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TRAUMA

Tibial plateau fractures in older adults are associated with a clinically significant deterioration in health-related quality of life

A PROPENSITY SCORE-MATCHED STUDY

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Aims

To investigate health-related quality of life (HRQoL) of older adults (aged ≥ 60 years) after tibial plateau fracture (TPF) compared to preinjury and population matched values, and what aspects of treatment were most important to patients.

Methods

We undertook a retrospective, case-control study of 67 patients at mean 3.5 years (SD 1.3; 1.3 to 6.1) after TPF (47 patients underwent fixation, and 20 nonoperative management). Patients completed EuroQol five-dimension three-level (EQ-5D-3L) questionnaire, Lower Limb Function Scale (LEFS), and Oxford Knee Scores (OKS) for current and recalled prefracture status. Propensity score matching for age, sex, and deprivation in a 1:5 ratio was performed using patient level data from the Health Survey for England to obtain a control group for HRQoL comparison. The primary outcome was the difference in actual (TPF cohort) and expected (matched control) EQ-5D-3L score after TPF.

Results

TPF patients had a significantly worse EQ-5D-3L utility (mean difference (MD) 0.09, 95% confidence interval (CI) 0.00 to 0.16; $p < 0.001$) following their injury compared to matched controls, and had a significant deterioration (MD 0.140, 95% CI 0 to 0.309; $p < 0.001$) relative to their preoperative status. TPF patients had significantly greater pre-fracture EQ-5D-3L scores compared to controls ($p = 0.003$), specifically in mobility and pain/discomfort domains. A decline in EQ-5D-3L greater than the minimal important change of 0.105 was present in 36/67 TPF patients (53.7%). Following TPF, OKS (MD -7; interquartile range (IQR) -1 to -15) and LEFS (MD -10; IQR -2 to -26) declined significantly ($p < 0.001$) from pre-fracture levels. Of the 12 elements of fracture care assessed, the most important to patients were getting back to their own home, having a stable knee, and returning to normal function.

Conclusion

TPFs in older adults were associated with a clinically significant deterioration in HRQoL compared to preinjury level and age, sex, and deprivation matched controls for both undisplaced fractures managed nonoperatively and displaced or unstable fractures managed with internal fixation.

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Introduction

Tibial plateau fractures (TPFs) account for 8% of all fractures in older adults[1] . Lower limb trauma in older adults is often complicated

by poor bone stock, tissue fragility, pre-existing osteoarthritis (OA), patient comorbidities, frailty, and low pre-fracture mobility and functionality.[2] In older patients severe patterns of injury can occur even in low energy falls such as from standing height.[3] As such, TPFs in older adults typically fall into the National Institute for Health and Care Excellence (NICE) definition of complex fractures which includes "joints broken into multiple pieces".[4]

A recent priority setting partnership identified ten research priorities in complex fracture management.[5] Functional recovery and return to life roles after complex fractures was identified within this top ten by patients, carers, healthcare professionals and clinical academics. Though we typically measure functional outcome using both generic health and joint specific patient-reported outcome measures (PROMs), it can be difficult to interpret many of these scores in the context of trauma, as most were developed to measure improvements in chronic conditions after treatment such as arthritis. Measuring outcomes and managing expectations after fracture is more complex as patients often do not return to their baseline function despite treatment being "successful" in restoring joint congruity and achieving fracture union. Patient recall has been used to retrospectively report preoperative joint specific scores in arthritis,[6] but this has not been investigated as a method of collecting pre-fracture PROMs and determine within patient changes. In patients recovering from hip fracture, it has been shown that general health-related quality of life (HRQoL) measures, such as the EuroQol five-dimension (EQ-5D) questionnaire, are responsive measures of outcomes in this cohort.[7]

To quantify the impact of TPF on HRQoL, it may be helpful to compare outcomes to those expected in the general population. Normal population values for the EQ-5D three-level (3L) questionnaire are collected annually as part of the Health Survey for England (HSE), which monitors trends in the health of adults and children across England.[8]

The primary aim of this study was to compare HRQoL, measured using the EQ-5D-3L score, in patients aged ≥ 60 years following TPF, to those expected in age, sex, and deprivation-matched controls from the general population based upon HSE data. Secondary aims included examining change in HRQoL and joint/limb specific outcomes after TPF and assessing what aspects of TPF treatment were most important to patients.

