly rotate it, altering the scapulohumeral relationship,[13] which leads to muscle weakness and decreased range of motion. As a result, shoulder impingement syndrome may be present.

Due to the aging process or illness, the thoracic curvature tends to increase. In addition, various soft tissue restrictions occur. The upper trapezius muscle is placed in shortened position and its ability to generate tension is affected. In the slouched posture, the deltoid and the supraspinatus are also in the excessively shortened position.

Poor posture can also precipitate translation of the humeral head, resulting in impingement.

Decreased ability to abduct the shoulder is clinically significant due to the fact that the upper extremity function depends on the activities performed at the shoulder level. The shoulder girdle has no direct articulation with the vertebral column and is dependent on complex muscle activity to provide the necessary support for the functional arm. The action of the serratus anterior and pectoralis minor in scapula stability depends upon stable thorax due to these muscle attachments on the rib cage. Similarly the pectoralis major involved with arm movement requires a stable thorax in order to act in shoulder flexion, internal rotation, and adduction due to its attachment to nearly all the true ribs. To allow the pectoralis major to function efficiently, the abdominal muscles act in holding the ribs down. All the muscles that act on the shoulder depend on the stability provided by the shoulder girdle, which itself depends on the stability of the thorax. Because the trunk is involved in every activity performed against gravity, without its stable center, the movements of the upper extremity are difficult or impossible.

Thoracic and lumbar spine pathology in the neurologically impaired patient is reflected in the upper extremity function. The neuromuscular assessment of the thoracolumbar system provides a comprehensive understanding of the upper extremity function. After onset of hemiplegia, the abdominal muscles demonstrate a significant loss of activity and tone and the patient experiences difficulty in moving against gravity. The effect of trunk instability on upper extremity function is profound. When one of the aforementioned groups of muscles becomes weak, the body assumes a position that eliminates the necessity of action of this group. The vertebral column will concave toward the side of the weak muscles and the lateral curvature of the spine will increase on the opposite side. The muscles on the convex side are placed in the stretched position, and they are no longer able to provide an adequate stability of the spine in the upright position.

In early stages of hemiplegia, the patient usually maintains unsupported sitting with hips in some degree of extension and thoracic spine in flexion. Due to the approximation of the abdominal muscles origin and insertion, the muscles are not able to perform a stabilizing function for the trunk and upper extremity. With the lack of selective trunk activity and poor stability of the ribs due to weak abdominals, the scapula is no longer held in a steady position required for effective shoulder movement.

When working on achieving a functional movement of the upper extremity for a patient with hemiplegia, clinicians need to focus their attention on the position and movement of the trunk, rib cage, and scapula. Only this stable foundation will allow the patient a functional use of the upper extremity.

Functional Anatomy and Kinesiology of the Upper Extremity: Scapular Perpective

Having fully evaluated the trunk, clinicians must next consider the role of the scapula when evaluating and treating functional ability and use of the hemiplegic upper extremity. DePalma et al.[14] notes that the scapula is central in proficient shoulder activity, and rotator cuff muscles will not operate optimally if the scapula is poorly positioned. As has already been noted, the scapula can only be stabilized dynamically if the thoracic spine and the ribs can provide adequate anchorage or foundation for the relevant muscle groups.[15] Poor position, alignment, or stability of the scapula on the chest wall will significantly impact the available range of motion of the shoulder, may also cause pain, and will consequently impede functional use of the upper extremity.

The scapula is a flat triangular bone with three borders: medial, lateral, and superior. The superior border contains the coracoid process, described by Calais-Germain[16] as looking like a bent finger pointing forward. The scapula rests on the ribcage just lateral to where the ribs curve anteriorly. The spines of the scapulae should be at the same level and can be easily palpated. The depressions above and below these structures are known as the supraspinous and infraspinous fossa, respectively. The scapula itself extends from T2 spinous process to T7/8 spinous process of the

