

CHAPTER III

MATERIALS AND METHODS

Patients Selection

Between January 2007 and December 2007, 200 consecutive knee magnetic resonance imaging studies were performed on the Thai subjects. The selection criteria of each subject included 40 to 70 years of age, with normal lower limb alignment and no clinical symptoms and signs of knee arthritis with normal anatomical profile of the femoral and tibial bones. Eighty-one knees were males and 119 females. The demographic data are shown in Table 1.

Table 1.

The basic information of the subjects*

Sex	Subjects Number	Age (year)	Weight (Kg.)	Height (cm.)
Total	200	52 ± 7.5 (40-70)	64.38 ± 13.13 (41-100)	158.75 ± 7.57(150-176)
Male	81	51 ± 7.6 (40-70)	73.59 ± 9.72 (54-100)	166.83 ± 8.11(152-176)
Female	119	52 ± 7.4 (40-68)	59.58 ± 12.10 (41-97)	156.55 ± 5.85(150-170)

*Represented as mean ± standard deviation, median (range)

MRI Measurements

MRI was performed using a 1.5 Tesla whole body MR imaging system (Siemens 1.5 Tesla, Avanto, Germany) with an extremity coil. Pulse sequences were T1-weighted images. The direction of axial slice imaging placed the slice perpendicular to the femoral mechanical axis in the coronal plane and perpendicular to the long axis of the femur in the sagittal plane. All 200 images were reconstructed at 3-mm intervals. This study separated the knee joint in 3 parts. There were included the distal femoral condyle, the proximal tibia and the patellar.

The knee joint structures

Part I

Distal femoral condyle

We used the size of the resected femurs to compare with the size of the femoral prostheses in this study. The anterior-posterior length and the medial-lateral width of the distal femoral condyle were measured after a distal femoral cut was completed. The medial condyle was then cut approximately at 10mm and the lateral condyle was cut approximately at 8 mm from the lowest points on the posterior condyles to simulate the optimal cutting thickness^(11, 12) After then, the resected femur was measured. The first line was drawn passing through the anterior cortex of the distal femoral condyle just proximal to the trochlea. This line was paralleled to the transepicondylar axis which was the line from the most medial prominence of the epicondyle to the most lateral prominence of the epicondyle. The second line was drawn passing through the resected posterior condyles. The resected anterior-posterior (AP) length was defined as a distance of the line between the first line to the second line. The resected AP length line was perpendicular to the transepicondylar axis (Fig.1).

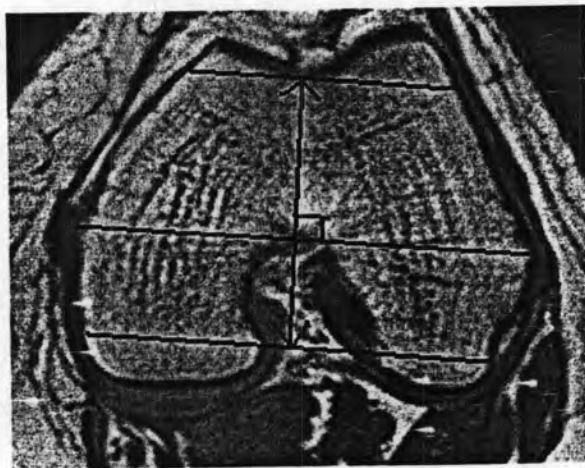


Fig.1 Resected anterior-posterior (AP) length

Medial-lateral (ML) width was defined as the distance between the edges of the medial resected condyle to the lateral resected condyle (Fig.2).

