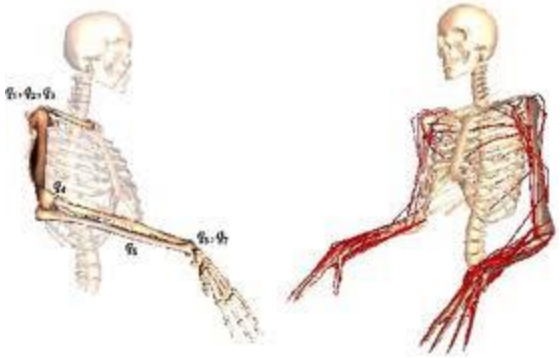
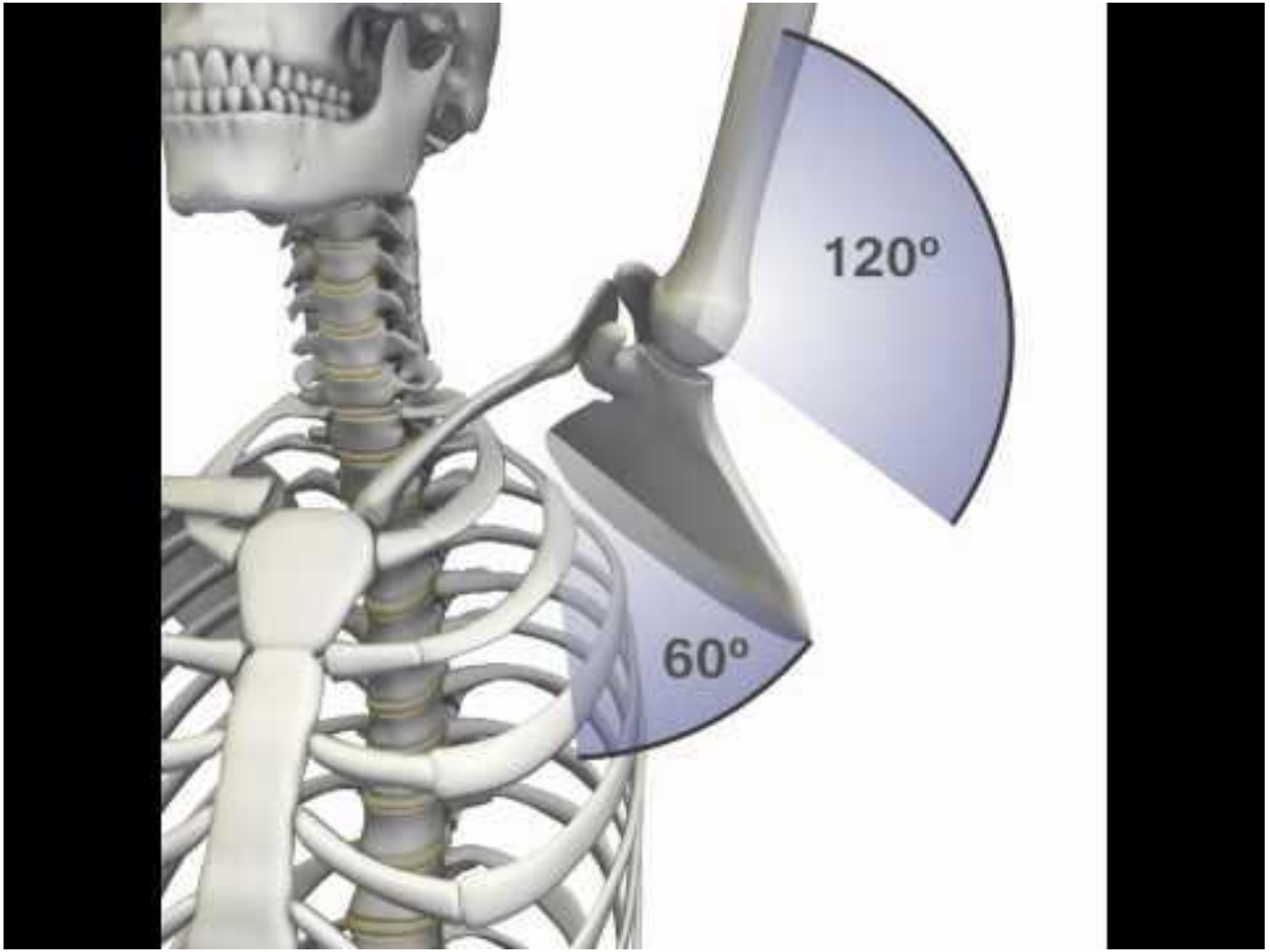


Universidad Industrial de Santander
CONSTRUIMOS FUTURO

Biomecánica de miembro Superior

Ft. Maria Solange Patiño Segura
Docente Escuela de Fisioterapia
Maestría en Fisioterapia



