

## **-The Scientific Dossier for SpineForce-**

### ***Scientific and Bibliographical Demonstrations of The Claims of The System Spine Force/Huber Technology***

This file provides scientific substantiation of the claims and affirmations made in the United States SpineForce collateral materials. The sources of the cited studies are from both the Medline data bank and from targeted studies conducted by LPG Systems Corporation.

**CLAIM: The first technology to pinpoint and tone deep spinal muscles**

**CLAIM: The protocols strengthen and condition the entire spinal structure, including the previously neglected 180 deep spinal muscles**

Many scientific articles have shown the importance of targeting the deep muscles of the spine relative to its rehabilitation. Before SpineForce was created, however, there was no technology in existence capable of precisely targeting these muscles to increase their strength and improve their volume. In the past, it was believed that only isometric exercises were able to reinforce, tone, and condition the spinal musculature. Surrounding the deep muscles of the spine, however, is a network of torso muscles; some, like the abdominal muscles, have an essential role to play in the highly targeted SpineForce exercises. SpineForce's ergonomic design places the body in a state of inequilibrium, simultaneously it employs resistance and support to force the highly targeted muscles of the deep spinal musculature to be strengthened and overcome the muscular deficiencies.

These muscles are most responsible for chronic low back pain.

The following studies were organized in Paris, France in conjunction with the Myologie Institute and the Institute of the Human Performance and provide scientific validity to the affirmations previously cited and those poised below:

*A training period of 8 weeks on Spine Force does promote an improvement of the motor functions.*

- Are there modifications in the evaluation of the exercises in relation to the sessions?

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- Are the deep muscles of the vertebral spinal column accurately pinpointed and conditioned when using SpineForce?
- Are the force and muscle weaknesses of the thigh and back, in particular the deep muscles of the lower back, modified significantly?

In the collateral materials, many documents reiterate the necessity of having the deep spinal musculature strengthened, stressing the importance of these muscles in protecting the spinal column.

**Arch Phys Med Rehabil. 2001 Aug;82(8):1089-98.  
'Back and abdominal muscle function during stabilization exercises.'  
Arokoski JP, Valta T, Airaksinen O, Kankaanpaa M.**

*Departments of Physical and Rehabilitation Medicine  
Kuopio University Hospital  
Kuopio, Finland*

**OBJECTIVES:** To assess the paraspinal and abdominal muscle activities during different therapeutic exercises and to study how load increment produced by varying limb movements and trunk/lower back positions could affect these muscle activities.

**DESIGN:** A cross-sectional study comparing muscle activities between men and women.

**SETTING:** Rehabilitation clinic in university hospital.

**PARTICIPANTS:** Twenty-four healthy volunteers (14 women, 10 men) aged 21 to 39 years.

**INTERVENTIONS:** Subjects performed 16 different therapeutic exercises commonly used to treat low back pain.

**MAIN OUTCOME MEASURES:** Surface electromyography was recorded from the paraspinal (T9, L5) and abdominal (rectus abdominis, obliquus externus) muscles during these exercises. Average electromyographic amplitudes obtained during the exercises were normalized to the amplitude in maximal voluntary contraction (% MVC) to produce inter-individually comparable muscle activity assessments.

**RESULTS:** Mean average normalized electromyographic amplitudes (% MVC) of the exercises were below 50% MVC. At L5 level, the multifidus muscle activities

were significantly higher (p <.05) in women than in men, whereas no significant difference was found at T9 level. Similarly, rectus abdominis and obliquus externus activities were significantly higher (p <.001, p <.05) in women than in men. Load increment in hands or unbalanced trunk and limb movements produced higher paraspinal and abdominal muscle activities (p <.05).

**CONCLUSIONS:** Simple therapeutic exercises are effective in activating both abdominal and paraspinal muscles. By changing limb and trunk/lower back positions or unbalancing lower back movements, it is possible to increase trunk muscle activities. Women were better able to activate their stabilizing trunk/lower back muscles than men; but it is also possible that men, having a much higher degree of strength on maximal contraction, only need to activate a smaller amount of that maximum to perform a similar activity.

**Br J Sports Med. 2001 Jun;35(3):186-91.**

**'Effects of three different training modalities on the cross sectional area of the lumbar multifidus muscle in patients with chronic low back pain.'**  
**Danneels LA, Vanderstraeten GG, Cambier DC, Witvrouw EE, Bourgois J, Dankaerts W, De Cuyper HJ.**

*Department of Rehabilitation Sciences and Physical Therapy  
Faculty of Medicine  
Ghent University, Belgium. lieven.*

**OBJECTIVES:** To determine the effect of different training schedules on the cross sectional area (CSA) of the lumbar multifidus muscle in patients with chronic low back pain.

**METHODS:** Each of 59 nine patients was randomly assigned to one of three programs: 10 weeks of stabilization training (group 1; n = 19); 10 weeks of stabilization training combined with dynamic resistance training (group 2; n = 20); 10 weeks of stabilization training combined with dynamic-static resistance training (group 3; n = 20). Before and after 10 weeks of training, multifidus CSAs were measured from standard computed tomography images at three different levels (upper end plate of L3 and L4, and lower end plate of L4).

**RESULTS:** The CSA of the multifidus muscle was significantly increased at all levels after training in group 3. In contrast, no significant differences were found in groups 1 and 2.

**CONCLUSIONS:** General stabilization exercises and dynamic intensive lumbar resistance training have no significant effect on the CSA of the lumbar multifidus muscle in patients with chronic low back pain. The static holding component between the concentric and eccentric phase was found to be critical in inducing muscle hypertrophy during the first 10 weeks. Treatment consisting of stabilization training combined with an intensive lumbar dynamic-static strengthening program seems to be the most appropriate method of restoring the size of the multifidus muscle.

**Clin Biomech (Bristol, Avon). 1995 Oct;10(7):379-384.**  
**'Effects of various iso-resistive training programs on trunk muscle performance.'**

**Scutter S, Fulton I, Trott P, Parnianpour M, Grant R, Brien C.**

School of Physiotherapy  
University of South Australia  
North Terrace, Adelaide, SA 5000, Australia.

Iso-resistive movements provide a functional method of testing muscle performance and of providing exercise; the resistance applied is usually a percentage of the maximal isometric torque which can be developed by individual subjects. The aim of the current study was to compare the effectiveness of dynamic iso-resistive exercise programs using 25, 50 or 75% of the maximum isometric flexion torque and static isometric exercises for improving the performance of the trunk flexors and extensors. Subjects comprised 42 asymptomatic females aged 18-25 years who were randomly assigned to control or exercise groups. The exercise groups undertook 2 min of exercise 3 times per week. The control subjects showed significant improvement between tests indicating a strong learning effect. The study showed that the subjects who exercised at 50% of maximum flexion isometric torque achieved the greatest increases in muscle performance on most measures. maximal isometric flexion and extension torques did not significantly change in any of the groups. Flexion and extension velocity and power were the muscle performance characteristics which improved the most in response to the training programs.

