### SCREENING FOR THE IDENTIFICATION OF SHOULDERS AT RISK OF INJURY

**Presenter:** Shaw Bronner PT, MHS, EdM, OCS; Director of ADAM Center at Long Island University, Brooklyn, NY and Director of Therapy Services at Alvin Ailey, New York, NY.

**Description:** Performing artists experience high rates of musculoskeletal injuries. The annual incidence of musculoskeletal injury in dancers is 67 – 95% with the majority of injuries at the lower extremity (57-75%). [1-4] Less than 10% are upper extremity injuries. Not surprisingly, the majority of injuries in musicians are at the upper extremity, with shoulder problems ranging from 12 to 32%. [5-7]

Approximately 360,000 college athletes undergo preseason screening annually. In contrast, most performing artists do not. While performing artists are often referred to as "athletes", it is apparent that they are not receiving the same considerations for wellness.

A screen of the shoulder region includes the following:

<u>Performance or functional assessment</u>. For the dancer, a technique-specific analysis includes the portebras and lifting. For the musician, interaction of player with instrument is key.

Beighton laxity test. [8]

Scoliosis screen.

Injury history.

Risk factors. [1-4, 9]

**Objectives:** At the conclusion of this presentation, participants will be able to:

- 1. Describe the objectives and elements of pre-participation screening of the shoulder girdle in dance populations.
- 2. Describe the objectives and elements of pre-participation screening of the shoulder girdle in musicians.
- 3. Understand risk factors for shoulder injury in dance and music populations.

Level: Multilevel.

**Content:** The major points in this presentation are:

- 1. Ergonomic and human factor analysis of the functional demands of the instrumentmusician or dance-specific activity is key.
- 2. Previous injury of the area is an important risk factor.

#### References

**1.** Bronner S, Ojofeitimi S, Rose D: Injuries in a modern dance company: Effect of comprehensive management on injury incidence and time loss. American Journal of Sports Medicine 2003; 31(3): 365-373.

**2.** Byhring S, Bo K: Musculoskeletal injuries in the Norwegian National Ballet: a prospective cohort study. Scand J Med Sci Sports 2002; 12(6): 365-70.

**3.** Nilsson Ć, Leanderson J, Wykman A, Strender LE: The injury panorama in a Swedish professional ballet company. Knee Surgery, Sports Traumatology, Arthroscopy 2001; 9(4): 242-246.

**4.** Solomon R, Solomon J, Micheli LJ, McGray E: The "cost" of injuries in a professional ballet company: A five year study. Medical Problems of Performing Artists 1999; 14: 164-169.

**5.** Fishbein M, Middlestadt SE: The ICSOM Medical Questionnaire. Senza Sordino 1987; 25(6): 1-8.

**6.** Hunter JH, Fry MS: Incidence of overuse syndrome in the symphony orchestra. Medical Problems of Performing Artists 1986; 1(2): 51-55.

7. Larsson L-G, Baum J, Mudholkar GS, Kollia GD: Nature and impact of musculoskeletal problems in a population of musicians. Medical Problems of Performing Artists 1993; 8: 73-76.
8. Gannon LM, Bird HA: The quantification of joint laxity in dancers and gymnasts. Journal of Sports Sciences 1999; 17: 743-750.

**9.** Miller G, Peck F, Watson JS: Pain disorders and variations in upper limb morphology in music students. Medical Problems of Performing Artists 2002; 17: 169-172.

#### EMERGENCY BACK STAGE CARE OF A SHOULDER INJURY IN A PERFORMING ARTIST

Teresa L. Schuemann, PT, SCS, ATC, CSCS Director, Skyline Hospital Physical Therapy and Sports Medicine

This lecture is about the initial evaluation and treatment of the performing artist who has suffered an injury to his/her shoulder. It will provide a systematic approach for evaluation and treatment to provide adequate initial medical care, minimize effect of injury and facilitate rapid recovery from the shoulder injury.

# Objectives

At the end of the lecture, the participant will be able to:

- 1. Follow a systemic approach to initially evaluate a performing artist who has suffered an acute shoulder injury.
- 2. Initiate appropriate stabilization and initial treatment of a performing artist who has suffered an acute shoulder injury.
- 3. Understand and acknowledge classic "red flags" that lead to direct referral for further medical care and radiological studies
- 4. Properly "package" a performing artist who has suffered an acute shoulder injury to transport to another facility for further medical care.

**Level** – Intermediate 2

# Content

## Mechanism of Injury

What happened?

