Acta Orthop. Belg., 2015, **81**, 131-140

ORIGINAL STUDY

Functional outcome following primary total knee arthroplasty cannot be predicted using the initial post-operative radiograph

Quen O. Tang, Panagiotis D. Gikas, Philippa A. Tyler, Rikin Hargunani, Robin C. Pollock, Jonathan Miles

From the Institute of Orthopaedics and Musculoskeletal Science, UCL, Adult hip and knee Reconstruction Unit, Royal National Orthopaedic Hospital, Stanmore, HA7 4LP, United Kingdom

Obtaining standardised post-operative radiographs following total knee arthroplasty is common practice. Little is known regarding how measurements taken from the initial post-operative radiograph correlate to functional outcome. The initial post-operative radiographs for 110 primary total knee arthroplasties were reviewed retrospectively. Femoral and tibial component alignment was measured by two independent consultant radiologists. Functional outcome was assessed by the Oxford Knee Score pre-operatively and one year post-operatively. Correlation was determined by Pearson correlation analysis. There was no significant correlation between the radiographic measurements with the one year post-operative Oxford Knee Score nor was there significant correlation with the difference in pre-operative and post-operative scores. The initial post-operative radiograph cannot be used as a tool to reliably predict functional outcome at one year.

Keywords : primary knee arthroplasty ; functional outcome ; plain radiograph ; total knee arthroplasty ; functional score.

INTRODUCTION

Total knee arthroplasty (TKA) surgery is an established and consistently successful treatment option for severe degenerative conditions of the knee (*13,19*). In order to restore function the surgeon aims to achieve suitable alignment of the femoral, tibial and patellar components to reduce both mechanical and shear stresses. Optimal alignment also aids the balancing of forces transmitted to the soft tissue envelope which is critical for the joint's overall function.

Although earlier implants in the 1960s and 1970s were basic and sub-optimal, considerable research has highlighted deficiencies in implant design, type of fixation and surgical technique (*17*). It is now widely recognised that one aspect of surgical technique that significantly impacts on patient satisfaction and implant survival is correct alignment of the tibial and femoral components (*21*). Over the years orthopaedic surgeons around the world are continuing to improve their services ; according to the

■ Quen O. Tang.
■ Panagiotis D. Gikas.
■ Philippa A. Tyler.
■ Rikin Hargunani.
■ Robin C. Pollock.
■ Jonathan Miles.
Institute of Orthopaedics and Musculoskeletal Science, UCL, Adult hip and knee Reconstruction Unit, Royal National Orthopaedic Hospital, Stanmore, HA7 4LP, United Kingdom.
Correspondence : Mr Quen O. Tang, MBChB, BSc, MRCS, 12A, Sterne Street, Shepherds Bush, London, W12 8AD, United Kingdom. E-mail : quentang@gmail.com

No benefits or funds were received in support of this study. The authors report no conflict of interests.

National Joint Registry for England and Wales, TKA's have been reported to achieve improved function, pain relief and > 80% patient satisfaction (*2*). With this information becoming more widely available to the public and ever-increasing mechanical demands from our patients, there is even greater expectation to achieve optimal functional outcome and the so-called "forgotten joint".

Orthopaedic surgeons often request routine immediate post-operative radiographs as a part of their technical assessment and feedback. Some may even advocate that a "good" position will reflect on the patient's functional outcome and satisfaction however the literature to support this is lacking. Although many studies have investigated the relationship between alignment parameters and implant survival (*3,12,14*) few have specifically observed the relation between the immediate post-operative radiograph and functional outcome. In this study we aim to correlate standardised immediate post-operative radiographic parameters with patient functional outcome at one year following primary total knee arthroplasty surgery. In turn we will determine whether patient functional outcome and satisfaction can be predicted with the initial post-operative antero-posterior and lateral knee radiographs.

MATERIALS AND METHODS

All adult (> 18 years) patients, under the care of six Consultant Orthopaedic Surgeons who underwent a primary TKA at the Royal National Orthopaedic Hospital between January 2011 and March 2012 were reviewed. Both male and female subjects were included whose primary pathology was degenerative joint disease including primary and secondary osteoarthritis, rheumatoid arthritis and/or osteonecrosis. All patients had current joint systems that included the Genesis II Total Knee Arthroplasty System (Smith & Nephew), the Press-fit Condylar (PFC) Sigma Knee System (Depuy) and the Triathlon Total Knee System (Stryker). Unicompartmental knee arthroplasties and revision systems used for primary complex total knee arthroplasty were excluded. Patients who had significant premorbid functional disability (i.e. cerebral palsy, contralateral limb amputation) that prevented meaningful functional assessment were also excluded. A total of 110 patients were included in the study.

