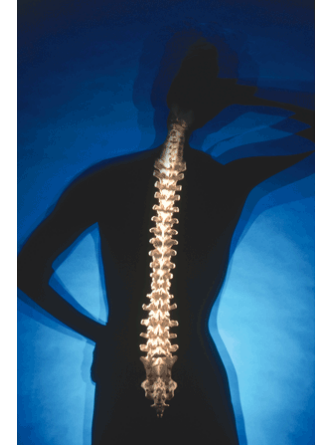


Biomecánica de Columna



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

Biomecánica de Columna

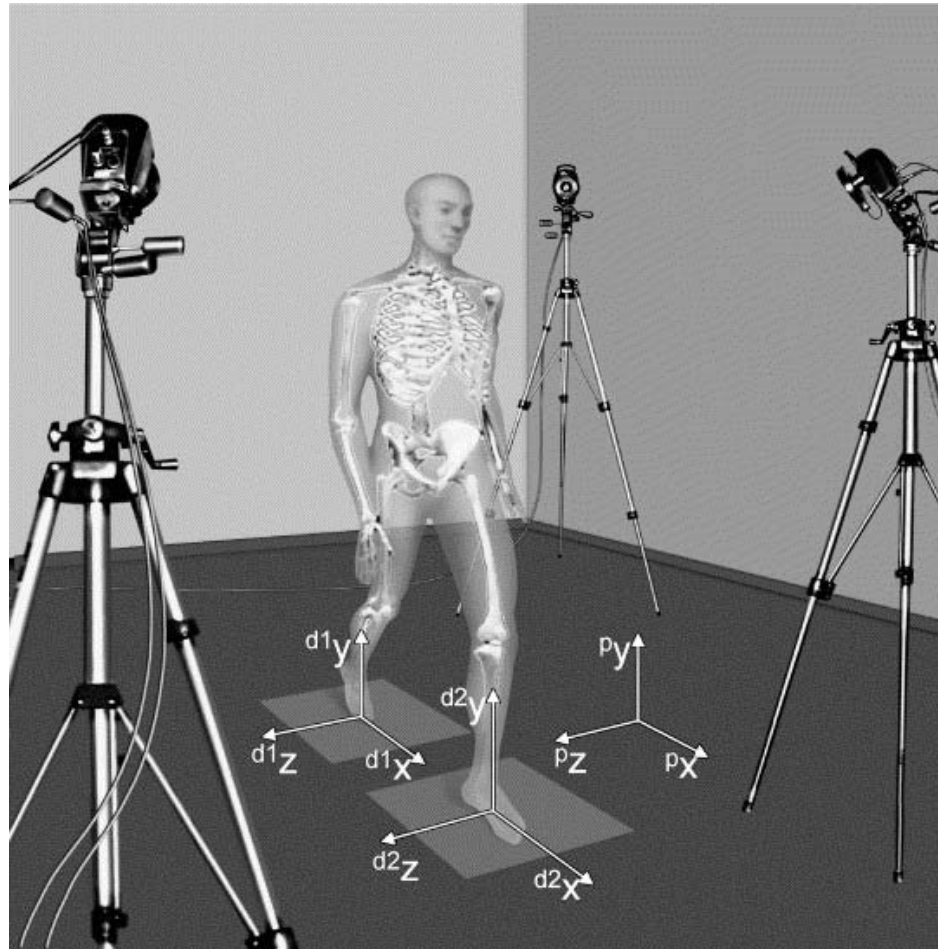


- Movilidad por segmento?
- Cómo varía según la postura?
- Patrón de activación muscular?
- Cual es la respuesta de los tejidos frente a la carga?
- Existen diferencias por género y edad?
- Movilidad torácica y el patrón respiratorio?

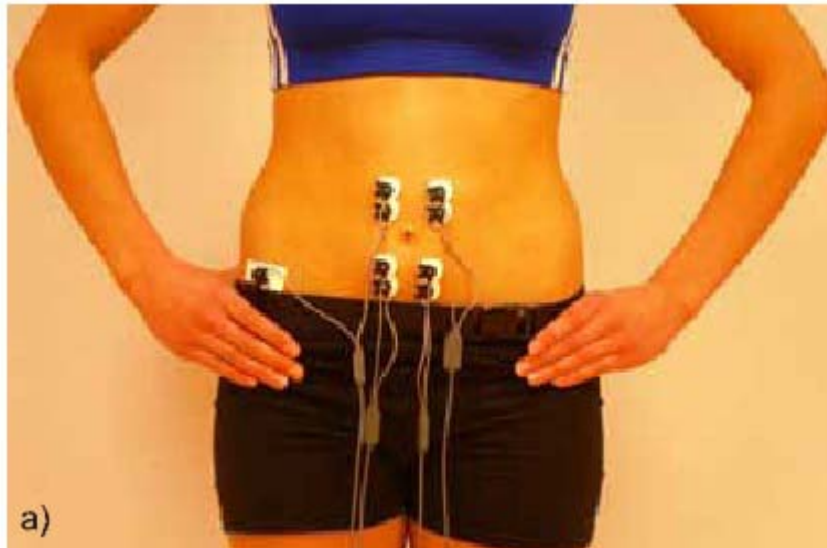
CINEMÁTICA



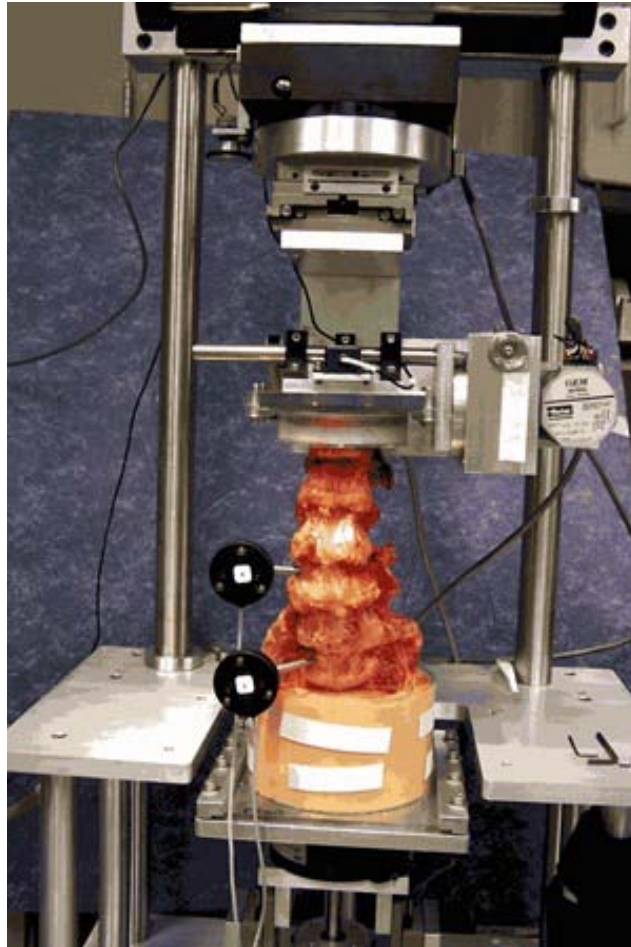
ESTEREOFOTOGRAMETRÍA y CINÉTICA



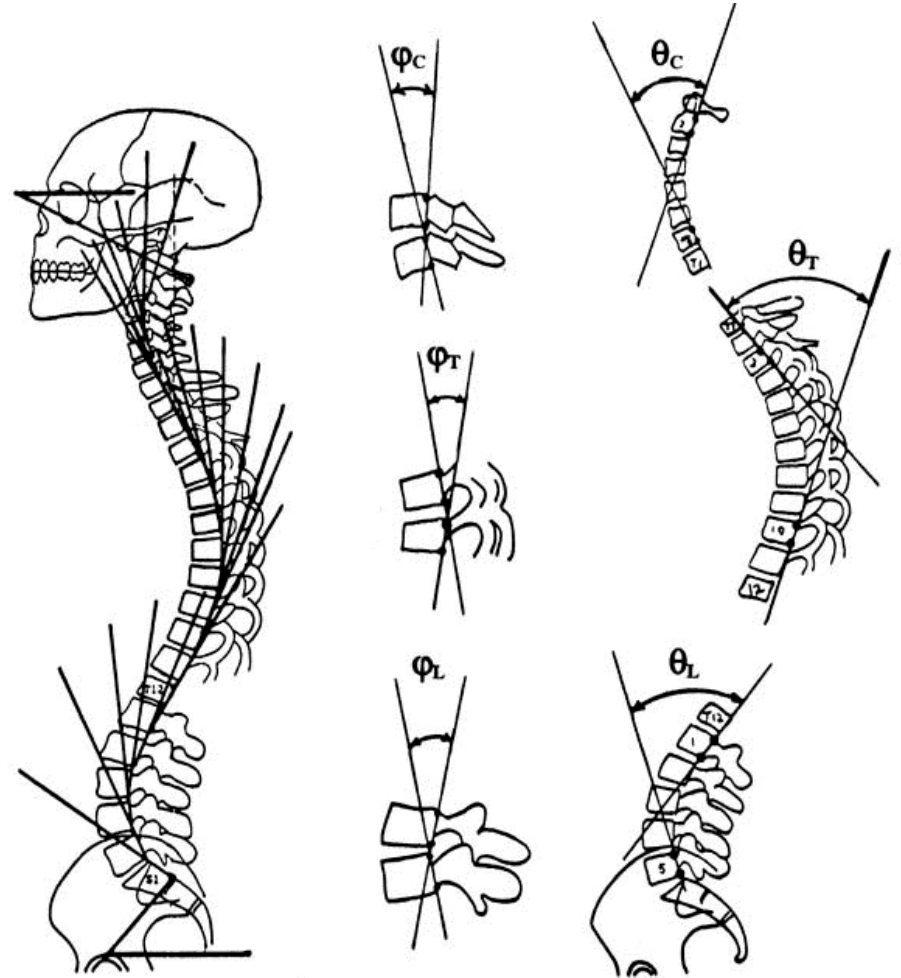
ELECTROMIOGRAFÍA



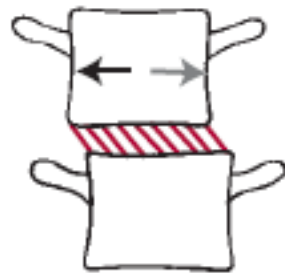
BIOMATERIALES



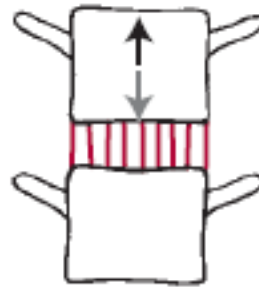
MOVILIDAD POR SEGMENTO



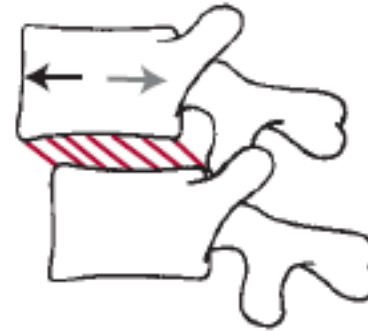
ARTROCINEMATICA



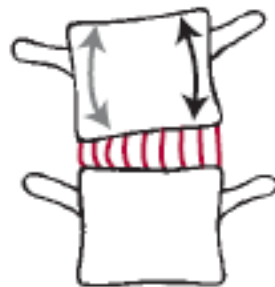
deslizamiento



distracción
compresión



deslizamiento



inclinación



rotación



inclinación

OSTEOCINEMATICA

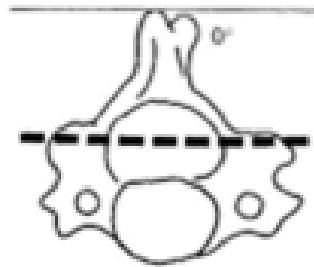
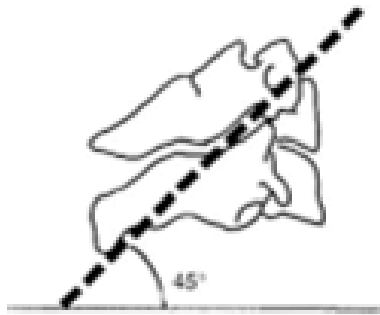


RX

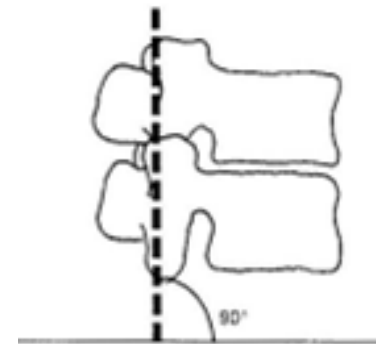


Fluoroscopia

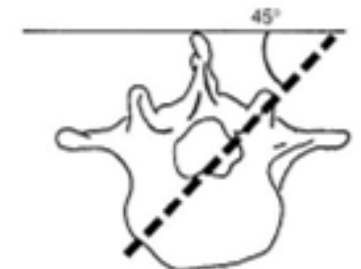
ORIENTACIÓN DE LAS FACETAS



Cervical
(C3-C7)

