Strength Gains Through Lumbar Lordosis Restoration

Mark W Morningstar, DC[a]

Journal of Chiropractic Medicine 2003;2:137-141

For Correspondence:

5521 S Saginaw
Flint, MI 48507

[a] Private spine clinic, Grand Blanc MI

Abstract

Objective: To test the hypothesis that restoring the lumbar lordosis will increase a patient's voluntary muscular strength and decrease back pain symptoms.

Clinical Features: The patient was diagnosed with mechanical low back pain. The initial radiographic study revealed a loss of the lumbar lordosis. The patient determined his maximum bench press prior to the treatment program. The treatment outcome was based upon post intervention radiographs, a Borg pain scale, and the patient's post intervention maximum bench press.

Intervention and Outcome: The treatment program consisted of warm-up exercises, spinal manipulation, rehabilitative exercises, neuromuscular re-education, and prescribed home care. The treatment period consisted of 12 visits in the first 4 weeks, followed by once weekly for another 12 weeks, for a total of 24 visits in 4 months. In the first month, the Borg scale decreased from 5/10 to 0/10, and after 4 months the lumbar lordosis was increased from 2º to 31º. The sacral base angle (Ferguson's angle) increased from 18º to 31º. The patient's maximum bench press also increased from 245 pounds to 305 pounds.

Conclusion: Restoration of the lumbar lordosis appears to have a positive effect on muscular strength. This study supports the previous premise that a lumbar lordosis provides an inherent mechanical advantage for strength and stability.

Key Indexing Terms: lumbar spine, biomechanics, lordosis, spinal manipulation

Introduction

The lumbar lordosis serves to provide strength against the compressive forces of gravity, while at the same time to allow a certain amount of flexibility for locomotion. It has been previously shown by Svard et al[1] that athletes with back pain have less of a lumbar lordosis than a healthy control group. A normal lumbar lordosis protects the posterior spinal ligament system from excess strain[2,3] and acts as a shock absorber during sudden applied vertical forces.[4] Gracovetsky[5] has illustrated that a human can lift about three times his body weight, compared to a gorilla, which can only lift about half of its body weight and lacks a lumbar lordosis. The purpose of the present case study was to quantify the strength gains made as the lumbar lordosis was restored in a single patient.

Case Report

An 18-year-old male patient reported to a private spine clinic with a chief complaint of low back pain. Physical examination confirmed that the back pain was mechanical in origin. Seated anteroposterior and lateral lumbar radiographs were taken to quantify the configuration of the lumbar spine initially. At the onset of care, the lumbar

curve measured 2º and the sacral base angle (Ferguson's angle) measured 18º. The low back pain was initially rated as a 5/10 at its worst and a 2/10 at its best.

At the beginning of the treatment program, the patient was asked to find out his maximum bench press and provide the clinic with that information. The patient was then prohibited from performing weightlifting activities of any kind until the trial period had been completed. The only exercises performed by the patient were those specifically prescribed by the attending physician. These exercises will be illustrated later. Prior to treatment intervention, the patient's maximum bench press was 245 pounds.

The treatment was a multi-faceted program consisting of specific warm-up exercises, spinal manipulation, neuromuscular re-education, and rehabilitative exercise. The warm-up exercises were performed on a Pettibon Wobble Chair® designed to isolate active motion to the lumbar spine and its associated structures. The goal of this exercise was to decrease the amount of hysteresis in the white tissues so that the manipulative procedures can overcome this stored energy and focus more on mobilizing the spinal joints effectively. These exercises are demonstrated in Figure 1. The spinal manipulative procedures used were an anterior thoracic adjustment applied to the T7-T11 area, and a lumbar roll performed on each side. Due to the fact that active rehabilitation was used, the goal of the spinal manipulative procedures was not to fix joint dysfunction, but rather to mobilize all of the lumbosacral and sacroiliac joints so that the rehabilitative exercises and neuromuscular re-education could have a quicker and more immediate effect. The manipulative techniques are demonstrated in Figure 2. For neuromuscular re-education, a Pettibon anterior headweight was used to force the body to realign the entire spine closer to the center of gravity, through neurological adaptation. The author has previously outlined this procedure[6,7]. In conjunction with the anterior headweight, the patient also wore a backpack with 25 pounds of weight over the low shoulder. The weight hangs around the patient's waistline, thereby enhancing the lumbar lordosis immediately. A lateral lumbar radiograph was taken to verify this combined effect (Figure 3). While wearing the headweight and backpack, the patient walked on a treadmill for 7 minutes immediately following the manipulative procedures. These procedures are presented in Figure 4. Finally, the rehabilitative exercises were performed on the Pettibon Linked Trainer®. The exercises prescribed were specific to the spinal configuration present on the patient's anteroposterior lumbar film. This machine allows the physician to prescribe specific isometric exercises that functionally change the action of a given muscle. For example, the main action of the rhomboid muscles is to retract and elevate the scapulae.[8] However, if the scapula is stabilized and not allowed to retract, then the resultant action of the rhomboid muscle is to rotate the spine toward the stabilized scapula. The muscle is simply changing the load from the scapula and distal attachment to the spine or proximal attachment. Additionally, when certain muscle groups are worked bilaterally simultaneously, such as the latissimus dorsi, the result is theoretically an increased lumbar lordosis. These exercises are shown in Figure 5. In addition to the standard office visits, the patient was required to perform specific home rehabilitation care to complement the corrective program. The home care consisted of wearing the anterior headweight for 20 minutes twice daily, and lying on a set of high density foam blocks once daily for 20 minutes immediately prior to bed.