thoracic vertebrae, and it is slightly upwardly rotated. The spines of the scapulae on the medial border should be equidistant and approximately three to four fingers width from the thoracic spine. The inferior angle of the medial border should be four to five fingers width from the spine. Lack of symmetry of the scapulae will result in poor position, alignment, or stability of the scapula. An example of this is scapular winging, often due to weak serratus anterior musculature. The serratus anterior muscle originates at ribs one through eight and inserts along the medial border of the scapulae. Its function is to laterally rotate and abduct the scapula. It also maintains proximity between the scapula and the thoracic wall.[14] Weakness or paralysis of this muscle due to a stroke may result in the medial border moving away from the thoracic wall (winging). This can be most clearly observed when the patient is engaged in forward flexion of the upper extremity in a closed chain modified push-up position against a wall. It can also be seen during functional tasks such as ambulation while weight bearing on a walker. Because the serratus anterior is the most effective muscle for producing scapular upward rotation during arm elevation,[17] the individual will be unable to raise the affected upper extremity greater that 120º. In lateral scapular winging, the lateral border of the scapula is prominent during humeral abduction and the upper trapezius is flattened.[14] This indicates upper trapezius weakness. The upper trapezius muscle is the only muscle responsible for elevation of the lateral aspect of the spine of the scapula, and weakness or imbalance here will result in a notable depression of the lateral angle.[18] In conjunction with the upper fibers of the trapezius, the levator scapulae and the rhomboids assist in elevation of the scapula. When the upper trapezius musculature becomes weak or paralyzed, elevation becomes the sole responsibility of the levator scapulae and the rhomboids. They respond reflexively to the increase in stretch, thus they contract to produce excessive elevation of the superior angle of the scapula. Early identification and management of weak musculature can reduce malalignment of the humeral head in the glenoid fossa, which could result in painful movement later in the rehabilitation process due to impingement. Pain during movement will greatly affect the functional use of the upper extremity and must be a priority for the therapist.

The lateral border of the scapula contains the shallow glenoid cavity that, when properly aligned, articulates with the head of the humerus to form the glenohumeral joint. The glenoid labrum is a fibrocartilaginous ring that helps to seal the joint and somewhat increase the depth of the glenoid cavity. Davies[19] notes that this makes the shoulder joint unstable to allow for the enormous range of movement required for skilled manipulations of the hand and fingers.

To elevate the upper extremity, the humeral head must be placed within the glenoid fossa. The deltoid and rotator cuff muscles act together as a force couple to achieve this. Weakness or paralysis of the normally strong musculature can result in subluxation of the shoulder. A patient who has experienced a stroke may not experience any pain due to subluxation; however the different muscle groups may be vulnerable to overstretching, increased contraction, and premature fatigue. This can most certainly decrease the coordination of muscular activity, alter muscle patterns, and ultimately impede the functional use of the upper extremity. The posterior fibers of the deltoid, the supraspinatus, and the infraspinatus are the most important muscles in preventing subluxation of the glenohumeral joint.[19] The deltoid muscle originates from the spine and acromion of the scapula and lateral third of the clavicle and inserts on the deltoid tuberosity on the lateral aspect of the humeral shaft. The deltoid primarily acts to abduct the humerus. When the deltoid is combined with the rotator cuff muscles (adduction of the humerus) as a force couple, the humerus is prevented from jamming into the bony structures (i.e., the acromion) and causing pain. A force couple is defined as two equal forces acting in opposite directions to rotate a part about its axis of motion.[20] Weakness or paralysis of these muscles will result in a downward sloping glenoid fossa. Davies[19] notes that with the scapula rotating downward and retracted, the humerus is in a position of abduction. The capsule is no longer taut, and the head of the humerus slides around in the glenoid fossa. The weak or paralyzed posterior portion of

the deltoid, supraspinatus, and infraspinatus cannot maintain the head of the humerus in the glenoid fossa and subluxation occurs. During clinical observation, a droop in the shoulder girdle can be noted, a flattening of the normal round deltoid muscle area can be seen, and a sulcus sign can be observed. Early detection and prevention of subluxation through correct positioning and alignment will reduce the likelihood of overstretched soft tissue, edema, and pain.

According to Bobath,[7] there is also evidence of spasticity in a predominately flaccid arm, particularly around the lateral flexors of the neck and those around the scapula. The shoulder girdle is retracted and the inferior angle of the scapula is fixed, restricting movement laterally and upward when the arm is elevated. The acromion therefore does not turn upward to maintain the head of the humerus in the glenoid fossa. Bobath[7] concludes that it is not only gravity that pulls the humeral head out of the glenoid cavity, but also the spasticity of the depressors of the humerus, that is, the subscapularis, infraspinatus, and teres minor.