Revisión de estudios sobre la medición del movimiento escapular

Table Scapular rotations measured by various authors

Author	Method	Range of arm motion	Mean scapular motion
Inman et al, 1944[7]* (estimated from graphs)	2D radiographs	Flexion 30°-150°	50° Upward rotation 25° Clavicle elevation 30° Clavicle posterior rotation
		FP abd 30°-150°	40° Upward rotation 30° Clavicle elevation 30° Clavicle posterior rotation
Doody et al, 1970[4]*	2D goniometry	SP abd 5°-176°	59° Upward rotation
Poppen and Walker, 1976[19] (estimated from regression equation)†	2D radiographs	SP abd 0°-150°	54° Upward rotation 40° Posterior tilt ("twisting")
Kondo et al, 1984[11]*	3D double radiograph	SP abd 0°-max	60° Upward rotation 24° Posterior tilt 8° Int rotation ("medial tilt")
Bagg and Forrest, 1988[2]†	2D photographic	SP abd 0°-168°	64° Upward rotation
Johnson et al, 1993[8] (mean of 2 testers)*	3D electromagnetic digitizer (static)	FP abd 0°-120°	32° Upward rotation 9° Posterior tilt‡ 6° Int rotation ("protraction")
McQuade et al, 1995[15]	3D electromagnetic digitizer (static)	SP abd 0°-135°	32° Upward rotation 31° Posterior tilt

McClure P, et al. J Shoulder Elbow Surg, 2001.

Table Scapular rotations measured by various authors

Author	Method	Range of arm motion	Mean scapular motion
van der Helm and Pronk, 1995[14] (estimated from graphs)*	3D electromechanical digitizer (static)	Flexion 0°-180°	→ 60° Upward rotation 30° Posterior tilt −25° Int rotation ("retraction") −22° Clavicle protraction 10° Clavicle elevation
		FP abd 0°-180°	→ 60° Upward rotation 30° Posterior tilt −25° Int rotation ("retraction") −22° Clavicle protraction 10° Clavicle elevation
Ludewig et al, 1996[12]*	3D electromechanical digitizer (static)	SP abd 0°-140°	34° Upward rotation 15° Posterior tilt −13° Int rotation
Meskers et al, 1998[16] (values estimated from graphs)*	3D electromagnetic digitizer (quasi-static)	Flexion 0°-150°	→ 58° Upward rotation 24° Posterior tilt‡ 0° Int rotation ("protraction")
		FP abd 0°-150°	→ 60° Upward rotation 13° Posterior tilt‡ 3° Int rotation ("protraction")
Current study (McClure et al)*	3D electromagnetic continuous tracking	Flexion 16°-153°	→ 46° Upward rotation 31° Posterior tilt −26° Int rotation −20° Clavicle protraction 9° Clavicle elevation
		SP abd 11°-147°	→ 50° Upward rotation 30° Posterior tilt −24° Int rotation −21° Clavicle protraction 10° Clavicle elevation

JSPT

ORIGINAL RESEARCH

A NOVEL TECHNIQUE FOR DETERMINING SCAPULOHUMERAL TRANSLATION: A CASE-CONTROL AND INTER-RATER RELIABILITY STUDY

Keith M. Baumgarten, MD[1]
Roy Osborn, MS, DPT, OCS[2]
William E. Schweinle, PhD[3]
Jay Eidsness, PT, MS[2]
Drew Schelhaas, PT, MS[2]

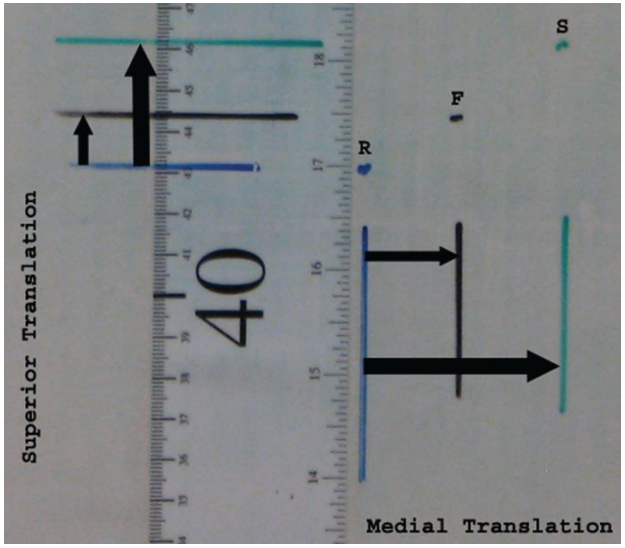


Table 2. *Inter-rater reliability of scapular translation measurements.*

Test Measurement Position	ICC
Resting Position	0.996
Vertical Flexion Translation	0.608
Vertical Scaption Translation	0.704
Horizontal Flexion Translation	0.697
Horizontal Scaption Translation	0.723
All Horizontal Measurements	0.712
All Vertical Measurements	0.753
All Flexion Measurements	0.616
All Scaption Measurements	0.807

Participantes: 10 sujetos asintomáticos (25-50 años).

