Preventing Shoulder Injuries

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Physical therapists are health care professionals who restore, maintain and improve movement..

Introduction

- Any cycle in sports community rounds up at Olympic Games;
- To achieve best level, optimum athletic form, best results and most satisfaction – athlete have to improve all the time;
- “A good traveller is one who knows how to travel with a wisdom”;
  - Avoidance obstacles (restrictions: hardware - alignment);
  - Pay attention to signs (symptoms: sensorymotor system);
  - Choose wisely.. (adapted to the imposed demand).

Overhead athletes shoulder pathologic cascade

- Shoulder functional and anatomical complexity exposes it to injury;
- Interrelatedness to the proximal and distal regions;
- Athletes often ride the line between performance and injury (Iannotti 2014);

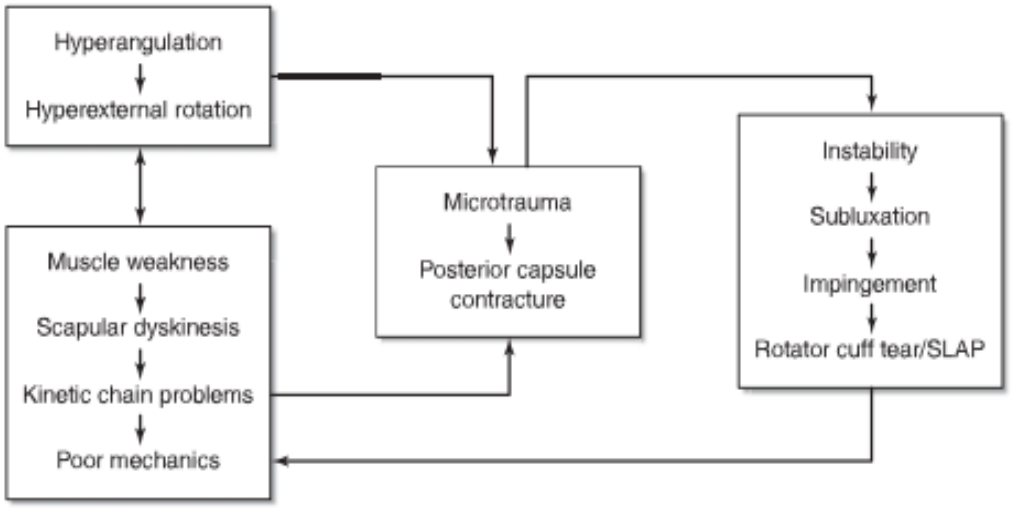


FIGURE 1-3. The overhead athlete's shoulder pathologic cascade involves multiple interrelated entities including microinstability, internal impingement, and changes in shoulder mechanics from microtrauma and weakness such as GIRD and scapular dyskinesis. From ElAttrache NS, Gonzalez-Lomas G, Ahmad CS. The shoulder in athletes. In: Matsen FA, Rockwood CA Jr, Lippitt SB, Wirth MA, eds. *The Shoulder*, Philadelphia, PA: Elsevier Health Sciences, 2009.

Functional Pathology

- “Functional pathology of motor system – vast field of functional impairments (K. Lewit);
  - Its interaction with the whole organism, mainly of a reflex nature;
  - We have to keep in mind that motor system functions as an entity principally wrong approach to understand impairments of different parts of motor system separately, without understanding the function of the motor system as a whole” (V. Janda 1978)

Clinical picture

- Signs and Risk FACTORS ..
  - Altered CNS Motor Control (Quality);
  - Restricted ROM (Quantity);
  - Postural deficit (Initial phase of movement - alignment);
  - Change in muscle tone (Hyper/Hypo Reactive);
  - V.Janda: “In various pathologic conditions we observe typical muscle changes of function:
    - Tightness;
    - Inhibition/Weakness”.

Keep the pace

- “The objective of injury prevention strategies is to ensure that tissue adaptation stimulated from exposure to load keeps pace with, and ideally exceeds the accumulated tissue damage.”
- *Stuart McGill, Ph.D.*

Why injury prevention is so important???

