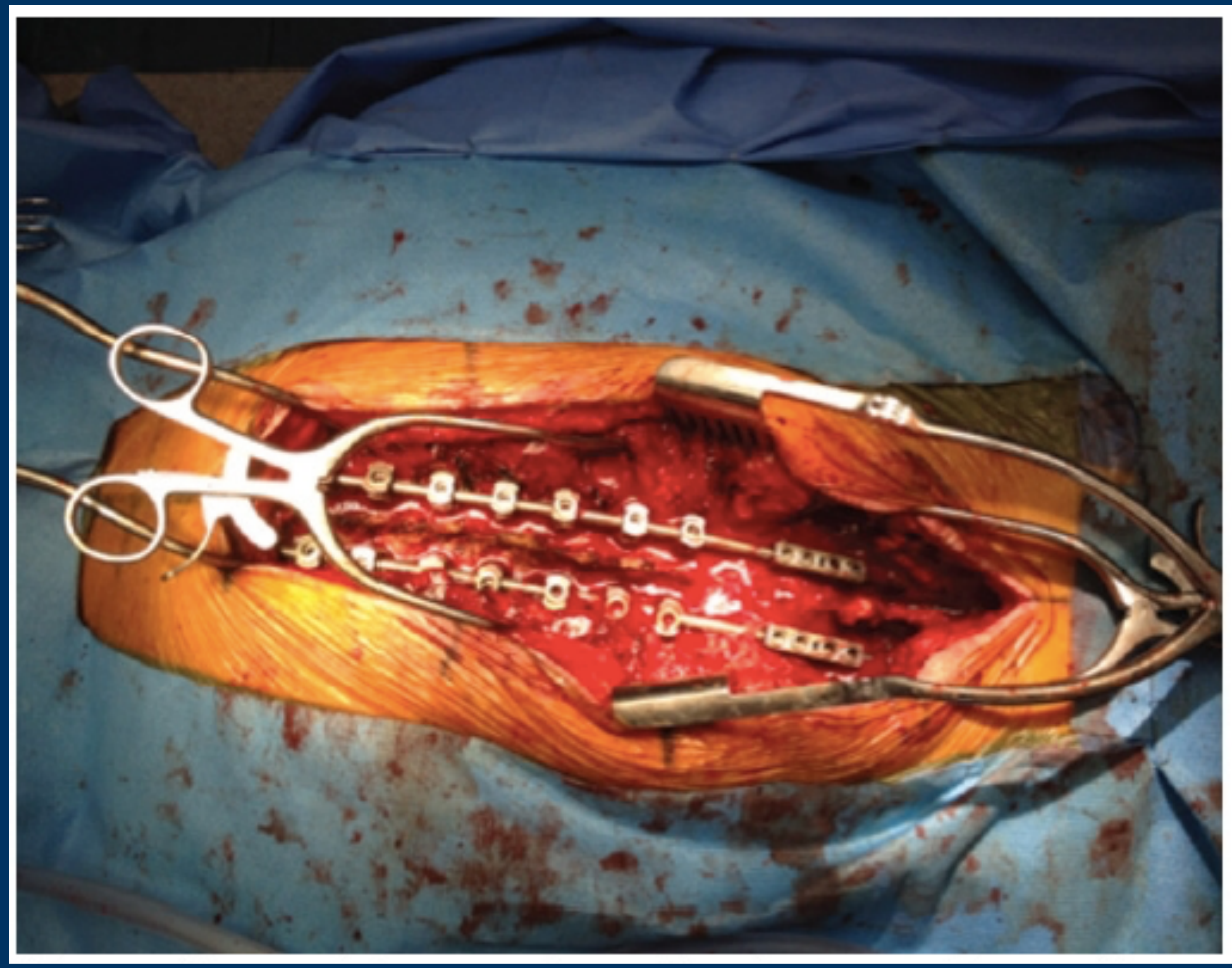
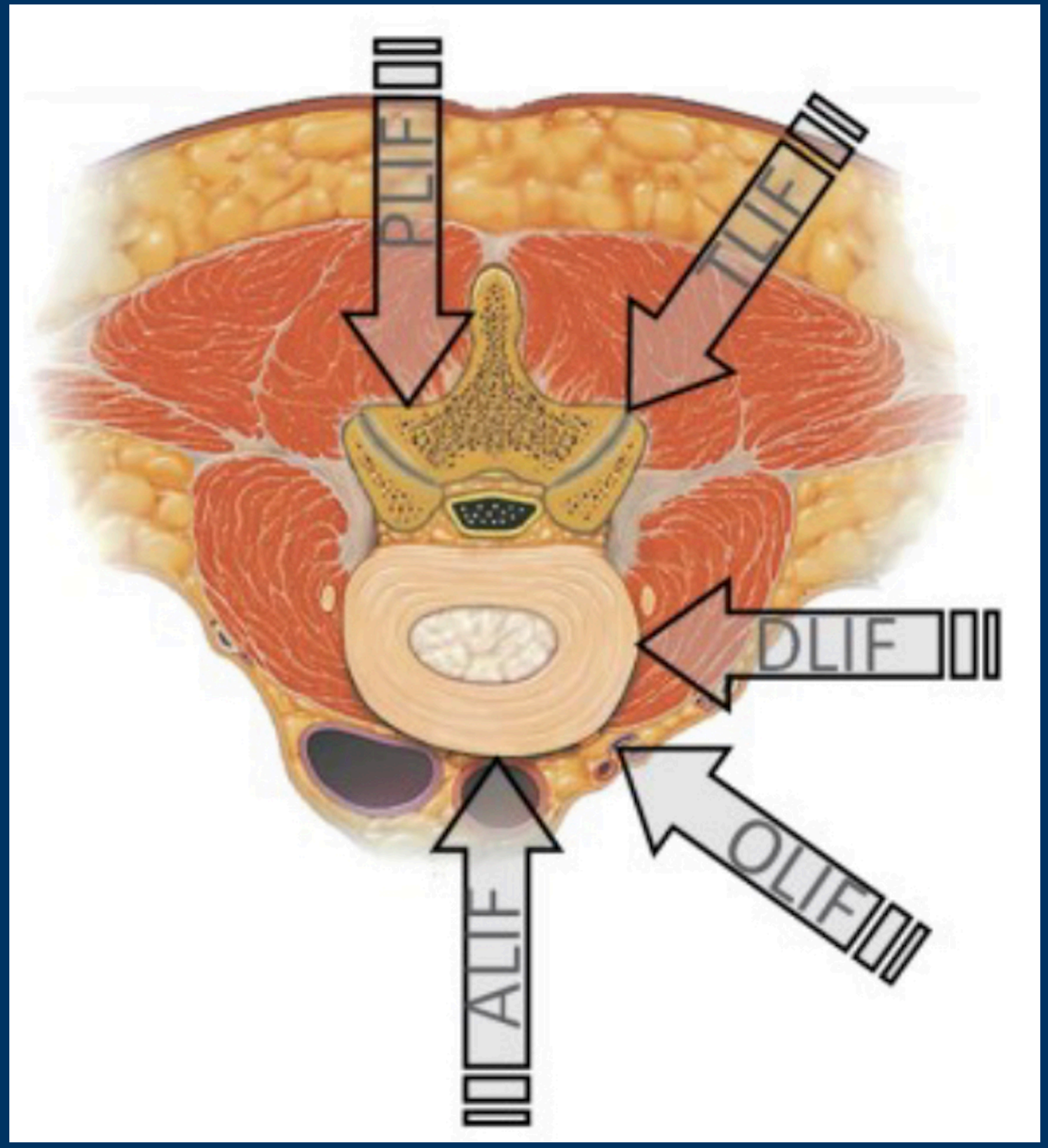
Post-operative rehabilitation strategies : Individualized program for back pain

Kang Seok, MD, PhD
Korea University Guro Hospital

Spine surgery

- Decompression surgery
  - Discectomy, laminectomy
- Fusion
  - PLIF, TLIF, DLIF, OLIF, ALIF
- Interspinous spacer





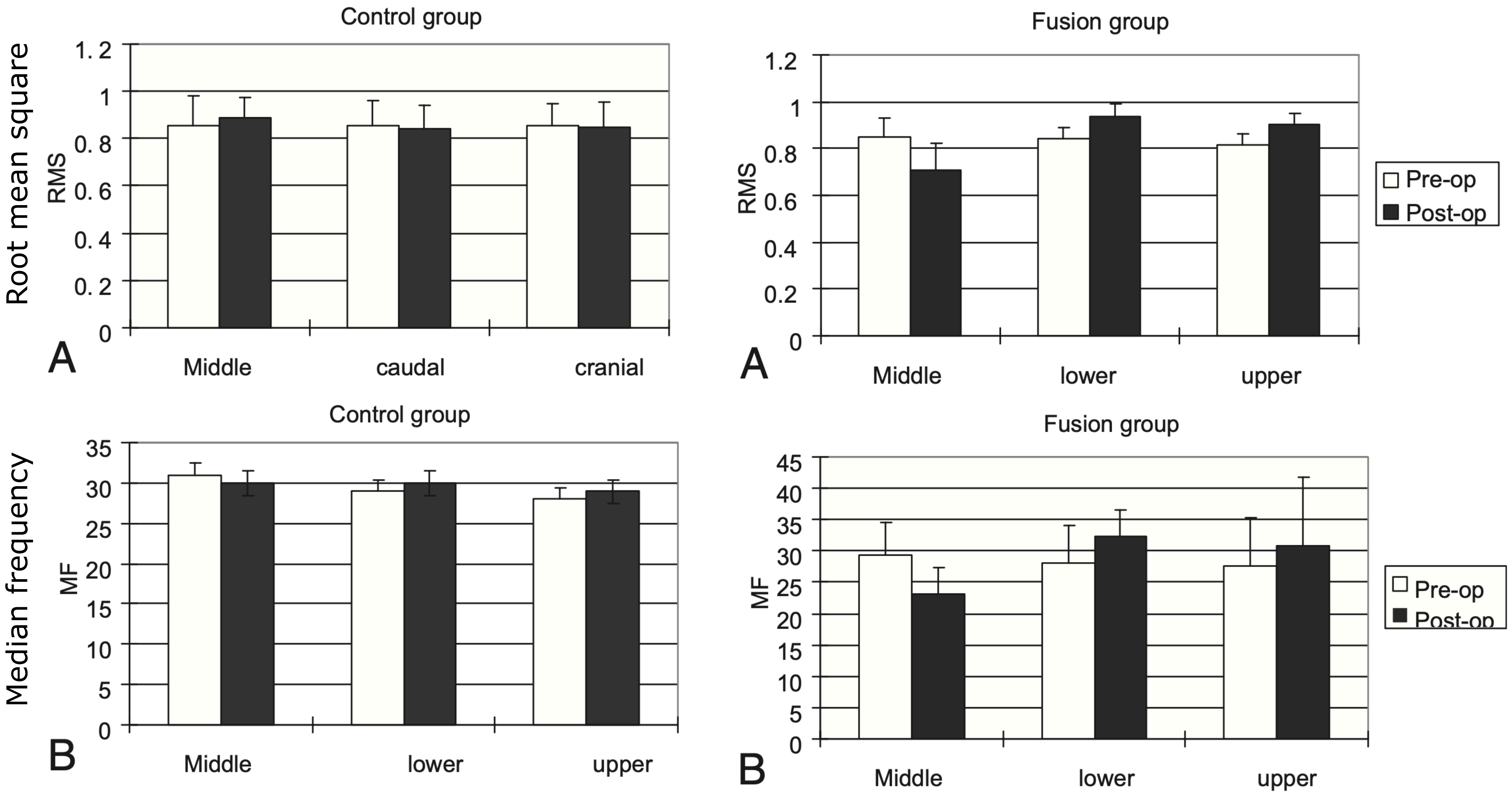
Spine 2008;33:1418–1422

Histologic and Electrophysiological Changes of the Paraspinal Muscle After Spinal Fusion

