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PATIENT REPORTED KNEELING ABILITY IN FIXED AND MOBILE BEARING KNEE ARTHROPLASTY

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Abstract

Kneeling is an important function of the knee joint required for many daily activities. Bearing type is thought to influence functional outcome following UKA and TKA. Self-reported kneeling ability was recorded in 471 UKA and 206 TKA patients with fixed or mobile bearing implants. Kneeling ability was recorded from the oxford knee score question 7. The self-reported ability to kneel was similar in patients with fixed and mobile bearing UKA implants following surgery. In TKA, greater proportions of patients were able to kneel in the fixed compared to the mobile bearing groups up to two years after surgery indicating that self-reported kneeling ability is enhanced in fixed compared to mobile bearing TKA.

Introduction

Knee arthroplasty is a common procedure used to treat knee osteoarthritis. Since 2003 almost 600,000 knee replacement procedures have been performed in England, Wales and Northern Ireland[1], with 76,497 primary total knee arthroplasties (TKA) and 7,065 primary unicompartmental knee arthroplasties (UKA) performed in 2012 alone[1]. Reports from registry data indicate that approximately 85% of patients are satisfied with their knee replacement and up to 90% describe improvements in symptoms after surgery[1]. However, despite these high levels of symptomatic improvement and satisfaction many patients continue to struggle with more challenging activities that require high-flexion knee angles such as kneeling, squatting and sitting crossed-legged[2,3]

Kneeling is an important function of the knee joint required for many normal activities and lifestyles and is indicative of a highly functioning knee[2,3]. Several studies have shown that the ability to kneel is not always possible after knee arthroplasty[2,4,5]. Consequently, functional limitations have been shown during occupational, recreational, sporting and religious activities that can impact greatly upon patient quality of life and satisfaction following knee arthroplasty[6,7].

It is reported that although approximately 50% of patients undergoing knee arthroplasty consider the post-operative ability to kneel as an important outcome, almost 80% will have limitations in their kneeling ability[8], and a recent study has indicated that with appropriate education and practice, kneeling ability can be significantly improved after knee arthroplasty (UKA)[9] that may have a beneficial impact on function and quality of life.

The ability to kneel also appears to be better in patients undergoing UKA compared to total knee arthroplasty (TKA)[4]. Several studies have suggested that in both UKA and TKA, mobile bearing implants restore kinematics closer to those of the native knee, yet despite this, none of the published clinical series have demonstrated a significantly superior function[10-12]. Recent reviews also suggest that mobile bearing TKA implants have no superiority in kneeling ability or functional outcomes over fixed bearing prostheses[13,14]. However the literature comparing these different designs is scarce and further investigation is warranted to determine whether mobile or fixed bearing implants provide the best outcome after surgery, particularly with respect to highly demanding activities such as kneeling.

With the limited information on kneeling ability after knee replacement in mobile and fixed bearing knee arthroplasties, the primary aim of this study was to investigate mid-term kneeling ability in both fixed and mobile bearing UKA and TKA prostheses. The secondary aim of this study was to investigate the relationship between kneeling ability and measured knee motion, pain and function. Our hypothesis was that mobile bearing implants (both total and unicompartmental) would confer and advantage for patient kneeling ability.

Materials and Methods

Between 2000 and 2010, four hundred and seventy-one medial unicompartmental knee arthroplasties were performed in our unit. The medial UKA group consisted of 205 mobile bearing knees (102 male, 103 female, with mean age 62.0 years) and 284 fixed bearing knees (158 male, 126 female, with mean age 71.4 years). Between 2001 and 2006, two-hundred and six total knee arthroplasties were performed as part of a prospective randomised controlled study. The TKA group consisted of 104 mobile bearing knees (47 male, 57 female, with a mean age of 61.7 years) and 102 fixed bearing (54 male, 48 female, with a mean age of 61.6 years). All data was collected and stored on our knee group database which has been granted approval by the regional ethical committee (reference number 09/H0206/72).

Outcome measures

Self-reported kneeling ability was determined from question 7 of the Oxford Knee Score (OKS)[15]. In addition, all patients completed the Western Ontario and McMaster Universities Arthritis Index (WOMAC)[16]. Range of motion (ROM) was assessed using a universal Goniometer. All data was collected preoperatively and at one, and two-years following surgery by an experienced research nurse or physiotherapist.

