■ KNEE

Predicting dissatisfaction following total knee arthroplasty in patients under 55 years of age

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Aims

Risk of revision following total knee arthroplasty (TKA) is higher in patients under 55 years, but little data are reported regarding non-revision outcomes. This study aims to identify predictors of dissatisfaction in these patients.

Patients and Methods

We prospectively assessed 177 TKAs (157 consecutive patients, 99 women, mean age 50 years; 17 to 54) from 2008 to 2013. Age, gender, implant, indication, body mass index (BMI), social deprivation, range of movement, Kellgren-Lawrence (KL) grade of osteoarthritis (OA) and prior knee surgery were recorded. Pre- and post-operative Oxford Knee Score (OKS) as well as Short Form-12 physical (PCS) and mental component scores were obtained. Post-operative range of movement, complications and satisfaction were measured at one year.

Results

Overall, 44 patients with 44 TKAs (24.9%) under 55 years of age were unsure or dissatisfied with their knee. Significant predictors of dissatisfaction on univariate analysis included: KL grade 1/2 OA (59% dissatisfied), poor pre-operative OKS, complications, poor improvements in PCS and OKS and indication (primary OA 19% dissatisfied, previous meniscectomy 41%, multiply operated 42%, other surgery 29%, BMI > 40 kg/m^2 31%, post-traumatic OA 45%, and inflammatory arthropathy 5%). Poor pre-operative OKS, poor improvement in OKS and post-operative stiffness independently predicted dissatisfaction on multivariate analysis.

Conclusion

Patients receiving TKA younger than 55 years old should be informed about the increased risks of dissatisfaction. Offering TKA in KL 1/2 is questionable, with a dissatisfaction rate of 59%.

Cite this article: *Bone Joint J* 2016;98-B:1625–34.

The number of total knee arthroplasties (TKA) performed is increasing each year. Data indicate that 13% to 14% of TKAs are performed in patients under 55 or 60 years old.[1,2] The use of TKA is increasing disproportionately among young patients, and those aged 45 to 55 years are the fastest-growing group of recipients.[1,3,4] This trend is set to continue over the coming decades.[1] Registry data show inferior implant survivorship in the under 55 years age group, with a ten-year cumulative risk of revision of 9% to 11%.[2,4] However, there is a paucity of information regarding non-revision clinical outcome in this young patient group.[5] Patient satisfaction is known to be a complex, multifactorial issue and multivariate analyses have shown patient expectations[6,7] and their fulfilment,[8] pain relief,[9,10] complications,[7] and the experience of healthcare delivery[11] to be significant predictors of (dis)satisfaction when considering all TKA patients. These studies have either not stratified patients by age, or have had too few patients in the young age group to draw any firm conclusions. Patients coming to TKA at young ages often have complex knee histories with previous injury, deformity, a high body mass index (BMI), or inflammatory conditions contributing to their arthropathy. It remains unclear whether the often complex indications for surgery, the kinematic limitations of TKA, a failure to meet high expectations, or higher activity levels, contribute to poor outcomes and early failure in this patient group.

The aim of this study was to identify predictors of dissatisfaction in patients aged under 55 years using univariate and multivariate analysis to understand better the patient-reported outcome of TKA in this young age group.

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doi:10.1302/0301-620X.98B12.BJJ-2016-0375.R1 $2.00

Bone Joint J 2016;98-B:1625–34.
Received 5 May 2016; Accepted after revision 22 August 2016

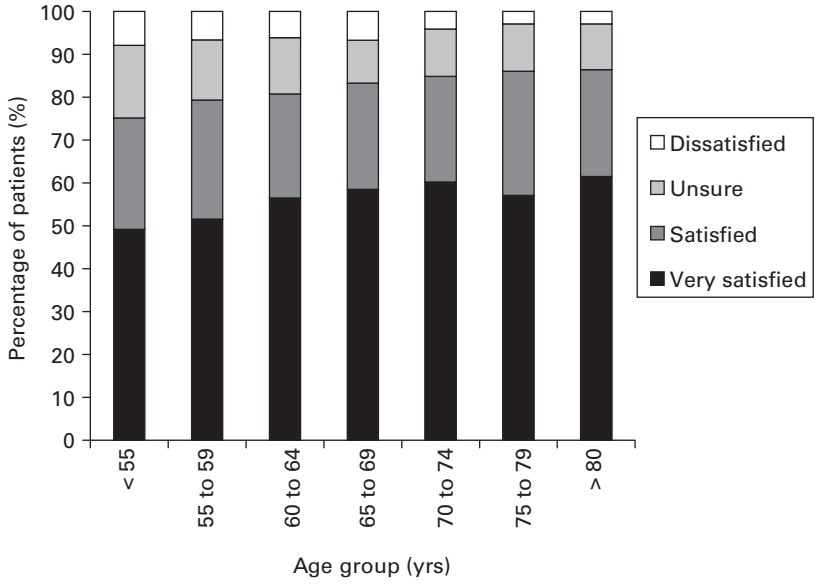

Fig. 1

Chart demonstrating satisfaction reported in relation to total knee arthroplasy (TKA) (by knees) in our study cohort (n = 177 TKAs, in 157 patients < 55 years old) and the responses for 2831 TKAs in 2270 patients aged > 55 years treated in our unit during the study period.