Methods

This retrospective, case-control study compares patients aged > 60 years following TPF to the general population. Ethical approval was obtained (Scotland (A) Research Ethics Committee 16/SS/0026). This study is reported in accordance with the Strengthening the reporting of observational studies in epidemiology (STROBE) guidelines. Demographic and PROMs data was obtained from two separate sources: patients with TPFs treated in a single university teaching hospital; and the HSE.

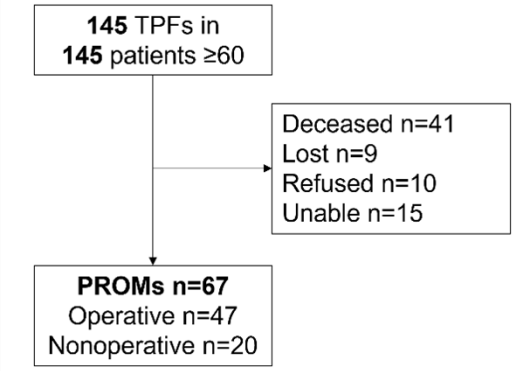

Fig. 1
Tibial plateau fracture cohort.

Tibial plateau fracture cohort (cases). From 1 January 2016 to 31 December 2020, 145 consecutive patients with tibial plateau fractures aged ≥ 60 years were admitted to the study institution and were identified from a prospectively collected trauma database. Patients aged < 60 years and those with fractures occurring around prostheses were excluded. Electronic patient records and radiographs were examined, and PROMs questionnaires were sent to patients who were still alive at a mean of 3.5 years (standard deviation (SD) 1.3; 1.3 to 6.1) after fracture. Radiographs were examined by two authors (JFK, CEHS). Fractures were classified according to the Schatzker classification,[9] and the quality and maintenance of reduction was recorded. Patients were asked to complete PROMs scores via postal questionnaire for both the current status and their recalled prefracture status. Patients who did not respond to the questionnaire were contacted by telephone. Patients who were uncontactable (n = 9 (6.2%)), those who could not complete PROMs (n = 15 (10.3%)) and those who did not want to be included were excluded (n = 10 (6.9%)). This gave a study population of 67 TPFs in 67 patients aged ≥ 60 years with a minimum of one-year follow-up (Figure 1).

Questionnaires included validated PROMs: EQ-5D-3L questionnaire;[10] Oxford Knee Score (OKS);[11] and the Lower Limb Functional Scale (LEFS).[12] EQ-5D is a validated and widely used five-dimension (Mobility (MO), Self-Care (SC), Usual Activities (UA), Pain and Discomfort (PD), and Anxiety and Depression (AD)) multi-attribute general health questionnaire that defines an overall health index (from -0.594 to 1). In the 3L version, each question has three possible levels indicating the degree of impairment ("none" = 1, "some" = 2, "extreme" = 3), giving 243 potential health states. The minimal important change (MIC) for the EQ-5D-3L in patients with knee OA

