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Spinal manipulation results in immediate H-reflex changes in patients with unilateral disc herniation

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Abstract The aim of this clinical investigation was to determine whether the abnormal H-reflex complex present in patients with S1 nerve root compression due to lumbosacral disc herniation is improved by single-session lumbar manipulation. Twenty-four patients with unilateral disc herniation at the L5-S1 level underwent spinal H-reflex electro-physiological evaluation. This was carried out before and after single-session lumbar manipulation in the side-lying position. Eligibility criteria for inclusion in the study were: predominant sciatica, no motor or sphincteric involvement, unilateral disc herniation at the L5-S1 level on CT or MR imaging, age between 20 and 50 years. H-reflex responses were recorded bilaterally from the gastrosoleous muscle following stimulation of tibial sensory fibers in the popliteal fossa. H-reflex amplitude in millivolts (HR-A) and H-reflex latency in milliseconds (HR-L) were measured from the spinal reflex response. Pre- and post-manipulation measurements were compared between the affected side and the healthy side. Statistical evaluation was performed by the Wilcoxon matched-pairs test (SPSS). Thirteen patients displayed abnormal H-reflex parameters prior to lumbar manipulation, indicating an S1 nerve root lesion. The mean amplitude was found to be significantly lower on the side of disc herniation than on the normal, healthy side ($P = 0.0037$). Following manipulation, the abnormal HR-A increased significantly on the affected side while the normal HR-A on the healthy side remained unchanged ($P = 0.0045$). There was a significant difference between latencies on the affected side and those on the healthy side ($P = 0.003$). Following manipulation there was a trend toward decreased HR-L. However, this trend did not reach statistical significance ($P = 0.3877$). Eight patients displayed no H-reflex abnormalities before or after manipulation. Their respective HR-A and HR-L values did not change significantly following manipulation. Three additional patients were excluded due to technical difficulties in achieving manipulation or measuring spinal reflex. These observations may lend physiological support for the clinical effects of manipulative therapy in patients with degenerative disc disease.

Key words H-reflex · Lumbar manipulation · Lumbar radiculopathy

Introduction

Spinal manipulation entails passive movement of a spinal segment within and sometimes beyond its active range of motion [12, 13]. Lumbar manipulation is probably one of the most popular modalities among the conservative measures employed in the management of back pain. This modality is a most controversial one, perhaps because little is known of the mechanism underlying the reported benefits from manipulation of the spine. Mechanical and neurophysiological effects have been proposed as a mechanism explaining the beneficial effects of back manipulation, as well as psychological and placebo effects [13]. In search of a mechanism that may shed light on the physiological effects of manipulation, we elected to study whether manipulation has any electrophysiological effects on a reflex response mediated by the S1 root.

The aim of this clinical investigation was to determine whether the abnormal H-reflex complex present in patients with S1 nerve root compression due to lumbosacral disc herniation is improved by single-session lumbar manipulation. If our null hypothesis is confirmed, this study may give some explanation as to the clinical effects of spinal manipulation.

Patients and methods

Twenty-four patients with unilateral disc herniation at the L5-S1 level underwent spinal H-reflex electro-physiological evaluation. This was carried out in a supine position before and after a single session of lumbar manipulation. The duration of symptomatic sciatica averaged 2 months, but was no less than 3 weeks. No patient displayed motor or sphincteric abnormality.

Eligibility criteria for inclusion in the study were: predominant sciatica along the distribution of the S1 nerve root, unilateral disc herniation at L5-S1 with mass effect on the involved S1 root and without other lumbar spine pathology as viewed on CT or MR imaging. Subjects' ages ranged from 20 to 50 years. Individuals who were significantly overweight or were over 1.90 m tall were excluded from the study.

All individuals had positive straight leg raising test, 20 at less than 40° C and the rest at less than 60° C. In 16 individuals the achilles reflex was diminished or absent. None of the patients displayed motor deficit.

H-reflex responses were recorded bilaterally from the medial aspect of the gastrosoleous muscle following stimulation of tibial sensory fibers in the popliteal fossa [10]. Submaximal square wave pulses (constant current) with fixed duration (1 ms) and intensity were delivered through a bipolar electrode (Medelec 16893, Woking, UK) with the cathode located proximally. The intensity was selected to produce a maximal H-reflex response together with a minimal or no M response (muscle action potential) [6].