**RELEVANCE:** This paper attempts to determine which among several options is the most effective iso-resistive protocol for conditioning trunk muscle

performance, as improved strength and power of these muscles may contribute in preventing episodes of LBP.

**J Orthop Res. 2001 May;19(3):463-71.**

**'Functional roles of abdominal and back muscles during isometric axial rotation of the trunk.'**

**Ng JK, Parnianpour M, Richardson CA, Kippers V**

*Department of Physiotherapy  
The University of Queensland, Australia*

Electromyographic (EMG) studies have shown that a large number of trunk muscles are recruited during axial rotation. The functional roles of these trunk muscles in axial rotation are multiple and have not been well investigated. In addition, there is no information on the coupling torque at different exertion levels during axial rotation. The aim of the study was to investigate the functional roles of rectus abdominis, external oblique, internal oblique, latissimus dorsi, iliocostalis lumborum and multifidus during isometric right and left axial rotation at 100%, 70%, 50% and 30% maximum voluntary contractions (MVC) in a standing position. The coupling torques in sagittal and coronal planes were measured during axial rotation to examine the coupling nature of torque at different levels of exertions. Results showed that the coupled sagittal torque switches from nil to flexion at maximum exertion of axial rotation. Generally, higher EMG activities were shown at higher exertion levels for all the trunk muscles. Significant differences in activity between the right and left axial rotation exertions were demonstrated in external oblique, internal oblique, latissimus dorsi and iliocostalis lumborum while no difference was shown in rectus abdominis and multifidus. These results demonstrated the different functional roles of trunk muscles during axial rotation. This is important considering that the abdominal and back muscles not only produce torque but also maintain the spinal posture and stability during axial rotation exertions. The changing coupling torque direction in the sagittal plane when submaximal to maximal exertions were compared may indicate the complex nature of the kinetic coupling of trunk muscles.

**Scand J Med Sci Sports. 2001 Dec;11(6):335-41.**

**'The effects of three different training modalities on the cross-sectional area of the para-vertebral muscles.'**

**Danneels LA, Cools AM, Vanderstraeten GG, Cambier DC, Witvrouw EE, Bourgois J, de Cuyper HJ.**

*Department of Rehabilitation Sciences and Physical Therapy  
Faculty of Medicine  
Ghent University, Center of Sports Medicine  
Ghent University Hospital, Belgium.*

The purpose of this study was to determine the effect of different training schedules on the cross-sectional area (CSA) of the para-vertebral muscles (PA) in chronic low back pain (CLBP) patients. To achieve this goal 59 patients were randomly assigned to three different 10-week rehabilitation programs: stabilization training (group 1, n=19), stabilization training combined with dynamic resistance training (group 2, n=20) and stabilization training combined with dynamic-static resistance training (group 3, n=20). The CSA of the PA was derived from standard computerized tomography (CT) images at three different levels. The CSA of the PA was found to increase statistically in group 2 (upper end-plate of L4) and group 3 (upper end-plate of L3 and lower end-plate of L4). In contrast, no statistical differences over time were found in group 1. Since stabilization exercises have no effect on the CSA of the PA, intensive lumbar resistance training seems to be necessary to restore the size of the PA in CLBP patients with atrophied back muscles. No systematic difference in hypertrophy between dynamic and dynamic-static strengthening training modes was found.

**Eur Spine J. 2002 Feb;11(1):13-9.**

**'Differences in electromyographic activity in the multifidus muscle and the iliocostalis lumborum between healthy subjects and patients with sub-acute and chronic low back pain.'**

**Danneels LA, Coorevits PL, Cools AM, Vanderstraeten GG, Cambier DC, Witvrouw EE, De CH.**

*University Hospital  
Department of Rehabilitation Sciences and Physiotherapy  
Ghent, Belgium*

The present study was carried out to examine possible mechanisms of back muscle dysfunction by assessing a stabilizing and a torque-producing back muscle, the multifidus (MF) and the iliocostalis lumborum pars thoracis (ICLT),

respectively, in order to identify whether back pain patients showed altered recruitment patterns during different types of exercise. In a group of healthy subjects (n=77) and patients with sub-acute (n=24) and chronic (51) low back pain, the normalized electromyographic (EMG) activity of the MF and the ICLT (as a percentage of maximal voluntary contraction) were analysed during coordination, stabilization and strength exercises. The results showed that, in comparison with the healthy subjects, the chronic low back pain patients displayed significantly lower (P=0.013) EMG activity of the MF during the coordination exercises, indicating that, over the long term, back pain patients have a reduced capacity to voluntarily recruit the MF in order to obtain a neutral lordosis. In contrast, during the stabilization exercises, no significant differences between patients and controls were found for the normalized EMG activity of the two muscles. These findings indicated that, during low-load exercises, no insufficiencies in back muscle recruitment were evident in either subacute or chronic back pain patients. During the strength exercises, the normalized activity of both back muscles was significantly lower in chronic low back pain patients (P=0.017 and 0.003 for the MF and ICLT, respectively) than in healthy controls. Pain, pain avoidance and de-conditioning may have contributed to these lower levels of EMG activity during intensive back muscle contraction. The possible dysfunction of the MF during coordination exercises and the altered activity of both muscles during strength exercises may be of importance in symptom generation, recurrence or maintenance of low back pain.

**J Electromyogr Kinesiol. 2004 Jun;14(3):333-42.**

**'Reliability of EMG measurements for trunk muscles during maximal and sub-maximal voluntary isometric contractions in healthy controls and CLBP patients.'**

**Dankaerts W, O'Sullivan PB, Burnett AF, Straker LM, Danneels LA.**

*School of Physiotherapy, Bld 408  
Curtin University of Technology  
GPO Box U1987, Perth, 6845, WA, Australia*

The purpose of this study was to compare the reliability of trunk muscle activity measured by means of surface electromyography (EMG) during maximal and sub-maximal voluntary isometric contractions (MVC/sub-MVC) over repeated trials within-day and between-days in healthy controls and patients with chronic

low back pain (CLBP). Eleven volunteers (six controls and five CLBP patients) were assessed twice with a 1-week interval. Surface EMG signals were recorded bilaterally from six trunk muscles. Intra-class correlation coefficients (ICC) and standard error of measurement as a percentage of the grand mean (%SEM) were calculated. MVC and sub-MVC showed excellent within-day reliability in both healthy controls and CLBP patients (ICC mean 0.91; range 0.75-0.98; %SEM mean 4%; range 1-12%). Sub-MVC for both groups between-days showed excellent reliability (ICC mean 0.88; range 0.78-0.97; %SEM mean 7%; range 3-11%). The between-days MVC for both groups showed trends towards lower levels of reliability (ICC mean 0.70; range 0.19-0.99; %SEM mean 17%; range 4-36%) when compared to sub-MVC. Findings of the study provide evidence that sub-MVC are preferable for amplitude normalization when assessing EMG signals of trunk muscles between-days.