Patients and Methods

Ethical approval was obtained for this study. Between 2008 and 2013, 3008 consecutive primary TKAs were performed at our institution. Of these, 177 TKAs were performed in 157 patients under the age of 55 years – these patients formed our study group. One patient required a primary hinged implant. The remaining 156 patients (176 TKAs) received cruciate retaining prostheses of three designs: 109 Triathlon (Stryker, Orthopaedics, Mahwah New Jersey); 63 PFC Sigma (Depuy Synthes, Johnson & Johnson, Raynham, Massachusetts); and four Kinemax (Stryker). Supplementary components required included: one medial tibial augment, nine tibial stems and one femoral stem. No primary patellar resurfacing was performed. All procedures were performed or supervised by consultant orthopaedic surgeons (14 involved over the course of the study period) with a subspecialty interest in TKA and annual volumes > 50 TKAs per year (mean 72; 50 to 108).

All patients underwent standardised rehabilitation programmes. All data were collected prospectively. Prior to surgery patients completed a questionnaire including the Short Form-12 (SF-12)[12] and Oxford Knee Scores (OKS).[13] The SF-12 is a validated health questionnaire with physical and mental health components.[12] The OKS is a validated knee specific outcome measure of 12 questions[14] with five possible answers giving a score from 0 to 48. Higher scores represent better function. Completed questionnaires were collected at a pre-assessment clinic. Similar post-operative questionnaires were sent to patients at the 12-month follow-up. These included patient satisfaction questions in addition to the SF-12 and OKS. Patients were asked, 'How satisfied are you with your operated knee?' with options 'very satisfied', 'satisfied', 'unsure' or 'dissatisfied'.[10] They were also asked how well the surgery had relieved pain; how it increased ability to perform regular activities; how it enabled heavy work/sporting activity and how it met their expectations. Responses were indicated on a six-point Likert scale. Collection of data was independent of the routine clinical care of the patient. These patient-reported outcome measures (PROMs) were collected for the 2831 TKAs performed in patients aged > 55 years during the same time period for comparison.

Medical notes were reviewed for all patients aged < 55 years. Data collected included patient characteristics, Scottish Index of Multiple Deprivation (SIMD),[15] indication for TKA, pre- and post-operative range of movement, complications and re-operations. Short-leg weight-bearing radiographs were examined pre-operatively by one author (WMO) to define Kellgren-Lawrence (KL)[16] grade of arthritis and femorotibial alignment, and post-operatively at one to two years to measure implant alignment[17] and define location of radiolucency according to the Knee Society Score.[18]

Statistical analysis. This was performed using Statistical Package for Social Sciences version 19.0 (SPSS Inc., Chicago, Illinois). Univariate analysis was performed using parametric (Student's *t*-test: paired and unpaired) and non-parametric (Mann-Whitney U test) tests as appropriate to assess continuous variables for significant differences between satisfied and dissatisfied patients. One way

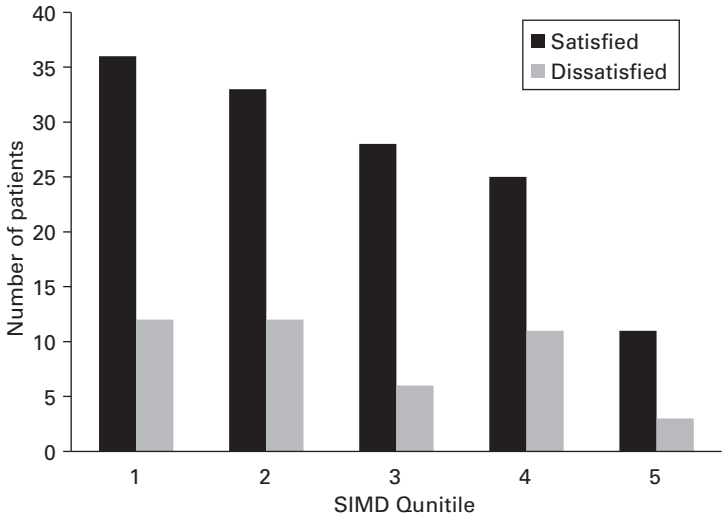

Fig. 2

Scottish Index of Multiple Deprivation (SIMD) quintile (1, most deprived; 5, least deprived) and satisfaction with total knee arthroplasty.

analysis of variance (ANOVA) was used to compare continuous variables with multiple groups (OKS in SIMD quintiles). Nominal categorical variables were assessed using a chi-squared or Fisher's exact test. Pearson's correlation was used to assess the relationship between linear variables. Variables found to be significantly associated with dissatisfaction were entered stepwise into a multivariate binary logistic regression analysis using an 'enter' methodology to identify independent predictors of dissatisfaction correcting for compounding factors. Statistical significance was defined as a p-value < 0.05.

