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DOI: 10.5603/FM.a2020.0129
Article type: ORIGINAL ARTICLES
Submitted: 2020-09-12
Accepted: 2020-10-12
Published online: 2020-10-26

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Musculus peroneus longus in fetal period

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Abstract

The lateral compartment of the leg, due to its distal and concurrent superficial
positioning, is a multiple trauma site. Detailed knowledge of compartimentum lateralis
cruris (CLC) structure is crucial for physicians. Musculus peroneus longus (MPL) is
located within the structures of the CLC the most superficially. There is a lot of data on
the morphology of the MPL but there is no publication analysing in detail its anatomy in
the foetal period. The aim of the study was to determine the variability of metric and
morphological parameters of MPL in a studied period of prenatal ontogenesis. The
analysis included 207 human fetuses (101 males and 106 females)) at calendar age from
113 to 222 days The analysed material comes from the local anatomy collection.
Fetuses were stored in a typical preservation solutions. Access to the muscle was
obtained on the basis of standard preparation techniques. The authors evaluated the
metric parameters of the muscle showing the presence of variable dynamics of metric increments of the examined muscle in particular age classes. In the studied period of prenatal ontogenesis, the features of MPL increase by about 60% in the length and width dimension and by about 100% in the thickness dimension. The topography of the initial and final muscle attachment was also evaluated. Statistically significant dimorphic differences were found in some aspects of muscle attachment topography. The analysis of the place of the origin and insertion of MPL showed a relatively large variety of these features.

**Key words:** fetus, lateral compartment of the leg, dissection, Fibularis longus muscle

**INTRODUCTION**

The lateral compartment of the leg (*compartimentum lateralis cruris*) is bounded by two fibrous intermuscular septa, which are attached to the crural fascia (1,2). It contains several important anatomical structures, which are of great importance for the mechanics of the foot (3). The following muscles: *Musculus peroneus longus* and *Musculus peroneus brevis*, filling the compartment, are not only responsible for the pronation and plantar flexion of the foot, but they also stabilize the first ray of the foot in the toe-off phase of gait (4). The lateral compartment of the leg, due to its distal and concurrent superficial positioning, is a multiple trauma site, which may contribute to the occurrence of various clinical pathologies (5). It is subject to a high risk of fractures of bones, which constitute its scaffolding, bruises, lacerations or stab wounds. One of the most serious consequences leg injuries is the compartment syndrome, which can be the result of injuries as well as of intensive physical activity. If untreated, it can lead to irreversible disturbances in the innervation and blood supply of the foot and leg. This may cause tissue necrosis (6–9). Detailed knowledge of *compartimentum lateralis cruris* structure is therefore significant not only for an anatomist but also for surgeons and traumatologists. Peroneus longus muscle (MPL) is located within the structures of the lateral compartment of the lower leg the most superficially (10). The proximal
muscle attachment is wide, as fibres branch off in two groups: the proximal one, from the lateral condyle of the shin, capsule of tibiofibular joint and head of the fibula, and the distal one begins on the shaft of the fibula and the crural fascia. Proximal part of the muscle is divided into two compartments by the common fibular nerve (*nervus fibularis communis*), running in this area. In many anatomical publications, the more superficially positioned compartment is referred to as a superficial head, while the deeper part is defined as a deep head (1,4). The terminal tendon of the nerve lies in a gutter formed by the peroneus brevis muscle (*musculus fibularis brevis*), and just above the lateral malleolus of the tendon of both muscles they pass under the fibular retinaculum and penetrate the fibro-osseous canal, which allows the tendon to pass from the leg to the foot (10). This is where the tendons cross. In the plantar region of foot the MPL is attached to the base of the first metatarsus and medial cuneiform bone. The terminal section of the muscle plays an extremely important role in supporting the plantar arch of foot (11). There is a lot of data on the morphology of the described muscle in the available literature, (1,2,4) but there is no publication analyzing in detail the anatomy of the MPL in the fetal period. The aim of the study was to determine the variability of metric and morphological parameters of *musculus peroneus longus* in a studied period of prenatal ontogenesis. In addition, the authors of the paper will determine the presence of possible dimorphic and bilateral differences.