- ♦ Fall/Impact
  - Direct blow
  - Onto Outstretched arm
- Traction injury
- Overuse leading to failure

## Primary survey

- ABC's
  - Head or cervical spine injury
  - DOTS
    - **D**eformity
    - Open Injuries
    - Tenderness
    - Swelling

## **Transport Decision**

- Mode of transport
  - Independent with UE stabilization

- Assisted with people with UE stabilization
- Dependent
  - Carry
  - Stretcher
- UE Stabilization/Immobilization
  - Anatomical stabilization
  - ♦ Sling/Swathe

#### **Secondary Survey**

- Subjective evaluation
  - Mechanism of Injury
  - Audible sounds at time of injury
  - Feeling/Sensation immediate after injury
  - Pain description
- Palpation
  - Deformities
  - Sensation
    - Injury area
    - Distal to injured area
    - Dermatomes C2 T1
    - Dermatomes peripheral nerve distribution
      - ♦ Axillary
  - Pulse
    - Brachial
    - Radial
  - Circulation
    - Capillary refill
  - ♦ Warmth
  - Swelling
  - Pain upon palpation
- Active ROM

- ◆ Cervical
- ♦ Scapular
- ♦ Shoulder
- ◆ Elbow/Forearm/Wrist
- Manual Muscle Testing
  - Myotome (C2 T1)
  - Major Muscle Groups
    - Upper trapezius/Levator scapulae
    - Deltoid
    - Supraspinatus
    - Infraspinatus
    - Supscapularis
    - Biceps
    - Triceps

#### **Secondary Treatment**

- Interventions re: Injury for correction and/or stabilization
- Anti-inflammatory treatments

### **Case Scenarios**

- Shoulder dislocation
  - ♦ Anterior
    - Mechanism of Injury
    - Presentation
    - Initial treatment
      - Relocation attempt
    - Follow up treatment
  - Posterior
    - Mechanism of Injury
    - Presentation
    - Initial treatment
    - Follow up treatment
- AC Sprain/Separation
  - Mechanism of Injury
  - Presentation
  - Initial treatment
  - Follow up treatment
- Rotator Cuff Tear
  - Mechanism of Injury
  - Presentation
  - Initial treatment
  - Follow up treatment

#### **Return to Performance Decisions**

- Options
  - No return to performance with referral to further medical care
    - "Package" to transport
    - Initial anti-inflammatory treatment
  - No return to performance with further backstage evaluation
    - Stabilize for comfort, support and avoidance of further injury
    - Initial anti-inflammatory treatment
  - Return to limited performance with support
    - Restriction delineation
    - Support application
    - Re-evaluation/treatment plan
  - Return to full performance with support
    - Support application
    - Re-evaluation/treatment plan
  - Return to limited performance without support
     Re-evaluation/treatment plan
  - Return to performance without restriction
    - Re-evaluation/treatment plan

- Functional testing to make these decisions
  - ♦ ROM
  - ♦ MMT
  - Shoulder clock in appropriate weight bearing position
  - Rhythmic Stabilization in appropriate positions
  - Push-up in appropriate position
  - Hanging in appropriate position

## References

- 1. Emergency Response Textbook, American Red Cross 2000
- 2. Basic Life Support for Healthcare Providers American Heart Association 2000
- 3. Andrews JR, Clancy, JR, Whiteside JA <u>On Field Evaluation and Treatment of</u> Common Athletic Injuries Mosby pp. 91, 216 – 218, 219 – 222.
- 4. Connolly JF <u>The Management of Fractures and Dislocation: An Atlas</u> W.B. Saunders Co. pp 620, 634, 659, 715 716.
- 5. Hayes K, Callanan M, Walton J, Paxinos A, Murrell GAC "Shoulder Instability: Management and Rehabilitation JOSPT 32(10), 2002.
- 6. Hoppenfield S. Physical Examination of the Spine and Extremities. 31 34.
- Itoi E, Hatakeyama Y, Masakazu U, Pradhan RL, Kido T, Sato K. "Position of Immobilization after Dislocation of the Shoulder. A Cadaveric Study JBJS 81:385-90, 1999
- Itoi E, Sashi R, Minagawa H, Shimizu T, Wakabayashi I, Sato K. "Position of Immobilization after Dislocation of the Glenohumeral Joint" JBJS 83:661-667, 2001
- 9. Magee DJ <u>Orthopedic Physical assessment</u> Fourth Edition. Saunders. pp. 274 275, 210 211, 215, 218.
- 10. Nicholas JA, Hershman EB. <u>The Upper Extremity in Sports Medicine</u>. CV Mosby Co. pp 169 179, 188-190, 198 202, 867.
- 11. Robinson CM, Kelly M, Wakefield AE. "Redislocation of the Shoulder during the First Six weeks after a Primary Anterior Dislocation: Risk Factors and Results of Treatment. JBJS 84:1552-1559, 2002
- 12. Rockwood CA, Green DP, Bucholz RW. <u>Fractures in Adults Third Edition</u>JB Lippincott Co. pp. 946, 953-954, 1205 – 1207

CASE STUDY OF A PERFORMING ARTIST LIMITED BY SHOULDER PAIN

Noel Goodstadt, MPT, OCS, CSCS. University of Delaware Sports & Orthopedic PT Clinic

Description: Shoulder pain is a common ailment in all upper extremity activities of repetitive nature, occurring in the work place, sports, and the performing arts. There are a large variety of pathologies and/or combination of pathologies responsible for shoulder pain. It's important to rule out the common causes, but even more important to consider the uncommon causes. Shoulder pathology for a viola player can be significantly limiting, and can prevent an individual from participating in his/her season of concerts if not resolved quickly. Therefore, it is important to have a sound physical therapy diagnosis to guide the treatment intervention. There is limited evidence of the relationship between restricted thoracic spine movement and shoulder pain, however the evidence suggests an effect on scapular kinematics (Kebaetse, et al.1999). In this case presentation we hypothesized that her shoulder pain was due to poor thoracic mobility and weak scapular musculature.