Results

The mean age of our cohort was 50 years (median 51, range 17 to 54) and 99 of 177 TKAs (56%) were performed in women. In total, patients were very satisfied with 87 of 177 TKAs (49%), satisfied with 46 (26%), uncertain with 30 (17%) and dissatisfied with 14 (8%). All patients with bilateral TKAs (n = 20) were very satisfied or satisfied with both knees. We split these into two groups, with 113/157 patients (72%) satisfied with 133/177 (75%) TKAs and 44/157 patients (28%) dissatisfied with 44/177 (25%) TKAs. During the same period, 2831 TKAs were performed in 2270 patients over 55 years. Patient satisfaction by age group is shown in Figure 1.

Satisfaction and clinical outcome. Univariate analysis of pre-operative variables showed that in patients < 55 years, gender (p = 0.573), responsible consultant (p = 0.967), annual surgeon TKA volume (p = 0.992) and deprivation level (p = 0.784, Fig. 2) did not affect dissatisfaction (Table I). Social deprivation quintile had a significant effect on pre-operative OKS (p = 0.012, ANOVA), being worse in those most deprived. This effect had resolved by one year (p = 0.248, ANOVA). There were no significant differences in SF-12 physical (PCS) or mental component score (MCS) between deprivation quintiles at any point. Implant type had no effect on patient dissatisfaction (p = 0.257, chi-squared) or improvement in OKS at one year (p = 0.277, ANOVA).

Significant predictors of dissatisfaction at one year included KL grade (p = 0.003, chi-squared) (Fig. 3), indication (p = 0.004, chi-squared) (Table II), and pre-operative OKS (p = 0.004, unpaired *t*-test) (Table I). In all, 17 knees in 17 patients had osteoarthritis (OA) assessed as KL grade 1 or 2. Of these ten patients were dissatisfied at one year with ten knees (58.8%). In total, 13 of the 17 knees had undergone previous knee surgery including six arthroscopic partial meniscectomies and six knees, which were multiply operated. There was no significant difference in pre-operative OKS between KL grades (p = 0.622, ANOVA), but both one year OKS (p < 0.001, unpaired *t*-test) and improvement therein (p < 0.001, unpaired *t*-test) were significantly better in patients with higher KL grades (Fig. 3). The pattern of OA in terms of the maximally involved compartment (p = 0.467, chi-squared) and resultant coronal plane alignment (p = 0.572, chi-squared) were not associated with dissatisfaction. Compared with patients within this < 55 years old cohort with primary OA in previously un-operated upon knees, odds ratios (OR) for dissatisfaction by indication were: secondary OA with previous menisectomy OR 2.86 (1.1 to 7.7); secondary OA with multiply operated (three or more operations) knee OR 2.94 (0.77 to 11.1); OA with BMI > 40 kg/m^2 OR 2.0 (0.59 to 5.6); post-traumatic OA OR 3.3 (0.77 to 14.3); secondary OA with

Table I. Pre-operative predictors of dissatisfaction for knees. Presented as mean (range) or number (%) and confidence intervals (CI)

Variable	Satisfied (n = 133)	Dissatisfied (n = 44)	p-value	95% CI
Age (yrs)	49.8 (17 to 54)	50.6 (40 to 54)	0.39*	-2.7 to 1.0
Female gender	76 (*57*)	23 (*53*)	0.57‡	
BMI (kg/m^2)	34.0 (17 to 55)	34.2 (22 to 51)	0.90*	-3.5 to 3.1
SIMD				
Quintile 1 (most deprived)	36 (*27*)	12 (*27*)	0.784‡	
Quintile 2	33 (*25*)	12 (*27*)		
Quintile 3	28 (*21*)	6 (*14*)		
Quintile 4	25 (*19*)	11 (*25*)		
Quintile 5 (least deprived)	11 (*8*)	3 (*7*)		
Indication				
OA	46 (*35*)	11 (*25*)	0.004‡	
OA with partial meniscectomy	19 (*14*)	13 (*30*)		
OA Multiply operated	7 (*5*)	5 (*11*)		
OA BMI > 40 kg/m^2	16 (*12*)	7 (*16*)		
PTOA	5 (*4*)	4 (*9*)		
OA with other knee surgery	5 (*4*)	2 (*5*)		
Inflammatory arthropathy	35 (*26*)	2 (*5*)		
Kellgren-Lawrence Grade				
1	1 (*1*)	2 (*5*)	0.003‡	
2	6 (*5*)	8 (*18*)		
3	77 (*58*)	23 (*52*)		
4	39 (*29*)	6 (*14*)		
Alignment (°)				
FTA	178.8 (15 to197)	178.3 (164 to 193)	0.44*	-1.7 to 0.8
Range of movement (°)				
FFD > 10°	22 (*17*)	5 (*11*)	0.39‡	
Flex < 90°	11 (*8*)	2 (*5*)	0.42‡	
PROMs				
OKS	17.7 (5 to 34)	14.4 (2 to 26)	0.004*	1.1 to 5.6
PCS	29.0 (14 to 53)	27.8 (19 to 41)	0.29*	-1.4 to 4.6
MCS	48.3 (20 to 68)	44.2 (20 to 67)	0.91†	

