
가		180 (canal flare index)	
(normal)	79.4%	(champagne flute)	15.0%
가	가	4.02 ± 0.65	(stovepipe) 5.6%
가	가	가	가
가	가	가	가

가	가	1,17)	2	3
가	가	가	가	가
가	가	가	가	가
가	가	가	가	가

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* 2004 48

가

가

10,11,22,26)

(Fig. 1).

가 , 3 가

가¹⁸⁾ ,

가 3

가

20

mm

20 mm
(canal flare index)

1.

¹³⁾(Fig. 2).

2001 3 2003 12

180

20 83

(20 ~ 29, 30 ~ 39, 40 ~ 49, 50 ~ 59, 60 ~ 69,

70 ~ 83) 6

30

2.

1)

(offset)

15

2)

Noble ¹³⁾

(offset),

20 mm

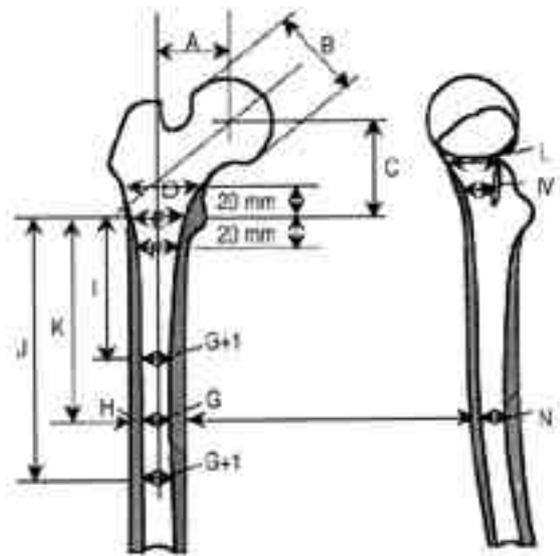


Fig. 1. Diagrammatic representation of the standard dimensions of the femur in the anteroposterior and lateral views. (A) Femoral head offset (B) Femoral head diameter (C) Femoral head position (D) Canal width at 20 mm proximal to lesser trochanter (E) Canal width at lesser trochanter (F) Canal width at 20 mm distal to lesser trochanter (G) Mediolateral isthmus width (H) Mediolateral extracortical width (I) Proximal border of isthmus (K) Isthmus position (L) Anteroposterior canal width at osteotomy level (M) Anteroposterior canal width at femoral neck center (N) Anteroposterior isthmus width.

1 mm

가

, p 0.05

Pearson

13 mm

1.

3)

8.3%

parameter)	(endosteal parameter)	(periosteal parameter)		
Noble ¹³⁾	3.0	4.7	41.1±4.0 mm	37.4
(stovepipe)	3.0	4.7	±4.2 mm	39.2±4.5 mm
(normal)	4.7			49.9±3.1 mm
(champagne flute)			44.2±2.3 mm	47.0±3.9
			50.8±5.7 mm	54.0±4.9
			47.6±4.5 mm	20 mm
			47.0±4.9 mm	
			43.6±4.6 mm	45.3±5.1 mm
				28.8
			±3.6 mm	26.0±3.0 mm
			27.4±3.6 mm	20 mm
				20.8±2.8 mm
			18.3±2.4 mm	19.6±2.9
			mm	12.2±
			1.8 mm	10.9±1.7 mm
			11.5±1.9 mm	
			28.0±2.2 mm	25.8±2.6 mm
				26.8±2.6 mm
				71.9±16.6 mm
			74.7±13.9 mm	73.3±15.4 mm
				141.3±20.3 mm
				140.9±17.8 mm
			141.1±19.0 mm	101.5
			±18.0 mm	101.7±13.2 mm
				102.1±15.7 mm
				24.6±2.8 mm
			±2.4 mm	23.6±2.8 mm
				17.3±2.4 mm
				15.9±2.1 mm
			16.6 ±2.4 mm	
				13.9±2.1 mm
				12.3±1.8 mm
				13.1±2.1 mm
				126.2±4.1°
				127.3±5.1°
				126.8±4.7°
				(Table 1, 2).