**MATERIALS AND METHODS**

The analysis included 207 human foeti (101 males and 106 females) at calendar age from 113 to 222 days of fetal life. Only four fetuses of both sexes were analysed in the fourth month, and three fetuses in the ninth month. Due to the insufficient number in these classes, the mentioned fetuses were excluded from the metric analysis. The analysed fetal material is derived from the collection of the Department of Anatomy, Medicine Faculty, Wroclaw Medical University. The material was obtained from the maternity wards of local clinics as a result of preterm births and miscarriages in the years 1960-1996. Before conservation, the calendar and morphological age of each fetus were determined individually for each of them. To assess the morphological age of foeti, a multi-characteristic assessment method for the foetus age, was used (12–14). If
the difference between morphological and calendar age was more than 2 weeks, the foeti were determined as dysmorphic and excluded from the analysis. The fetuses are stored in an appropriate solid preservative solution containing ethanol, glycerol and formaldehyde in constant proportions in a room at a stable temperature. The way of storing fetuses did not change during the whole period of storage. The study excluded fetuses with visible developmental malformations and those that did not have complete clinical documentation. The reliability and scientific value of the collection used for research have been confirmed in many previously published studies (14–21). Basic data of the studied fetus population have been presented in Table (Table I).

Access to the muscle was obtained on the basis of standard preparation techniques. In the first stage, the skin and subcutaneous tissue were removed. Then the fascia was cut and the structures of compartimentum lateralis cruris were shown. MPL was cleaned from its top, at the head of the fibula up to the lateral malleolus canal. In the second stage, the terminal tendon of the studied muscle was prepared by removing the surface structures within the plantar region of foot. The morphological features of the examined muscle were evaluated after final visualization of its whole structure. The data collected during the morphological evaluation were recorded in the form of schematic drawings. Photographs, which documented the research, were taken. The length and thickness of the muscle belly and the length of the muscle tendon were measured using digital caliper Mitutoyo - Absolute Digimatic 573-125-10, Mitutoyo Corp, Kawasaki, Japan. Each measurement was performed three times and the average value was taken into account for statistical analysis. All measurements were carried out with a fetus being positioned in a fixed, uniform manner on the measuring table. The obtained data was routed to MS Excel 2010, Microsoft Corp.,Redmond,WA, USA. The obtained digital data were then statistically analysed using the Statistica PL, Tibco Software Inc, USA statistical package. The average values were adjusted to the middle of the age class according to the Legrange interpolation formula (22). Aim of this statistical procedure was to achieve equal time intervals between successive age classes. This made it possible to precisely determine the growth rate of each of the analysed features. Two-factor ANOVA variance analysis was used to assess bilateral and dimorphic differences. In order to examine the differences between the quality features,
the chi-square test of independence was used. For the analysed metric features, the rate of their growth was calculated using the formula:

\[ \frac{b-a}{a} \times 100 \]

Where \( a \) = average value of the characteristic in the month of development, \( b \) = average value of this characteristic in the following month of development. Work has a local bioethical commission acceptance KB-708/2017. Authors declare any conflict of interest.

**RESULTS**

**Metric evaluation**

Length of the muscular belly as well as the length of terminal tendon of MPL (Table II) were determined on the basis of preparation studies. In the case of the assessment of the length of the MPL belly, statistical analysis (T-student test) did not reveal any statistically significant bilateral differences in both the male (p=0.416) and female (p=0.337) genders. Additionally, Anova's two-factor analysis showed that among the analysed parameters only age, regardless of gender, significantly differentiated the MPL length (\( p < 0.001 \)). At the same time, Tukey's post hoc test revealed the presence of a statistically significant difference between the MPL length in 5-month-old fetuses and fetuses in the remaining age classes for both male and female sex. The test did not reveal differences between fetuses of different sexes in the same age class. However, a statistically significant difference was found between 6- and 8-month fetuses in both sexes (Table II).

The student's t-test for the two dependent variables showed no statistically significant bilateral differences between male (p=0.41) and female (p=0.09) fetuses while evaluating the length of the final MPL tendon. The analysis of the relationship between sex and age of fetuses (ANOVA) and the dynamics of growth of the tendon length showed that only age significantly differentiated the length of the tendon (\( p < 0.001 \)) regardless of the examined side. Additionally, the post hoc test revealed that there is a statistically significant difference between the length of the MPL tendon in 5-
month-old fetuses and fetuses in other age classes. A difference was also observed between six- and eight-month-old fetuses but only the male gender (Table IV).