Handbook of Sports Medicine and Science Sports Injury Prevention (Bahr, 2009)

- Longevity? If underachiever..
- Health benefits? Winning all costs ..
- Specific group of individuals..
- Highly motivated, even if they'll be injured

WADA research studies

PMC full text: Subst Abuse Rehabil. 2014; 5: 95–105.
Published online 2014 Aug 14. doi: 10.2147/SAR.S53784

Table 1

Substance use rates among different populations of athletes as reported in various recent research studies

Substance	Athlete population	Percentage of athletes using substance
Any substances banned by WADA	Elite athletes across sports (positive drug tests)	2% over past year[5]
Alcohol	College athletes (self report)	75%–93% for male athletes; 71%–93% for female athletes over past year[6]
		85% over past year[7]
Anabolic steroids	High school students (self report)	0.7%–6.6% over past year[8]
	College athletes (self report)	0.2%–5% for males depending on sport; 0.0%–1.6% for females depending on sport over past year[7,8]
	Professional football players (self report)	9% used at some point in career[8]
	Competitive power lifters (self report)	67% used at some point in career[8]
Cannabis	College athletes (self report)	28% over past year[7]
Opiates	Professional football players (self report)	52% used at some point in career (71% of those misused at some point in career)[9]
Smokeless tobacco	College athletes (self report)	23% over past year[7]
	College baseball players (self report)	40%–50% over past year[10]
	Professional baseball players (self report)	35%–40% over past year[10]
	Professional football players (self report)	20%–30% over past year[10]
Stimulants	College athletes (self report)	3% over past year[6]

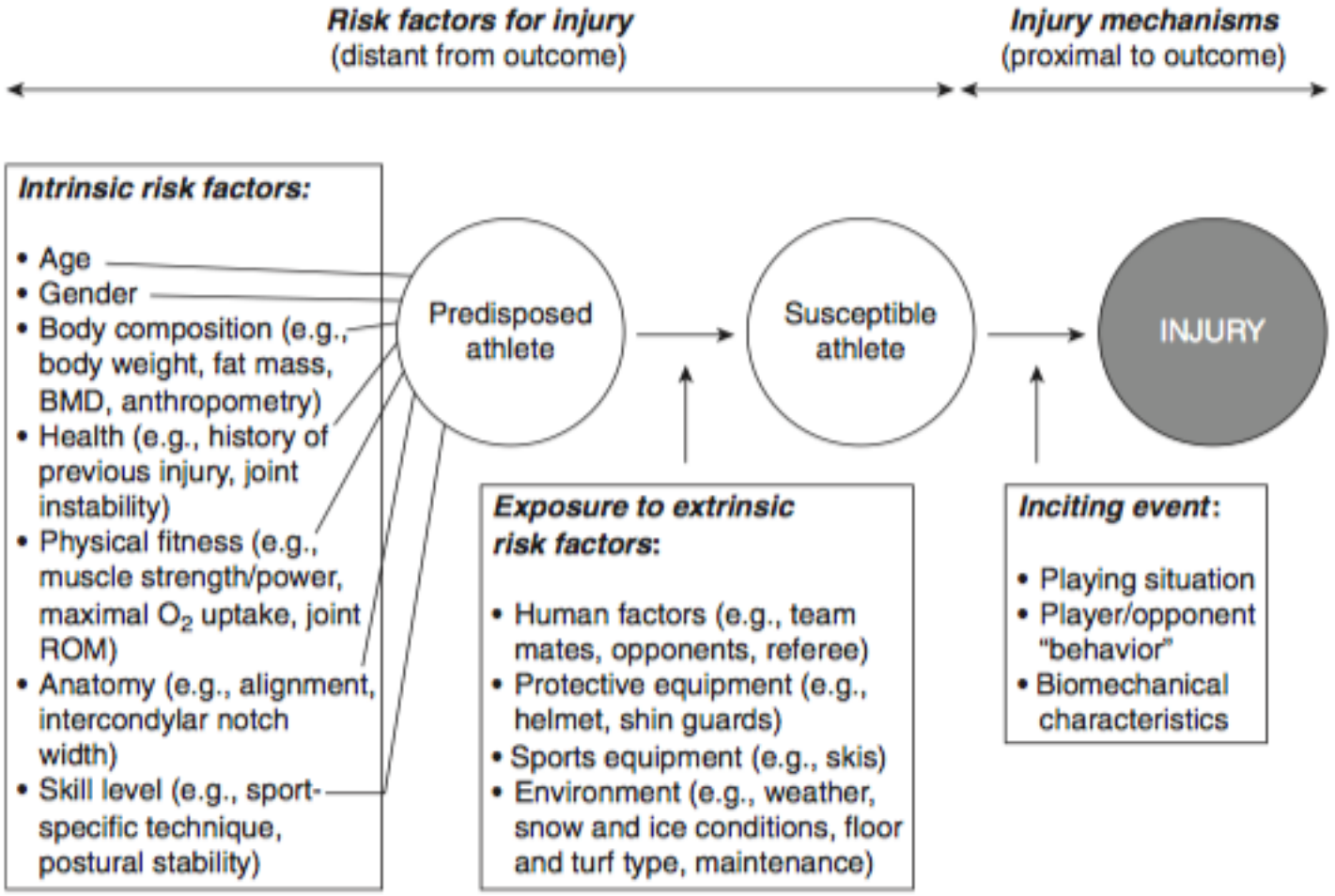
Abbreviation: WADA, World Anti-Doping Agency.

