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L4-L5-S1 HUMAN DERMATOMES

A clinical, electromyographical, imaging and surgical findings

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Abstract – There is substantial controversy in literature about human dermatomes. We studied L4, L5, and S1 inferior limb dermatomes by comparing clinical signs and symptoms with conduction studies, electromyographical data, neurosurgical findings, and imaging data from computerized tomography (CT) or magnetic resonance imaging (MRI). After analyzing 60 patients, we concluded that L4 is probably located in the medial aspect of the leg, L5 in the lateral aspect of the leg and foot dorsus, and S1 in the posterior aspect of the backside, tight, leg and plantar foot skin. This is the first time that these human dermatomes have been evaluated by combined analysis of clinical, electromyographical, neurosurgical, and imaging data.

KEY WORDS: eletromyography, human dermatome, imaging, inferior member.

Dermátomos humanos L4, L5 e S1: achados clínicos, eletromiográficos, de imagem e cirúrgicos

Resumo – Há controvérsia na literatura sobre os dermátomos humanos. Estudamos dermátomos do membro inferior comparando sinais e sintomas com estudos eletromiográficos, de imagem e achados cirúrgicos. Analisando 60 pacientes, concluímos que o dermátomo L4 provavelmente está localizado na região medial da perna, o dermátomo L5 na região lateral da perna e dorso do pé, e o dermátomo S1 na nádega, região posterior da coxa e da perna e na região plantar. Este é o primeiro estudo que os dermátomos do membro inferior foram analisados através de dados clínicos, eletromiográficos, imagem e achados cirúrgicos.

PALAVRAS-CHAVE: dermátomo humano, eletromiografia, imagem, membro inferior.

The most commonly affected territory of human inferior limb dermatomes in neurology are L4, L5, and S1, but controversy exists as to their exact location in the legs. Classical anatomy and neurology text-books contain discrepancies presenting these human dermatomes in different skin territories. The L4 map is presented differently by Bickerstaff[1], Barraquer[2], and Duus[3]; the L5 dermatome in Testut and Latarjet's[4] classical text-book is different to text-books by Carpenter[5] and DeJong[6], and the S1 dermatome is different in text books by Déjerine[7], Bing[8], Moore[9], and Mummenthaler[10]. The cause of the discrepancies may be due to the different methods employed.

The objective of this study is to furnish probable L4, L5 and S1 human dermatome maps by comparing clinical, electromyographical, surgical findings, CT scan, and MRI data from 60 patients. As far as we known, this is the first time that these human dermatomes have been evaluated by the combined analysis of clinical, electromyographical, neurosurgical, and imaging data.

METHOD

This study included patients with a clinical diagnosis of lumbar radyculopathy, seen at our university hospital between 1992 and 2005. After approval from the Ethics Committee on Human Research, patients with clinical diagnosis of L4 and/or L5 and/or S1 lumbar radyculopathy were included in accordance with the following criteria:

I - Conduction studies and electromyographical diagnosis of lumbar radyculopathy on symptomatic leg were in accordance to electromyography text-books[11,12] and included: A) normal la-

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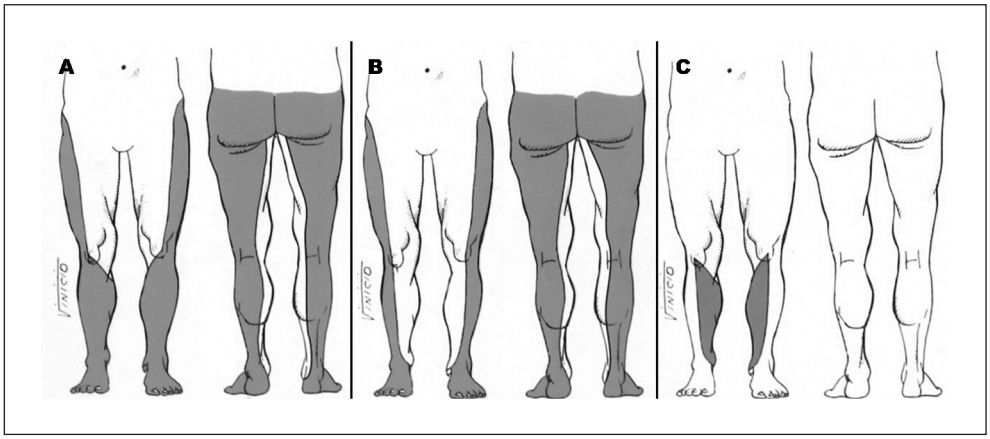