The most intensive increase in the length of this muscle (belly and tendon) is characteristic for the period between 5 and 6 months of age. Period between 6 and 7 month of the intrauterine development demonstrates a decrease in the rate of growth by 70 - 80 %. Re-acceleration of the growth rate takes place in the 8 month and it is about 1/3 of the value when compared to the first observed period.

The data on the thickness of the MPL belly are presented in Table V. Statistical analysis carried out with the Student's T-test for the two dependent variables confirmed the absence of bilateral differences in the male sex (p=0.70) and the presence of borderline statistical differences in the female sex (p=0.049). Similarly to muscle length and tendon length of the MPL, its thickness varies only by age of the individuals regardless of body side (ANOVA; p=0.000). Analysis of the maximum thickness of the MPL indicates that the most intensive growth rate is observed between 5 and 6 month of the fetal life and this is visible for both sexes. Period between 6 and 7 month of a fetal development reveals the reduction of the growth rate by 50 to 75 %. Between 7 and 8 month of the prenatal period development, the rate of growth of the characteristics decreases very rapidly. The decrease ranges from as much as up to 98 %. It was only in the case of the right MPL in male fetus that growth rate remained at the same level as in the previous period. Detailed statistics (Tukey's post hoc test) are shown in Table VI.

Morphological evaluation

**Proximal attachment**

According to data from the previously published studies, based on an evaluation of the dissection materials, the proximal attachment of the MPL is located on the lateral surface of the knee region. The original attachment of the muscle was being observed between the proximal part of the fibula and the proximal part of the tibia due to the course of the common fibular nerve in majority of the examined specimens. The site of the original attachment was found to be either very large, including the head of fibula, part of the shaft of fibula as well as the lateral condyle of tibia or very narrow, including
only the fibula head. Based on anatomical observations, six basic types of primary muscle attachments were determined (Figure 1):

— Type I — head of the fibula, ½ superior of the shaft of the fibula, lateral condyle of the tibia
— Type II — head of the fibula, ½ superior of the shaft of the fibula;
— Type III — head of the fibula, lateral tibia, superior 1/3 of the body of fibula
— Type IV — head of the fibula, lateral tibia, superior 2/3 of the body of fibula;
— Type V — head of the fibula, lateral condyle of the tibia;
— Type VI — other locations not included within the aforementioned and remaining types of the original attachment.

Statistical analysis (test for two structure parameters) did not reveal statistically significant dimorphic differences in the frequency of individual types of MPL proximal attachments on the right and left side (p=>0.05).

**Distal attachment**

Analysis of the distal part of the MPL has shown that in about 90% of cases the terminal attachments are located on the medial cuneiform bone and on the base of the first metatarsal bone. Three basic types of this attachment have been distinguished:

— Type 1 — medial cuneiform bone with the base of the first metatarsal bone (Figure 2);
— Type 2 — base of the first metatarsal bone (Figure 3);
— Type 3 — medial cuneiform bone (Figure 4);

The remaining 10% of the population was characterised by a very variable terminal attachment including the surface of medial cuneiform bone, shaft of the first metatarsal bone and the navicular bone. For statistical purposes, this differentiated group was defined as type 4 of the terminal attachment of the MPL. The analysis did not reveal the presence of statistically significant differences in the location of terminal
attachment of the MPL in the right limb. Analysis of the left lower limb revealed a significantly statistical difference in the occurrence of type 3 terminal attachment of the MPL - was more common in male fetuses (14.56%) than in female fetuses (5.77%). Statistically significant differences in type 4 were also found (Table VII).

**DISCUSSION**

*Musculus peroneus longus* is of great clinical importance. Cases of its damage accompanied by the occurrence of the inter-fascial tightness syndrome have been frequently described (6,8,23,24). First of all, peroneus longus tendon autografts are commonly used in many orthopaedic procedures like deltoid ligament reconstruction (25) and medial patellofemoral ligament reconstruction (26) and anterior cruciate ligament reconstruction (27) (anterior half of the peroneus longus tendon). One of the reasons associated with clinical usefulness of the tendon is its length and its stable, unchangeable course, which has been shown in our study. Additionally, its attractiveness in terms of surgical procedures results from synergistic function of the MPL and peroneus brevis muscle.