Prostheses and Surgical Technique

Unicompartmental Knee Arthroplasty

The Uniglide (Corin, Cirencester, UK) femoral component has a triple-radius femoral design made of cobalt chrome coated with titanium nitride. The tibia has both fixed and mobile-bearing options. The fixed-bearing component is a flat, ultra-high molecular-weight all polyethylene design with a stubby keel. The mobile-bearing option consists of a titanium nitride coated cobalt chrome tibial component which has a flat articular surface with a medial flange that lies against the tibial intercondylar eminence and an ultra-high molecular-weight polyethylene meniscal insert that is unconstrained. For all medial UKAs a limited medial parapatellar approach without patella dislocation was used. There was a minor variation in surgical technique between a small sub-vastus or mid-vastus extension or complete quads sparing where possible.

Total Knee Arthroplasty

All TKAs were the Rotaglide+ prosthesis (Corin, Cirencester, UK). Both mobile and fixed bearing options are compatible with a universal femoral component and tibial baseplate. For the fixed bearing option, the specific bearing simply snaps into place on the same tibial baseplate[17]. All TKA cases were done through a midline skin incision and a medial parapatellar approach.

Statistical Analysis

Descriptive statistics where used to calculate the proportion of scores recorded for the OKS question 7 for each mobile and fixed bearing knee arthroplasty. TKA and UKA data were analysed separately when comparing kneeling ability of fixed and mobile bearing prostheses at each time point. Pearson’s Chi-squared test was used to compare kneeling ability before and after surgery and between bearing types. Kneeling ability was correlated with WOMAC pain and function scores using Spearman's rank correlation coefficient. Significance was accepted at the 5% level. IBM SPSS statistical software package version 21 was used to analyse the data.

Results

Kneeling ability and range of motion before and after surgery for both UKA and TKA are shown in Tables 1-4.

TABLE 1

Pre-operative		**Knees**	**Kneeling score (%)**				
			0	**1**	**2**	**3**	**4**
UKA	***Fixed***	248	89 (36)	92 (37)	49 (20)	15 (6)	3 (1)
	Mobile	223	70 (31)	85 (38)	56 (25)	9 (4)	3 (1)
	All	471	159 (34)	177 (38)	105 (22)	24 (5)	6 (1)
TKA	***Fixed***	102	43 (42)	40 (39)	15 (15)	3 (3)	1 (1)
	Mobile	104	58 (56)	36 (35)	7 (7)	3 (3)	0 (0)
	ALL	206	101 (49)	76 (37)	22 (11)	6 (3)	1 (0)

Table 1. Proportions of scores recorded for the oxford knee score question 7 (kneeling ability) in fixed and mobile bearing UKA and TKA before surgery. (0=no impossible, 1=with extreme difficulty, 2=moderate difficulty, 3=little difficulty, 4=yes).

TABLE 2

1-year post-op		**Knees**	**Kneeling score (%)**				
			0	**1**	**2**	**3**	**4**
UKA	***Fixed***	218	82 (38)	45 (21)	33 (15)	48 (22)	10 (5)
	Mobile	219	69 (32)	53 (24)	45 (21)	38 (17)	14 (6)
	All	437	151 (35)	98 (22)	78 (18)	86 (20)	24 (5)
TKA	***Fixed***	95	35 (37)	15 (16)	22 (23)	18 (19)	5 (5)
	Mobile	101	52 (51)	22 (22)	15 (15)	11 (11)	1 (1)
	ALL	196	87 (44)	37 (19)	37 (19)	29 (15)	6 (3)

Table 2. Proportions of scores recorded for the oxford knee score question 7 (kneeling ability) in fixed and mobile bearing UKA and TKA at one-year after surgery. (0=no impossible, 1=with extreme difficulty, 2=moderate difficulty, 3=little difficulty, 4=yes).

TABLE 3

2-years post-op		Knees	Kneeling score (%)				
			0	**1**	**2**	**3**	**4**
UKA	***Fixed***	151	45 (30)	34 (23)	25 (17)	30 (20)	17 (11)
	Mobile	153	52 (34)	38 (25)	26 (17)	21 (14)	16 (10)
	All	304	97 (32)	72 (24)	51 (17)	51 (17)	33 (11)
TKA	***Fixed***	91	33 (36)	17 (19)	16 (18)	18 (20)	7 (8)
	Mobile	93	50 (54)	19 (20)	14 (15)	8 (9)	2 (2)
	ALL	184	83 (45)	36 (20)	30 (16)	26 (14)	9 (5)

Table 3. Proportions of scores recorded for the oxford knee score question 7 (kneeling ability) in fixed and mobile bearing UKA and TKA at two-years after surgery. (0=no impossible, 1=with extreme difficulty, 2=moderate difficulty, 3=little difficulty, 4=yes).