Assessment of scapulohumeral rhythm for scapular plane shoulder elevation using a modified digital inclinometer

Jason S Scibek, Christopher R Carcia

World J Orthop 2012 June 18; 3(6): 87-94
ISSN 2218-5836 (online)

Table 1 Humeral elevation increments, mean scapular upward rotation measures, and scapulohumeral rhythm ratios

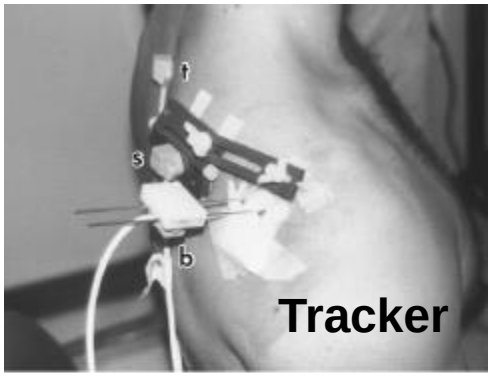
Shoulder elevation increments	Mean scapular upward rotation (± SD)	Scapulohumeral rhythm
0°-120°	35.95 (6.50)	2.34:1
0°-30°	0.73 (4.91)	40.05:1
30°-60°	10.99 (7.18)	1.73:1
60°-90°	8.45 (6.17)	2.55:1
90°-120°	15.78 (7.01)	0.90:1
0°-30°	0.73 (4.91)	40.05:1
30°-45°	5.69 (2.33)	1.64:1
45°-60°	5.29 (6.15)	1.83:1
60°-75°	3.15 (3.67)	3.76:1
75°-90°	5.29 (5.83)	1.83:1
90°-120°	15.78 (7.01)	0.09:1

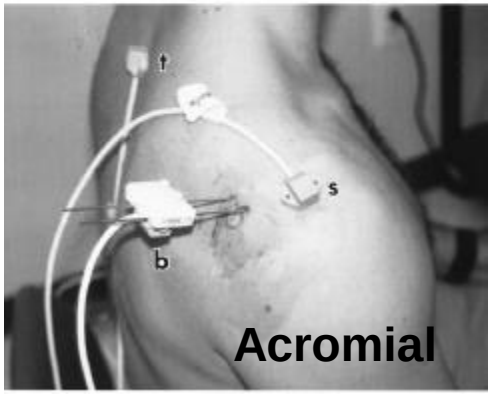
Participantes: 13 sujetos saludables (21.46 ± 1.13 años).

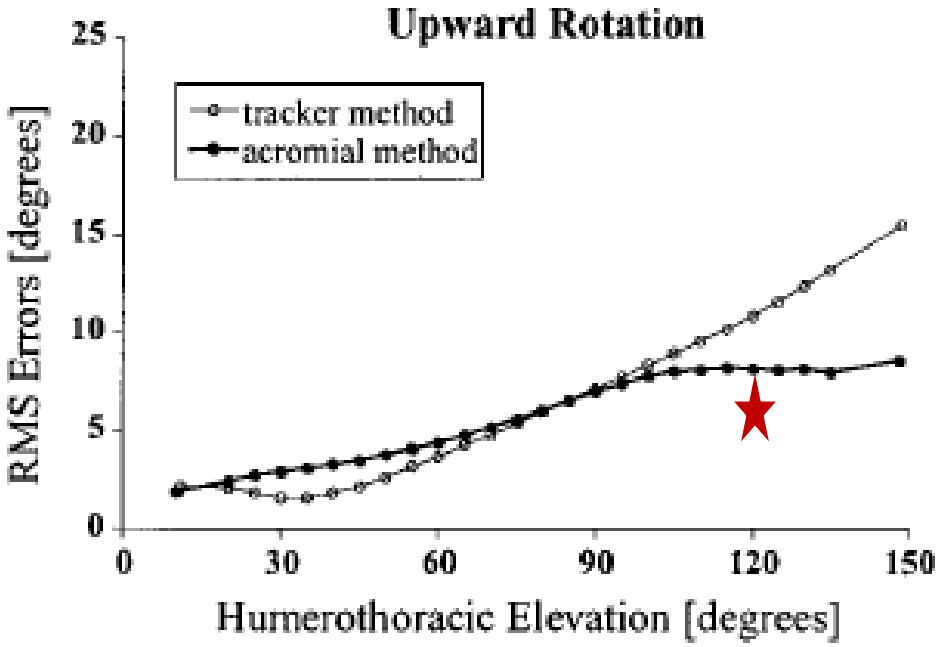
Journal of Biomechanical Engineering, 2001

Dynamic Measurements of Three-Dimensional Scapular Kinematics: A Validation Study