When analyzing the proximal part of the MPL, the most frequently pointed are the lateral condyle of the tibia and the head of fibula (28) as the site of the original attachment. According to Davda et al., (29) its origin is on the proximal 2/3 lateral side of fibula, anterior intermuscular septum and the lateral condyle of the tibia. The results obtained in this study also indicated that the site of the original attachment of this muscle is quite varied. The original attachment was usually located on the head and the closer half of the fibula and on the lateral condyle of the tibia. This applies to the whole examined fetus cohort, which may imply that this feature does not show any significant dimorphic and bilateral differences. Evaluating the dynamics of the belly and MPL tendon development, the authors, who describe the leg muscles in the fetal period, present very diverse and contradictory data. For example Domagala et al., (30) when analyzing the peroneus tertius, proved that as the fetus age increase, an increasingly longer belly and proportionally shorter tendon are being observed. According to the authors of the paper this is to be a result of physical activity of the fetus, which increases in utero with age. It must be emphasised that the study of Domagala et al. (30)
includes the analysis of an atypical muscle within the anterior compartment of the leg and relatively large fetal material is examined by the authors. Within the MPL analysis, Albay (31) proves that the length of tendon increases rapidly in the third trimester. This work, however, is based on a much smaller study group and the material is divided into only 3 age classes (second trimester, third trimester, full time newborns). On the other hand, the results of our work indicate that the growth rate of both the belly and the MPL tendon is similar, the highest in the fifth to sixth month of life, whereupon it drops sharply to slightly increase in the last age class. It has not been proved that the dynamics of an increase in the tendon length has significantly changed in relation to the length of the belly.

From 5 month of the fetal life the MPL tendon in the examined fetuses proved to be very long. Its length is close to the length of the entire muscle. It was observed that the tendon begins deeply between the muscle fiber bundles, which has been confirmed by the research of Bogacka et al.,(4) carried out on adults. This tendon subsequently runs along the plantar region of foot and is usually attached to the base of the first metatarsal bone (27). Shyamsundar et al. (32) suggest that the MPL attachment to the first metatarsal bone is most commonly observed and typical muscle termination. The authors claim that the connection observed between the tendon and the medial cuneiform bone is only a weak slip. According to our observations, the dominating attachment was the one connected within the MCB and the first metatarsal bone, but the distribution of fibres between the bones was either proportional or the majority of fibres were directed towards the plantar surface of the medial cuneiform bone. Similarly to our observations, Davda et al. (29) indicate the site of the muscle attachment on the closer part of the plantar surface of the medial cuneiform bone and on the base of the first metatarsal bone in a more precise manner. Despite the fact, the authors emphasize a relatively high variability of the terminal attachment. Moreover, a major interpersonal differentiation of this trait has been revealed by the fetal studies. In more than 70% of all examined individuals, the site of terminal attachment of the MPL was shown to be on the medial cuneiform bone and on the base of the first metatarsal bone. The remaining types are present in 30% of cases, so it may be concluded that the encountering any of them in practice is less likely.
Analysis of differences between average values of length, breadth and thickness of both muscles in successive age classes has shown that the growth rate of both muscles is very similar to that of the scapula (33). The authors indicate a negative correlation with the length-width index of the scapula in fetuses, observed with age. This study has revealed that thickness increases most intensely, then as in the case of the scapula, it is followed by the width and finally the length.

The authors have described a great number of anomalies and variations within the peroneal muscles region. Example: a low-located muscle tummy, presence of a bone spur of the fibula penetrating into the muscles, a very extended peroneal trochlea, a very slack inferior peroneal retinaculum and many others (1,34,35). However, in the examined sample, no aforementioned varieties or abnormalities in the course of peroneal muscles were found. It should therefore be concluded that the anomalies and varieties mentioned within the peroneal muscles, are secondary. They do not result from developmental errors in the embryonic period, but suggest that they occur along with the motility of the lower limbs. Thus, they are rather the result of paragenetic or epigenetic and environmental factors.

Acknowledgements

The authors of the paper thank Mrs. Alina Proniewicz, MSc for help in choosing fetuses, Mrs. Joanna Grzelak, MSci, PhD for statistical analysis and Miss Victoria Tarkowski, BA from Toronto, Canada for linguistic correction. Authors declare no conflict of interest.

