

# Can Total Knee Arthroplasty (TKA) Achieve Its Goal in Knee Flexion Floor Activity of Thai Buddhist Monks?

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**Objective:** To study knee's angulation required for Thai Buddhist monks whose activity based on floor sitting basis. And to identify an inter-observer reliability of knee flexion measurement based on radiologic reading.

**Material and Method:** Descriptive analysis study comprised of measuring bilateral knee flexing angulation in 4 postures of floor activities; kneeling, monk's position in both right and left manner, and sit cross-legged position, in 35 Thai Buddhist monks at Priest Hospital using plain radiograph image. The radiograph imaging for each patient was performed by one radiologist and two orthopedics. The measurement result was also analyzed for inter-observer reliability.

**Results:** Mean knee flexion angle in kneel, left monk's position, right monk's position and sit cross-legged postures were 163.21, 146.49, 148.89 and 138.38 degree, respectively. No statistical difference between knee flexion measurements among 3 investigators.

**Conclusion:** Daily floor activity of Thai Buddhist monks need more flexion capacity than that can achieve by total knee arthroplasty instrument using nowadays.

**Keywords:** Range of motion of the knees in Thai Buddhist monks, Reliability of measurement by radiograph, Kneeling position, Cross-legged position, Left monk's position and right monk's position

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Osteoarthritis of knee (OA knee) is common in elderly and more common in women<sup>(7,9)</sup>. Currently, total knee arthroplasty (TKA) is the is a successful surgical procedure in fail conservative treatment for this disease. This treatment is sufficient to reduce pain and improve knee flexion as well as patient's quality of life.

In Thailand, there are over 300,000 Buddhist monks. Daily activity of Buddhist monk such as meditation required them to spend time mainly on the floor. With number of elderly monks increases, the osteoarthritis of knee became a major problem among them. There has been one study on Thai monks' knee flexion, regardless of associated OA knee. However<sup>(1,10)</sup>, there is no study on knee flexion in floor activities and knee flexing angulation post total knee arthroplasty.

The purpose of the present study was to demonstrate the knee flexing angulation in floor activities using radiograph imaging of various common sitting postures. As well as to assess the possibility to resume daily floor activity in post total knee arthroplasty

patients.

## Material and Method

This descriptive analysis study collected data from 35 Thai Buddhist monks who visit at outpatient department, Priest Hospital. All patients were male. Range of age was 35 to 80 years. The radiograph imaging study was performed on bilateral knees in kneeling, crossed-leg and monk's position. Inclusion criteria were Thai monks who visited orthopaedic outpatient department with or without knee problem from October 2010 to September 2011 and willing to participate in the present study. Exclusion criteria were inflammatory arthritis, Septic arthritis, History of knee injury, History of knee surgery, Burn scar at knee area, Post-radiation at knee area and Mass at knee area. Angulations measurement was done on the radiograph film uses the reference line at the posterior cortex of the femur and posterior cortex of the tibia-as shown in the Fig. 2. One radiologist and two orthopedists measured the angles and compared with each other to define the reliability and accuracy of the measurements. The author data will be comparing with the previous range of motion's data of the TKA patient from many studies to predict the outcome of total knee arthroplasty in Thai monks.

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### Statistical analysis

Knee flexion data were analyzed for mean and standard deviation. Multiple comparisons (F-test) were used to compare knee flexion angle measurements by 3 investigators in each sitting postures.

### Results

Mean knee flexion angulations by age were shown in Table 1. Knee flexing angulation in each posture of three observers was shown in Table 2. In kneeling posture, mean knee flexion angle was  $163.06 \pm 6.23$  (144-174) degree. In sitting crossed-leg posture, mean knee flexion angle was  $138.44 \pm 11.70$  (168-104) degree. In sitting monk position posture, mean knee flexion angle of left knee and right knee were  $145.02 \pm 11.00$  (120-168) and  $149.91 \pm 13.90$  (98-168) degree, respectively. In kneeling posture, mean knee flexion angle were  $163.68 \pm 6.32$  (145-172) degree. In sitting crossed-leg posture, mean knee flexion angle were  $138.57 \pm 12.08$  (104-167) degree. In sitting monk position posture, mean knee flexion angle of left knee and right knee were  $145.44 \pm 11.17$  (120-168) and  $150.44 \pm 14.39$  (98-168) degree, respectively. In kneeling posture, mean knee flexion angle were  $163.21 \pm 6.18$  (172-144) degree. In sitting crossed-leg posture, mean knee flexion angle were  $138.57 \pm 12.00$  (104-168) degree. In sitting monk position posture, mean knee flexion angle of left knee and right knee were  $145.22 \pm 11.05$  (120-168) and  $150.28 \pm 14.38$  (98-166) degree, respectively. In kneeling posture, mean knee flexion angle were  $162.29 \pm 6.29$  (146-174) degree. In sitting crossed-leg posture, mean knee flexion angle were  $138.17 \pm 11.35$  (106-164) degree. In sitting monk position posture, mean knee flexion angle of left knee and right knee were  $144.39 \pm 11.07$  (120-168) and  $149.00 \pm 13.25$  (100-168) degree, respectively. All knee flexion angle measurement by 3 investigators in each sitting posture were not statistical different (p-value > 0.05) as shown in Table 3. Multiple comparisons to compare knee flexion angle measurement when matching two from three investigators are showed in Table 4. There were no statistical different (p-value < 0.05) between two investigators in any sitting postures.