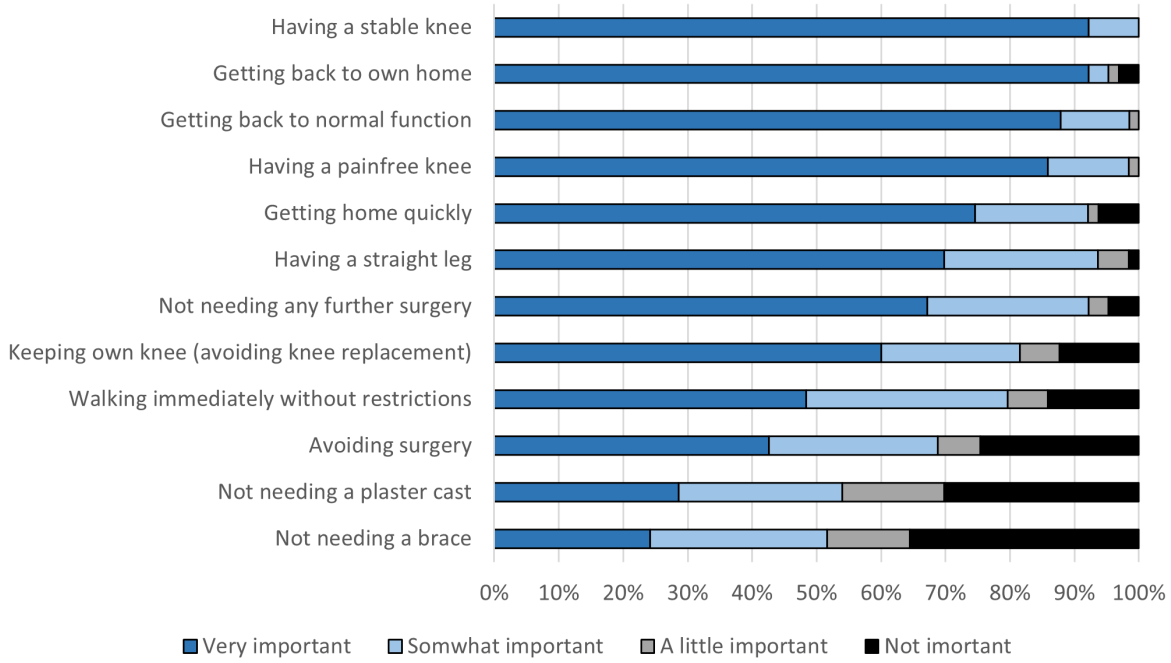

Fig. 2

The importance to patients of 12 aspects of fracture care and recovery.

is reported as 0.105.[13] The EuroQol visual analogue scale (EQ-VAS) is a secondary element of the EQ-5D-3L encompassing the individual's overall health beyond the five dimensions covered in the health profile and is rated from 0 (worst health imaginable) to 100 (best health imaginable).[14] The OKS is a validated knee specific outcome measure where 12 questions (five possible answers) give scores from 0 to 48 (higher scores = better function). An MIC in OKS was defined as 7 points.[15] The LEFS is a validated lower limb specific score consisting of 20 questions (four possible answers) giving a score of 0 to 80 where higher scores reflect better function. It is both responsive and reliable with an MIC of 9 points.[12] Satisfaction with the affected knee was measured using a five-point Likert scale from "very dissatisfied" to "very satisfied".[15]

Patient demographics were recorded from electronic patient records. The Scottish Index of Multiple Deprivation (SIMD) was calculated according to postcode.[16] Patients were also asked a series of qualitative questions regarding the importance of 12 aspects of their fracture care and recovery to help understand what elements of management are most important to patients (Figure 2). Patients were asked, "How important were the following aspects of your care to you after your fracture?" with the options "not important", "a little important", "somewhat important" and "very important".

General population cohort (controls). The HSE is an annual survey used to monitor trends and health-related behaviours in a nationally representative cohort of adults and children. The UK Data Service provides access to de-identified individual level data from the HSE,[8] and responses were considered representative of the general population. For the purposes of this study, the 2010 to 2012 HSE data were extracted as those years included in the EQ-5D-3L. All respondents were considered for inclusion in this study. Individuals were excluded if they had incomplete data or if they were aged under 60 years. During the period 2010 to 2012, there were a combined 22,143 participants in the HSE (Table I). The individual weight variable published with each HSE dataset was used to account for non-responder bias.[8]

