como sendo frequente: num estudo conduzido por Hirai et al. verificou-se em 43% dos casos e num estudo de Celik et al. verificou-se em 24,1%.[3,5,6,8]

No Caso 2, o ECD emitia quatro tendões: um tendão que se unia ao tendão do longo extensor do polegar (LEP), um tendão para o 2º dedo, um tendão para o 3º dedo e um tendão para o 4º dedo que, por sua vez, emitia um tendão que se unia ao tendão do EDM. O facto do ECD emitir um tendão que se une ao tendão do LEP não ocorre com frequência, estando descrito que ocasionalmente o ECD pode emitir um tendão para o polegar.[2]

Observou-se também no Caso 2 que o tendão do ECD para o 4º dedo emitia um tendão para o 5º dedo. Esta variação também foi verificada em vários casos descritos por el-Badawi et al.[3] Num estudo conduzido por Tanaka et al, em 34% dos casos foi encontrado um tendão comum do ECD para o 4º e 5º dedos.[9]

Outra variação que se observou no Caso 2 foi a existência de dois tendões provenientes do EDM para o 5º dedo. A literatura relata que o músculo EDM tem origem no epicôndilo lateral do úmero (tendão comum dos extensores) e se continua inferiormente por um tendão que se dirige para o 5º dedo.[1]

Num estudo de Celik et al a prevalência de tendões duplos do EDM atinge 88,9% dos casos, designando-se o tendão medial do EDM por EDM-ulnar e o tendão lateral por EDM-radial.[6] Este padrão do tendão do EDM tem sido relatado com bastante frequência nos estudos em cadáver, chegando a atingir frequências de 60% e 90% dos casos, de acordo com el-Badawi e Hirai et al, respectivamente.[3,5,8] O tendão radial do EDM encontra-se frequentemente unido ao tendão do ECD para o 5º dedo.[2,3,10]

CONCLUSÕES

Existe um grande número de variações no padrão dos tendões dos músculos extensores da mão. O conhecimento destas variações pelo cirurgião é mito importante, nomeadamente quando é realizada a reparação de tendões.

CONFLITO DE INTERESSES

Os autores declaram que não houve conflito de interesse na realização deste trabalho.

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An Unusual Variety of the Extensor Digiti Muscles: Report with Notes on Repetition Strain Injuries

Variante Anatómica dos Músculos Extensores dos Dedos: Um Achado Invulgar Suscitando Comentário sobre Tendinopatias

Maria Alexandre BETTENCOURT PIRES[1,2], Diogo CASAL[1], Luis MASCARENHAS de LEMOS[1], Carlos Eduardo GODINHO[1,2], Diogo PAIS[1,2], João GOYRI-O'NEILL[1,2,3]

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ABSTRACT

In over 500 human cadaveric dissections of arms and forearms, performed to the present date, we find frequent anatomical variations, corresponding to classic descriptions. Last year, we found a singular anatomic variation of the extensor muscles of the forearm, which seems previously undescribed. It is our strong belief that gross anatomy studies, and gross dissection should be updated and reintroduced in modern anatomical studies, for teaching, research, or surgical training purposes. We detected a peculiar anatomical variant of the *Superficial Extensor Digiti* Muscles in the forearm of a human 73 year old male Caucasian cadaver. We clearly identified a thick bundle of muscular fibres, connecting the main muscular shafts of the *Extensor Digiti Minimi*, and the *Extensor Digitorum Communis*

1. Departamento de Anatomia. Faculdade de Ciências Médicas. Universidade Nova de Lisboa. Lisboa. Portugal.
2. Sociedade Anatómica Portuguesa. Lisboa. Portugal.
3. Centro de Estudos e Investigação CEFITEC. Departamento de Física. Faculdade de Ciências e Tecnologia. Universidade Nova de Lisboa. Lisboa. Portugal.

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Muscles, in a perfectly defined muscular expansion, bridging obliquely downwards and outwards, between the two main muscular shafts. In our series, this is the first occurrence of such anatomical disposition. Anatomical variations of the extensor tendons to the fingers are frequently detected in the wrist, hand and fingers compartments. The careful analysis of the variants of muscular shafts in the forearm compartment, as commonly reported in the earliest anatomical descriptions will bring renewed light to the functional assessment of the extensor mechanism of the human fingers. In this sense, we reviewed the oldest anatomical descriptions, from the 16th century to the present date.