Students t-test

CANAL FLARE INDEX = AB

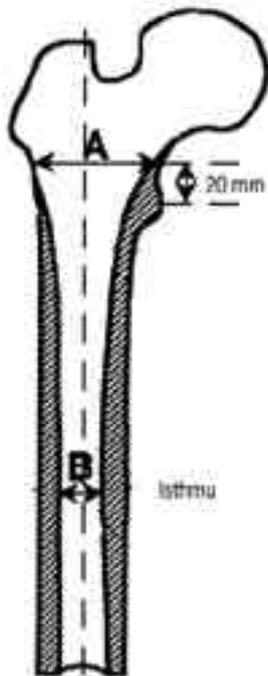


Fig. 2. Diagrammatic representation of the canal flare index.

(0.72-

2. 0.92) (Table 3).

Pearson -0.008((r=0.76) 1.139)

0.915(20 mm)
5%

3.

± 0.65 2.4 5.8 4.02
143 (79.4%), 10 (5.6%), 27 (15.0%)

Table 1. Mean values of variables measured in the total subjects

Parameters	Average	Minimum	Maximum
Femoral head offset (mm)	39.2 ± 4.5	25.9	51.4
Femoral head diameter (mm)	47.0 ± 3.9	39.1	57.2
Femoral head position (mm)	50.8 ± 5.7	37.6	66.0
Canal width at 20mm proximal to LT (mm)	45.3 ± 5.1	32.5	61.2
Canal width at LT (mm)	27.4 ± 3.6	17.6	42.7
Canal width at 20mm distal to LT (mm)	19.6 ± 2.9	13.1	32.9
Mediolateral isthmus width (mm)	11.5 ± 1.9	7.4	19.7
Mediolateral extracortical width (mm)	26.8 ± 2.6	20.8	36.7
Proximal border of isthmus (mm)	73.3 ± 15.4	32.1	119.6
Distal border of isthmus (mm)	141.1 ± 19.0	81.1	204.0
Isthmus position (mm)	102.1 ± 15.7	57.3	142.7
AP canal width at osteotomy level (mm)	23.6 ± 2.8	16.6	30.4
AP canal width at femoral neck center (mm)	16.6 ± 2.4	10.0	22.7
AP isthmus width (mm)	13.1 ± 2.1	8.5	20.0
Neck-shaft angle (degree)	126.8 ± 4.7	114.4	140.1

Table 2. Comparison of mean values and statistical significance between male and female subjects

Parameters	Male	Female	p value
Femoral head offset (mm)	41.1 ± 4.0	37.4 ± 4.2	<0.05
Femoral head diameter (mm)	49.9 ± 3.1	44.2 ± 2.3	<0.05
Femoral head position (mm)	54.0 ± 4.9	47.6 ± 4.5	<0.05
Canal width at 20mm proximal to LT (mm)	47.0 ± 4.9	43.6 ± 4.6	<0.05
Canal width at LT (mm)	28.8 ± 3.6	26.0 ± 3.0	<0.05
Canal width at 20mm distal to LT (mm)	20.8 ± 2.8	18.3 ± 2.4	<0.05
Mediolateral isthmus width (mm)	12.2 ± 1.8	10.9 ± 1.7	<0.05
Mediolateral extracortical width (mm)	28.0 ± 2.2	25.8 ± 2.6	<0.05
Proximal border of isthmus (mm)	71.9 ± 16.6	74.7 ± 13.9	>0.05
Distal border of isthmus (mm)	141.3 ± 20.3	140.9 ± 17.8	>0.05
Isthmus position (mm)	101.5 ± 18.0	101.7 ± 13.2	>0.05
AP canal width at osteotomy level (mm)	24.6 ± 2.8	22.5 ± 2.4	<0.05
AP canal width at femoral neck center (mm)	17.3 ± 2.4	15.9 ± 2.1	<0.05
AP isthmus width (mm)	13.9 ± 2.1	12.3 ± 1.8	<0.05
Neck-shaft angle (degree)	126.2 ± 4.1	127.3 ± 5.1	>0.05

(Fig. 3).

3.93±0.61, (r=-0.75, p<0.05), 4.11±0.67
 4. (r=-0.35, p<0.05) (r=-0.54, p<0.05)가
 (r=-0.15, p>0.05). (r=-0.24, p<0.05)
 (r=0.26, p<0.05) (r=0.30, p<0.05), (r=0.23, p<0.05)

5.