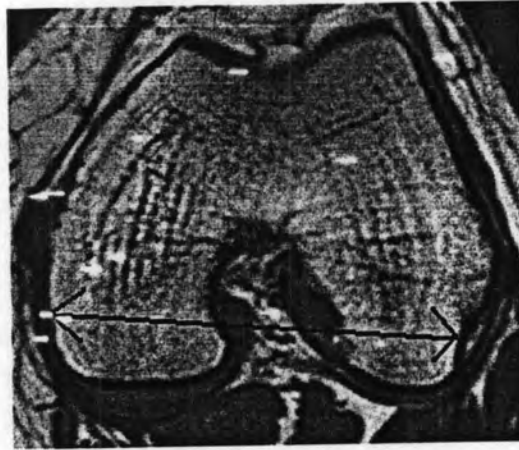


Fig.2 Medial-lateral (ML) width

Part II

Proximal tibia

The slice traversing at the proximal tibia (usually 6 to 8 mm below the lateral tibial plateau) were selected. For choosing tibial slice, a line paralleling the transepicondyle axis and traversing the longest distance on the tibia was drawn, and its length was defined as medial-lateral width. A line perpendicular and through the midpoint of this line was drawn, the length was defined as the anterior-posterior length⁽¹⁰⁾ (Fig.3).

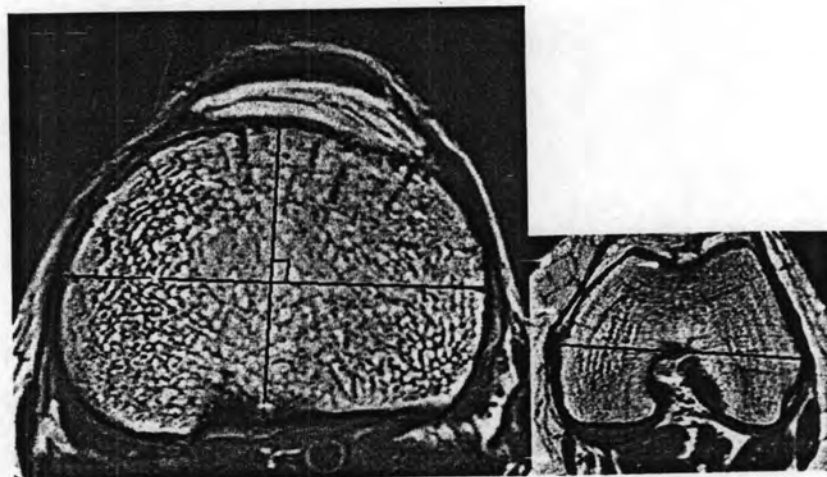


Fig.3 Medial-lateral (ML) width and Anterior-posterior (AP) length

Part III

Patellar

In the axial view or sagittal view, the thickest distance was drawn on the patellar. This line was defined as patellar thickness (Fig.4).

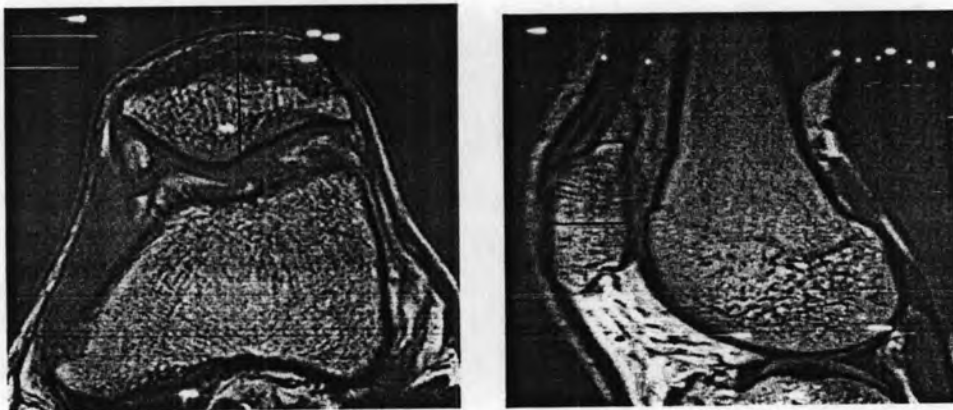


Fig.4 Patellar thickness

In the coronal view or sagittal view, the longest distance between the superior pole and inferior pole of the patellar was defined as superior-inferior (SI) length (Fig.5). In the coronal view or axial view, the longest distance between the medial and lateral side of the patellar was defined as medial-lateral (ML) width ⁽¹⁵⁾ (Fig.6).