Keywords: Cadaver; Dissection; Fingers; Forearm; Hand; Humans; Tendons.

RESUMO

Na série alargada de mais de 500 dissecções de antebraços e mãos cadavéricas humanas, efectuadas por rotina anual do Departamento de Anatomia da Faculdade de Ciências Médicas da Universidade Nova de Lisboa desde 1973, detectam-se frequentemente variações anatómicas, com especial incidência a nível dos tendões extensores dos dedos. Detectámos em 2011, uma disposição peculiar dos feixes musculares dos músculos extensores superficiais dos dedos de que, por extensa revisão bibliográfica, não encontramos descrição. Identificou-se um curto feixe de fibras musculares unindo os ventres principais dos músculos extensor comum dos dedos e extensor do dedo mínimo, na margem ulnar do terço médio do antebraço de um caucasiano do sexo masculino, com 73 anos de idade. Consultando textos de Anatomia publicados, desde o séc. XVI até á actualidade, verifica-se que as mais antigas descrições anatómicas se referem precisamente a uma maior coesão, com divisão baixa entre os ventres musculares destes dois músculos. Apresentámos os resultados preliminares deste estudo no XXII International Symposium of Morphological Sciences, em Fevereiro de 2012, reservando a redacção pormenorizada deste achado anatómico para um dos primeiros números da publicação Archives of Anatomy da Sociedade Anatómica Portuguesa. É nossa profunda convicção de que os estudos anatómicos, e em particular a dissecção cadavérica humana, necessitam ser revalorizados e modernizados, no início do novo milénio, pelo seu imprescindível contributo aos estudos médicos, tanto em termos curriculares básicos, como ainda na investigação clínica e cirúrgica, ou em termos de treino pósgraduado de técnicas cirúrgicas.

Palavras-chave: Antebraço; Cadáver; Dissecção; Dedos; Humanos; Mão; Tendões.

INTRODUCTION

The Department of Anatomy of the New University of Lisbon has been performing routine human cadaveric dissection, since its foundation in 1973(*[1]), first for undergraduate teaching and research purposes and, more recently, also for the purpose of «Hands-on» postgraduate courses. Simultaneously to these intense teaching activities, with access to cadaveric donations, the Department maintains important activities of scientific research in the domain of human morphological studies and of vascular anatomy, in particular. The Anatomy Department of the New University of Lisbon, presently directed by João Erse de Goyri O'Neill, is well equipped to receive and conserve every cadaveric donation, and the Anatomy dissection room is also well equipped to receive several working stations simultaneously. (Fig.1)

1 (*) Emeritus Professor J.A. Esperança Pina was the founder of the Faculty of Medical Sciences of Lisbon, where he rebuilt and modernized the *Lisbon Dissection room* in 1973, and later elected President of the *International Federation of Associations of Anatomists* – I.F.A.A. – (1994/1998). From him, we learned the value of dissection.

Figure 1 – «The Lisbon Dissection room»: The Anatomy Department of the New University of Lisbon is well equipped to receive and conserve every cadaveric donation, and the dissection room can receive several working stations simultaneously.

Scope of the study**:** In more than 500 human cadaveric dissections of arms and forearms, as performed to the present date in our Department, we find frequent anatomical variations, most of which correspond to classic descriptions and classification, when we review a careful bibliographical research. Last year, during routine cadaveric dissection for teaching purposes, we detected a singular anatomic variation of the extensor muscles of the forearm, which seems previously undescribed.

We presented the preliminary results of this study to the XXII International Symposium of Morphological Sciences, in Feb. 2012[1] and prepared the enlarged report of the case for publication in one of the first issues of the Archives of Anatomy, the official publication of the Portuguese Anatomical Society (AAP/SAP), because it is our strong belief that gross anatomy studies, and gross dissection should be updated and reintroduced in modern anatomical studies, both for teaching and research, as for surgical training purposes. (*[2])

Much has been written on the subject of anatomical variations of the muscles of the forearm to the fingers. The main anatomical variations belong to the topographic zones I to VII (fingers, hand and wrist), according to the functional classification of C Verdan[2,3](*[3]), commonly in use in Orthopaedics, as reviewed by JA Clavero et al.[8]

The anatomical variations in the forearm compartment (zones VIII-X), though not less frequent, are more rarely

2 (*) *Doctors without anatomy are like moles. They work in the dark and the work of their hands are mounds.* (Tiedemann: Heidelberg, 1781–1861).[4]