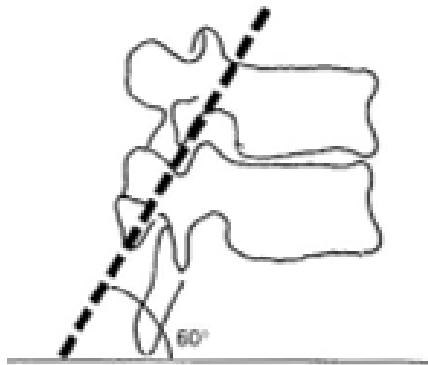


plano
tranverso

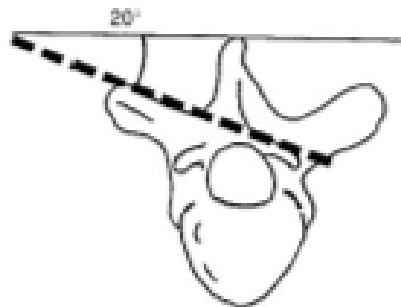


Lumbar

plano
frontal



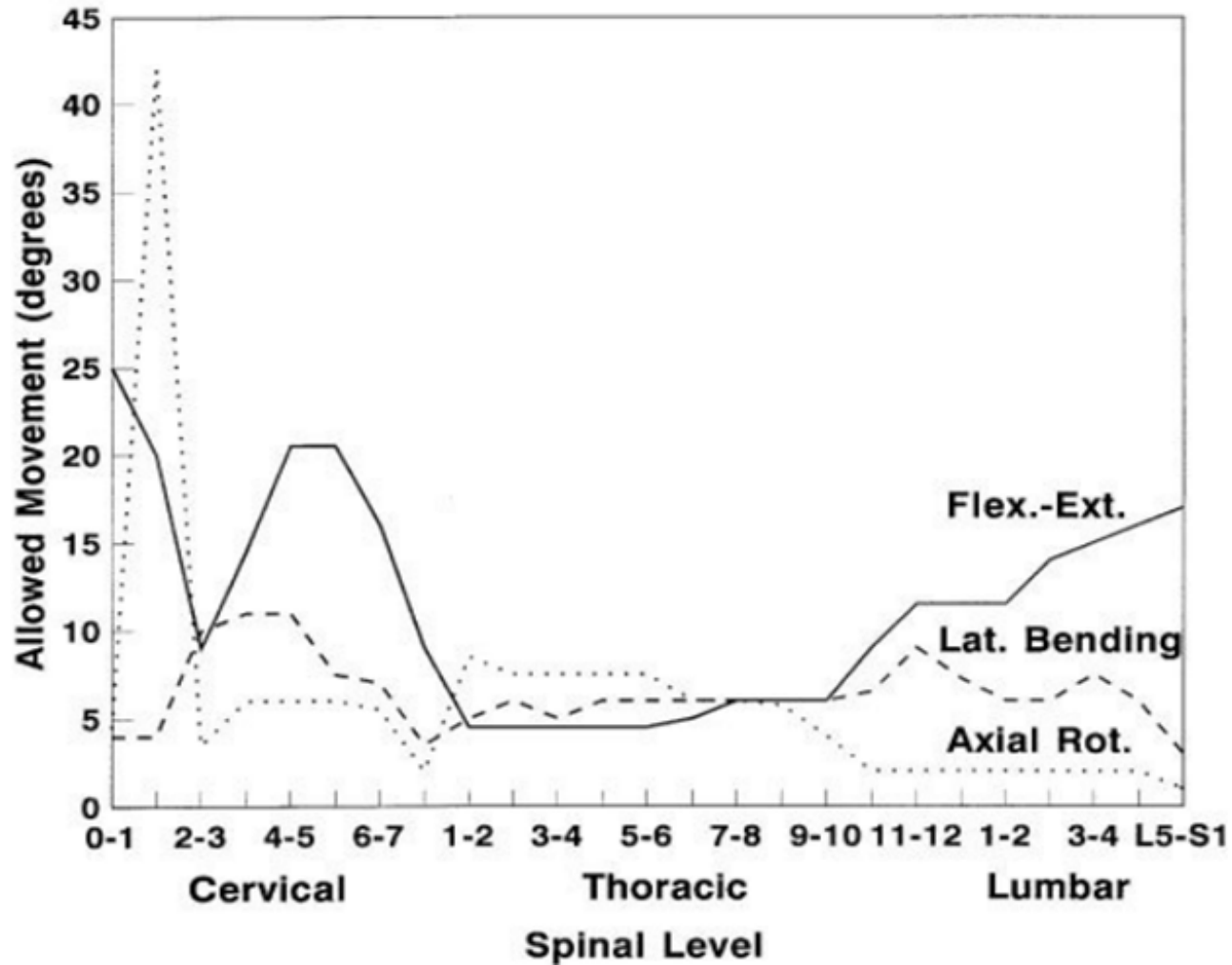
plano
tranverso



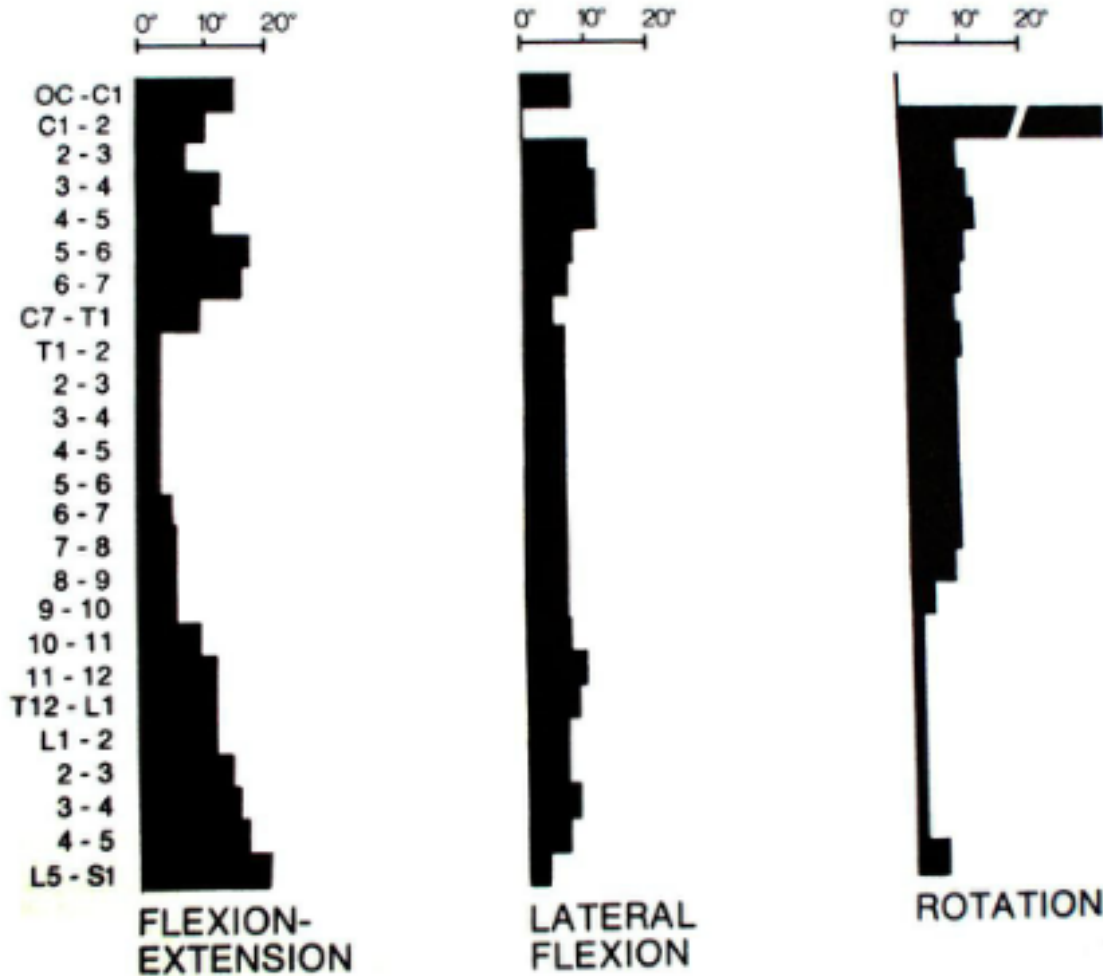
Thoracic

plano
tranverso

OSTEOCINEMATICA

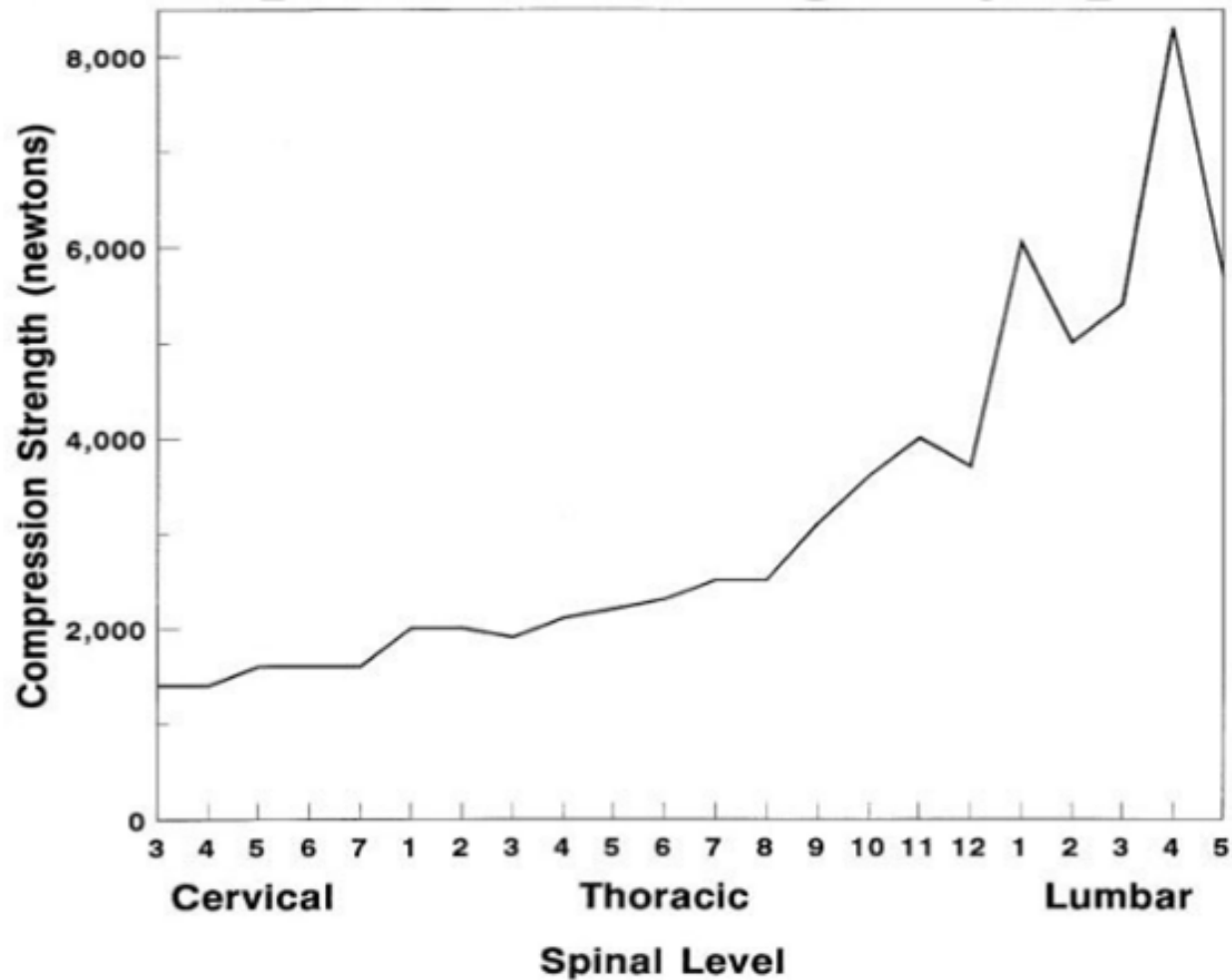


MOVIMIENTOS DE LA COLUMNA

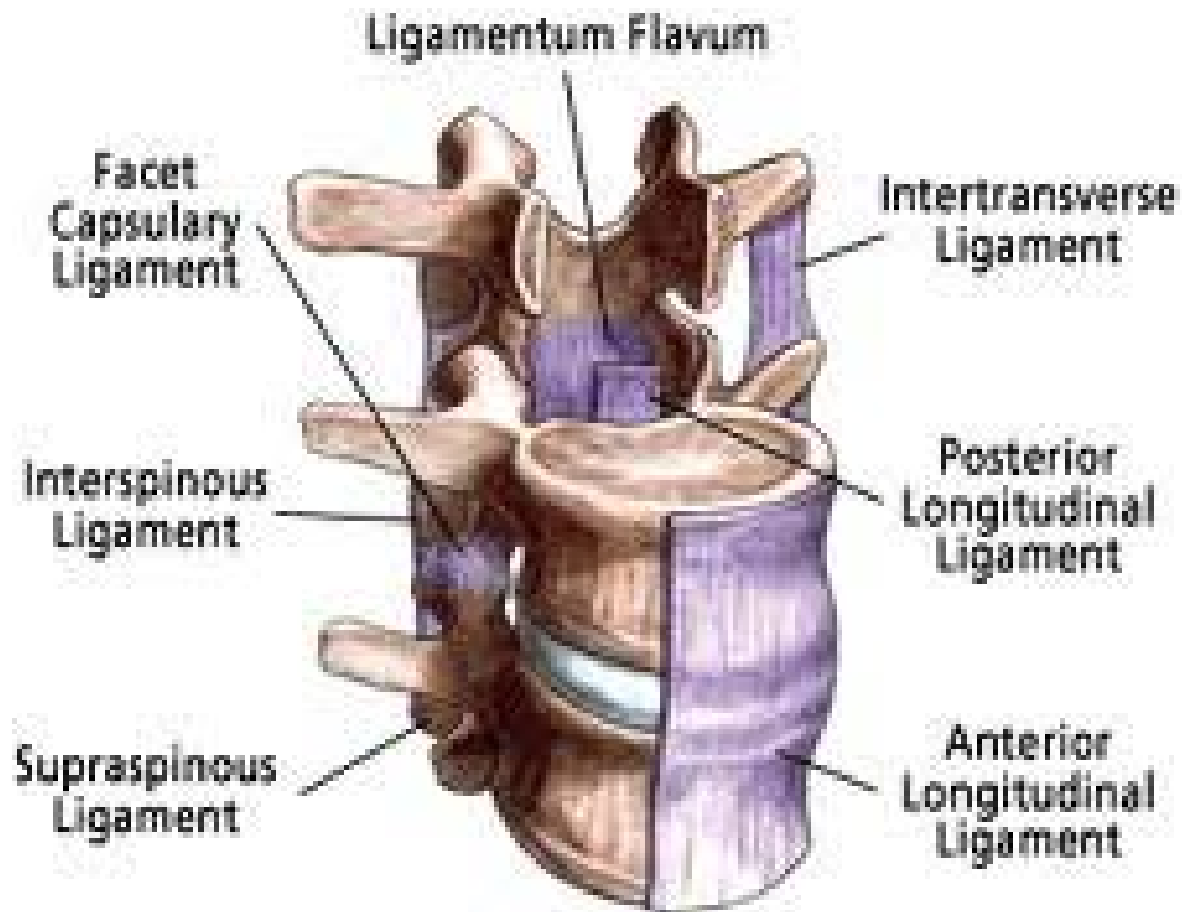


White A, Panjabi M. 1990.

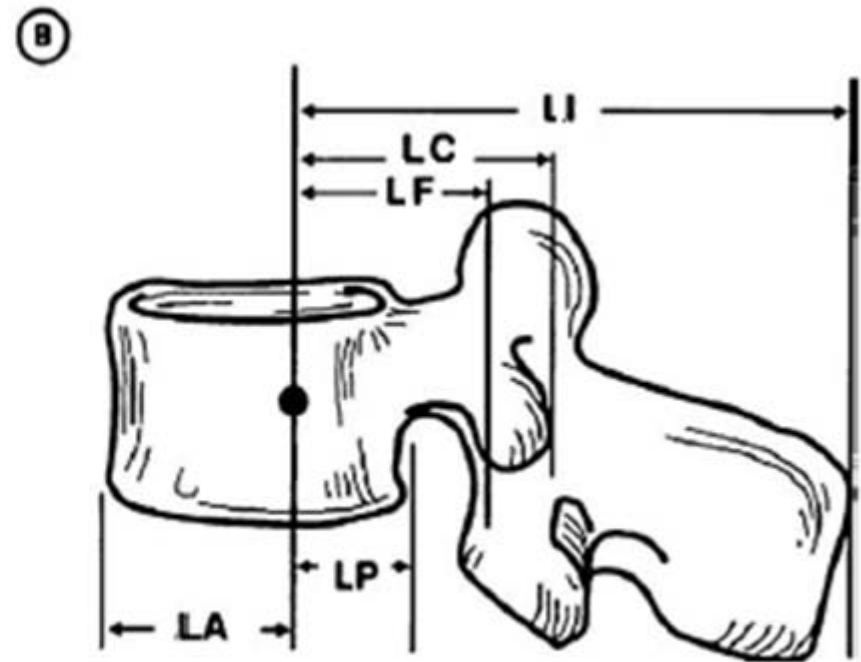
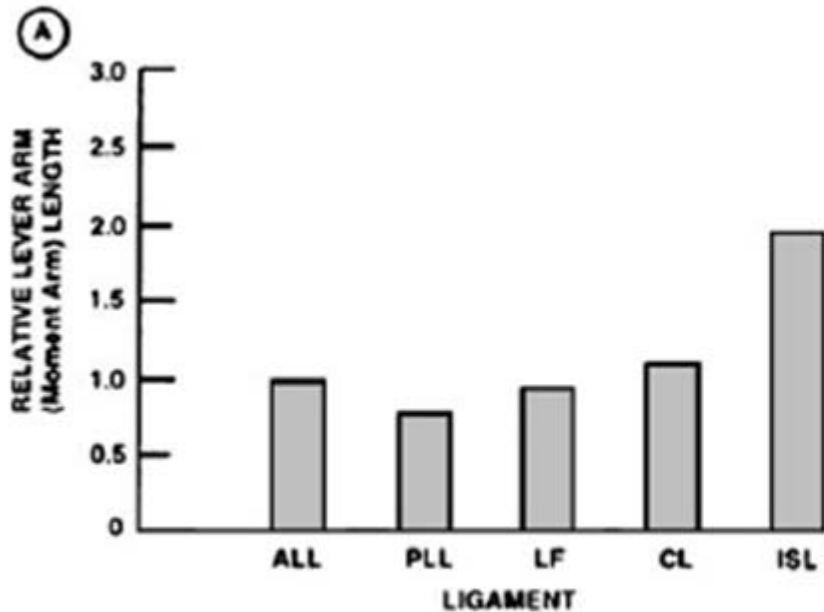
FUERZAS COMPRESIVAS