The lateral end of the spine is enlarged and flattened to form the acromion process. The acromion and the lateral end of the clavicle articulate to form the acromioclavicular joint. If a flaccid hemiplegic patient with subluxation experiences pain with shoulder elevation above 90º, it is likely indicative of supraspinatus impingement against the acromion. The supraspinatus muscle originates at the supraspinous fossa of the scapula and inserts at the greater tubercle of the humerus (superior aspect). Its primary function is abduction of the humerus. The supraspinatus is sometimes visible as it produces a slight outward bulging of the trapezius immediately above the scapular spine.[18] It is difficult to palpate, because the overlying upper trapezius muscle also contracts during abduction. A weakened or impinged supraspinatus muscle may cause the individual to hike the shoulder to achieve abduction. Rotation (upward) and abduction of the scapula may be prevented if there is spasticity of the rhomboids, latissimus, and trapezius muscles. The glenoid fossa is then unable to rotate upward and remains downward facing, resulting in pain as the humerus is pushed against the acromion, impinging the supraspinatus tendon. The position of the scapula must be corrected and the cause of the impingement identified to achieve decreased pain and improved functional ability of the upper extremity.

When examining the functional use of the upper extremity, the clinician must also observe the scapulohumeral rhythm. Scapulohumeral rhythm refers to the smooth and integrated motion of the shoulder girdle joints and muscles as they move through full elevation (shoulder flexion/abduction) of the upper extremity and the consequent relationship between the humerus and the scapula. The initial 30º to 60º of shoulder flexion or abduction is known as the setting phase where the scapula positions itself on the thoracic wall. Beyond 60º, the humerus maintains a 2:1 movement ratio with the scapula. That is, for every 30º of scapular rotation, there is 60º of humeral elevation. Impaired functional use of the upper extremity occurs when any of the many components of the scapula and the shoulder (including all four articulations) malfunctions. An individual with poor posture and weakened shoulder muscles due to stroke will experience disruption of the normal rhythm. Attempting elevation of the upper extremity in the presence of pain, capsular adhesions, or weak musculature, according to Kelley,[21] will lead to excessive scapular elevation, lateral rotation, or shoulder shrugging. Lumbar hyperextension and contralateral lateral trunk flexion may also occur. Improving biomechanical deficits related to posture and alignment of the trunk and scapula must be the initial goal of rehabilitation, according to the authors, to begin facilitating normal scapulohumeral rhythm.

Looking at the scapula from a neurological perspective may attribute any malalignment to, for example, increased tone or abnormal movement patterns. Landel and Fisher[22] also highlight that an orthopedic perspective can be extremely effective in determining the relative alignment of various body segments. They note the importance of the position of the head on the neck, neck on thorax, and shoulder girdle on thorax and conclude that other possible reasons for malalignment could be lack of range, weakness, habit, and resting muscle tension. They state that therapists need to recognize that faulty alignment may predispose the pa-

Figure 1. Kinesio® taping technique for trunk extensors. This is a mechanical correction technique to assist with proper trunk alignment.

tient to move abnormally. Only after scapular stabilization is achieved should treatment focus on distal upper extremity dysfunction.

Promoting Functional Use of the Upper Extremity: Kinesio® Taping Perspective

Kinesio® tape can be used in a variety of ways to promote postural alignment and stability of the thoracic spine and scapula. This section illustrates a number of taping methods that can be used alone or in combination to support weak muscle, relax overstretched muscle, and reduce pain to promote functional use of the upper extremity.

It is apparent that the equilibrium between the abdominal and parspinal muscle stabilizing the thoracic and lumbar spine is necessary for the functional use of the upper extremity. After onset of hemiplegia, the abdominal and trunk muscles demonstrate a significant loss of activity. Lumbar hyperextension and contralateral lateral trunk flexion may occur. The thoracic curvature tends to increase, affecting the function of the shoulder girdle muscles. Kinesio® tape can assist with achieving proper trunk alignment, and several taping techniques have been described. The purpose of this application is to facilitate a functional, upright position of the trunk and to reduce spine convexity on the nonaffected site. Kinesio® tape mechanical correction technique is applied from distal to proximal attachments of the erector spinae on the nonhemiplegic site (Figure 1). The patient is instructed to maintain upright position during unsupported sitting, but manual assistance is often necessary to maintain proper alignment. Two-inch tape is stretched over the length of the muscle with downward pressure, and the elasticity is taken out of the tape as it is applied. The tape is secured in place without any tension on its end.

