RELATIONSHIP BETWEEN THE LATERAL PATELLOFEMORAL LIGAMENT AND THE WIDTH OF THE LATERAL PATELLAR FACET

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ABSTRACT

Objective: The aim of this study, with cadavers, is to evaluate the relationship between the width and length of the lateral patellofemoral ligament (LPFL) and the size of the lateral patellar articular facet (LPAF). Patellofemoral instability is closely related to patellar morphology and the lateral retinacular layers. Studies evidence that the wider the lateral patellar facet and the more strained the lateral retinaculum, the greater the tendency for development of pathology in the patellofemoral joint. Methods: 20 knees were dissected in 20 cadavers. The parts were identified according to gender, age, dissected side, length and width of LPFL and width of LPAF. In order to carry out the statistical analysis we adopted the significance level of 5% (0.050) and also used Spearman's Coefficient of Rank Correlation. Results: The LPFL presented a mean width of 16.05 millimeters (standard deviation 2.48) and 42.10 millimeters of length (standard deviation 8.84). The width of the LPAF varied from 23 to 37 millimeters (mean 28.1). It was observed that the relationship between the LPAF and LPFL widths is not statistically significant (p=0.271), whereas the relationship between the LPAF width and the LPFL length is statistically significant (p=0.009). Conclusion: The shorter the LPFL the greater the width of the LPAF.

Keywords: Knee/anatomy & histology. Joint instability. Patellar ligament. Patellar dislocation. Chondromalacia. Dissection.

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INTRODUCTION

The detailed study of knee anatomy is essential for the understanding of the conditions that affect it.[1,2] The patellar retinaculum is an important stabilizer of the patellofemoral joint, mainly its medial and lateral components. The lateral retinaculum is comprised of the superficial oblique and deep transverse layers.[3] Two of the main patellar stabilizing lateral retinacular structures are the lateral patellotibial ligament and the lateral patellofemoral ligament (LPFL).[4,5]

There is great anatomical diversity in the structures of the knee responsible for patellar disorders. Among these variables there is a strong association between patellar format and patellofemoral instability.[6,7] The increase of lateral patellar retinaculum tension during development may cause lateral patellar inclination, lateral patellar dislocation and alteration of patellar excursion.[8]

The patella lateralized during the individual's growth may be responsible for the development of a broader lateral patellar facet, predispose to hypoplasia of the lateral femoral condyle, entail a high patella and a shallow trochlear fovea.[9] Studies evidence that the larger the lateral patellar articular facet and the more tense and shortened the LPFL, the greater the propensity of an individual to develop previous pain in the knee and lateral patellar instability.[10,11]

Therefore, we have attempted to evaluate through the study on cadavers whether there is a relationship between LPFL morphology and the size of the lateral patellar articular facet.

All the authors declare that there is no potential conflict of interest referring to this article.

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METHOD

The dissection of 20 knees was carried out on 20 cadavers in the Coroner's Service of the Municipality of the Capital City of São Paulo (SVOC-FM USP). The survey was approved by UNIFESP's Committee of Ethics in Research (postal code 0093/07).

Twelve cadavers were of the male gender and eight of the female. The parts were prepared fresh and not formolized. The parts were identified in terms of gender, age, dissected side, dissection date, length and width of the lateral patellofemoral ligament (LPFL) and patellar length (PL). We did not consider the color of the cadavers, as we did not find such relevance in the literature studied. The parts were chosen at random, aiming to avoid bias. A caliper ruler with millimeter graduations was used for the measurement of values. All the measurements were made with the knee in flexion of 30°.

The knees that presented signs of some ailment or scars were not used. When both knees appeared in good dissection conditions the choice of side was random.

Of the 20 dissected knees, 11 were on the right side and 9 on the left side. The average age was 50.2 years (from 20 to 88 years).

An anterolateral longitudinal incision was made on the knee halfway between the lateral epicondyle and the lateral edge of the patella, as described by Dye et al.[12] The initial incision started two centimeters from the upper edge of the patella and ended two centimeters distal to the tibial tuberosity (Figure 1).

After careful dissection, the superficial oblique retinaculum (Figure 2) was identified and removed in order to expose the deep transverse retinaculum (Figure 3), pursuant to the studies of Fulkerson.[13]

The LPFL was identified after removal of the superficial retinacular layer, in the form of visible and palpable thickening in the layer of the deep transverse retinaculum. The LPFL was isolated and dissected from the femoral to the patellar region (Figure 4).