*_t_-test
† Mann-Whitney U test
‡ chi-squared
SIMD, Scottish Index of Multiple Deprivation; OA, osteoarthritis; PTOA, post-traumatic osteoarthritis; BMI, body mass index; FTA, femorotibial angle; FFD, fixed flexion deformity; PROMs, patient-reported outcome measures; OKS, Oxford Knee Score; PCS, Short Form (SF)-12 Physical Component Score; MCS, SF-12 Mental Component Score

other knee surgery OR 1.7 (0.29 to 10) and inflammatory arthropathy OR 0.23 (0.05 to 1.15). Rates of dissatisfaction by indication are shown in Table II.

Post-operatively both satisfied (18.2 mean improvement, standard deviation (SD) 8.8, 95% confidence interval (CI) 16.6 to 19.7; $p < 0.001$ paired, *t*-test) and dissatisfied patients (5.5 mean improvement, SD 7.5, 95% CI 3.0 to 7.7; $p < 0.001$, paired *t*-test) displayed significant improvements in OKS (Fig. 4a). This was also true for mean SF-12 PCS (satisfied, mean improvement 13.7, SD 12.5, 95% CI 11.6 to 15.9; $p < 0.001$, paired *t*-test: dissatisfied, 3.1, SD 9.4, 95% CI 0.2 to 5.9; $p = 0.035$, paired *t*-test) (Fig. 4b). The mean SF-12 MCS declined in both satisfied (4.4 decline, SD 21.4, 95% CI 0.7 to 8.2; $p = 0.02$, paired *t* -test) and dissatisfied (6.0 decline, SD 14.3, 95% CI 1.6 to 10.3; $p = 0.008$, paired *t* -test) patients (Fig. 4c). The mean OKS improvement was significantly less in dissatisfied patients (18.2, SD 8.8 *versus* 5.3, SD 7.5; $p < 0.001$, unpaired *t*-test). On univariate analysis, other significant post-operative predictors of dissatisfaction included the extent of improvement by one year in SF-12 PCS and MCS and the presence of a complication (18/30 $p < 0.001$, chi-squared), in particular patient reported stiffness (9/12 patients dissatisfied, $p < 0.001$ Fisher's exact test) and superficial wound infections (4/4 patients dissatisfied, $p < 0.001$ Fisher's exact test). Of 12 patients reporting stiffness in 12 TKAs, five required re-operation (four early manipulations under anaesthetic and one arthroscopic arthrolysis), two of whom remained dissatisfied at one year. Both absolute values and improvements in OKS, SF-12 PCS and MCS, significantly predicted dissatisfaction at one year (Table III). Implant alignment and overall coronal plane alignment (femorotibial angle) did not predict dissatisfaction. Objective flexion of < 90° was associated with dissatisfaction (7/10 dissatisfied,