### Discussion

The present study intends to measure the range of motion of the knee by radiograph the knees in different floor routines of Thai Buddhist monks. The different positions of the monk's floor activities that the authors have studied are kneeling, cross-legged and left and right monk's positions. These positions

**Table 1.** Mean knee flexion angulations by age n = 35

age	kneeling	Cross-legged	Left Monk's position	Right Monk's position
< 50	Mean $160.86 \pm 10.57$ (144-170)	$136.67 \pm 22.72$ (104-166)	$142.57 \pm 15.04$ (120-162)	$141.14 \pm 16.85$ (108-156)
≥ 50	Mean $162.07 \pm 12.98$ (102-174)	$139.78 \pm 9.40$ (120-154)	$147.33 \pm 10.66$ (128-168)	$152.15 \pm 12.70$ (120-166)
p-value	0.914	0.907	0.508	0.059

**Table 2.** Show knee flexing angulation in each posture of three observers n = 35

	kneeling	Cross-legged	Left Monk's position	Right Monk's position
Mean	$163.06 \pm 6.23$ (144-174)	$138.44 \pm 11.70$ (104-168)	$145.02 \pm 11.00$ (120-168)	$149.91 \pm 13.90$ (98-168)

**Table 3.** Inter-observer measurement results

	Sum of Squares	df	Mean Square	F	Sig.
<b>Kneeling Position</b>					
Between Groups	33.588	2	16.794	0.428	0.653
Within Groups	3,882.059	99	39.213		
Total	3,915.647	101			
<b>Cross-legged Position</b>					
Between Groups	3.733	2	1.867	0.013	0.987
Within Groups	14,242.114	102	139.629		
Total	14,245.848	104			
<b>Monk's left Position</b>					
Between Groups	22.296	2	11.148	0.091	0.913
Within Groups	12,925.667	105	123.102		
Total	12,947.963	107			
<b>Monk's right Position</b>					
Between Groups	44.963	2	22.481	0.114	0.892
Within Groups	20,628.111	105	196.458		
Total	20,673.074	107			

**Table 4.** Multiple comparison tests for two doctors

Dependent Variable	(I) Doctor	(J) Observing doctor	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Kneelingposition	1	2	0.47	1.519	0.953	-3.30	4.25
		3	1.38	1.519	0.662	-2.39	5.16
	2	1	-0.47	1.519	0.953	-4.25	3.30
		3	0.91	1.519	0.835	-2.86	4.69
	3	1	-1.38	1.519	0.662	-5.16	2.39
		2	-0.91	1.519	0.835	-4.69	2.86
Cross-leggedposition	1	2	0.00	2.825	1.000	-7.02	7.02
		3	0.40	2.825	0.990	-6.62	7.42
	2	1	0.00	2.825	1.000	-7.02	7.02
		3	0.40	2.825	0.990	-6.62	7.42
	3	1	-0.40	2.825	0.990	-7.42	6.62
		2	-0.40	2.825	0.990	-7.42	6.62
Monk'sright position	1	2	0.22	2.615	0.996	-6.27	6.72
		3	1.06	2.615	0.922	-5.44	7.55
	2	1	-0.22	2.615	0.996	-6.72	6.27
		3	0.83	2.615	0.951	-5.66	7.33
	3	1	-1.06	2.615	0.922	-7.55	5.44
		2	-0.83	2.615	0.951	-7.33	5.66
Monk's left position	1	2	0.17	3.304	0.999	-8.04	8.37
		3	1.44	3.304	0.909	-6.76	9.65
	2	1	-0.17	3.304	0.999	-8.37	8.04
		3	1.28	3.304	0.928	-6.93	9.48
	3	1	-1.44	3.304	0.909	-9.65	6.76
		2	-1.28	3.304	0.928	-9.48	6.93

also use the motion of the hip and ankle joints. This study did not include any analysis of the motion of hip

and ankle joints which may affect the angulations of the knee.