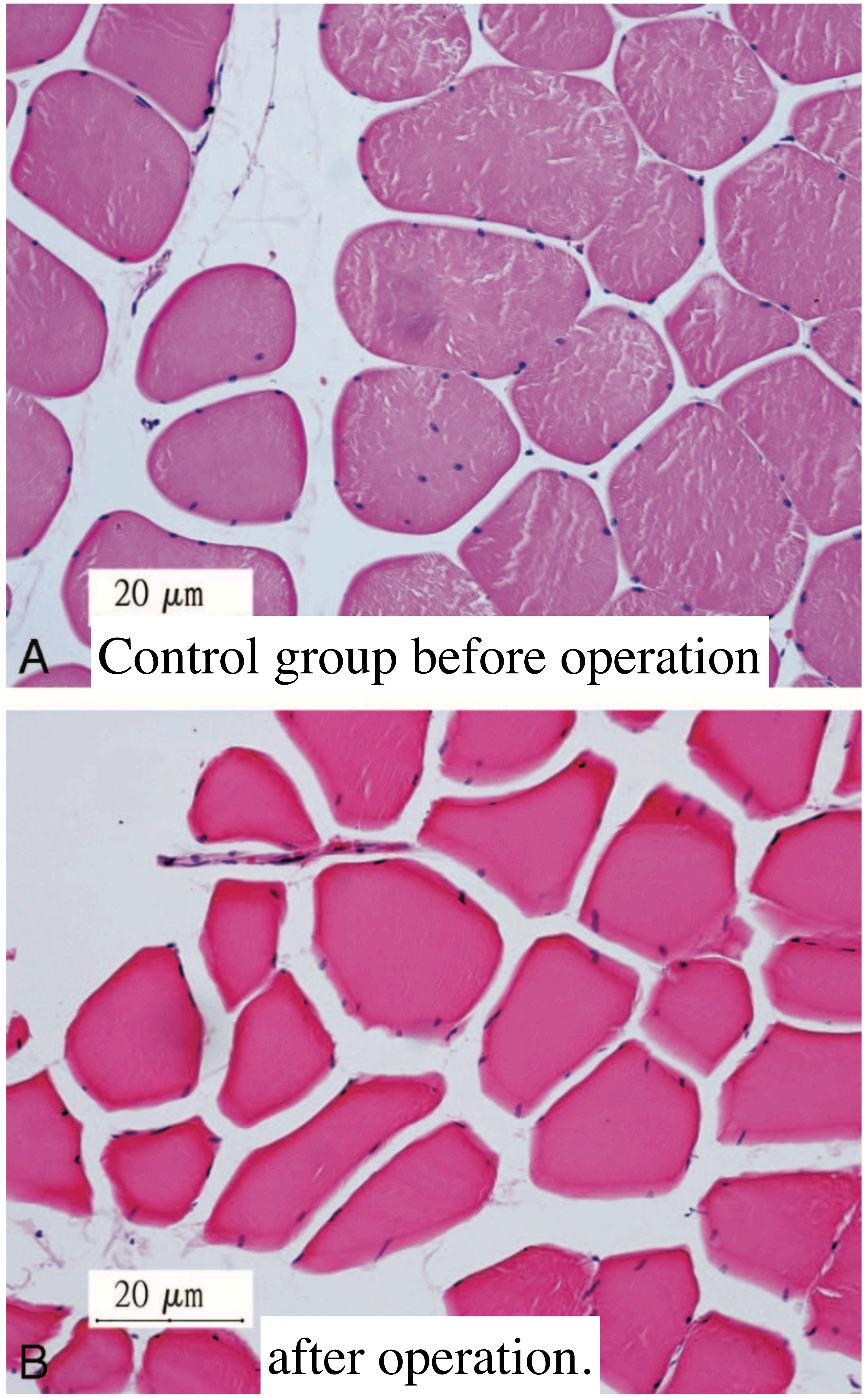
An Experimental Study

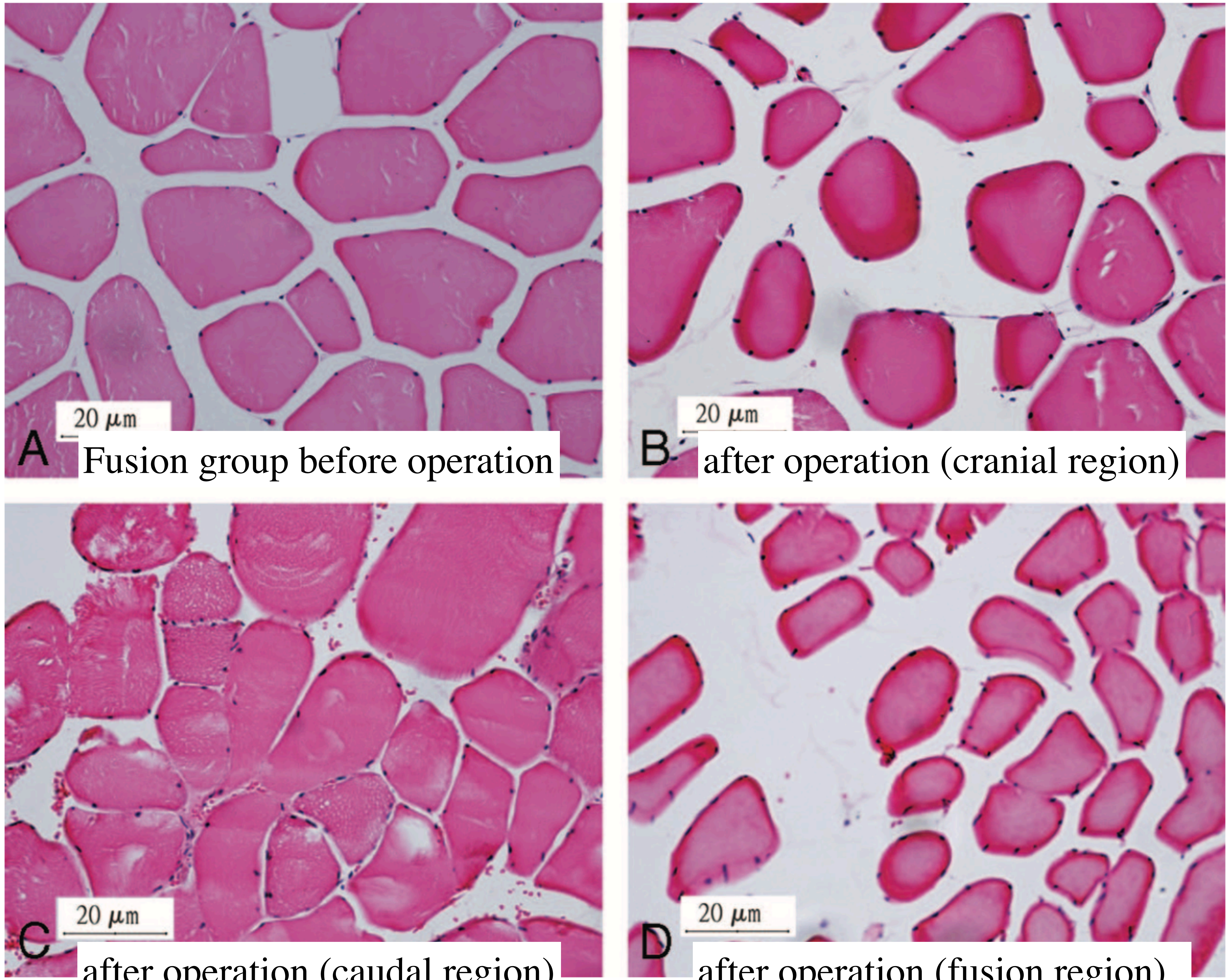
Methods. Thirty New Zealand white rabbits were divided into 2 groups: 2-level posterior spinal fusion with instrumentation (group F) and the sham control group (group S). Preoperative and follow-up electromyography tests, as well as histologic assessments, were performed in 6-month intervals.

