Flexion of the knee increases the distance between the popliteal artery and the proximal tibia

MRI measurements in 15 volunteers

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ABSTRACT – We determined which angle of flexion best prevents popliteal artery injury during knee surgery. We took MRIs of the knee in the lateral position with the knee in 0°, 45°, 90°, and 120° of flexion in 15 volunteers. The shortest distance between the posterior cortex of the tibia and the popliteal artery was measured at various levels from the knee joint to 60 mm distally. At the level of the joint and 15 mm distally, the distance between the tibia and artery increased with increasing knee flexion. More distally, no significant difference was noted with increasing flexion.

Flexion of the knee may minimize injury to the popliteal artery in procedures between the level of the joint and 15 mm distal to the joint.

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Injury to the popliteal artery is a serious complication of knee surgery. Zaidi et al. (1995) reported the distance from the artery to the posterior tibial cortex at 15 mm below the joint line at various degrees of flexion of the knee, using duplex ultrasonography. To evaluate other levels, we obtained MRIs of the proximal tibia at various degrees of knee flexion, and measured the distance from the popliteal artery to the posterior tibial cortex.

Subjects and methods

We took MRIs of the left knee of 15 volunteers (4 healthy, 11 with osteoarthrosis of the knee; 9 women, mean age 55 (26–75) years, mean height 163 (134–176) cm, mean weight 64 (42–85) kg). We used a 1.5 Tesla magnetic field, and obtained axial images on conventional spin-echo techniques (TR 600ms, TE 20ms, FOV 24 cm, matrix 256 × 192 cm).

The subjects were imaged in the lateral position. The flexed positions of the knee (0°, 45°, 90° and 120° of flexion) were determined with a goniometer. We used a scout view (Figure 1), the axial view parallel to the joint line at distances of 7.5 mm from the joint level to 60 mm below the knee joint. The shortest distance from the popliteal artery to the posterior cortical wall was measured using the micrometer on the image obtained. No value was recorded at 120° of flexion in 3 subjects who could not bend their knee that much due to osteoarthrosis.

We used the student's t-test for the statistical analysis. Differences were considered significant when p-values were less than 0.05.

Results

During extension of the knee, the average distance at the level of the joint was 9.2 mm, at 7.5 mm distal from the joint 8.6 mm, at 15 mm distal from the joint 9.2 mm. These were the shortest distances in our measurements of the proximal tibia (Table). The average distance 23 mm distal from the joint, which showed no change distally from 23 mm to 60 mm from the joint, was greater than those within 15 mm from the joint on extension of the knee (Figure 2).

At the joint level, 7.5 mm, and 15 mm distal from the level of the joint, the distance increased

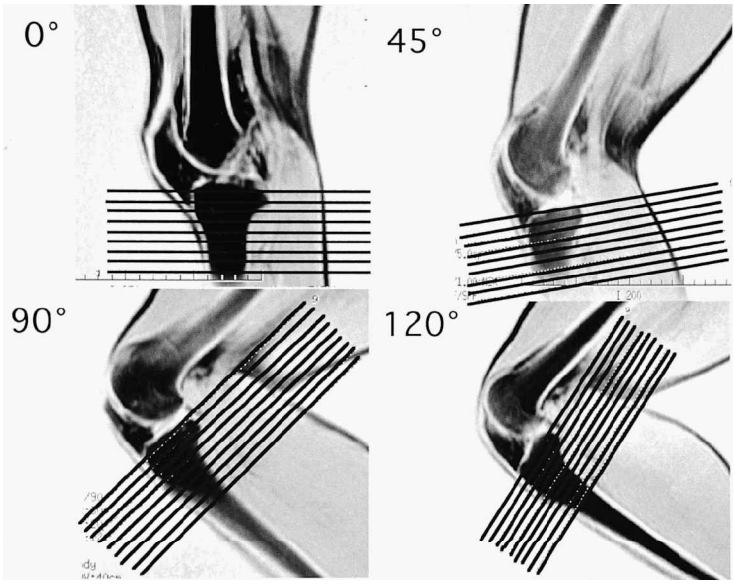

Figure 1. Scout view of the lower leg in 0, 45, 90, and 120 degrees of flexion.

with increasing flexion. There was a difference in the distance between extension and 120° flexion from the joint level to 15 mm distal ($p < 0.05$). However, we found no significant differences when the flexion angles were changed at levels of 22.5 mm or more distal to the joint.