All radiographs were non-weight bearing views performed within 48 hours post-operatively. The operated leg was positioned with the anterior aspect of the patella pointing directly toward the ceiling with the patient supine. A 110 cm tube to film distance was used. For the antero-posterior (AP) view, the beam was directed perpendicular to the joint line. For the horizontal ray lateral, the knee and extremity were positioned in the same manner except the x-ray beam is directed laterally, 90 degrees to the AP view. All post-operative dressings were in place at the time of radiograph.

The initial post-operative supine antero-posterior and lateral knee radiographs were calibrated using known prosthesis dimensions and analysed using Picture Archiving and Communication System (PACS) software. Measurements were taken by two blinded independent consultant musculoskeletal radiologists to account for inter-observer variability. Radiological assessment comprised the following as determined by the American Knee Society (*6*) :

Coronal plane measurements : The femoral flexion angle in the coronal plane (α) was measured as the angle of a line drawn between the tip of the two femoral condyles of the prosthesis and the anatomical axis of the femur. The tibial angle in the coronal plane (β) was measured as the angle of a line drawn parallel to the tibial base plate and the anatomical axis of the tibia (Fig. 1A and Fig. 2).

Sagittal plane measurements : The femoral flexion angle in the sagittal plane (γ) was measured as the angle of a line drawn perpendicular to the prosthesis that sits on the distal femoral cut and the anatomical axis of the femur. The tibial angle in the sagittal plane (σ) was measured as the angle of a line drawn parallel to the tibial base plate and the anatomical axis of the tibia (Fig. 1B and Fig. 3).

Functional assessment

Patient recorded functional outcome and satisfaction was measured using the Oxford Knee Score (OKS) (Table I). The pre-operative OKS questionnaire was performed during the clinic appointment before they were listed for surgery. Patients were also asked to complete a questionnaire at their one year appointment. The OKS which was devised by Dawson *et al* (*4*) from Oxford is a validated questionnaire that assesses function and pain specifically in patients undergoing TKA surgery. The questionnaire is composed of 12 questions relating to either pain or function. Each is scored between 1 to 5 where no pain scores 1 to severe pain all the time scores 5 for the questions pertaining to pain. Regarding the functional questions ; not at all or easily scores 1 and impossible or

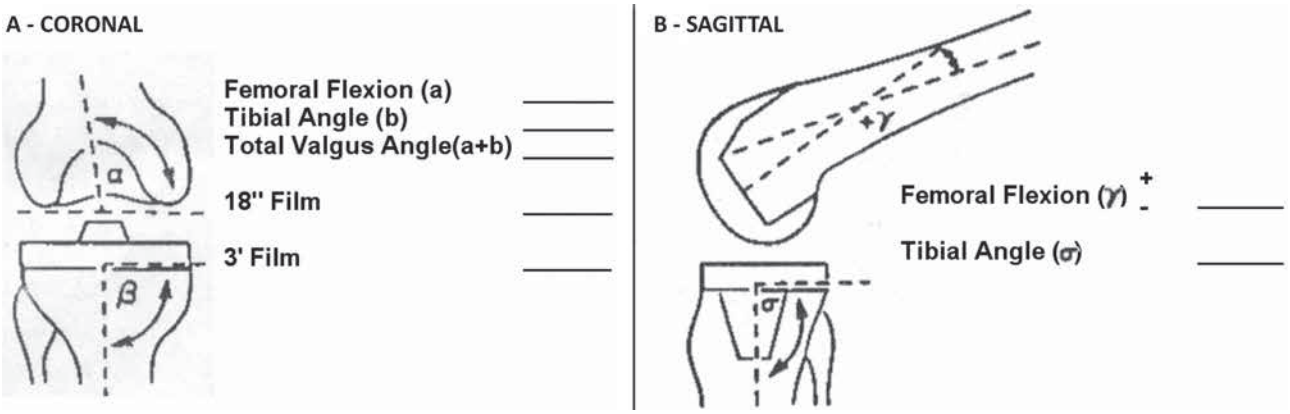

Fig. 1A. — (Coronal) + ***B*** (Sagittal). The measurement criteria as determined by the American Knee Society (*6*)