Objectives: Upon completion of this case study the participant should be able to:

- 1. Identify profiles of patients who may benefit from the use of thoracic manipulation/mobilization in the treatment of shoulder pain.
- 2. Understand and apply the appropriate reasoning for keeping the artist practicing vs. resting during the initiation of PT.

Level: Multilevel

## Content:

- I. History of Present Illness
  - a. Student involved in the University Concert Band with 3 week history of left shoulder pain.
  - b. Decreased frequency of practice
- II. Review of the Literature
- III. Differential Diagnosis
  - a. Hypothesis
- IV. Intervention
  - a. Segmental Mobilizations
  - b. Thoracic Manipulation

### V. Results/Conclusion

References:

- 1. Kebaetse M, McClure P, Pratt NA. Thoracic position effect on shoulder range of motion, strength, and three-dimensional scapular kinematics. *Arch Phys Med Rehabil*, 1999; Aug; 80 (8):945-950.
- 2. Norlander S, Nordgren B. Clinical symptoms related to musculoskeletal neckshoulder pain and mobility in the cervico-thoracic spine. Scand J Rehabil Med, 1998; Dec; 30(4):243-351.

Kaiser Permanente Los Angeles Physical Therapy Clinic	Name	
Evaluation and Treatment	MR#	
Describe your problem:	DOB	
How long has your problem existed?		
If you have pain, mark on the body diagram the location symptoms.	of these	
If you work or exercise, what type of physical activity or (i.e. sitting, standing, bending, lifting, walking) does it e	r body posture ntail?	
What types of treatment have you had for this problem in	n the past?	
**************************************	**************************************	****
MED/SURG:	_ STAGE I (Pain Limited)	Date
	Peripheral Nerve Entrapment Reduction	
INITIAL NDI/SPADI Date:	Neck Stabilisation Procedures Shoulder Physical Agents	
FINAL NDI/SPADI Date:	Ergonomics/Postural Training	
	Neck/Shoulder Taping Procedures	
SIGNIFICANT IMPAIRMENTS/CATEGORIES (See for	form B for details)	
Pain Limited Peripheral Nerve Mobility	STAGE II (Resistance Limited)	
Pain Limited Cervical/Thoracic/Rib Mobility	Cervical Mobilisation Procedures	
Pain Limited Shoulder Mobility	Thoracic/Rib Mobilization Procedures	
Resistance Limited Peripheral Nerve Mobility	Neural Elements Mobilization Procedures	
Resistance Limited Cervical Mobility	Shoulder Mobilization Procedures	
Resistance Limited Shoulder Mobility		
Shoulder Impingement	STAGE III (Exercise, Biomechanical, Multic	lisciplinary)
Shoulder Instability	Flexibility Exercises	
Physical Medicine & Kenabilitation Consultation	Stabilizing/ Strengthening Exercises	
Neurosurgery/Spine or Orthonaedic Consult	Multidisciplinary Pain Mont Program	
rearesurgery spine of orthopaedic consult	manuscipinary i an mant i togram	
PATIENT RECEIVED EDUCATION IN: Date	PATIENT RECEIVED TRAINING IN:	Date
Sitting and Lying Ergonomics	Flexibility Exercises	
Job Task Ergonomics	Strengthening Exercises	
Recreational/Athletic Ergonomics	Stabilization Exercises	
Self Care/Wellness and Prevention		

Kaiser Permanente Los Angeles Physical Therapy Clinic Cervical Spine and Shoulder Disorders Evaluation and Treatment	Name MR#			
Reported problem:	DOB	DOB		
History of problem/reason for onset/progression:				
Body Chart (Include type of pain, aggravating and easir	ng factors):			
Patient's occupational/recreational ergonomic stresses:				
Previous treatment:				
**************************************	**************************************	****		
MED/SURG:	STAGE I (Pain Limited) Peripheral Nerve Entrapment Reduction	Date		
INITIAL NDI/SPADI Date:	Neck Stabilisation Procedures			
FINAL NDI/SPADI Date:	Shoulder Physical Agents Ergonomics/Postural Training			
TINAL NDI/STADI Date	Neck/Shoulder Taping Procedures			
SIGNIFICANT IMPAIRMENTS/CATEGORIES (See	form B for details)			
Dain Limited Darinharal Narya Mahility	STACE II (Pasistanaa Limitad)			
Pain Limited Cervical/Thoracic/Rib Mobility	Cervical Mobilisation Procedures			
Pain Limited Shoulder Mobility	Thoracic/Rib Mobilization Procedures			
Resistance Limited Peripheral Nerve Mobility	Neural Elements Mobilization Procedures			
Resistance Limited Cervical Mobility	Shoulder Mobilization Procedures			
Resistance Limited Shoulder Mobility		• •• •		
Shoulder Impingement	STAGE III (Exercise, Biomechanical, Multidis	ciplinary)		
Physical Medicine & Rehabilitation Consult	Stabilizing/Strengthening Exercises			
Refer For Immediate Physician Consultation	Biomechanical Eval & Mgmt			
Neurosurgery/Spine or Orthopaedic Consult	Multidisciplinary Pain Mgmt Program			
DATIENT DECEIVED EDUCATION IN. Data	DATIENT DECEIVED TO A INING IN-	Data		
Sitting and Lying Ergonomics	Flevibility Exercises	Date		
Job Task Ergonomics	Strengthening Exercises			
Recreational/Athletic Ergonomics	Stabilization Exercises			
Self Care/Wellness and Prevention				

