Precision of a Needle Localization Technic in the Lumbosacral Multifidus Muscles for Segmental Specific Needle Electromyographic Study : A Cadaveric Study

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Abstract

The authors studied 14 cadavers to evaluate the claimed precision of needle placement into segment specific multifidus fascicles when using the "paraspinal mapping" electromyographic technic. Injection of acrylic dye was made according to landmarks proposed by Haig. The dissection showed 86.6 per cent of the injected dye in the correct fascicles. Only 1.4 per cent of the dye was lost. Spinous process level misidentification was the cause of the other 11.8 per cent incorrect injection. The authors expected that in living humans, in which the spinous processes are move identificable than embalmed cadavers, the precisions may be as high as 98.5 per cent. This remains to be studied in a further "*in vivo*" study

Key word : EMG, Needle, Electromyography, Paraspinal, Multifidus

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Electromyographic examination (EMG) is one of the oldest and the most commonly used diagnostic test to confirm radiculopathies. However, the EMG involving only limb muscles is not very sensitive and testing of up to eight muscles may be needed for adequate sensitivity[1]. By studying both paraspinal muscles and limb muscles, the sensitivity can be significantly increased[2,3] but specificity of the test must then be compromised because the commonly studied paraspinal muscles such as iliocostalis

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are polysegmentally innervated. It has been shown that the usual paraspinal muscles EMG examination technic can not differentiate between normal patients with L5 or S1 radiculopathy[4].

A recent anatomical study proved that the Multifidus muscles are the only paraspinal muscles with single segmental innervation[5]. Fasicles of the muscle orginating from a spinous process are exclusively innervated by branches of primary posterior rami, which exit through the intervertebral foramen between that vertebral segment and the adjacent lower one. For example fibers of multifidus originating from the L4 spinous process are innervated by branches of the L4 root which exit through the L4-5 intervertebral foramen. Focal atrophy of the muscles has been documented by computer tomography in patients with known single-root L5 raduculopathy[6] There is probably no S1 root innervation to the Multifidus muscles[7].

Haig has proposed a technic for precise localization of the EMG needle into specific fascicles of the Multifidus muscles[8]. Precision of this technic has been confirmed by a cadaveric study[9]. EMG study of multifidus muscles in normal subjects showed none[10] or a very small amount of the "spontaneous activities"[11]. This results in higher specificity of the test compared to the traditional technique, which can yield as high as 42 per cent false negative[12].

Multifidus EMG may be the only positive electrodiagnostic study in some cases, such as high lumbar disc herniation[4] or selective posterior primary rami lesion after spinal surgery[13].

Usefulness of this promising technic depends on ability to precisely place examining needle tip into the target muscles. The authors have found only one cadaveric study that confirmed the claim of the proposed localization technic[9].

Objective

The goal of this study was to evaluate the precision of needle tip localization into a specific part of the multifidus muscles when using the "paraspinal mapping" technique introduced by Haig.

MATERIAL AND METHOD

Fourteen embalmed cadavers were studied. The posterior iliac spines and the inferior border of the lumbar spinous process were identified by manual palpation. 0.1 ml of Acrylic paint was injected using a number 18 spinal needle into the multifidus muscles. Location, direction and depth of the needle insertion in the present study were the same as described by Haig[9].

Because the segment specific multifidus fibers which originate from any spinous process will pass just lateral to the next lower spinous process and course toward it's insertion on the lamina of the lower vertebras, needle insertion aiming at L1 segment specific multifidus were inserted at 2.5 cm lateral and 1cm cephalad to the most caudal palpable part of the L2 spinous process. The needle was angled 45 degrees toward the skin surface and pointed toward the midline unitl bone contace. Needle insertion toward the L2 to L5 segment specific Multifidus followed the same guideline. The only exception was that the insertion aimed at L5 specific Multifidus fibers was made at point 2.5 cm lateral to the midpoint between both posterior iliac spines (PSIS). Fig. 1 illustrates the points of needle insertion. A total of 5 injections were made on each side, aimed at the L1 to L5 segment specific multifidus fascicles. Injections were bilateral in almost every cadaver. The authors made unilateral injections in one cadaver on the side because the other side was for another purpose not compatible with the present study. Dissection and paint identification was done one day after the injections were made. Attempts were made to identify and separate fibers of the multifidus by their originating spinous process.

RESULTS

The number of injected dyes was counted as "correct" if the paint was found in the correct fasicles of multifidus and "missed" if found elsewhere. If the injected paint was not found, it was counted as "lost". Results are presented in Table 1. The dye was not difficult to identify. Only 2 (1.4%) of the 135 injected points were lost. 117 of the injected paints were in the correct fasicles of the multifidus. This was equal to 86 per cent precision. Because of missed identification of the L4 spinous process to be the L5 spinous process, the other 16 injections were in multifidus fascicle originating from the L4 spinous process. Each and every one of the dye injections aimed at L5 segment specific multifidus were found to be in the correct multifidus fascicles.