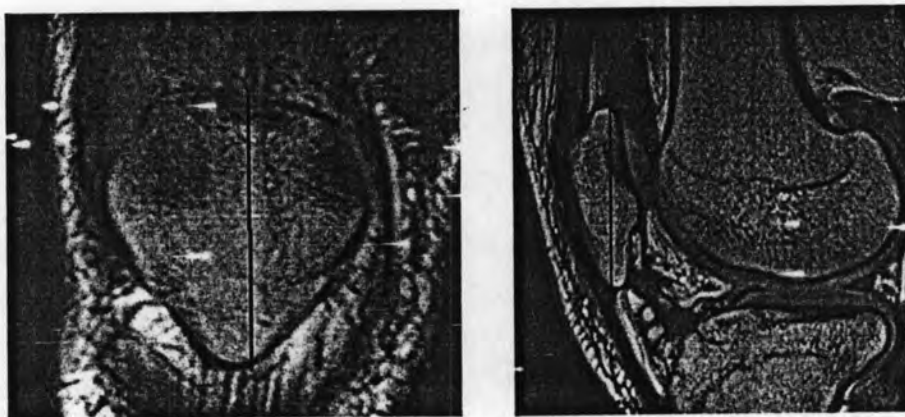


Fig.5 Superior-inferior (SI) length



Fig.6 Medial-lateral (ML) width

All measurements were recorded in millimeters using DICOM imaging program. These dimensions are summarized as the mean and standard deviation (SD). All parameters of the distal femoral condyle and the proximal tibia were compared to the size of the total knee prosthesis (femoral component, tibial component) with four prosthetic systems which were currently used in Thailand, namely; NexGen (Zimmer, Warsaw, Indiana)⁽¹⁶⁾; P.F.C. Sigma (Depuy-Johnson and Johnson, Warsaw, Indiana)⁽¹⁷⁾; Genesis II (Smith&nephew)⁽¹⁸⁾; and Scorpio[™] (Stryker)⁽¹⁹⁾. Each company supplied data regarding the size of these components.

The knee prostheses

Design and sizing features of prostheses

I. NexGen[®] (Zimmer, Warsaw, Indiana)⁽¹⁶⁾

NexGen Legacy Posterior Stabilized (LPS)

Femoral component

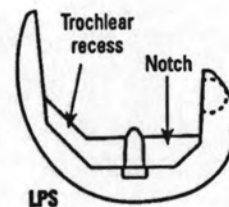
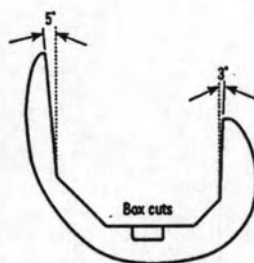
Femoral Size	A/P Box (mm)	M/L (mm)
A	33	54
B	38	58
C	40	60
D	44	64
E	49	68
F	53	72
G	57	76.5
H	62	81

Posterior Stabilized Group

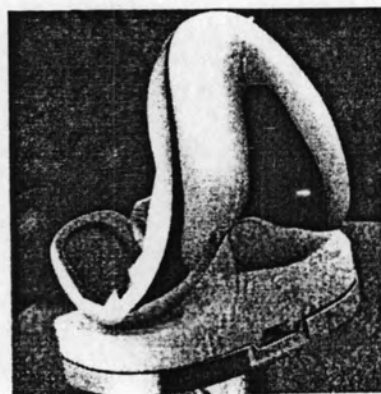


Legacy Posterior
Stabilized (LPS)

T



LPS



LPS

Fig.7 Femoral component and tibial component LCS

Tibial component

SIZE	M/L (mm)	A/P (mm)
1	59	41
2	62	42
3	67	43
4	67	47
5	75	47
6	75	51
7	83	51
8	83	55