Subst Abuse Rehabil

When?

- Stop???
- Change???
- Assess the risk factors..

Risk factors in sports (Bahr, 2009)



A model of injury causation (Meeuwisse, 1994; Bahr & Krosshaug, 2005)

Preventing Shoulder injuries (Bahr 2009)

- External factors:
  - Exposure to loads – years of weight lifting, hours of swimming, numbers of throws..
  - Mechanical factors – mistakes in technical/specific movement – dysfunctional movement pattern. Throwing event – leaning forward with the head..

Screen the athlete

- To ensure optimal function of the shoulder in a specific task performance:
  - Filling the gap..

Optimal function performing specific task

- History of the previous injuries:
  - Sensorymotor system function (optimal sensory input for optimal motor output);
  - Limbic system (fear, state of mind, cognitive control, concentration);
  - Hydration and sleep quality (recovery after the previous stress!);
  - BioPsychoSocial Model.

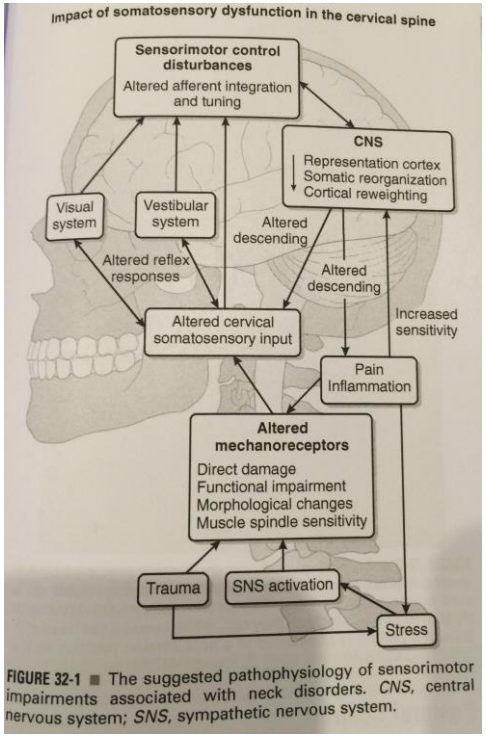


FIGURE 32-1 ■ The suggested pathophysiology of sensorimotor impairments associated with neck disorders. *CNS*, central nervous system; *SNS*, sympathetic nervous system.