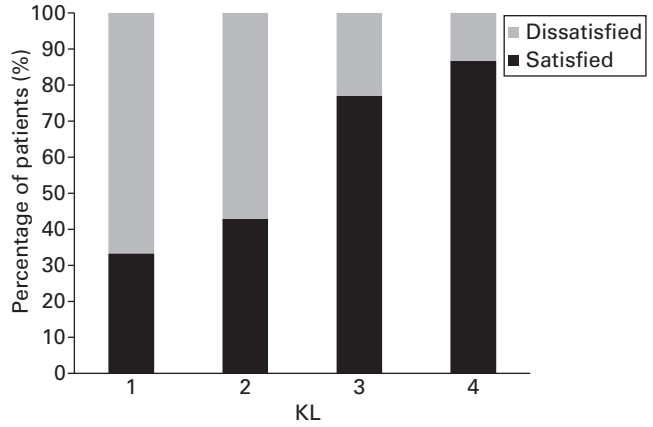

Fig. 3a

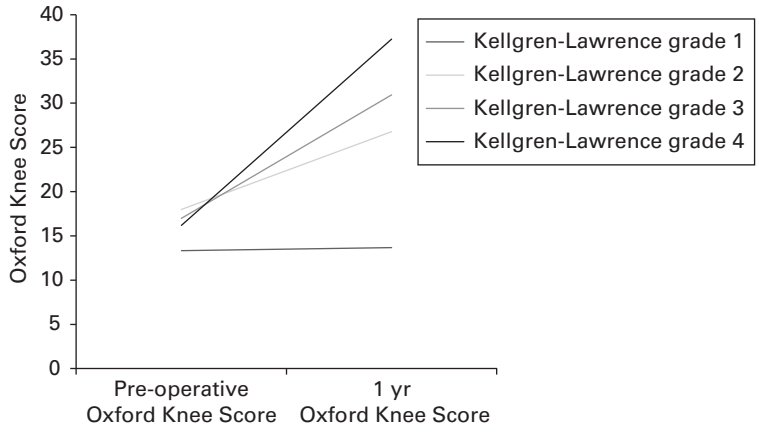

Fig. 3b

Kellgren-Lawrence (KL) grade of arthritis and outcome of total knee arthroplasty; a) patient satisfaction and b) Oxford Knee Score. (KL grading on anteroposterior weight-bearing radiograph: grade 1 - doubtful joint space narrowing (JSN) and possible osteophytic lipping; grade 2 - definite osteophytes and possible JSN; grade 3 - multiple osteophytes, definite JSN, sclerosis, possible bony deformity; grade 4 - large osteophytes, marked JSN, severe sclerosis and definite bony deformity.)

Table II. Rates of dissatisfaction by indication for total knee arthroplasty (by knees)

Indication	Dissatisfied (n)	Dissatisfaction rate (%)
Primary osteoarthritis (OA)	11/57	19.3
Secondary OA with meniscectomy	13/32	40.6
Secondary OA multiply operated	5/12	41.7
Secondary OA other surgery	2/7	28.6
OA body mass index > 40 kg/m^2	7/23	30.5
Post-traumatic OA	4/9	44.4
Inflammatory arthropathy	2/37	5.4

p = 0.007, chi-squared), but a fixed flexion deformity of > 5° (5/16 dissatisfied, p = 0.57 chi-squared) or > 10° (3/8 dissatisfied, p = 0.412 chi-squared) was not.

Multivariate analysis of pre-operative factors showed KL grade (low grade) and pre-operative OKS (poor score) to predict dissatisfaction independently (Table IV). Post-operative factor multivariate analysis accounted for greater variation in satisfaction (as indicated by a higher R^2 value) and confirmed stiffness (p = 0.001) and improvement in OKS (p = 0.001) to predict dissatisfaction independently (Table V). Combining pre- and post-operative factors confirmed pre-operative OKS (p = 0.033), improvement in OKS at one year (p = 0.027) and stiffness (p = 0.001) to predict dissatisfaction independently at one year (R^2 = 0.585).

The responses to additional satisfaction questions were correlated with overall patient satisfaction (Table VI), which correlated most accurately with pain relief, followed by whether expectations had been met. Satisfaction correlated least well with the ability to perform heavy work or sports.