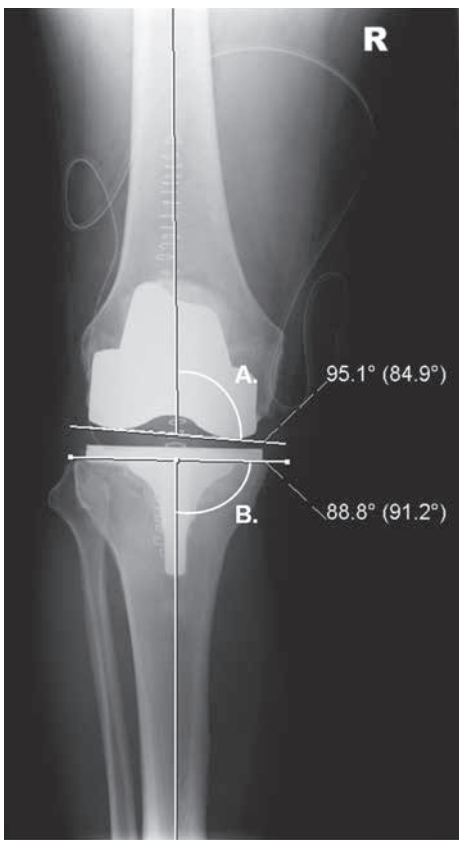

Fig. 2. — Antero-posterior initial post-operative radiographs to illustrate radiographic parameters taken as per the American Knee Society (*6*). A) Frontal Femoral Flexion Angle. B) Frontal Tibial Angle.

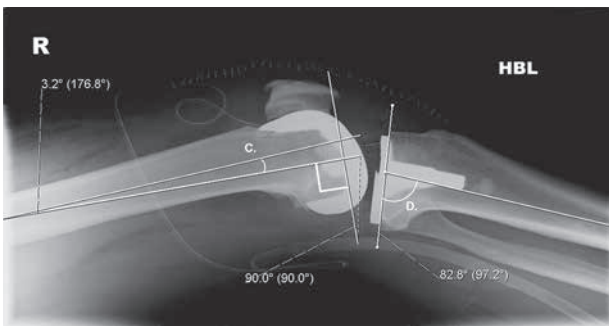

Fig. 3. — Lateral initial post-operative radiographs to illustrate radiographic parameters taken as per the American Knee Society (*6*). C) Lateral Femoral Flexion Angle. D) Lateral Tibial Angle.

totally scores 5. The final score is calculated by subtracting the score from the questionnaire from 60. A maximum score of 48 equates to no pain nor limitations of function.

Statistical methodology

The Intraclass Correlation Coefficient (ICC) two-way random model on absolute agreement was used to analyse measurement reliability between observers (*20*). The ICC ranges from 0 (no agreement) to 1 (perfect agreement). For Interpretation of ICC, Fleiss *et al* (*7*) advises 'No universally applicable standards are possible for what constitutes poor, fair, or good reliability'. In general, values below 0.4 may be taken to represent poor reliability, values above 0.75 represents excellent reliability, and values between 0.4 and 0.75 may be taken to represent fair to good reliability (*7*). To detect an ICC of 0.75 to within 20% using 2 repeats for each subject, at least 75 subjects would be required (calculation performed using

Table I. — Breakdown of the Oxford Knee Score (*4*). (P) pain question, (F) function question

Question	Scoring categories
1. How would you usually describe the pain from you knee ? (P)	1 None 2 Very mild 3 Mild 4 Moderate 5 Severe
2. Have you had any trouble with washing and drying yourself (all over) because of your knee ? (F)	1 No trouble at all 2 Very little trouble 3 Moderate trouble 4 Extreme difficulty 5 Impossible to do
3. Have you had any trouble getting in and out of a car or using public transport because of your knee ? (whichever you tend to use) (F)	1 No trouble at all 2 Very little trouble 3 Moderate trouble 4 Extreme difficulty 5 Impossible to do
4. For how long have you been able to walk before the pain from your knee becomes severe ? (with or without a stick) (P)	1 No pain/> 30 min 2 16 to 30 min 3 5 to 15 min 4 Around the house only 5 Not at all - severe on walking
5. After a meal (sat at a table), how painful has it been for you to stand up from a chair because of your knee ? (P)	1 Not at all painful 2 Slightly painful 3 Moderately painful 4 Very painful 5 Unbearable
6. Have you been limping when walking, because of your knee ? (F)	1 Rarely/never 2 Sometimes or just at first 3 Often, not just at first 4 Most of the time 5 All of the time
7. Could you kneel down and get up again afterwards ? (F)	1 Yes easily 2 With little difficulty 3 With moderate difficulty 4 With extreme difficulty 5 No impossible
8. Have you been limping when walking, because of your knee ? (P)	1 No nights 2 Only 1 or 2 nights 3 Some night 4 Most nights 5 Every night
9. How much has pain from your knee interfered with your usual work (including housework) ? (P)	1 Not at all 2 A little bit 3 Moderately 4 Greatly 5 Totally
10. Have you felt that your knee might suddenly “give way” or let you down ? (F)	1 Rarely/never 2 Sometimes or just at first 3 Often, not just at first 4 Most of the time 5 All of the time
11. Could you do the household shopping on your own ? (F)	1 Yes easily 2 With little difficulty 3 With moderate difficulty 4 With extreme difficulty 5 No impossible
12. Could you walk down a flight of stairs ? (F)	1 Yes easily 2 With little difficulty 3 With moderate difficulty 4 With extreme difficulty 5 No impossible

Stata/IC version 12.1). Pearson correlation analysis was used to determine the relationship between the radiographic measurements and the one year post op and the numerical difference in OKS (a negative value corresponding to a deterioration in function and a positive value corresponding to an improvement in function at one year). 110 patients enable detection of a correlation coefficient of 0.30 to 0.35 with 90% power and 5% significance (*11*). Statistical analysis was performed using SPSS/IBM.