Andrew R. Karduna[1]
Phil W. McClure
Lori A. Michener
Brian Sennett



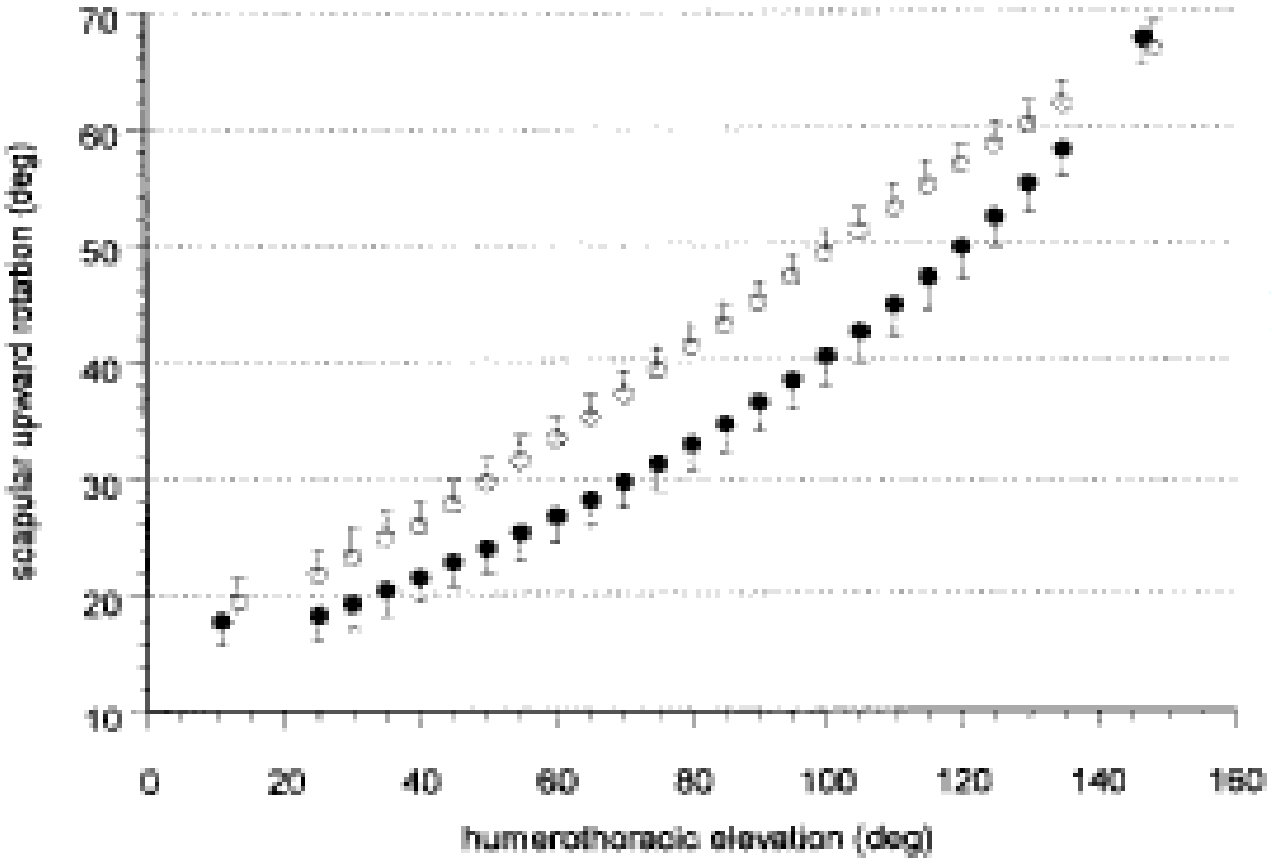




Participantes: 8 adultos jóvenes saludables.

Direct 3-dimensional measurement of scapular kinematics during dynamic movements in vivo

Philip W. McClure, PhD, PT,[a] Lori A. Michener, MEd, PT, ATC,[b] Brian J. Sennett, MD,[c] and Andrew R. Karduna, PhD,[d] *Glenside and Philadelphia, Pa, and Richmond, Va*



Elevar brazo

Descender brazo

Participantes: 8 adultos jóvenes saludables.

Sports Med 2009; 39 (8): 663-685

Shoulder Muscle Activity and Function in Common Shoulder Rehabilitation Exercises

Rafael F. Escamilla,[1,2,3] *Kyle Yamashiro,*[3] *Lonnie Paulos*[1] and *James R. Andrews*[1,4]

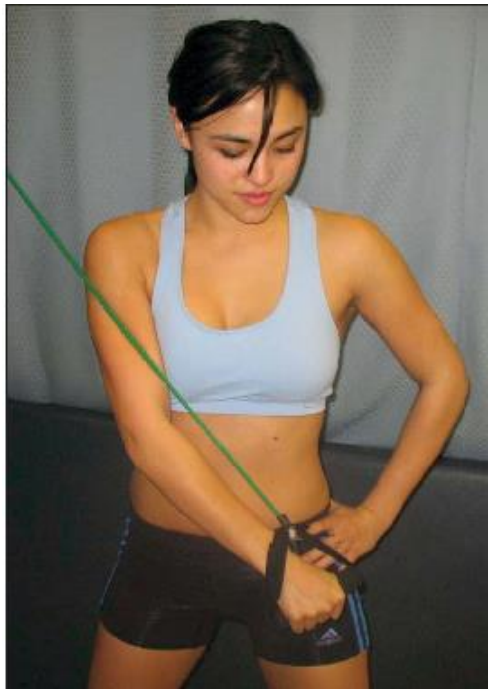


Table VIII. Mean (± SD) tubing force and glenohumeral and scapular electromyograph (EMG), normalized by a maximum voluntary isometric contraction (MVIC), during shoulder exercises using elastic tubing. Data for muscles with EMG amplitude >45% of an MVIC are set in bold italic type, and these exercises are considered to be an effective challenge for that muscle (adapted from Meyers et al.,[14] with permission)