A total of 12 office visits were scheduled in the first 4 weeks. These visits included the warm-up exercises, spinal manipulation, and the headweight and backpack.

After the first month, the Linked Trainer® exercises were added and performed after the headweight and backpack. After the initial 12 visits, the visit frequency dropped to once a week for 12 weeks. By the end of the first month of care, the patient had been relieved of his back pain symptoms. The total program consisted of 24 visits in a 4-month period. After the 24 visits were completed, a post intervention set of radiographs were performed, analyzed, and compared to the initial radiographs. Jackson et al[9] have previously reported the patient positioning procedures used here to verify repeatability. The post radiograph revealed a lumbar lordosis of 31º and a sacral base angle of 31º (See Figure 6). Upon completion of the program, the patient was instructed to resume weightlifting and find out if his maximum bench press had increased. Under the supervision of his school's strength coach, the patient was able to bench press 305 pounds, a 60-pound increase. The patient had not bench pressed the entire 4 months.

Discussion

The goal of the present study was to restore a normal lumbar lordosis and evaluate its effect on physical strength and function. Restoring a normal lordosis implies knowing a normal lumbar lordosis. Several authors have previously developed respective versions of a normal spinal model[10-12]; therefore, the present study was able to work with a beginning reference point. However, future research needs to identify universal parameters so that a single acceptable model can be created. The present study did not measure the quality or quantity of either the cervical lordosis or the thoracic kyphosis. Some of the manipulative and rehabilitative procedures were likely to have affected these spinal regions, and this may have contributed to both the symptom reduction and the gains made in the bench press. However, manipulative techniques were not performed on the cervical or upper thoracic regions so any incidental structural improvement in these areas may be attributed to the rehabilitative exercises and the neuromuscular re-education.

The published literature on relationship between back pain and lumbar lordosis is mixed at best.[12-18] Therefore, symptomatic reduction in the present patient could have originated from multiple sources, including placebo, somatosensory effects from the spinal manipulative procedures[18], exercise-induced analgesia[19], or the global realignment of the centers of mass, thus reducing the amount of tension in the postural muscles.[6,20]

Patient compliance likely enhanced the results of this program. The home care was performed at a self-reported rate of about 80% of the time, according to the patient. Although this study is preliminary, there have been no other studies published that have specifically tested any chiropractic medical techniques for increasing voluntary muscle strength through spinal structural re-alignment.

Several authors have reported the distinct mechanical advantage of maintaining a normal lumbar lordosis.[21-23] The present study is evidence for previous observations made by Porter[24], who notes that weight lifters can lift heavier weights with an intact lumbar lordosis than if the lordosis is allowed to be flattened or reversed.

The initial measurements of the sacral base angle and lumbar lordotic angle were not surprising. These radiographs were taken in a seated position. The author hypothesizes that due to the loss of lumbar lordosis, when the patient is asked to "sit up straight" for the radiograph, this action is achieved by tilting the pelvis in a +RX

direction. This would cause the increase in sacral base angle despite the loss of lumbar lordosis. However, this has not been previously tested in the literature, to the author's knowledge.

Conclusion

By restoring the lumbar lordosis in a single patient, the protocol outlined was able to provide for a 60-pound increase in the patient's bench press after 4 months. This study supports the previous premise that a normal lumbar lordosis provides inherent biomechanical stability and strength. Expanding this study to include a large number of subjects may be valuable to certain groups within the population concerned with strength and endurance, such as athletes and bodybuilders.

Acknowledgments

The author would like to thank Darin Weeks and Randy Dodson for volunteering to be models for the illustrations.