RESISTENCIA DE LIGAMENTOS

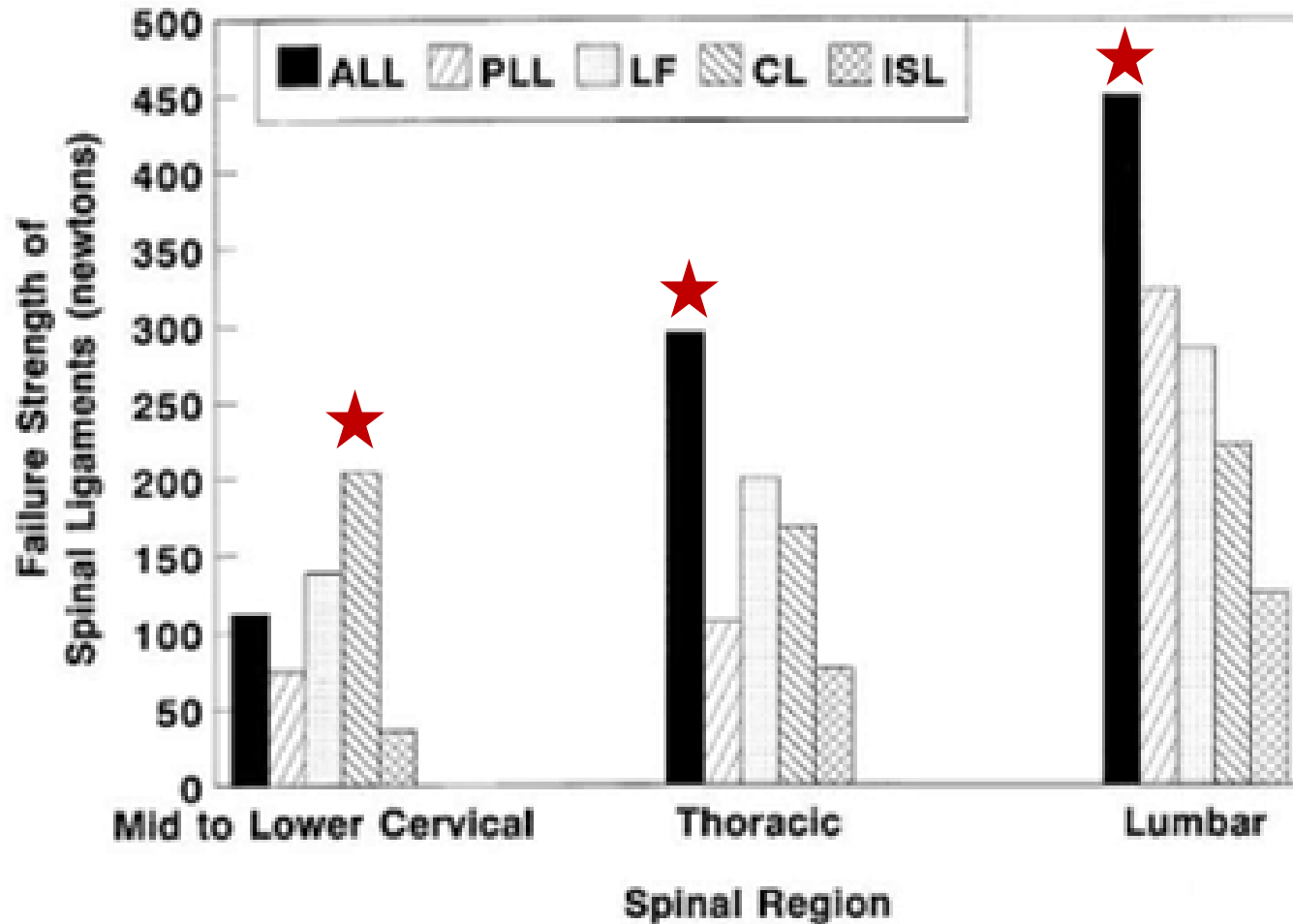


Brazo de momento de los ligamentos

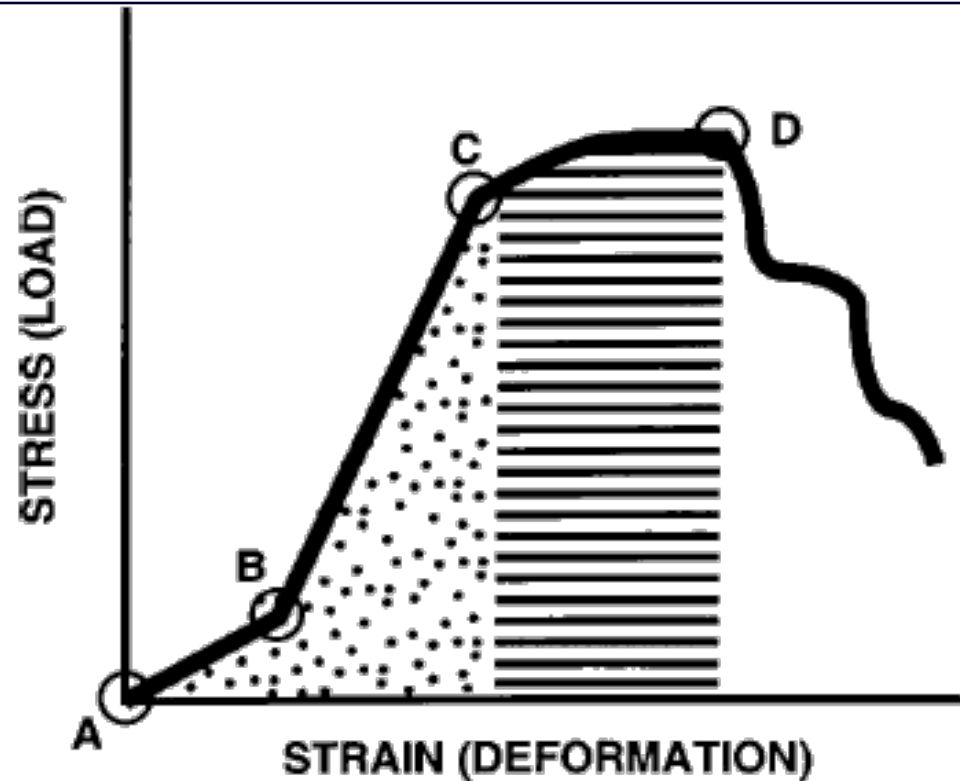


Benzel EC. *Biomechanics of Spine Stabilization*. AANS Publications; 2001;9.

RESISTENCIA DE LIGAMENTOS

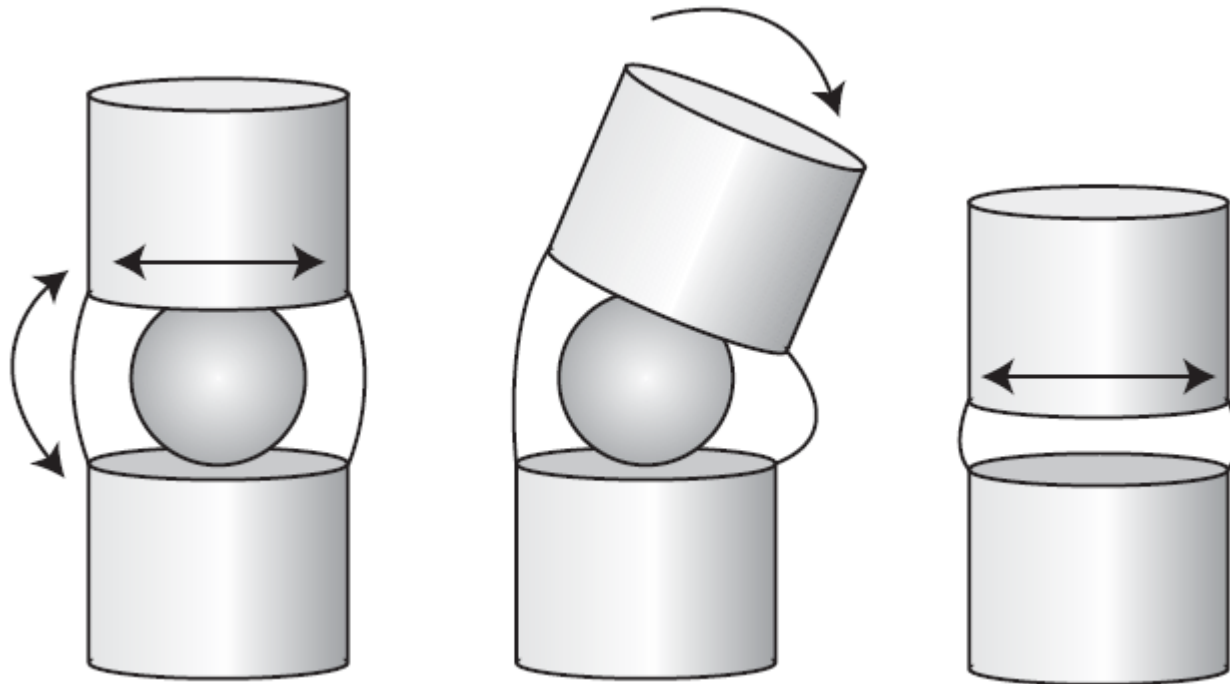


Curva tensión-deformidad (ligamentos)

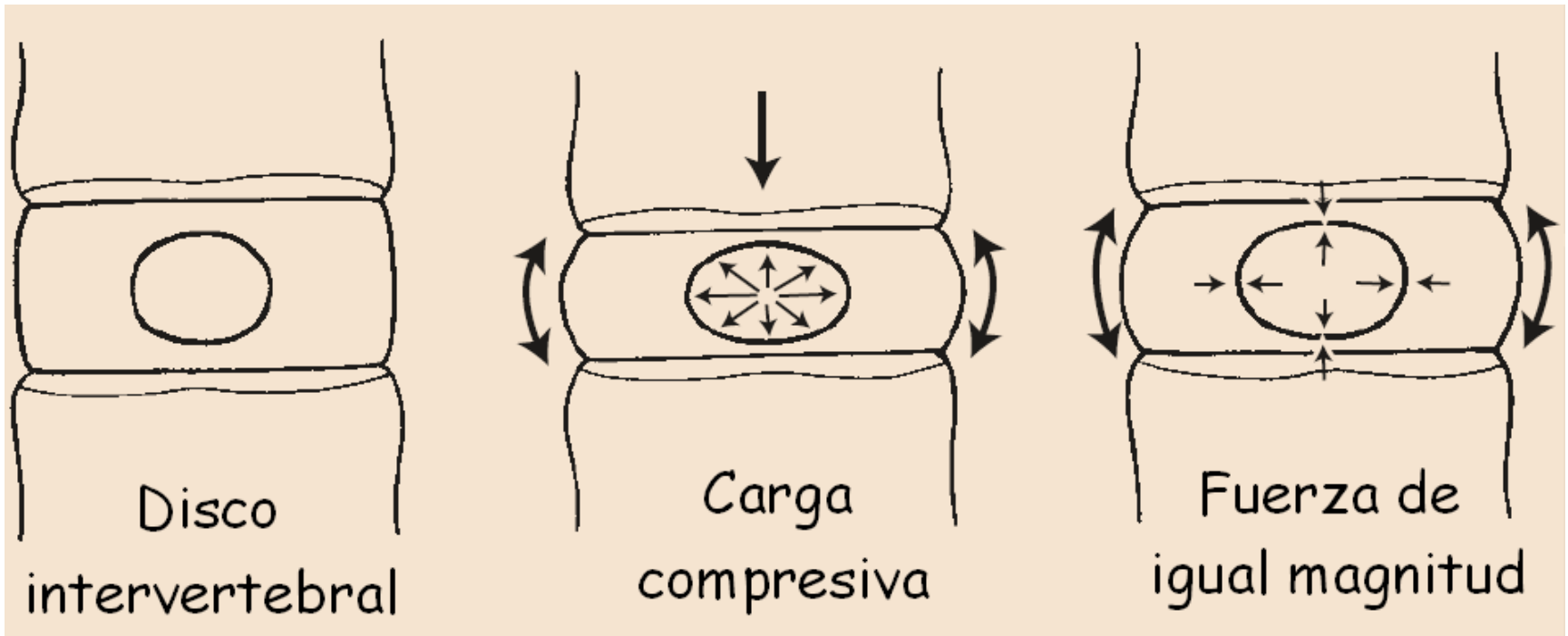


Benzel EC. *Biomechanics of Spine Stabilization*. AANS Publications; 2001;24.