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Table I. Basic metric data of the examined group of foetuses.

| Age class | Number of foeti | age M̅m [g] | M̅fx [g] | L̅xm [mm] | L̅xf [mm] | vtub̅xm [mm] | vtub̅xf [mm] | C̅xm [mm] | C̅xf [mm] |
|-----------|----------------|-------------|-----------|-----------|-----------|-------------|-------------|-----------|-----------|
| 5         | 69             | 18.80       | 211.47    | 255.77    | 212.56    | 219.94      | 182.08      | 188.38    | 182.08    |
| 6         | 78             | 22.49       | 397.28    | 429.64    | 263.21    | 263.82      | 185.15      | 189.06    | 185.15    |
| 7         | 40             | 25.83       | 580.50    | 524.95    | 300.61    | 292.50      | 208.83      | 207.50    | 208.83    |
| 8         | 13             | 30.62       | 615.13    | 712.00    | 322.25    | 335.00      | 217.00      | 229.60    | 217.00    |

M – body mass, L – body length, Vtub – vertex-tuberale length, X̅ – mean value interpolated at the center of age class, f- female, m – male, age - average calendar age in weeks. C – CRL = crown-rump length
### Table II. Basic metric characteristics of *musculus peroneus longus* (MPL) in examined population

| Age class | Male right (SD) | Male left (SD) | Female right (SD) | Female left (SD) |
|-----------|-----------------|---------------|-------------------|-----------------|
| 5         | 34              | 39.57 (6.12)  | 39.21 (1.33)      | 37.94 (5.73)    |
|           |                 | 39.76 (0.99)  | 39.21 (1.33)      | 37.94 (5.73)    |
| 6         | 39              | 54.56 (7.34)  | 54.83 (1.24)      | 53.90 (0.99)    |
|           |                 | 54.83 (0.93)  | 54.83 (1.24)      | 53.90 (0.99)    |
| 7         | 18              | 59.36 (7.26)  | 59.07 (1.37)      | 57.45 (0.93)    |
|           |                 | 59.07 (1.37)  | 59.07 (1.37)      | 57.45 (0.93)    |
| 8         | 8               | 66.68 (5.42)  | 65.68 (2.75)      | 64.04 (6.41)    |
|           |                 | 65.68 (2.75)  | 65.68 (2.75)      | 64.04 (6.41)    |

L - belly length, T - tendon length, SD - standard deviation

### Table III. Results of the post-hoc test (Tukey's test) for two-way ANOVA age* to sex in the range of *musculus peroneus longus* belly length in the examined fetal group. The red numbers indicate statistically significant result.

| Right side | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
| sex        | age | age | age | age | age | age | age | age |
| male       | 5   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| male       | 6   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| male       | 7   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| male       | 8   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| female     | 5   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| female     | 6   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| female     | 7   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| female     | 8   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |

| Left side  | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
| sex        | age | age | age | age | age | age | age | age |
| male       | 5   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| male       | 6   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| male       | 7   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| male       | 8   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| female     | 5   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| female     | 6   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| female     | 7   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
| female     | 8   | 9.5 | 54.6 | 59.3 | 66.7 | 42.3 | 56.0 | 59.9 |
Table IV. Results of the post-hoc test (Tukey's test) on *musculus peroneus longus* tendon length for the examined group. Results in red are statistically significant.

| Right side | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
| sex        | age |     |     |     |     |     |     |     |
| male 5     | 34  | 1.31| 0.38| 0.99716| 0.021118| 0.000032| 0.440039| 0.036944|
| male 6     | 39  | 2.09| 0.68| 0.000032| 0.205708| 0.99961| 0.634922| 0.440039|
| male 7     | 18  | 2.41| 0.74| 0.000032| 0.017520| 0.425621| 0.999965| 0.036944|
| male 8     | 39  | 1.50| 0.58| 0.000032| 0.641422| 0.4019| 0.555593|
| female 5   | 35  | 1.50| 0.58| 0.000032| 0.036944| 0.634922| 0.440039| 0.036944|
| female 6   | 39  | 2.14| 0.53| 0.000032| 0.316984| 0.999961| 0.036944| 0.036944|
| female 7   | 22  | 2.57| 0.79| 0.000032| 0.765517| 0.999961| 0.036944| 0.036944|
| female 8   | 39  | 1.50| 0.58| 0.000032| 0.765517| 0.999961| 0.036944| 0.036944|

Table V. Basic statistical data of *musculus peroneus longus* belly thickness.

| Age [sex,side] | N   | Mean value | SD  | [sex,side] | N   | Mean value | SD  |
|----------------|-----|------------|-----|------------|-----|------------|-----|
| 5 [male,right] | 34  | 1.31       | 0.38| [female,right] | 35  | 1.50       | 0.58|
| 6 [male,right] | 39  | 2.09       | 0.68| [female,right] | 39  | 2.14       | 0.53|
| 7 [male,right] | 18  | 2.41       | 0.74| [female,right] | 22  | 2.57       | 0.79|
### Table VI. Results of the post-hoc test (Tukey’s test) on *musculus peroneus longus* belly thickness for the examined group. Results in red are statistically significant.