DISCUSSION

The present study confirms the high precision of placing the needle tip into the segment specific

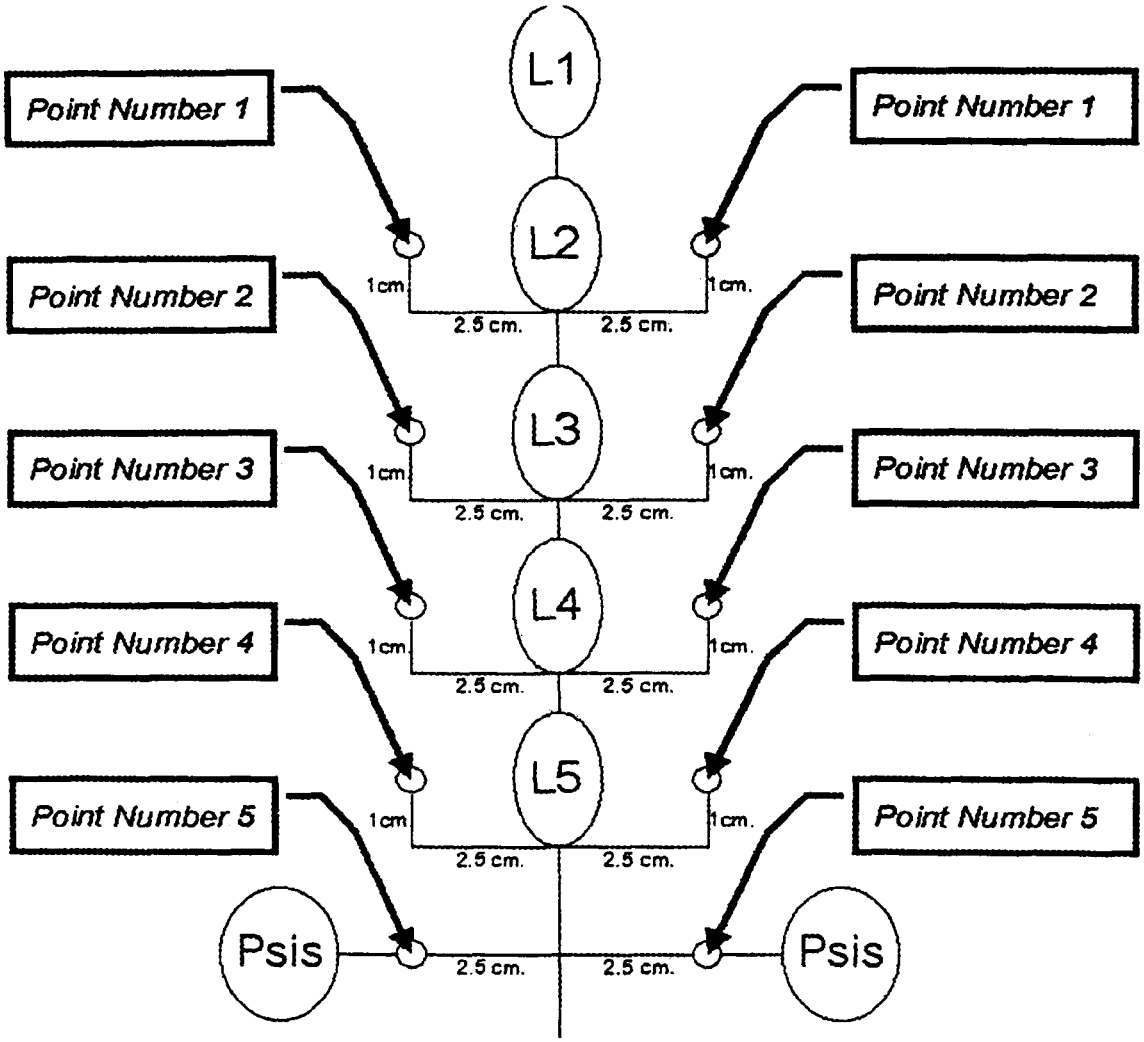

Fig. 1. Points of needle Insertion. Point number 1 to 4 were 2.5 cm lateral and 1cm cephalad to the most caudal palpable end of L2 to L4 spinous process respectively. Point number 5 was located 2.5 cm lateral to the midpoint between both posterior iliac spines (PSIS). Needles were inserted 45 degree to the skin surface pointing toward the midline until the needle contacted the lamina. Injections of the acrylic paint were done after slight needle withdrawal.

part of the multifidus muscles, when following the landmark proposed by Haig. Because the cadeveric preservation process causes hardening of soft tissue consistency, the spinous processes are much harder to identify in cadavers than in living persons. If this palpation error can be eliminated, 133 of 135 injections (98.5%) will be in the intended target. This, in combination with finding that normal asymtomatic

Table 1. Precision of needle tip localization into the segment specific multifidus fibers.