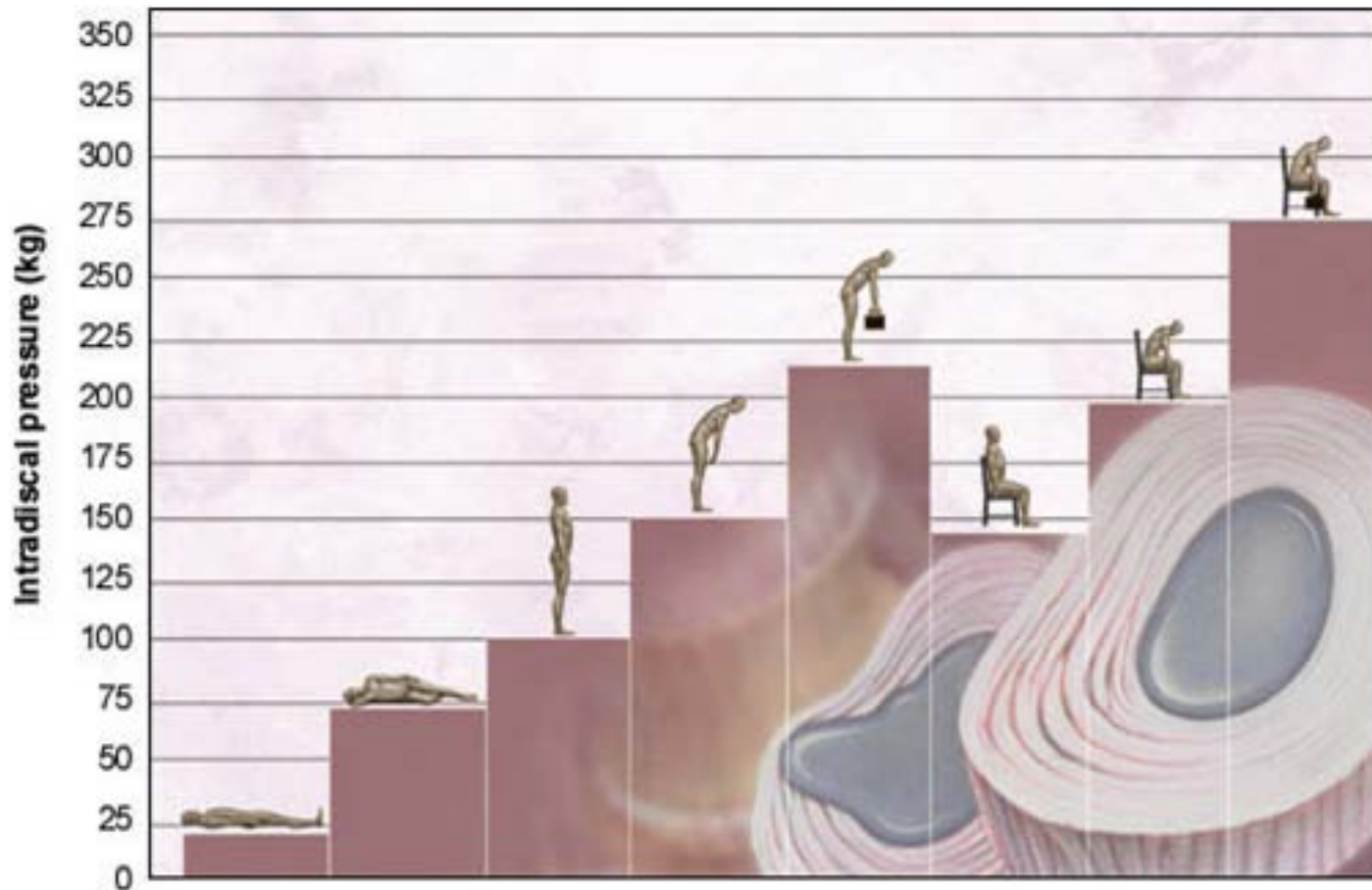
DISCO INTERVERTEBRAL



CARGA SOBRE EL DISCO



CARGA SOBRE EL DISCO



CARGA SOBRE EL DISCO

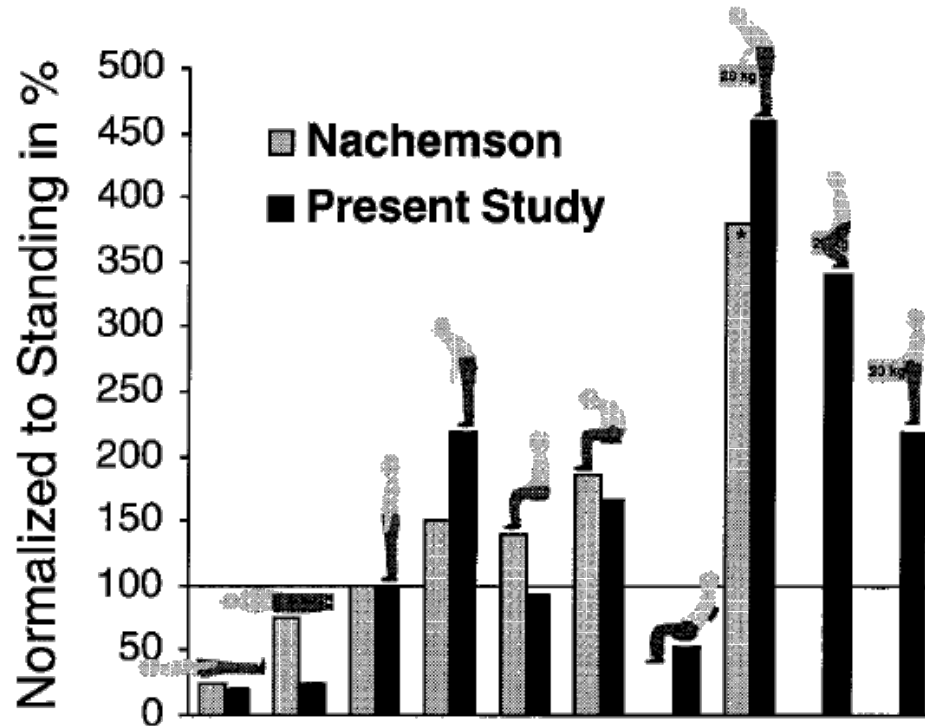
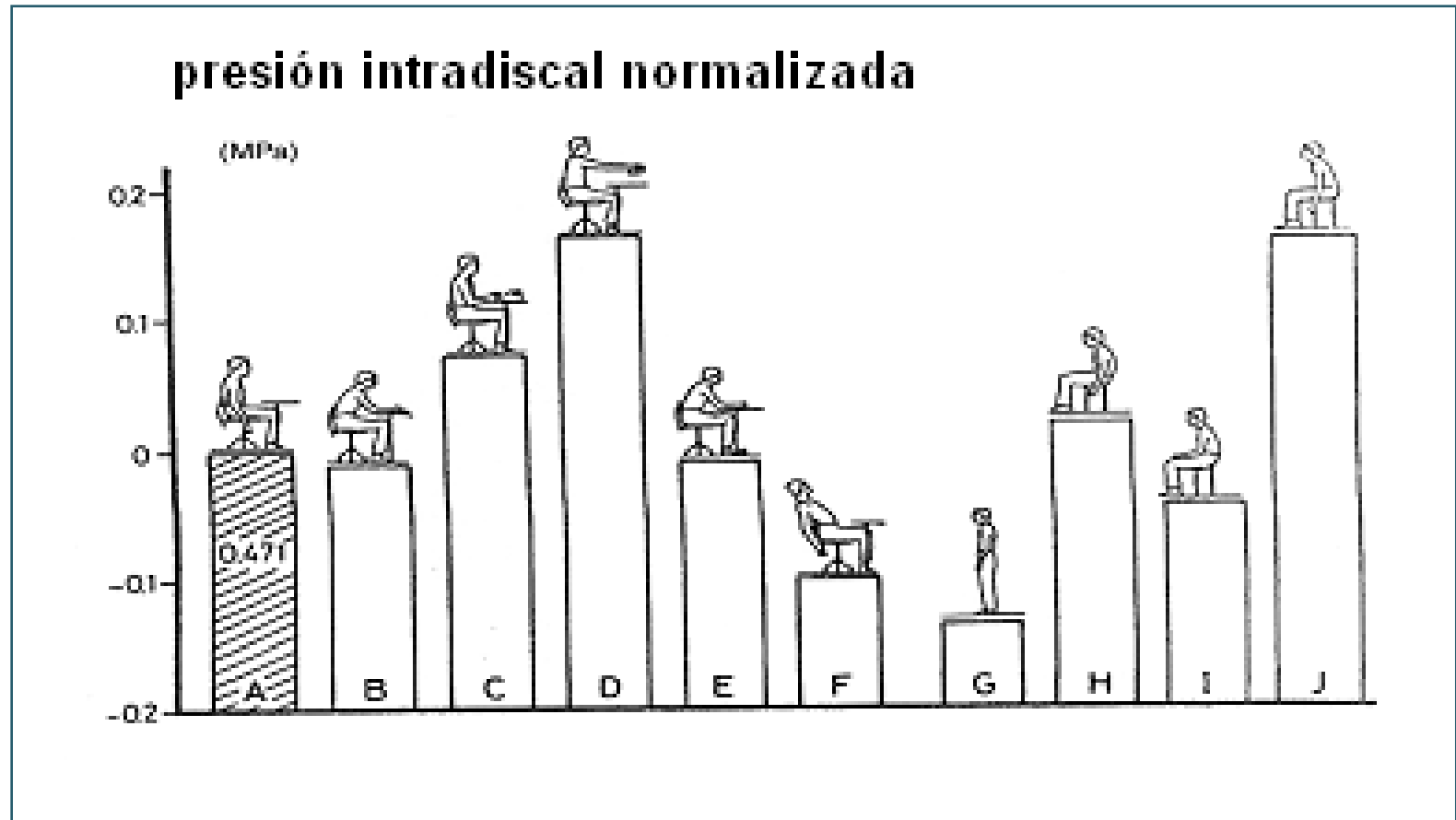
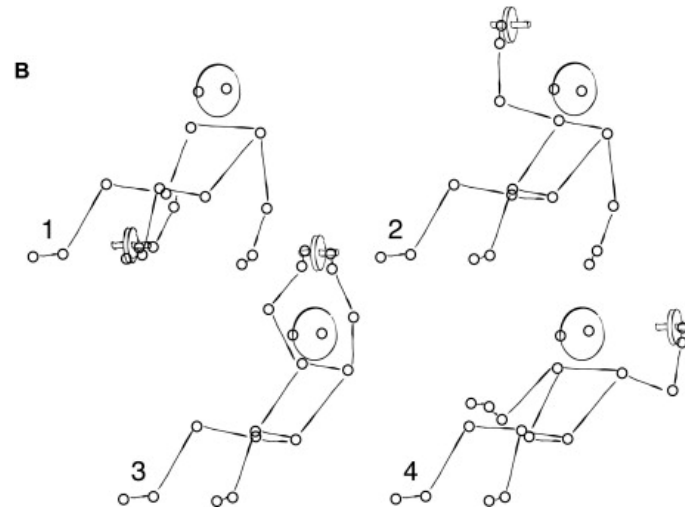
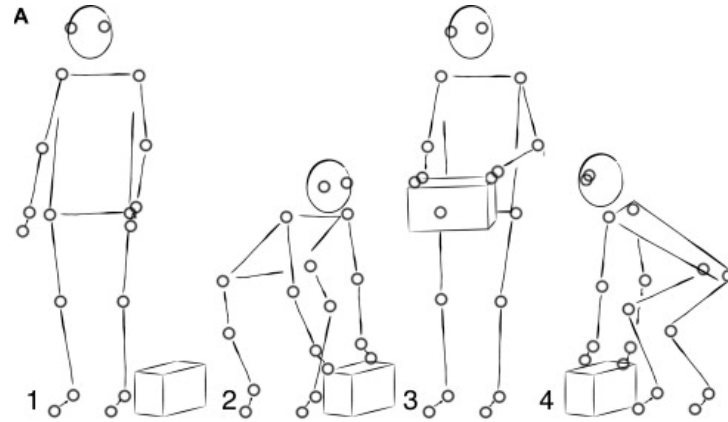


Figure 11. A comparison between data of Nachemson^{17,19} and those of the current study (both for 70-kg individuals) regarding intradiscal pressure in common postures and activities, normalized to standing. Lifting weight = 20 kg in the current study; *lifting weight = 10 kg in Nachemson study.

CARGA SOBRE EL DISCO



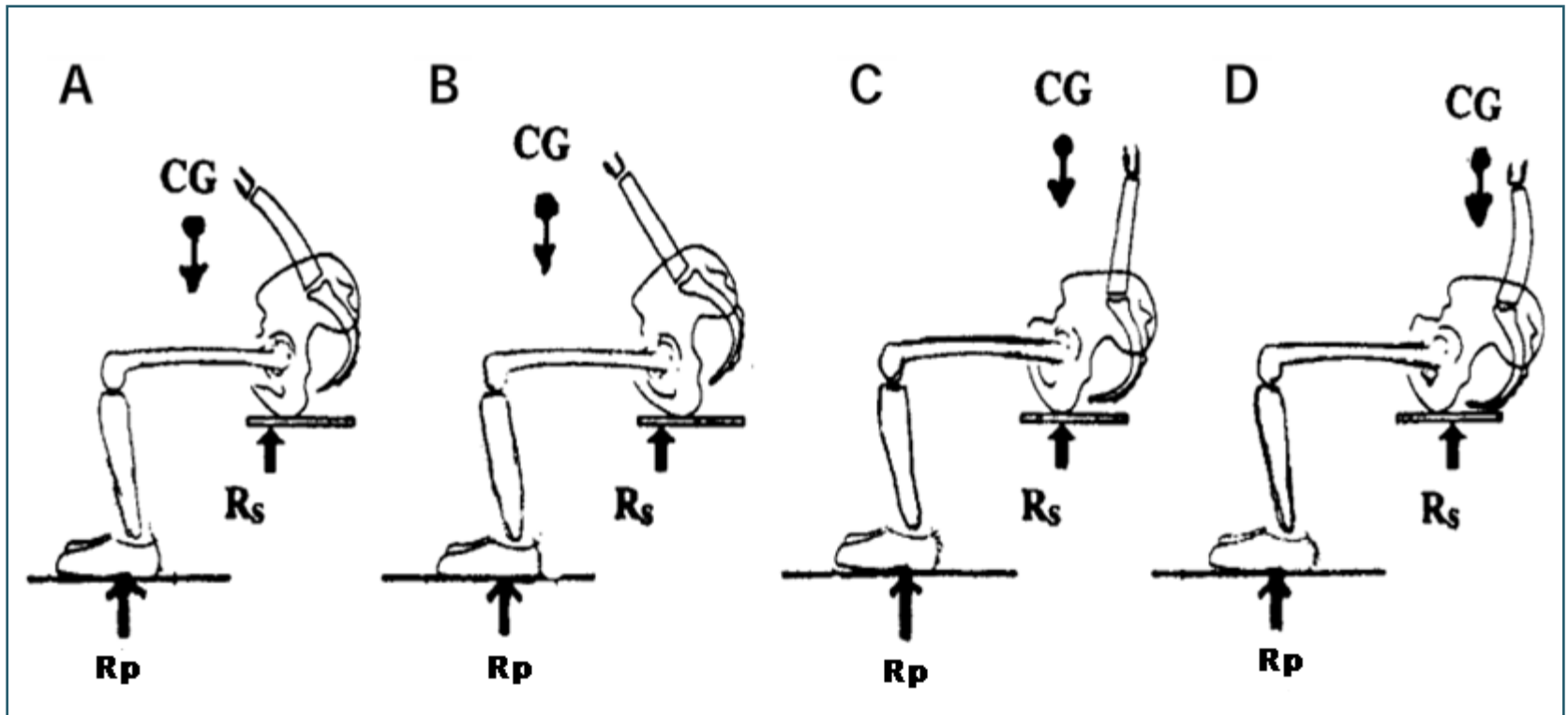
DIFERENCIAS ENTRE POSTURAS Y PATRONES



Postura en sedente



CG en sedente



Sentado con aumento cifosis



- ▶ Sobrecarga los ligamentos posteriores
- ▶ Aumenta la presión intradiscal
- ▶ Altera la función respiratoria y digestiva
- ▶ Disminuye los niveles de actividad en los músculos lumbares, oblicuo interno y espinales torácicos

¹ Lord MJ, et al. Spine.1997; 22(21):2571-2574.

² Claus AP, et al. Manual Therapy.2008;06(1)1-5.

³ O Sullivan PB, et al .Spine. 2002; 27(11):1238-44.

⁴ O Sullivan PB, , Spine. 2006; 31(9):E707-E712.

Sentado con control lumbopélvico



- ▶ Mantiene las curvas fisiológicas.
- ▶ Activa la musculatura.
estabilizadora de la columna lumbar
- ▶ Distribución simétrica del centro de gravedad.

Casas AS. Asociación entre el dolor de espalda y la postura en sentado en estudiantes de la Facultad de Salud de la UIS, 2009.



Postura de referencia¹⁻⁴



¹ Lord MJ, et al. Spine.1997; 22(21):2571-2574.

² Claus AP, et al. Manual Therapy.2008;06(1)1-5.

³ O Sullivan PB, et al .Spine. 2002; 27(11):1238-44.

⁴ O Sullivan PB, , Spine. 2006; 31(9):E707-E712.

Silla con apoyabrazo



D

N: 124 (27,2%)

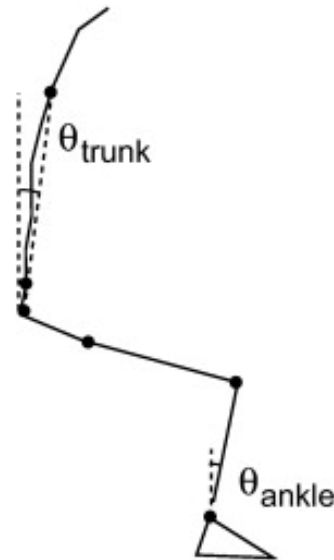
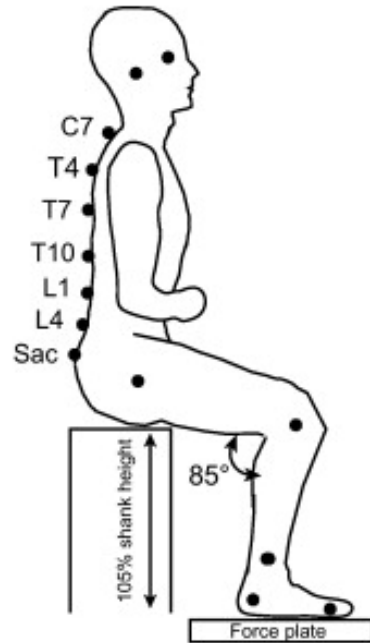


H

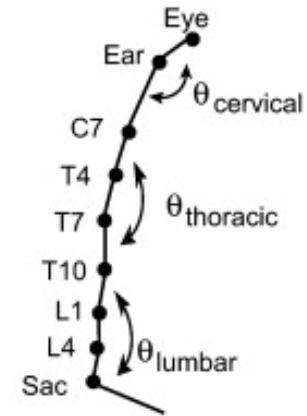
N:144 (31,6%)

Variable	RP	IC 95%
dolor de cuello-día encuesta		
Postura E,F	2,84	1,62 - 4,97
dolor de cuello agudo		
Postura E,F	2,41	1,03 - 5,69
dolor de cuello crónico		
Postura E,F	4,13	1,56 - 10,92
dolor de espalda-día encuesta		
Postura F	1,81	1,14 - 1,74
dolor de espalda agudo		
Postura F	2,0	1,10 - 3,61
dolor de espalda crónico		
Postura D	1,61	0,92 - 2,81

Cacciatorea TW y cols. Prolonged weight-shift and altered spinal coordination during sit-to-stand in practitioners of the Alexander Technique. Gait and posture, 2011.

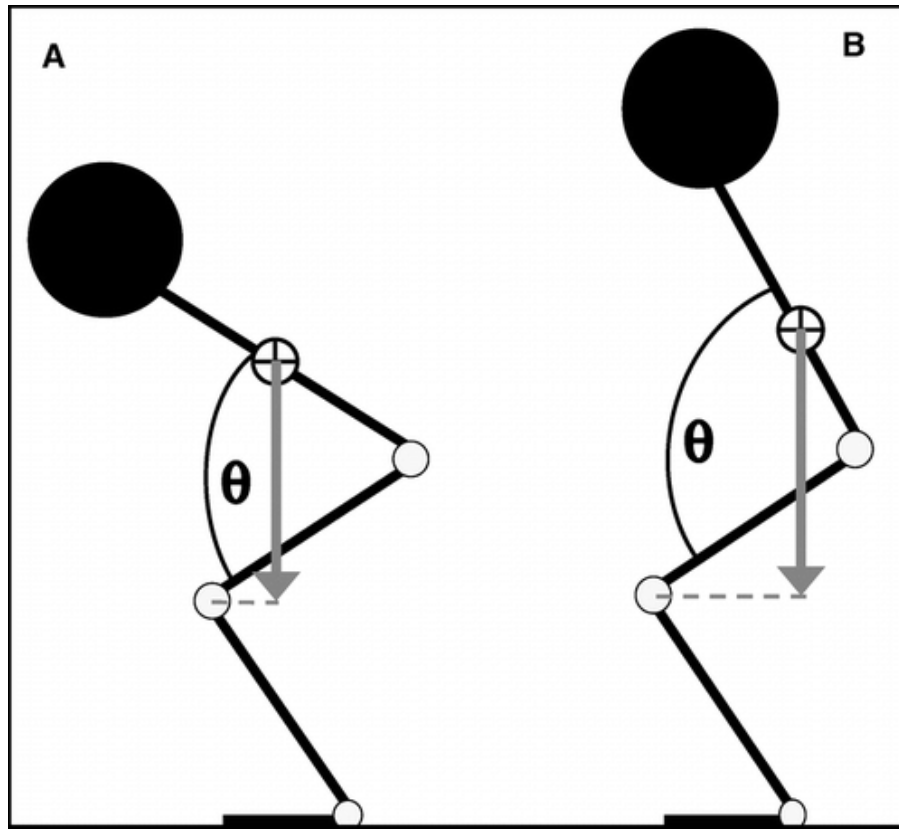


Ángulo del tronco (entre C7 y el sacro).



Angulo cervical, torácico (T4, T7, T10) y lumbar (L1 a L4).

Blackburn JT, Padua DA. Sagittal-Plane Trunk Position, Landing Forces, and Quadriceps Electromyographic Activity. Journal of Athletic Training, 2009.