|        | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|
| **Right side** |     |     |     |     |     |     |     |     |
| sex     | age |     |     |     |     |     |     |     |
| male    | 5   | 0.0000332 | 0.000032 | 0.000032 | 0.894120 | 0.000032 | 0.000032 | 0.000243 |
| male    | 6   | 0.000033 | 0.607280 | 0.044574 | 0.000692 | 0.999977 | 0.062652 | 0.641840 |
| male    | 7   | 0.000032 | 0.759939 | 0.000038 | 0.078102 | 0.977459 | 0.998673 |
| male    | 8   | 0.000032 | 0.759939 | 0.000033 | 0.078102 | 0.977459 | 0.998673 |
| female  | 5   | 0.894120 | 0.000692 | 0.000033 | 0.000032 | 0.000178 | 0.000032 | 0.003537 |
| female  | 6   | 0.000032 | 0.779637 | 0.078102 | 0.000178 | 0.133019 | 0.746058 |
| female  | 7   | 0.000032 | 0.990376 | 0.078102 | 0.000178 | 0.133019 | 1.000000 |
| female  | 8   | 0.000243 | 0.998376 | 0.003537 | 0.746058 | 1.000000 |
| **Left side** |     |     |     |     |     |     |     |     |
| sex     | age |     |     |     |     |     |     |     |
| male    | 5   | 0.000041 | 0.000032 | 0.000035 | 0.890278 | 0.000039 | 0.000032 | 0.003249 |
| male    | 6   | 0.000032 | 0.314252 | 0.004389 | 1.000000 | 0.311993 | 0.879043 |
| male    | 7   | 0.000032 | 0.314252 | 0.004389 | 1.000000 | 0.311993 | 0.879043 |
| male    | 8   | 0.00035 | 0.314252 | 0.327963 | 0.984605 | 0.999654 |
| female  | 5   | 0.890278 | 0.004389 | 0.000032 | 0.000032 | 0.003775 | 0.331978 | 0.886912 |
| female  | 6   | 0.000039 | 0.327963 | 0.003775 | 0.331978 | 0.331978 | 0.886912 |
| female  | 7   | 0.000032 | 0.311993 | 0.984605 | 0.999654 |
| female  | 8   | 0.003249 | 0.99954 | 0.003297 | 0.886912 | 1.000000 |

### Table VII. Distal attachment of the *musculus fibularis longus* typology. Type 4 constitutes a group of single unrelated attachment types.

| Distal attachment type | Male Right | Female Right | Total Right | Male Left | Female Left | Total left |
|------------------------|------------|--------------|-------------|-----------|-------------|------------|
|                        | N          | N            | p           | N         | N           | P          |
| Type    | %    | %   | %    | %    |
|---------|------|-----|------|------|
| Type 1  | 77   | 74.76 | 153  | 70  |
|         | 76   | 73.08 | 0.34 | 67.96 |
|         | 77   | 74.04 | 147  | 0.51 |
| Type 2  | 7    | 6.80 | 17   | 10 |
|         | 10   | 9.62 | 0.52 | 9.71 |
|         | 18   | 17.31 | 28  | 0.1259 |
| Type 3  | 10   | 9.71 | 24   | 15 |
|         | 14   | 13.46 | 0.46 | 14.56 |
|         | 5    | 5.77 | 20  | 0.01 |
| Type 4  | 9    | 8.73 | 13   | 8 |
|         | 4    | 3.84 | 0.31 | 7.77 |
|         | 4    | 3.85 | 12  | 0.02 |
| ALL     | 103  | 100 | 207  | 103 |
|         | 104  | 100 | 104  | 100 |
|         | 207  | 100 | 207  | 100 |

**Figure 1.** The main six types of fibularis longus muscle proximal attachments.

**Figure 2.** Type 1 of the distal attachment of the musculus fibularis longus. A - the base of the first metatarsal bone, B - medial cuneiform bone, female, right, 7 month.

**Figure 3.** Type 2 of the distal attachment of the musculus fibularis longus; female, right, 7 month.

**Figure 4.** Type 3 distal attachment of the musculus peroneus longus; male, right, 7 month.