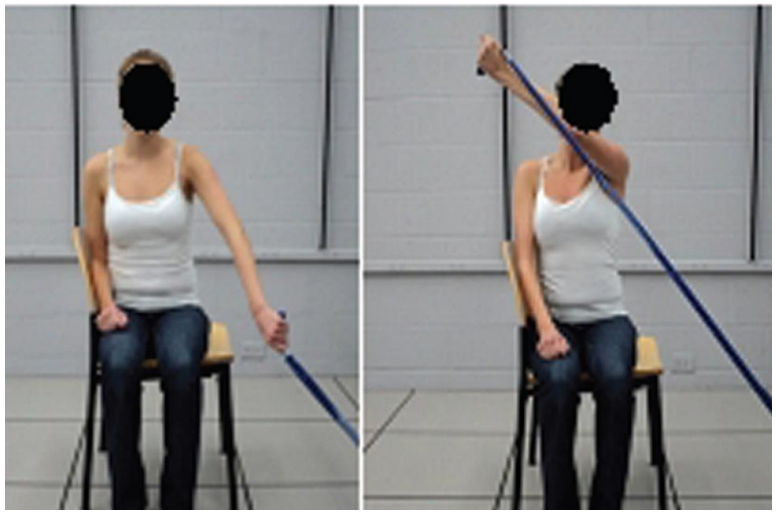
Exercise	Tubing force (N)	Pectoralis major EMG (%MVIC)	Latissimus dorsi EMG (%MVIC)	Biceps brachii EMG (%MVIC)	Triceps brachii EMG (%MVIC)	Lower trapezius EMG (%MVIC)	Rhomboids EMG (%MVIC)	Serratus anterior EMG (%MVIC)
D2 diagonal pattern extension, horizontal adduction, IR (throwing acceleration)	30±11	36±30	26±37	6±4	32±15	***54±46***	***82±82***	***56±36***

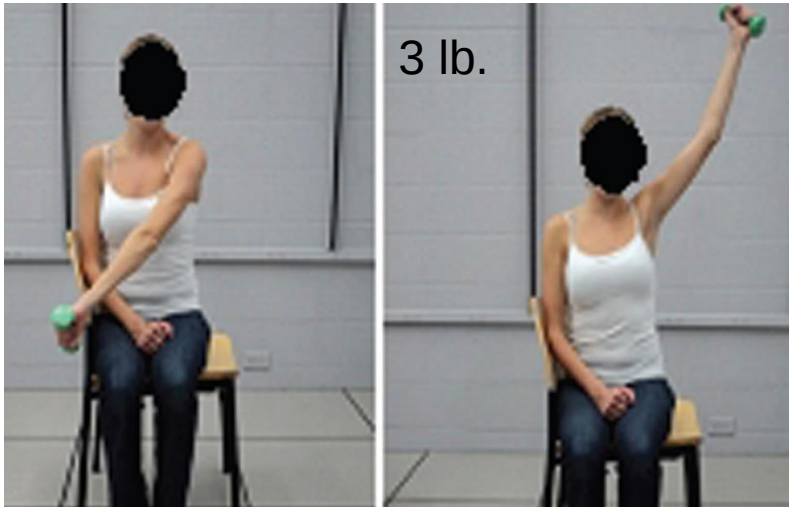
IJSPT

ORIGINAL RESEARCH

ELECTROMYOGRAPHIC ACTIVITY OF SCAPULAR MUSCLES DURING DIAGONAL PATTERNS USING ELASTIC RESISTANCE AND FREE WEIGHTS

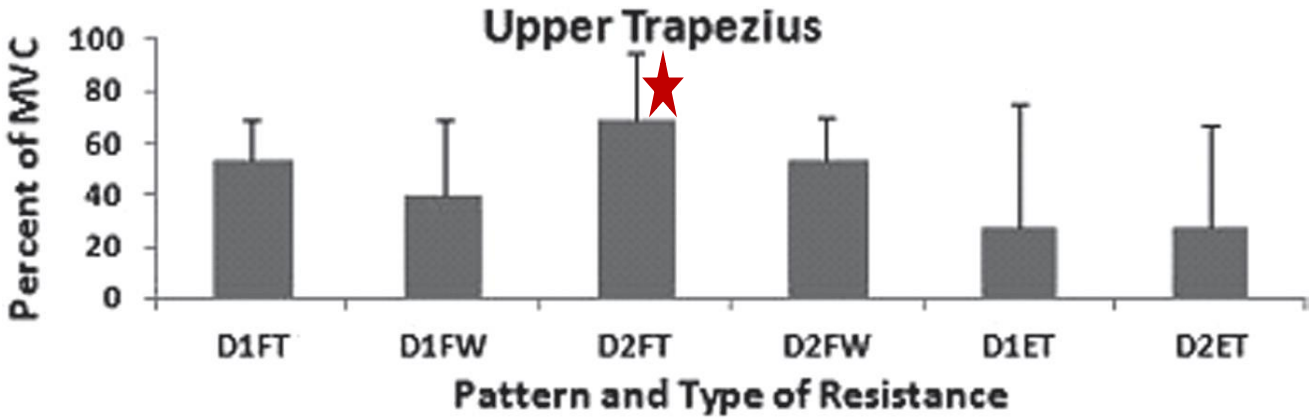
Dexter Witt, PT, DPT, OCS[1]
Nancy Talbott, PT, PhD[1]
Susan Kotowski, PhD, CPE