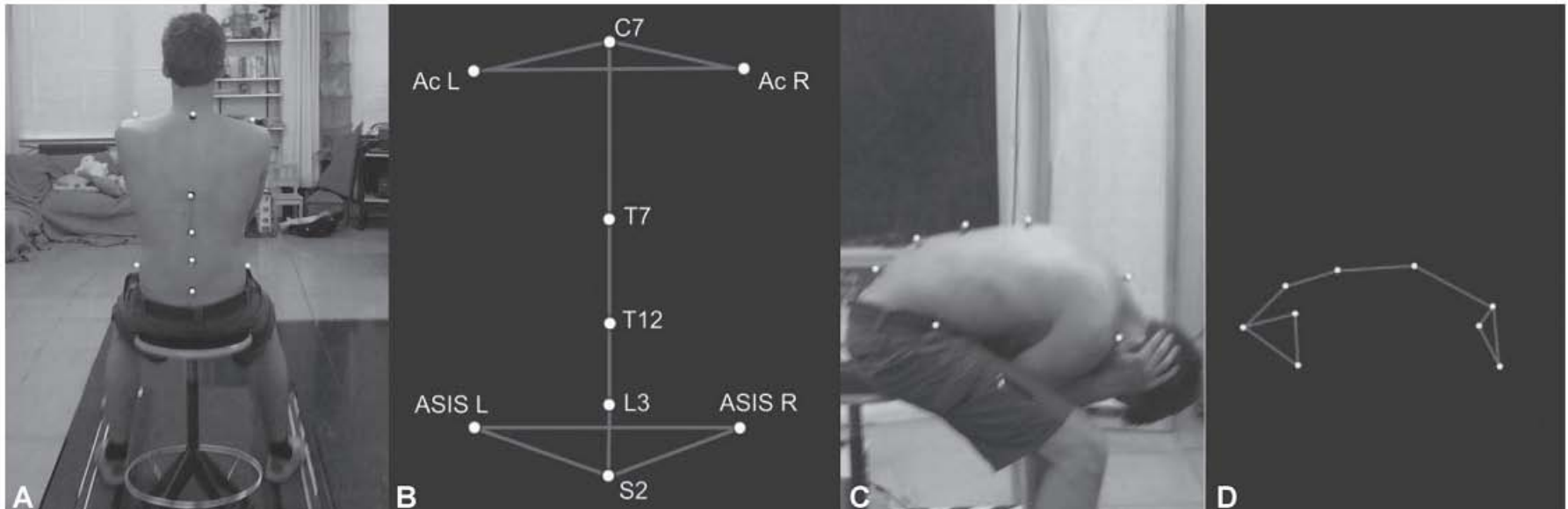


Angulo de flexión del tronco y disminución del brazo de momento del tronco, cuando el CM del tronco está cercano al centro articular de rodilla (A) y lejano (B).

Angulo del tronco durante el alcance funcional



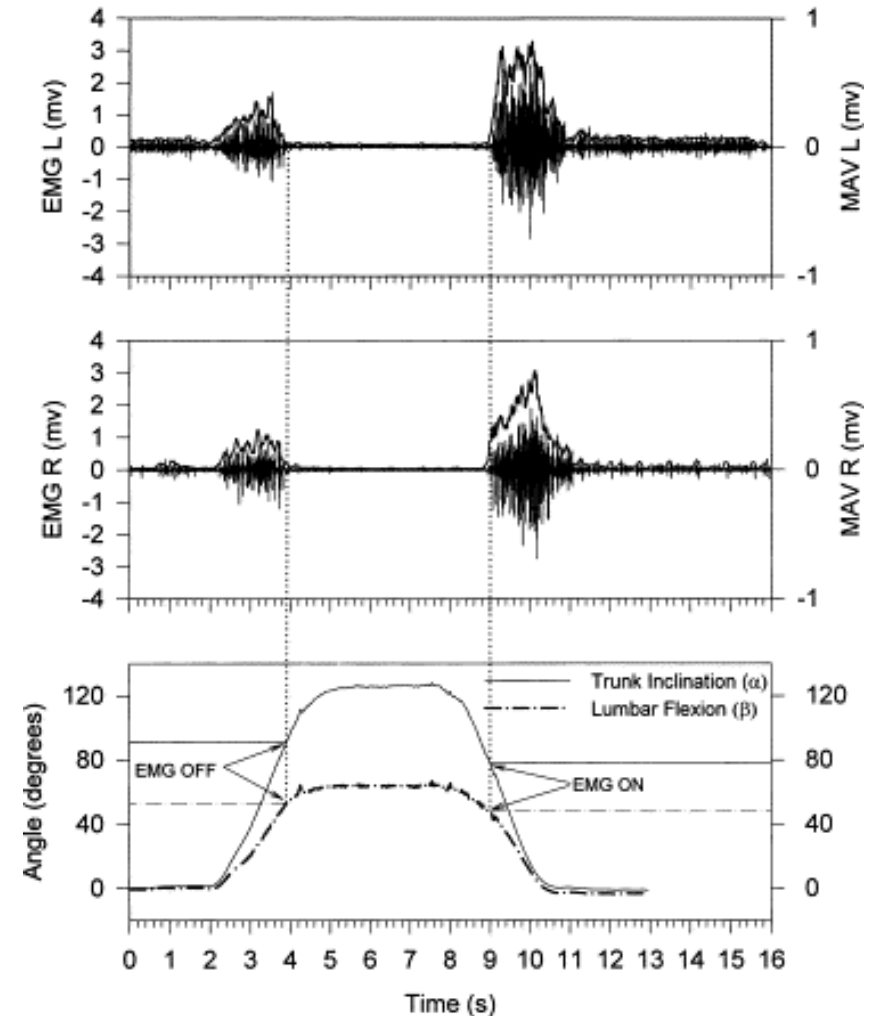
Angulo del tronco durante el Movimiento de flexión



Angulo de flexión e inclinación del tronco y EMG espinales

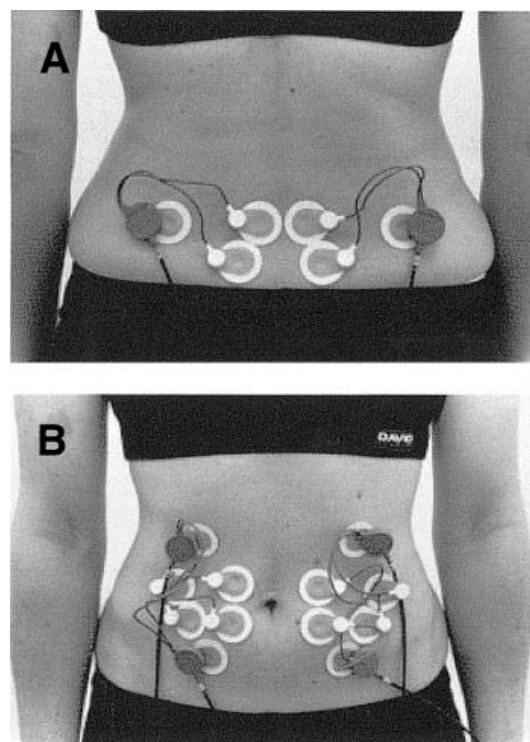


Subject NL Trial01(Before)

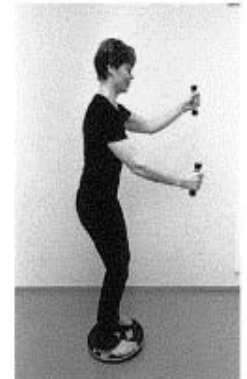
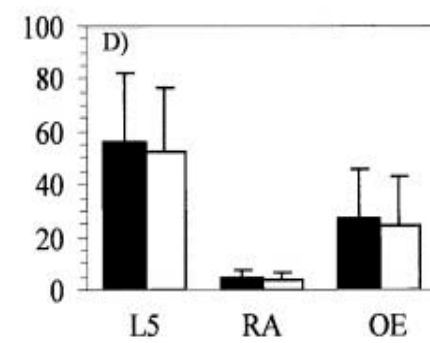
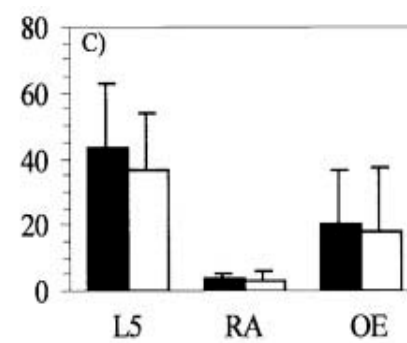
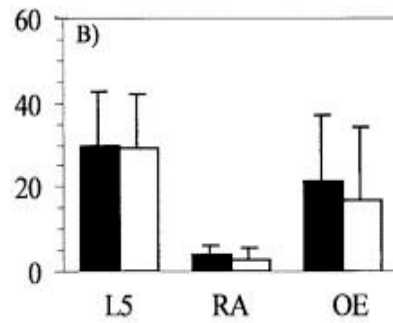
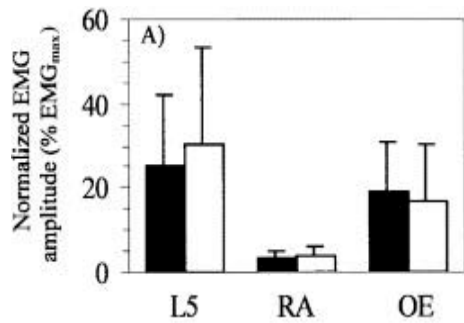


Activation of lumbar paraspinal and abdominal muscles during therapeutic exercises in chronic low back pain patients¹ ☆

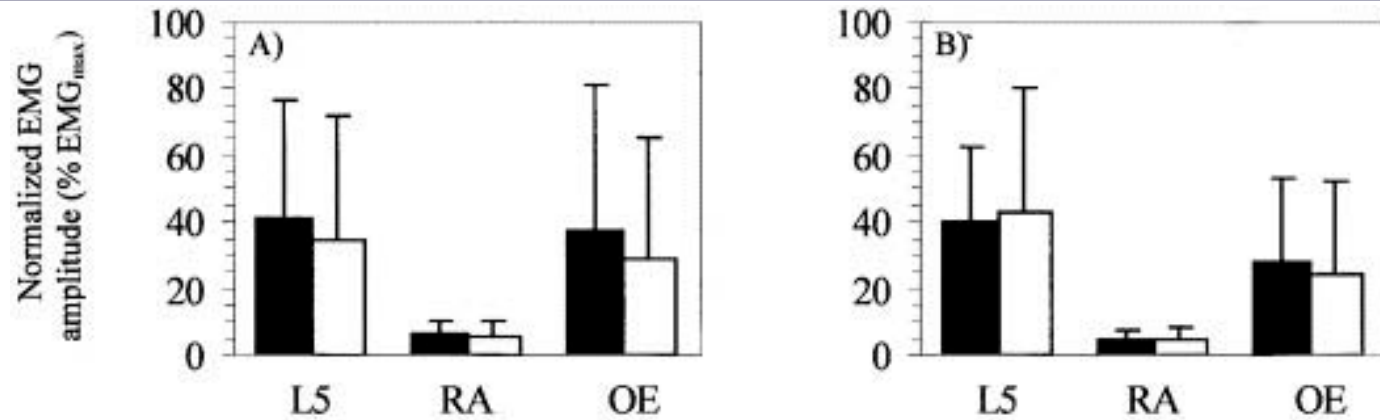
Jari P Arokoski, DMSc^{a, c},  , Taru Valta, PT^b, Markku Kankaanpää, DMSc^{a, b, c}, Olavi Airaksinen,



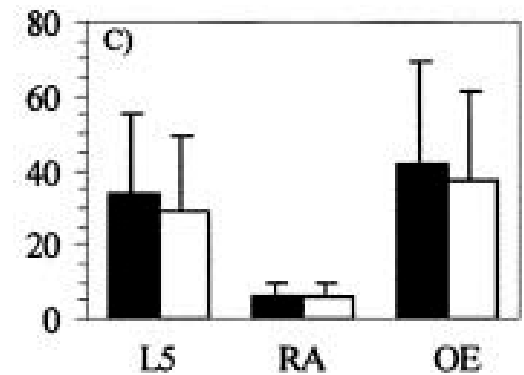
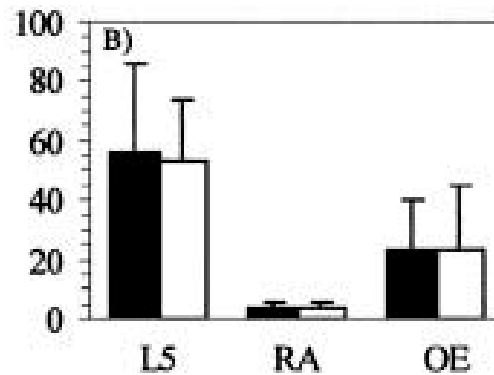
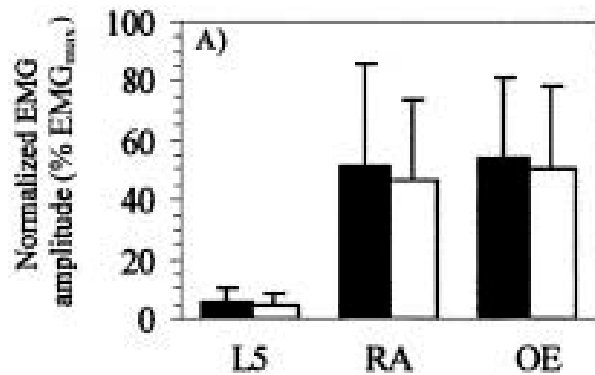
EMG espinales, recto abdominal y oblicuo externo



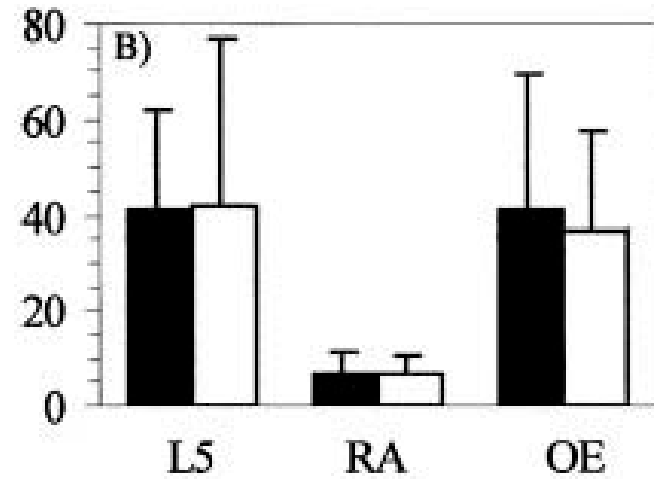
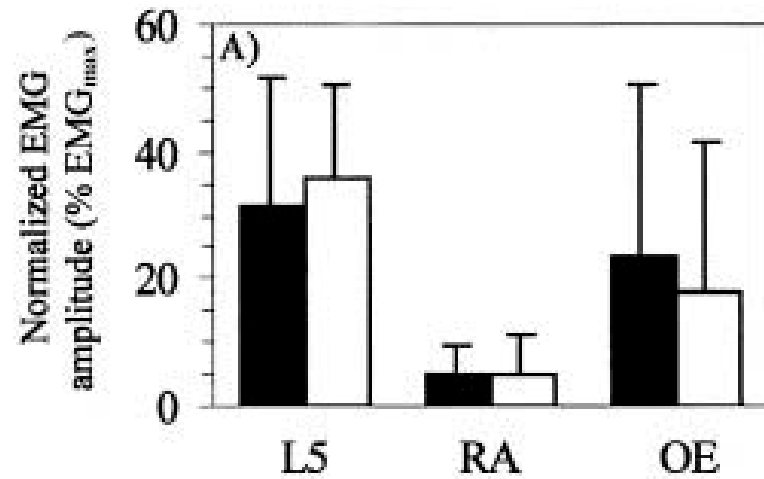
EMG espinales, recto abdominal y oblicuo externo