Point of needle insertion	Myotomal representation of the target Multifidus fibers	Amount of paint in correct position	%	Amount of paint in wrong position	%	Amount of loss paint	%
Point 1	L1	22	81.5	4	14.8	1	3.7
Point 2	L2	23	85.2	4	14.8	0	0
Point 3	L3	22	81.5	4	14.8	1	3.7
Point 4	L4	23	85.2	4	14.8	0	0
Point 5	L5	27	100	0	0	0	0
Total		117	86.7	16	11.8	2	1.5

persons have few, if any EMG abnormalities in the paraspinal muscles[11], suggested that this technic may have a very high test specificity. Then, segment specific paraspinal EMG should be the investigation of choice when one wants to rule out lumbar radiculopathy in questionable cases.

Further studies should aim to demonstrate and improve the precision of "live" identification of the lumbar spinous proceses by manual palpation. Subsequently the "*in vivo*" needle placement, especially to the problematic L4 originating multifidus should be studied.

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REFERENCES

1. Dillingham TR, Lauder TD, Andary M, et al. Identifying lumbosacral radiculopathies: An optimal electromyographic screen. Am J Phys Med Rehabil 2000; 79: 496-503.
2. Zambelis T, Piperos P, Karandreas N. Fibrillation potentials in paraspinal muscles in chronic lumbosacral radiculopathy. Acta Neurol Scand 2002; 105: 314-7.
3. Johnson EW, Melvin JL. Value of electromyography in lumbar radiculopathy. Arch Phys Med Rehabil 1971; 52: 239-43.
4. Haig AJ, Yamakawa K, Hudson DM. Paraspinal electromyography in high lumbar and thoracic lesions. Am J Phys Med Rehabil 2000; 79: 336-42.
5. Bogduk N, Wilson AS, Tynan W. The human lumbar dorsal rami. J Anat 1982; 134: 383-97.
6. Campbell WW, Vasconcelos O, Laine FJ. Focal atrophy of the multifidus muscle in lumbosacral radiculopathy. Muscle Nerve 1998; 21: 1350-3.
7. Haig AJ. Clinical experience with paraspinal mapping I: Neurophysiology of the paraspinal muscles in various spinal disorders. Arch Phys Med Rehabil 1997; 78: 1177-84.
8. Haig AJ, Talley C, Grobler LJ, et al. Paraspinal mapping: Quantified needle electromyography in lumbar radiculopathy. Muscle Nerve 1993; 16: 477-84.
9. Haig AJ, Moffroid M, Henry S, et al. A technique for needle localization in paraspinal muscles with cadaveric confirmation. Muscle Nerve 1991; 14: 521-6.
10. Tomasella M, Crielaard JM, Wang FC. Dorsal and lumbar paraspinal electromyographic study. Multi-MUP analysis and drawing up normal values in a reference population. Neurophysiol Clin 2002; 32: 109-17.
11. Haig AJ, LeBreck DB, Powley SG. Paraspinal mapping. Quantified needle electromyography of the paraspinal muscles in persons with out low back pain. Spine 1995; 20: 715-21.
12. Nardin RA, Raynor EM, Rutkove SB. Fibrilations in lumbosacral paraspinal muscles of normal subjects. Muscle Nerve 1998; 21: 1347-9.
13. Sihvonen T, Herno A, Paljarvi L, et al. Local denervation atrophy of paraspinal muscles in postoperative failed back syndrome. Spine 1993; 18: 575-81.

ความแม่นยำของเทคนิคการปักเข็มเข้าในกล้ามเนื้อ Multifidus ระดับเอว เพื่อการตรวจอิเลคโตรมัยโอกราฟฟี่ เฉพาะส่วนที่ได้รับการสั่งการจากรากประสาทเฉพาะระดับเดียว : การศึกษาโดยการผ่าศพ

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คณะผู้ทำการวิจัยได้ทำการศึกษาโดยการผ่าศพจำนวน 14 ศพเพื่อยืนยันตำแหน่งของสีอะคริลิคที่ฉีดเข้าไปตามเทคนิคการตรวจอิเลคโตรมัยโอกราฟฟีแบบ paraspinal mapping ที่เสนอโดย Haig พบว่าก้อนสีจำนวน 1.4% ของทั้งหมดที่ฉีดสีไว้สูญหายไปและอีก 11.8% พบอยู่นอกบริเวณเป้าหมาย ก้อนสีที่เหลือประมาณ 86% อยู่ในตำแหน่งที่ต้องการ เนื่องจากการคลำปุ่มกระดูกต่าง ๆ ในศพทำได้ยากกว่าคนปรกติมาก ดังนั้นจึงคาดว่าหากนำเทคนิคนี้ไปใช้ในการตรวจคนปรกติ อาจมีความแม่นยำสูงขึ้นถึง 98.5% ซึ่งควรมีการศึกษาเพื่อยืนยันต่อไป

คำสำคัญ : ไฟฟ้าวินิจฉัย, อิเลคโตรมัยโอกราฟฟี่, กล้ามเนื้อ, เทคนิค, ความแม่นยำ

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