3 (*) C. Verdan's topographic classification of anatomical zones, as established in 1981, and modified by M.A.Wehbe (1995),[5] is nowadays commonly in use in orthopaedic and reconstructive surgery. The study of anatomical variants of the extensor tendons compartments is of interest, not only for the clinical assessment and functional approach, as discussed in the present article, but also and mainly, for the MRI assessment and surgical approach of hand and finger injuries, as reported by ZILBER (2004)[6] or MEHTA (2009).[7]

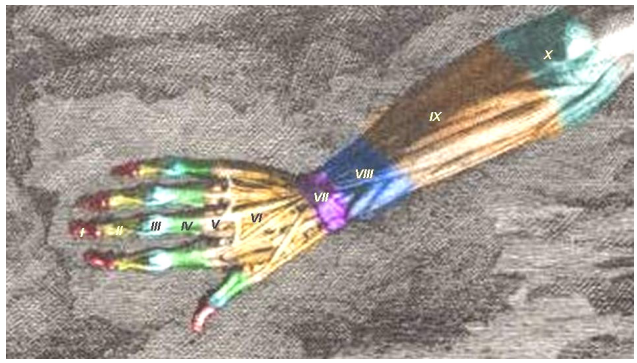

Figure 2 – Verdan's classification of the functional and topographic zones of the extensor muscles of the forearm and hand (Drawing adapted from Clavero's, on Albinus's plate [20], of a dorsal view of the forearm and hand. – (I)= *Distal Inter-Phalangeal Joint*, drawn in pink; (II)= *Middle Phalange* , drawn in yellow; (III)= *Proximal Inter-Phalangeal Joint*, drawn in blue; (IV)= *Proximal Phalange*, drawn in green; (V)= *MCP Joint*, drawn in ocre; (VI)= *Dorsum of Hand*, drawn in yellow; (VII)= *Wrist Extensor Compartment*, drawn in violet; (VIII)= *Extrinsic Extensor Tendons*, drawn in cyan; and the additional Wéhbe's zones: (IX)= *Intramuscular Tendon Compartment*, drawn in brown; (X)= *Muscle belly Compartment*, drawn in grey)

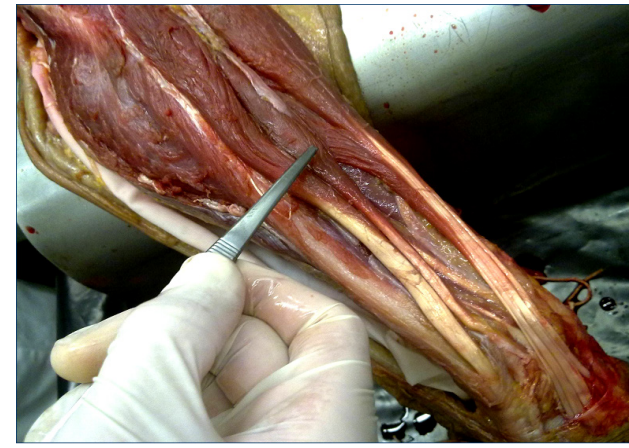

Figure 3 – Muscular bridging expansion. Muscular bridging expansion between the main muscular shafts of the *Extensor Digiti Minimi* and the *Extensor Digitorum Communis* Muscles, in the right forearm of a 73 year old male caucasian cadaver. (The tweezers point to a clearly defined bundle of muscular fibers connecting the two main muscular bellies)

presented in modern studies. They are more difficult to describe but to our belief, they have the fundamental importance to underlie the functional and clinical variants of the extensor mechanism of fingers in respect to their functional ability. (Fig.2)

MATERIAL AND METHODS

The anatomical specimen in this case-report belongs to a 73 year old male caucasian cadaver, previously embalmed through intermittent perfusion of a modified mixture of Theile, and kept in high-freezing chambers, commonly used in our Department, for conservation of donated cadaveric material.

Careful dissection of the dorsal aspects of the right forearm and hand was performed by a group of three students under our supervision, in one of the regular dissection training for teaching purposes. The superficial muscular and fascial layers of the forearm, hand and fingers were examined and the extensor muscles to the fingers were exposed from their origin in the lateral epicondyle to the isolated tendons in the fingers.

CASE REPORT

In February 2011, during one of the routine human cadaveric dissections, our attention was caught to the peculiar anatomical finding of a variation of the muscle fibres disposition of the Superficial *Extensor Digiti* Muscles in the forearm of a human 73 year old male Caucasian cadaver.