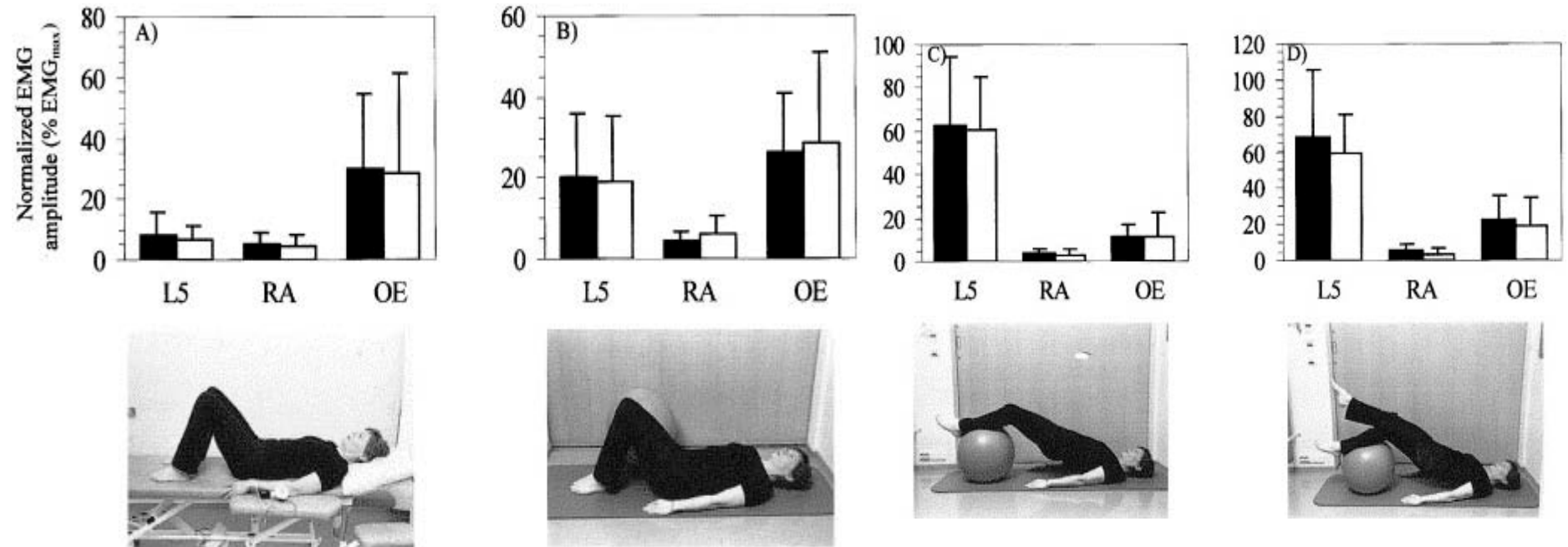
EMG espinales, recto abdominal y oblicuo externo



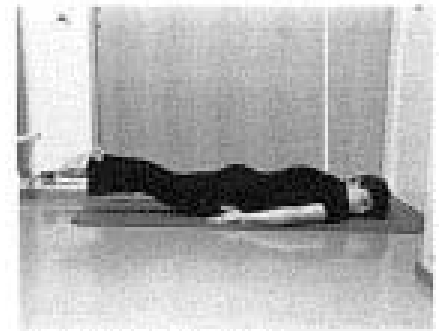
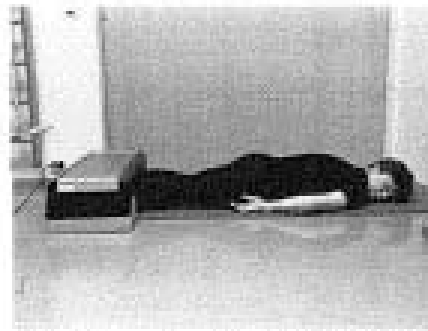
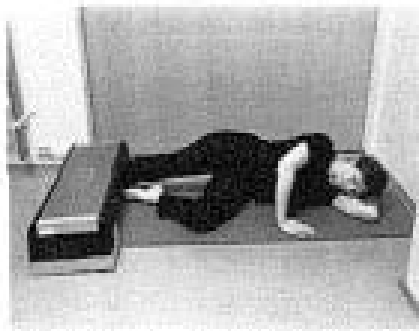
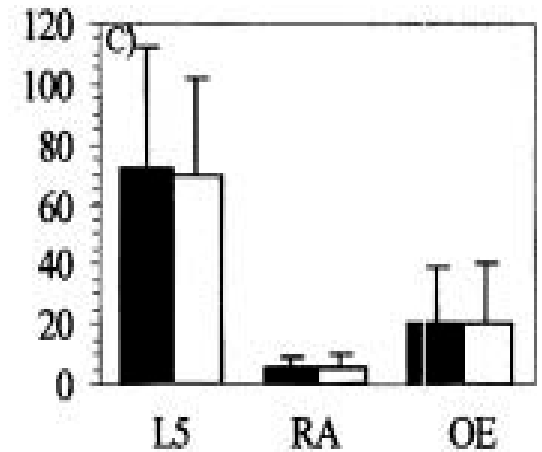
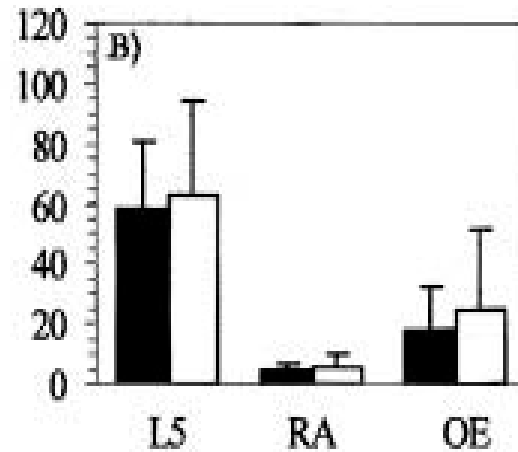
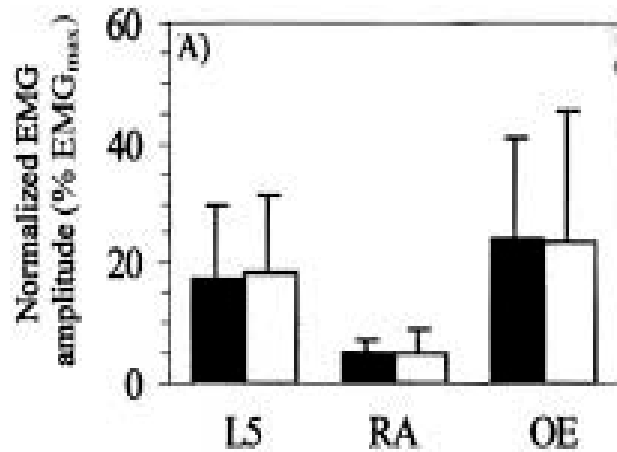
EMG espinales, recto abdominal y oblicuo externo



EMG espinales, recto abdominal y oblicuo externo

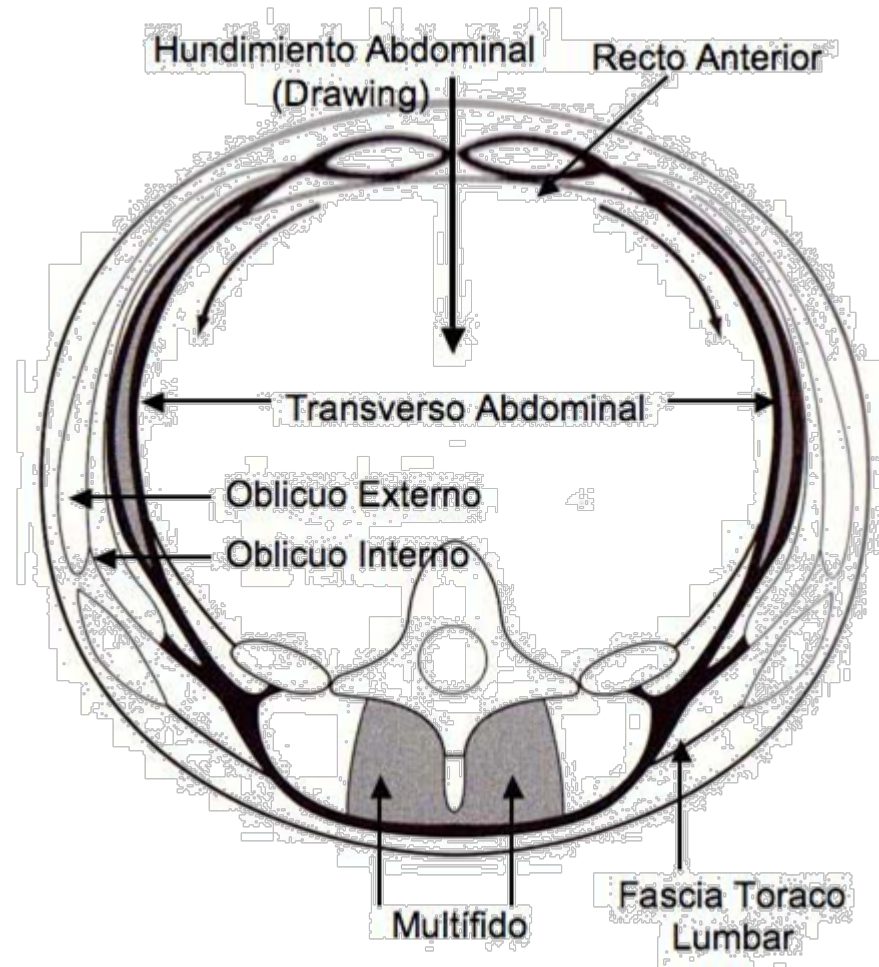


EMG espinales, recto abdominal y oblicuo externo

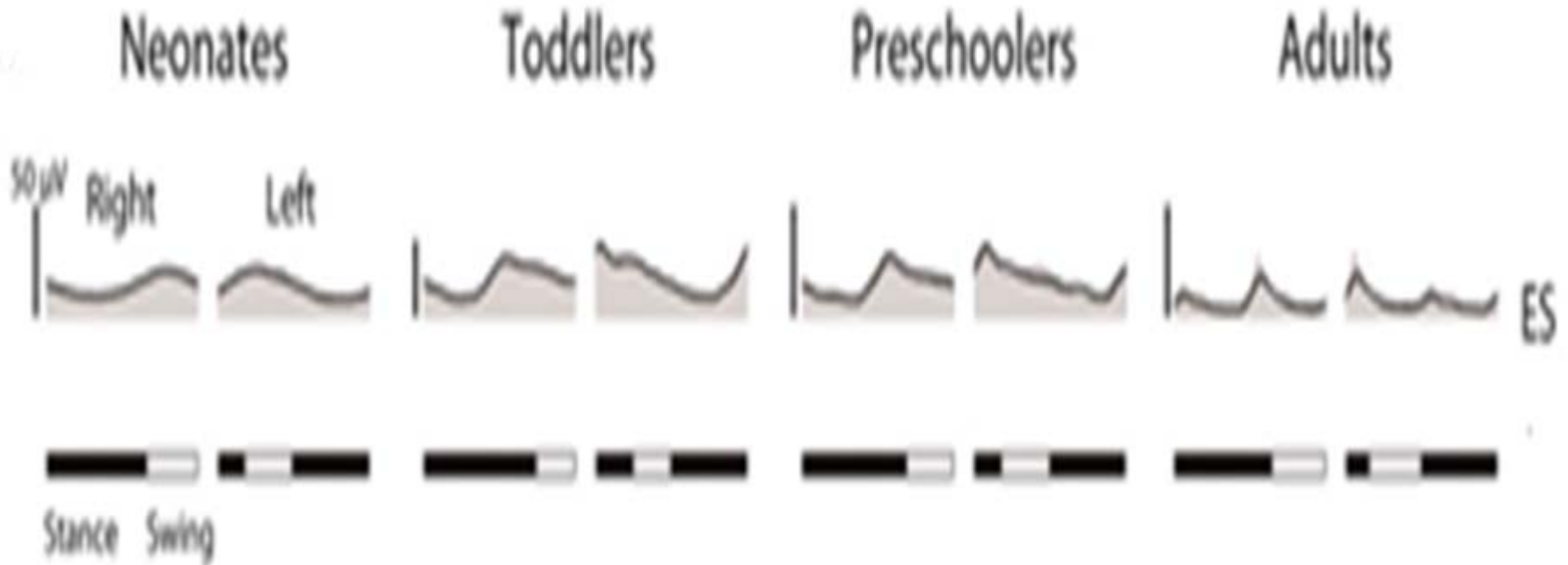


Ejercicio de contracción del abdomen

- Activación selectiva y simultánea del TrA y MTL.
- El recto anterior, oblicuo externo e interno permanecen relajados.



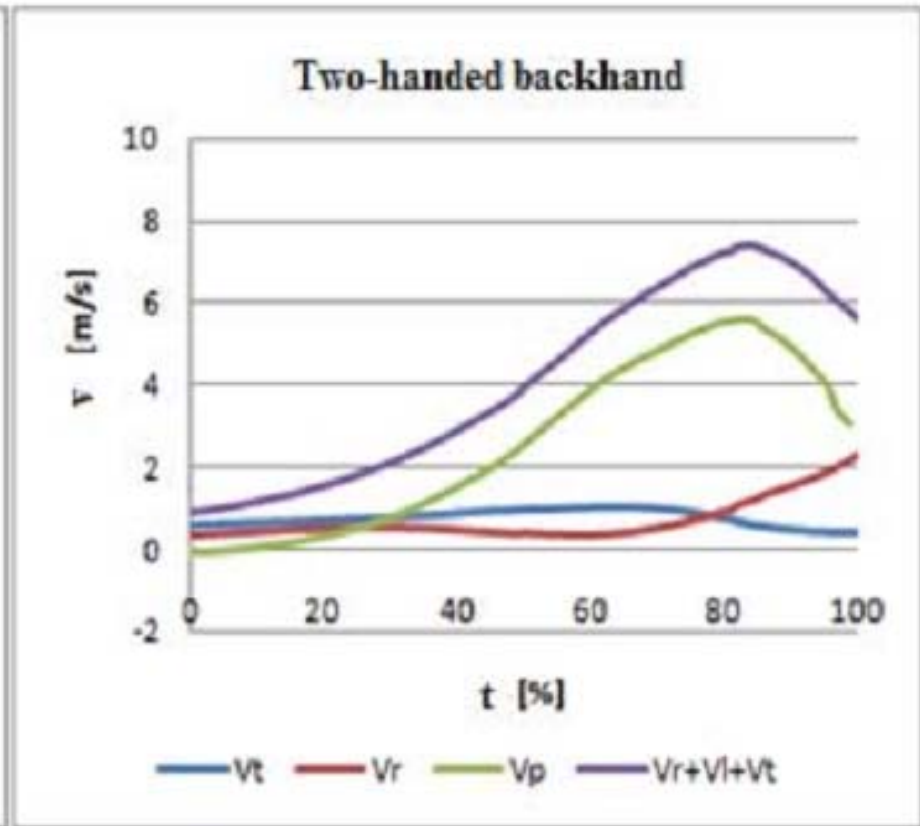
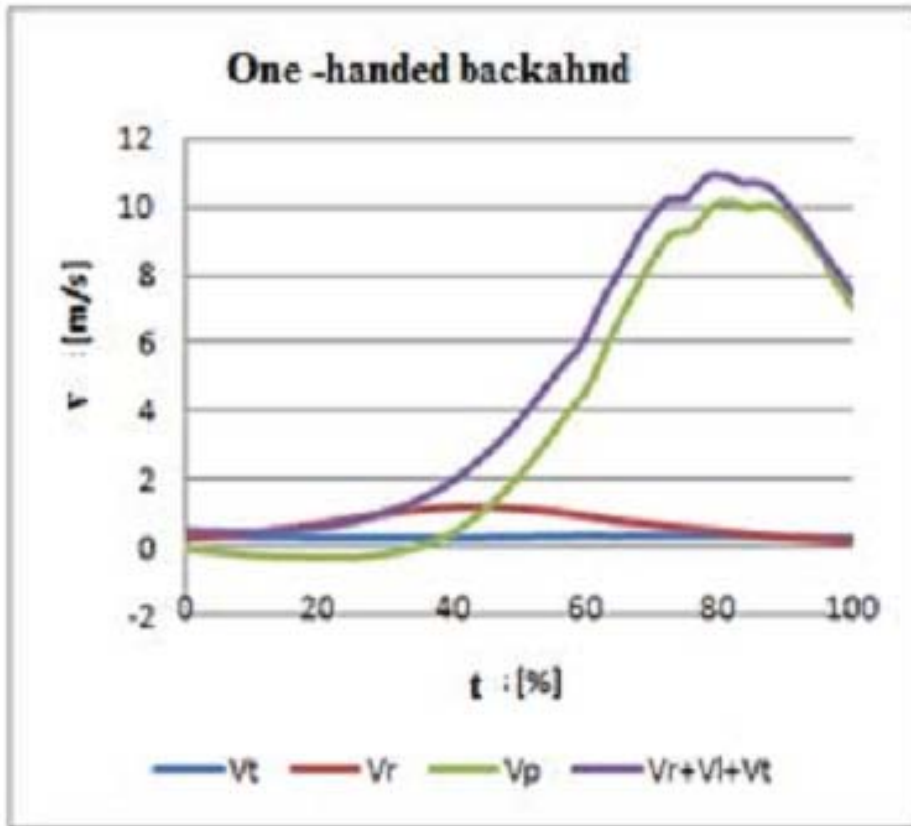
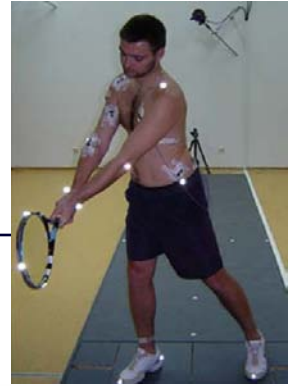
EMG espinales, por grupo de edad en la marcha.