Physical Therapist\_

(Signature)

Form A

Kaiser Permanente Los Angeles Physical Therapy Clinic		Cervical and Physical Imp	Shoulder airments	Name MR#	
C/S Ligament Stability <b>F</b>	Exam (Note "+")	findings/impairments): -/-	+		
C/S Mobility Exam:	Pain onset at end range (√), during movement (x), or negative (-):         Left Rotation Ipsilat/Contralat Sx         Left C/S quadrant⇒Radicular         VBI (Note "+"findings)				
<b>Neurological Status</b> (Note Manual Muscle Tests -/+ Reflex Tests -/+	"+" findings impa	airments): Sensatic UMN/C	on Tests -/+ ranial Nerve Tests	_/+	
Nerve Mobility: Sx Repi	oduced with	Median Bias	Radial B	as Ulnar Bias	
Palpatic Spinal Mobility:	on of Entrapme	nt Site (Note Area)			
Pain Limited Pain Limited Resistance Limit Resistance Limit	L C0/1 C R C0/1 C ed L C0/1 ed R C0/1	C1/2 C2/3 C3/4 C4/5 C C1/2 C2/3 C3/4 C4/5 C C1/2 C2/3 C3/4 C4/5 C1/2 C2/3 C3/4 C4/5 C1/2 C2/3 C3/4 C4/5	C5/6 C6/7 C7/T1 1 C5/6 C6/7 C7/T1 1 C5/6 C6/7 C7/T1 1 C5/6 C6/7 C7/T1 1 C5/6 C6/7 C7/T1 1	<sup>st</sup> Rib T1/2 T2/3 T3/4 T4/5 <sup>st</sup> Rib T1/2 T2/3 T3/4 T4/5 <sup>st</sup> Rib T1/2 T2/3 T3/4 T4/5 <sup>st</sup> Rib T1/2 T2/3 T3/4 T4/5	
Shoulder AROM: Scaption 90/90ER IR (HBB)	Pain onset at L R Note L R L R	end range ( $$ ), during Abnormalities:	movement (x), or j	pain free ( -):	
Shoulder PROM: Flexion/TOS Abduction 90/90ER IR (HBB)	Pain onset at L R Note L R L R L R	end range ( $$ ), during Abnormalities:	movement (x), or p	pain free with overpressure (-):	
Shoulder Accessory Mol L R Hypern L R Hypom L R Pain lir	bility: nobile A obile A nited A	G-H P/PA/Inf Glide P/PA/Inf Glide P/PA/Inf Glide	A-C AP/PA/Inf Glide AP/PA/Inf Glide AP/PA/Inf Glide	S-C AP/Inf Glide AP/Inf Glide AP/Inf Glide	
Resisted Exam: (x) weal Left/Right/Both Active compression tests	k, (√) painful, o I 5 <b>(- or +):</b> L	or (-) 5/5 strength/pair ER with sulcus eft/Right Labru	i free IR m/Rotator Cuff	Biceps Bracii AC Dysfunction	
Tenderness (- or +):	Subacromial B	ursa Supraspina	tus Infraspin	atus Bicipital Groove	
Strength Deficits (- or +)	Left/Right/Bo	th Lower Trap	Middle Trap	Serratus Anterior RC	
Flexibility Deficits: Pec Major	<i>Left/Right/Bo</i> Pec Minor	th Upper Trap Suboccipitals	Levator Scap. Latissimus Dor	SCM Subscapuaris rsi Teres Major	
Postural Deficits: E	xcessive Capit	al Extension Prot	racted Scapula	Excessive Thoracic Kyphosis	
Date	Phys	ical Therapist			

Cervical and Shoulder Examination

#### Algorithm #1



Emmanuel Yung PT, MA, OCS Skulpan Asavasopon PT, OCS Joe Godges DPT, MA, OCS

#### Cervical Examination and Intervention

#### Algorithm #2



Shoulder Examination and Intervention

Algorithm #3



Emmanuel Yung PT, MA, OCS Skulpan Asavasopon PT, OCS Joe Godges DPT, MA, OCS



#### Associated Upper Quarter Impairment Examination

#### Algorithm #4



#### Selected References

- Aker PD, Gross AR, Goldsmith CH, Peloso P. Conservative management of mechanical neck pain: systematic overview and meta-analysis. *BMJ*. 1996;313:1291-6.
- Antonaci F, Ghirmai S, Bono G, Sandrini G, Nappi G. Cervicogenic headache: evaluation of the original diagnostic criteria. *Cephalalgia*. 2001;21:573-83.

Aprill C, Dwyer A, Bogduk N. Cervical zygapophyseal joint pain patterns. II: a clinical evaluation. *Spine*. 1990;15:458-61.