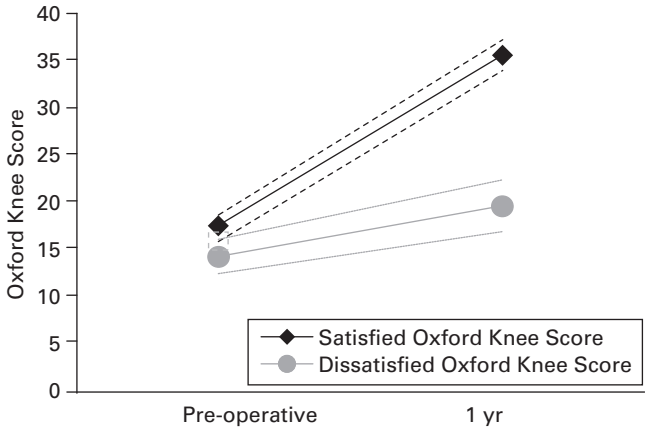

Fig. 4a

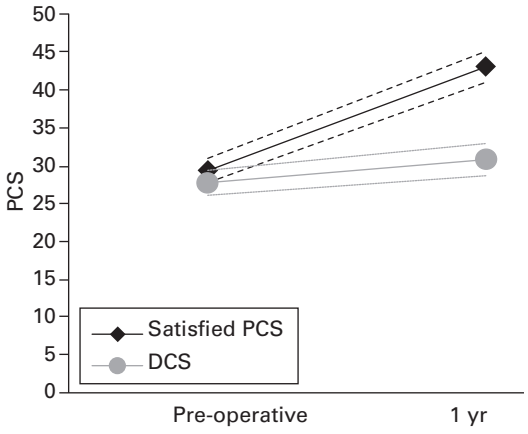

Fig. 4b

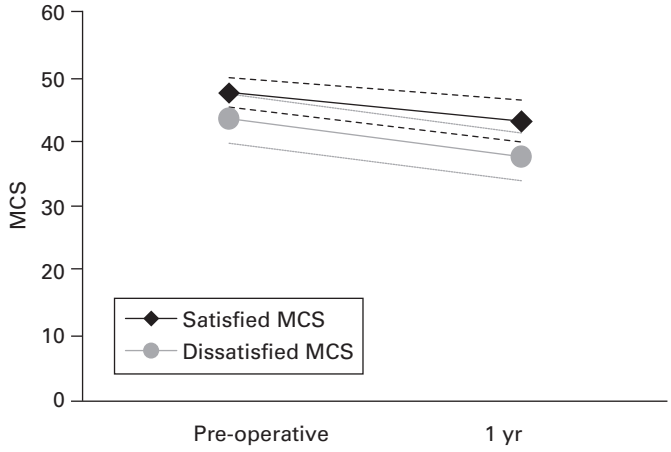

Fig. 4c

Patient-reported outcomes measures in satisfied and dissatisfied patients; a) Oxford Knee Score; b) Short Form (SF)-12 physical (PCS) and; c) mental component score (MCS). Dotted lines are 95% confidence intervals.

Radiographic analysis. With regard to the tibial component, 11/177 TKAs had non-progressive radiolucent lines: in ten TKAs in zone 1; and in four in zone 4. On the femoral side 14/177 had non-progressive radiolucent lines: six in zone 1 and ten in zone 4. A total of two patients (one TKA each) went on to early revision TKA at 13 and 17 months for instability: both had been dissatisfied at one year. One further patient underwent secondary patellar resurfacing for anterior knee pain at 17 months.

Discussion

The overall patient dissatisfaction rate of 25% at 12 months in the under 55 age group is higher than that found in older age groups at our institution (Fig. 1: 55 to 59 years 21%; 60 to 64 years 19%; 65 to 69 years 17%; 70 to 74 years 15%; 75 to 79 years 14%; > 80 years 14%), and higher than the 14% to 19% reported for all age groups in other studies.[6,7,9,10] Our study has identified pre-operative OKS, poorer improvement in OKS and post-operative knee stiffness as independently significant predictors of dissatisfaction in this age group. Other significant predictors of dissatisfaction included underlying indication for surgery, low KL grade, post-operative SF-12 PCS and MCS, and the presence of other complications, which were no longer significant after adjusting for these three variables (pre-operative OKS, poor improvement in OKS and post-operative knee stiffness).

Indications. Uncomplicated primary OA in knees which have undergone no previous surgery was the indication in only 32% (57/177) of TKAs in this cohort. A further 21% (37/177) had an inflammatory arthropathy, with a very high rate of satisfaction of 94.6% (35/37 knees). It could be argued that all other indications in this study constituted secondary arthritis, which is a known risk factor for revision in this age group.[19] Secondary OA can be due to a range of circumstances, with post-traumatic OA differing from OA secondary to meniscal injury/surgery or to instability/ligament reconstruction in terms of deformity, technical difficulties, the incidence of complications and outcome. Post-traumatic OA has been associated with inferior outcomes[20] and elevated complication rates,[21] however, in contrast previous menisectomy has not.[22] We have

Table III. Post-operative predictors of dissatisfaction by knees. Presented as mean (range) or number (%) and confidence intervals (CI)

Variable	Satisfied (n = 133)	Dissatisfied (n = 44)	p-value	95% CI
Complication	12 (*10*)	25 (*57*)	< 0.001‡	
Pain	3 (*2*)	10 (*23*)	< 0.001**	
Subjective stiffness	3 (*2*)	9 (*7*)	< 0.001**	
Objective instability	2 (*1.5*)	2 (*5*)	0.26**	
Subjective instability	2 (*1.5*)	0	1.0**	
Infection	0	4 (*9*)	0.003**	
VTE	2 (*1.5*)	0	1.0**	
Alignment (°)				
FTA	176.5 (168 to 188)	177.0 (171 to 189)	0.44*	-1.7 to 0.8
MPTA	88.4 (83 to 93)	88.2 (84 to 92)	0.44*	-0.4 to 1.0
LDFA	84.7 (78 to 92)	84.4 (81 to 89)	0.45*	-0.5 to 1.2
PTS	4.0 (-4 to 11)	4.1 (-2 to 12)	0.80*	-1.1 to 1.4
Femoral flexion	2.7 (-8 to 9)	3.6 (-3 to 8)	0.09*	-1.8 to 0.1
ROM (°)				
FFD > 5°	11 (*8*)	5 (*12*)	0.57‡	
Flexion < 90°	4 (*3*)	7 (*16*)	0.002‡	
PROMs at 1 yr				
OKS	35.8 (9 to 47)	19.8 (4 to 41)	< 0.001†	
OKS improvement	18.2 (-8 to 34)	5.3 (-8 to 24)	< 0.001*	9.8 to 15.8
PCS	43.2 (16 to 63)	30.9 (18 to 49)	< 0.001*	8.5 to 16.1
PCS improvement	13.7 (-12 to 45)	3.1 (-17 to 28)	< 0.001*	8.5 to 19.8
MCS	43.8 (0 to 67)	38.2 (0 to 59)	0.001†	
MCS improvement	-3.4 (-38 to 32)	-5.2 (-34 to 18)	0.014†	