Spine 2008;33:1418–1422

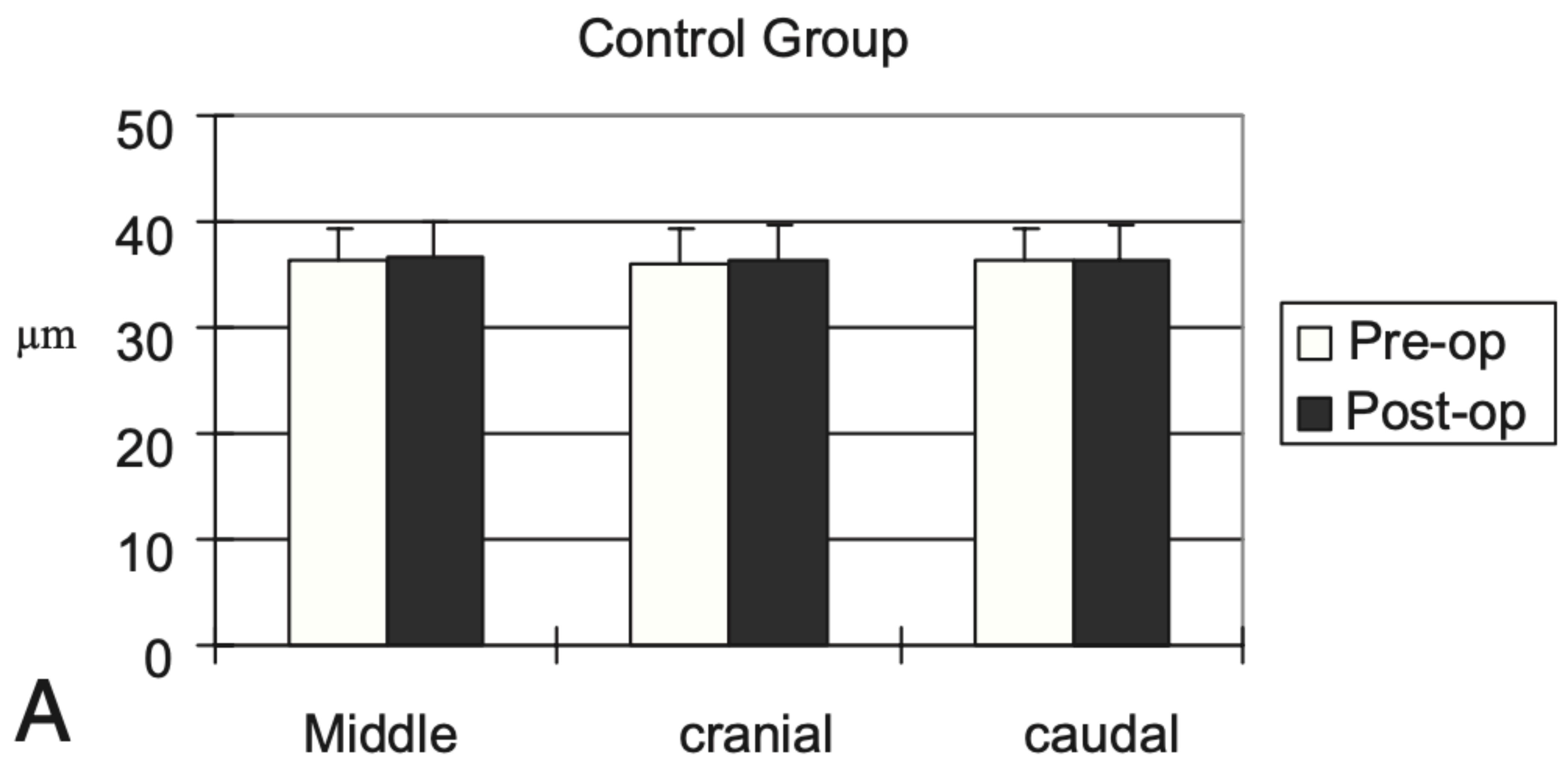


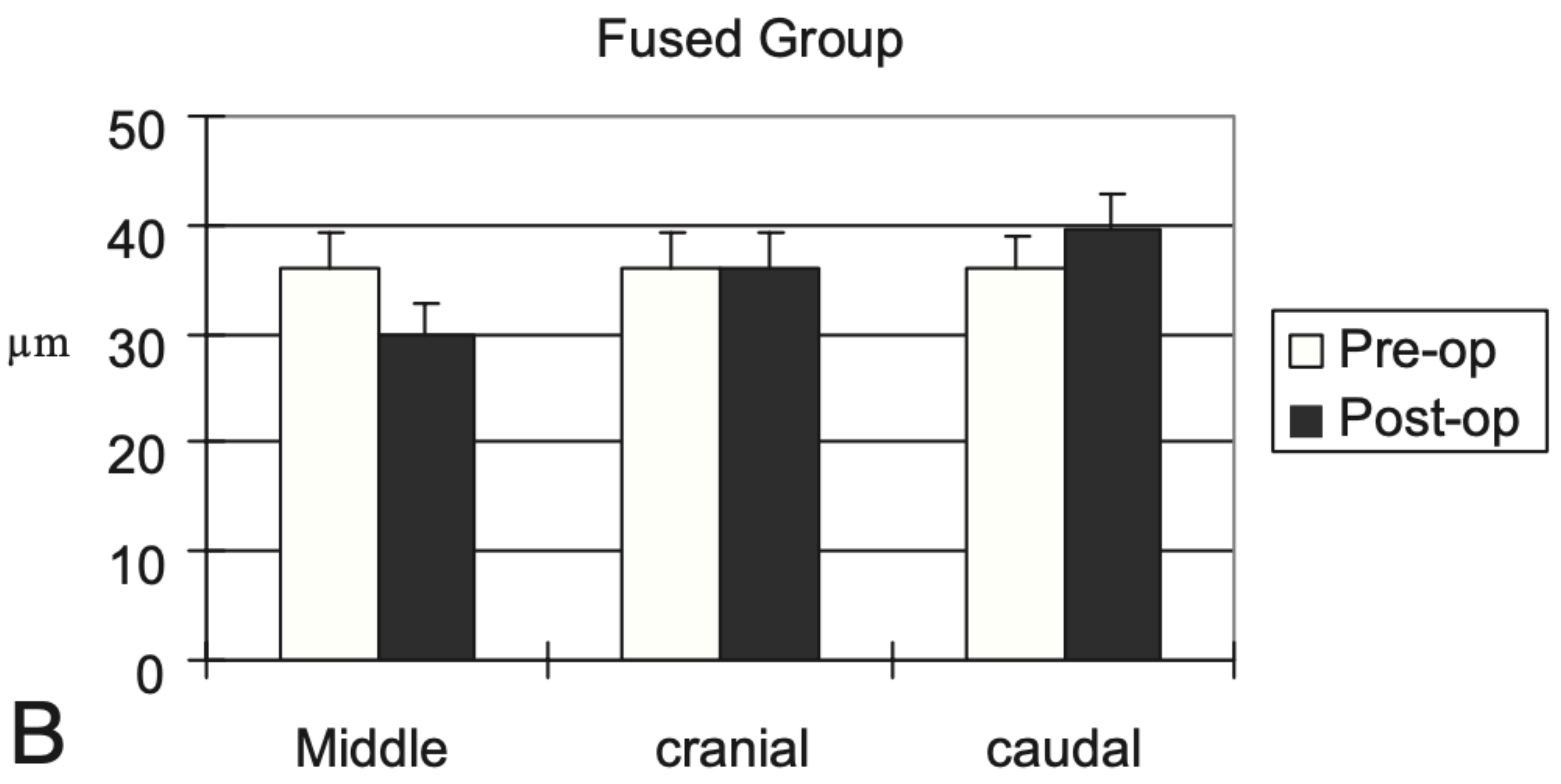
Spine 2008;33:1418–1422



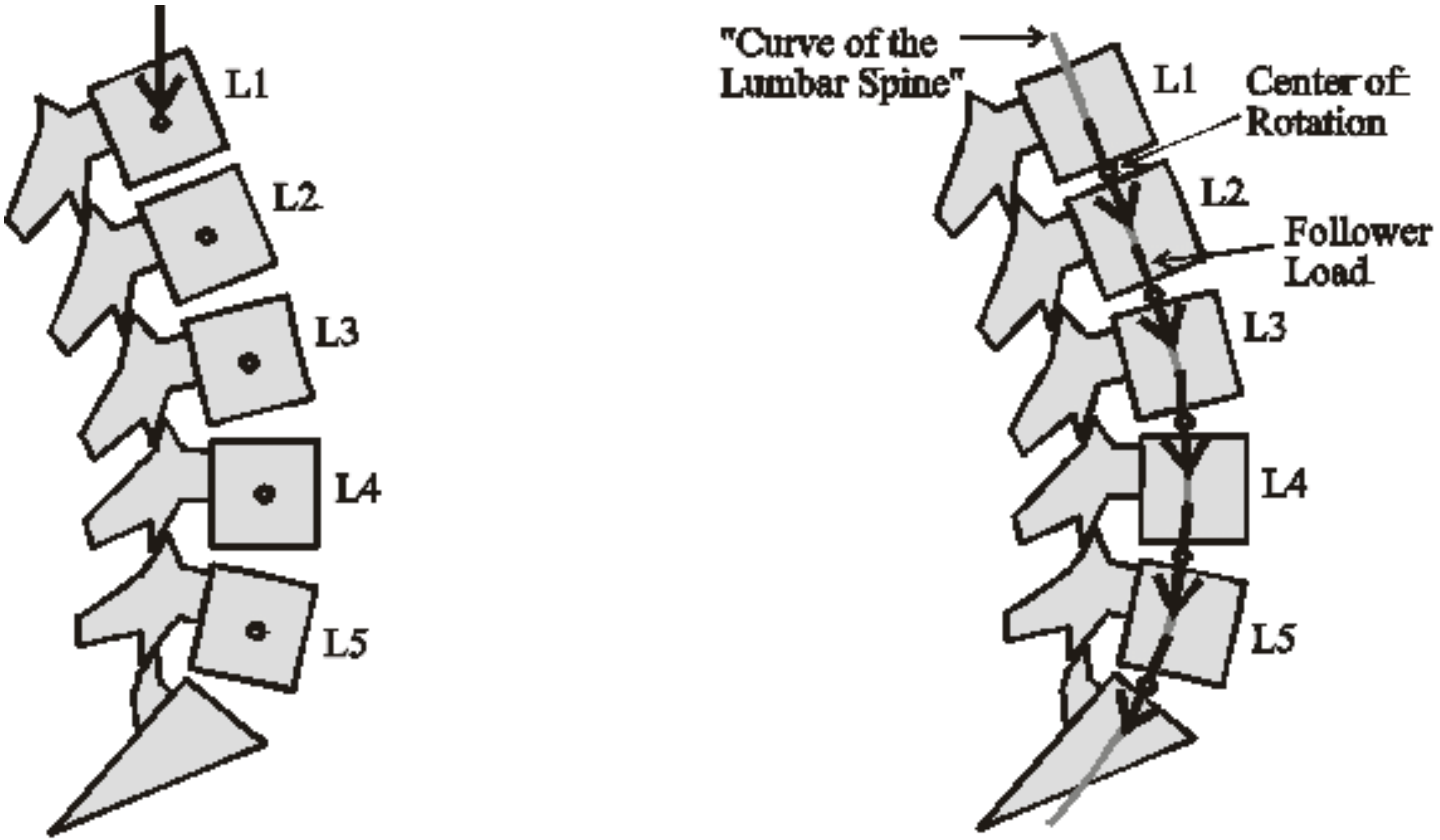


Spine 2008;33:1418–1422





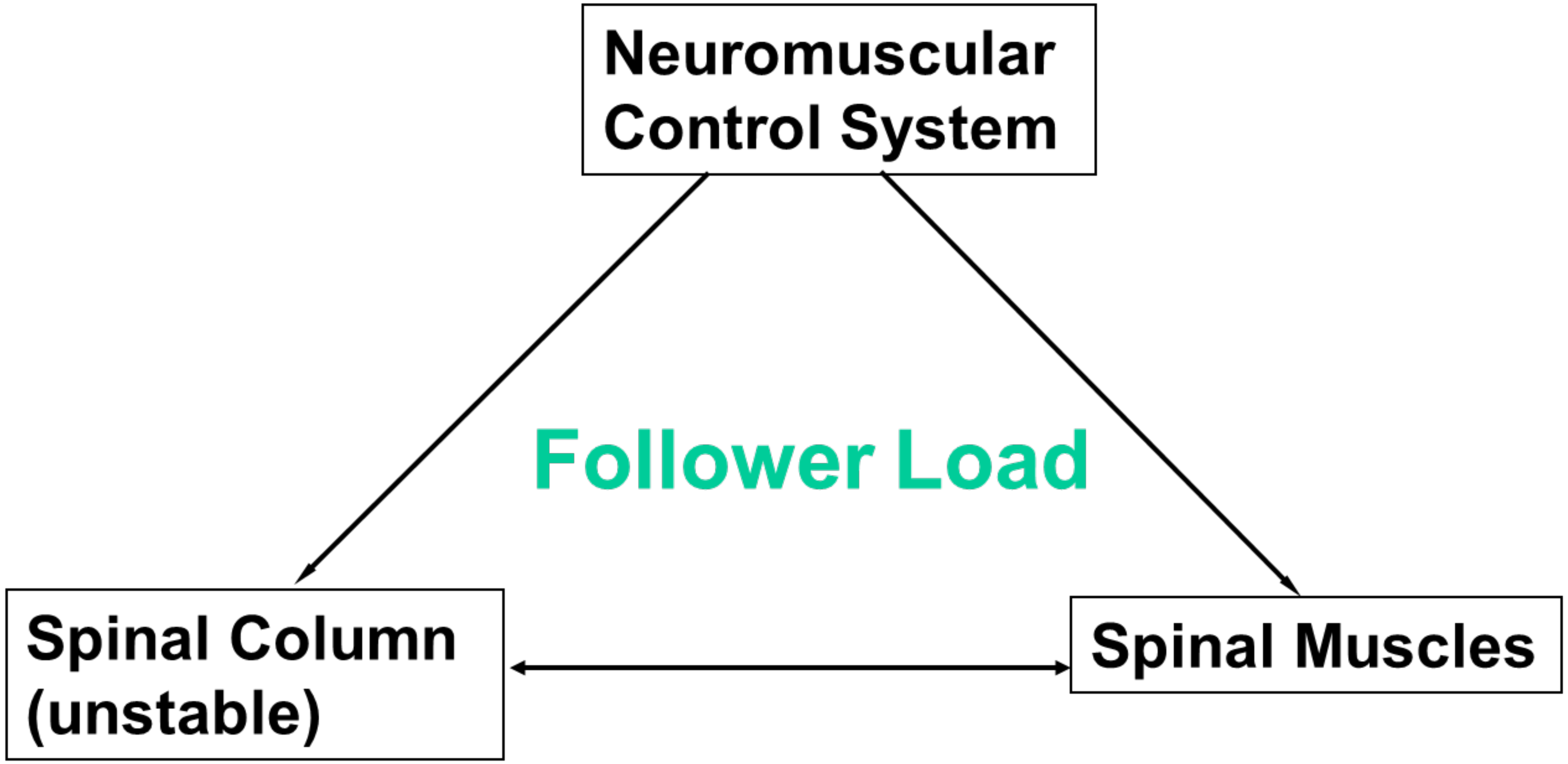
Conclusion. These results demonstrated that spinal fusion resulted in atrophy and reduced adjacent paraspinal muscle activity. Muscular activity was greater in the adjacent regions after spinal fusion, which may indicate muscle hypertrophy.



(a) Compressive Vertical Load

(b) Compressive Follower Load

Spine can maintain stability and flexibility when the follower load is produced in the spine.



Problems after spinal surgery

- Re-occurring of pathology
- Segmental instability
- Pain
- Weakness

Microdiscectomy

- overall success rate of microdiscectomy: 84%
- improvement in symptoms for up to 2 years
- Recurrence of disc herniation: 1-20%
- most common in first 3 months after surgery
- multiple recurrence → spinal fusion or artificial disc could be needed

Laminectomy

- success rate: approximately 70~80%
- postoperative instability: 5-10%
- avoid pars interarticularis
- recurring symptom & spondylolithesis → fusion could be needed

Spinal fusion

- failure to relieve symptoms: minimum 20%

↓

Failed back surgery syndrome

Journal of Pain Research 2016:9 979–987

Failed back surgery syndrome: current perspectives

IASP definition of FBSS

Lumbar spinal pain of unknown origin either persisting despite surgical intervention or appearing after surgical intervention for spinal pain originally in the same topographical location.[4]

Journal of Pain Research 2016:9 979–987

Table 1 FBSS statistics

Rajaee et al[3]
• 170.9% increase of primary lumbar fusions from 77,682 to 210,407 between 1998 and 2008
• 11.3% increase in laminectomies from 92,390 to 107,790 between 1998 and 2008
Parker et al[6]
• 5%–36% recurrence rate of back or leg pain 2 years after discectomy for disc herniation
Skolasky et al[7]
• 29.2% of patients had same or increased pain 12 months after surgical laminectomy for lumbar stenosis secondary to degenerative changes
Arts et al[24]
• 35% success rate in terms of perceived recovery, functional disability, and pain. 15 months after instrumented fusion for treatment of FBSS

Abbreviation: FBSS, failed back surgery syndrome.