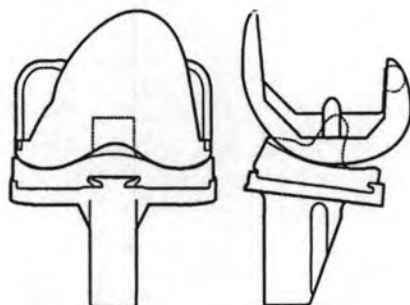


Figure 4-20
Frontal and sagittal views of LPS Femoral Component with a fluted-stem tibial base plate

Fig.8 LCS prosthesis

NEXGEN LEGACY POSTERIOR STABILIZED (LPS)
COLOR KEY FOR ARTICULAR SURFACES AND PATELLAS

		FEMORAL SIZE							
		A	B	C	D	E	F	G	H
M/L		54	58	60	64	68	72	76.5	81
A/P		45.5	49.5	53.5	57.5	61.5	65.5	70.5	76
A/P Box		33.0mm	38.00	40.0	44.0	49.0	53.0	57.0	62.0
Bearing Spacing		36.5mm		42.0mm		44.0mm		48.0mm	
STEMMED TIBIAL SIZE	1-2	P	P	SP	SP				
	3-4	SY _{AB}	SY _{AB}	Y	Y	SY _{EF}	SY _{EF}		
	5-6			SG _{CD}	SG _{CD}	G	G	‡	‡
	7-10					SB	SB	B	B
PATELLA SIZE		Use standard size Patellas with all LPS Femorals.							
	Standard	Standard			Standard				
	26mm* 5972-05-26	32mm* 5972-05-32			38mm 5972-05-38				
	29mm* 5972-05-29	35mm* 5972-05-35			41mm 5972-05-41				

- STEPS**
1. Size femur
 2. Size tibia
 3. Select articular surface color to match femur and tibia
 4. If articular surface is a mis-match, make adjustments to tibial or femoral size
 5. Select patella to match femur

- COLOR KEY**
- P = Purple
 - Y = Yellow
 - G = Green
 - B = Blue
 - SP = Striped Purple
 - SY = Striped Yellow
 - SG = Striped Green
 - SB = Striped Blue

* 26mm Patella is for inseting only
 † 26mm, 29mm, and 32mm Patellas not for use with size G and H Femoral Components, unless used in an inset mode
 ‡ SG_{CD} Articular Surface for size G and H Femoral Components available at a later date

II. P.F.C. Sigma (DePuy-Johnson and Johnson, Warsaw, Indiana)⁽¹⁷⁾

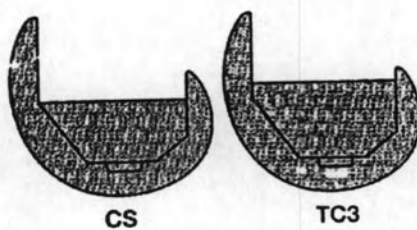
Cruciate Substituting Primary and Revision P.F.C. Sigma Knee System

Femoral and Tibial Insert

Compatibility

Size	Femoral Components		Tibial Inserts	
	resected A/P	M/L	A/P	M/L
1.5	40.5	57	41	61
2	44.5	60	43	64
2.5	45.5	63	45	67
3	48.5	66	47	71
4	52.5	71	51	76
5	56.5	73	55	83
6	61.5	78	59	89

Femoral Components



Tibial Inserts

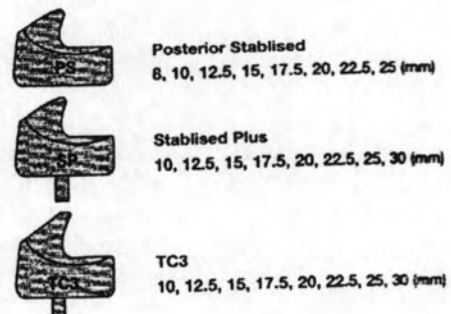


Fig.9 Femoral component and tibial component P.F.C. Sigma

Cruciate Substituting Primary and Revision Femoral and Tibial Insert Compatibility