- Aspinall W. Clinical testing for the craniovertebral hypermobility syndrome. *J Orthop Sports Phys Ther*. 1990;12:47-54.
- Bang MD, Deyle GD. Comparison of supervised exercise with and without manual physical therapy for patients with shoulder impingement syndrome. *J Orthop Sports Phys Ther*. 2000;30:126-37.
- Bigliani LU, Kelkar R, Flatow EL, Pollock RG, Mow VC. Glenohumeral stability. biomechanical properties of passive and active stabilizers. *Clin Orthop Rel Res.* 1996;330:13-30.
- Bokor DJ, Hawkins RJ, Huckell GH, Angelo RL, Schickendantz MS. Results of nonoperative management of full-thickness tears of the rotator cuff. *Clin Orthop Rel Res.* 1993;294:103-10.
- Bronfort G, Evans R, Nelson B, Aker PD, Goldsmith CH, Vernon H. A randomized clinical trial of exercise and spinal manipulation for patients with chronic neck pain. *Spine*. 2001;26:788-97.
- Bulgen DY, Binder AI, Hazleman BL, Dutton J, Roberts S. Frozen shoulder: prospective clinical study with an evaluation of three treatment regimens. *Ann Rheum Dis*. 1984;43:353-60.
- Burkehead WZ, Rockwood CA. Treatment of instability of the shoulder with an exercise program. *J Bone Joint Surg*. 1992;74A:890-6.
- Calis M, Akgun K, Birtane M, Karacan I, Tuzun F. Diagnostic values of clinical diagnostic tests in subacromial impingement syndrome. *Ann Rheum Dis.* 2000;59:44-7.
- Chesworth BM, MacDermid JC, Roth JH. Movement diagram and "end-feel" reliability when measuring passive lateral rotation of the shoulder in patients with shoulder pathology. *Phys Ther.* 1998;78:593-601.
- Coderre TJ, Katz J, Vaccarino AL, Melzack R. Contribution of central neuroplasticity to pathological pain: review of clinical and experimental evidence. *Pain*. 1993;52:259-85.
- Conroy DE, Hayes KW. The effect of joint mobilization as a component of comprehensive treatment for primary shoulder impingement syndrome. *J Orthop Sports Phys Ther.* 1998;28:3-14.
- Dall'Alba PT, Sterling MM, Treleaven JM, Edwards SL, Jull GA. Cervical range of motion discriminates between asymptomatic persons and those with whiplash. *Spine*. 2001;26:2090-4.
- Davidson RI, Dunn EJ, Metzmaker JN. The shoulder abduction test in the diagnosis of radicular pain in cervical extradural compressive monoradiculopathies. *Spine*. 1981;6:441-6.
- Di Fabio RP. Manipulation of the cervical spine: risks and benefits. *Physical Therapy*. 1999;79:50-65.
- Donatelli R, Greenfield B. Rehabilitation of a stiff and painful shoulder: a biomechanical approach. *J Orthop Sports Phys Ther*. 1987;9:118-26.
- Dreyfuss P, Michaelsen M, Fletcher D. Atlanto-occipital and lateral atlanto-axial joint pain patterns. *Spine*. 1994:1125-31.
- Dreyfuss P, Tibiletti C, Dreyer SJ. Thoracic zygapophyseal joint pain patterns. a study in normal volunteers. *Spine*. 1994;19:807-11.
- Dwyer A, Aprill C, Bogduk N. Cervical zygapophyseal joint pain patterns. I: a study in normal volunteers. *Spine*. 1990;15:453-7.
- Farmer JC, Wisneski RJ. Cervical spine nerve root compression. an analysis of neuroforaminal pressures with varying head and arm positions. *Spine*. 1994;19:1850-5.
- Feinstein B, Langton JNK, Jameson RM, Schiller F. Experiments on pain referred from deep structures. *J Bone Joint Surg.* 1954;36A:981-97.
- Fukui S, Ohseto K, Shiotani M, Ohno K, Karasawa H, Naganuma Y, Yuda Y. Referred pain distribution of the cervical zygapophyseal joints and cervical dorsal rami. *Pain*. 1996;68:79-83.
- Fukui S, Ohseto K, Shiotani M. Patterns of pain induced by distending the thoracic zygapophyseal joints. *Regional Anesthesia*. 1997;22:332-6.
- Gifford LS, Butler DS. The integration of pain sciences into clinical practice. J Hand Therapy. 1997;10:86-95.
- Glousman RE. Instability versus impingement syndrome in the throwing athlete. *Orthop Clin North Am.* 1993;24:89-99.