Journal of Pain Research 2016:9 979–987

Table 2 Summary of factors leading to failed back surgery syndrome

Preoperative factors	Postoperative factors
Litigation, worker's compensation	Progression of degenerative changes (new onset foraminal stenosis, new/recurrent disc herniation)
Smoking	Altered biomechanics leading to joint leading, muscular hypertrophy, atrophy, and spasms
Obesity	
Preoperative psychiatric disorders (depression and anxiety)	
Etiology of back pain (foraminal stenosis > disc herniation)	

Journal of Pain Research 2016:9 979–987

Table 3 Diagnostic modalities for FBSS

Modality	Comments
History and physical examination	Assess for radicular symptoms, range of motion, paraspinal and SIJ tenderness, alleviating and exacerbating factors
X-ray	Assess for bony spinal deformities with flexion and extension images
MRI	Gadolinium-enhanced T1 is Gold standard for assessing soft tissue injuries. Assess for disc herniations, stenosis, and fibrosis
CT myelogram	Useful when implanted hardware creates artifact with MRI
CT with multiplanar reconstructions	Assess for osseous changes in the spine. Helpful for visualization of hardware
Discography	Helpful in isolating a specific intervertebral disc as source of back/leg pain
Diagnostic injections	Helpful in ruling in/out a specific nerve root or joint as cause of pain. Steroids may be added to provide sustained relief

Original Article

Journal of Clinical and Diagnostic Research. 2017 May, Vol-11(5): TC06-TC09

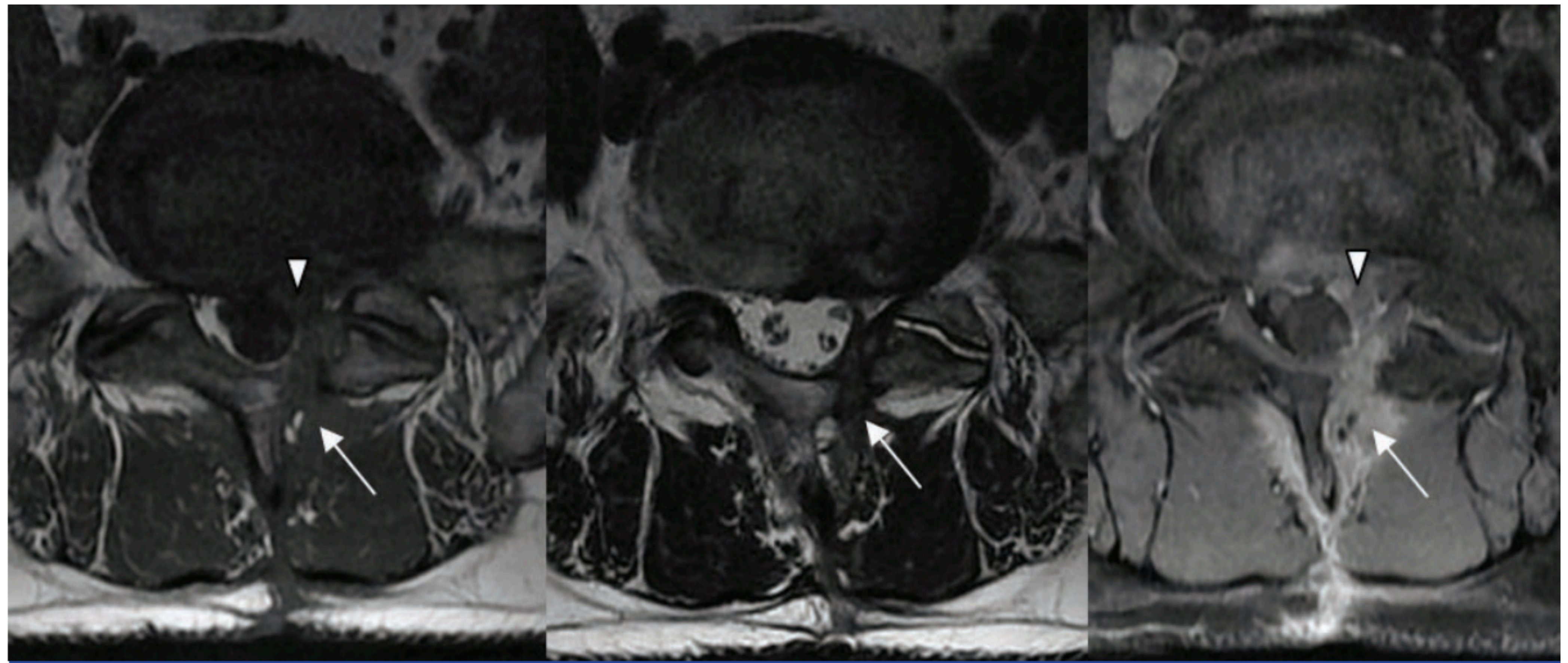
Failed Back Surgery Syndrome: Evaluation with Magnetic Resonance Imaging

Symptoms	Number
Backache (worsening/recent onset)	27
Neurological deficit (worsening/recent onset)	11
Mechanical instability	02
Fever	01

[Table/Fig-1]: Distribution of symptoms.

Cause of FBSS	N=30 (100%)
Recurrent/residual disc prolapse	16 (53%)
Epidural scar	06 (20%)
Disc prolapsed with scar tissue	03 (10%)
Arachnoiditis	02 (7%)
Postoperative discitis	02 (7%)
Malaligned implant	01 (3%)

[Table/Fig-2]: Distribution of aetiology.



[Table/Fig-5]: Epidural Scar: Axial T1W image (a); Axial T2W image (b) Shows epidural scar (arrow) in the left partial laminectomy defect and epidural space at L4-5 level. This scar tissue is encasing the left traversing nerve root (arrowhead) and appears hypointense on T1W and T2W images. Axial postcontrast T1 fat suppressed image (c) Show enhancing scar tissue surrounding the non enhancing nerve root. (All Image left to right)

Rehabilitation goal

Prevent re-occurring of HIVD
Prevent epidural scarring
Prevent segmental instability

→

Pain reduction
Improvement of gait
Return to activity or sports

Rehabilitation program

- Pain control
- Exercise
  - Stretching exercise
  - Lower back stabilization exercise
  - Conditioning exercise
- Cognitive behavioral therapy
- Education

Rehabilitation program

Every patient is different!!!

Pain control

- Medications
  - Acetaminophen
  - Tramadol, Opioid
  - Anticonvulsant, antidepressant
  - *NSAID*: avoid for 1~3 months in spinal fusion
- Pain modality
  - Ice pack
  - Heat therapy
  - *Ultrasound*: CIx in laminectomy
  - Electrical stimulation

Systematic Review

Pain Physician 2017; 20:E29-E43

Treatment Outcomes for Patients with Failed Back Surgery

Objectives: To evaluate the outcomes of each treatment modality and to present treatment guidelines for patients with FBSS.

Study Design: A systematic review of each treatment regimen in patients with FBSS.

Results: Twenty-three articles were finally identified and reviewed. Based on our analysis, epidural adhesiolysis showed a short-term (6 to 24 months) effect (grade A) and spinal cord stimulation showed a mid-term (2 or 3 years) effect (grade B). Epidural injections showed a short-term (up to 2 years) effect (grade C). However, other treatments were recommended as grade D or inconclusive.

Conclusions: Epidural adhesiolysis or spinal cord stimulation can be effective in order to control chronic back pain or leg pain due to FBSS, and its recommendation grades are A and B, respectively. Other treatments showed poor or inconclusive evidence.

Exercise

Lumbar disc herniation surgery

- long period of inactivity before surgery
  → decreased muscle strength
  → impairment of the voluntary neural activation rate

- disuse or reflex inhibition
  → atrophy of type 2 fibers and alterations in the connective tissue of multifidus muscle

Exercise

Main objectives of the postoperative rehabilitation

- accelerate and maximize function recovery
- prevent further injury

Exercise → improves pain and disability

SPINE Volume 28, Number 10, pp 1068–1073

Trunk Muscle Strength in Flexion, Extension, and Axial Rotation in Patients Managed With Lumbar Disc Herniation Surgery and in Healthy Control Subjects

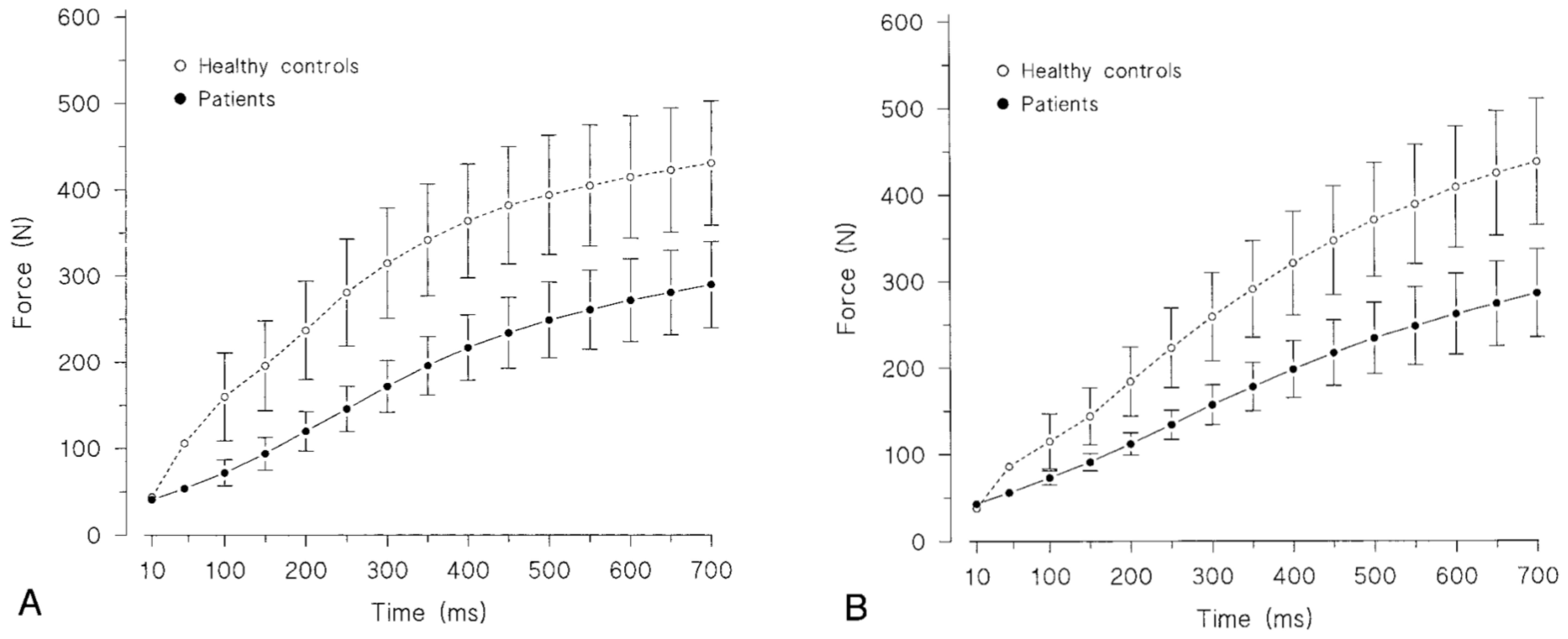


Figure 1. Force-time curve of the trunk flexors (**A**) and extensors (**B**) in the patients 2 months after lumbar disc herniation surgery and in the healthy control subjects.

