SAGITTAL PLANE BLOCKAGE OF THE FOOT, ANKLE AND HALLUX AND FOOT ALIGNMENT-PREVALENCE AND ASSOCIATION WITH LOW BACK PAIN

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ABSTRACT

Introduction: Some practitioners believe mechanical low back pain may be caused or aggravated by a stiff ankle, stiff great toe or flat feet. This study investigates subjects with and without mechanical low back pain and measures ankle and great toe range of motion and flattening of the medial longitudinal arch in both groups.

Methods: The study was a blinded, 2-arm, non-randomized clinical study involving 100 subjects with chronic or recurrent mechanical low back pain (intervention group) and 104 subjects without chronic mechanical low back pain (control group) between the ages of 18 and 45. A blind assessor performed weight-bearing goniometry of the ankle and big toe and the navicular drop test on all subjects in both groups.

Results: An independent t-test (inter-group) revealed a statistically significant decrease ($p \leq 0.05$) in ankle dorsiflexion range of motion in individuals with chronic mechanical low back pain. The independent t-test suggested individuals with chronic mechanical low back pain have a significantly smaller navicular drop and higher arches ($p \leq 0.05$).

Conclusion: This study supports previous reports suggesting decreased ankle dorsiflexion may be a factor in chronic mechanical low-back pain. Further research and replication of this study is necessary before firm conclusions or recommendations can be made. (*J Chiropr Med* 2006;5: 123–127)

INTRODUCTION

Seventy to 85% of people suffer from back pain.^{1,2} Additionally, 80% of people report foot problems at some point during their lifetime.^{1,2} Although back and feet seem like isolated regions of the body they are functionally interconnected through the lower extremity kinematic chain. The clinical experience of practitioners has led to the observation that flatfeet (or pelvic un-levelling from a flatfoot) and stiffness in the ankle or big toe will produce altered gait, altered alignment and/or loss of shock absorption which can facilitate the emergence of locomotor conditions such as low back pain.^{3,4} If these hypotheses are correct then there should be a measurably increased incidence of flat feet and decreased range of motion (sagittal plane blockage) in the ankle and big toe among subjects with low-back pain versus those without low-back pain. To investigate whether these clinical observations can be supported beyond the level of anecdotal report, a research study to evaluate between group differences was conducted by measuring range of motion in the ankle, big toe and foot alignment of subjects with and without lower back pain.

METHODS

The study was a blinded, two-arm, non-randomized clinical study involving 100 subjects with chronic or recurrent mechanical low back pain (intervention group) and 104 subjects without chronic mechanical low back pain (control group) between the ages of 18 and 45.⁵

Subject Selection

Convenience samples were chosen using a non-probability method. Between April 2, 2003, and September 19, 2003, all subjects presenting to the Chiropractic Day Clinic at the Durban University of Technology (DUT) who fit the inclusion criteria, and not the exclusion criteria, were eligible for participation. This project received approval from the institutional review board committee of DUT.

Inclusion criteria

1. Subjects 18 to 45 years of age to eliminate significant degenerative joint disease.
2. Chronic low-back pain >6 weeks or recurrent mechanical low back pain >12 weeks or no low back pain at all or pain in an area other than the low back, but not the lower limb.
3. Understanding and completion of informed consent.

Exclusion criteria

1. Non-mechanical or pathological low-back pain.
2. Foot pain, foot surgery, lower limb pain or any condition affecting measurement.
3. Subjects who had received treatment of their feet or lower back within one week of the consultation.

For Group 1, the low back pain group, the average age of the subjects was 31.23 years (range 18–45). Of these subjects, 68% were female and 32% were male. For Group 2, the group with no low back pain, the average age of the subjects was 28.82 years old (range 18–44). In this group, 39% of subjects were female and 61% were male.

Blinding

For the investigator to remain blind, initial consultation and diagnosis were completed by student interns in the DUT Chiropractic Day Clinic. Interns and subjects were counselled on and directed not to reveal evaluation, diagnosis or group assignment.

