The California Tri-pull Taping (CTT) Method for Shoulder Subluxation

Kate Hayner, EdD, OTR
Samuel Merritt University
510-879-9279
khayner@samuelmerritt.edu

Ginny Gibson, OTD, OTR/L, CHT
Samuel Merritt University
UCSF Benioff Children's Hospital Oakland
ggibson@samuelmerritt.edu

Joint of the Pectoral Girdle

- Scapulothoracic
- Sternoclavicular
- Acromioclavicular
- Glenohumeral

Scapulohumeral Rhythm

- Reduce shear forces
- Increase range in elevation of humerus while providing dynamic stability
- Maintain a good length-tension ratio throughout the range of motion and prevent active insufficiency

Orientation of the Pectoral Girdle

- Resting position of scapula
    - Between 2nd and 7th ribs
    - Scapular plane: Scapula tilted 35° anterior to frontal plane
    - Upward rotation: Glenoid fossa facing superior (5 degrees)
- Humeral head: Retroversion: 30° relative to medial lateral axis of distal humerus

Scapular Malalignment

- Trunk malalignment
- Inactivity of scapular muscles
- Muscle imbalance around scapula
- Downward rotation of glenoid fossa

- Historically researchers have proposed downward rotation orients glenoid fossa inferiorly resulting in humeral head sliding inferiorly (Basmajian & Bazant, 1959; Ikai, Tei, Yoshida, Miyano, & Yonemoto, et al., 1998; Runyan, 1995)

- Later, others suggest no relationship between subluxation and slope of glenoid fossa (Cailliet, 1981; Ikai et al., 1992)

- Researchers compared affected and unaffected shoulders using a 3-dimensional radiographic technique that determines true position of the humeral head in relationship to the scapula. This technique revealed *less* downward rotation of the glenoid fossa than originally expected, and *no significant relationship* was found between the extent of scapular orientation and the severity of subluxation (Culham, Noce, Bagg, 1995; Prévost, Arsenault, Dutil, Drouin 1987)

Sternoclavicular Joint

- Costoclavicular ligament
- Sternoclavicular ligament
- Interclavicular ligament

Motions of the clavicle

- Elevation
- Protraction
- Rotation

Acromioclavicular Joint

- Acromioclavicular ligament
- Coracoacromial ligament
- Coracoclavicular ligament

Motions of the AC joint

- Scapular rotation
- Internal & external rotation; horizontal plane adjustment
- Tilt; sagittal plane adjustments

Glenohumeral Joint

- Glenoid labrum – deepens glenoid fossa
- Coracohumeral ligament
- Capsular ligament (superior, middle, inferior)
- Long head of the biceps brachii

Impingement

- Osseous structure: Acromion
- Weakness of rotator cuff muscles
- Role of LH of biceps

Inferior Subluxation

- Occurs when muscles supporting the GH joint weaken, ligaments elongate, and humerus slides inferiorly
- Groove “sulcus sign” between acromion (A) and head of humerus (HH)

Subluxation Patterns

- Inferior
- Anterior
- Superior
- Posterior

Shoulder Subluxation

- Early poststroke, about 90% of patients experience UE muscle flaccidity (Moskowitz, Goodman, Smith, Balthazar & Mellins, 1969; Andersen, 1985)

- Flaccid paralysis of shoulder muscles compromise stability:
  - Low muscle activity of the supraspinatus (Basmajian & Bazant, 1959; Chaco & Wolf, 1971; Ikai et al., 1998)
  - Posterior deltoid (Basmajian & Bazant, 1959; Ikai et al., 1998)

- Overstretch if coracohumeral ligament (Basmajian & Bazant, 1959)

- Subluxation develops within several weeks after stroke. UE muscles are flaccid and normal muscle contraction does not occur in response to loading (Chaco & Wolf, 1971)

- Effect of gravity, or loading, on the flaccid arm may cause elongation of superior glenohumeral joint capsule and muscle, leading to subluxation (Chaco & Wolf, 1971; Moskowitz, et. al., 1969)

Shoulder Pain with Hemiplegia - Not Specifically Subluxed
- Shoulder pain post-stroke varies between 5% and 84% in different studies as a result of different definitions of pain and patient selection (Roy, 1988)
- The most reliable estimate of shoulder pain in hemiplegia is 72% (Van Ouwenaller, Laplace & Chantraine, 1986)

Should Pain and Impact
- Pain may impede rehabilitation and is associated with longer hospital stays and poorer outcomes (Turner-Stokes & Jackson, 2002)
- Reduced arm function (Lindgren, Jonsson, Norrving & Lindgren, 2007)
- Reduced performance of activities of daily living (Lee, Shin, Moon, Jeong, Song & Kim, 2009; Lindgren et al., 2007).