Discussion

Injuries of the popliteal artery have tended to increase as arthroscopic surgery and TKA have become common (Jeffries et al. 1987, Tawes et al. 1988, Potter and Morris-Jones 1995).

Zaidi et al. (1995) studied the distance from the popliteal artery to the posterior tibial cortex at 15 mm below the joint line in various degrees of flexion of the knee. using ultrasound. They showed that the distance on knee extension was longer than that on 90° of flexion. However, they measured one level alone (15 mm below the joint line).

We found that the distance on 120°flexion was significantly greater than that on extension, 0–15 mm from the joint. However, the angle of the knee position was not the same, and our results differed from those of Zaidi et al. (1995). The cause is

The distance from the popliteal artery to the posterior cortical wall of the tibia, according to the degrees of knee flexion within 15 mm distal from the joint. Significance was determined by comparing the value on extension (0°) with that at each level

		Joint level Flexion angle				7.5 mm distal from the joint Flexion angle				15 mm distal from the joint Flexion angle			
Age	Gender	0°	45°	90°	120°	0°	45°	90°	120°	0°	45°	90°	120°
67	F	9	10	11	18	9	10	11	15	9	13	13	17
70	F	14	16	20		13	15	18		10	14	18	
61	F	6	10	13	13	8	9	10	11	10	9	10	10
72	F	10	13	14		10	10	11		13	13	13	
66	F	10	11	11	14	6	6	8	11	6	7	11	15
28	M	12	12	16	13	9	10	16	11	7	7	10	10
27	M	8	10	11	15	6	8	8	11	8	12	13	13
27	M	8	10	19	23	11	8	14	18	8	10	10	11
26	M	5	8	13	16	3	5	5	6	4	4	4	4
53	M	13	19	23	28	9	14	16	23	8	10	9	16
52	F	8	9	12		8	12	12	12		12	11	
69	F	11	13	13	15	10	11	11	11	11	14	14	16
71	F	6	6	6	8	9	6	6	8	9	9	8	11
75	F	11	13	14	15	11	11	13	14	13	13	12	13
49	F	9	13	14	17	10	13	16	18	11	11	13	18
Average, mm		9	11	14	16	9	10	12	13	9	10	11	13
SD		3	3	4	5	2	3	4	5	3	3	3	4
P-value			0.04	0.0006	0.0001		0.3	0.01	0.003		0.2	0.08	0.008

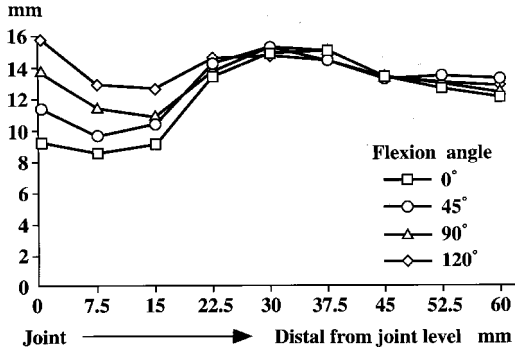

Figure 2. Distance from the popliteal artery to the posterior cortical wall of the tibia related to the distance from the knee joint and degrees of knee flexion.

uncertain, but may be due to different instruments for making the measurements. The use of a MRI scout view in sagittal position permits accurate measurements from the top of the tibia.

We took the images in the lateral position because the subjects could not bend their knee in the coil sufficiently in other positions. The supine position is mainly used during knee surgery. We have no reason to believe that our measurements should differed between the supine and lateral positions.

In TKA, the bone cut of the tibia is usually done within 20 mm from the joint level. At these levels, the distance increased at 90° or 120° of knee flexion. However, the distance from the posterior cortex to the artery is relatively short even with sufficient flexion of the knee. Therefore, the retractor for protection of neurovascular structures should always be set at the middle posterior edge of the tibia.

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