RESULTS

Out of the 110 patients included in the study 49 (45%) were male and 61 (55%) were female. Patients were of Caucasian, Asian and Afro-Caribbean ethnicity. The age ranged between 34 to 88 years (mean 67 years). The male patients ranged between 34 to 88 (median 66 years) and the female patients ranged between 40 to 87 (median 72 years). Between the 2 observers the smallest measured frontal femoral flexion angle was 79.2 degrees and the largest was 102.6 degrees (95.95 degrees median). The smallest measured frontal tibial angle was 82.2 degrees and the largest was 98.3 degrees (88.85 degrees median). The smallest measured lateral femoral flexion angle was -5.1 degrees and the largest was 10.1 degrees (2 degrees median). Finally the smallest measured lateral tibial angle was 79 degrees and the largest was 100.2 degrees (85.75 degrees median). The lowest recorded pre-operative OKS was 2 and the highest was 39 (20 median). The lowest one year post operative OKS was 6 and the highest was 48 (33 median). Fourteen out of 110 patients reported that their function and pain had increased at one year since their TKA. Two out of 110 reported that their pain and function was indifferent at one year. The remaining 94 patients reported that their pain and function had improved. The individual values obtained for each patient is summarised in table II.

The ICC showed very good to excellent agreement of measurements between the observers (Table III). The ICC ranged from 0.70 for frontal femoral flexion angle to 0.85 for lateral femoral flexion angle. Values between 0.4 and 0.75 represents fair to good reliability whereas values above 0.75 represents excellent reliability. The agreement of all the radiographic measurements were statistically significant ($p < 0.001$).

There was no significant correlation between the radiographic measurements with the one year post-operative OKS nor was there significant correlation with the difference in pre-operative and post operative scores according to the Pearson Correlation Coefficient (Table IV). The Pearson Correlation Coefficient ranged from 0.39 to -0.18, all of which were statistically insignificant.

DISCUSSION

We have shown that the inter-observer reliability in measuring the frontal femoral flexion angle and the frontal tibial angle from the initial standardised post-operative radiograph following TKA is very good (ICC 0.70 and 0.71 respectively). Moreover, inter-observer reliability in measuring lateral femoral flexion angle and lateral tibial angle was excellent (ICC 0.85 and 0.78 respectively). We also illustrate that there is no significant correlation between any of the radiographic measurements taken from an initial post-operative standardised radiograph with functional outcome as determined by the OKS at one year ($p > 0.05$). There was also no significant correlation between any of these radiographic measurements with the difference in OKS at one year ($p > 0.05$). Our results suggest that one cannot reliably predict improvement or deterioration in functional outcome nor can one reliably predict overall functional outcome at one year from assessing the initial standardised post-operative radiograph.

There are studies that investigate the factors affecting longevity and survivorship of TKA prostheses (*1,9,16*). Certainly, a crucial factor is prosthesis alignment and positioning (*5,18,22*). However, there is a scarcity of literature investigating the information one can obtain from a standardised post-operative film with regards to prosthesis alignment and how this relates to long term functional outcome. Long leg films are preferable in assessing the overall prosthesis alignment (*15*) because it allows accurate calculation of the mechanical and anatomical axis of both femur and tibia. However, this is rarely done routinely due to difficulties with pain and

Table II. — Summary of patient radiographic measurements as taken by two independent consultant musculoskeletal radiologists. The patients are in ascending order dependant on their Oxford Knee Score at one year