**J Orthop Res. 2002 Jan;20(1):112-21.**

***'EMG activity of trunk muscles and torque output during isometric axial rotation exertion: a comparison between back pain patients and matched controls.'***

**Ng JK, Richardson CA, Parnianpour M, Kippers V**

*Department of Physiotherapy  
The University of Queensland, Australia*

Abnormal patterns of trunk muscle activity could affect the biomechanics of spinal movements and result in back pain. The present study aimed to examine electromyographic (EMG) activity of abdominal and back muscles as well as triaxial torque output during isometric axial rotation at different exertion levels in back pain patients and matched controls. Twelve back pain patients and 12 matched controls performed isometric right and left axial rotation at 100%, 70%, 50% and 30% maximum voluntary contractions in a standing position. Surface EMG activity of rectus abdominis, external oblique, internal oblique, latissimus dorsi, iliocostalis lumborum and multifidus were recorded bilaterally. The primary torque in the transverse plane and the coupling torques in sagittal and coronal planes were measured. Results showed that there was a trend ( $P = 0.08$ ) of higher flexion coupling torque during left axial rotation exertion in back pain patients. Higher activity for external oblique and lower activity for multifidus was shown during left axial rotation exertion in back pain group when compared to

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the control group. In right axial rotation, back pain patients exhibited lesser activity of rectus abdominis at higher levels of exertion when compared with matched controls. These findings demonstrated that decreased activation of one muscle may be compensated by overactivity in other muscles. The reduced levels of activity of the multifidus muscle during axial rotation exertion in back pain patients may indicate that spinal stability could be compromised. Future studies should consider these alternations in recruitment patterns in terms of spinal stability and internal loading. The findings also indicate the importance of training for coordination besides the strengthening of trunk muscles during rehabilitation process.

### **CLAIM: Improves mobility and flexibility**

The stretching exercises and fundamental concept of active and passive movements are included in a number of steps to treat the spinal cord. These exercises showed a clear relation between chronic lumbar pain and lack of mobility by improving range of motion and decreasing lumbar pain (lower back). Spine Force makes it possible, with the oscillating platform and the automatically adjusting arms, to improve mobility in each section of the vertebral column. Tests (**Cf. study to come**) will have to be practiced on healthy subjects and subjects with chronic lumbar pain; these tests will focus on the variant stages of lumbar mobility, including improvement in hip motion and its relativity to the decreasing of lumbar pain. Tests will be done before and after the classical exercise techniques of stretching and contrast the results of subjects to the treatments and exercises performed with Spine Force.

### **CLAIM: Improves neuromotor equilibrium and posture**

### **CLAIM: Visibly improves bone stature and physique**

Whole body balance, posture, equilibrium and general homeostasis is completely dependent on the vertebral column, of its state of health and solidity. By maintaining and treating the control/nerve center of the body, the deep spine, one is able to address other, related bodily senses, such as hearing and sensitivity to extéroceptives and proprioceptives. SpineForce has been scientifically proven in its ability to solicit all of these systems effectively. Such

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efficacy on the musculature and the related nervous system, allows for the strong assertions concerning SpineForce's ability to dramatically improve balance.

The new study by Pierre Portero should bring responses to the following questions:

- Is there a significant change in the realization of exercise objectives due to SpineForce training?
- Does a training period of 8 weeks on SpineForce system induce an improvement of the neuromotor functioning

And particularly:

- Is the posture noticeably improved?
- Is the balance/equilibrium significantly improved?
- Is the coordination between posture and movement improved?

A parallel study has been proposed and shall be conducted in Italy to further examine the relativity of SpineForce's ability to improve the disturbances of balance and equilibrium in aging subjects. Such research will provide complimentary information to further substantiate the results of the Portero study.

The study conducted by Doctor Saggini clearly defines the characteristics of alignment and postural balance abnormalities of aging subjects, setting up objectives contrasting the use of SpineForce to more classical rehabilitative techniques for balance improvement (specifically the LIBRA platform and other isometric balance techniques).

This study will be conducted for 3 months and will be followed by follow-up checks (at 6, 9 and 12 months; allowing for the placement of a rehabilitation model to restore and correct posture).

The following studies support the previously established importance of the vertebral column in all bodily motor functions.

**Spine. 2002 Jan 15;27(2):E29-36.**  
**'Deep and superficial fibers of the lumbar multifidus muscle are differentially active during voluntary arm movements.'**  
**Moseley GL, Hodges PW, Gandevia SC.**

*Prince of Wales Medical Research Institute  
University of New South Wales  
Sydney, Australia*

**STUDY DESIGN:** A cross-sectional study was conducted.

**OBJECTIVE:** To determine the activity of the deep and superficial fibers of the lumbar multifidus during voluntary movement of the arm.

**SUMMARY OF BACKGROUND DATA:** The multifidus contributes to stability of the lumbar spine. Because the deep and superficial parts of the multifidus are near the center of lumbar joint rotation, the superficial fibers are well suited to control spine orientation, and the deep fibers to control intervertebral movement. However, there currently is limited tangible data resources to support these claims.

**METHODS:** Electromyographic activity was recorded in the deep and superficial multifidus, transversus abdominis, erector spinae, and deltoid using selective intramuscular electrodes and surface electrodes during single and repetitive arm movements. The latency of electromyographic onset in each muscle during single movements and the pattern of electromyographic activity during repetitive movements were compared between muscles.

**RESULTS:** With single arm movements, the onset of electromyography in the erector spinae and superficial multifidus relative to the deltoid was dependent on the direction of movement, but the onset in the deep multifidus and transversus abdominis was not. With repetitive arm movements, peaks in superficial multifidus and erector spinae electromyography occurred only during flexion for most subjects, whereas peaks in deep multifidus electromyography occurred during movement in both directions.

**CONCLUSIONS:** The deep and superficial fibers of the multifidus are differentially active during single and repetitive movements of the arm. The data from this study support the hypothesis that the superficial multifidus contributes

to the control of spine orientation, and that the deep multifidus has a role in controlling intersegmental motion.