		FEMORAL COMPONENTS															
		Size 1.5 60AP/61 ML		Size 2 64AP/64 ML		Size 2.5 68AP/68 ML		Size 3 61AP/66 ML		Size 4 65AP/71 ML		Size 5 69AP/73 ML		Size 6 74AP/78 ML			
		CS	TC3	CS	TC3	CS	TC3	CS	TC3	CS	TC3	CS	TC3	CS	TC3		
TIBIAL INSERTS																	
Size 1.5																	
41AP/61 ML	PS-SP	■	■	■	■												
	TC3		■		■												
Size 2																	
43AP/64 ML	PS-SP	■	■	■	■	■	■	■	■								
	TC3		■		■			■		■							
Size 2.5																	
45AP/67 ML	PS-SP			■	■	■	■	■	■								
	TC3				■		■		■								
Size 3																	
47AP/71 ML	PS-SP			■	■	■	■	■	■	■	■						
	TC3					■		■		■		■					
Size 4																	
51AP/76 ML	PS-SP							■	■	■	■	■	■				
	TC3								■		■		■		■		
Size 5																	
55AP/83 ML	PS-SP									■	■	■	■	■			
	TC3										■		■		■		
Size 6																	
60AP/89 ML	PS-SP											■	■	■			

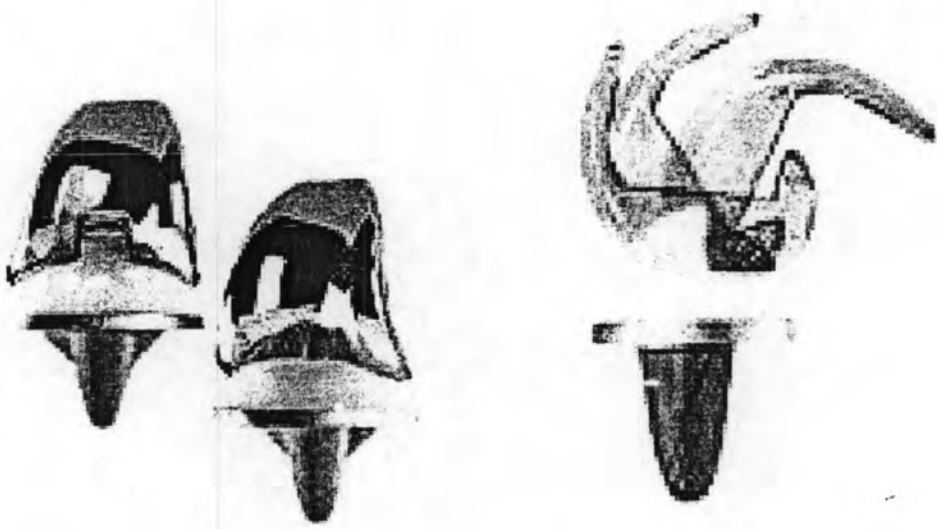


Fig.10 P.F.C. Sigma prosthesis

III. Genesis II (Smith&nephew)⁽¹⁸⁾

Femoral Component

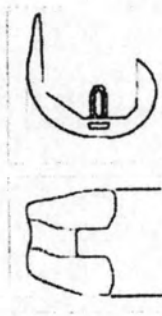
Femoral Size	A/P Box (mm)	M/L (mm)
1	30.5	55
2	34.3	58
3	38.1	58
4	41.7	66
5	45.0	70
6	48.3	73
7	50.3	77
8	54.9	80
9	57.7	85

Tibial component

Tibial Size	A/P (mm)	M/L (mm)
1	42.0	60
2	45	64
3	48	68
4	50	71
5	52	74
6	54	77
7	56	81
8	59	85

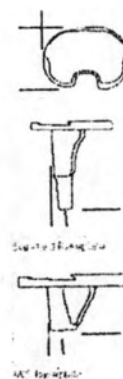
Femoral Component Dimensions

	A/P	ML	A/P Box
Size 1	47.0	55	30.5
Size 2	50.5	58	34.3
Size 3	54.5	58	38.1
Size 4	58.5	66	41.7
Size 5	62.0	70	45.0
Size 6	65.5	73	48.3
Size 7	69.5	77	50.3
Size 8	75.0	80	54.9
Size 9	80.0	85	57.7