Measurement

Weight-bearing ankle and hallux goniometer range of motion, and the navicular drop test (a recent standard), have been reported as achieving up to

moderate intra-tester reliability, when taken by the same therapist over time.^{6,7,8,9,10}

Measurements performed included weight-bearing ankle range of motion (ROM), weight-bearing hallux ROM and difference in navicular height between resting and neutral standing postures using the navicular drop test (NDT) to determine flat feet or foot alignment. All measurements were taken three times and the mean recorded.^{11,12}

The range of ankle dorsiflexion (weight-bearing) measurement was taken on a low marked platform using a goniometer. With the knee straightened, the stationary arm was aligned along the lateral aspect of the fibula, and the mobile arm along the lateral aspect of the fifth metatarsal. Subjects were asked to dorsiflex their ankle straight upward.¹² For this study, normal ankle dorsiflexion was considered to be 20°, with anything less considered as a decreased ROM.²

Subject range of hallux dorsiflexion (weight-bearing) was taken standing with their hallux parallel to the platform. The examiner then performed goniometry measurement of hallux dorsiflexion.^{13,14} Less than 65° ROM was considered decreased.¹⁵

The navicular drop test was performed with the subject relaxed in a standing posture and with the subtalar joint positioned in neutral. Using a marked platform, the height of the navicular tuberosity was measured from the ground in millimetres.^{2,10} Various authors have suggested a drop of 10 to 15 mm as abnormal.^{16,17} In this study, anything greater than a 10 mm drop was considered abnormal.

RESULTS

As shown in Figure 1 and Table 1, an independent t-test (inter-group) revealed a statistically significant decrease ($p \leq 0.05$) in ankle dorsiflexion ROM in individuals with chronic mechanical low back pain (intervention group) in comparison to individuals without low back pain (control group) in both the right and left feet ($p = 0.002$ and $p = 0.032$ respectively). An independent t-test (inter-group) did not demonstrate a statistically significant difference between the two groups regarding hallux dorsiflexion ROM ($p > 0.05$).

Figure 1. Group 1 (low back pain) had statistically significant decreased ankle dorsiflexion ROM vs group 2 (no low back pain).

TABLE 1
RESULTS OF THE INDEPENDENT SAMPLES
T-TEST FOR ANKLE DORSIFLEXION BETWEEN
GROUPS 1 AND 2

MEASUREMENT	P-VALUE
RIGHT ANKLE DORSIFLEXION	0.002
LEFT ANKLE	0.032

The independent t-test (inter-group) indicated a statistically significant difference regarding navicular drop between the two groups in the right foot ($p = 0.003$) and left foot ($p = 0.009$). In this study individuals with chronic mechanical low back pain had a significantly smaller difference, or drop in navicular height (they had higher arches) in comparison to individuals without low back pain (Fig 2 and Table 2).

These navicular drop findings were supported by Chi-square and Cramer's V tests ($p \leq 0.05$) for the right ($p = 0.005$) but not the left foot ($p = 0.324$), as shown in Tables 3 and 4. Table 3 shows that there is an association between the difference in navicular height between the resting and neutral standing postures for the right foot and chronic mechanical low back pain at the 5% level of significance. The null hypothesis was therefore rejected. Table 4 shows that there is no association between the difference in navicular height between the resting and

neutral standing postures for the left foot and chronic mechanical low back pain at the 5% level of significance. The null hypothesis was therefore accepted.

DISCUSSION

The findings of this blinded study support previous reports¹³ suggesting that decreased ankle dorsiflexion may be a factor in chronic mechanical low-back pain. There was no clear association found between decreased hallux ROM and mechanical low back pain in this study. If these findings are confirmed through additional studies, exercise and manipulative therapy to increase ankle range of motion could become an important consideration in the treatment of some patients with mechanical low back pain disorders.