**Fig. 1** Main floor activity positions of Thai monks. (A = Kneeling, B = Cross-legged, C = Right monk's position, D= Left monk's position)



**Fig. 2** Radiograph films shown the references line at posterior cortex of the femur and posterior cortex of the tibia (A = Kneeling, B = Cross-legged, C = Right monk's position, D = Left monk's position)

The present study shows that there's no inter-observer different when measure the knee angle by radiograph imaging. This means that the measurement by radiograph imaging has a high reliability.

For further consideration, the results of the previous postoperative TKA range of motion's studies were as follows: Western population-average 100-115 degrees<sup>(11)</sup>, Japanese population-average 127 degrees<sup>(8)</sup>, Hong Kong & China-average  $105.1 \pm 14.2$ <sup>(5)</sup> degrees, The LPS design (high flex TKA) had an average of 140 degrees (115-160 degrees) as at three months after surgery, Muslim population-average 142 degrees (115 – 160 degrees) as at twenty-four months<sup>(6)</sup>.

### Conclusion

After performed TKA, the knee flexing capacity may not high enough for Thai Buddhist monk to live comfortably with their daily floor-based activity. In the future, the authors should focus on developing novel prostheses that can achieve more flexing capacity

for Thai monks.

### Potential conflicts of interest

None.

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## วิเคราะห์พิสัยการงอข้อเข่าในท่าคุกเข่า ท่าพับเพียบและท่าขัดสมาธิของพระสงฆ์ไทยและความเป็นไปได้ในการทำกิจวัตรของสงฆ์หลังผ่าตัดเปลี่ยนข้อเข่า

วิริยะ ศรีสุริยสวัสดิ์

**วัตถุประสงค์:** เพื่อศึกษามุมงอของข้อเข่าในท่าคุกเข่า ท่าพับเพียบและท่าขัดสมาธิในพระสงฆ์ไทย เพื่อศึกษาความน่าเชื่อถือ (interobserver reliability) ของการวัดค่ามุมงอข้อเข่าในท่าคุกเข่า ท่าพับเพียบ และท่าขัดสมาธิโดยใช้ภาพถ่ายรังสี ตลอดจนวิเคราะห์ความเป็นไปได้ในการทำท่าดังกล่าวหลังจากผ่าตัดเปลี่ยนข้อเข่าเทียม

**วัสดุและวิธีการ:** เก็บข้อมูลการวิจัยแบบ descriptive study โดยเก็บข้อมูลค่ามุมงอข้อเข่า 2 ข้าง ในท่าคุกเข่า ท่าพับเพียบและท่าขัดสมาธิในพระสงฆ์ไทย ที่โรงพยาบาลสงฆ์ จำนวน 35 ราย โดยใช้ข้อมูลจากภาพถ่ายรังสีในท่านั่งคุกเข่า ท่าพับเพียบและท่าขัดสมาธิ โดยใช้ภาพถ่ายรังสี วัดมุมโดยรังสีแพทย์ 1 คน แพทย์ศัลยกรรมกระดูก 2 คน เพื่อศึกษาความแตกต่างและความน่าเชื่อถือของการวัดมุมโดยใช้ภาพถ่ายรังสี นำค่าที่ได้จากการวัดมุมงอข้อเข่าจากการศึกษานี้ไปเปรียบเทียบกับข้อมูลของมุมงอเข่าหลังผ่าตัดเปลี่ยนข้อเข่าเทียมจากการศึกษาก่อนหน้านี้

**ผลการศึกษา:** มุมงอข้อเข่าเฉลี่ยในท่าคุกเข่ามีค่า 163.21 องศา ท่าพับเพียบข้างซ้ายมีค่า 146.49 องศา ท่าพับเพียบข้างขวามีค่า 148.89 องศา มุมงอข้อเข่าในท่าขัดสมาธิมีค่า 138.21 องศา การวัดมุมงอข้อเข่าเฉลี่ยโดยใช้ภาพถ่ายรังสีในท่าคุกเข่า ท่าพับเพียบและท่าขัดสมาธิมีความแม่นยำสูงถึงแม้จะวัดจากแพทย์ 3 คน

**สรุป:** ภายหลังจากการผ่าตัดเปลี่ยนข้อเข่าเทียม มุมงอของข้อเข่าเฉลี่ยมีค่า 100-127 องศา ซึ่งมีค่าน้อยกว่ามุมงอเฉลี่ยที่จำเป็นต้องใช้ในการนั่งคุกเข่าพับเพียบและขัดสมาธิ

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