During the thorough dissection work of the right forearm, we clearly identified a thick bundle of muscular fibres, bridging between the main muscular shafts of the *Extensor Digiti Minimi*, and the *Extensor Digitorum Communis* Muscles. This perfectly defined muscular expansion, of cc. 2 cm thickness, was obliquely directed downwards and outwards, from the muscular belly of the of the Extensor Digiti Minimi, to the main muscular shaft of the *Extensor Digitorum Communis*. (Fig. 3)

The two main shafts of the superficial extensor digiti muscles had a well defined independent trajectory shortly after their common upper insertion in the lateral epicondyle of the umerus, and the muscular bridging occurred in the middle third of the forearm.

Around the upper third of the main muscles, a few other smaller muscle fibre expansions connected the two main muscle bellies. These were better defined, as all the fibrous sheaths and fasciae were dissected, and the main muscular bundles isolated and separated, with dissection tools (Fig. 4)

No such muscular disposition was observed in the left forearm of the same cadaver and, in our series of more than 500 human forearm dissections, this is the first occurrence of such anatomical variation.

We cannot consider this as a supernumerary muscle, since no vasculo-nervous bundle was observed in relation to the muscular expansion bridging.

DISCUSSION

In our series of more than 500 human forearm dissections, this is the first occurrence of such anatomical disposition.

Anatomical variations of the extensor tendons to the fingers are frequently detected in the wrist, hand and fingers compartments (zones I, II and II of the Verdan classification). We have often found variations in these compartments, in our extended series of dissections of forearms and hands in our yearly routine for teaching and research purposes of the Anatomy Department of the New University

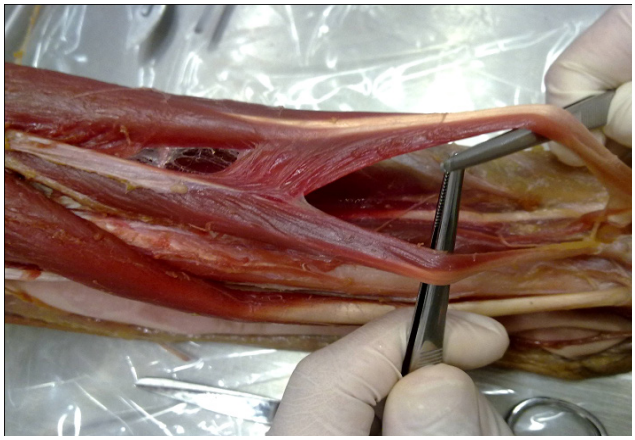

Figure 4 – Muscular bridging expansion between the main belly of the *Extensor Digiti Minimi* and the *Extensor Digitorum Communis* Muscles, in the right forearm of a 73 year old male caucasian cadaver.(The dissection tools are used to deviate the two muscles, to emphasize the presence of the thick bundle of muscular fibres, bridging obliquely between the two main bellies of the muscles. Shouldn't this disposition be considered a new type of *Junctura,* the *Junctura Musculorum,* in zones VIII and IX of the extensor mechanism of the fingers?)

of Lisbon.[9]

SR Nayak[10] remarks, on this purpose, that 'the extensor compartment of the forearm is one of the regions of the human body with frequent variations of its content'. (*[4]) Most of these variations respect the distribution pattern of the extensor tendons to the fingers, as commonly reported in the modern anatomical literature.[12-17]

An interesting variant, frequently found in what regards the extensor apparatus of the fingers, is the presence of intertendinous connections (*juncturae tendinum*) between the various extensor tendons, on the dorsum of the hand. Their frequency is so high, that they were commonly depicted in the earliest Anatomy books and drawings, such as Vesalius (1543 - IXth and XIth Plates of the muscles),[18] Valverde (1566 - Libri II, Tabula IX & XV-Fig.XIX),[19] Albinus (1747),[20] M Verdier (1751),[21] or Chaussier (1823).[22] (*[5])

Modern clinical Anatomy reports often refer the presence of tendinous slips between the extensor tendons on the dorsum of the hand.

HP von Schroeder et al[24] classify these *Juncturae Tendinum* of the extensor tendons into three types: Type I junctura consist of filamentous regions within the intertendinous fascia; Type II consists of much thicker and well-defined connecting bands; and Type III consist of tendon slips from the extensor tendons and were subclassified into «y» or «r» subtypes, depending on shape. In their series of 548 cadaveric hand dissections, Y Hirai et al[25] found that the most common pattern of intertendinous connections were classified into Type I in the second intermetacarpal space, into Type III-r in the third metacarpal space, and into type III-y in the fourth intermetacarpal space.