* *t*-test
† Mann-Whitney U test
‡ chi-squared
** Fisher's exact
VTE, venous thromboembolism; FTA, femorotibial angle; MPTA, medial proximal tibial angle (β); LDFA, lateral distal femoral angle (α); PTS, posterior tibial slope (σ); ROM, range of movement; PROMs; patient reported outcome measures; OKS, Oxford Knee Score; PCS, Short Form (SF)-12 Physical Component Score; MCS, SF-12 Mental Component Score

Table IV. Multivariate analysis of pre-operative predictors of dissatisfaction by knees

Predictors in the model (R^2 = 0.286)	B (95% CI)	p-value
Kellgren-Lawrence grade	0.44 (0.22 to 0.91)	0.025
OKS	0.91 (0.83 to 1.0)	0.003
Indication		
2° OA with meniscectomy	2.86 (1.1 to 7.7)	0.149
2° OA multiply operated	2.94 (0.77 to 11.1)	0.365
2 at OA other surgery	1.7 (0.29 to 10)	0.353
OA BMI > 40 kg/m^2	2 (0.59 to 5.6)	0.424
PTOA	3.3 (0.77 to 14.3)	0.057
Inflammatory arthropathy	0.23 (0.05 to 1.15)	0.085

OKS, Oxford Knee Score; OA, osteoarthritis; BMI, body mass index; PTOA, post-traumatic osteoarthritis; CI, confidence interval

tried to investigate outcome by aetiology. Whether super obesity (BMI > 40 kg/m^2) should be included as a cause of secondary OA via overload is a matter for debate.[23-25] Obesity is a well-proven risk factor for the development of knee OA[23,26] and its progression: a BMI of 25 to 30 is associated with a relative risk of OA progression of 2.4 (95% CI 1.0 to 3.6) increasing to 2.9 (95% CI 1.7 to 4.1) with a BMI > 30.[25] Becoming overweight earlier in adulthood increases the risk of knee OA further.[24] Just as meniscal damage/excision or malalignment following fracture disrupts the normal loading environment of the knee leading to 'secondary osteoarthritis', so too does super obesity.

BMI. There is a four- to five-fold increase in the risk of developing OA for obese patients.[26] Super obesity increases the technical difficulty of TKA, and the elevated incidence of multiple comorbidities[26] increases the risks of surgery. Inferior outcomes and survival of TKA have been reported in patients with a BMI > 40 kg/m^2[27] in addition to a greater risk of failure of revision TKA.[28] In all, 13% of this young cohort (23/177 knees) were classified a super obese.

Radiographic severity. Dissatisfaction was significantly associated with low radiographic severity of OA on both univariate analysis and pre-operative multivariate analysis. Low radiographic OA severity has been associated with

Table V. Multivariate analysis of post-operative predictors of dissatisfaction

Predictors in the model (R^2 = 0.653)	B (95% CI)	p-value
Complication		
Stiffness	100 (5.9 to 1000)	0.001
Pain	6.67 (0.85 to 50)	0.071
Infection	1.00	0.999
OKS improvement	0.87 (0.81 to 0.94)	0.001
PCS at 1 yr	0.90 (0.84 to 0.97)	0.005
MCS at 1 yr	1.00 (0.96 to 1.04)	0.977

OKS, Oxford Knee Score; PCS, Short Form (SF)-12 Physical Component Score; MCS, SF-12 Mental Component Score; CI, confidence interval

Table VI. Pearson's correlation of overall patient satisfaction with other questionnaire elements by knees

Knee outcome variable	Pearson's correlation with satisfaction
Pain relief	0.828
Expectations met	0.810
Increased physical ability	0.723
Ability to perform heavy work or sports	0.445

worse function following TKA[29] and poor patient satisfaction rates of 68% (30/44 knees)[30] have been reported, with an increased risk of re-operation compared with patients with more severe radiographic arthritis.[30] A study by Polkowski et al[31] found 49% of 49 patients with unexplained pain and dissatisfaction following TKA had a low radiographic grade of OA (KL grade 1/2). Our dissatisfaction rate in patients with KL grade 1/2 OA was 59% (ten of 17 patients). Though pre-operative OKS did not differ between KL grades, improvement therein was significantly worse in patients with low KL grades. When considering both pre- and post-operative variables, poor OKS improvement was a more significant predictor of dissatisfaction than OA grade itself. However, the radiographic OA grade is an important consideration, especially when counselling patients on the expected outcome of TKA.