SPINE Volume 28, Number 10, pp 1068–1073

Trunk Muscle Strength in Flexion, Extension, and Axial Rotation in Patients Managed With Lumbar Disc Herniation Surgery and in Healthy Control Subjects

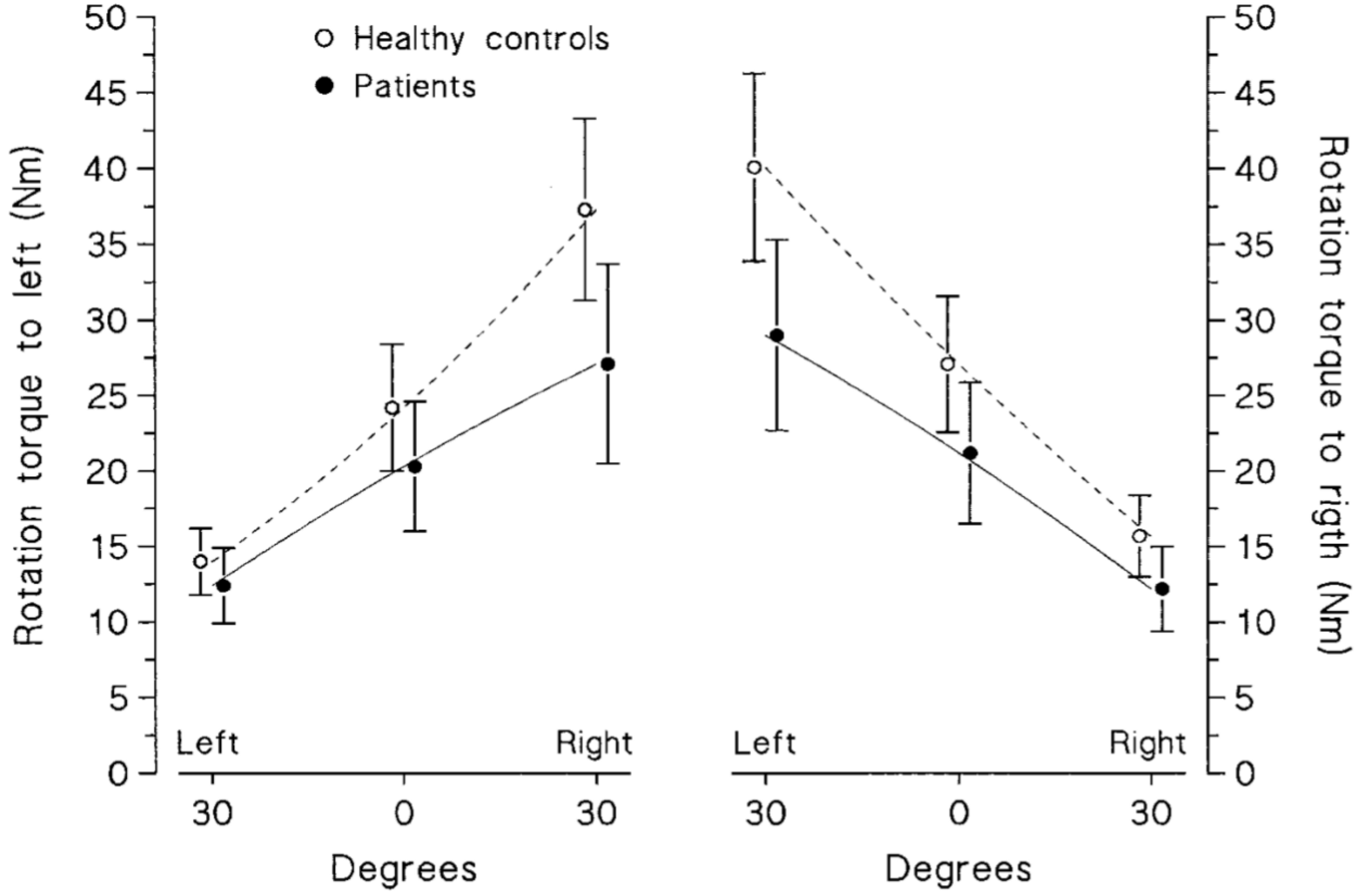


Figure 2. Maximal isometric trunk rotation strength (means with 95% CI) produced at the neutral angle and 30° prerotated positions by the patients 2 months after lumbar disc herniation surgery and by the healthy control subjects.

Clinical Rehabilitation 2005; **19:** 4–11

The effectiveness of exercise programmes after lumbar disc surgery: a randomized controlled study

Intervention: The patients were randomly split into three groups. The first group received an intensive exercise programme and back school education while the second group received a home exercise programme and back school education. The third group was defined as the control group and did not receive education or exercise.

Main measures: The patients were evaluated at the beginning and end of the treatment with clinical parameters, pain levels, endurance tests and weight-lifting tests, modified Oswestry Disability Index, Beck Depression Inventory, Low Back Pain Rating Scale and return to work.

Results: The groups doing exercises experienced a decrease in the severity of pain and disability, also functional parameters showed better improvement than the control group. The intensive exercise programme was better than the home exercise programme.

Conclusions: It seems that intensive exercise is more effective in reduction of pain and disability, but whether it is cost-effective is not clear.

J Rehabil Med 2003; 35: 163–167

EFFICACY OF DYNAMIC LUMBAR STABILIZATION EXERCISE IN LUMBAR MICRODISCECTOMY

Design: A prospective, randomized, controlled study.
Subjects: Forty-two patients who were diagnosed as having lumbar disc herniation and had been operated on using the microdiscectomy method were divided randomly into 3 groups.
Methods: Dynamic lumbar stabilization exercises were set for the first group and a home exercise programme for the second. The third group given no exercises was considered as a control group. All patients were examined twice, once before the exercise programme and once 8 weeks later.
Results: Improvement in the first group was highly significant after the treatment ($p < 0.0001$). The second group improved significantly more in some parameters (pain, functional disability, lumbar Schober, progressive isoinertial lifting evaluation (neck), trunk endurance (flexion-extension)) than did the third group. The third group of patients showed some improvement in fingertip–floor distance, functional disability, modified lumbar Schober and left rotation in 8 weeks, but there were no significant improvements in the other parameters.
Conclusion: Dynamic lumbar stabilization exercises are an efficient and useful technique in the rehabilitation of patients who have undergone microdiscectomy. They relieve pain, improve functional parameters and strengthen trunk, abdominal and low back muscles.

Journal of Back and Musculoskeletal Rehabilitation 30 (2017) 109–120

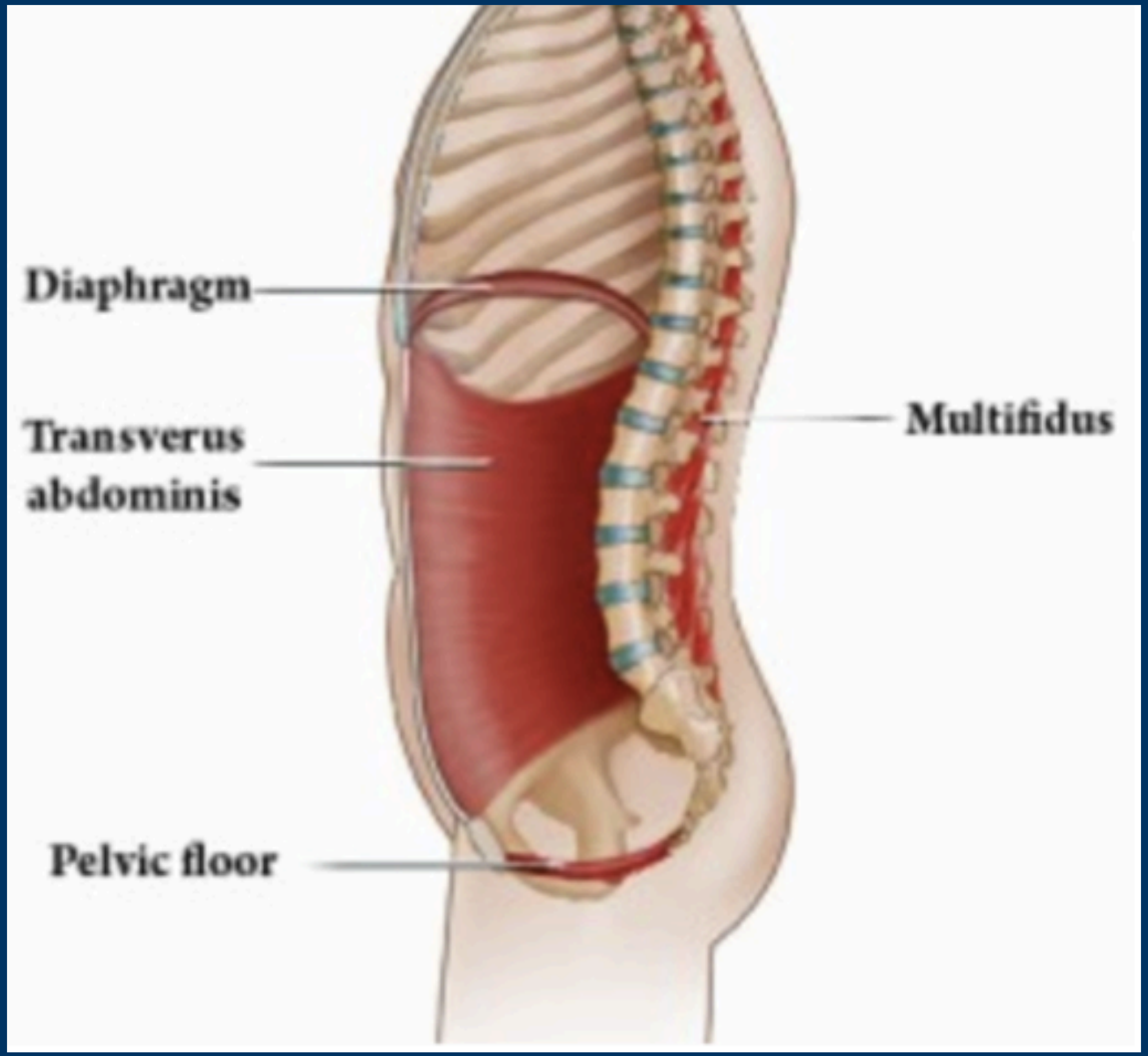
Comparison of effectiveness of different exercise programs in treatment of failed back surgery syndrome: A randomized controlled trial

METHODS: A single-blind, randomized, controlled trial designed. One hundred participants with failed back surgery syndrome were randomly assigned to three different exercises groups (Isokinetic, Dynamic lumbar stabilization (DLS), and home exercises (HE) groups) and a control group. Patients were evaluated before and after 8-week exercise program and follow-ups at the 3rd and 6th months after the exercise program. Finger-floor distance and lumbar Schober for lumbar mobility, visual analog scale (VAS) for pain, Modified Oswestry Disability Index, Beck Depression Inventory, fear-avoidance attitudes survey, and progressive-isoinertial weight lifting test were used as follow-up parameters. Lumbar muscle strength was assessed with the isokinetic dynamometer.

RESULTS: VAS levels were decreased from 67.7 to 22.8 in isokinetic and from 68.7 to 25.0 in DLS and from 64.6 to 47.1 in HE groups at the end of the program ($p < 0.05$). Also, all of other follow-up parameters of the isokinetic and DLS exercise groups viewed significant improvements compared to the control group.

CONCLUSIONS: According to our results either isokinetic or DLS exercises are more effective in FBSS patients.