Mixed Findings Regarding Subluxation and Pain
- Some regard subluxation to be a major cause of pain (Andersen, 1985; Griffin & Reddin, 1981; Van Ouwenaller, et al., 1986)
- Many studies have not found a direct correlation between subluxation and pain (Bohannon & Andrews, 1990; Ikai et al., 1998; Van Langenberghe & Hogan, 1988; Zorowitz, Hughes, Idank, Ikai, & Johnston, 1996)

Pain in the Shoulder Is Due To
- Limited shoulder range of motion, especially in GH joint external rotation (Ikai et al., 1998; Zorowitz et al., 1996)
- Trauma such as tears and impingement (Shai, Ring, Costeff, & Solzi, 1984; Van Langenberghe & Hogan, 1988)
- Injury and tears to the rotator cuff or long head of the biceps (Dromerick, Edwards, & Kumar, 2008)
- Adhesive capsulitis (frozen shoulder) (Ikai et al., 1998; Ridgway & Byrne, 1999)
- Tendonitis (Ridgway & Byrne, 1999)
- Complex regional pain syndrome (Griffin & Reddin, 1981)
- Spasticity (Van Ouwenaller et al., 1986)
- Biomechanical malalignment
- Inappropriate treatment choices
- Mishandling and poor positioning (Andersen, 1985; Davis, 2001; Runyan, 1995)

Pain and Subluxation

If there is a correlation between pain and subluxation, it is the result of increased risk of trauma from improper handling of the subluxed hemiplegic shoulder (Davis, 1985; Hayner, 2014) and overstretching of tissue, possibly leading to impingement problems and tears (Hayner, 2014)

Treatment of Subluxation

- Incorporates the subluxed arm while considering the closest approximation of normal movement and scapulohumeral rhythm (Gilmore, Spaulding, & Vandervoort, 2004)
- Humeral head correctly aligned in the glenoid fossa and full scapular ROM
- If pain co-occurs, needs to be addressed because it can limit patient desire and ability to participate during treatment

Treatment of Subluxation: Slings

Research has not shown the effectiveness of slings:

- Facilitates flexor pattern (flexion, adduction and internal rotation) (Moodie, Brisbin & Morgan, 1986; Ridgway & Byrne, 1999; Van Dyck, 1999)
- Does not realign the scapular symmetry or support the scapula to the ribcage (Cailliet, 1980; Paci, Nannetti, & Rinaldi, 2005)
- Does not reduce subluxation
- Increases horizontal asymmetry
- May prevent functional use of the arm (Moodie et al., 1986; Ridgway & Byrne, 1999; Van Dyck, 1999)
- May have an adverse effect on gait pattern (Miller, 1975)
- No research to support that slings reduce shoulder pain (Cailliet, 1981; Hurd, Farrell, & Waylonis, 1974)

Pros:

- Reduces self-injury from movement in clients with perceptual neglect or inattention
- Supports a heavy, flaccid UE, thereby reducing stretch to the tissue and possibly pain during ambulation (Ridgway & Byrne, 1999)

Use of Slings

- For arm support
- Minimal use
- Continue to evaluate for alternative means of support

Treatment of subluxation: Positioning

- Support of the hemiplegic arm with arm troughs, lap boards & tables
- Prevent stretching the joint capsule and ligaments
- Does not approximate the head of the humerus into the glenoid fossa

Treatment of Subluxation: Electrical Stimulation (ES)

ES applied to the supraspinatus and posterior deltoid muscle for 6-hr period, 7 days/wk for 6 wk was effective for:

- Improving arm function
- Reducing subluxation (Ikai et al., 1992; Wang, Chan, & Tsai, 2000)

https://www.youtube.com/watch?v=SRgxOjFFFJU

Electrical stimulation applied to the supraspinatus and the middle deltoid for 15 min twice a day for 6 wk. was effective in reducing subluxation (Kobayashi, Onishi, Ihashi, Yagi, and Handa, 1999)

Meta-analysis concluded: Evidence supports the use of electrical stimulation to prevent subluxation early after a stroke but little evidence supports using electrical stimulation late after a stroke (Ada and Foongchomcheay, 2002)