1)

Noble¹³⁾ Rubin¹⁸⁾가
 Noble

20 mm
 13, 14, 18)
 20 mm (Table 4).
 5.6%,
 79.4%, 15.0% Noble¹³⁾
 9%, 83%, 8%
 Noble¹³⁾ 3.8±0.74 Rubin¹⁸⁾ 4.02±0.65
 3.36±0.75 (Table 5).
 가

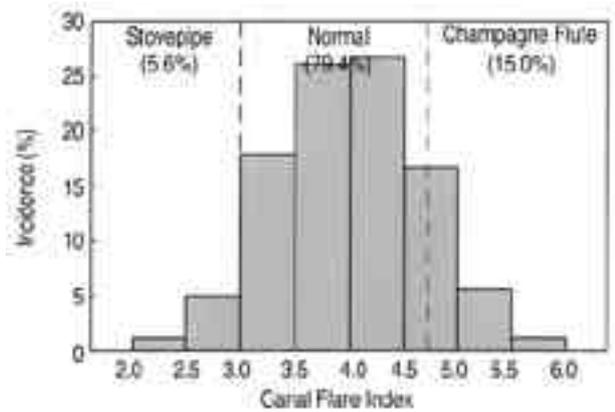


Fig. 3. Distribution of values of the canal flare index.

Table 3. Typical values of Pearson correlation coefficients for dimensions in the total subjects

Variables	Correlation Coefficient(r)	p value
Periosteal / Periosteal		
Femoral head diameter vs. Femoral head position	0.594	<0.05
Femoral head diameter vs. Mediolaral extracortical width	0.560	<0.05
Femoral head offset vs. Mediolaral extracortical width	0.525	<0.05
Femoral head diameter vs. Neck-shaft angle	-0.033	>0.05
Endosteal / Endosteal		
Canal width at 20mm distal to LT vs. Canal width at LT	0.915	<0.05
Canal width at 20mm proximal to LT vs. Canal width at LT	0.863	<0.05
Canal width at LT vs. Mediolaral isthmus width	0.474	<0.05
Distal border of isthmus vs. AP canal width at neck center	-0.008	>0.05
Periosteal / Endosteal		
Canal width at 20mm distal to LT vs Femoral head diameter	0.563	<0.05
Mediolaral isthmus width vs. Mediolaral extracortical width	0.522	<0.05
Mediolaral isthmus width vs. Femoral head offset	0.326	<0.05
Isthmus position vs. Femoral head offset	0.053	>0.05
Distal border of isthmus vs. Femoral head diameter	-0.061	>0.05

70 40
 70 83 (75.4)
 3.55±0.63(20.0%, 73.3%,
 6.7%) Noble¹³⁾ Rubin¹⁸⁾ 3,4,9,20,23)
 , 40 83 (59.3)
 3.95±0.62 Noble¹⁴⁾ 가 ,
 가 (Table 6).
 가
 10,11,22,26)

Table 4. Comparison of variables with those of Westerner

Parameters	Average	Noble et al (1988)	Rubin et al (1992)
Femoral head offset (mm)	39.2	43.0	47.0
Femoral head diameter (mm)	47.0	46.1	43.4
Femoral head position (mm)	50.8	51.6	56.1
Canal width at 20mm proximal to LT (mm)	45.3	45.4	43.1
Canal width at LT (mm)	27.4	29.4	27.9
Canal width at 20mm distal to LT (mm)	19.6	20.9	21.0
Mediolateral isthmus width (mm)	11.5	12.3	13.1
Mediolateral extracortical width (mm)	26.8	27.0	26.7
Proximal border of isthmus (mm)	73.3	86.1	
Distal border of isthmus (mm)	141.1	145.0	
Isthmus position (mm)	102.1	113.4	105.7
AP canal width at osteotomy level (mm)	23.6	24.1	
AP canal width at femoral neck center (mm)	16.6	16.5	
AP isthmus width (mm)	13.1	16.9	
Neck-shaft angle (degree)	126.8	124.7	122.9