TABLE 4

		Pre-op	**1 year**	**2 year**
UKA	***Fixed***	108.7 (15.4)	115.6 (12.0)	118.6 (23.6)
	Mobile	110.0 (14.0)	118.7 (14.9)	117.0 (14.7)
TKA	***Fixed***	99.9 (16.7)	104.4 (15.3)	104.3 (15.8)
	Mobile	100.2 (18.3)	103.8 (12.7)	105.1 (13.6)

Table 4. Mean (SD) range of motion (̊) in fixed and mobile bearing TKA and UKA before surgery and at one and two-years after surgery.

TABLE 5

		ROM	**WOMAC Pain**	**WOMAC Function**
TKA	*Pre*	0.366	-0.211	-0.302
	1-year	0.342	-0.505	-0.522
	2-year	0.370	*-0.528*	*-0.562*
UKA	*Pre*	0.100	-0.365	-0.422
	1-year	0.047	-0.546	-0.571
	2-year	0.189	-0.486	-0.551

Table 5. Spearman's rank correlation coefficients (R) between kneeling score (OKS question 7) and range of motion (ROM), WOMAC pain and function score in TKA and UKA before surgery and at one and two years after surgery.

Unicompartmental knee arthroplasty

Pre-operative scores

Before surgery kneeling ability was poor with only 6% of patients awaiting UKA reporting the ability to kneel with little or no difficulty compared to 34% reporting that kneeling was impossible (Table 1). No difference in kneeling ability was observed between those patients awaiting a fixed or mobile bearing UKA (p=0.683). Correlation between self-reported kneeling ability and WOMAC measures of pain and function were R=-0.365 (p<0.001) and R=-0.422 (p<0.001) respectively indicating a significant but poor correlation before surgery (Table 5).

Post-operative scores

Kneeling ability was not significantly different between fixed or mobile bearing prosthesis at one (p=0.801) or two (p=0.199) years after surgery (Tables 2 and 3 respectively). One-year after surgery the proportions of patients reporting an inability to kneel (35%) was similar to before surgery. However, at one-year after surgery 25% of patients were able to kneel with no or little difficulty compared to 6% before surgery (p<0.001). At one-year after surgery correlation between kneeling ability, pain and function was moderate (R=-0.546, p<0.001) and (R=-0.571, p<0.001) respectively (Table 5).

At two-years after surgery 32% of patients reported kneeling as impossible and 28% indicated an ability to kneel with little or no difficulty. No significant differences were observed for kneeling ability between one and two years after surgery (p=0.374). Kneeling ability at two-years after surgery showed a significant but moderate correlation with self-reported levels of pain (R=-0.486, p<0.001) and function (R=-0.511, p<0.001).

Total knee arthroplasty

Pre-operative scores

Kneeling ability in patients awaiting a total knee replacement was poor with 49% of patients found it impossible to kneel down (Table 1). No differences in the ability to kneel was observed between patients awaiting either a fixed or mobile bearing prosthesis (p=0.452).

Post-operative scores

A significant difference in kneeling ability was observed between mobile and fixed bearing groups at one ($p=0.01$) and two ($p=0.002$) years after surgery with a greater proportion of patients unable to kneel in the mobile group (Tables 2 and 3 respectively). In the mobile bearing group, kneeling ability had significantly improved at one ($p=0.017$) and two ($p=0.037$) years after surgery. Similar improvements were observed for kneeling ability in the fixed bearing group at both time points ($p<0.001$).

Correlation between kneeling ability, range of motion and WOMAC pain and function was similar to UKA with significant but poor correlation before surgery for WOMAC pain ($p=0.003$) and function ($p<0.001$) and significant moderate correlation at one and two years after surgery for all measures ($p<0.001$) (Table 5).

Discussion

The primary aim of this study was to compare the ability to kneel following knee arthroplasty between mobile and fixed bearing total and unicompartmental knee implants. Overall, kneeling ability before surgery was poor and it remained poor following surgery for both TKA and UKA groups. The results indicate that up to 2 years after surgery kneeling ability had improved in all groups with a higher proportion of patients finding it less difficult to kneel, but similar proportions of patients reporting kneeling as an impossible task. The improvements observed were evident during the first post-operative year with little subsequent change over the following year. The fact that all groups showed some improvement in kneeling ability with surgery, suggested that localised symptoms from the osteoarthritic knee were at least partially responsible for the poor pre-operative kneeling function. This finding may provide essential information for surgeons and rehabilitation specialists to optimise kneeling ability within this time period. Kneeling ability can be improved by rehabilitation[9] and therapists may wish consider specific exercises and treatment techniques to assist patients to kneel following knee arthroplasty. The results suggest that approximately 35% of UKA and 45% of TKA patients could not kneel after surgery. Factors that influence kneeling ability were not explored in this study but could be related either to intrinsic knee problems or extrinsic factors limiting this task performance. Many patients that undergo knee arthroplasty have existing comorbidities that can impact on activities of daily living and lower limb function.