Fig 1. [A] The clinical alteration territory for patients with L4, L5, and S1 injuries. [B] The clinical alterations territory for patients with L5 and S1 injuries. [C] The probable human L4 dermatome.

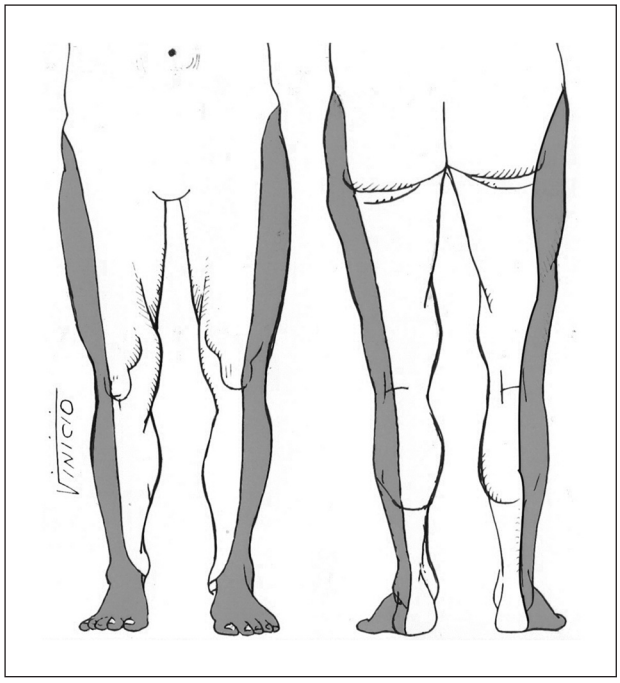

Fig 2. The probable human L5 dermatome.

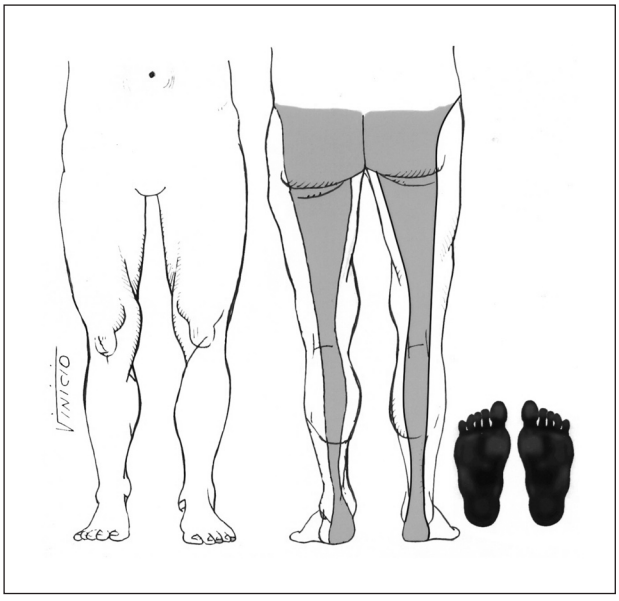

Fig 3. The probable human S1 dermatome.

tencies, amplitudes, and conduction velocities of the saphenous internus, fibularis superficialis, and suralis nerve; normal latencies and velocities of the deep peroneal and tibialis posterior nerves, coexisting with neurogenic electromyographical findings in the vastus lateralis muscle for L4 diagnosis, tibialis anterior and extensor halux longus for L5 diagnosis, and soleus for S1 diagnosis. B) Neurogenic findings were: spontaneous activity, with positive sharp waves or fibrillations and/or muscle at rest fasciculation; increased duration and amplitude neurogenic motor unit potentials with mild effort; reduced recruitment and incomplete interference pattern at maximum muscle contraction. C) Decreased F wave persistence in deep peroneal and tibialis posterior nerve were additional criteria for L5 and S1 diagnosis (respectively).