Table 5. Comparison of canal flare index and age distribution

Authors	Canal flare index	Age (years)
Noble et al (1988)	3.8 ± 0.74 (9%, 83%, 8%)	22~95 (79.9)
Rubin et al (1992)	3.36 ± 0.75	70~95 (82.0)
Noble et al (1995)	4.05 ± 0.66	40~90 (62.5)
Our Study	4.02 ± 0.65 (5.6%, 79.4%, 15.0%)	20~83 (49.5)
Kim et al (1996)	4.3 ± 0.81 (3.3%, 65.2%, 31.5%)	18~69 (43.5)
Khang et al (2003)	4.4 ± 0.8 (1.5%, 71.1%, 27.4%)	20~69
Yoo et al (1994)	3.8 ± 0.7 (8.4%, 70.0%, 21.6%)	

Table 6. Comparison of canal flare index with that of Westerner in the similar age group

Authors	Canal flare index	Age (years)
Our Study (>70 yrs)	3.55 ± 0.63 (20.0%, 73.3%, 6.7%)	70~83 (75.4)
Noble et al (1988)	3.8 ± 0.74 (9%, 83%, 8%)	22~95 (79.9)
Rubin et al (1992)	3.36 ± 0.75	70~95 (82.0)
Our Study (>40 yrs)	3.95 ± 0.62 (6.7%, 82.5%, 10.8%)	40~83 (59.3)
Noble et al (1995)	4.05 ± 0.66	40~90 (62.5)

가 , 가 가
 Noble¹³⁾ 가 Noble¹³⁾ 가
 Noble¹³⁾ 3.8±0.74
 Noble¹³⁾ 9%, 83%, 8% Rubi¹⁸⁾
 (0.72 ~ 0.92) 3.36±0.75
 Noble¹³⁾ 0.7 가 8.4%, 70%, 21.6% 3.8±
 Noble¹³⁾ (1.374) 1.139 4.3±0.81, 가 3.3%, 65.2%,
 가¹¹⁾ (1.139)¹⁰⁾ 31.5% 4.4±0.8, 가 1.5%, 71.1%, 27.4%
 (1.125) 가^{10,11,26)}
 5.6%,
 79.4%, 15.0% Noble¹³⁾
 13, 18) 9%, 83%, 8%
 가 0.65 Noble⁷⁾ 3.8±0.74 Rubi¹⁸⁾
 47.0 ± 3.9 18) 3.36±0.75
 mm Noble¹³⁾ 46.1±4.8 mm Clark
⁵⁾ 47.5±4.2 mm
^{14,22)} 126.8±4.7°
 Noble¹³⁾ 124.7±7.4° Rubi¹⁸⁾ 가 22
 122.9±7.6° 95 Noble¹³⁾ 가 22
²²⁾ 127.8±5.2°²⁶⁾ 127.8 가 70 95 Rubi¹⁸⁾
 ±5.7°²²⁾ 82 가¹¹⁾ 가
 18 69 43.5
 20 83 49.5
 126.2°, 127.3°¹⁰⁾ 가 20
 69 가
 (Table 5).
 Noble¹³⁾ 가 가^{6,13,14,18,19,21)}
 가 가 Noble¹³⁾
 Noble¹³⁾ 가 가
 11.3 mm, 12.8 mm, 3.9 mm 가
 20 mm 60
^{13,14,18)} 20 mm
 13,14,18) 가 70 40

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ABSTRACT

Radiographic Analysis of the Size and Shape of Proximal Femur

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Purpose: This study aimed to evaluate anatomical character of proximal femoral canal of Korean.

Materials and Methods: Total 180 radiographs of proximal femur of healthy subjects without previous trauma or other pathology in hip joint were reviewed to measure the parameters and analyze the correlation.

Results: Femoral head offset of Korean was small and femoral neck-shaft angle was large. Weakest correlations were observed between pairs of periosteal and endosteal parameters. Stronger correlations were observed between parameters describing the width of the canal in the vicinity of the lesser trochanter. The proximal canal was more flared at proximal to lesser trochanter. The shape of the endosteal canal of isthmus is nearly circular in Korean. Canal flare index was distributed from 2.4 to 5.8 with an average of 4.02 ± 0.65 . The stovepipe, the normal, and the champagne flute type included 5.6%, 79.4%, 15.0%, respectively. The canal flare index decreased gradually according to age.

Conclusion: Geometry of femur from Korean showed some characteristic features. The canal flare index of Korean femur and its distribution of type are not differ from those of American femur in the similar age group.

Key Words: Proximal femur, Size and shape, Canal flare index