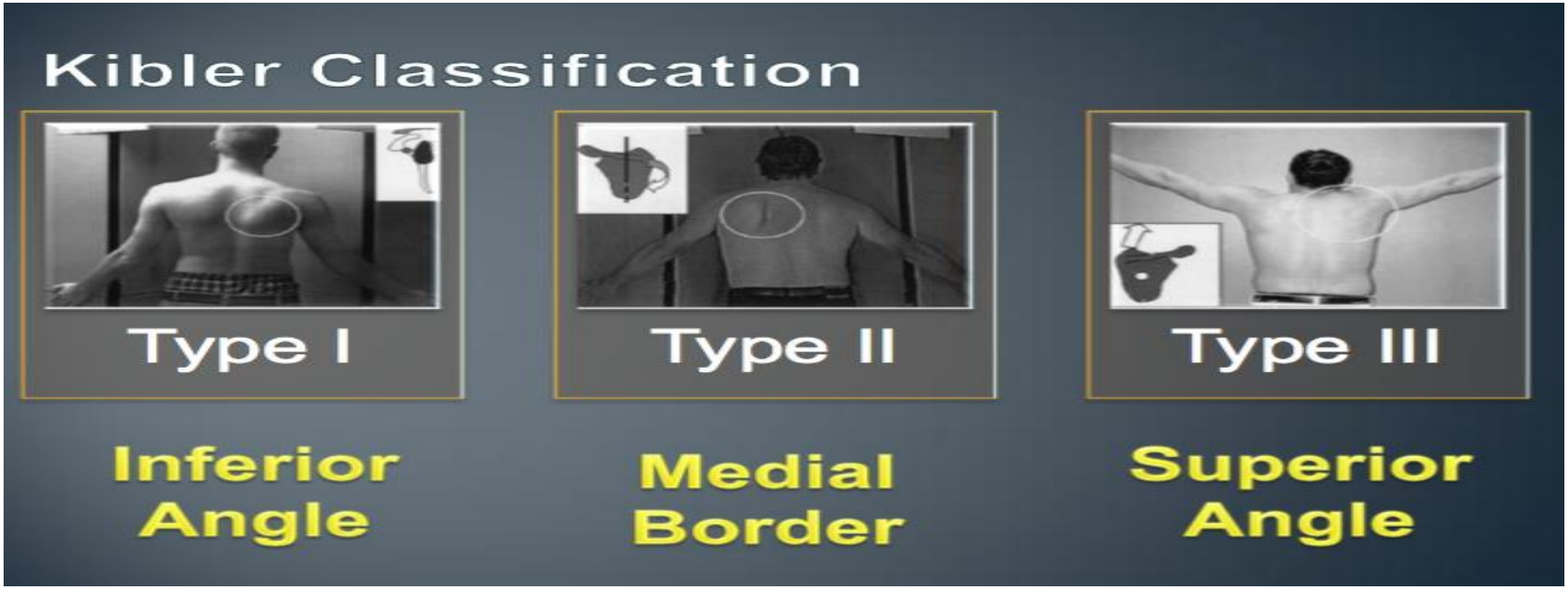
(Jull, 2015)

Optimal function performing specific task

- MC – Motor Control / Dynamic stability / Coordination:
  - Scapula / GH (Jobe, 1993; Kibler, 2013; Voight, 2013; Borich, 2006; Laudner, 2007; et. Al.)
  - Neck – Altered activity of the serratus anterior during unilateral arm elevation in patients with cervical disorder (Helagdottir, 2011);
  - Integration in to kinetic chain – Core stability and lower/upper extremities functional relation (Kibler, 2006)
- Range Of Motion performing specific tasks:
  - GH (Ellenbecker, 2013; Wilk, 2012)
  - Thoracic spine and Rib cage (Iveson, 2010)

Scapula

- The scapulothoracic articulation is one of the least congruent joints in the body.
- No actual bony articulation exists between the scapula and thorax, which allows tremendous mobility in many directions including:
  - protraction, retraction;
  - elevation, depression;
  - anterior/posterior tilt, and;
  - internal/external and upward/downward rotation.
- When describing scapular positions, the point of reference is the glenoid.



- Weakness of the scapular stabilizers and resultant altered biomechanics could result in:
- 1) abnormal stresses to the anterior capsular structures of the shoulder;
- 2) increased possibility of rotator cuff compression, and;3) decreased shoulder complex neuromuscular performance.

Scapular Dyskinesis

- Most of the abnormal biomechanics and overuse injuries that occur about the shoulder girdle can be traced to alterations in the function of the scapular stabilizing muscles (Voight, 2013);
- Altered scapular motion and position have been termed scapular dyskinesis. The definition of dyskinesis is the alteration of normal scapular kinematics (Kibler, 2013);
- Weakness of the scapulothoracic muscles potentially leads to abnormal positioning of the scapula, disturbances in scapulohumeral rhythm, and generalized shoulder complex dysfunction (Jobe, 1993);
- Neurological causes including cervical radiculopathy or nerve palsy. Soft tissue factors including inflexibity (tightness) or intrinsic muscle problems, and alterations in periscapular muscle activation (Kibler, 2013).