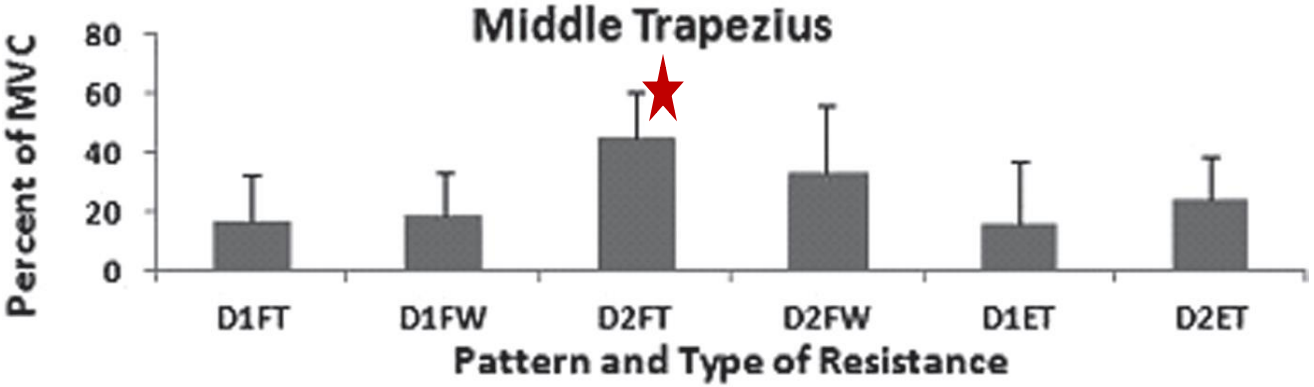


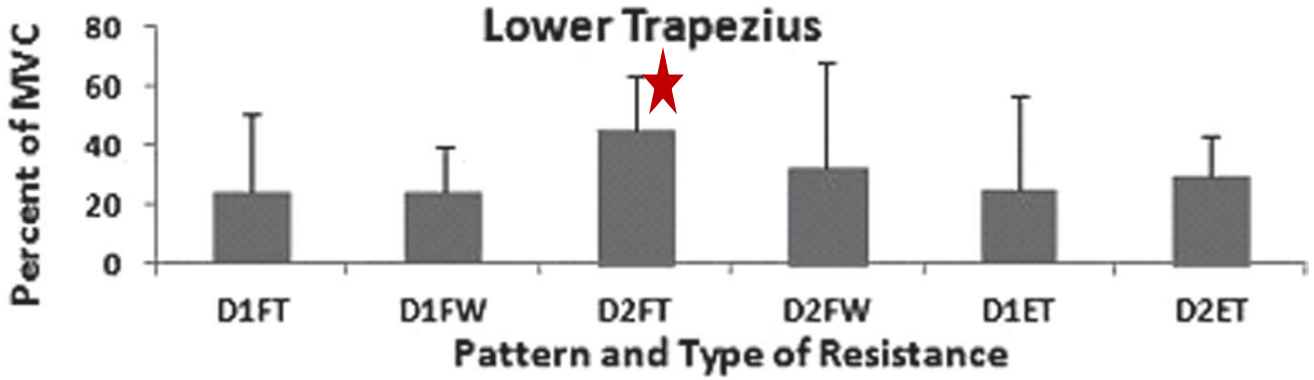


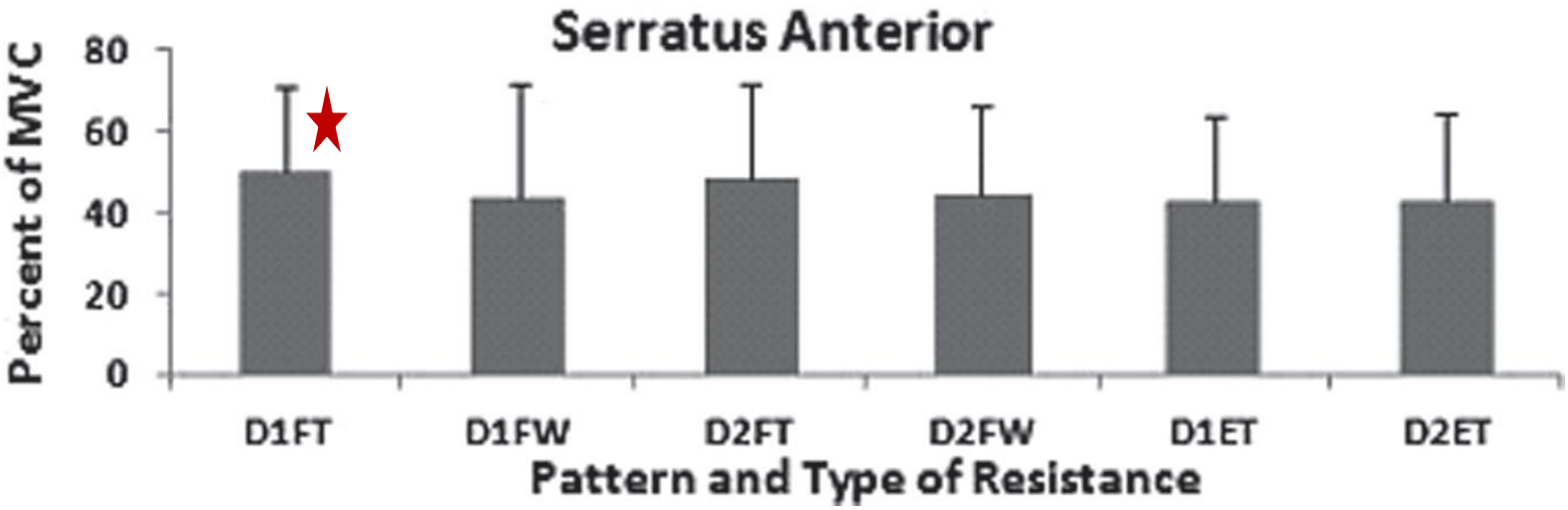
Participantes: 6 hombres y 15 mujeres saludables, entre 21-37 años.

