Clinical Evaluation of Fibularis Tertius Muscle Prevalence

Evaluación Clínica de la Prevalencia del Músculo Fibular Tercero

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SUMMARY: The fibularis tertius muscle (FTM) in man has been developed over time to acquire subsequent bipedal gait. The FTM functions as a crucial contributor in dorsiflexion and eversion, postulated over the years as a stabilizer of the talocrural joint, avoiding forced investment and protecting the anterior talofibular ligament. The literature describes that FTM is absent in 10% of cases, with no data on Chilean population. A study of surface anatomy in 168 young subjects, 60% female and 40% male students at the Universidad de Talca, Chile, with a mean age of 20.6 ± 1.68 years, was conducted. The presence of FTM was identified following the implementation of a clinical assessment protocol that determines the presence of muscle on the basis of a progression called F1, F2, and F3. The FTM was present in 49.11% of cases. On the right side, 20% (n = 37) of the subjects presented the FTM in F2 and 30% (n = 50) in F3. On the left side, 1% (n = 2) showed the muscle in F1, 21% (n = 35) in F2, and 26% (n = 44) in F3. Our results contrast with the high prevalence of FTM in the literature and suggest studies of association with lesions of the talocrural region.

KEY WORDS: Fibularis tertius muscle; Talocrural Joint; Leg; Anterior talofibular ligament.

INTRODUCTION

The fibularis tertius muscle (FTM) is part of the anterior leg region and is considered by Moore & Dalley (2002) as a derivation of the extensor digitorum longus muscle (EDLM), even called by Williams & Warwick (1985) as the fifth tendon of this muscle. Rouvière & Delmas (2002), Williams & Warwick, Latarjet & Ruiz-Liard (1999), and Joshi *et al.* (2006) describe that it extends from the inferolateral surface of the fibula and the anterior face of the interosseous membrane, finally inserting into the base of the fifth metatarsal, and also may be inserted in the shaft of the fifth metatarsal and fourth interosseous space, the shaft of the fourth metatarsal (Rourke *et al.*, 2007), or at the base of the fourth metatarsal (De los Reyes *et al.*, 2005).

Macalister (1875) analyzed the prevalence of FTM, determining which an inconstant muscle is—the development of which is characteristic of anthropoids, especially in man being bipedal. For this author, the presence of the FTM is a progressive feature, and its absence is a feature regression.

For Rouvière & Delmas, Latarjet & Ruiz-Liard, and Moore, the FTM is involved in dorsiflexion and eversion of

the foot, whereas for Soames *et al.* (2007), it is difficult to assess the functional significance of this small muscle, as their actions are hidden by other muscles that are more efficient mechanical levers. For this author, the FTM plays an important role in neuromuscular control and protection against talofibular ligament injuries; this is due to the way the muscle proprioceptors are activated to elongate the FTM during inversion of the foot. This hypothesis was developed by Witvrouw *et al.* (2006), who analyzed the relationship between the absence of the FTM and the talocrural joint injuries incidence and the contribution of this muscle in the strength of the movements of dorsiflexion and eversion. The absence of the FTM is generally considered asymptomatic; this condition is occasionally reported as a finding after the dissection of the region (Das *et al.*, 2009). However, considering its role in ankle stability, as a protective factor in an anterior talofibular ligament injury, and in preventing excessive foot investment, assessing the presence of the FTM is clinically relevant in individuals who participate in sports activities that require stability in the talocrural region.

Against this background, the purpose of this study was to describe the prevalence of fibular muscle third party

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through a clinical evaluation of the three steps in a group of young adult individuals.

MATERIAL Y METHOD

Sample. Surface anatomy study, developed in the right and left legs of 168 students (100 females and 68 males) of Kinesiology at the Universidad de Talca, Chile. The average age of the sample was 20.6 ± 1.68 years, with upper and lower limits of 18 and 26 years, respectively. The study was conducted between the months of June and November of 2009.

Evaluation technique. To determine the presence of the FTM, we developed an assessment protocol based on those described by Tixa (2006) and Kendall *et al.* (2000).

Estimated time. 20 seconds in the evaluation of left and right legs.

Preparation. Discover the area to assess from the knee.

Location of the patient. Seated, knee flexed approximately 110° . Foot to assess plantar support.

Location of the evaluator. Kneeling on the floor before the patient's leg fixed on the ankle joint. The other hand touches the insertion of the FTM.

Test. It is divided into three steps:

Step 1: Palpate the tendon of the FTM on their way to the fifth metatarsal, quarter metatarsal, or fourth interosseous space, without muscular tension. Staff called F1. (Fig. 1). If this is not seen, perform step 2.

Step 2: The patient in dorsiflexion and eversion of the foot. Identify the tendon of the FTM on the same course of step 1. The result of being identified is called F2. (Fig. 2). If not seen or felt, perform step 3.