Scapulo – humeral dependency

- Posterior shoulder tightness is thought to be a contributing cause of the anterior tilted scapula. Borich et al showed a correlation between decreased internal rotation and anterior tilted scapula in normal subjects (Borich,2006);
- Laudner showed a moderate correlation to posterior shoulder tightness and forward scapular posture in baseball players. Launder believes that increased laxity in baseball pitchers may contribute to a downwardly rotated scapula (Laudner, 2007).

Range Of Motion

- Most overhead athletes exhibit an excessive amount of external rotation (ER) and a decrease in internal rotation (IR) when measured from 90 of abduction. This physiological adaptation to the throwing shoulder occurs in those that play baseball, softball, and tennis. Furthermore this increase in shoulder ER and decrease in shoulder IR is seen in both active and passive motions (Ellenbecker, 2013);
- TROM - glenohumeral internal rotation + glenohumeral external rotation
- Wilk et al found that pitchers whose TROM arc was limited 5 degrees or more than the uninvolved side exhibited 2.5 times greater risk of sustaining a shoulder injury (Wilk, 2012).

Sequence of activation

- This study demonstrates that there are patterns of activation of muscles around the scapulohumeral articulation in the normal accomplished tennis serve. Rehabilitation and conditioning programs for tennis players should be structured to restore and optimise the activation sequences (scapular stabilisers before rotator cuff), task specific functions (serratus anterior as a retractor of the scapula, lower trapezius as a scapular stabiliser in the elevated rotating arm) and duration of activation of these muscles.

Muscle activation in coupled scapulohumeral motions in the high performance tennis serve

William B Kibler, T Jeff Chandler, Robert Shapiro, Michael Conuel

Br J Sports Med 2007;**41**:745–749. doi: 10.1136/bjsm.2007.037333

Proximal stability for distal performance capacity..

- Chae-Woo, Ju-Yong Shin, Youn-Joung Kim ;
- “The effects of finger extension on shoulder muscle activity”
- According to the result of this study, finger extension is considered to affect the muscles for connected shoulder joint stability (Chae-Woo, 2015).

- Jeongok Yang, Joongsook Lee, BomJin Lee et.,al;
- “The Effects of Active Scapular Protraction on the Muscle Activation and Function of the Upper Extremity”
- The adjustment of scapula into its ideal position through active scapular protraction increased the activations of the muscles surrounding the shoulder joint and improved the function of the upper extremity (Jeongok, 2014).

We Have A Problem

- Screening Scapula Motor Control
- The difficulty with validating such programs lies in the ability to measure changes in scapular position;
- It has been difficult to assess and track scapular motion secondary to the relatively deep position of the scapula and overlying muscles;
- Most methods for evaluating scapular dyskinesis involve some sort of tool, test, or observation in a single plane;
- A problem due to the three-dimensional nature of scapular movement.

Screening

- Lateral Scapula Slide test (Kibler, 1998)
  - Scapulohumeral and Thoraco - Scapular assessment;
  - Positions: resting arm at the side; hands on the hips, fingers anteriorly and thumb posteriorly (humerus in 45 degrees aprox.); arm elevation at 90 degrees internally rotated;
  - Measurement reference point: nearest spinous process to the inferior angles of the scapula;
  - A difference of 1,5 cm clinical significant, in pathology 3 cm.

- Tippett (Voight, 2000) – radiographic comparison for the validity 0.9.