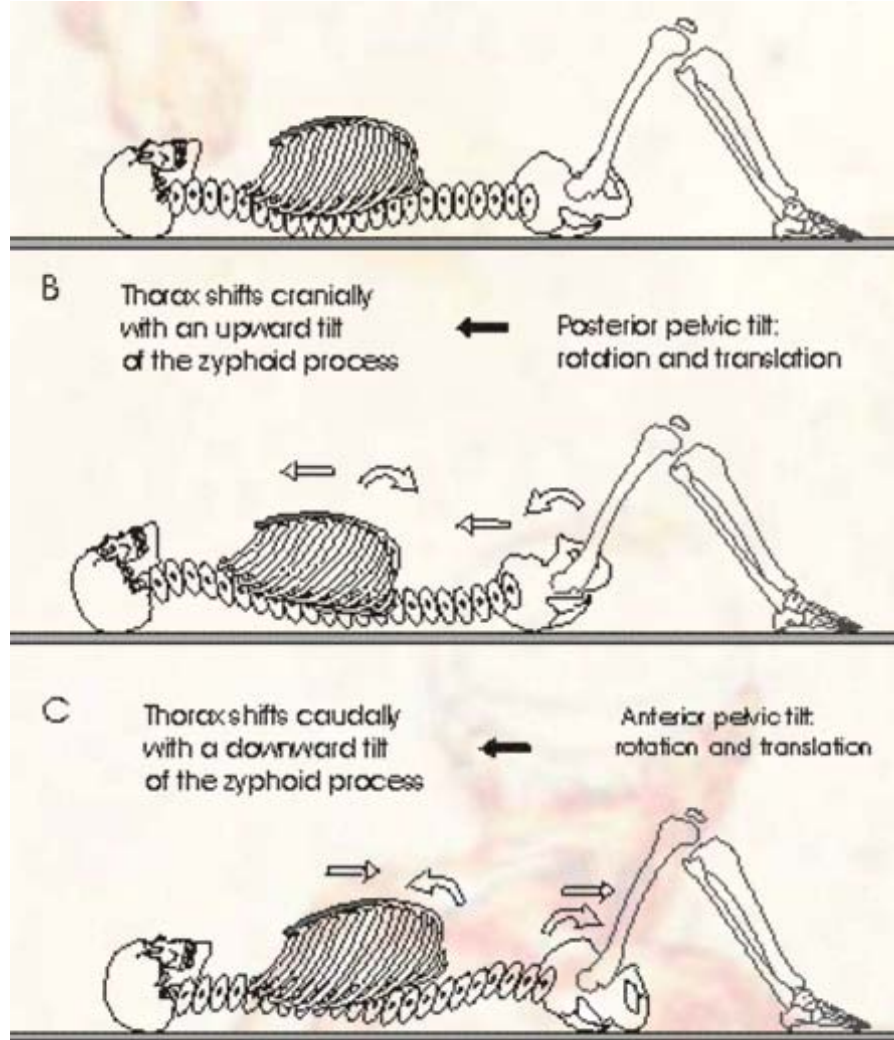
Stępień A y cols. The kinematics of trunk and upper extremities in one-handed and two-handed backhand stroke. Journal of Human Kinetics.2011



Velocidad lineal traslacional y rotacional del tronco y la raqueta

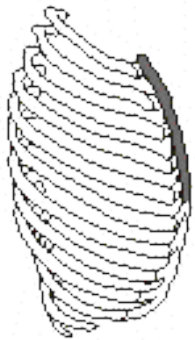


Movimientos de la pelvis y el tórax

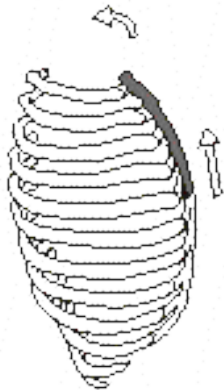


El tórax en posición de pie

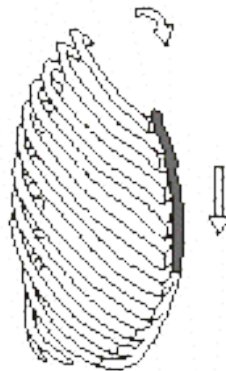
Thorax in Neutral



Extension



Flexion



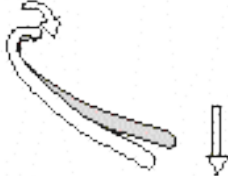
Rib in Neutral



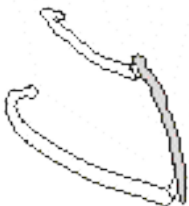
Extension



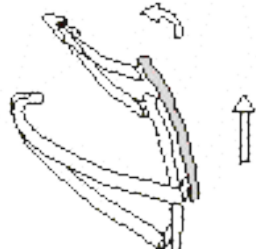
Flexion



Sternum rib interaction



Extension



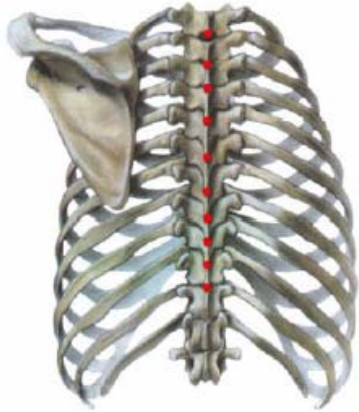
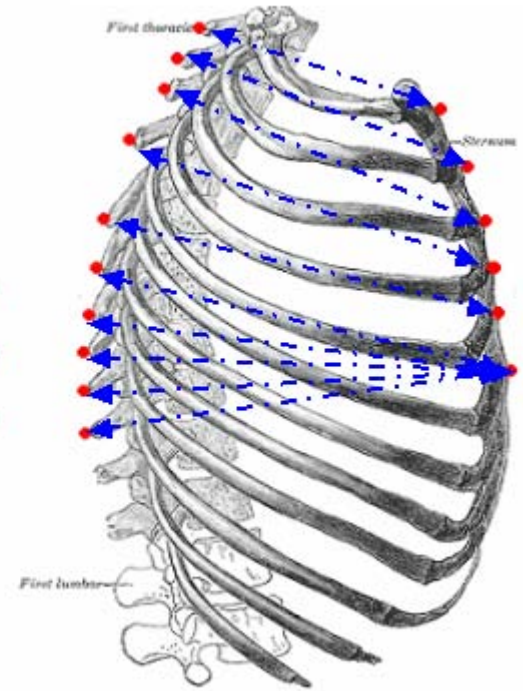
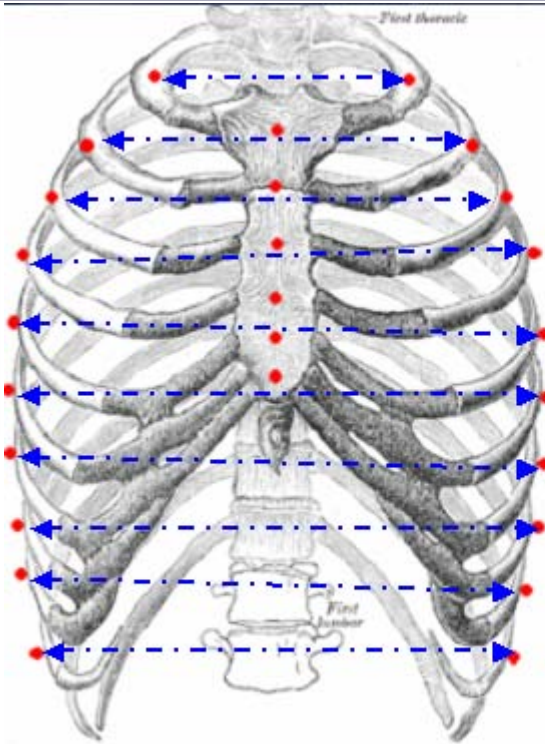
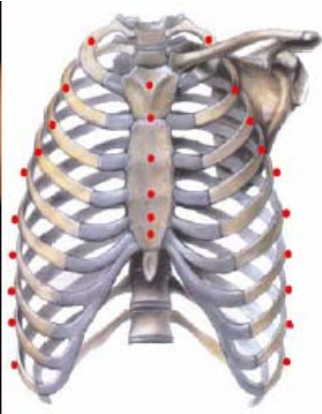
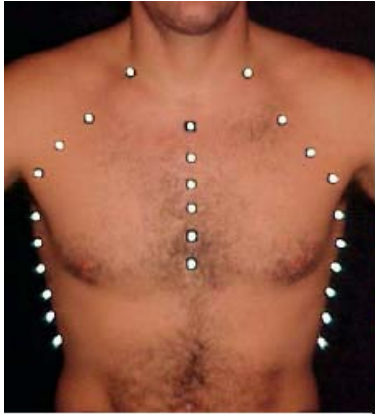
Flexion



- En **extension**, las costillas rotan posteriormente y se elevan con el esternón.

- En **flexión**, las costillas rotan anteriormente y el esternón se deprime (Lee 1993).

Cinemática del tórax



Ricieri D, Rosario N. Impacto de fatores externos sobre a mecânica respiratória avaliada por um modelo fotogramétrico específico: biofotogrametria. J Brasileiro Pneumologia. 2008

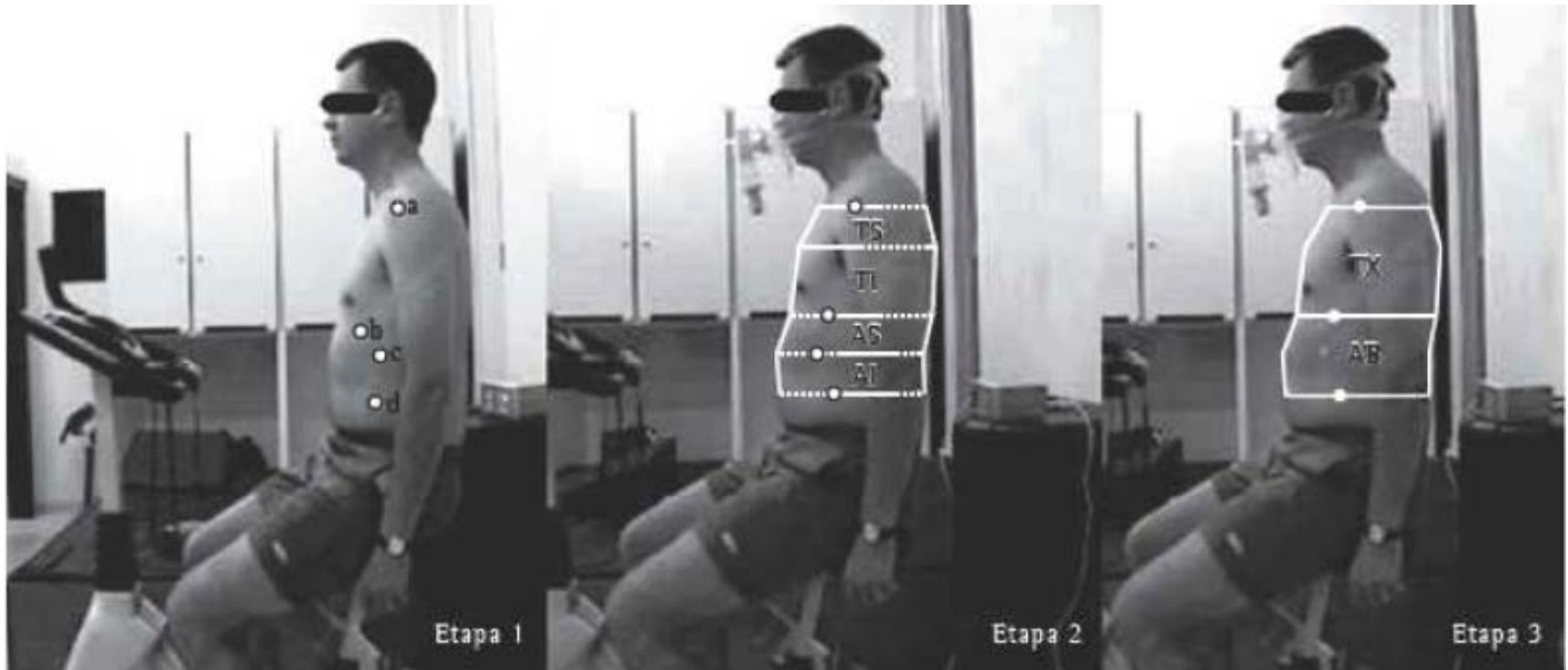


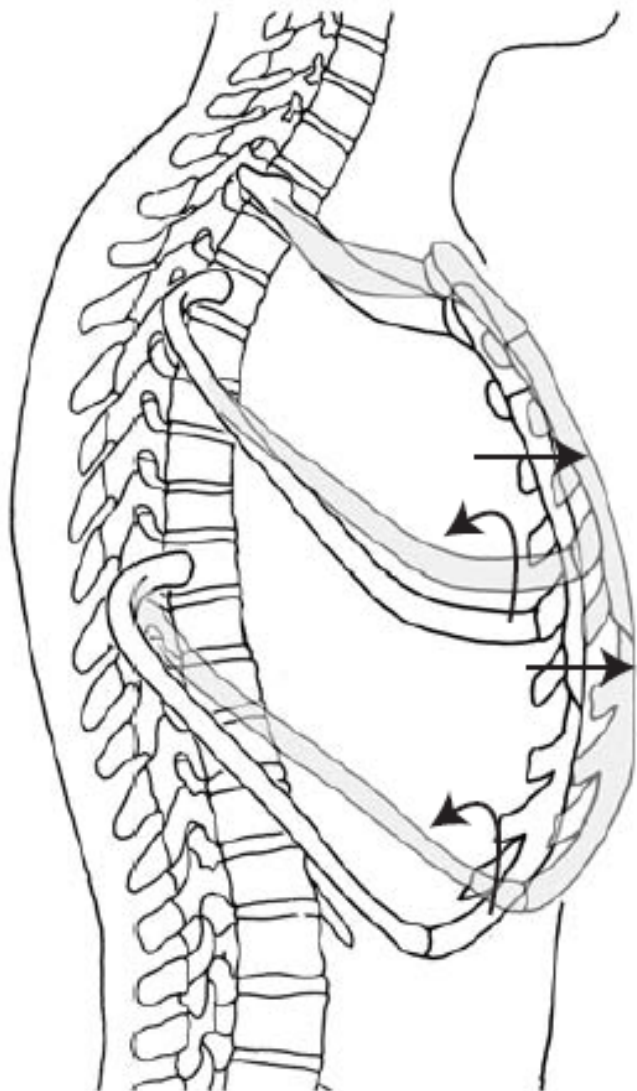
Figura 1 – Modelo biofotogrametria para análise da mecânica respiratória. Etapa 1: marcadores de superfície na delimitação da parede torácica: (a) articulação acromioclavicular, (b) nível do apêndice xifóide; (c) ângulo inferior da cartilagem da décima costela; (d) nível da cicatriz umbilical. Etapa 2: fracionamento da parede torácica em quatro subcompartimentos: torácico superior (TS), torácico inferior (TI), abdominal superior (AS) e abdominal inferior (AI). Etapa 3: divisão da parede torácica em compartimentos torácico (TX) e abdominal (AB).



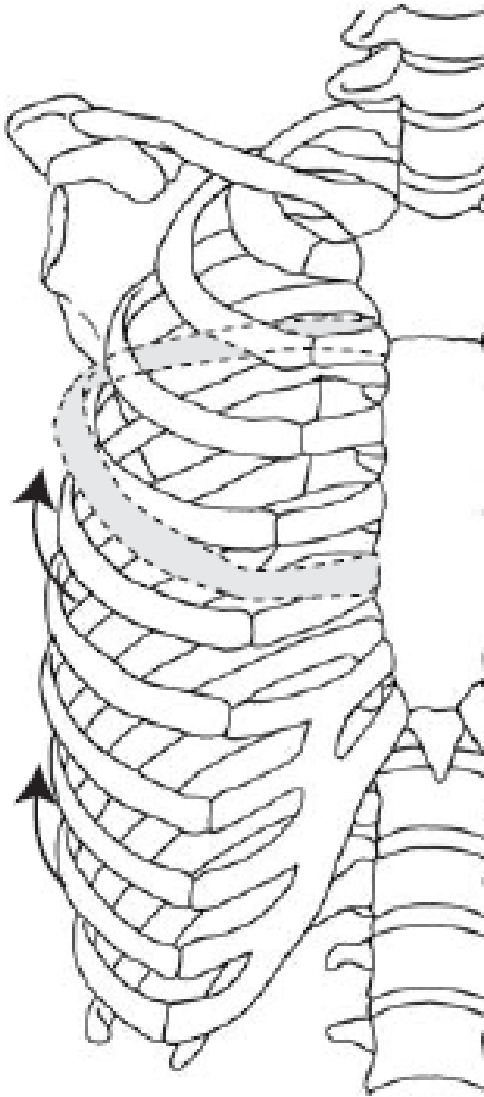
Participant positioning during inspiratory exercise and data collection.