The functional importance of these *juncturae* would be to strengthen the frail tendons of the extensor mechanism of the fingers, at the cost of some loss of independence of the IVth finger.[26-30]

What if the tendinous or muscular slips were more proximal, instead of distal, as is the case in discussion? Wouldn't this disposition confer more strength to Vth finger, without loss of gliding independence of the IVth tendon?

As we expand our review of the anatomical literature, to older anatomical notes, we discover a nearly forgotten world of accurate and 'picturesque' descriptions of Miology, which prove to be quite useful to a modern understanding of the frequent anatomical variations found in cadaveric dissections. We researched the works of some of the most representative authors in Anatomy, from Leonardo da Vinci (1508)[31] to the present date, with JA Esperança Pina.[32]

With this expanded bibliographic research, one can easily verify that the earliest texts provide the more extensive anatomical descriptions, leading us to a collection of original notes on the extensor muscles of the fingers.[33]

M Lieutaud (1776)[34] remarks that the Extensor muscle of the Vth. Finger should be considered a dependence of the common Extensor of the fingers. The two tendons have a common origin and a common muscular belly that divides shortly above the extensor retinaculum, to rejoin again, at the metacarpal region, through a tendinous or fibrous slip. Poissonnier (1783)[35] and M Sabatier (1791)[36] offer the same description: Both tendons have a common muscular belly until the lower third of the forearm. (…) At the dorsum of the hand, the extensor tendons of the fingers communicate through thick oblique tendinous slips. Baron Boyer (1815)[37] offers the description that most resembles our anatomical variant, as he remarks that the medial margin of the muscular belly of the extensor digiti communis is strongly united to extensor digiti minimi muscle, in the upper half of the forearm, and the two muscles remain united in the lower half, through some bundles of cellular tissue. X. Bichat (1823),[38] on the other hand, remarks that the muscular fibres of the Extensor Digiti Minimi are only separated from the muscular fibres of the Extensor Digitorum Communis through fibrous tissue.

None of the quoted works refer the presence of muscular slips between the two muscular bellies in the forearm.

Astonishingly, J Cruveilhier (1872)[39] (*[6]) includes, on this

4 (*) According to P. Daas (2012),[11] the *extensor digiti minimi* tendon showed normal anatomy in only 20% of the 100 cases studied.

5 (*) Honoré de Fragonard's meticulous dissections of whole bodies[23] were kept since 1766 to the present days, in France, and his dissections of forearms and hands clearly demonstrate the existence of *junctura tendinum* between the extensor tendons of the IVth and Vth and of the IIIrd and IVth fingers, at the dorsum of the hand.

6 (*) Quoting from the original edition of Cruveilhier*(Pg.686)* :

«Les tendons de l'annulaire et du petit doigt sont si intimement unis entre eux par la bande fibreuse transversale située au-dessus de l'articulation métacarpo-phalangienne, qu'il est bien difficile d'étendre isolément l'un ou l'autre de ces doigts ; C'est là une des grandes difficultés du jeu des instruments de musique, et surtout du piano. Les grands artistes seuls parviennent, par un exercice continuel, qui doit commencer dés l'âge le plus tendre, à obtenir l'indépendance de ces doigts ; encore n'est elle jamais complète.

L'auteur d'un instrument ingénieux destiné à obtenir cette indépendance m'ayant consulté à ce sujet, je lui ai fait connaître les dispositions anatomiques qu'il fallait vaincre pour arriver à ce résultat ; son appareil me parait atteindre le but autant que possible.»

purpose, some remarks on musician's hands injuries that led us to conclude on the modernity and usefulness of our present review, in consideration to repetition strain injuries. His report on the Extensor muscles of the fingers and the frequent finding of *junctura tendinum* is stunningly modern in the sense that he includes several interesting remarks on the functional anatomy of the human fingers and a surprising historical note, with the mention of a musician who consulted his advice on building a mechanical device to exercise on the independence of the 4th finger, to improve pianist performance. Even though these devices were common in the 19th century, the anecdote immediately reminded us of Schumann's hand injury, as particularly reported by RA Henson & H Urich.[40] This article led to an interesting collection of postscripts,[41-44] that we remember reading with special interest on the British Medical Journal edition of 1978. Jonas Sén[45] reported several other cases, of musician's repetition strain injuries.