Patient number	Sex	Age (years)	OBSERVER 1				OBSERVER 2				Pre op Oxford Knee Score	One year post-op Oxford Knee Score	Oxford Knee Score difference
			Front Fem Flex Angle (degrees)	Front Tib Angle (degrees)	Lat Fem Flex Angle (degrees)	Lat Tib Angle (degrees)	Front Fem Flex Angle (degrees)	Front Tib Angle (degrees)	Lat Fem Flex Angle (degrees)	Lat Tib Angle (degrees)			
1	M	42	96	88	3.1	81	96	87	3.3	81	8	6	-2
2	F	71	93.9	86.7	3.2	90.4	93.9	85.1	3.1	90.2	16	7	-9
3	F	75	96.9	89	3.5	86.4	98.3	89.7	3.5	87	19	8	-11
4	F	69	97.9	87.7	0.6	93.1	100.2	87.2	2.7	92.9	12	8	-4
5	M	62	93.2	90.8	5.6	88.6	95.4	90.1	4.1	86.7	19	9	-10
6	F	60	99.4	89.4	4.5	86.9	100.5	91.3	4.4	85.3	27	13	-14
7	F	75	97.3	98.3	1.2	87.2	98.5	90.2	1.8	87.7	2	14	12
8	F	59	96.2	89.4	1.8	85.1	95.7	89.2	2.1	85.1	8	14	6
9	M	53	93.5	86.6	1.9	89.4	95.4	85.8	0.5	91.1	23	14	-9
10	F	64	82.1	93.7	5.1	91.4	79.2	95	2.8	87.9	16	14	-2
11	F	72	95.1	88	0.4	85.2	94.6	88.8	1.6	85.5	11	15	4
12	F	40	99.7	89.3	4.5	81.8	99	89.3	3.1	79.5	12	15	3
13	F	65	99.3	92.5	0	85	100.9	92.5	0.8	87.3	32	16	-16
14	M	73	94.5	88.7	2.6	85.2	93.4	87.5	1.4	86.9	17	18	1
15	F	69	93.1	91.3	2.9	87	92.6	89.6	2	86.6	5	18	13
16	F	70	100.2	89.4	5.1	87.9	102.2	89.7	4.5	87	13	18	5
17	M	61	97.4	90.5	1.8	87.6	99.3	88.9	2.2	86.3	15	19	4
18	F	74	100.3	91.2	9.7	100.2	80.1	89.2	10.1	85.3	11	19	8
19	M	65	93.8	87.3	1.1	91.2	93.2	87.8	1.6	90.8	19	19	0
20	F	70	95.5	89.9	0.2	85.4	96.2	88.4	0.5	84.1	17	20	3
21	F	73	96.3	89.7	3.1	88.1	98	89	3.5	84.7	21	20	-1
22	M	61	96.8	85.1	2.3	85.5	97.2	83.6	2.7	82.6	19	21	2
23	F	75	95.6	87.4	3.1	84.8	92.8	85.9	3.8	83.9	16	22	6
24	F	66	85.9	90.4	2.1	91.2	86.2	88.4	2.2	92.1	11	22	11
25	F	75	98.2	89.6	0.3	89	101.9	89	0.1	87.8	15	22	7
26	M	64	96.7	90.1	4	83.2	97.5	88.5	0.5	84.2	15	23	8
27	F	62	92.3	92.4	1.4	84.9	94.2	91.2	1.5	82.9	14	25	11
28	M	74	94.1	86.5	0.5	83.8	94.2	86.7	0.3	83.2	28	25	-3
29	F	52	96.9	89.4	3.4	85.4	99.3	87	3	84.8	7	26	19
30	F	79	96	89.5	0.3	83.7	96.6	87.6	1.2	81.8	16	26	10
31	M	72	95.5	88.3	1.6	87.9	95.6	86.6	1.8	87.2	19	26	7
32	F	72	94.6	87.3	1.7	84.1	96.4	87.8	0.5	82.7	25	26	1
33	M	66	95.6	88.9	2	81.2	95.5	88.3	3.3	80.2	20	27	7