**CLAIM: Reduces the onset of chronic back pain**

**CLAIM: Reduces fatigue and stiffness**

**CLAIM: Improves quality of life**

Many authors established the relation between lower back pain to insufficiently developed deep spinal muscles while others highlighted the fact that the reinforcement of the deep spinal muscles such as the multifidus and transversals had a noteworthy improvement on the relief of chronic lower back pain. However, such muscles were not always easy to target correctly or consistently with the prescribed exercises; in fact, even if pain is decreasing, the persistent atrophy would cause a recurrence. The ideal treatment of such deep spinal muscles should take into account both precise targeting and integrated coordination exercises; this is precisely what SpineForce does.

From the aforementioned criterion on the pain and fatigue, a study has been proposed to evaluate the kind of programs and exercises that SpineForce may have to be most effectively decrease pain, measuring the amplitude needed to improve quality of life (study pending).

**Spine. 2001 Jun 1;26(11):E243-8.**

***'Long-term effects of specific stabilizing exercises for first-episode low back pain.'***

**Hides JA, Jull GA, Richardson CA.**

Department of Physiotherapy  
Mater Misericordiae Public Hospitals  
South Brisbane, Queensland, Australia.

**STUDY DESIGN:** A randomized clinical trial with 1 and 3-year telephone questionnaire follow-ups.

**OBJECTIVE:** To report a specific exercise intervention's long-term effects on recurrence rates in acute, first-episode low back pain patients.

**SUMMARY OF BACKGROUND DATA:** The pain and disability associated with an initial episode of acute low back pain (LBP) is known to resolve spontaneously in the short-term in the majority of cases. However, the recurrence rate is high,

and recurrent disabling episodes remain one of the most costly problems in LBP. A deficit in the multifidus muscle has been identified in acute LBP patients, and does not resolve spontaneously on resolution of painful symptoms and resumption of normal activity. Any relation between this deficit and recurrence rate was investigated in the long-term.

**METHODS:** Thirty-nine patients with acute, first-episode LBP were medically managed and randomly allocated to either a control group or specific exercise group. Medical management included advice and use of medications. Intervention consisted of exercises aimed at rehabilitating the multifidus in cocontraction with the transversus abdominis muscle. One year and three years after treatment, telephone questionnaires were conducted with patients.

**RESULTS:** Questionnaire results revealed that patients from the specific exercise group experienced fewer recurrences of LBP than patients from the control group. One year after treatment, specific exercise group recurrence was 30%, and control group recurrence was 84% ( $P < 0.001$ ). Two to three years after treatment, specific exercise group recurrence was 35%, and control group recurrence was 75% ( $P < 0.01$ ).

**CONCLUSION:** Long-term results suggest that specific exercise therapy in addition to medical management and resumption of normal activity may be more effective in reducing low back pain recurrences than medical management and normal activity alone.

**Eur Spine J. 2000 Aug;9(4):266-72.**

**'CT imaging of trunk muscles in chronic low back pain patients and healthy control subjects.'**

**Danneels LA, Vanderstraeten GG, Cambier DC, Witvrouw EE, De Cuyper HJ.**

*Department of Rehabilitation Sciences and Physical Therapy*

*Faculty of Medicine*

*Ghent University, Belgium. lieven*

Increasing documentation on the size and appearance of muscles in the lumbar spine of low back pain (LBP) patients is available in the literature. However, a comparative study between unoperated chronic low back pain (CLBP) patients and matched (age, gender, physical activity, height and weight) healthy controls with regard to muscle cross-sectional area (CSA) and the amount of fat deposits

at different levels has never been undertaken. Moreover, since a recent focus in the physiotherapy management of patients with LBP has been the specific training of the stabilizing muscles, there is a need for quantifying and qualifying the multifidus. A comparative study between unoperated CLBP patients and matched control subjects was conducted. Twenty-three healthy volunteers and 32 patients were studied. The muscle and fat CSAs were derived from standard computed tomography (CT) images at three different levels, using computerized image analysis techniques. The muscles studied were: the total paraspinal muscle mass, the isolated multifidus and the psoas. The results showed that only the CSA of the multifidus and only at the lowest level (lower end-plate of L4) was found to be statistically smaller in LBP patients. As regards amount of fat, in none of the three studied muscles was a significant difference found between the two groups. An aetiological relationship between atrophy of the multifidus and the occurrence of LBP can not be ruled out as a possible explanation. Alternatively, atrophy may be the consequence of LBP: after the onset of pain and possible long-loop inhibition of the multifidus a combination of reflex inhibition and substitution patterns of the trunk muscles may work together and could cause a selective atrophy of the multifidus. Since this muscle is considered important for lumbar segmental stability, the phenomenon of atrophy may be a reason for the high recurrence rate of LBP.

**Spine. 1996 Dec 1;21(23):2763-9.**

***'Multifidus muscle recovery is not automatic after resolution of acute, first-episode low back pain.'***

**Hides JA, Richardson CA, Jull GA.**

*Department of Physiotherapy  
University of Queensland  
Brisbane, Australia*

**STUDY DESIGN:** A clinical study was conducted on 39 patients with acute, first-episode, unilateral low back pain and unilateral, segmental inhibition of the multifidus muscle. Patients were allocated randomly to a control or treatment group.

**OBJECTIVES:** To document the natural course of lumbar multifidus recovery and to evaluate the effectiveness of specific, localized, exercise therapy on muscle recovery.

**SUMMARY OF BACKGROUND DATA:** Acute low back pain usually resolves spontaneously, but the recurrence rate is high. Inhibition of multifidus occurs with acute, first-episode, low back pain, and pathologic changes in this muscle have been linked with poor outcome and recurrence of symptoms.

**METHODS:** Patients in group 1 received medical treatment only. Patients in group 2 received medical treatment and specific, localized, exercise therapy. Outcome measures for both groups included 4 weekly assessments of pain, disability, range of motion, and size of the multifidus cross-sectional area. Independent examiners were blinded to group allocation. Patients were reassessed at a 10-week follow-up examination.

**RESULTS:** Multifidus muscle recovery was not spontaneous on remission of painful symptoms in patients in group 1. Muscle recovery was more rapid and more complete in patients in group 2 who received exercise therapy ( $P = 0.0001$ ). Other outcome measurements were similar for the two groups at the 4-week examination. Although they resumed normal levels of activity, patients in group 1 still had decreased multifidus muscle size at the 10-week follow-up examination.

**CONCLUSIONS:** Multifidus muscle recovery is not spontaneous on remission of painful symptoms. Lack of localized, muscle support may be one reason for the high recurrence rate of low back pain following the initial episode.