Recordings were made with surface disc electrodes separated by 5 cm, with the active electrode located proximally. Data were recorded (Nicolet Viking IV, Madison, Wis.) at sweep speeds of 5 ms per division with automatic measurements of latencies and amplitudes. Eight successive recordings of H-reflex responses were obtained and averaged from each side, and amplitude in millivolts (HR-A) and latency in milliseconds (HR-L) were measured. This procedure was carried out before and after chiropractic manipulation delivered in the side-lying position. One manipulation with audible release was delivered in identical sequence (right and then left), so both the affected side and the contralateral non-involved side were manipulated. Manipulation was delivered by the same individual. The complete procedure including all measurements lasted approximately 15 min. Pre- and post-manipulation measurements were compared between the affected side and the healthy side. Statistical evaluation was performed by the Wilcoxon matched-pairs test (SPSS). This evaluation was carried out because the statistical influence is based on a ranking (non-parametric) distribution.

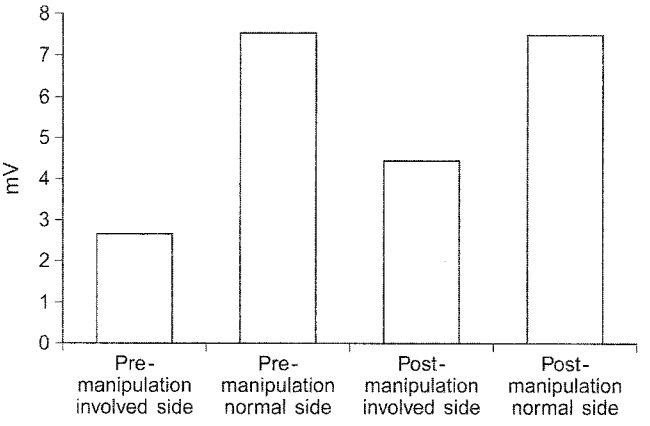

Fig. 1 Pre- and post-manipulation H-reflex mean amplitude levels (mV) on the involved side and the normal side ($P = 0.0045$)

Results

Thirteen patients displayed abnormal H-reflex parameters prior to lumbar manipulation, indicating an S1 nerve root lesion. The mean amplitude level was found to be significantly lower on the side of disc herniation than on the normal, healthy side (2.641 mV vs 7.525 mV, $P = 0.0037$) (Fig. 1). Following manipulation, the abnormal HR-A increased significantly on the affected side while the normal HR-A on the healthy side remained unchanged (mean HR-A 4.388 mV vs 7.431 mV, $P = 0.0045$) (Figs. 1, 2).

There was a significant difference between latencies on the affected side as compared to the healthy side. Pre-manipulation HR-L on the affected side was 32.23 ms as compared to 30.87 ms on the healthy side ($P = 0.003$). Following manipulation there was a trend toward decreased HR-L. However, this trend did not reach statistical significance ($P = 0.3877$).

Eight patients displayed no H-reflex change abnormalities before or after manipulation. Their respective HR-A and HR-L values did not change significantly following manipulation. Three additional patients were excluded due to technical difficulties in achieving manipulation or measuring spinal reflex.

Discussion

This study focused on patients with unilateral S1 nerve root compression undergoing manipulation to the L5-S1