Emmanuel Yung PT, MA, OCS Skulpan Asavasopon PT, OCS Joe Godges DPT, MA, OCS

- Godges JJ, Matson-Bell M, Shah D, Thorpe D. The immediate effects of soft tissue mobilization with PNF on shoulder external rotation and overhead reach. *J Ortho Sports Phys Ther*. 2003;33:713-718.
- Grad A, Baloh RW. Vertigo of vascular origin. clinical and electronystagmographic features in 84 cases. *Arch Neurology*. 1989;46:281-4.
- Green S, Buchbinder R, Glazier R, Forbes A. Systematic review of randomised controlled trials of interventions for painful shoulder: selection criteria, outcome assessment, and efficacy. *BMJ*. 1998;316:354-60.
- Haldeman S, Kohlbeck FJ, McGregor M. Risk factors and precipitating neck movements causing vertebrobasilar artery dissection after cervical trauma and spinal manipulation. *Spine*. 1999;24:785-94.
- Hanson JA, Blackmore CC, Mann FA, Wilson AJ. Cervical spine injury: a clinical decision rule to identify high-risk patients for helical CT screening. AJR. 2000;174:713-7.
- Hawkins RJ, Abrams JS. Impingement syndrome in the absence of rotator cuff tear (stages 1 and 2). Orthop Clin North Am. 1987;18:373-82.
- Hawkins RJ, Kennedy JC. Impingement syndrome in athletes. Am J Sports Med. 1980;8:151-8.
- Heald SL, Riddle DL, Lamb RL. The shoulder pain and disability index: the construct validity and responsiveness of a region-specific disability measure. *Phys Ther.* 1997;77:1079-89.
- Hoffman JR, Mower WR, Wolfson AB, Todd KH, Zucker MI. Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma. National Emergency X-Radiography Utilization Study Group. [erratum appears in *N Engl J Med* 2001;344:464]. *N Engl J Medicine*. 2000;343:94-9.
- Hoving JL, Gross AR, Gasner D, Kay T, Kennedy C, Hondras MA, Haines T, Bouter LM. A critical appraisal of review articles on the effectiveness of conservative treatment for neck pain. *Spine*. 2001;26:196-205.
- Hurwitz EL, Aker PD, Adams AH, Meeker WC, Shekelle PG, Barr JS. Manipulation and mobilization of the cervical spine: a systematic review of the literature. *Spine*. 1996;21:1746-60.
- Ide M, Ide J, Yamaga M, Takagi K. Symptoms and signs of irritation of the brachial plexus in whiplash injuries. *J Bone Joint Surg.* 2001;83:226-9.
- Johnson EG, Godges JJ, Lohman EB, Stephens JA, Zimmerman GJ. Disability self-assessment and upper quarter muscle balance between female dental hygienists and non-dental hygienists. *J Dent Hyg.* 2003;77:217-23.
- Jordan A, Bendix T, Nielsen H, Hansen FR, Host D, Winkel A. Intensive training, physiotherapy, or manipulation for patients with chronic neck pain. a prospective, single-blinded, randomized clinical trial. *Spine*. 1998;23:311-8
- Jull G, Trott P, Potter H, Zito G, Niere K, Shirley D, Emberson J, Marschner I, Richardson C. A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache. Spine. 2002;27:1835-43.
- Kasch H, Stengaard-Pedersen, Arendt-Nielsen L, Staehelin Jensen T. Headache, neck pain, and neck mobility after acute whiplash injury: a prospective study. *Spine*. 2001;26:1246-51.
- Katayama Y, Fukaya C, Yamamoto T. Poststroke pain control by chronic motor cortex stimulation: neurological characteristics predicting a favorable response. *J Neurosurgery*. 1998;89:585-91.
- Keating L, Lubke C, Powell V, Young T, Souvlis T, Jull G. Mid-thoracic tenderness: a comparison of pressure pain threshold between spinal regions, in asymptomatic subjects. *Manual Therapy*. 2001;6:34-9.
- Kellgren JH. Observation on referred pain arising from muscle. Clin Sci. 1938;3:175-190.
- Kellgren JH. On the distribution of pain arising from deep somatic structures with charts of segmental pain areas. *Clin Sci.* 1939;4:35-46.
- Kopell H, Thompson W. *Peripheral Entrapment Neuropathies*. Florida, Robert I. Krieger Pub. Co., 1976, pp. 146-153,156,167.
- Larson E, Bjerg-Nielsen A, Christensen P. Conservative or surgical treatment of acromioclavicular dislocation. *J Bone Joint Surg*. 1986;68A:552-5.
- Levy AS, Lintner S, Kenter K, Speer KP. Intra- and interobserver reproducibility of the shoulder laxity examination. *Am J Sports Med.* 1999;27:460-3.
- Lorei M, Hershman E. Peripheral nerve injuries in athletes. Sports Medicine. 1993;16:130-147.
- MacDonald PB, Clark P, Sutherland K. An analysis of the diagnostic accuracy of the Hawkins and Neer subacromial impingement signs. *J Shoulder Elbow Surg*. 2000;9:299-301.
- Mahadevan S, Mower WR, Hoffman JR, Peeples N, Goldberg W, Sonner R. Interrater reliability of cervical spine injury criteria in patients with blunt trauma. *Ann Emerg Med.* 1998;31:197-201.
- McFarland EG, Campbell G, McDowell J. Posterior shoulder laxity in asymptomatic athletes. *Am J Sports Med.* 1996;24:468-71.
- McFarland EG, Kim TK, Savino RM. Clinical assessment of three common tests for superior labral anterior-posterior lesions. *Am J Sports Med*. 2002;30:810-5.

