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Electromyographic Examination of Gluteal Muscles in the Differential Diagnosis of Lumbar Herniated Discs

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Summary. The aim of the present investigation was to establish the value of gluteal muscles (m. gluteus medius, GME; m. gluteus maximus, GMX) as segmental reference muscles in the topical diagnosis of lumbar root compression syndromes. The methodological rationale consisted in determining the frequency with which denervation potentials could be recorded in the GME and GMX of patients with clinically and electromyographically well-defined monosegmental or bisegmental lumbar root compression syndromes. Of the L5-syndromes ($N=36$), 81% revealed denervation potentials in GME, but only 6% in GMX. Of the S1 syndromes ($N=26$), 63% exhibited denervation potentials in GMX and 32% in GME. L5 syndromes showed a better correlation of positive findings to GME than S1 syndromes to GMX. As far as the differential diagnosis is concerned, the advantages of recording EMG from GME and GMX are two-fold: (a) the immediate certainty of excluding a peripheral nerve lesion and (b) a reduction in the incidence of false negative findings.

Key words: Electromyography – Lumbar herniated discs – Gluteal muscles.

Zusammenfassung. Ziel dieser Untersuchung war es, den Wert der glutaealen Muskulatur (M. glut. med., M. glut. max.) als Kennmuskeln lumbaler Wurzelkompressionssyndrome zu überprüfen. Eindeutig monosegmentale Läsionen wurden mit den elektromyographischen Befunden des M. glutaeus med. und max. korreliert. Von 251 Patienten mit klinisch oder elektromyographisch manifesten Wurzelkompressionssyndromen wurden 55 (36 elektromyographisch reine L5-Syndrome, 26 elektromyographisch reine S1-Syndrome) ausgewertet. 81% der L5-Syndrome zeigten Denervierungspotentiale im M. glutaeus med., nur 6% ebenfalls im M. glut. max. 63% der S1-Syndrome zeigten Denervierung im M. glut. max., 32% im M. glut. med. und/oder des M. glut. max. In 8% aller untersuchten Wurzelkompressionssyndrome wurden

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isoliert im M.glut.med. und in 6% im M.glut.max. Denervierungen aufgedeckt. L5-Syndrome zeigen eine höhere Korrelation positiver Befunde zum M.glut.med. als S1-Syndrome zum M.glut.max. Der differentialdiagnostische Gewinn besteht im sicheren Ausschluß peripherer Nervenläsionen (N. ischiadicus, N.peronaeus, N.tibialis) und in selteneren falsch-negativen EMG-Befunden.

Schlüsselwörter: Elektromyographie - Lumbale Wurzelkompression - M. glutaeus.

Introduction

As is well known, the topical diagnosis of lumbar and sacral root compression syndromes is confronted by a number of difficulties: most muscles have a nerve supply derived from more than one root; paresis of segmental muscle groups of the leg may be difficult to detect, especially in powerful and bulky muscles like the quadriceps femoris and the gastrocnemius muscles; muscle weakness may be simulated by pain-induced submaximal innervation. To reduce diagnostic unreliability it is thus advisable to establish the diagnosis by means of objective electrophysiological examinations (Marinacci, 1965). The larger the spectrum of muscles with recordable denervation activities, the more accurately it can be ascertained which roots have been affected.

Little appears to be known about the practical importance of gluteal muscles as indicators of lumbar root syndromes (Kaeser, 1965; Krott et al., 1969), and this subject has also been neglected in neurological textbooks and reviews (Cohen and Brumlik, 1976). It was therefore the aim of this study to analyze electromyographically the extent and frequency of gluteal muscle involvement in various root lesions of the leg. Two interrelated questions should be answered: how often can denervation activity be observed in each of the gluteal muscles in L5 and S1 syndromes, and thus, how valuable are such proximal electromyographical examinations in comparison with distal segmental reference muscles?

The methodological rationale was to correlate clinically and electromyographically well-defined monosegmental or bisegmental lumbar root lesions with the electromyographically determined gluteal muscle (m.gluteus maximus, GMX; m.gluteus medius, GME) involvement.

Materials and Methods

The subjects were 251 patients (age range 21–73 years; 158 male, 93 female) admitted to the hospital during 1975–1977 suffering from a radicular type of pain or sensory deficits attributable to lumbar disc disease (see Table 1). The duration of the symptoms prior to commencement of the investigations varied from one month to ten years. Each patient was first carefully examined clinically. In the electromyographical analysis of myotomes L4–S1, the following muscles were investigated for denervation activity: paraspinal muscles (L4–S1), m.quadriceps femoris (QUA), m.tibialis anterior (TBA), m.extensor hallucis longus (EHL), m.extensor digitorum longus (EDL), m.peronaeus longus (PER), m.triceps surae muscle (TS), GMX and GME.