Step 3: Repeat step 2 but in opposition by manual resistance to the lateral border of the foot at the fourth and fifth metatarsals; if the tendon is visualized or palpated, the result is called F3 (Fig. 3).

RESULTS

Of the 168 subjects evaluated, 49.11% presented the FTM, 50% ($n = 84$) to the right and 48% ($n = 81$) to the left. In presenting the results according to our way of evaluation, we found that in the right leg, 20% ($n = 37$) of the subjects presented the FTM in F2 and 30% ($n = 50$) in F3. In the left leg, 1% ($n = 2$) showed the FTM in F1, 21% ($n = 35$) in F2, and 26% ($n = 44$) in F3.

The presence of FTM was lower in women than in men; the prevalence among females was 46% ($n = 46$) on the right side and 41% ($n = 41$) on the left side. In males, the FTM was observed in 55.88% ($n = 38$) on the right side and 57.35% ($n = 39$) on the left side. In females, the highest rates of the presence of FTM were obtained in F3 on both sides. In males, however, the highest rates were identified predominantly in muscle F2 on the right side and equally in F2 and F3 on the left side. These results can be seen in Fig. 4.

DISCUSSION

FTM prevalence was 49.11%, slightly higher in men than in women, and these results are in contrast with the literature. Table I shows the results of various studies on the prevalence of FTM. The difference may relate primarily to how the FTM was analyzed. In our study, we evaluated clinically progressive FTM test sequence F1-F2-F3, ranging from inspection to evaluation of passive muscle force against resistance, a procedure different from that used in most studies. Witvrouw *et al.* evaluated the FTM by asking patients to complete the dorsal flexion and eversion of the

Fig. 1. FTM is observed in F1.

Fig. 2. FTM is observed in F2.

Fig. 3. FTM is observed in F3.

Fig. 4. FTM prevalence distribution in 168 individuals in the left and right.

foot, making its palpation similar to our procedure. This evaluation technique is discussed by De los Reyes *et al.*, because the property of aponeurosis which sometimes takes the tendon of the FTM difficult the clinical evaluation and may underestimate their prevalence.

However, FTM assessment by palpation of the tendon has been validated by comparing the presence of the FTM with magnetic resonance imaging that has a ratio of 100% accuracy (Witvrouw *et al.*). This palpation is possible because of the FTM, despite being a rudimentary muscle, reaching a critical mass with the tendon. Studies on cadaveric specimens show that the tendon of the FTM can be as thick as, or even thicker than, the EDLM tendon (Joshi *et al.*). Mabit *et al.* (1996) found that in 60% of cases, the width of the tendon in the FTM exceeds 4 mm.

The appearance of the FTM is closely related to the development and evolution of the EDLM because its

embryonic formation is based on the progressive separation from the EDLM until the final insertion into the lateral border of the foot, known as the only specially trained human muscle (Jungers *et al.*, 1993). According to Morimoto *et al.* (1959), the training of FTM is genetically controlled by a single pair of autosomal genes with variable expression and/or reduced dominance. The relatively high presence of primitive forms of FTM and its lower incidence are mainly described in fetuses in comparison to adolescents and adults. This may suggest that, during the postnatal period, the muscle is still developing as a result of age and physical activity primarily (Domagala *et al.*, 2006). According to this, the significant differences found by Witvrouw *et al.* (prevalence, 81.5%), as compared with our results (prevalence, 49.11%), could be due to the subjects. Their sample consists of young athletes with increased muscle development because of continuous physical activity, whereas our sample includes individuals without significant physical activity and therefore with reduced muscle development.

Table I. Prevalence studies fibular muscle third, comparable to Ramirez et al.

Author	Year	Population studied	Sample	Type of study	FTM prevalence %
Ramírez <i>et al.</i>	2010	Talca, Chile	168	Surface anatomy	49.11
Joshi <i>et al.</i>	2006	Maharashtra, India	110	Cadaver dissection	89.55
Witvrouw <i>et al.</i>	2006	Belgium	200	Surface anatomy	81.5
Domagala <i>et al.</i>	2006	Poland	193	Cadaver dissection	83.16
Marin <i>et al.</i>	2006	Brazil	32	Cadaver dissection	94.0
Rourke <i>et al.</i>	2005	Swansea, UK	41	Cadaver dissection	93.9
Larico & Jordán	2005	La Paz, Bolivia	46	Cadaver dissection	100.0
Bertelli &	1991	France	44	Cadaver dissection	90.1
Krammer <i>et al.</i>	1979	Austria	169	Cadaver dissection	92.9
Testut & Latarjet	1979	Black people	Not	Cadaver dissection	86.0
Testut & Latarjet	1979	Jews	Not	Cadaver dissection	10.0

The above results reveal that the FTM is similar on both sides, with a rate of 50% in the right leg and 48% in the left leg. This contrasts with those presented by Joshi et al. who indicate a greater presence of the FTM on the right side. The proportionate presentation of this muscle on both sides can describe a source at any level in front of the fibula, predominantly in the middle third (70% of cases) (Marin *et al.*, 2006), extending sickle inserts commonly in the neck of the fifth metatarsal (Raheja *et al.*, 2005), dorsal tubercle (Eliot & Jungers, 2000), and interosseous space and extending also to the base of the fourth metatarsal (Reimann, 1981). Insertion is also granted in the other side of the foot (Eliot & Jungers). These FTM insertions could define its role in providing adequate support to the outer surface of the foot. Hence, it is important to be aware of the prevalence and diversity of insertions of this muscle, which can be easily injured when performing a local injection of hydrocortisone or during surgical procedures (Lee, 1957).