Tibial Tray Dimensions

	A/P	ML
Size 1	42	60
Size 2	45	64
Size 3	48	68
Size 4	50	71
Size 5	52	74
Size 6	54	77
Size 7	56	81
Size 8	59	85



Note: Stem sloped 3° posteriorly. Stem length is 51 mm on all nonporous sizes and 25 mm on all porous sizes.

Fig.11 Femoral component and tibial component Genesis II



Genesis II
Total Knee System



Profile
Total Knee System

Fig.12 Genesis II prosthesis

IV. Scorpio™ (Stryker)⁽¹⁹⁾

Scorpio™ PS

Posteriorly Stabilized Single Axis Knee

Femoral Components

Size	Resected A/P (mm)	M/L (mm)
# 3	35	56
# 5	39	61
# 7	44	66
# 9	49	71
# 11	53	76
# 13	58	81

Scorpio™

Single Axis Total Knee System

Tibial Trays

Size	A/P (mm)	M/L (mm)	Stem Length (mm)
3	40	61	30
5	44	66	30
7	47	71	35
9	51	77	35
11	54	82	40
13*	58	88	40

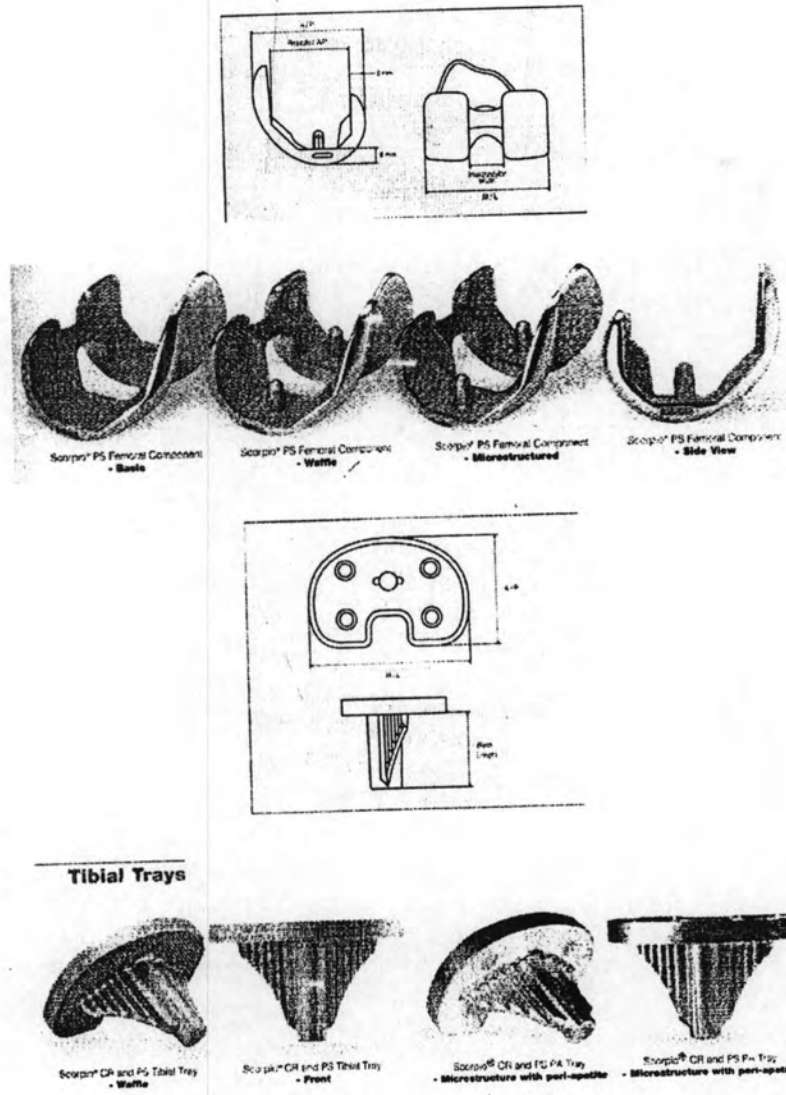