Figure 1 – *Demarcation of the incision on the left knee. The entire line corresponds to the initial incision and the dotted line shows the subsequent incisions.*

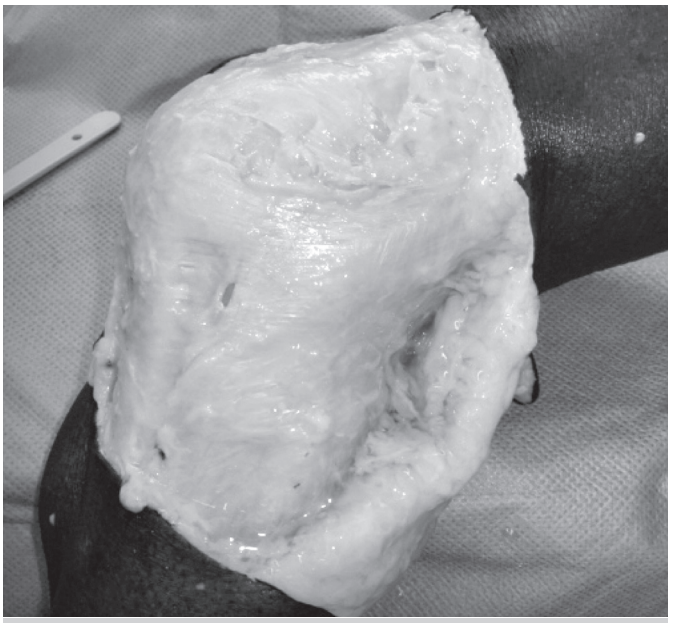

Figure 2 – *Exposure of the anterolateral region of the left knee after removal of the superficial fascia.*

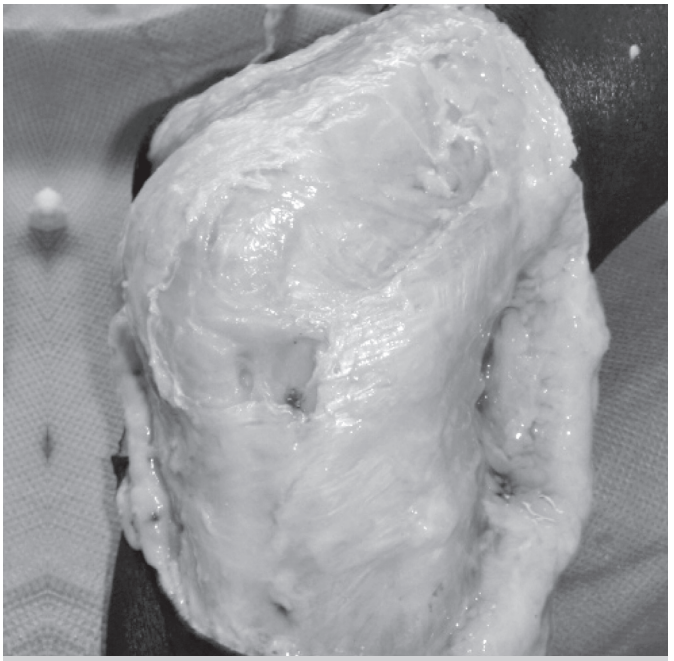

Figure 3 – *Deep transverse retinaculum after removal of the superficial retinacular layer.*

The length was measured between the junctions of the LPFL with the femur and with the patella. The width was measured halfway along its length.

Once the LPFL had been analyzed we sectioned the lateral retinaculum and everted the patella to measure the width of the lateral patellar facet. This measurement was performed at the patellar equator, between the patellar edge and its lateral articular extremity.

For the statistical analysis the participants adopted the significance level of 5% (0.050) and used Spearman's rank correlation.

RESULTS

The results obtained from the dissections are presented in Table 1. The mean width of the LPFL was 16.05mm (ranging from 13 to 20 mm) with standard deviation of 2.48 and the mean length of the LPFL was 42.1 mm (ranging from 31 to 53 mm) with standard deviation of 8.84.

The width of the lateral patellar facet ranged from 23 to 37 millimeters, with mean value of 28.1 millimeters.

The statistical results are set out in Table 2. The relationship between the variables 'lateral patellar facet' and 'lateral patellofemoral ligament width' (LPFL_W) is statistically non-significant, while the relationship between the variables 'lateral patellar facet' and 'lateral patellofemoral ligament length' (LPFL_L) is statistically significant.