Table 1. Details of patients (investigated electromyographically because of a lumbar radicular pain symptomatology)

Total	251
EMG negative (distal segmental ref. muscles)	87
EMG positive (distal segmental ref. muscles)	76
L5	36
S1	26
L5 + S1	14
L4	4
L4 + L5	5
EMG positive complicated by additional affections (see text)	80

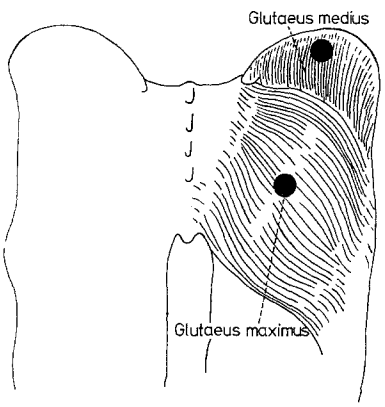

Fig. 1. Location of needle insertion for GME and GMX

Several recordings were made in each muscle, the position and depth of the electrode being varied. For GMX, the concentric needle electrode was inserted to a depth of 1–3 in. midway between the greater trochanter and the sacrum; for GME, it was inserted 1–2 in. distal to the midpoint of the iliac crest (see Fig. 1). Denervation activity (fibrillation potentials and/or positive sharp waves at rest) was the only EMG criterion used to decide the involvement of the investigated muscles, because interpretations based on interference patterns, particularly in large muscles, or fasciculation potentials are not always reliable (see Discussion). To ensure that root compression syndromes were the only source of denervation potentials in the recorded muscles, all patients ($n = 80$) whose symptoms were complicated by additional affections (posttraumatic states, postoperative states of root compression syndromes, polyneuropathy, cauda equina lesions, neoplastic processes in the region of the plexus lumbosacralis or peripheral nerves, repeated intragluteal injections, unresolved problems) were excluded from the analysis (see Table 1).

Results

Evaluations were made on a total of 76 patients with clinically and electromyographically well-defined monosegmental (L5, $N = 36$; S1, $N = 26$) or bisegmental (L5/S1, $N = 14$) radiculopathy. With pure L4 ($N = 4$) and L4/L5 syndromes ($N = 5$), the number of cases was too small to warrant further elaboration (see Table 1).

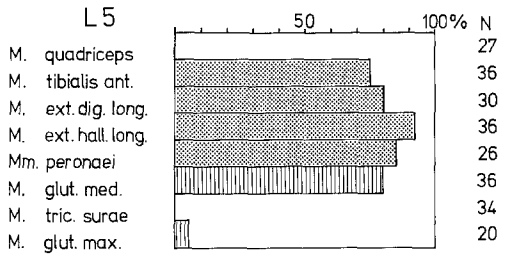

Fig. 2. L5 syndromes. Percentage distribution of denervation potentials in the eight investigated muscles. N = absolute values of examined muscles

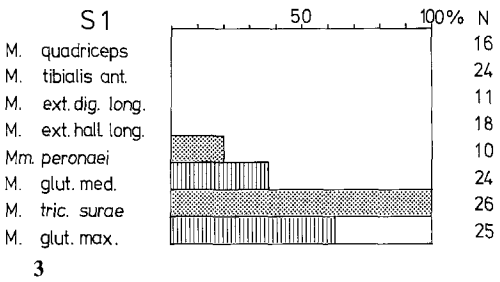

Fig. 3. S1 syndromes. Percentage distribution of denervation potentials in the eight investigated muscles. N = absolute values of examined muscles

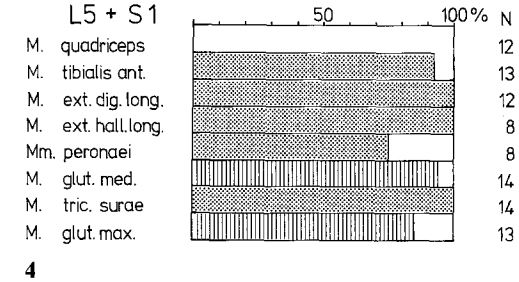

Fig. 4. L5/S1 syndromes. Percentage distribution of denervation potentials in the eight investigated muscles. N = absolute values of examined muscles

L5 Syndromes. L5 root compression syndromes were identified by combined objective clinical and electromyographical criteria. An L5 syndrome was assumed to be present when denervation activity could be obtained in EHL and/or TA, EDL, and PER. In all cases classified in this manner, denervation activity failed to appear in QUA and TS. Clinically, all cases (24 male and 12 female subjects) exhibited weakness in dorsiflexion of the big toe and the foot. Walking on the heels was more or less difficult and uncomfortable. Relative to the nonpathological side, no significant diminution in the knee and ankle jerk was observed. In seven cases, the tibialis posterior reflex was unilaterally absent on the pathological side. Figure 2 shows the percentage occurrence of denervation potentials in the eight routinely investigated muscles. The highest incidence of denervation potentials (92%) was found in EHL, but the value for GME (80%) was readily comparable with that for PER (85%), EDL (80%), and TBA (75%). GMX was affected in only 5% of the investigated subjects (see Fig. 2).