Emmanuel Yung PT, MA, OCS Skulpan Asavasopon PT, OCS

Joe Godges DPT, MA, OCS

- Moseley JB, Jobe FW, Pink M, Perry J, Tibone J. EMG analysis of the scapular muscles during a shoulder rehabilitation program. *Am J Sports Med.* 1992;20:128-34.
- Muhle C, Bischoff L, Weinert D, Lindner V, Falliner A, Maier C, Ahn JM, Heller M, Resnick D. Exacerbated pain in cervical radiculopathy at axial rotation, flexion, extension, and coupled motions of the cervical spine: evaluation by kinematic magnetic resonance imaging. *Investigative Radiology*. 1998;33:279-88.
- Muhle C, Resnick D, Ahn JM, Sudmeyer M, Heller M. In vivo changes in the neuroforaminal size at flexion-extension and axial rotation of the cervical spine in healthy persons examined using kinematic magnetic resonance imaging. *Spine*. 2001;26:E287-93.
- O'Brien SJ, Pagnani MJ, Fealy S, McGlynn SR, Wilson JB. The active compression test: a new and effective test for diagnosing labral tears and acromioclavicular joint abnormality. *Am J Sports Med.* 1998;26:610-3.
- Panjabi MM. The stabilizing system of the spine. Part I. function, dysfunction, adaptation, and enhancement. J Spinal Disorders. 1992;5:383-9.
- Panjabi MM. The stabilizing system of the spine. Part II. neutral zone and instability hypothesis. *J Spinal Disorders*. 1992;5:390-7.
- Panjabi MM, Lydon C, Vasavada A, Grob D, Crisco JJ, Dvorak J. On the understanding of clinical instability. *Spine*. 1994;19:2642-50.
- Peeters GG, Verhagen AP, de Bie RA, Oostendorp RA. The efficacy of conservative treatment in patients with whiplash injury: a systematic review of clinical trials. *Spine*. 2001;26:E64-73.
- Petersen CM, Hayes KW. Construct validity of Cyriax's selective tension examination: association of end-feels with pain at the knee and shoulder. *J Orthop Sports Phys Ther*. 2000;30:512-21; discussion 522-7.
- Pevny T, Hunter RE, Freeman JR. Primary traumatic anterior shoulder dislocation in patients 40 years of age and older. *Arthroscopy*. 1998;14:289-94.
- Philadelphia Panel. Philadelphia Panel evidence-based clinical practice guidelines on selected rehabilitation interventions for neck pain. *Phys Ther.* 2001;81:1701-17.
- Philadelphia Panel. Philadelphia Panel evidence-based clinical practice guidelines on selected rehabilitation interventions for shoulder pain. *Phys Ther*. 2001;81:1719-30.
- Pho C, Godges JJ. Management of whiplash-associated disorders addressing thoracic spine impairments: a case report. *J Ortho Sports Phys Ther*. 2004;34:511-523.
- Pope DP, Croft PR, Pritchard CM, Macfarlane GJ, Silman AJ. The frequency of restricted range of movement in individuals with self-reported shoulder pain: results from a population-based survey. *British Journal of Rheumatology*. 1996;35:1137-41.
- Rheault W, Albright B, Byers C. Intertester reliability of the cervical range of motion device. *J Orthop Sports Phys Ther.* 1992;15:147-150.
- Richards RR, An KN, Bigliani LU, Friedman RJ, Gartsman GM, Gristina, AG, Iannotti JP, Mow VC, Sidles JA, Zuckerman JD. A standardized method for the assessment of shoulder function. *J Shoulder and Elbow Surg*, 1994;3:347-52.
- Riddle DL, Stratford PW. Use of generic versus region-specific functional status measures on patients with cervical spine disorders. *Phys Ther.* 1998;78:951-63.
- Robinson CM, Kelly M, Wakefield AE. Redislocation of the shoulder during the first six weeks after a primary anterior dislocation: risk factors and results of treatment. *J Bone Joint Surg*. 2002;84-A:1552-9.
- Rowe CR. Recurrent anterior transient subluxation of the shoulder. the "dead arm" syndrome. *Orthop Clin North Am*. 1988;19:767-72.
- Sarhadi NS, Korday SN, Bainbridge LC. Radial tunnel syndrome: diagnosis and management. *J Hand Surgery British Volume*. 1998;23:617-9.
- Schmitt L, Snyder-Mackler L, Role of scapular stabilizers in etiology and treatment of impingement syndrome. *J Ortho Sports Phys Ther.* 1999;29:31-8.
- Schoensee SK. Jensen G. Nicholson G. Gossman M. Katholi C. The effect of mobilization on cervical headaches. J Ortho Sports Phys Ther. 1995;21:184-96.
- Sonnabend DH. Treatment of primary anterior shoulder dislocation in patients older than 40 years of age. conservative versus operative. *Clin Orthopaedics Rel Res.* 1994;304:74-7.
- Speer KP, Hannafin JA, Altchek D, Warren RF. An evaluation of the shoulder relocation test. *Am J Sports Med*. 1994;22:177-83.