Unicompartmental knee arthroplasties have been shown to exhibit more normal kinematics and better knee flexion than TKA[18,19]. Therefore it is not surprising that kneeling ability was better in the UKA than in the TKA group despite the fact that the average age of the UKA group in this study was slightly higher. In addition, the majority of the UKA group had reduced incisions without patellar eversion. This would have resulted in a lesser area of sensory impairment over the front of the knee, which combined with greater knee flexion, has been associated with better kneeling ability[21].

The mid-term absence of difference in kneeling ability between mobile and fixed bearing UKA is not a surprising finding in this large cohort of patients and supports the current evidence demonstrating that neither fixed nor mobile bearing prostheses provide great clinical outcomes for kneeling[21,22]. Despite the notion that mobile bearing prosthesis improves kinematics[23] the range of motion achieved by patients with mobile and fixed bearing prostheses in the current study indicates that any such benefits are lost within the first year after implantation and have no influence on the mid-term outcome. Why some patients are able to kneel and others are not following UKA remains uncertain and requires further work to identify specific factors that might be amenable to new surgical techniques or therapeutic exercise.

Interestingly, patients with fixed bearing TKA reported a greater ability to kneel after surgery compared to those with a mobile bearing implant despite having a similar range of motion and WOMAC score. Many authors report functional outcome in fixed and mobile bearing TKA to be similar[13,14,24]. In the TKA group the mobility of the implant may be a factor reducing their willingness to kneel[25]. It should also be noted that the proportions of patients unable to kneel before surgery was higher, although not significantly, which may contribute to the values observed at one and two-years after surgery. When examining the amount of change from pre-operative to one-year post-operatively there was a similar reduction (5%) in patients reporting an inability to kneel for both mobile and fixed bearing groups. Conversely, when examining the proportions of patients in the TKA groups reporting little or no difficulty in kneeling ability the fixed bearing group improved from 4% before surgery to 28% at two-years after surgery in comparison to 3% before surgery to 11% at two-years after surgery in the mobile group. The reason for improvements in kneeling ability in the fixed bearing group is not clear, but the assertion that mobile bearing TKA functions better does not appear to hold true for kneeling ability consistent with the growing literature.

A previous study has shown that many patients can actually kneel though they may report an inability to do so[4]. It is therefore probable that this particular knee function could be improved with education, advice and physiotherapy[4,9]. The present study has shown that mobile bearing offers no advantage in kneeling ability and there is possibly an advantage to using a fixed bearing implant if kneeling ability is important to the patient.

In this study we also found a poor to moderate relationship between subjective kneeling ability, pain and function after TKA and UKA. The correlation between knee range of motion and self assessment of kneeling ability was poor following both UKA and TKA, indicating that factors other than range of motion influence whether patients can kneel or not. Relationships between ROM and function have been shown to be weak in knee osteoarthritis[26] and after knee arthroplasty[27], with predictive variables such as patient expectation[28] and pre-operative levels of function[29] indicative of post-operative outcome. The ability to kneel is thought to reflect high functional activity however our study suggests that this relationship is not necessarily the case.

This study is not without limitations. Participants in the UKA cohort were not randomly allocated to fixed or mobile bearing groups, but by surgeon preference; this cohort led on to an ongoing RCT of fixed v mobile UKA. Consequently, the groups were also not age-matched; however baseline statistics indicate the participants were of a similar pain and activity status. The follow-up is relatively short-term and longer term data will be important. A final limitation is that no objective measure of kneeling ability was performed and only self reported kneeling ability was recorded. Future studies should look to include and compare such objective and subjective assessments of kneeling.

We suggest future randomised trials comparing fixed and mobile bearing UKA with the inclusion of objective and subject measures of functional tasks such as kneeling. Furthermore we would be interested in investigating kneeling ability in long term comparisons between fixed and mobile bearing TKA and UKA and developing rehabilitation strategies to improve high-flexion activities such as kneeling.

Conclusion

Our hypothesis was disproved; the ability to kneel appears to be independent of bearing type in UKA. In TKA however, patients with fixed bearing prosthesis have a greater improvements in self-reported kneeling ability. The direct relationship between kneeling ability, range of motion and patient reported measures of pain and function is questionable following both UKA and TKA indicating that many factors will contribute to whether patients are able to kneel.

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