Treatment of Subluxation: Supports
Different supports available
- Support the forearm
- Support under the axilla
- Cuff the proximal humerus to reduce downward pull
- Apply elastic straps on the anterior and posterior of the arm to the palm to also reduce downward traction.
- Found to have varying effectiveness in reducing subluxation (Kieran, Willingham, Schwartz, & Firooznia, 1984; Moodie et al.,1986; Zorowitz, Idank, Ikai, Hughes, & Johnston, 1995)

To Maintain ROM & Prevent Pain
- Joint/soft tissue mobilization
- Low load prolonged stretch
- Use deliberate full movement of limbs
- Positioning
- ROM (pain free and addressing the muscles that act on the shoulder)
- Stretching the scapulohumeral joint
- Stretching the glenohumeral joint

Stretching the scapulohumeral joint

Shoulder flexion ROM

- Always pain free
- Support the arm
- Shoulder flexion while flexed at the hips (leaning forward) or table slides

Stretching Muscles of the Scapulohumeral and Scapulothoracic Joints
- Approximate scapula glide to thorax
- If scapula is not rotating upwards during shoulder flexion, tearing may occur
- Place your hand over the scapula to assist upward rotation of the scapula during shoulder flexion
- Never force movement
- Stop with pain

Stretching the Glenohumeral Joint

Slow rolling to bent knees

- Pt supine, knees flexed
- Slowly roll knees R & L
- Increasing as stiffness subsides

Why? Stretches the latissimus dorsi which is impacted by spasticity and stiffness and greatly influences the glenohumeral joint ROM and the scapula (Van Dyck, 1999)

Slow upper body rolling

- Positioned side lying on hemiplegic side, hips and knees flexed (to isolate movement to UB)
- UE is positioned near trunk, lengthened position
- Scapula is in protraction
- Have pt slowly roll UB forward and backward
- As stiffness decreases, slowly move arm into greater degrees of flexion (Van Dyck, 1999)

Why? Reduces tone effect on latissimus dorsi and pectoralis major (powerful internal rotators) and stretches the anterior, posterior and inferior structures of the glenohumeral joint allowing pain-free ROM in all planes (Van Dyck, 1999)

Stretching the Glenohumeral Joint

- Periods of positioning into (gentle) external rotation (low load prolonged duration)
- Ask client to attempt to intertwine hands behind head when watching TV. Allow the elbows to move back to toward the pillow for a gentle stretch

Shoulder Taping & Strapping

- Shoulder taping and shoulder strapping have been used interchangeably in the literature (Ancliffe, 1992; Appel, Mayston & Perry, 2011; Griffin & Bernhardt, 2006; Hanger et al., 2000; Hayner, 2012; Morin et al., 1997; Morin & Bravo, 1997; Pandian et al., 2013; Peters & Lee, 2003; Peterson, 2004; Van Peppen, Kwakkel, Wood-Dauphinee, Hendricks, Van dee Wees & Dekker, 2004)
- Different types of tape used (elastic and rigid)
- Placement of tape varies
- The similarity is that the tape is adhesive

Effectiveness of Shoulder Taping Post CVA

Studies have looked at:

- Pain (Ancliffe, 1992; Hanger et al., 2000; Hayner, 2012; Peters & Lee, 2003)
- ROM (Hanger et al., 2000; Hayner, 2012; Peters & Lee, 2003)
- ADL function (Hanger et al., 2000; Hayner, 2012; Peters & Lee, 2003)
- Subluxation (Hayner, 2012; Peters & Lee, 2003)
- Findings mixed regarding pain, ROM, & ADLs. Two studies on subluxation demonstrated a reduction in subluxation (Hayner, 2012; Peters & Lee, 2003)

Systematic Review: Appela, Perry and Jones (2014)

- Examined efficacy, adverse effects of shoulder taping to reduce stroke-related shoulder impairments, and function.
- 8/888 studies met inclusion criteria
- Interventions, outcomes and measures were diverse

- Conclusions:
    - Insufficient evidence of efficacy or inefficacy but minimal adverse effects and should be further evaluated
    - Potential to delay the onset of shoulder pain was indicated, albeit without necessarily decreasing it overall

Background to the California Taping Method

- AOTA conference in Chicago
- Trials with clients
- Revisions to tape placement
- Sharing of method
- Research study
- Published findings in AJOT. Open access (free to download). Link on last slide.