Realizaron 3 repeticiones, con 20 s de descanso.


Upper Trapezius
Percent of MVC
100
80
60
40
20
0
D1FT
D1FW
D2FT
D2FW
D1ET
D2ET
Pattern and Type of Resistance


Middle Trapezius
Percent of MVC
80
60
40
20
0
D1FT
D1FW
D2FT
D2FW
D1ET
D2ET
Pattern and Type of Resistance


Lower Trapezius
Percent of MVC
80
60
40
20
0
D1FT
D1FW
D2FT
D2FW
D1ET
D2ET
Pattern and Type of Resistance



D2 flexion activa el 40% de la CVM del Trapecio y el serrato anterior.

D1 activa el serrato anterior, con menor activación del trapecio medio e inferior.

Se recomienda la resistencia del elástico.

NORTH AMERICAN JOURNAL OF SPORTS PHYSICAL THERAPY | MAY 2007 | VOLUME 2, NUMBER 2

SHOULDER MUSCULATURE ACTIVITY AND STABILIZATION DURING UPPER EXTREMITY WEIGHT-BEARING ACTIVITIES

Marisa Pontillo, DPT[a]
Karl F. Orishimo, MS[b]
Ian J. Kremenic, MEng[b]
Malachy P. McHugh, PhD[b]
Michael J. Mullaney, DPT[b]
Timothy Tyler, MSPT, ATC[c]

Participantes: 15 sujetos saludables (10 hombres y 5 mujeres); edad 30 ± 6 años.

Mantuvieron la postura por 20 s.

Muscle	Floor %MVC (SD)	Green %MVC (SD)	Blue %MVC (SD)	Condition Main Effect (p-value)
Anterior Deltoid	11.0 (7.2) >	9.9 (7.0)	9.7 (7.0)	**0.023***
Posterior Deltoid	12.5 (8.5)	12.1 (9.1)	12.0 (8.3)	0.506
Infraspinatus	26.3 (10.0)	26.0 (9.9)	25.4 (10.5)	0.656
Lower Trapezius	16.2 (8.9) >	15.4 (9.4)	14.5 (8.2)	**0.029***
Upper Trapezius	4.6 (4.6)	4.3 (4.1)	4.3 (4.1)	0.103
Serratus Anterior	15.0 (9.3) >	13.5 (9.2)	13.0 (9.6)	**<0.001***
Pectoralis	8.7 (7.2)	9.6 (8.6)	9.6 (8.1)	0.135
Triceps	23.1 (11.6)	25.1 (12.8) >	25.1 (12.5) >	**0.002#**

(*) EMG activity decreased as task stability decreased. **(#) EMG activity increased as task stability decreased.**