Due to poor trunk alignment and with the thoracic curvature increased, various soft tissue restrictions occur. The upper trapezius pulls the scapula upward and inward. The middle fibers of trapezius stabilize the scapula and the lower fibers pull the medial border of the scapula down. In conjunction, the middle and lower fibers of the trapezius assist with elevation of the glenoid fossa, thus contributing to the scapulohumeral rhythm. Following stroke, the upper trapezius muscle is often placed in shortened position and its ability to generate tension is affected. Early identification and management of the tight upper trapezius can

Figure 2. Basic Kinesio® taping method for upper trapezius using insertion to origin application to "relax" tight muscle.

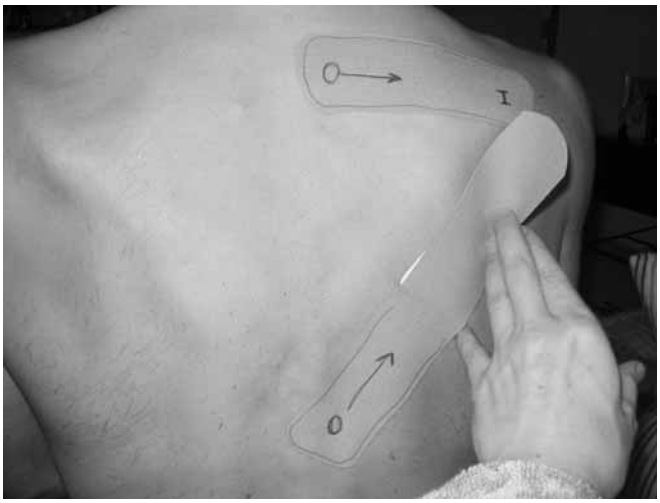

Figure 3. Kinesio® taping technique for middle and lower trapezius using origin to insertion application to assist weak muscle.

Figure 4. Kinesio® taping techniques for postural alignment and scapula alignment using mechanical correction technique for trunk extension and basic application technique for middle and lower trapezius.

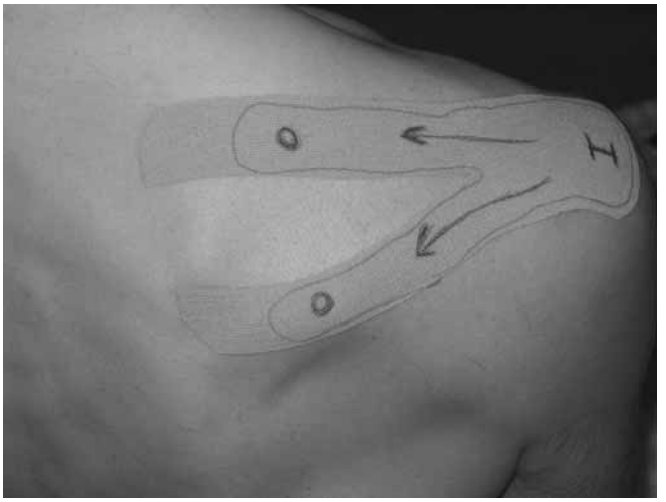

Figure 5. Basic Kinesio® taping technique for supraspinatus using insertion to origin application. This technique is used to "relax" overstretched muscle and provide proprioceptive feedback to rotator cuff muscles.

reduce the malalignment of the scapula. A basic Kinesio® taping method for upper trapezius is used. Kinesio® Tex Tape is applied from insertion to origin to relax tight muscle. The base of the 2-inch I strip Kinesio® tape is attached to the lateral third of the clavicle. The patient rotates his or her head toward the opposite shoulder, and the tape is adhered to the stretched skin just below the hair line (Figure 2).

The middle and lower trapezius muscles are vulnerable to overstretching, increased contraction, and premature fatigue. The Kinesio® tape can help to support weak muscle and improve scapula alignment, thus improving the functional use of the upper extremity. Origin to insertion application is used for the middle and lower trapezius. Both applications require 2-inch I strip Kinesio® tape approximately affixed on spinous processes of C6-T3 for middle trapezius and on spinous processes of T4-T12 for lower trapezius (Figure 3). The tape is laid down along the muscle fibers with paper off tension, and it is affixed to the acromion and the spine of the scapula, respectively (Figure 4).