**J Orthop Res. 2002 Jan;20(1):112-21.**

**'EMG activity of trunk muscles and torque output during isometric axial rotation exertion: a comparison between back pain patients and matched controls.'**

**Ng JK, Richardson CA, Parnianpour M, Kippers V.**

*Department of Physiotherapy  
The University of Queensland, Australia.*

Abnormal patterns of trunk muscle activity could affect the biomechanics of spinal movements and result in back pain. The present study aimed to examine electromyographic (EMG) activity of abdominal and back muscles as well as triaxial torque output during isometric axial rotation at different exertion levels in back pain patients and matched controls. Twelve back pain patients and 12 matched controls performed isometric right and left axial rotation at 100%, 70%,

50% and 30% maximum voluntary contractions in a standing position. Surface EMG activity of rectus abdominis, external oblique, internal oblique, latissimus dorsi, iliocostalis lumborum and multifidus were recorded bilaterally. The primary torque in the transverse plane and the coupling torques in sagittal and coronal planes were measured. Results showed that there was a trend ( $P = 0.08$ ) of higher flexion coupling torque during left axial rotation exertion in back pain patients. Higher activity for external oblique and lower activity for multifidus was shown during left axial rotation exertion in back pain group when compared to the control group. In right axial rotation, back pain patients exhibited lesser activity of rectus abdominis at higher levels of exertion when compared with matched controls. These findings demonstrated that decreased activation of one muscle may be compensated by overactivity in other muscles. The reduced levels of activity of the multifidus muscle during axial rotation exertion in back pain patients may indicate that spinal stability could be compromised. Future studies should consider these alternations in recruitment patterns in terms of spinal stability and internal loading. The findings also indicate the importance of training for coordination besides the strengthening of trunk muscles during rehabilitation process.

**Z Orthop Ihre Grenzgeb. 2003 Jul-Aug;141(4):401-5.  
'Evaluation of specific stabilizing exercise in the treatment of low back pain and lumbar disk disease in outpatient rehabilitation.'  
Kladny B, Fischer FC, Haase I.**

*Specialty Clinic Herzogenaurach  
Department fur Orthopadie, Germany*

**OBJECTIVE:** The objective of the study was to evaluate the outcome of outpatient rehabilitation in patients with low back pain and lumbar disk disease with a specific stabilizing exercise of the M. multifidus and M. transversus abdominis.

**METHOD:** 99 outpatients admitted to a rehabilitation unit were included in a prospective randomized controlled interventional trial. The interventional group consisted of 50 patients (34 male, 16 female; mean age 41.1 +/- 9.1, range; 21 - 54 years), 49 patients (31 male, 18 female; mean age 37.9 +/- 9.5, range; 19 - 55 years) were in the control group. Outcomes were assessed at the beginning

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and the end of the treatment and at a three month follow-up with the Oswestry Low Back Pain Disability Questionnaire, the Hannover Functional Ability Questionnaire FFbH-R, the pain scale SES and a numeric rating scale.

**RESULTS:** In both groups there was a significant functional improvement as measured with the Oswestry Score and the FFbH-R. The interventional group showed better values at the end of the treatment. Pain as well could be reduced significantly by the treatment, but no differences were noted between the two groups.

**CONCLUSION:** Outpatient rehabilitation improved functional capacity and pain in both groups. Advantages could be seen in the interventional group concerning functional status. The specific stabilizing exercise approach appears to be effective in conservative treatment programs of low back pain and lumbar disk disease.

**CLAIM: Conditioning up to 80 muscles<sup>1</sup>, SpineForce stimulates key muscle chains in the body.**

The knowledge of the physiology of the muscular chains allows for claims that the exercises employed with SpineForce, more than 80 muscles are recruited simultaneously (as described and advocated in the scientific literature).

**CLAIM: Improves endurance, agility and proprioception**

**CLAIM: Optimizes the performance of athletes and sports enthusiasts**

A study was conducted in France the staff of Doctor Jean Marcel Ferret to Lyon (CEREC) showing the impact of the SpineForce treatments on subjects in different age categories, including those with both sedentary and active lifestyles (age group was from 18-60 years).

The initial report (S1) divided the 102 subjects into 6 groups to truly identify the force and coordination of each subject group. The divisions were athletic young women aged 18-25, sedentary young women aged 18-25, athletic young men aged 18-25, sedentary men aged 18-25, athletic senior men aged 50-60, and sedentary senior men aged 50-60.

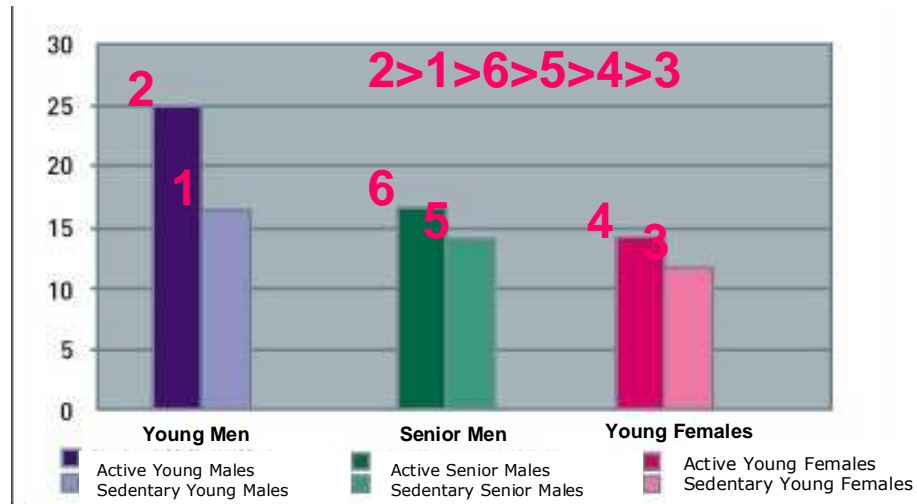
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<sup>1</sup> In the whole body, there are over 180 deep spinal muscles targeted and conditioned.

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A second report, 5 weeks later (S5) of the 4 first groups, showed the effects of SpineForce treatments (after 10 full sessions).