In relation to the sex of the sample, our results show a greater presence of the FTM in males, with 55.88% in the right leg and 57.35% in the left leg. As for the right leg maximum detection in F2 and in the left leg similarly for F2 and F3. Witvdrow *et al.* reported a prevalence of 81.6% in males and 81.4% in females, without a left-right differentiation.

The FTM can be considered as an accessory muscle for eversion and dorsiflexion of the foot, so its absence should not significantly decrease this function (Witvrouw *et al.*). Thus, its absence does not cause many problems in the stability of the talocrural region for athletes and in performing transplant or resection for surgeons. However, we have studied that the absence of the FTM may play an important etiologic role in Jones fractures and stress fractures of the fifth metatarsal, where its attachment assumes importance in the imposition of the torque (Vertullo *et al.*, 2004) mainly by the component of stress on the fifth finger, which would undoubtedly alter in cases of absence. In such circumstances, the absence of the FTM may be considered an advantage

because these subjects would be less vulnerable to the stress of these fractures, as reported in our results.

Moreover, in the presence of the FTM, the hypertrophy is reported as a cause of chronic anterolateral ankle region and crack on the lateral aspect of the talus, which may occur in the presence or absence of trauma (Sammarco & Henning, 2007). In addition, longitudinal tear of the FTM is frequently observed and is considered one of the causes of chronic ankle pain and disability by modifying the mechanism of ankle motion (Taser *et al.*, 2009).

The detection and prevalence of this muscle becomes very important for surgeons of the foot because they can use a transposition FTM flap or for the treatment of chronic instability in the wake of functional lateral ankle sprains. In addition, the tendon of FTM can be used for transplant surgery in pathologies of foot drop (Das *et al.*), manipulation of the posterior tibial tendon where it can be transferred to the anterior compartment of the tendon anastomosis with FTM (Ozkan *et al.*, 2009), or anterior talofibular ligament replacement because it meets the specifications required for the stabilization of anatomical ankle (Desnoyers *et al.*, 2002). This also has been reported useful in cases of length-dependent peripheral neuropathy (PN), where only the distal muscles of the lower limbs may show abnormalities in the electromyographic examination, most frequently being considered is the Hallux abductor. However, the usefulness of this muscle is decreased because of spontaneous activity, even in normal subjects, and is now more useful in the diagnosis of PN (Boon & Harper, 2009).

The study of the FTM is relevant from an academic, anatomical, physiotherapeutic, and orthopedic surgery view (Das *et al.*), due to its high variability and significant influence on the shape and biomechanics of the foot. We suggest analyzing the prevalence of FTM using a gold standard imaging, evaluating its role as a protective factor of injuries to the talocrural joint in subjects with high functional demands.

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RESUMEN: El músculo fibular tercero (MFT) es un músculo que en el hombre se ha desarrollado paulatinamente, al adquirir la posición bípeda y posteriormente la marcha. Dentro de las funciones del MFT destaca su contribución en la flexión dorsal y eversion, postulándose que actuaría como estabilizador de la articulación talocrural, al evitar la inversión forzada y proteger al ligamento talofibular anterior. La literatura describe que el MFT se encuentra ausente en un 10% de los casos, no existiendo datos de la población chilena. Se realizó un estudio de anatomía de superficie en 168 sujetos jóvenes, el 60 % de sexo femenino y 40% de sexo masculino, estudiantes de la Universidad de Talca, Chile, con edad promedio de 20,6±1,68 años. La presencia del MFT se identificó tras la aplicación de un protocolo de evaluación clínica que determina la presencia del músculo en base a una progresión denominada F1, F2, F3. El MFT estuvo presente en el 49,11% de los casos. En el lado derecho el 20% (n=37) de los sujetos presenta el MFT en F2 y un 30% (n=50) en F3. En el lado izquierdo un 1% (n=2) exhibe el músculo en F1, 21% (n=35) en F2 y un 26% (n=44) en F3. Nuestros resultados contrastan con la alta prevalencia del MFT descrita en la literatura y se sugiere la realización de estudios de asociación con las lesiones de la región talocrural.

PALABRAS CLAVE: Músculo fibular tercero; Articulación talocrural; Pierna; Ligamento talofibular anterior.

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