In 12 of 17 knees (17 patients) with KL grade 1/2 arthritis, an arthroscopy had been previously undertaken. A dissatisfaction rate of about 40% was found in patients who had undergone previous arthroscopy. The effect of arthroscopy on outcome of TKA is uncertain, although Issa et al[22] found no effect on Knee Society Score (KSS) or survival, when performed within months of TKA. Our findings suggest the need for frank counselling regarding the likelihood of dissatisfaction from TKA in young patients when only arthroscopic evidence of arthritis is present.

Deprivation. Although social deprivation level did not predict dissatisfaction, the most deprived were found to predominate in this young population. This concurs with Clement et al,[32] who found that the most deprived patients underwent TKA at earlier ages. Whether this is due to greater levels of manual work, or greater levels of comorbidities, including mental ill-heath and elevated BMI, has not been investigated here, and is a weakness of our study.

PROMs. Both the OKS and SF-12 PCS improved significantly in both satisfied and dissatisfied patients, but the mean improvement in OKS was 13 points less in those who were dissatisfied. In addition to post-operative stiffness, differences in OKS were the most important predictors of satisfaction. In contrast to other studies,[10,32,33] mean mental health scores worsened following TKA in this cohort. Both satisfied and dissatisfied patients experienced a mean decline in SF-12 MCS in their first post-operative year, though this was less marked in those who were satisfied. Mental health scores were not significant predictors of satisfaction in this age group. This is a new finding as pre-operative mental health, and post-operative improvement, have repeatedly been found to predict satisfaction following TKA for all ages.[10,33,34]

Reports on functional outcome in young patients receiving TKA have been few. A recent systematic review of the < 55-year-old group identified 908 TKAs in 671 patients and determined mean clinical and functional KSS improvements of 47 and 37 points, respectively, at a minimum of two years.[5] The KSS is a surgeon-completed score and we are not aware of studies of true PROMs in this age group. To our knowledge, this is the first report of patient dissatisfaction following TKA in young patients.

Complications. The presence of a post-operative complication, in particular pain, stiffness or infection, significantly predicted dissatisfaction on univariate analysis. Previous studies have shown pain to be the most significant predictor of dissatisfaction at one year.[9,10] While pain scores can be derived from PROMs, measures of stiffness cannot, and to our knowledge, have not previously been examined as predictors of dissatisfaction. Patient-reported stiffness (12/177 knees, 6.8%) was an independent predictor of dissatisfaction on multivariate analysis with a greater influence than pain. A total of four manipulations were required, which is slightly greater than some published rates of 1.5% for this supplementary procedure.[35] This may reflect the high incidence of the reported risk factors for manipulation, namely female gender, age < 60 years, and BMI > 30 kg/m^2, in this

population.[35] Investigating stiffness further found that a lack of flexion beyond 90º, rather than a fixed flexion deformity, was associated with dissatisfaction. This is surprising as persistent fixed flexion deformity forces the quadriceps to continually contract with associated increases in energy expenditure, slower walking velocity, abnormal gait mechanics and overloading of the contralateral limb.[36]

It has been reported that non-infective modes of TKA failure tend to be a predominant factor in younger patients (aseptic loosening, 32%; infection; 17%; instability, 16%; stiffness, 14%; wear, 9%; pain, 7% and malalignment, 2%).[3] Accordingly inferior implant survival in young patients is often attributed to the effects of high levels of activity in young patients, sustained over long periods.[37] As confirmed in this study, the indications for TKA in young patients are often complex. A recent study comparing activity levels in young (150 patients < 55 years) and older (262 patients 65 to 75 years) patients receiving TKA has confirmed that activity levels in this patient cohort are not as high as expected:[37] pre-operatively 87% of the young group were sedentary or only mildly active *versus* 77% in the older group. Post-operatively, 56% and 52%, respectively remained in this low activity category and only 10% of the young group returned to regular recreational or sporting activities.[37] These low activity scores were attributed to the preponderance of women in the young cohort, but also to the higher BMI and non-OA diagnoses present in the young group. Our cohort was similarly constituted and the ability to do heavy work or sporting activities correlated least with overall satisfaction.

We acknowledge the limitations of this study, which include its retrospective nature, the lack of other comorbidity data, and of a specific patient activity score. Nevertheless, patients receiving TKA aged < 55 years of age had a high incidence of post-operative dissatisfaction. Offering TKA when radiographic changes are minimal is questionable with dissatisfaction rates approaching 60%. While low radiographic severity of OA, indication for TKA, and the presence of a complication were all associated with dissatisfaction, the most significant independent predictors were worse pre-operative OKS, poor improvement in the OKS and ongoing stiffness, particularly limited flexion.

Take home message:

Patients undergoing TKA when < 55 years of age differ from the general arthroplasty population and display higher rates of dissatisfaction, risk factors for which include low grade radiographic osteoarthritis; indication for TKA; post-operative stiffness in flexion; and poor OKS improvement.

Author contributions:
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The authors thank all of the orthopaedic surgeons and patients of the Royal Infirmary of Edinburgh.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

This article was primary edited by G. Scott.

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