The supraspinatus is the rotator cuff muscle that can be affected by the slouched posture. With increased thoracic kyphosis and poor posture resulting from muscle weakness and imbalance, the supraspinatus is in the excessively shortened position. The weak or paralyzed muscle, along with other rotator cuff muscles and deltoid, cannot maintain the head of the humerus in the glenoid fossa, affecting anterior-posterior stability of the shoulder. As a result, pain and impingement may occur. Kinesio® tape may assist with achieving proper shoulder and scapula alignment to reduce soft tissue overstretch, edema, and pain. For this application, Kinesio® Y strip was applied from the muscle insertion at the greater tuberosity of the humerus to its origin at the supraspinatus fossa of scapula. For this application, basic Kinesio® taping technique using 2-inch tape is demonstrated to relax overstretched muscle and to provide proprioceptive feedback to rotator cuff muscles. Kinesio® Tex Tape is laid down on the skin stretched over the muscle with no tension on the tape (Figure 5).

During subluxation of the humerus, the deltoid muscle is noted to be weakened or paralyzed. Kinesio® tape is applied from origin to insertion to support the weak muscle. Prior to application, the patient is positioned with the head, trunk, and scapula in the best possible alignment. The tape is cut in a Y shape with the anchor applied to the acromion using paper off tension with no stretch applied to the tape. The shoulder is abducted to 90° during application. The shoulder is next moved into extension, and the first tail is applied to the anterior portion of the deltoid in a stretched

Figure 6. Basic Kinesio® taping method for deltoid using origin to insertion application to support weak muscle.

Figure 7. Basic Kinesio® taping for deltoid; application completed.

position (Figure 6). The second tail is applied to the posterior portion of the deltoid with the shoulder in horizontal abduction. No tension is applied to the tails. Patients have subjectively reported a feeling of "support" to the joint (Figure 7).

As was noted previously, the humeral head must be positioned in correct alignment prior to application. Kinesio® tape does not have the tensile strength to stop the humeral head from dislocating or subluxing, however it can provide proprioceptive feedback to the tissues and assist in the positioning of the muscle, fascia tissue, or joint.[23] A

Figure 8. Basic Kinesio® taping method for deltoid; this is the final application using two Y strips for additional support.

Figure 9. Basic Kinesio® taping application for serratus anterior using origin to insertion application to support weak muscle.

Figure 10. Basic Kinesio® taping for serratus anterior. Application completed.

large shoulder may require the application of more than one strip (Figure 8).

The scapula cannot rotate unless it lies flat on the thoracic wall, thus impairing functional use of the upper extremity. Abduction of the scapula (winging) can be addressed by Kinesio® tape in the following way. For medial scapular winging with serratus anterior involvement, the Kinesio® tape can be applied using a Kinesio® I strip from origin to insertion with paper off tension only. The Kinesio® Tex Tape is anchored between ribs one through eight (Figure 9). With the upper extremity in full elevation, the patient is instructed to take a deep breath to elevate the ribcage. The Kinesio® I strip is anchored up, and the end of the tape is attached to the medial border of the scapula (Figure 10).

Conclusion

The use of taping method in conjunction with an established rehabilitation program may play an important role in the reduction of poststroke shoulder pain, soft tissue inflammation, muscle weakness, and postural malalignment. We believe

that the Kinesio® Tex Tape may improve the position of the glenohumeral joint and may provide the proprioceptive feedback to achieve proper body alignment. These factors are fundamental when exercises to restore the upper extremity functions are performed. The use and the position of the upper extremity following a stroke affect not only the patients' ability to reach, hold, and manipulate an object, but also their ability to stand up and walk.

The taping method using Kinesio® Tex Tape described in this article was developed solely based on our clinical experience and in-depth knowledge of the anatomy and kinesiology of the shoulder complex. We understand that a limitation of this presentation includes the lack of direct evidence for the correlation between the Kinesio® taping method and improvement in the upper extremity function after the stroke. As clinicians, we are obligated to provide evidence-based therapy, and an initiative has begun to examine the effects of the Kinesio® tape in the clinical trial.[10] Further research is needed to determine the exact mechanism underlying the effect of Kinesio® Tex Tape on the sensory, musculoskeletal, and neuromuscular systems. Most important, further research is needed to demonstrate the safety and long-term effectiveness of the various application techniques. In our view, however, clinicians are obligated to use every available treatment option to assist the patient with achieving a goal of independence.

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