Fig.13 Femoral component and tibial component Scorpion™



Fig.14 Scorpion™ prosthesis



Patellar component

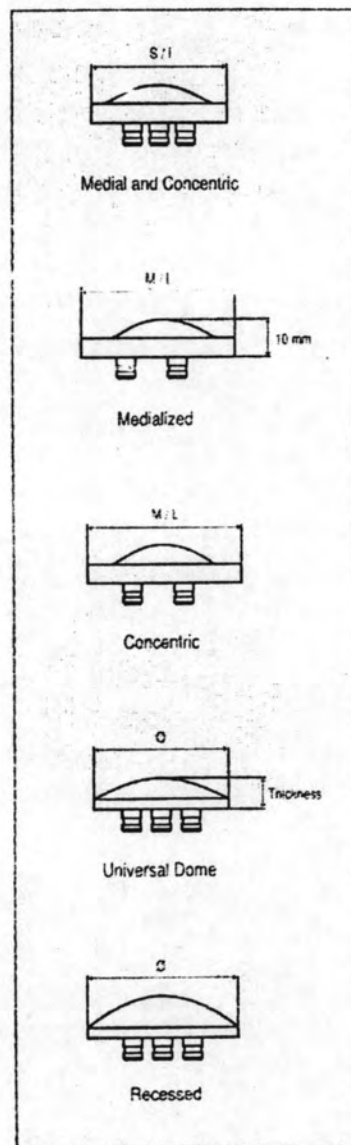
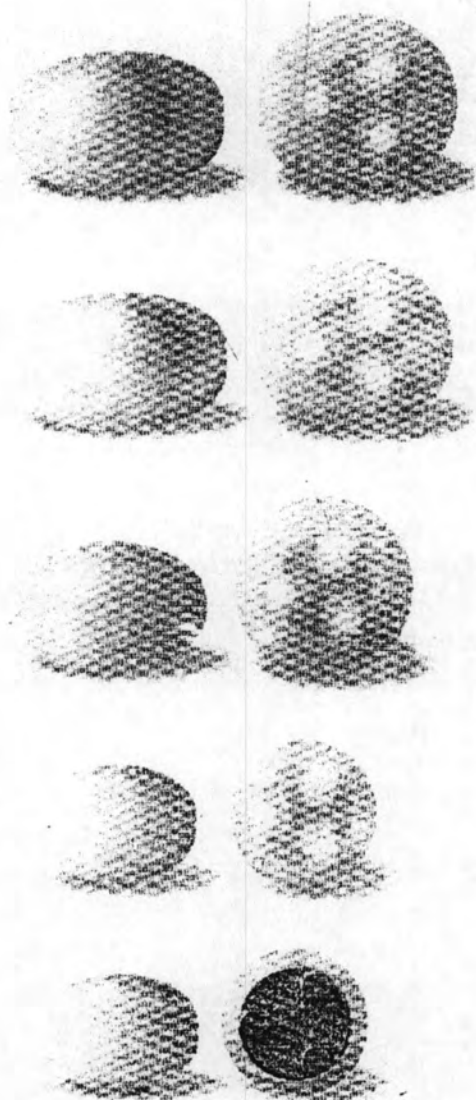


Fig.15 Patellar components

Statistical analysis

The results were represented as mean \pm standard deviation (SD) for comparing the various measurements of the knee joints between genders. Statistical analysis of the results was done using nonparametric test (Mann-Whitney test) by two-tailed p values option. A p value of < 0.05 indicated a significant effect. Linear regression analysis was performed to determine the correlation of the various measurements of the knee joint with the sizing of the four prosthetic systems. Comparative statistical analysis was done by GraphPad Prism 5.01.336 program.