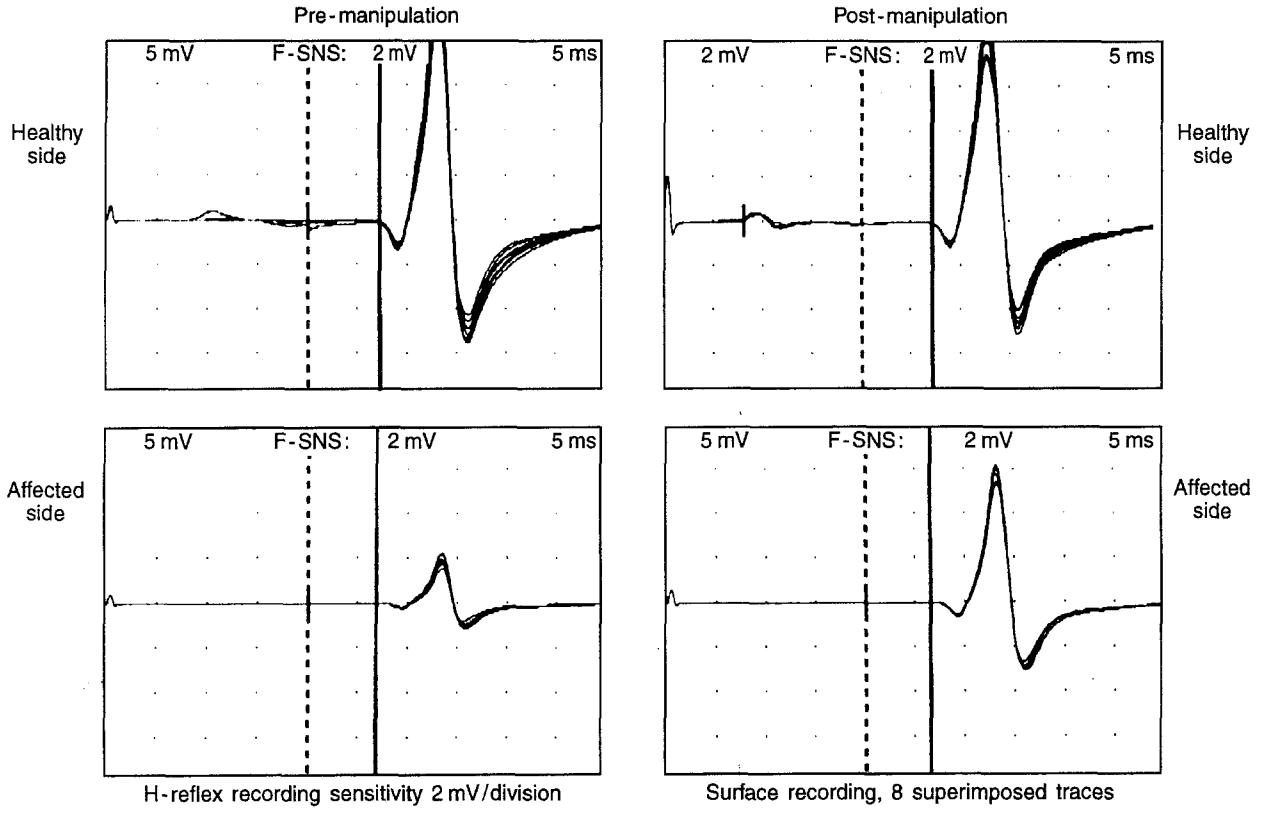

Fig. 2 H-reflex amplitude recovery in a patient with unilateral L5-S1 disc herniation following spinal manipulation. Spinal manipulation did not affect the H-reflex amplitude on the healthy, non-involved side

level. Manipulation in the presence of disc herniation is considered by some to be controversial or even contraindicated [9, 13]. Other practitioners believe, however, that careful monitoring of the patient and the absence of overt neurologic abnormality permit spinal manipulation [13]. Indeed, ill effects of manipulation in the lumbar spine are rarely encountered. This is reflected in the findings of a study published by Doran and Newall [5]. Moreover, other studies in individuals with back pain and radiculographic defects have demonstrated significant symptom relief following manipulation [16].

The H-reflex consists of a sensory motor monosynaptic reflex arc. It can measure with a high degree of accuracy the presence of S1 radiculopathy [1–3, 14]. H-reflex amplitude depends on stimulation intensity and on the excitability of the alpha motor neurons. In the current study a constant uniform stimulus was used throughout the clinical investigation to produce a maximal response for each patient. H-reflexes were identical in response to repetitive stimuli, as each trial transynaptically activates the same motor neurons [8]. We have demonstrated in our study immediate post-manipulation change in H-reflex amplitude in those patients who displayed an abnormal amplitude before manipulation. The current study also showed clearly that spinal manipulation does not affect normal H -reflex parameters either on the normal, healthy side or on the side affected by disc herniation. The change in the abnormal H-reflex was observed immediately following manipulation. No data are yet available regarding whether the improved H-reflex amplitude persists and, if so, for how long.

Some of the patients with abnormal H-reflex, as well as some of those with a normal reflex, obtained immediate pain relief following manipulation. Because the natural history of lumbar radiculopathy is favorable in most cases and owing to the small sample of tested subjects, no attempt was made to correlate pain relief with post-manipulation changes of the H-reflex.

The mechanism leading to immediate post-manipulation changes in the HR-A is unknown. It is conceivable that spinal manipulation may promote relief from radicular conduction block secondary to disc herniation. This phenomenon may account for the clinical effects of lumbar manipulation.

We could not demonstrate in our study an equivalent change in H-reflex latency following manipulation. Although there was a trend towards shorter HR-L following manipulation, it did not reach statistical significance. Since lumbar disc herniation causes a conduction block over a rather short segment in relation to the full length of the S1 reflex pathway, this may account for the relatively small latency changes observed following manipulation.