34	M	66	98.1	89.8	1.2	83	96.2	90.5	0.9	83.6	16	27	11
35	F	77	99.8	89.3	-1.9	84.6	100.4	86.9	-1.9	86.4	24	27	3
36	M	46	93.9	86.3	1.1	84.9	93.8	87.4	0.1	85	17	27	10
37	F	66	97.5	90.3	2.3	88.9	97.5	89.6	2.9	89.5	19	27	8
38	M	47	98.4	89.3	-1	81.2	100	86.8	-1	80.6	5	28	23
39	F	72	97.9	87.8	0.1	81.9	97.2	86.8	0.9	80.2	19	28	9
40	F	69	97.6	90	2.5	85.2	95.1	90.2	1.5	86.1	38	28	-10
41	F	65	93.5	88.8	1.9	84.1	93.7	88.2	2.4	83.5	16	29	13
42	F	74	95.5	87.9	6.7	83	96.2	88.4	4.7	84.4	19	29	10
43	F	48	94.8	93.5	2.9	85	96.2	88.2	0.8	86.7	19	29	10
44	F	73	93.7	88.2	0.7	88.3	93.9	88.6	1.6	90	6	29	23
45	F	72	97.2	87.2	5	87.7	96.6	87	7.1	88.4	27	29	2
46	F	59	95.5	88.8	3.9	83.2	96.8	91.2	5.2	83.9	36	30	-6
47	M	48	96.2	87.2	0.4	86.5	95.4	86.9	1	88.7	8	30	22
48	M	66	96.1	89.6	0.6	89.1	96.8	86.2	1.8	89.1	36	30	-6
49	M	83	98	89.5	4.1	82.5	99.1	88.4	6.4	85	30	30	0
50	F	77	94.4	88.2	-5.1	82.4	95.1	88.6	-5.1	82.1	20	31	11
51	F	73	96.9	92.8	0.6	79.7	99.6	92.7	0.5	81.5	21	31	10
52	F	64	95.3	90	0.9	85	97.5	89	2.5	86.1	22	31	9
53	M	67	97.7	86.3	4.4	84.3	97	87.1	4.8	82	22	31	9
54	M	60	95.6	88.5	1.9	85.9	96.7	87.1	4.5	85.6	21	32	11
55	M	83	94.1	90.4	3.8	95	93.8	89	2.9	92.8	21	33	12
56	M	54	91.7	88.8	2.7	85.3	92.4	89.1	1.6	86	30	33	3
57	F	72	97.8	87	5.5	83.2	98.3	88.2	4.4	82.6	22	33	11
58	F	72	94	91.1	6	82.5	94.8	90.2	8.6	82.8	9	33	24
59	F	74	94.3	87.2	0.2	80	95	85.9	1.7	79	23	34	11
60	F	81	95	91	1.7	85	98.2	91.1	1	84.4	26	34	8
61	M	34	92.2	88.3	2.8	84.6	94.8	87.6	3.8	86.5	20	34	14
62	M	71	102.6	90.1	3	85	102.1	89	3.5	82.1	21	34	13
63	M	63	94.8	88.1	-2.4	86.7	92.8	88.8	-2.5	86.8	13	34	21
64	F	78	95.8	87.4	2.2	88.7	94.4	87.4	2	85.8	26	35	9
65	F	68	94.5	90.5	0.5	83.6	94.3	91.7	0.5	83.6	15	36	21
66	F	70	100	87.8	4.9	86.9	98	87	3.2	86.3	14	36	22
67	F	77	94.9	90.8	1.2	85.5	96.1	87.4	1	82.3	21	36	15
68	M	60	96.7	87.9	8.8	88.3	96.8	89.5	7.8	87.4	34	36	2
69	M	83	96.9	88.3	0.2	86.4	98.3	89	0.5	83.6	25	37	12
70	M	80	96	89.9	1.1	88.2	94.5	87.7	2	86.2	31	38	7
71	M	57	96.1	91.7	1.9	86.5	95.3	88.2	1.8	87.6	26	38	12
72	F	87	98.7	84.6	1.1	86.9	96.7	85.7	0.4	84.6	13	38	25

73	F	67	94.3	89.4	2.2	85.4	95.3	88.7	3.9	86.3	28	38	10
74	F	80	97.3	86.7	-3.5	89.8	98.2	82.2	-3.2	88	21	39	18
75	M	47	94.6	90.2	1.2	86.1	93.1	89.3	2.8	85.5	12	39	27
76	F	71	95.3	89.6	2.9	85.7	95.8	87.4	3.3	84.8	15	39	24
77	F	69	93.3	92.2	-2	92.3	93.1	94.3	-5	93	28	39	11
78	F	49	93	88.8	3.7	88.6	90.9	89.2	4.1	88.6	12	39	27
79	M	78	99.2	88.7	4.1	88.1	98.1	85	2.8	87.6	35	39	4
80	M	61	95.6	85.2	3.5	89.7	96.7	84.5	4.3	86.5	21	39	18
81	M	59	94.8	91.5	5	88.6	91.7	91.2	6.6	87.3	18	40	22
82	M	34	97.3	85.3	0.3	89.5	99	84.8	3	85	24	40	16
83	M	60	93.9	89.7	1.3	85.5	93.2	91	2	82	18	41	23
84	M	74	96.8	89	1.5	86	97.4	88.5	2.3	84.8	22	41	19
85	M	83	98.1	94.3	0.1	82.6	100	92	1.4	82.7	32	41	9
86	F	86	94.1	86	0.7	90.5	94.8	87.6	1.3	90	10	41	31
87	M	79	96	87.2	2	85	94.9	87.9	3.7	88.7	39	41	2
88	M	72	98.6	89.2	-2.1	82	98.7	86.8	-3.7	82.8	9	42	33
89	F	69	96.9	90.6	0.5	82.3	97.5	90.2	1.9	81.9	21	42	21
90	F	78	95	90.8	0.7	92	92.5	86.6	2.1	92.2	7	43	36
91	M	76	93.3	86.1	0.1	91.5	93.8	86	1.8	91	18	43	25
92	M	69	99.7	86	0.1	86.5	96.8	86.7	1.6	85.5	30	43	13
93	M	66	95.9	85.6	1.8	88.5	96.4	85.3	2.8	89.5	25	43	18
94	F	73	96.9	89.5	0.6	86.8	95.3	89.3	0.9	85	24	43	19
95	F	69	99.2	90.2	1.3	82.8	98.8	90.3	4.9	82.1	22	43	21
96	M	64	97.8	90.6	0.2	88.9	97	89.9	0	89	26	43	17
97	F	53	90	87.6	1.6	83	90.3	89	2.1	83.9	31	44	13
98	M	67	94.3	87.4	1.8	84	92.7	88.9	0.5	86.7	22	44	22
99	F	72	94.8	86.4	3.3	82.2	92.8	86.5	4.9	82	13	44	31
100	F	81	96.7	89.6	5.6	85.9	95.2	90.1	3.8	87	28	44	16
101	F	74	94.9	92.2	5.7	83.1	92.9	91.1	5.5	82.3	30	45	15
102	F	68	96.8	89.7	3.3	82.9	97.1	87.4	3	82.7	30	46	16
103	M	77	95.1	91.9	0.2	82.6	97.5	91	0.4	84.6	23	47	24
104	M	77	93.4	90.9	1.5	86.4	91.4	90	2	89.2	23	47	24
105	M	60	94.9	89.1	1.2	85.8	94.9	89.2	3.7	86.4	18	47	29
106	M	78	94.7	87.5	3.6	83.3	95.1	86.3	2.9	86.8	30	47	17
107	M	41	100.6	89.1	2.8	89.5	99	86.5	5.5	88.5	32	47	15
108	F	60	96.6	90	5.1	85.9	97	89.6	6.6	87.6	29	48	19
109	M	83	94	89.7	0.6	90.2	94.9	89.6	0.3	90.8	33	48	15
110	F	79	96.8	87.2	4.1	86.4	95	87.8	3.5	84	20	48	28