My Research

Title: Effectiveness of the California Tri-Pull Taping Method for Shoulder Subluxation Post Stroke: A Single Subject ABA Design

I named the taping technique The California Tri-Pull Taping Method

Method

- An interrupted time series quasi experimental single-subject ABA design
- Each participant acted as his or her own control
- Baseline (A) was the control period. Subluxation, AROM, and ADL function of the affected shoulder was measured over a 5-day period
- The intervention period (B) consisted of applying shoulder tape every Monday, Wednesday, and Friday for 3 wks for nine taping sessions
- Followed 10 participants for nine weeks

Measured

- Subluxation
- Active range of motion
- Shoulder pain
- Activity of daily living function
- Tape comfort (during the treatment phase)

Measurement Tools

- Finger-width palpation to determine subluxation
- Measuring tape, measuring amount of subluxation in centimeters from the inferior aspect of the acromion to the superior aspect of the humeral head.
- Visual analog scale to measure pain at rest ranging from 1, indicating no pain, to 10, indicating extreme pain.
- Goniometric measurement for AROM in shoulder flexion and shoulder abduction.
- Katz Index of Independence in Activities of Daily Living to measure Functional ADL performance
- The Katz Index ranks performance in six ADLs: bathing, dressing, toileting, transfers, continence, feeding.

- A score of 0 is given for full assistance, 1 for some assistance, and 2 for no assistance. Twelve is the maximum score for full independence in all domains.

Inclusion Criteria
- Poststroke
- Minimum of 5 mm shoulder subluxation in involved UE or palpation of at least one finger's breadth gap between the inferior aspect of the acromion and the superior aspect of the humeral head in comparison with the contralateral upper extremity
- Ability to understand and respond to simple verbal instructions or attend all sessions with translator
- Age 18 years or older

Exclusion Criteria
- History of severe trauma or debilitating osteoarthritis of the affected shoulder
- History of a postsurgical or orthopedic procedure on the affected shoulder in the past year
- Evidence of fragile skin and open wounds
- Allergy to taping products

Participants
- All received some amount of therapy after their CVA and before participating in the study
- No participants were receiving concurrent treatment or therapy for their hemiplegic upper extremity during their enrollment in the study

Research Findings - Subluxation

The taping decreased inferior subluxation significantly from baseline to intervention, but not post-intervention

Research Findings – Active Range of Motion

There was significant increased active range of motion in **shoulder flexion and abduction** between baseline and intervention and intervention and post-intervention phases

Research Findings - Pain

No significant difference in pain was found. Why?

- Participant 4: fall at home → increased pain at first post-intervention baseline measure. At this visit, opted to drop out of study so that the tape could be reapplied for a reported reduction in his pain
- Participant 1 withdrew from study at Intervention 8 because of an unrelated medical complaint (she started with 10/10 pain and wanted to maintain the taping and not participate in the withdrawal period)
- Participants, 6,7,9 & 10 all started without pain

Research Findings – Activities of Daily Living

Functional activity of daily living scores were significant

Research Findings – Tape Comfort

The taping was reported comfortable

Implications of this Research for Occupational Therapy

- The California Tri-Pull Taping Method offers an intervention for addressing subluxation which is quick and easy to apply and is reported to be comfortable.
- When applied, allows for functional use of the subluxed extremity.
- Reduces subluxation during the taping period.
- Improvements in active shoulder flexion and abduction would allow for increased functional ability in our clients with non-flaccid extremities.
- Improvements found in functional ADLs, following the taping, would benefit clients working on increased independence.

Supplies

Two types of tape

1. Self-adhesive 1.5-in. cotton undercover tape (N.C.: Mefix; S & N: Hypafix)
2. 1 ½ inch rigid strapping tape (N.C.: Leukotape P Sportstape; S & N: Rigid Strapping Tape)

- Skin prep (a protective skin barrier wipe)
- If necessary, a tape remover wipe to remove prior tape residue

Steps to Taping

Refer to handout

Link to instructions is also at the end of the handout

Open access Tri-Pull Taping research article in AJOT:

Hayner, K. (2012). Effectiveness of the California Tri-Pull taping method for shoulder subluxation poststroke: A single-subject ABA design. *Journal of Occupational Therapy, 66*, 727-736. doi:10.5014/ajot.2012.004663

http://ajot.aota.org/article.aspx?articleid=1851632

YouTube Video of Taping Method:

https://www.youtube.com/watch?v=ivgBxzFwbUE

(or type in “tri-pull taping” and pull it up)

PDF of steps to the Tri-Pull Taping Method:

https://drive.google.com/file/d/1mj8HVI6MzkxiH8VtXGHQvgLG85qJAEPX/view?usp=sharing

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