Scapular activation in closed kinetic chain

- “Shoulder Musculature Activation During Upper Extremity Weight-Bearing Exercise”
- Uhl T, Carver T, Mattacola C, et. Al.;
- Journal of Orthopaedic & Sports Physical Therapy (2003);

- Weight-bearing postures and the demand for shoulder muscles studied appears to be linearly related. Shoulder muscular activity increased as the weight-bearing loads progressed from the prayer position, quadruped, tripod, pointer, push-up, push-up feet elevated, and then to the 1-arm push-up. The results of this study support the notion that increasing upper extremity weight bearing requires increasing shoulder musculature demand.
- The weight-bearing exercise positions appear to preferentially activate the infraspinatus through most of the exercise positions. The position of the subject’s arm during the testing most likely produced a posterior shear force at the glenohumeral joint, though this was not measured.

Y-balance test

The upper quarter Y-balance test (UQYBT) has been proposed as a CKC assessment of upper quarter mobility and stability using a functional testing device;

UQYBT to measure upper quarter performance and difference in dominant and non-dominant upper extremity;

Glenohumeral Range of Motion

- The assessment of the ROM into rotation of the shoulder can be measured with a goniometer or an inclinometer, and in many positions of the body and the shoulder;
- There is great variability in the literature regarding shoulder position (e.g. scapular or frontal plane);
- Optimal standardization of body and shoulder position, supine position with the shoulder in the frontal plane and the elbow flexed 90°. The inclinometer is aligned with the forearm and the shoulder is moved into internal / external rotation.

Functional tests for ROM

- **Shoulder Mobility Reach Test**
- The Shoulder Mobility Reach Test (SMRT) assesses combined extension, internal rotation and adduction on one shoulder while simultaneously assessing combined flexion, external rotation, and abduction in the other. To perform the SMRT the subjects reached as far as possible behind their neck with one hand, while reaching behind the back with the opposite hand. The distance between the hands was recorded. The SMRT was intended to evaluate thoracic spine and scapular mobility as well as actual shoulder motion. The aver- age of 3 trials was used for analysis. SMRT intrarater reliability in this study was the same for both sides (ICC=0.99).

Functional tests for ROM

- **Side-lying Thoraco-lumbar Rotation Measurement (STRM)** ;
- Limitation in thoracic rotation could lead to increased motion at adjacent areas (i.e., shoulders and low back). This could potentially lead to excessive strain and subsequent injury from repetitive stress;
- Magee reports that total thoracic spine rotational range of motion is 35-50 degrees while total lumbar spine rotational range of motion is 3-18 degrees;

Clinical significance -

10% difference (Iveson, 2010);

Core stability and shoulder optimal performance

- The core is the region of the body comprised of the abdomen, the proximal lower limb, the hips, the pelvis, and the spine. The core musculature serves two functions: lumbopelvic stability and the creation and transfer of forces (Kibler, 2006);
- Core stability is an important component max- imising efficient athletic function. Function is most often produced by the kinetic chain, the coordinated, sequenced activation of body segments that places the distal segment in the optimum position at the optimum velocity with the optimum timing to pro- duce the desired athletic task (Kibler, 2006).

Core stability and shoulder optimal performance

Lateral Trunk Endurance Test (Side Bridge)

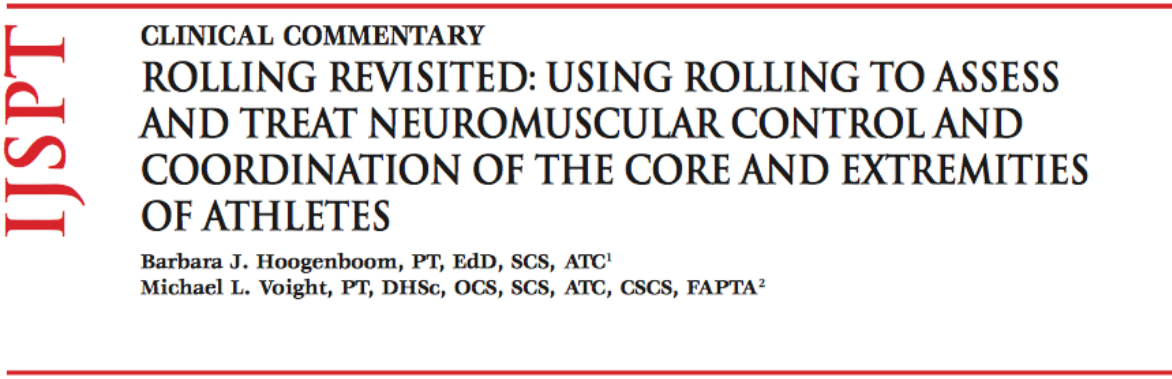
- The Lateral Trunk Endurance Test (LTET) is included to assess the endurance of the shoulder and lateral trunk musculature;
- The subjects were posi- tioned side-lying with their legs extended. The top foot was placed in front of the lower foot for support and the free hand was placed on the shoulder of the stance limb with the arm across the chest. Subjects lifted their hips off the surface to maintain a straight line over their body while supporting themselves with the stance limb and the sides of the feet. The test was terminated when the subject was no longer able to maintain position after one warning or 240 seconds (Manske, 2009)