S1 Syndromes. S1 root compression syndromes were also identified by combined objective clinical and electromyographical criteria. S1 syndromes were characterized electrophysiologically by denervation activity in the triceps surae muscle. Clinically, all cases (19 male and 7 female subjects) exhibited weakness in the flexor muscles of the foot and toes, in the abductors of the toes, and in the hamstring muscles; there was also a diminution or loss of the ankle jerk on the affected side. The percentage distribution of denervation potentials in the eight routinely investigated muscles is presented in Fig. 3, TRS (100%), followed by GMX (63%), GME (31%), and PER (20%).

L5/S1 Syndromes. Bisegmental L5/S1 root compression syndromes were identified by a concurrence of the clinical and electromyographical criteria used to detect monosegmental L5 and S1 syndromes (see above). Such a bisegmental syndrome was exhibited by 14 patients (6 males, 8 females). As can be seen from Fig. 4, GME showed signs of denervation almost as often (94%) as EHL (100%), EDL (100%), or TRS (100%).

Denervation Activity Only in GME and GMX. Of the 87 cases in whom no evidence of denervation potentials was found in distal segmental muscles (see Table 1), 11 cases nevertheless displayed fibrillation potentials and/or positive sharp waves in GME ($N=9$) and/or GMX ($N=4$).

Discussion

The results of the present study indicate the suitability of GME and GMX as segmental reference muscles in the diagnosis of lumbar radiculopathy. Particular mention should be made of the following aspects: (a) L5 syndromes show a higher incidence of denervation potentials in GME (80%) than S1 syndromes in GMX (63%); (b) in L5 syndromes, the proximal GME is as reliable for the topical diagnosis as the distal segmental references muscles (TBA, EDL, EHL); (c) in S1 syndromes, GMX is, after TS, clearly the second most important muscle for the diagnosis of S1 radiculopathy; (d) denervation potentials in GME and/or GMX enable peripheral nerve lesions (n. ischiadicus, n. tibialis, n. peronaeus), which can simulate lumbar radiculopathy (Schliack, 1959), to be excluded; (e) the isolated appearance of denervation potentials in GME and GMX decreases the number of cases in which—despite typical anamnestic clues—no radiculopathy or topical diagnosis could be established. It should be emphasized that the results and conclusions presented here are derived from denervation potentials attributable to axonal degeneration. Other electromyographical signs were not taken into consideration, although a number of authors accept some of these signs as positive evidence for radicular lesions (Mendelsohn and Sola, 1958; Johnson and Melvin, 1971; La Joie, 1973). The value of fasciculation potentials seems to be doubtful, since they also occur in peripheral nerve lesions; similarly, a reduced interference pattern is frequently encountered in patients without signs of denervation, often being the result of relaxation in order to alleviate pain.

In view of our results it seems astonishing that the gluteal muscles (especially GME) should find no mention in the many publications (Shea et al., 1950; Kugelberg and Petersen, 1955; Marguth et al., 1955; Mendelsohn and Sola, 1958; Knutson, 1961; Rau, 1969; Coul and Lie, 1970; Johnson and Melvin, 1971; La Joie, 1973; Despland et al., 1974) and reviews (Cohen and Brumlik, 1976; Goodgold and Eberstein, 1977) dealing with the electromyography of lumbar root compression syndromes, and that, in a large number of laboratories, these muscles are obviously not subjected to routine electromyographical investigation. One report which does present electromyographical evidence of gluteal muscle involvement in L5 and S1 root compression syndromes is that of Kaeser (1965). From Tables III and IV in this paper, however, it would appear that GMX and

GME were of only minor interest in his investigations, and the results suggest that these muscles were not examined in every patient. Signs of denervation in TS were found in 31 subjects with reduction of the achilles reflex, but in GMX such signs were apparent in only 4 cases; similarly, in patients with typical radicular sensory deficits of L5, denervation signs in TBA and EDL were observed in 19 and 18 cases respectively, but only 2 patients displayed signs of denervation in GME. Our results from L5 compression syndromes are also in contrast to the findings of Krott et al. (1969), who found a difference in the incidence of positive denervation signs for EHL (81.6%) and GME (19.2%) for more than 60%. Since only the percentage of denervation per muscle is given, one reason for the discrepancy might be that the number of distal and proximal muscles examined was highly unequal.

The higher incidence of positive signs of denervation in GME in L5 syndromes than in GMX in S1 syndromes might be attributable to the greater difficulty in detecting discretely localized denervation potentials in the larger GMX than in the smaller GME even with several insertions at different places.

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