- Spitzer WO, Skovron ML, Salmi LR, Cassidy JD, Duranceau J, Suissa S, Zeiss E. Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: redefining "whiplash" and its management.[erratum appears in Spine 1995 Nov 1;20:2372]. Spine. 1995;20(8 Suppl):1S-73S.
- Steiner WA, Ryser L, Huber E, Uebelhart D, Aeschlimann A, Stucki G. Use of the ICF model as a clinical problemsolving tool in physical therapy and rehabilitation medicine. *Phys Ther.* 2002;82:1098-107.
- Sterling M, Jull G, Vicenzino B, Kenardy J. Sensory hypersensitivity occurs soon after whiplash injury and is associated with poor recovery. *Pain*. 2003;104:509-17.
- Sterling M, Jull G, Carlsson Y, Crommert L. Are cervical physical outcome measures influenced by the presence of symptomatology?. *Physiotherapy Research International*. 2002;7:113-21.
- Tanaka N, Fujimoto Y, An HS, Ikuta Y, Yasuda M. The anatomic relation among the nerve roots, intervertebral foramina, and intervertebral discs of the cervical spine. *Spine*. 2000;25:286-91.
- Taylor DC, Arciero RA. Pathologic changes associated with shoulder dislocations. arthroscopic and physical examination findings in first-time, traumatic anterior dislocations. *Am J Sports Med.* 1997;25:306-11.
- Thomas D, Williams RA, Smith DS. The frozen shoulder: a review of manipulative treatment. *Rheumat Rehabil*. 1980;19:173-9.
- Tibone JE, Fechter J, Kao JT. Evaluation of a proprioception pathway in patients with stable and unstable shoulders with somatosensory cortical evoked potentials. *J Shoulder Elbow Surg*. 1997;6:440-3.
- Uitvlugt G, Indenbaum S. Clinical assessment of atlantoaxial instability using the Sharp-Purser test. *Arthritis Rheumatism.* 1988;31:918-22.
- Upton AR, McComas AJ. The double crush in nerve entrapment syndromes. Lancet. 1973;2:359-62.
- van der Heide B, Allison GT, Zusman M. Pain and muscular responses to a neural tissue provocation test in the upper limb. *Manual Therapy*. 2001;6:154-62.
- van der Heijden GJ, Van der Windt DA, De Winter AF. Physiotherapy for patients with soft tissue shoulder disorders: a systematic review of randomized clinical trials. *BMJ*. 1997;31:25-30.
- van der Windt DA, Koes BW, Boeke AJ, Deville W, De Jong BA, Bouter LM. Shoulder disorders in general practice: prognostic indicators of outcome. *British Journal of General Practice*. 1996;46:519-23.
- van der Windt DA, Koes BW, de Jong BA, Bouter LM. Shoulder disorders in general practice: incidence, patient characteristics, and management. *Ann Rheum Dis.* 1995;54:959-64.
- van der Windt DA, Koes BW, Deville W, et al. Effectiveness of corticosteroid injections versus physiotherapy for treatment of painful stiff shoulder in primary care: randomised trial. *BMJ*. 1998;317:1292-6.
- Vermeulen HM, Oberman WR, Burger BJ, Kok GJ, Rozing PM. End-range mobilization techniques in adhesive capsulitis of the shoulder joint: a multiple-subject case report. *Phys Ther*. 2000;80:1204-1213.
- Vicenzino B, Neal R, Collins D, Wright A. The displacement, velocity and frequency profile of the frontal plane motion produced by the cervical lateral glide treatment technique. *Clinical Biomechanics*. 1999;14:515-21.
- Wainner RS, Fritz JM, Irrgang JJ, Boninger ML, Delitto A, Allison S. Reliability and diagnostic accuracy of the clinical examination and patient self-report measures for cervical radiculopathy. *Spine*. 2003;28:52-62.
- Warner JJ, Micheli LJ, Arslanian LE, Kennedy J, Kennedy R. Patterns of flexibility, laxity, and strength in normal shoulders and shoulders with instability and impingement. *Am J Sports Med.* 1990;18:366-75.
- Warner JJ, Micheli LJ, Arslanian LE, Kennedy J, Kennedy R. Scapulothoracic motion in normal shoulders and shoulders with glenohumeral instability and impingement syndrome. a study using Moire topographic analysis. *Clin Orthop Rel Res.* 1992;285:191-9.
- Williams JW, Holleman DR, Simel DL. Measuring shoulder function with the Shoulder Pain and Disability Index. *J Rheumatology*. 1995;22:727-32.
- Wrisley DM, Sparto PJ, Whitney SL, Furman JM. Cervicogenic dizziness: a review of diagnosis and treatment. J Ortho Sports Phys Ther. 2000;30:755-66.
- Yamaguchi K, Sher JS, Andersen WK, Garretson R, Uribe JW, Hechtman K, Neviaser RJ. Glenohumeral motion in patients with rotator cuff tears: a comparison of asymptomatic and symptomatic shoulders. *J Shoulder Elbow Surg*. 2000;9:6-11.
- Yoo JU, Zou D, Edwards WT, Bayley J, Yuan HA. Effect of cervical spine motion on the neuroforaminal dimensions of human cervical spine. *Spine*. 1992;17:1131-6.
- Youdas JW, Carey JR, Garrett TR, Reliability of measurements of cervical spine range of motion-comparison of three methods. *Phys Ther.* 1991;71:98-106.

Emmanuel Yung PT, MA, OCS Skulpan Asavasopon PT, OCS Joe Godges DPT, MA, OCS