References

1. Svard L, Ericksson B, Petterson L. Anthropometric characteristics, passive hip flexion, and spinal mobility in relation to back pain in athletes. Spine 1990;15:376-382
2. Cyriax J. Textbook of orthopedic medicine Vol 1. Diagnosis of soft tissue lesions 7th ed. London Balliere Tindall 1978
3. McKenzie RA. The lumbar spine: Mechanical diagnosis and therapy. Spinal Publications, Waikanae, New Zealand 1981
4. Hultman G, Saraste H, Ohlsen H. Anthropometry, spinal canal width, and flexibility of the spine and hamstring muscles in 45 55-year-old men with and without low back pain. J Spinal Disord 1992;5:245-253
5. Gracovetsky S. Function of the spine. J Biomed Eng 1986;8:217-223
6. Morningstar M. Cervical curve restoration and forward head posture reduction for the treatment of mechanical thoracic pain using the pettibon corrective and rehabilitative procedures. J Chiropr Med 2002;1:113-115
7. Morningstar MW, Strauchman MN, Weeks DA. Spinal manipulation and anterior headweighting for the correction of forward head posture and cervical hypolordosis: A pilot study. J Chiropr Med 2003 (In Press)

8. Kendall FP, McCreary EK, Provance PG. Muscles: Testing and function 4th ed. Wilkins & Wilkins 1993 pg 282
9. Jackson BL, Barker WF, Pettibon BR, Woggon D, Bentz J, Hamilton D, Wiegand M, Hester R. Reliability of the Pettibon Patient Positioning System for Radiographic Production. J Vertebral Sublux Res 2000;4;1
10. Troyanovich SJ, Cailliet R, Janik TJ, Harrison DD, Harrison DE. Radiographic mensuration characteristics of the sagittal lumbar spine from a normal population with a method to synthesize prior studies of lordosis. J Spinal Disord 1997; 10:380-386
11. Kapandji IA. The Physiology of the Joints, vol III: The Trunk and Vertebral Column.
12. Lin RM, Jou IM, Yu CY. Lumbar lordosis: Normal adults. J Formos Med Assoc 1992; 91: 329-333
13. Harrison DD, Cailliet R, Janik TJ, Troyanovich SJ, Harrison DE, Holland B. Elliptical modeling of the sagittal lumbar lordosis and segmental rotation angles as a method to discriminate between normal and low back pain patients. J Spinal Disord 1998; 11: 430-439
14. Murrie VL, Dixon AK, Hollingsworth W, Wilson H, Doyle TA. Lumbar lordosis: Study of patients with and without low back pain. Clin Anat 2003; 16: 144-147
15. Ng JK, Richardson CA, Kippers V, Parnianpour M. Comparison of lumbar range of movement and lumbar lordosis in back pain patients and matched controls. J Rehabil Med 2002; 34: 109-113
16. Tsuji T, Matsuyama Y, Sato K, Hasegawa Y, Yimin Y, Iwata H. Epidemiology of low back pain in the elderly: Correlation with lumbar lordosis. J Orthop Sci 2001; 6:307-311
17. Hansson T, Bigos S, Beecher P, Wortley M. The lumbar lordosis in acute and chronic low-back pain. Spine 1985; 10:154-155
18. Nourbaksh MR, Moussavi SJ, Salavati M. Effects of lifestyle and work-related physical activity on the degree of lumbar lordosis and chronic low back pain in a Middle East population. J Spinal Disord 2001; 14: 283-292
19. Seaman DR, Winterstein JF. Dysafferentation: a novel term to describe the neuropathophysiological effects of joint complex dysfunction. A look at likely mechanisms of symptom generation. J Manipulative Physiol Ther 1998 21: 267-280
20. Gurevich M, Kohn PM, Davis C. Exercise-induced analgesia and the role of reactivity in pain sensitivity. J Sports Sci 1994; 12:549-559
21. Cailliet R. Soft tissue pain and disability. F.A. Davis and Company 1988 pg 122-169
22. Gracovetsky S, Farfan HF, Lamy C. The mechanism of the lumbar spine. Spine 1981;6:249-262
23. Farfan HF. Muscular mechanism of the lumbar spine and the position of power and efficiency. Orthop Clin North Am 1975;6:135-144
24. Farfan HF. The biomechanical advantage of lordosis and hip extension for upright activity. Spine 1978;3:336-342
25. Porter RW. Management of back pain. Edinburgh, Churchill Livingstone 1986 pg 18-19, 170

1

2,3

4

5

6,7

8

9

10-12

12-18

18

19

6,19 20

20-22