Lumbar stabilizing exercise

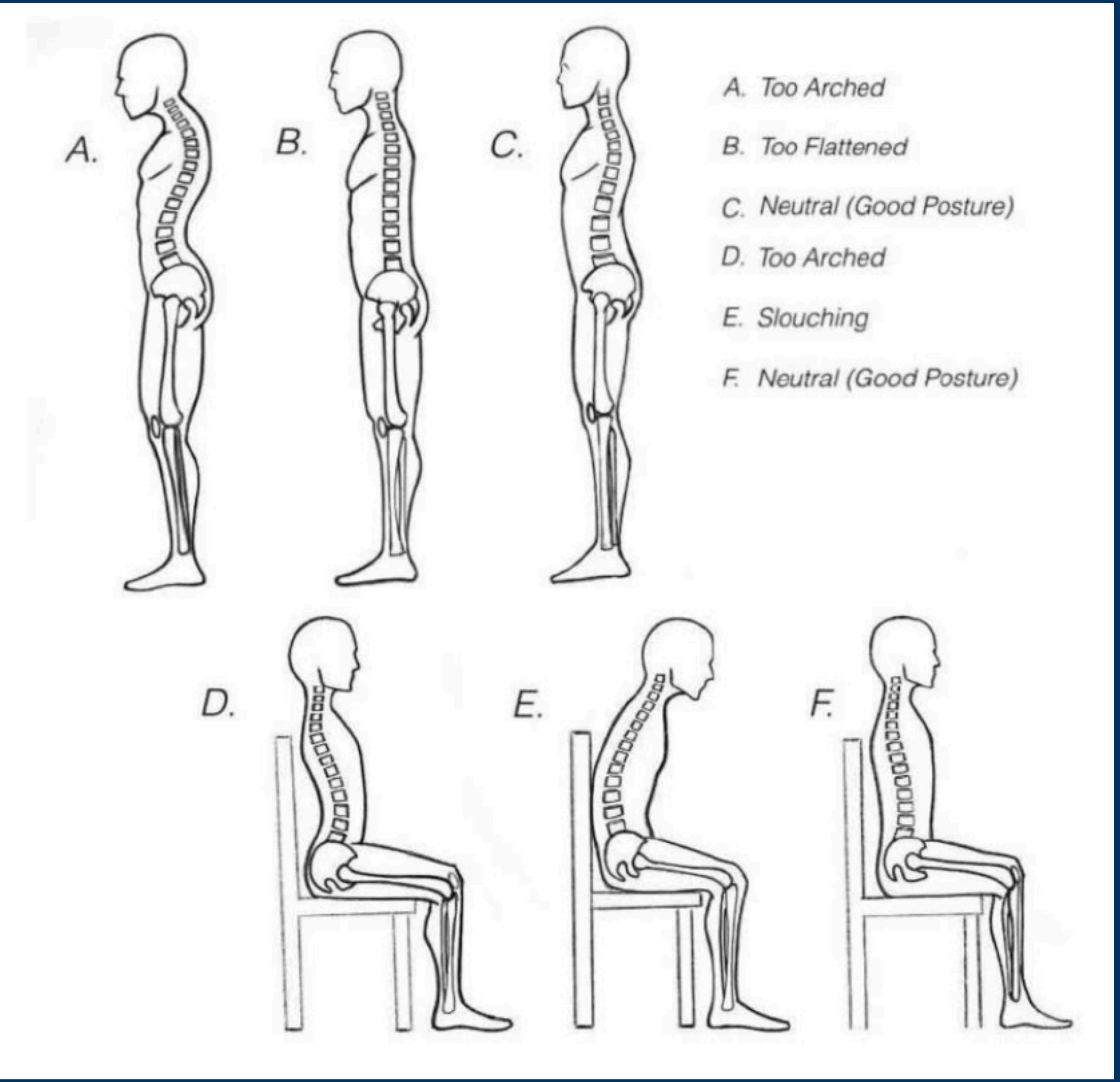


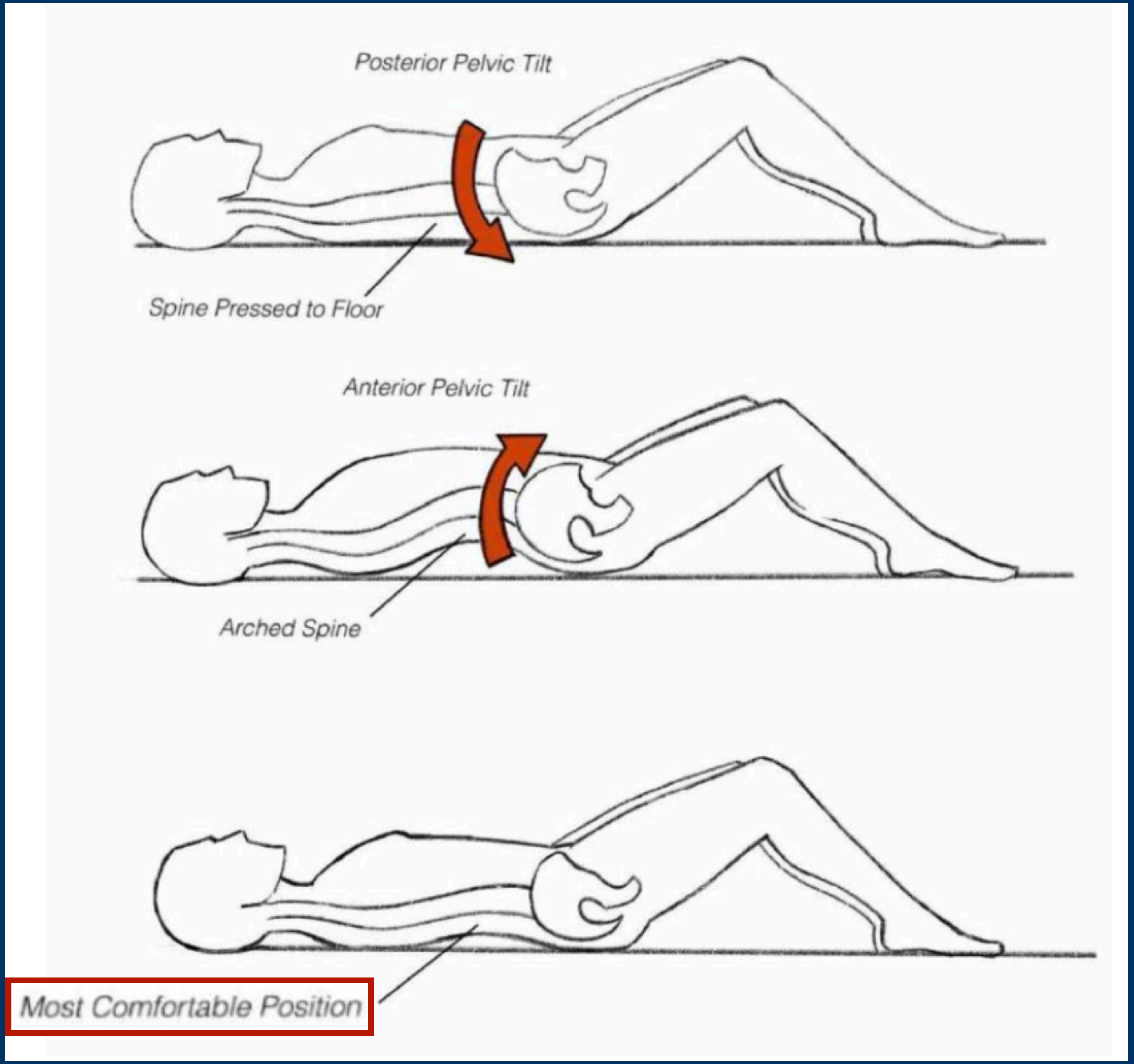
- Multifidus
- Transversus abdominis
- Diaphragm
- Pelvic floor

Table 2: Muscles of the Lumbar Spine

Global Muscles (dynamic, phasic, torque producing)	Local Muscles (postural, tonic, segmental stabilizers)
Rectus abdominis	Multifidi
External oblique	Psoas major
Internal oblique (anterior fibers)	Transversus abdominis
Iliocostalis (thoracic portion)	Quadratus lumborum
	Diaphragm
	Internal oblique (posterior fibers)
	Iliocostalis and longissimus (lumbar portions)

Neutral spine posture



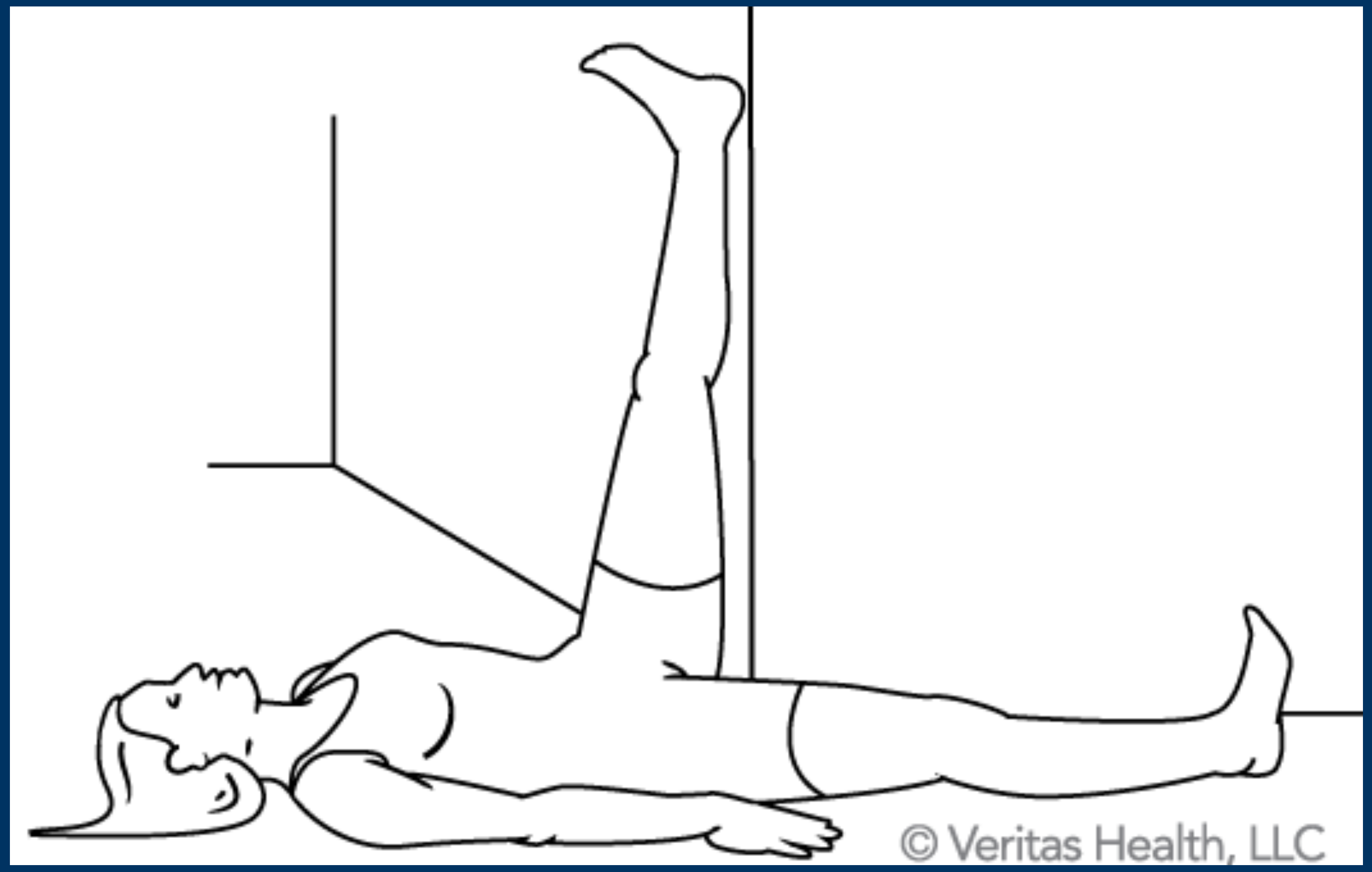


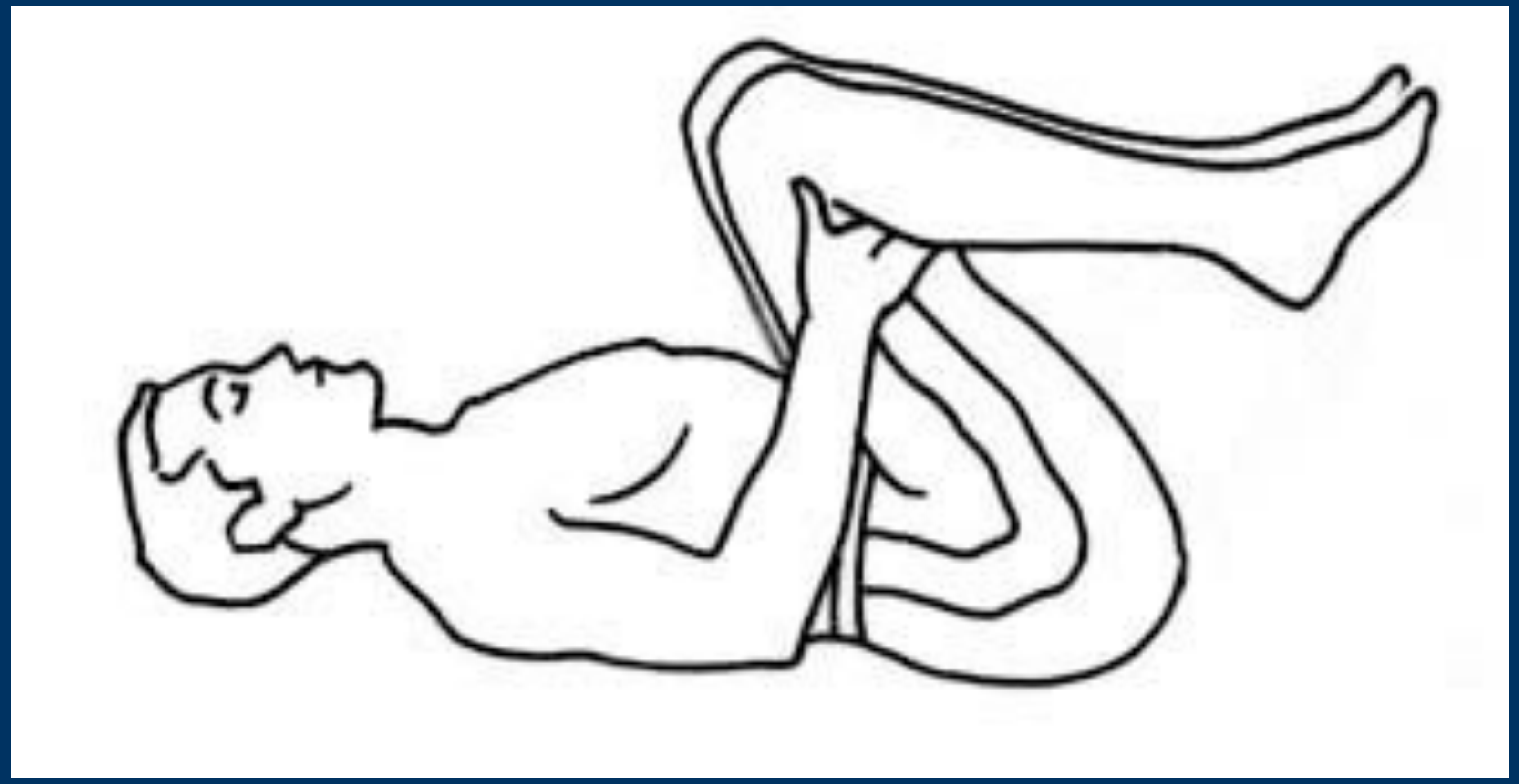
Lumbar stabilizing exercise

- From static (lying) to dynamic (standing or jumping)
- From resisting gravity to resisting additional outside force
- From predictable to unpredictjable movements
- From individual components of a movement to the complete range of motion in a movement