Table III. — The Intraclass Correlation Coefficient for each measurement parameter ranging from 0 (no agreement) to 1 (perfect agreement). Values between 0.4 and 0.75 represents fair to good reliability. Values above 0.75 represents excellent reliability (7)

Radiographic Measurement	ICC	95% Confidence Interval		P Value
		Lower bound	Upper bound	
Frontal Femoral Flexion Angle	0.70	0.59	0.78	< 0.001
Frontal Tibial Angle	0.71	0.61	0.79	< 0.001
Lateral Femoral Flexion Angle	0.85	0.79	0.90	< 0.001
Lateral Tibial Angle	0.78	0.69	0.84	< 0.001

mobility immediately post-operatively, time constraints and often requires experienced radiographers. All of the above leads to delays in early mobilisation and discharge. The standardised antero-posterior and lateral radiograph of the knee is more frequently requested post-operatively and has become common practice. The majority of surgeons request the immediate post-operative radiograph to exclude any immediate complications such as intra-operative fracture or mechanical failure, however this is extremely rare (*9,10,23*). In a study that retrospectively reviewed 200 consecutive primary TKA's, none of the immediate post-operative radiographs that were evaluated changed the normal management course of these patients (*9*). These findings are consistent with another study of 124 consecutive TKAs that compared recovery room radiographs with pre-discharge radiographs (*23*). They concluded that there was no change in the routine post-operative management upon reviewing the films. Furthermore, there is evidence to show that the probability of detecting a fracture, dislocation or other significant abnormality that would alter the immediate post-operative course to be less than 0.1% (*10*).

Taken together with our findings we must continue to question the cost effectiveness of requesting an immediate post-operative film in uncomplicated TKAs (*9,23*). The initial post operative radiograph although a useful tool in certain circumstances to assess workmanship and provides immediate feedback for the operating surgeon, it cannot be used as a tool to reliably predict functional outcome at one year.

Table IV. — The Pearson Correlation Coefficient (r) and the respective statistical significance (p) from measurements taken by 2 independent musculoskeletal radiologists. A p value < 0.05 was deemed as significant

Radiographic Measurement Observer 1	Post op OKS	Difference in OKS
Frontal Femoral Flexion Angle	r = 0.39 p = 0.69	r = -0.41 p = 0.67
Frontal Tibial Angle	r = -0.09 p = 0.33	r = -0.04 p = 0.66
Lateral Femoral Flexion Angle	r = -0.13 p = 0.17	r = -0.18 p = 0.05
Lateral Tibial Angle	r = -0.10 p = 0.30	r = -0.05 p = 0.59
Radiographic Measurement Observer 2	Post op OKS	Difference in OKS
Frontal Femoral Flexion Angle	r = -0.02 p = 0.81	r = -0.13 p = 0.17
Frontal Tibial Angle	r = -0.05 p = 0.62	r = -0.10 p = 0.29
Lateral Femoral Flexion Angle	r = -0.02 p = 0.88	r = -0.08 p = 0.41
Lateral Tibial Angle	r = -0.01 p = 0.92	r = -0.05 p = 0.63