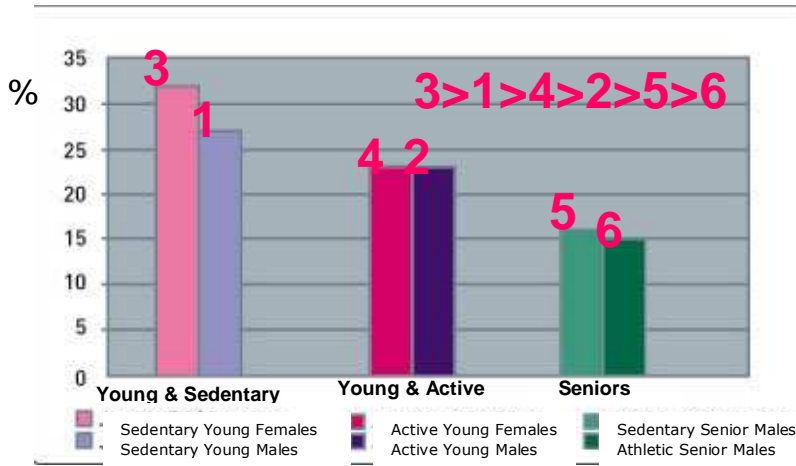
### **Muscle Force:**



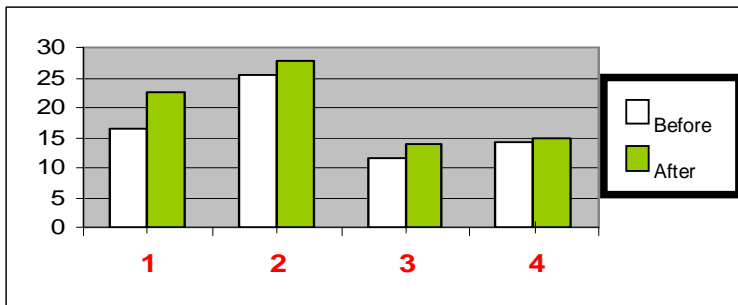
The groups are good representations of the differences of force in function and relativity of age: the young athletic men are more powerful than the athletic senior men; in terms of gender differences, the young athletic men are more powerful than the young, athletic women, idem for the sedentary in terms of both age and gender.

### **Coordination Score:**

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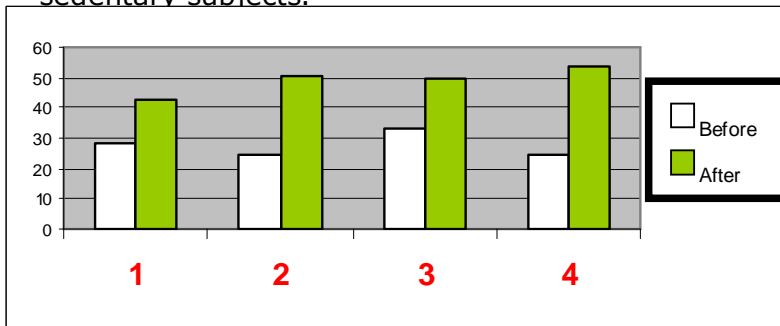


Evaluating the coordination of subjects with SpineForce treatments similarly profiles a person according to age, (with coordination deteriorating rapidly with seniors) and gender (the coordination is slightly improved when analyzing the sedentary women) and of physical activity (the athletic, more powerful subjects have lower coordination scores).



- 1= Sedentary Young Males
- 2= Active Young Males
- 3= Sedentary Young Females
- 4= Active Young Females

After a series of 10 sessions on SpineForce, the average improvement of muscular force is 24%, with a less noticeable progression in athletic than in sedentary subjects.



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After a series of 10 sessions on SpineForce, the average improvement of coordination is 106%, with a more noticeable improvement in the athletic subjects.

The pursuit of this study should take into consideration the variation between the sedentary to the senior athletic subjects.

A second study shall be performed in Italy by the Professor Faina of the National Italian Olympic Committee for Rome. This study (Concerning the effect of additional postural and coordination training with SpineForce, with posture control and select mechanical power and neuromuscular indices of the lower and upper limbs) will objectively analyze the effects of the sessions on postural adjustment and coordination relative to the mechanical and neuromuscular reactions of high-level athletes. It will further address the improvement of muscular and mechanical force, checking the posture for better neuromuscular effectiveness. This monocentric study will be checked and randomized on parallel groups of 50 subjects.

**CLAIM: Prevents the onset of debilitating structural conditions.**

**CLAIM: Aids in the prevention of osteoporosis.**

It has repeatedly been confirmed that physical activity aids in the prevention of osteoporosis, specifically for menopausal women. The muscular contractions that SpineForce elicits is able to gently force the spinal structure into correct alignment, making each of the separate vertebral segments work synergistically. This traction (dictated by the hand and feet positioning) combines with resistance efforts to provide similar exercises to those that have been proven to aid in the prevention of bone density loss.

**Osteoporosis int. 2004 Jun 17**

**'Effects of high-impact exercise on bone mineral density: a randomized controlled trial in premenopausal women.'**

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**Introduction:** The purpose of this randomized controlled study was to assess the effects of high-impact exercise on the bone mineral density (BMD) of premenopausal women at the population level.

**MATERIALS AND METHODS:** The study population consisted of a random population-based sample of 120 women from a cohort of 5,161 women, aged 35 to 40 years. Subjects were randomly assigned to either an exercise or control group. The exercise regimen consisted of supervised, progressive high-impact exercises three times per week and an additional home program for 12 months. BMD was measured on the lumbar spine (L1-L4), proximal femur, and distal forearm, by dual-energy X-ray absorptiometry at baseline and after 12 months. Calcaneal bone was measured using quantitative ultrasound.

**RESULTS:** Thirty-nine women (65%) in the exercise group and 41 women (68%) in the control group completed the study. The exercise group demonstrated significant change compared with the control group in femoral neck BMD (1.1% vs -0.4%;  $p=0.003$ ), intertrochanteric BMD (0.8% vs -0.2%;  $p=0.029$ ), and total femoral BMD (0.1% vs -0.3%;  $p=0.006$ ). No exercise-induced effects were found in the total lumbar BMD or in the lumbar vertebrae L2-L4. Instead, L1 BMD (2.2% vs -0.4%;  $p=0.002$ ) increased significantly more in the exercise group than in the control group. Calcaneal broadband ultrasound attenuation showed also a significant change in the exercise group compared with the control group (7.3% vs -0.6%;  $p=0.015$ ). The changes were also significant within the exercise group, but not within the control group. There were no significant differences between or within the groups in the distal forearm.

**Conclusions:** This study indicates that high-impact exercise is effective in improving bone mineral density in the lumbar spine and upper femur in premenopausal women, and the results of the study may be generalized at the population level. This type of training may be an efficient, safe, and inexpensive way to prevent osteoporosis later in life.

**'Benefits of 2 years of intense exercise on bone density, physical fitness, and blood lipids in early postmenopausal osteopenic women: results of the Erlangen Fitness Osteoporosis Prevention Study (EFOPS).'**  
**Kemmler W, Lauber D, Weineck J, Hensen J, Kalender W, Engelke K.**

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**BACKGROUND:** Growing evidence indicates that physical exercise can prevent at least some of the negative effects on health associated with early menopause. Here we determine the effects of intense exercise on physical fitness, bone mineral density (BMD), back pain, and blood lipids in early postmenopausal women.