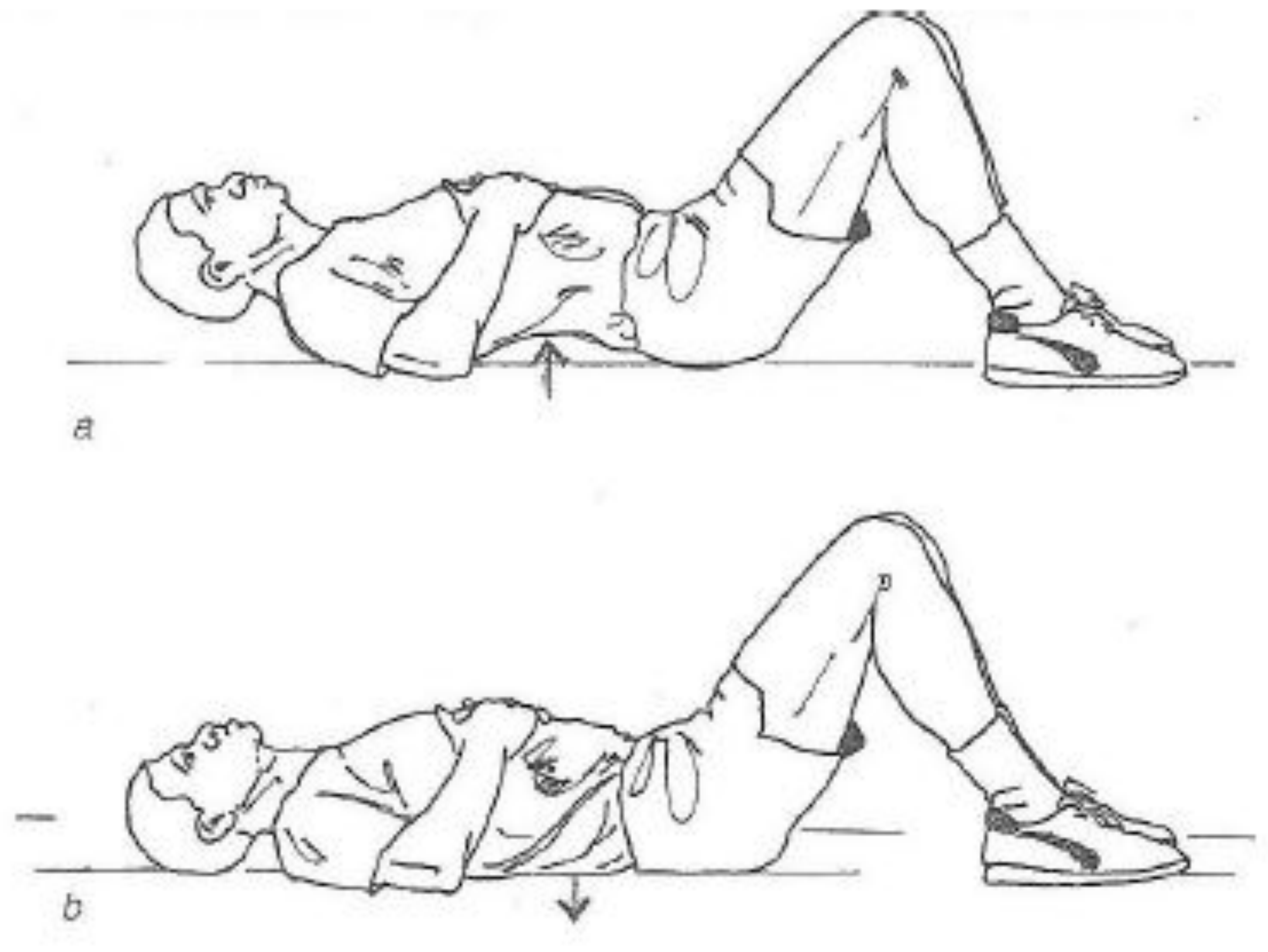
Stretching exercise

- Hamstring muscles
- Gluteal muscles
- Spine muscles





Pelvic tilting exercise

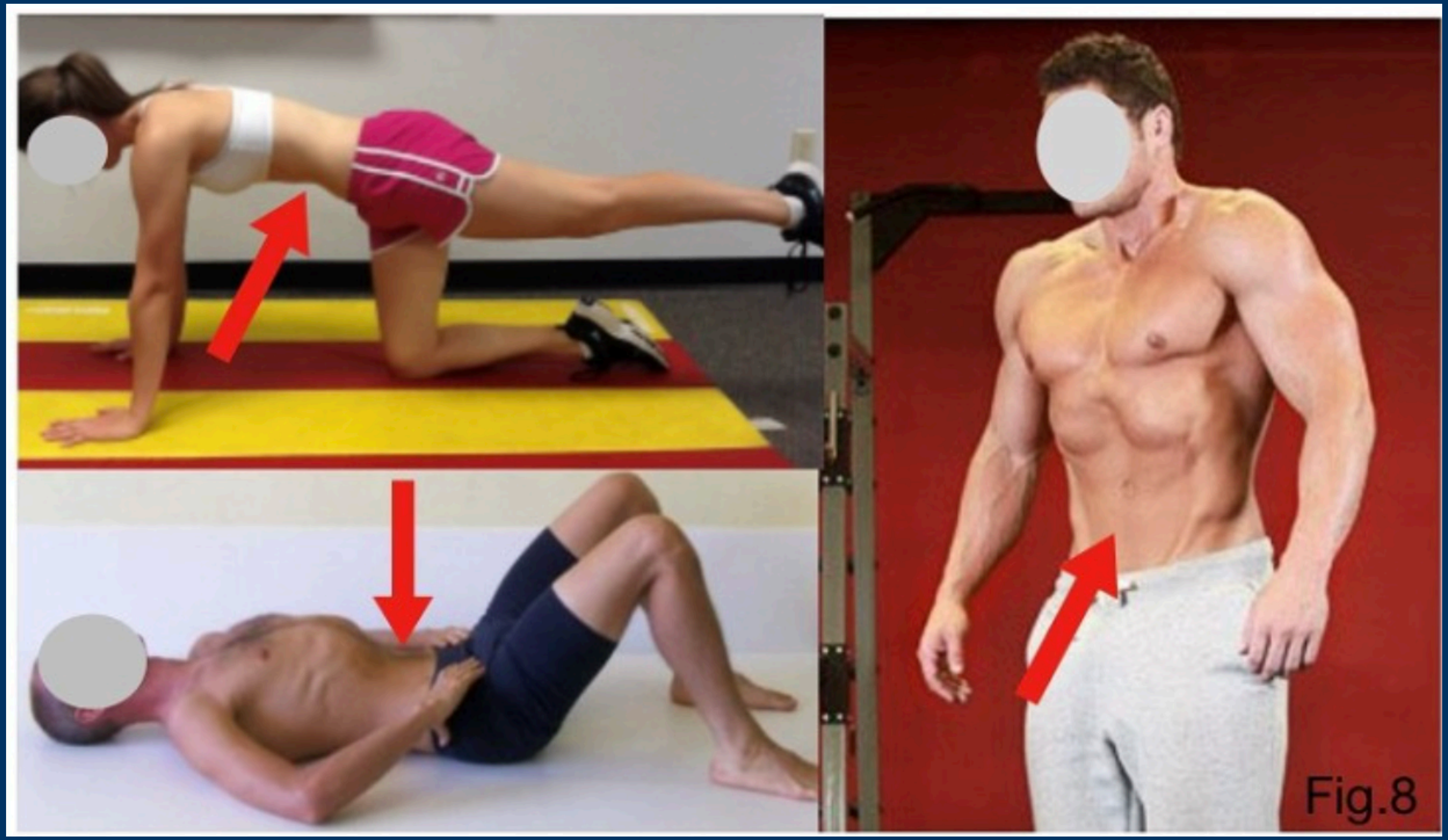


Top: Anterior Pelvic Tilt Bottom: Posterior Pelvic Tilt

- Lumbar paraspinal muscle stretching
- Transverse abdominis strengthening

Abdominal hollowing and bracing

- Abdominal hollowing - Co-contraction of multifidus and TrA
- Abdominal Bracing - Increase of abdominal pressure



Lumbar stabilization exercises




The Journal of Strength and Conditioning Research™
VOLUME 28 | NUMBER 7 | JULY 2014

Neutral Spine Control Exercises in Rehabilitation After Lumbar Spine Fusion

In this study, the effect of selected neutral spine control exercises on activation of trunk muscles after LSF was evaluated. Muscle activity was measured by surface electromyography of the rectus abdominis, external oblique, longissimus, and multifidus muscles during 6 exercises in 22 LSF patients (mean age = 59 years; age range = 25–84 years; 50% women).