Assessment of performance capacities

- Movement capacity – performance properties:
  - Endurance
  - Power
  - Strength
  - Speed of recovery ..

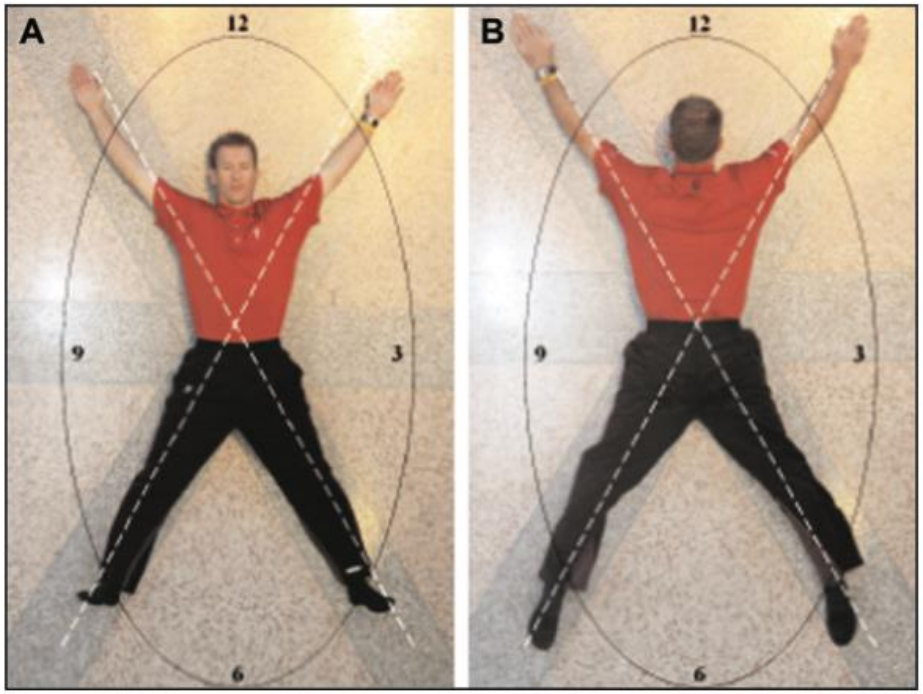
Reduce the risk with ..

- IF I could choose one movement pattern for correction – I would prefer .. Rolling movement pattern:
- – synkinesis of eye neck and upper limb movement;
- – Thoracic spine mobility;
- – Core stability;
- – Disociation of upper and lower limbs..



The rolling patterns can function as a basic assessment of the ability to shift weight, cross midline;

and coordinate movements of the extremities and the core (Hogenboom, 2015).



TGU

- Turkish Get Up – as strength and control assessment tool.
- Unpublished study..
- Descriptive EMG of Serratus Anterior and Trapezius muscles in the “Turkish Get Up” Exercise;
- Robert Morrison PT, DPT; Stephanie Wheeler PT, DPT, CSCS; Rachel Boutin PT, DPT, CSCS
- **PURPOSE/HYPOTHESIS:** The purpose is to quantify surface EMG activity of serratus anterior and upper, middle, lower trapezius (SA, UT, MT, LT) during the Turkish Get Up (TGU).
- **NUMBER OF SUBJECTS:** 24;
- **RESULTS:** EMG was significantly greater at the final weight than at rest for all muscles. There was moderate (37.28% of MVIC) activation of the SA with lower activation of the UT, MT and LT (17.68%, 21.77% and 20.78% of MVIC respectively)

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