Schumann's hand injury is the paradigm of repetition strain injuries frequently found in musicians, but also in modern days, in computer and electronic devices users.

CONCLUSIONS

The interest of anatomical studies of the forearm muscles has grown in modernity, since the advent of the computing era, in the 20th century: Nowadays, every human occupation involves the perfect accuracy of finger motion, from the virtuous pianist, to the manual factory worker in the assembly line, or even the modern intellectual who thrives through long working hours on his laptop keyboard. Even in their leisure times, many people now recur to computer keyboards, either for playing games, or for internet navigation and social communication. (*[7])

Apart from the obvious and fundamental importance for reconstructive surgery of injured fingers, the profound and meticulous knowledge of the regional anatomy of the forearm and hands is fundamental for the better understanding of the functional and clinical management of modern human beings, as repetitive strain injuries of the hand are slowly becoming one of the modern times plagues.

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CONFLICT OF INTERESTS

The authors declare that no conflict of interests was identified. (The main theme of this article was delivered at the XXII International Symposium of Morphological Sciences, in São Paulo, Brazil (Feb. 2012), however the abstract and the full text of the paper was totally re-written for submission to Acta Médica Portuguesa.)

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7 (*)in Bettencourt Pires MA, 2013. Hands in Medicine and in Art. In Ed. C.E.E.C.,Pires L, editora. *Science and Humanities – Ways of Seeing the World – Proceedings of the Symposium "Recontextualizing Sciences from the Humanistic Perspective"*, Lisboa, Universidade Católica, 2013. (*in print)*

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Variação Anatómica Rara de Ausência do Nervo Ciático: Completamente Substituído Pelos Nervos Tibial e Fibular Comum

Rare Anatomical Variation of Absence of the Sciatic Nerve: Completely Substituted by the Tibial and Common Fibular Nerve

Paulo COELHO[1], Catarina MELO[1], António BERNARDES[1]

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RESUMO

Introdução: Existem várias publicações referindo variantes anatómicas do nervo ciático, algumas associadas a síndromes clínicos (como sendo a síndrome do músculo piriforme). Neste contexto, pretendemos apresentar uma variante anatómica rara do nervo ciático.

Casos clínicos: Dois cadáveres leucodérmicos, masculinos, com 74 e 78 anos, falecidos de morte natural, sem patologia do membro inferior. Em ambos os casos, observou-se ausência do nervo ciático direito, tendo os nervos tibial e fibular comum origem e trajecto independentes, desde a sua origem nas raízes lombo-sagradas até à região poplítea. O nervo ciático contralateral apresentava a anatomia habitual.

Discussão: Analisando a literatura, na Medline, realçamos que apresentamos dois casos raros de ausência do nervo ciático, com origem e trajecto independentes dos nervos tibial e fibular comum. Esta variante poderá ter implicações clínicas, nomeadamente ser um factor de risco para o insucesso de bloqueios anestésicos poplíteos e para a síndrome do músculo piriforme.

Palavras-chave: Cadáver; Nervo Ciático; Nervo Tibial; Síndrome do Músculo Piriforme; Variação Anatómica.

ABSTRACT

Introduction: There are several reports of sciatic nerve anatomical variations. Some are associated with clinical entities, such as piriformis syndrome. We aim to report a rare anatomical variation of this nerve.

Cases report: Two leucodermic, 74 and 78-year-old male subjects, deceased of natural causes, without lower limb relevant medical history. In both subjects, the right sciatic nerve was absent, with an independent origin and course of the tibial and common fibular nerves. The contralateral sciatic nerve had the common anatomical presentation.

Discussion: After the analysis of the available data indexed in Medline, we conclude that we are reporting two cases of a rare anatomical variation (the absence of sciatic nerve, with an independent origin and course of the tibial and common fibular nerve). This anatomical variation may have clinical importance, as it may be, for example, a risk factor to unsuccessful sciatic nerve popliteal blocks and to the pyriformis syndrome.

Keywords: Cadaver; Genetic Variation; Muscle, Skeletal/abnormalities; Piriformis Muscle Syndrome; Sciatic Nerve/abnormalities; Tibial Nerve.

1. Instituto de Anatomia Normal. Faculdade de Medicina da Universidade de Coimbra. Coimbra. Portugal.

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