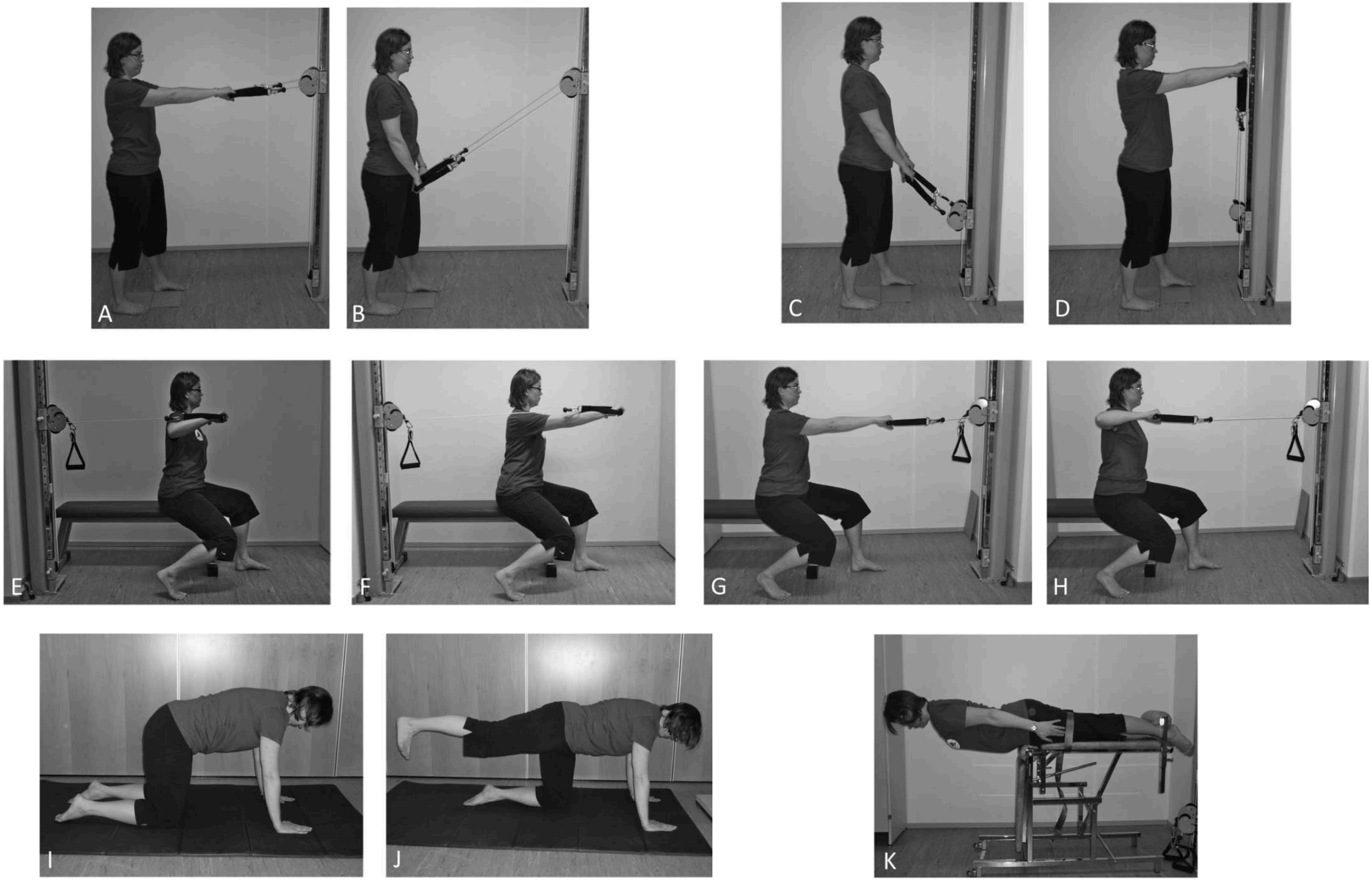

A
B
C
D
E
F
G
H
I
J
K

TABLE 3. EMG activation (% of MVIC) of abdominal muscles during the exercises.*

Exercise	Abdominal muscles: Rectus abdominis Left	Rectus abdominis Right	External oblique Left	External oblique Right
Bilateral shoulder flexion				
Concentric phase	11.0 ± 8.9†	9.9 ± 7.4†	34.3 ± 39.8†	29.3 ± 25.7†
Eccentric phase	8.6 ± 5.5†	7.4 ± 4.6†	24.9 ± 27.8†	20.4 ± 16.9†
Bilateral shoulder extension				
Concentric phase	51.4 ± 55.1†	47.4 ± 35.9†	30.2 ± 24.1†	25.8 ± 14.0†
Eccentric phase	25.1 ± 23.9†	22.3 ± 17.4†	24.9 ± 24.3†	19.3 ± 12.5†
Unilateral shoulder horizontal adduction				
Concentric phase	11.7 ± 8.2†	10.8 ± 5.9†	28.1 ± 19.1†‡	47.8 ± 21.6†‡
Eccentric phase	9.0 ± 6.4†	8.5 ± 5.4†	18.1 ± 15.6†‡	30.9 ± 17.9†‡
Unilateral shoulder horizontal abduction				
Concentric phase	9.1 ± 8.9	7.4 ± 5.4†	27.0 ± 24.9†	18.9 ± 10.3†
Eccentric phase	8.3 ± 6.5‡	6.2 ± 3.9†‡	19.3 ± 16.4†	14.1 ± 9.4†
Unilateral hip extension				
Concentric phase	12.0 ± 9.3	9.5 ± 6.6	25.2 ± 19.4†‡	46.1 ± 25.8‡
Eccentric phase	11.8 ± 9.1	9.2 ± 6.4	22.1 ± 16.9†‡	46.1 ± 23.8‡
Modified Roman chair	17.6 ± 24.5	14.2 ± 23.9	19.3 ± 19.7	21.2 ± 30.0

TABLE 4. EMG activation (% of MVIC) of back muscles during the exercises.*

Exercise	Back muscles			
	Longissimus		Multifidus	
	Left	Right	Left	Right
Bilateral shoulder flexion				
Concentric phase	77.6 ± 34.0†	80.8 ± 38.6†	60.4 ± 34.1†	64.7 ± 36.8†
Eccentric phase	49.2 ± 25.7†	52.5 ± 27.9†	44.7 ± 25.8†	48.3 ± 31.3†
Bilateral shoulder extension				
Concentric phase	23.4 ± 8.3‡	32.6 ± 17.6‡	28.6 ± 15.2	24.8 ± 19.7
Eccentric phase	28.1 ± 18.4‡	36.2 ± 21.2‡	30.3 ± 19.1	27.0 ± 21.8
Unilateral shoulder horizontal adduction				
Concentric phase	24.0 ± 12.1†‡	17.1 ± 8.7†‡	18.5 ± 10.1†	21.0 ± 14.5†
Eccentric phase	18.7 ± 9.3†	15.6 ± 7.1†	14.6 ± 9.6†	16.4 ± 11.3†
Unilateral shoulder horizontal abduction				
Concentric phase	30.3 ± 12.0†‡	36.6 ± 15.0†‡	27.8 ± 18.0†	24.0 ± 16.9†
Eccentric phase	23.5 ± 11.2†‡	30.6 ± 13.1†‡	20.9 ± 12.7†	20.8 ± 15.7†
Unilateral hip extension				
Concentric phase	41.3 ± 39.2†	42.9 ± 31.0†	30.8 ± 23.2†	39.3 ± 28.6†
Eccentric phase	31.2 ± 26.4†	34.0 ± 22.7†	26.2 ± 19.0†	31.3 ± 25.9†
Modified Roman chair	83.4 ± 33.5‡	104.0 ± 62.5‡	64.0 ± 33.2	61.8 ± 37.0

the Journal of Strength and Conditioning Research™
VOLUME 28 | NUMBER 7 | JULY 2014

Neutral Spine Control Exercises in Rehabilitation After Lumbar Spine Fusion

16 (26). Neutral spine control exercises activate trunk muscles and cause minimal pain and are therefore feasible exercises for home-based training to improve muscle endurance and postural control after LSF. In addition, the level of muscle activity during bilateral shoulder flexion and modified Roman chair exercises was over 60% of MVIC, justifying their use in training for strength of the trunk extensor muscles.

Benefits of Aerobic Exercise

- Reconditioning through aerobic exercise
- Fewer episodes of low back pain
- more likely to stay functional (e.g. continue working and carry on with recreational activities)
- easier to control weight or lose weight → decreasing the stress placed on the spine structures and joints
- increased production of endorphins after 30 or 40 minutes of exercise
  - Reduce pain medication
  - Elevate mood and prevent depression

Hydrotherapy

- Gentle and comfortable environment for patient
- Buoyancy: decrease weight loading on spine
- Viscosity: resistance → strengthening, balance
- Hydrostatic pressure: heart and lung conditioning

Spine brace

- Immobilize spine during healing
- Stabilize affected areas
- Minimize pain by restricting movement
- Promote recovery

Education

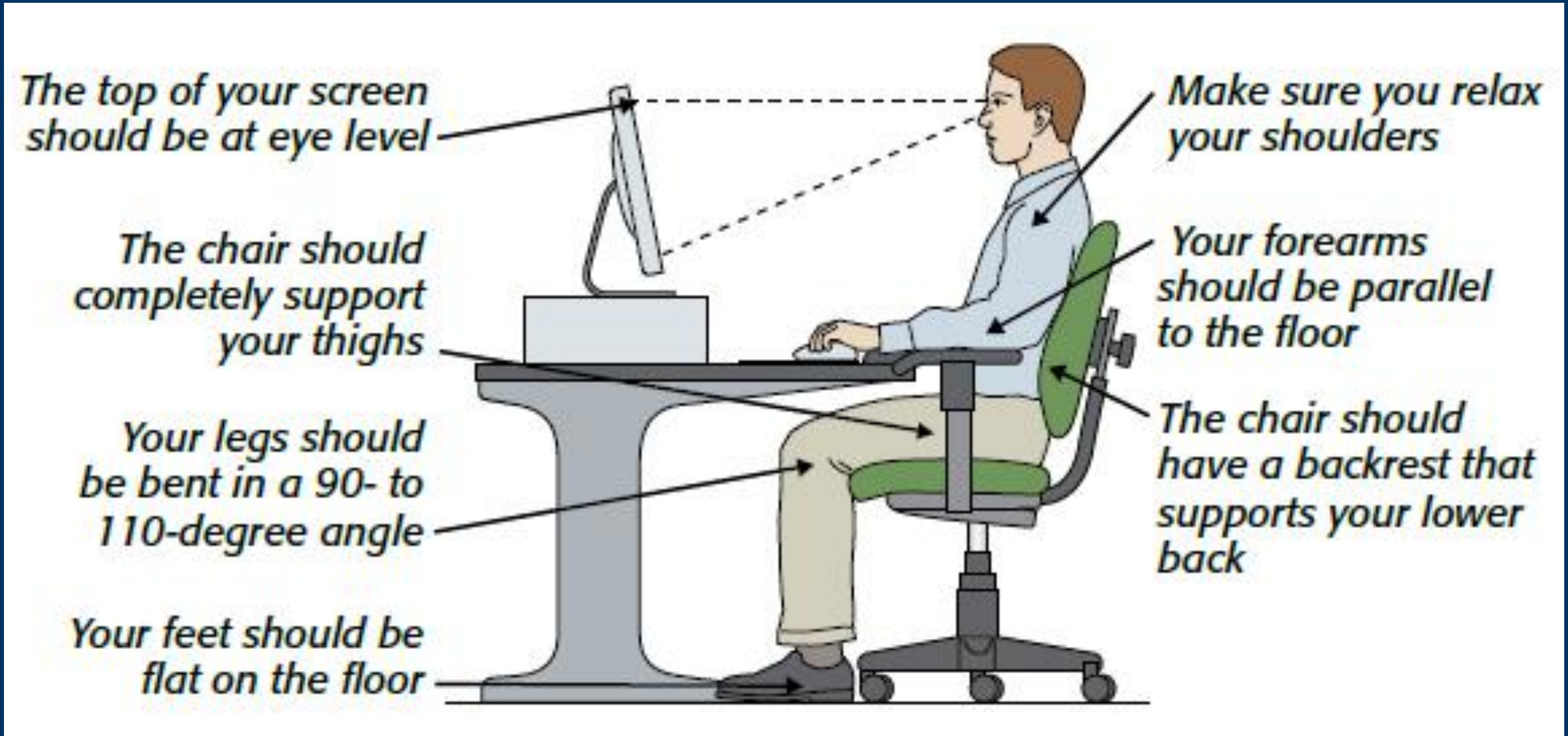
- Avoid smoking
- Avoid drinking excess alcohol
- Use lumbar support, ergonomic chairs
- Correct posture for back support
- Avoid sitting for prolonged period
- Achieve a healthy weight
- Eat nutritiously

Smoking and spine surgery

Nicotine

- Hurt the post-surgical healing process
- Fusion: inhibit bone growth
- Disc degeneration: impaired blood supply

Correct sitting posture



Cognitive-behavioral therapy

- To address fear avoidance, catastrophising and maladaptive coping behaviours
- To view the complaints as events that can be self-managed

Identifying from talks concerning actions

→ Giving information on the nature of pain related to FBSS

→ Encouraging to integrate these concepts with paced and active exercises to gradually improve physical competence and diminish pain perception

→ Relaxation to ease pain experience and gain control over it

Disability and Rehabilitation (2020): 1-8.

Multimodal exercises integrated with cognitive-behavioural therapy improve disability of patients with failed back surgery syndrome: *a randomized controlled trial with one-year follow-up*

Methods: By means of a parallel-group superiority-controlled trial, 150 outpatients were randomly assigned to a 10-week individual-based multimodal programme of task-oriented exercises integrated with cognitive-behavioural therapy (experimental group, 75 patients) or individual-based general physiotherapy (control group, 75 patients). Before treatment, 10 weeks later (post-treatment), and 12 months after the end of treatment, the Oswestry Disability Index (primary outcome), the Tampa Scale for Kinesiophobia, the Pain Catastrophising Scale, a pain intensity numerical rating scale and the Short-Form Health Survey were evaluated. Linear mixed model analysis for repeated measures was carried out for each outcome measure.

Results: Significant group ($p < 0.001$), time ($p < 0.001$), and time-by-group interaction ($p < 0.001$) effects were found for all outcome measures. Concerning disability, between-group differences (95% confidential interval) in favour of the experimental group of −9 (−10.7; −7.3) after training and of −13.2 (−14.7; −11.7) at follow-up were found. Also, kinesiophobia, catastrophising and pain showed significant between-group differences of 9, 12.5 and 1.7 points, respectively.

Conclusion: The multimodal intervention proposed was superior to general physiotherapy in reducing disability, kinesiophobia, catastrophising, and enhancing the quality of life of patients with FBSS. The effects were reinforced one year after the programme ended.

감사합니다.