II – Surgical findings: Several patients with unsuccessful clinical treatment required surgery for lumbar root decompression. These surgical anatomical data were analyzed.

III – Imaging diagnosis of L4 and/or L5 and/or S1 radyculopathy: All patients had imaging diagnosis of compressive radyculopathy by CT scan or MRI.

RESULTS

A total of 60 patients were analyzed in 2 groups: Group I, with associated radicular injuries (n=25) and Group II, with isolated radicular injuries (n=35). These 2 Groups were sub-divided into Ia, with L4, L5, and S1 impairment (n=12); Ib, with L5 and S1 injuries (n=13); IIa, with isolated L5 radyculopathy (n=26); and IIb, with isolated S1 radyculopathy (n=9). Table shows the sub-groups and

Table. Patients with associated radicular injuries (n=25) and with isolated radicular injuries (n=35) subdivided according to surgical procedure or clinical treatment.

Group	Impaired roots	Surgery	Clinical treatment
Ia	12	12	–
Ib	13	9	4
IIa	26	20	6
IIb	9	7	2
Total	60	48	12

number of patients with unsuccessful clinical treatment for whom surgical treatment was necessary.

Figure 1A shows the clinical alteration territories for the 12 patients with associated L4, L5, and S1 injuries. Figure 1B shows the clinical alteration territory for the 13 patients with associated L5 and S1 injuries. From these 25 patients we can infer that the probable territory for the L4 dermatome coincides with the saphenous internus nerve territory, a distal branch of the femoral nerve (Figure 1C). Figure 2 shows the clinical alteration territory for the 26 patients with isolated L5 injury. Figure 3 shows coincident clinical alteration territories for the 9 patients with isolated S1 injury.

DISCUSSION

Associated injuries on L4-L5-S1 and L5-S1 territories are common in our university hospital; this is probably because it is located near an important highway linking the State Capital of São Paulo City to the interior of the State, with several patients suffering radyculopathies after lumbar trauma from automobile accidents. These days, demonstrating associated lumbar root injuries are simple using MRI imaging studies, but they were probably difficult in the past when this method was not available. Association of lumbar root injuries must have been difficult in the past and somewhat explains the dermatome differences between different classical semiology authors such as Dejérine[7] and DeJong[6], Barraquer[2], and Bickerstaff[1], in the same way that classical clinical dermatome studies on patients with *Varicella zoster*, which commonly affect more than one dermatome[13-15] .

Our initial objective was to analyze all, electromyographical, imaging, and surgical data. This was not possible because not all our patients needed surgery as clinical treatment was successful. This is a common problem in human clinical studies but it did not invalidate our findings, because we were able to obtain clinical, electromyographical, and imaging data from all patients, and surgical findings from the majority.

We concluded that the L4 dermatome is probably located in the medial aspect of the leg, coincident with the territory of the saphenous internous nerve, the distal branch of the femoral nerve. The L5 dermatome is probably located in the lateral aspect of the leg and foot dorsus, and S1 on the posterior aspect of the backside, leg and plantar foot skin. The maps presented here are similar to dermatomes presented by Dejerine[7], Bickerstaff[1], Barraquer[2], Baker[16], and Sunderland[17], but are different to those of Testut[4], Erhart[18], Gardner[19], Carpenter[5], Moore[9], and Bing[8]. Thus most similarities were found with authors who had employed clinical methods, and most differences were with anatomists.

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