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Femoral and Popliteal Artery Pathway in Varus and Valgus Aligned Lower Limb; a CT Angiographic study

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Abstract
Objectives: The aim of this study was to compare the femoral and popliteal arteries pathway in varus and valgus- aligned lower limbs.
Methods: A retrospective CT angiography (CTA) study from October to December 2021 was conducted. Distance of the femoral and popliteal artery to specific bony landmarks in thigh and knee was measured.
Results: Eighty limbs including 40 varus and 40 valgus lower limbs were assessed. No significant difference between varus/valgus groups in terms of distances was noted.
Conclusion: Our study compared pathway of PA and FA artery in varus and valgus knees using CTA images; and no significant differences was seen between the two groups of varus and valus.
Keywords: Femoral artery, popliteal artery, anatomy, varus alignment, valgus alignment, knee

Introduction

Determining the pathway of the femoral and popliteal artery (FA and PA) is an essential step in performing surgical or radiological procedures. FA exits from the adductor canal then entering popliteal fossa posterior to the tibia plateau turning into popliteal artery.[1-3] The pathway might vary in accordance with lower limb different alignments-varus or valgus- in individuals. Procedures in the area of distal femur or proximal tibia could be risky in terms of vascular complications as the adjacency of the arteries to the surgical cuts has been incompletely addressed in literature. Limited studies are available to quantitatively describe the anatomic location of the FA and popliteal artery in relation to the shaft of the femur and tibia for a surgical approach guide in such region.[4-6]

The aim of this study was to compare the femoral and popliteal arteries pathway in varus and valgus- aligned lower limbs.

Methods

We carried out a retrospective study reviewing archived data Images of patients aged 18–60 yrs undergoing lower limbs CT angiography (CTA) from October to December 2021. The study design was approved by Shahid Beheshti University of Medical Sciences Ethics research board. Cases with pelvic, thigh and tibia fractures, and low-quality images were excluded. Sixty cases -80 limbs: 40 varus/40 valgus-were assessed using two-dimensional (2D) and three-dimensional (3D) reconstructions CTA (16-slice CT scanner, Siemens, Germany 2018). The perpendicular distance of the FA to medial, lateral and posterior cortex at the adductor tubercle and knee medial joint line was measured. The distances of the popliteal artery to the medial, lateral and posterior border of proximal tibia were also measured in axial images. Parametric variables were given as mean ± SD; variables were analyzed with student *t*-test. Nonparametric variables were reported as a median and range. The statistically significant threshold was $P < 0.05$.

Results

Eighty limbs including 40 varus (32 male, 8 females) and 40 valgus (19 males, 21 females) were assessed; mean age of participants was 41 ± 16 years (20–59 yr range) were included. There was detected no significant difference between varus/valgus groups in terms of distances. Also no statistically significant difference by age, limb side and sex were seen ($P = 0.31$). The average distance of the FA to the femoral cortex was 15.13/14.11 mm posteriorly, 26.30/27.40 mm medially, and 33.17/33.14 mm laterally at adductor tubercle level (varus/valgus). The average distance for the popliteal artery to the tibial cortex were 5.68/5.34 mm posteriorly, 21.75/21.25 mm medially, and 13.85/13.25 mm laterally at fibular head level (varus/valgus). Other distances to the specific anatomic levels are reported in Table 1. No significant differences were noted between the two varus and valgus groups ($P > 0.05$).

Discussion

Damage to the neurovascular structures is a major operative complication of around the knee procedures.[7-9] Knowing the pathway of arteries in lower limbs espacially in both varus and valgus limbs could be helpful; The most important finding of our study was to compare distances of femoral and popliteal arteries to bony landmarks in both varus and valgus knees. No similar study was available to compare the results; only some reports have given limited data; a report[9] showed that any kind of osteotomies occurred in knee could impose the risk of vascular injuries. Another study evaluated CTA in cadavers after the MIPO interventions and found no disruptions in deep and superficial femoral arteries.[10] Previous studies assessed 2-D CTA and reported the FA had at least 12 mm distance to the medial cortex of femur through its way;[6] also reported that FA

Table 1. **Average distance of femoral and popliteal artery to considered anatomic points**

Anatomic level	Distance to midline posterior cortex (mm)		Distance to posterior medial border cortex (mm)		Distance to posterior lateral border cortex (mm)		*P*
	Varus	Valgus	Varus	Valgus	Varus	Valgus	
Femur just above adductor tubercle	15.13 ± 4.23	14.11 ± 2.13	26.30 ± 3.47	27.40 ± 3.14	33.17 ± 2.02	33.14 ± 3.02	0.33
Level of knee joint line	3.23 ± 3.41	3.18 ± 2.31	21.20 ± 3.04	21.20 ± 3.04	19.25 ± 2.51	19.35 ± 3.22	0.29
Tibia at the level of fibular head	5.68 ± 2.45	5.34 ± 2.62	21.75 ± 3.40	21.25 ± 3.31	13.85 ± 2.32	13.25 ± 2.65	0.30
Tibia at the level of 5 cm below the knee joint line	10.58 ± 3.45	11.15 ± 3.15	19.55 ± 2.57	19.75 ± 2.45	12.30 ± 2.90	12.55 ± 2.70	0.28

was placed about 16 mm far from the borders of distal femur at minimum.[11] A MRI-based study detailed that the average distance between the PA and the tibia posterior cortex at the level of the knee joint was about 9.5 mm.[12]

Being familiar with the pathway of the femoral and popliteal artery especially in both knee alignments -varus or valgus- is important for managing fractures.[1,2,8] The adductor tubercle, medial femoral condyle and fibular head would be imperative bony indices which are distinguished on imagings, so accurate orientations to the artery distance o such landmarks help surgeons decrease complications in operations.[4,6,11-13]

Conclusion

This study was focused on comparing pathway of femoral and popliteal artery in distal thigh and around the knee in both varus and valgus knees using CTA images; no significant differences was reported between the two groups in our findings.

Conflicts of Interest

None.

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