REFERENCES

1. **Attar FG, Khaw FM, Kirk LM, Gregg PJ.** Survivorship analysis at 15 years of cemented press-fit condylar total knee arthroplasty. *J Arthroplasty* 2008 ; 23 : 344-349.
2. **Baker PN, van der Meulen JH, Lewsey J, Gregg PJ.** The role of pain and function in determining patient satisfaction after total knee replacement. Data from the National Joint Registry for England and Wales. *J Bone Joint Surg* 2007 ; 89-B : 893-900.
3. **Bonner TJ, Eardley WG, Patterson P, Gregg PJ.** The effect of post-operative mechanical axis alignment on the survival of primary total knee replacements after a follow-up of 15 years. *J Bone Joint Surg* 2011 ; 93-B : 1217-1222.
4. **Dawson J, Fitzpatrick R, Murray D, Carr A.** Questionnaire on the perceptions of patients about total knee replacement. *J Bone Joint Surg* 1998 ; 80-B : 63-69.
5. **Ensini A, Catani F, Leardini A, Romagnoli M, Giannini S.** Alignments and clinical results in conventional and navigated total knee arthroplasty. *Clin Orthop Relat Res* 2007 ; 457 : 156-162.
6. **Ewald FC.** The Knee Society total knee arthroplasty roentgenographic evaluation and scoring system. *Clin Orthop Relat Res* 1989 ; 248 : 9-12.
7. **Fleiss JL.** The Design and Analysis of Clinical Experiments. New York : Wiley ; 1986, pp 2-31.
8. **Font-Rodriguez DE, Scuderi GR, Insall JN.** Survivorship of cemented total knee arthroplasty. *Clin Orthop Relat Res* 1997 ; 345 : 79-86.
9. **Glaser D, Lotke P.** Cost-effectiveness of immediate post-operative radiographs after uncomplicated total knee arthroplasty : a retrospective and prospective study of 750 patients. *J Arthroplasty* 2000 ; 15 : 475-478.
10. **Hassan S, Wall A, Ayyaswamy B, Rogers S, Mills SP, Charalambous CP.** Is there a need for early post-operative x-rays in primary total knee replacements ? Experience of a centre in the UK. *Ann R Coll Surg Engl* 2012 ; 94 : 199-200.
11. **Hulley SB, Cummings SR, Browner WS, Grady DG, Newman TB.** Designing Clinical Research : Third Edition. Philadelphia : Lippincott Williams & Wilkins ; 2007, pp 65-93.
12. **Jeffery RS, Morris RW, Denham RA.** Coronal alignment after total knee replacement. *J Bone Joint Surg* 1991 ; 73-B : 709-714.
13. **Laskin RS.** The Genesis total knee prosthesis : a 10-year followup study. *Clin Orthop Relat Res* 2001 ; 388 : 95-102.
14. **Lotke PA, Ecker ML.** Influence of positioning of prosthesis in total knee replacement. *J Bone Joint Surg* 1977 ; 59-A : 77-79.
15. **Patel DV, Ferris BD, Aichroth PM.** Radiological study of alignment after total knee replacement. Short radiographs or long radiographs ? *Int Orthop* 1991 ; 15 : 209-210.
16. **Rand JA, Ilstrup DM.** Survivorship analysis of total knee arthroplasty. Cumulative rates of survival of 9200 total knee arthroplasties. *J Bone Joint Surg* 1991 ; 73-A : 397-409.
17. **Rand JA, Trousdale RT, Ilstrup DM, Harmsen WS.** Factors affecting the durability of primary total knee prostheses. *J Bone Joint Surg* 2003 ; 85-A : 259-265.
18. **Sah AP, Scott RD, Iorio R.** Angled polyethylene insert exchange for sagittal tibial malalignment in total knee arthroplasty. *J Arthroplasty* 2008 ; 23 : 141-144.
19. **Scott WN, Rubinstein M, Scuderi G.** Results after knee replacement with a posterior cruciate-substituting prosthesis. *J Bone Joint Surg* 1988 ; 70-A : 1163-1173.
20. **Shrout PE, Fleiss JL.** Intraclass correlations : uses in assessing rater reliability. *Psychol Bull* 1979 ; 86 : 420-428.
21. **Sikorski JM.** Alignment in total knee replacement. *J Bone Joint Surg* 2008 ; 90-B : 1121-1127.
22. **Spencer JM, Chauhan SK, Sloan K, Taylor A, Beaver RJ.** Computer navigation versus conventional total knee replacement : no difference in functional results at two years. *J Bone Joint Surg* 2007 ; 89-B : 477-480.
23. **Ververeli PA, Masonis JL, Booth RE, Hozack WJ, Rothman RH.** Radiographic cost reduction strategy in total joint arthroplasty. A prospective analysis. *J Arthroplasty* 1996 ; 11 : 277-280.