**METHODS:** The study population comprised 50 fully compliant women, with no medication or illness affecting bone metabolism, who exercised over 26 months (exercise group [EG]), and 33 women who served as a non-training control group (CG). Two group training sessions per week and 2 home training sessions per week were performed in the EG. Both groups were individually supplemented with calcium and cholecalciferol. Physical fitness was determined by maximum strength and cardiovascular performance. Bone mineral density was measured at the lumbar spine (dual-energy x-ray absorptiometry [DXA] and quantitative computed tomography [QCT]), the proximal femur (DXA), and the forearm (DXA). In serum samples taken from a subset of the study participants, we determined bone formation (serum osteocalcin) and resorption (serum cross-links) markers as well as blood lipid levels. Vasomotor symptoms related to menopause and pain were also assessed.

**RESULTS:** After 26 months, significant exercise effects determined as percentage changes compared with baseline were observed for physical fitness (isometric strength: trunk extensors [EG +36.5% vs CG +1.7%], trunk flexors [EG +39.3% vs CG -0.4%], and maximum oxygen consumption [EG +12.4% vs CG -2.3%]); BMD (lumbar spine [DXA L1-L4, EG +0.7% vs CG -2.3%], QCT L1-L3 trabecular region of interest [EG +0.4% vs CG -6.6%], QCT L1-L3 cortical region of interest [EG +3.1% vs CG -1.7%], and total hip [DXA, EG -0.3% vs CG -1.7%]); serum levels (total cholesterol [EG -5.0% vs CG +4.1%] and triglycerides [EG -14.2% vs CG +23.2%]); and pain indexes at the spine.

**CONCLUSION:** General purpose exercise programs with special emphasis on bone density can significantly improve strength and endurance and reduce bone loss, back pain, and lipid levels in osteopenic women in their critical early postmenopausal years.

**CLAIM:** **More precise, powerfully controlled movements decrease fatigue, reduce the risk of injury and speed recovery times.**

**CLAIM:** **Toning and firming the body for a firmer, slimmer figure.**

Physical exercise, specifically aerobic activity, draws upon a host of bodily functions responsible for the transportation of oxygen to the muscles, specifically, the circulatory system. This improved circulation greatly enhances energy while simultaneously eliminating the wastes and toxins expended from muscular contractions. The effect is not only externally visible, improving the outer appearances, but it further works to improve the body's organs and functioning, due to the duration of the aerobic effort. The resultant increase in energy expenditures solicits the fundamental bodily functions. The treatment provides and undeniable health benefit to the pulmonary and cardiovascular systems, while concurrently conditioning the ligaments and tendons for a more defined, shapely form.

SpineForce utilizes techniques that embrace the recognized principles of physical training:

1. Entire body effort/exercise
2. Exceeding minimal intensity levels
3. Developing equivalent maximum intensity and overall capacities

**J Hum Nutr Diet. 2004 Aug;17(4):293-316.**

**What interventions should we add to weight reducing diets in adults with obesity?**

**'A systematic review of randomized controlled trials of adding drug therapy, exercise, behaviour therapy or combinations of these interventions.'**

**Avenell A, Brown TJ, McGee MA, Campbell MK, Grant AM, Broom J, Jung RT, Smith WC.**

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**BACKGROUND:** Evidence is needed for the effectiveness of interventions given with reducing diets for obese adults: drug therapy, exercise, or behaviour therapy.

**METHODS:** Systematic review of randomized controlled trials in all languages, searching 13 databases and journals. Trials lasted 1 year or more with one investigator extracting data and another second checking the data extraction; trial quality was assessed.

**RESULTS:** Adding orlistat to diet was associated with weight change for up to 24 months (-3.26 kg, 95% CI, -4.15 to -2.37 kg), and statistically significant beneficial changes were found for total and LDL cholesterol, blood pressure and glycaemic control. Adding sibutramine to diet was associated with a 12 month weight change of -4.18 kg (95% CI, -5.14 to -3.21 kg), and statistically significant beneficial effects on high density lipoprotein cholesterol (HDL) and triglycerides (TGs), but an increase in diastolic blood pressure. Adding exercise to diet, or to diet and behaviour therapy, was associated with improved weight loss for up to 36 months and improvements in HDL, TGs and blood pressure. Adding behaviour therapy to diet, or to diet and sibutramine together, was associated with improved weight loss for up to 18 months. Adding drugs, exercise or behaviour therapy to dietary advice was each associated with similar weight change.

**CONCLUSIONS:** Adding orlistat, sibutramine, exercise, or behaviour modification to dietary advice can improve long-term weight loss.

**Diabetes Nutr Metab. 2004 Apr;17(2):124-7.  
'Short-term effects after a 3-month aerobic or anaerobic exercise  
program in Hong Kong Chinese.'  
Ko GT.**

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Information on the beneficial effects of exercise in Chinese concerning weight

reduction and fat loss is limited. The study subjects were 18 young, healthy Chinese volunteers; the study assessed the short-term effects of exercise on their anthropometric and biochemical parameters. Subjects had not done regular exercise before the study and were randomly assigned to aerobic or anaerobic exercise group (9 subjects in each group). Professional trainers for aerobic and anaerobic exercise were invited to teach and supervise the whole group on the exercise program. The study lasted 3 months with exercise of at least 3 sessions per week of 30 min each. Of the 18 subjects, 7 (38.9%) were men and 11 (61.1%) women. Their mean age was 28.9 +/- 3.6 yr (men: 29.6 +/- 4.2 yr, women: 28.5 +/- 3.4 yr, p value: NS). After the 3-month exercise program, body weight and body mass index reduction were significant only in the aerobic group but not in the anaerobic one, while body fat percentage was improved in both groups. These results suggest that anaerobic exercise may increase the lean to fat body mass ratio. Plasma glucose was reduced in the aerobic group but not in the anaerobic one. Plasma insulin level was, otherwise, similar before and after exercise in both groups. This is compatible with a blunted insulin hormonal response to endurance exercise and improved tissue sensitivity to insulin.

**Int J Obes Relat Metab Disord. 2000 May;24(5):566-72.**

***'The effects of 18 months of intermittent vs. continuous exercise on aerobic capacity, body weight and composition, and metabolic fitness in previously sedentary, moderately obese females.'***

**Donnelly JE, Jacobsen DJ, Heelan KS, Seip R, Smith S.**

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**OBJECTIVES:** To compare the effects of 18 months of continuous vs intermittent exercise on aerobic capacity, body weight and composition, and metabolic fitness in previously sedentary, moderately obese females.