Some practitioners have positioned theories of the etiology of central mechanical disorders being precipitated and/or perpetuated by distal disturbances in the locomotor system, such as the lower extremities.^{4,13} Many practitioners functionally evaluate gait, pelvic levelling, firing-patterns, muscle strength, and joint flexibility as a holistic mélange of diagnostic factors that may inform patient care considerations related to low back pain disorders.^{4,13,14,18,19} Much research remains to be done

Figure 2. Group 1 (low back pain) had statistically significant less navicular drop (or higher arches) than group 2 (no low back pain).

TABLE 2
RESULTS OF THE INDEPENDENT SAMPLES T-TEST FOR THE DIFFERENCE IN NAVICULAR HEIGHT BETWEEN THE RESTING AND NEUTRAL STANDING POSTURES BETWEEN GROUPS 1 AND 2

MEASUREMENT	P-VALUE
RIGHT NAVICULAR DIFFERENCE	0.003
LEFT NAVICULAR DIFFERENCE	0.009

TABLE 3
PEARSON'S CHI-SQUARE AND CRAMER'S V VALUES FOR DIFFERENCE IN NAVICULAR HEIGHT BETWEEN THE RESTING AND NEUTRAL STANDING POSTURES FOR THE RIGHT FOOT

	P-VALUE
PEARSON'S CHI-SQUARE	0.005
CRAMER'S V	0.005

in evaluating these functional influences on the outcomes of care for patient with low back pain.

Although recent studies have suggested that custom foot orthotics (that raise the arch) may decrease low back pain in some patients,¹⁹ this study's findings did not support, in the aggregate, that flatter feet correlate with low back pain. Since custom orthotics may represent significant expense for patients and are not without side-effects,^{13,14} it is important to determine which patients, with what types of mechanical

TABLE 4
PEARSON'S CHI-SQUARE AND CRAMER'S V VALUES FOR DIFFERENCE IN NAVICULAR HEIGHT BETWEEN THE RESTING AND NEUTRAL STANDING POSTURES FOR THE LEFT FOOT

	P-VALUE
PEARSON'S CHI-SQUARE	0.324
CRAMER'S V	0.324

low-back pain disorders and disturbed lower extremity locomotor factors, may benefit from this type of intervention. It may be that orthotics increase shock absorption decreasing low back pain independent of raising the arch.¹⁹ This research represents a step in that direction.

Discussion of some limitations to the interpretation of these findings is in order. The NDT with up to moderate intra-tester reliability remains controversial because measurement of subtalar "neutral" (STN) position, reliability and validity are questioned.^{2,7,8,19} Although radiographic measurement is preferred, measurement of navicular height by ruler, clinically practical and less invasive, is reliable. Thus use of the NDT with pre and post navicular height (from resting to weight-bearing—without use of the STN position) may improve accuracy. Yet, validity remains unknown due to a lack of agreement on normal and abnormal foot alignment. It

may be kept in mind that at the time this study was planned (around 2001) use of the STN position (with the NDT) was a common outcome measure. But, this study did not find the commonly expected significant association between chronic mechanical low back pain and flatter feet.¹³ In fact, no gold standard exists for clinically measuring flat feet but newer techniques currently being studied such as navicular height, arch index, foot posture index or navicular drift may improve similar future research.^{6,20} Additionally, the method of taking ankle range of motion, as described by Fryer et al,²¹ may improve data reliability.

The authors believe that significant error and decreased reliability (with weight bearing ROM and the NDT) was less likely because of successful blinding (three subjects with acute, severe low back were unblinded) and because this study was a one time intra-examiner measurement of pre and post navicular height.⁶

CONCLUSIONS

This study's data found that a statistically significant decrease in ankle dorsiflexion ROM, but not flatter feet, was associated with subject report of chronic mechanical low back pain disorders. Further research and replication of this study's findings is recommended before firm clinical implications can be drawn.

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