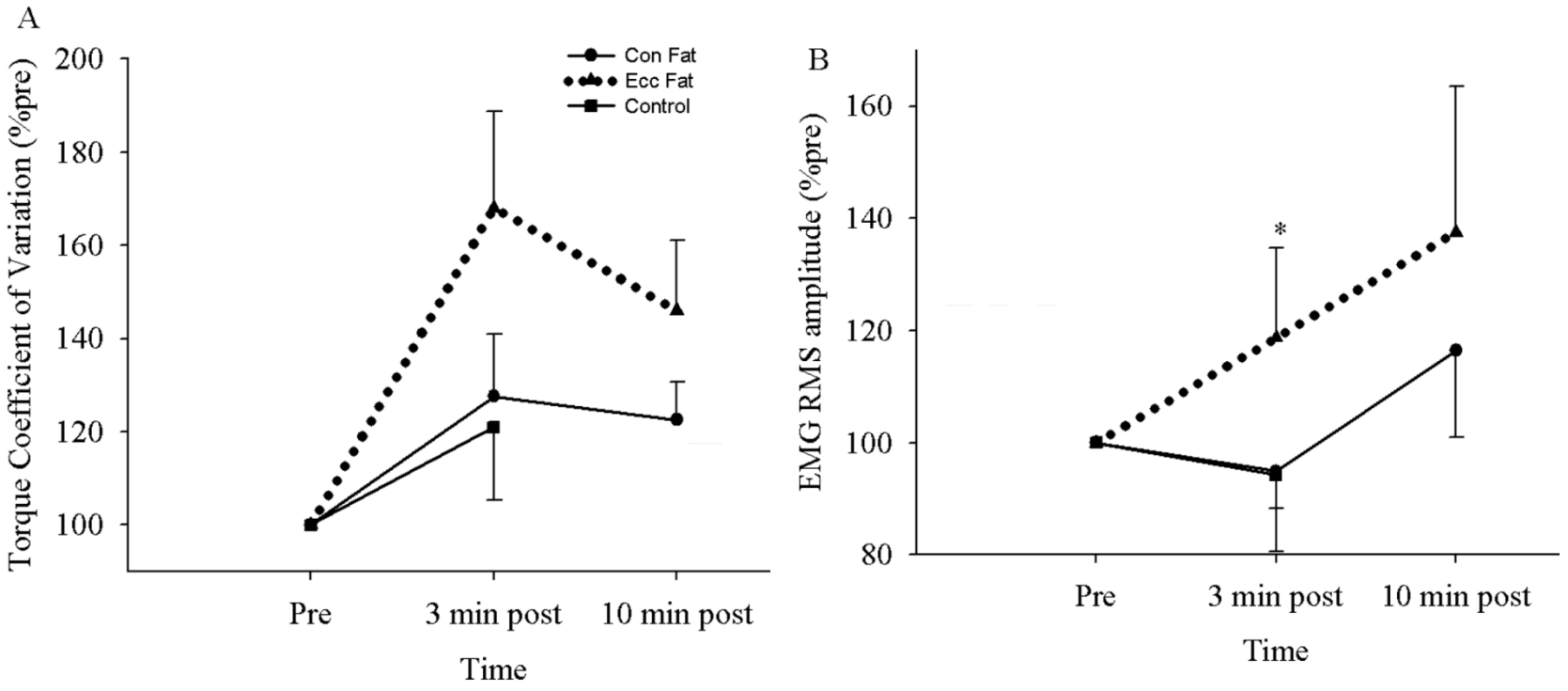
La actividad EMG del deltoides anterior, trapecio inferior y serrato anterior disminuye en las superficies inestables y aumenta la del triceps.

Se requiere el entrenamiento en diversas superficies.

J Electromyogr Kinesiol. 2010 August ; 20(4): 619–626. doi:10.1016/j.jelekin.2009.12.001.

Repetitive Eccentric Muscle Contractions Increase Torque Unsteadiness in the Human Triceps Brachii

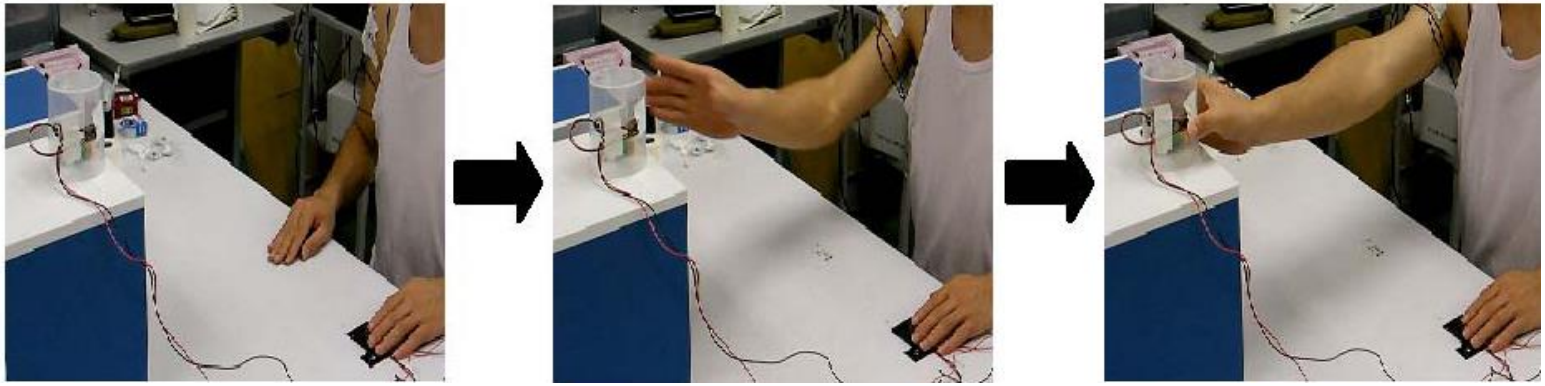
Andrew J. Meszaros, PhD[1], Masaki Iguchi, PhD[2], Shuo-Hsiu Chang, PhD[2], and Richard K. Shields, PhD[2]



Participantes: 17 hombres jóvenes saludables.

Classification of Upper Limb Motions from Around-Shoulder Muscle Activities: Hand Biofeedback

Jose González*, Yuse Horiuchi and Wenwei Yu



Participantes: 4 hombres jóvenes saludables.


GRACIAS