**DESIGN:** Randomized, prospective, long-term cohort study. Subjects performed continuous exercise at 60-75% of maximum aerobic capacity, 3 days per week, 30 min per session, or exercised intermittently using brisk walking for two, 15 min sessions, 5 days per week.

**MEASURES:** Aerobic capacity, body weight, body composition, and metabolic fitness (blood pressure, lipids, glucose and insulin).

**RESULTS:** Significant improvements for aerobic capacity of 8% and 6% were shown for the continuous and intermittent exercise groups, respectively. Weight loss for the continuous exercise group was significant at 2.1% from baseline weight and the intermittent group was essentially unchanged. The continuous group showed a significant decrease in percentage of body fat and fat weight while the intermittent group did not. HDL cholesterol and insulin were significantly improved for both groups.

**CONCLUSIONS:** In previously sedentary, moderately obese females, continuous or intermittent exercise performed long-term may be effective for preventing weight gain and for improving some measures of metabolic fitness.

**Diabetes Metab. 2003 Nov;29(5):509-18.**

**'Low intensity endurance exercise targeted for lipid oxidation improves body composition and insulin sensitivity in patients with the metabolic syndrome.'**

**Dumortier M, Brandou F, Perez-Martin A, Fedou C, Mercier J, Brun JF.**

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**BACKGROUND:** To investigate the effects of individualized training on the metabolic syndrome.

**METHODS:** Twenty-eight patients, suffering from the metabolic syndrome were studied before and after 2 months of training and compared to eleven patients who did not follow any training; all patients were overweight. Training was individualized at the point where fat oxidation was maximal (LIPOX(max)) as determined by calorimetry.

**RESULTS:** The patients exhibited a significant reduction in body weight (- 2.6 +/- 0.7 kg; P=0.002), fat mass (- 1.55 +/- 0.5 kg; P=0.009), waist (- 3.53 +/- 1.3 cm; P<0.05) and hip (- 2.21 +/- 0.9 cm; P<0.05) circumferences, and improved the ability to oxidize lipids at exercise (crossover point: + 31.7 +/- 5.8 W; P<0.0001; LIPOX(max): + 23.5 +/- 5.6 W; P<0.0001; lipid oxidation: + 68.5 +/- 15.4 mg.min(-1); P=0.0001). No clear improvement in either lipid parameters or fibrinogen were observed. The surrogates of insulin sensitivity evidenced a decrease in insulin resistance: HOMA%S (software): + 72.93 +/- 32.64; p<0.05; HOMA-IR (simplified formula): - 2.42 +/- 1.07; P<0.05; QUICKI:

+ 0.02 +/- 0.004; P<0.01; SI=40/I: + 3.28 +/- 1.5; P<0.05. Significant correlations were found between changes in body weight and HOMA-IR and between changes in LIPOX(max) and QUICKI.

**CONCLUSIONS:** Individualized aerobic training improves lipid oxidation, body composition and insulin resistance.

**J Gerontol A Biol Sci Med Sci. 2003 Mar;58(3):266-70.**

**'Effects of exercise training and hormone replacement therapy on lean and fat mass in postmenopausal women.'**

**Figueroa A, Going SB, Milliken LA, Blew RM, Sharp S, Teixeira PJ, Lohman TG.**

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**BACKGROUND:** Menopause is associated with decreases in lean mass and increases in fat mass. Serum hormone levels and hormone replacement therapy (HRT) may modify the effects of exercise training on body composition in postmenopausal women.

**METHODS:** We assessed the changes in total body and regional lean soft tissue and fat mass (using dual-energy x-ray absorptiometry) in 94 sedentary postmenopausal women, aged 40-65 years, after 12 months of resistance and weight-bearing aerobic exercise training. Women currently on oral HRT (n = 39) and not on HRT (n = 55) were randomized within groups to exercise and no exercise, resulting in four groups: exercise + HRT (n = 20), HRT (n = 22), exercise (n = 24), and control (n = 28). Fasting blood samples were measured for resting serum total levels of estrone, estradiol, cortisol, androstenedione, growth hormone, and insulin-like growth factor 1 at baseline and 12 months.

**RESULTS:** We found significant effects of exercise on increases in total body, arm, and leg lean soft tissue mass, and decreases in leg fat mass and percentage of body fat. There were no interaction effects of exercise and HRT on the changes in muscle strength and body composition. No significant changes in total hormone levels were found after 12 months.

**CONCLUSIONS:** Exercise training resulted in significant beneficial changes in lean soft tissue and fat mass in early postmenopausal women. These changes in

body composition were neither influenced by prolonged HRT use nor accompanied by changes in total levels of the hormones determined in this study.

**Lipids. 2000 Jul;35(7):769-76.**

**'Preferential loss of visceral fat following aerobic exercise, measured by magnetic resonance imaging.'**

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The aim of this study was to use whole-body magnetic resonance imaging (MRI) together with biochemical and anthropometric measurements to study the influence of regular moderate exercise with no dietary intervention on adipose tissue distribution in nonobese healthy women. We found significant decreases in both total (28.86+/-2.24 vs. 27.00+/-2.27 liters,  $P < 0.05$ ) and regional fat depots (visceral fat: 1.68+/-0.21 vs. 1.26+/-0.18 liters,  $P < 0.01$ ) using whole-body MRI despite no significant change in body weight, body mass index, or the waist-to-hip ratio. Interestingly, no changes in body fat content were found using anthropometry or impedance. There was a significant increase in high density lipoprotein cholesterol (1.58+/-0.06 vs. 1.66+/-0.08 mmol/L  $P < 0.02$ ) following exercise although there were no changes in other blood lipids such as triglycerides. In summary, moderate aerobic exercise over a period of 6 months resulted in a preferential loss in visceral fat in non-obese healthy women, and this may help to explain some of the health benefits associated with regular and moderate physical activity.

**CLAIM: To make a morphological analysis of bodily adaptation defects.**

In the ergonomic arms, SpineForce introduces an original system of integrated sensors; these sensors allow an integrated display to record the force of the push/pull efforts. Immediate feedback of the results allows for the judgment of symmetry and asymmetry of spinal strength, variation between the right and left sides of the spinal vertebrae, relative to the exerted force of efforts. A morphological assessment of the body's posture and stance; the strengths,

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weaknesses and defects are thoroughly analyzed. The degree of force that one must expend for efforts to obtain spinal symmetry and an upright posture is evaluated and improved. Sessions enable one to track the variations of efforts and resultant force exerted, distinguishing between the power differences between the right and left.