The current study is the first report investigating the influence of lumbar manipulation on the abnormal H-reflex in patients with lumbosacral disc herniation. However, the effects of massage or manipulation on the normal H-reflex have been previously reported [7, 11, 15]. Sullivan et al. [15] studied the effects of massage on spinal motorneuron excitability in normal volunteers. These investigators found that massage of the ipsilateral triceps surae muscle resulted in reduction of the H-reflex amplitude. Goldberg et al. [7] found that massaging the triceps surae muscle elicited an inhibitory effect on the normal H-reflex and that this inhibition was pressure sensitive. Murphy et al. [11] investigated the effects of sacroiliac joint manipulation on the H-reflex in asymptomatic volunteers. They also found that exerting a manual stimulation had an inhibitory effect on the H-reflex amplitude (about 13%). They concluded that joint manipulation exerts physiological effects on the central nervous system, probably at the segmental level. These reflex changes could be elicited even after cutaneous local anesthesia, indicating that the reflex modulation was influenced by joint or muscle afferents rather than by skin sensation [11]. Cramer and collaborators [4] examined the effects of spinal manipulation on the Hmax:Mmax latency ratio in subjects with acute low back pain. These investigators could not demonstrate a statistically significant change in the Hmax:Mmax ratio following manipulation. Our study clearly demonstrates that lumbar manipulation in patients with S1 nerve root compression and an abnormal H-reflex results in facilitation rather than inhibition of the H-reflex amplitude. In contrast to Murphy et al. [11], we did not find any changes in the normal H-reflex amplitude following manipulation.

In conclusion, regardless of whether the observed HR-A changes in our study are related to the beneficial clinical effects of manipulation, it is worthwhile to investigate further these immediate post-manipulation changes as this may provide some physiological basis for the clinical effects of lumbar manipulation.

References

1. Baylan SP, Yu J, Grant AE (1981) H-reflex latency in relation to ankle jerk, electromyographic, myelographic and surgical findings in back pain. Electromyogr Clin Electrophysiol 21: 201–206
2. Braddon RL, Johnson ER (1974) Standardization of H-reflex and diagnostic use in S1 radiculopathy. Arch Phys Med Rehabil 55: 161–166
3. Braddon RL, Johnson ER (1974) H-reflex: Review and classification with suggested clinical use. Arch Phys Med Rehabil 55: 412–417
4. Cramer GD, Humphreys CR, Hondras MA, McGregor M, Triano JJ (1993) The Hmax/Mmax ratio as an outcome measure for acute low back pain. J Manipulative Physiol Ther 16: 7–13
5. Doran DML and Newell DJ (1975) Manipulation in the treatment of low back pain: a multicentric study. Br Med J 2: 161–164
6. Garcia HA, Fisher MA, Gilai AN (1979) H-reflex analysis of segmental reflex excitability in flexor and extensor muscles. Neurology 29: 984–991
7. Goldberg J, Sullivan SJ, Seaborne DE (1992) The effect of two intensities of massage on H-reflex amplitude. Phys Ther 72: 449–457
8. Herdmann J, Dvorak J (1993) Electrophysiology of the normal and diseased spine. In: Floman Y, Farcy JPC, Argenson C (eds) Thoracolumbar spine fractures. Raven Press, New York, p 112
9. Hooper J (1973) Low back pain and manipulation: paraparesis after treatment of low back pain by physical methods. Med J Aust 1: 549
10. Hugon M (1973) Methodology of the Hoffman reflex in man. In: Desmedt J (ed) New developments in electromyography and clinical neurophysiology, vol 3. Karger, Basel, pp 277–293
11. Murphy BA, Dawson NJ, Slack JR (1995) Sacroiliac joint manipulation decreases the H-reflex. Electromyogr Clin Electrophysiol 35: 87–94
12. Paris SV (1983) Spinal manipulative therapy. Clin Orthop 179: 55–61
13. Paris SV (1996) Manipulation of the lumbar spine. In: Weisel SW, Weinstein JN, Herkowitz H, Dvorak J, Bell G (eds) The lumbar spine. Saunders, Philadelphia, pp 1012–1017
14. Schuchmann JA (1978) H-reflex latency in radiculopathy. Arch Phys Med Rehabil 59: 185–187
15. Sullivan SJ, Williams LR, Seaborne DE, Morelli M (1991) Effects of massage on alpha motorneuron excitability. Phys Ther 71: 555–560
16. Wilson JN, Ifeld FW (1952) Manipulation of the herniated intervertbral disc. Am J Surg 83: 173–175