Table 1 – *Results of lateral patellofemoral ligament dissections on the knee of fresh cadavers according to number of order, gender, age, dissected side, LPFL_W, LPFL_L and PL.*

Number	Gender	Age (years)	Side	LPFL_W (mm)	LPFL_L (mm)	LPF (mm)
1	M	40	E	13	31	28
2	M	20	D	18	38	34
3	M	60	D	14	32	27
4	M	50	D	20	58	25
5	M	25	E	14	39	29
6	M	50	E	16	49	29
7	M	42	E	13	31	28
8	M	48	E	19	48	23
9	M	60	D	14	45	23
10	M	43	D	20	57	24
11	M	33	D	16	40	35
12	M	44	E	14	54	25
13	F	61	D	13	31	37
14	F	88	D	14	34	28
15	F	71	E	16	45	23
16	F	45	D	15	39	32
17	F	44	D	18	36	30
18	F	62	E	18	37	34
19	F	57	E	16	45	25
20	F	61	D	20	53	23

M: male; F: female; D: right; E: left; mm: millimeters; LPFL_W: width of the lateral patellofemoral ligament in mm; LPFL_L: length of the lateral patellofemoral ligament in mm; LPF: width of the lateral patellar facet.

Table 2 – *Degree of relationship among the pairs of variables by Spearman's rank correlation.*

Pair of Variables	N	Correlation Coefficient	Value p
Lateral facet XLPFL_W	20	–0.259	0.271
Lateral facet XLPFL_L	20	–0.571	0.009*

N: number of knees; LPFL_W: width of the lateral patellofemoral ligament; LPFL_L: length of the lateral patellofemoral ligament; *statistically significant p<0.050.

DISCUSSION

The morphologic alterations of the lateral retinaculum are considered one of the main causes of patellofemoral conditions. The LPFL is directly involved in this pathophysiology, as this structure is considered a component of the lateral retinaculum and its exaggerated tension can cause patellar subluxation or lateral dislocation.[14]

Fulkerson and Gossling[13] demonstrated that the patella presents the first articular contact with the trochlea in the first 10º of knee flexion, with slightly lateralized entry. From 20º to 30º of flexion the patella is better adapted in the femoral trochlea and from 30º it stabilizes in the trochlear fovea. They mentioned that most patellofemoral problems are associated with abnormal excursion of the patella in the first 30º of flexion. If the lateral retinaculum is shortened and tense, there might be excessive increase of pressure and of lateral patellar facetary tension.[13] They also pointed out that the tense lateral retinaculum appeared more frequently in individuals with patellofemoral pain and lateral pressure syndrome. This excessive tension can produce lateral inclination of the patella and pain in the soft tissues surrounding it. According to this information, we noticed that detailed knowledge of the lateral retinaculum and of the LPFL is crucial for an understanding of the ailments that affect the anterior region of the knee.

In the anatomical study undertaken by Vieira et al.[2], on ten knees of fresh cadavers, they described the LPFL in the deep lateral retinacular layer. They also noticed that after its resection, the patella spontaneously describes a medial excursion movement, which demonstrates the importance of this ligament in patellar stability in the sagittal plane.[2]

Reider et al.[1] named the lateral patella-epicondyle ligament described by Kaplan[15] the lateral patellofemoral ligament. They observed that it is a palpable thickening of the joint capsule and connects the patella to the femoral epicondyle. They described its width as ranging from three to ten millimeters. In relation to the patella, its measurements were taken through the study of 21 fresh knees. When they classified them according to Wiberg[16], 24% of the specimens were of type I, 57% of type II and 19% of type III. The articular width of the patella was 3.5 centimeters on average (ranging from 3.0 to 3.9 centimeters), while the average anterior patellar length was 4.5 centimeters (from 3.8 to 5.3). When they analyzed the quantitative correlations of their measurements, the authors showed a significant relationship between patellar and lateral patellofemoral ligament morphology. They declared that the more the patella tends to Wiberg's type III morphology (the medial facet is small and convex, while the lateral one is broad and concave), the broader the LPFL. They also suggested that LPFL apply one of the main forces that influence the shape of the patella during knee development and that the width of this ligament is the parameter most closely related to patellar format. They also speculate that LPFL and the iliotibial tract are structures that potentially lateralize the patella, since they play a clinically relevant role in patellar mobility conditions.[1]

According to the outcome of our dissections, we observed significant correlation between the LPFL length and the width of the lateral patellar facet. Thus the shorter the LPFL, the wider the lateral patellar facet. We believe that a hypothesis for this correlation is the action of the lateral retinaculum tense and shortened during knee development. With patellar lateralization and increase of pressure on the lateral facet during the individual's growth, the

patella may develop with altered morphology and predispose to pathological alterations in the patellofemoral joint.

In the study of the function of soft tissues in lateral patellar translation in nine human knees conducted by Desio et al.[17], it was confirmed that the lateral retinaculum plays an important role to avoid lateral translation of the patella (representing 10% of the total lateral restriction force). This function of the lateral retinaculum can explain the incidence of high rates of failure in the procedures of isolated retinacular release found in literature in the treatment of alterations in the patellofemoral joint.

CONCLUSION

According to the anatomic measurement adopted, the value of the length of the lateral patellofemoral ligament is inversely proportional to the length of the width of the lateral patellar articular facet.

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