Elevación del tórax

- La elevación de las costillas tiene como punto de apoyo las articulaciones CV y CT.
- Movimiento anterior y superior del esternón, acompañado de torsión de los cartílagos costales.



Elevación del tórax



- La elevación de las costillas inferiores, produce un movimiento lateral de la caja torácica.

Espiración

Inspiración

Esternón

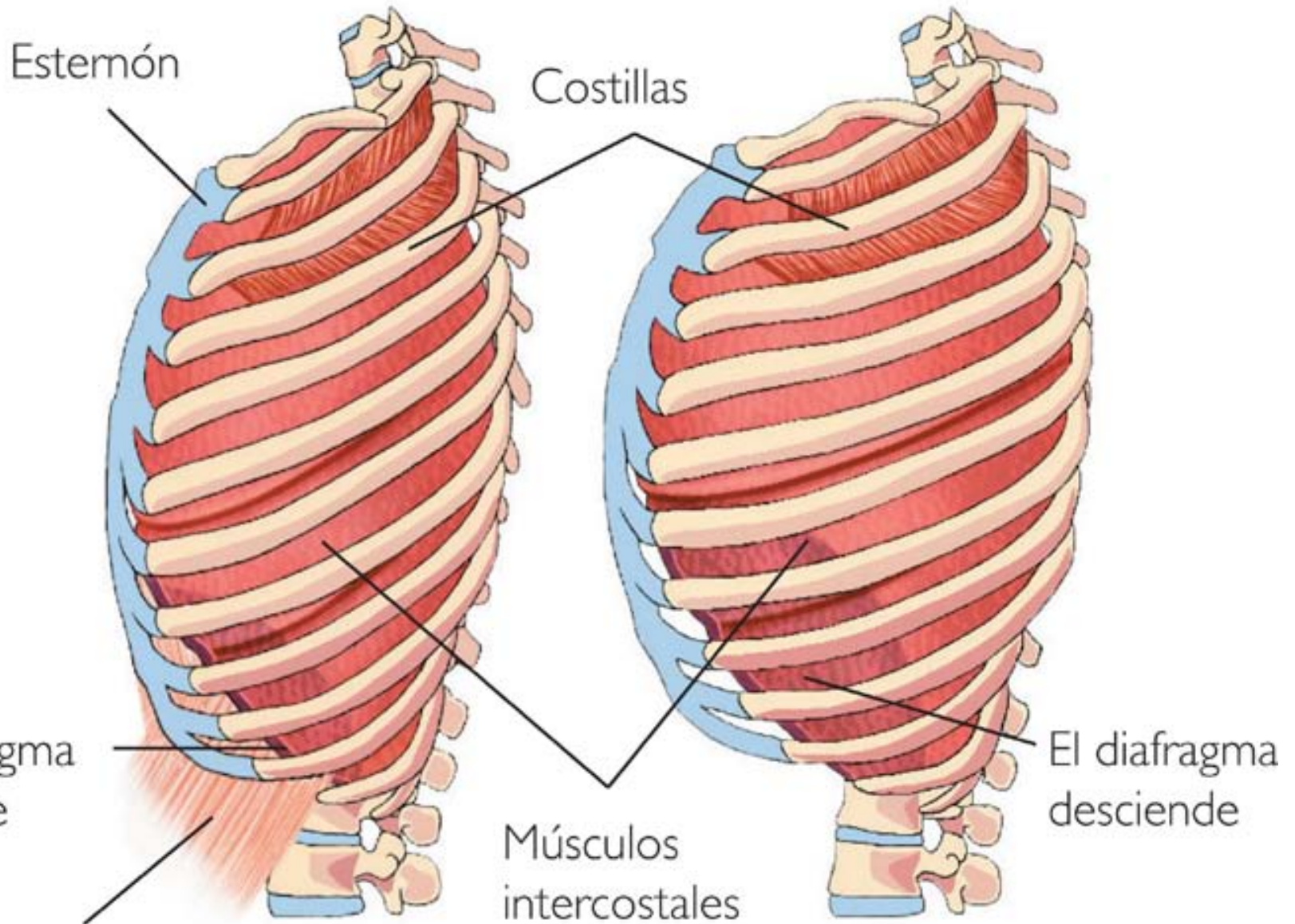
Costillas

El diafragma
asciende

El diafragma
desciende

Músculos
intercostales

Músculos rectos abdominales



Yamaguti W y cols. Avaliação ultra-sonográfica da mobilidade do diafragma em diferentes posturas em sujeitos saudáveis. J Bras Pneumol. 2007

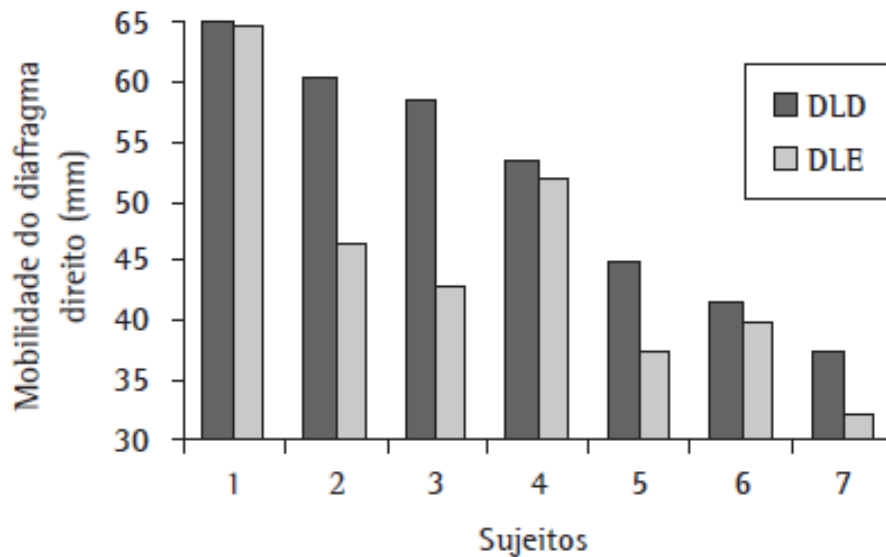
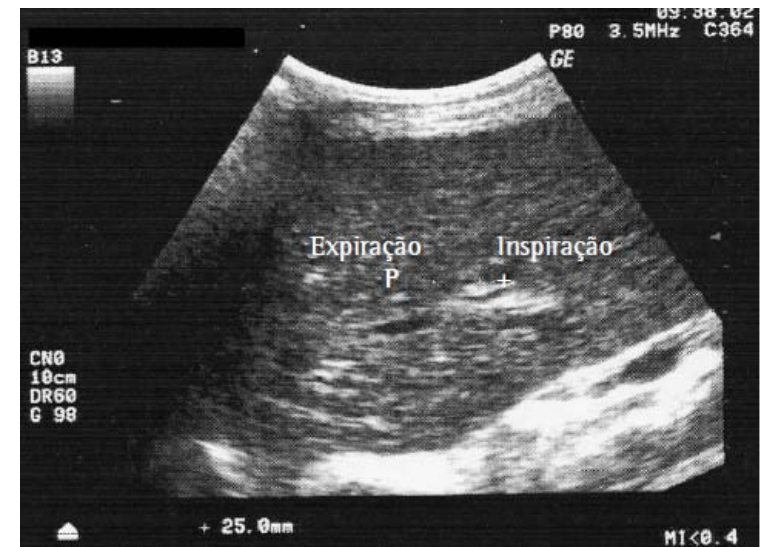
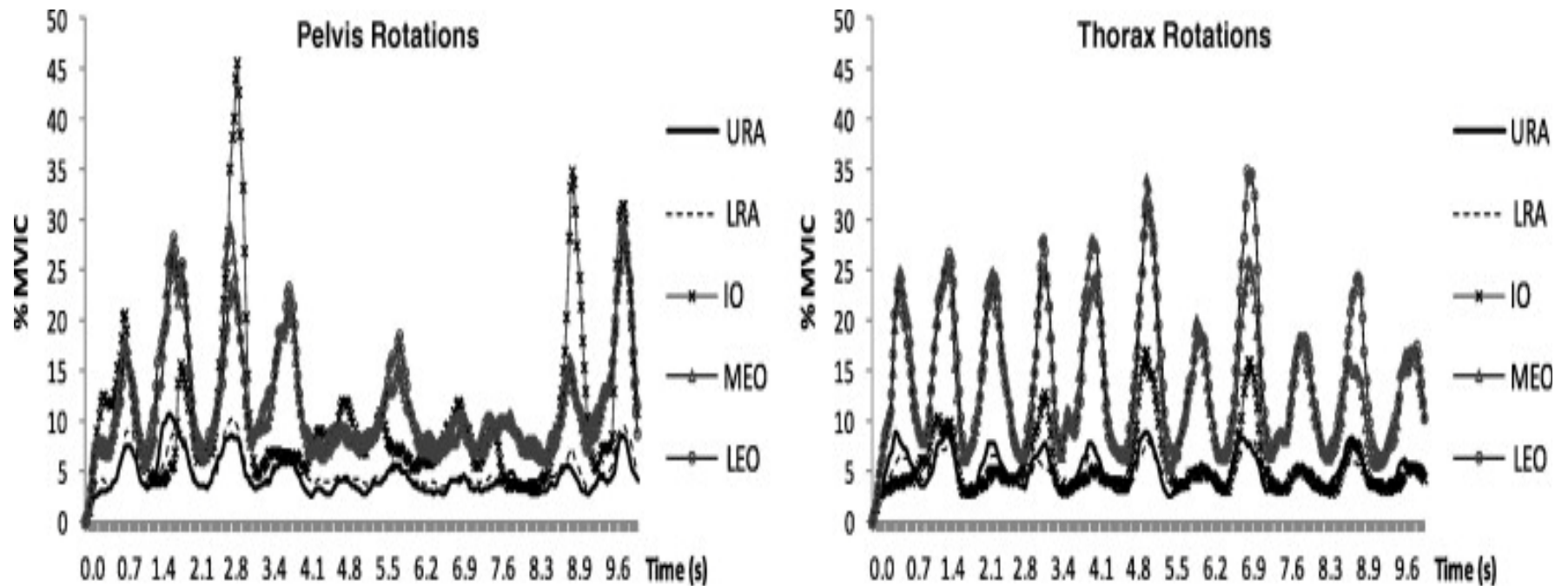


Figura 2 - Avaliação da mobilidade do diafragma direito de sete sujeitos saudáveis posicionados em decúbito lateral direito (DLD, decúbito dependente) e decúbito lateral esquerdo (DLE, decúbito não dependente).

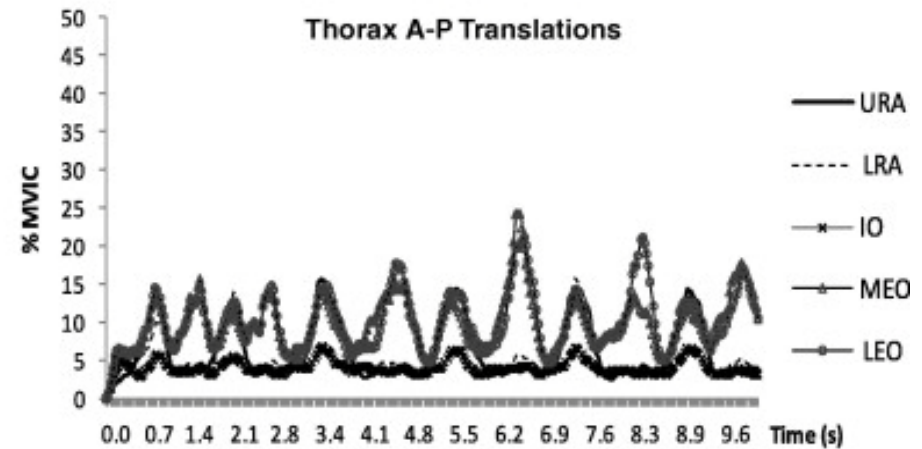
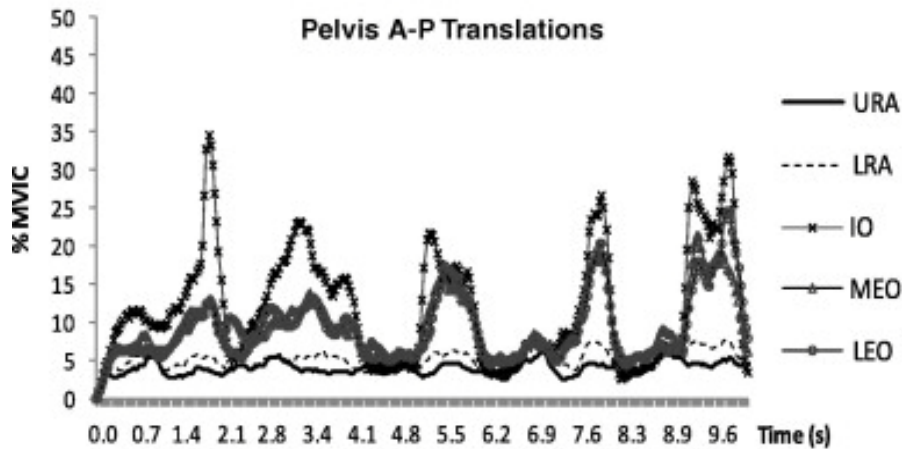


Abdominal muscle activation changes if the purpose is to control pelvis motion or thorax motion Vera-Garcia FJ y cols. Journal of Electromyography and Kinesiology, 2011.



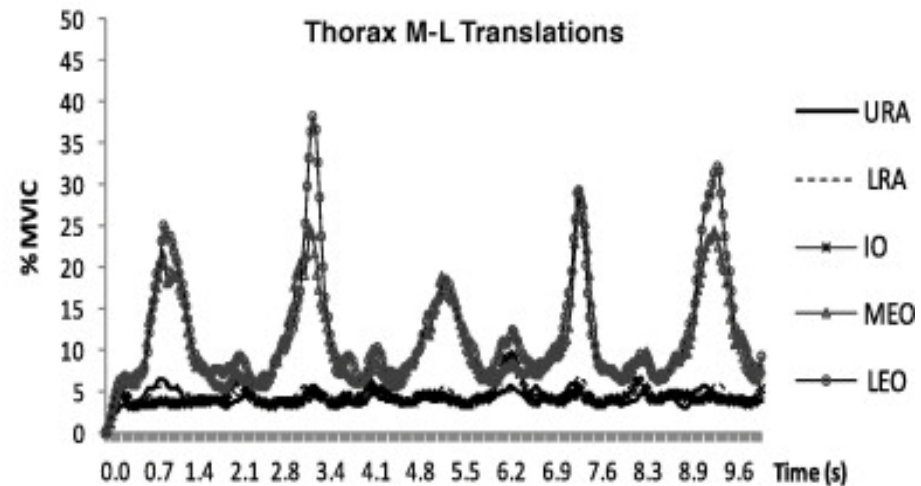
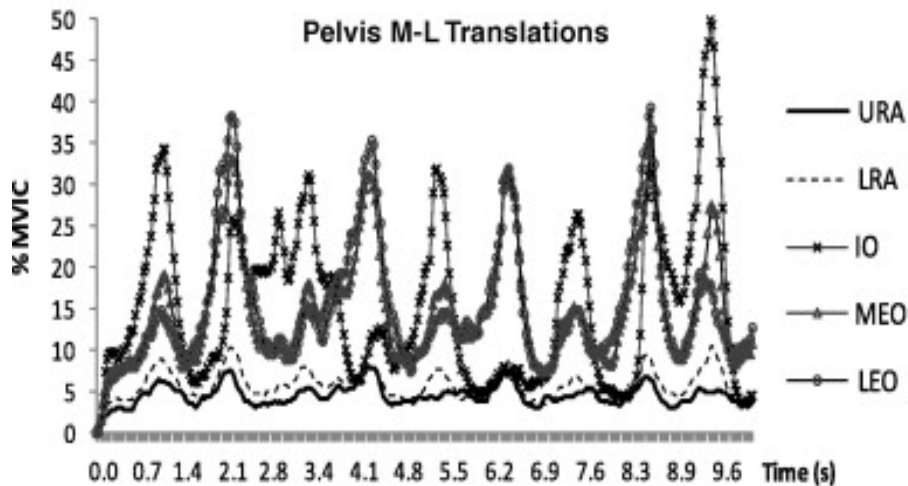
Los movimientos rotacionales producen mayores amplitudes EMG de los oblicuos.

Abdominal muscle activation changes if the purpose is to control pelvis motion or thorax motion Vera-Garcia FJ y cols. Journal of Electromyography and Kinesiology, 2011.



Los movimientos de traslación antero-posterior producen baja actividad EMG del recto abdominal.

Abdominal muscle activation changes if the purpose is to control pelvis motion or thorax motion Vera-Garcia FJ y cols. Journal of Electromyography and Kinesiology, 2011.



Los movimientos de traslación medio-lateral producen mayor actividad EMG de los oblicuos.

GRACIAS