Propensity score matching. To balance covariates and facilitate more meaningful group comparisons, a propensity score was estimated, using the MatchIt programme.[17] The propensity-score was derived from a logistic regression model, including the covariates sex, age, and deprivation, and used a 1:5 "nearest neighbour" method as this provided the best overall balance between cohorts. Balancing was assessed by estimating standardized mean differences for each covariate. Visual assessment was also undertaken using QQ plots. Two matched cohorts of 67 TPFs and 335 propensity-matched controls were obtained for the final analyses (Table I). The standardized mean differences for each covariate were below 0.1, suggesting adequate balance.[18]

Primary outcome. The primary outcome of interest was the difference in HRQoL (as measured by the EQ-5D-3L

Table I. Propensity score-matched cohorts (5:1).

Variable	General population		Tibial plateau fracture	Standardized mean difference	
	Unmatched (n = 22,143)	Matched (n = 335)	Cohort (n = 67)	Unmatched	Matched
Median age, yrs (IQR)	49 (35.0 to 64.0)	68 (64.0 to 73.0)	68 (64.5 to 73.0)	2.90	0.02
Sex, n					
Male	9,732	60	12	-0.68	0.00
Female	12,411	275	55	0.68	0.00
Index of Multiple Deprivation, quintile					
1	3,801	8	2	-0.83	0.04
2	4,105	72	14	0.06	0.01
3	4,568	40	8	-0.27	0.00
4	4,685	90	18	0.13	0.00
5	4,984	125	25	0.31	0.00

IQR, interquartile range.

index score) between the TPF cohort and the population matched control group.

Secondary outcomes. Secondary outcomes included assessing change following TPF in HRQoL using the EQ-5D and EQ-VAS,[1,2] and joint/limb specific functional outcomes measured using the OKS and LEFS,[3] and what aspects of TPF treatment were most important to patients using the 12 patient questionnaire.

Statistical analyses. Data handling and statistical analysis was undertaken using R Studio version 1.3.959 (USA). The distribution of continuous variables was plotted to assess appropriateness of parametric or non-parametric tests of differences. Differences between general population and TPF cohort EQ-5D-3L index scores were compared using unpaired Mann-Whitney U test. Differences between categorical variables between cohorts were measured using the chi-squared test. A p-value < 0.05 was considered statistically significant. Post-hoc power calculation demonstrated that using a mean EQ-5D of 0.69 after TPF and a normal population mean of 0.8 (SD 0.2), a sample size of 26 would detect this difference as significant at the 5% level with an α of 0.8.

Results

Of 145 patients aged ≥ 60 years who sustained a TPF from 2015 to 2020, 104 patients were alive at follow-up at a mean of 3.5 years (SD 1.3;1 1.3 to 6.1) after fracture, and 67 patients (64.4%) completed PROMs (Figure 1). TPF patient characteristics are given in Tables I and II. Median age was 67.5 years (60 to 87; interquartile range (IQR) 64 to 72). Fixation had been performed in 47/67 cases and 20 had been managed nonoperatively. Nonoperative management typically consisted of six weeks non-weightbearing in a hinge knee brace with free flexion to 90°. Where internal fixation was performed, ten underwent percutaneous fixation with cannulated screws and 37 underwent open reduction and internal fixation (ORIF). Fractures treated with internal fixation included three Schatzker type I; 23 type II; seven type III; 5 type IV; one type V; and seven type VI. ORIF procedures included 25 single lateral plate fixations ± calcium phosphate cement via an anterolateral approach; three single medial plate plus bone grafting via a medial approach; eight bicolumn plating via anterolateral and posteromedial approaches; and a single nail plus anterolateral plate construct. Following fixation, patients were typically managed non-weightbearing in a hinge knee brace with 0 to 90° flexion for six weeks. Significant displacement of > 2 mm was present preoperatively in 37 cases and an anatomical or acceptable reduction (with < 3 mm residual

Table II. Additional characteristics of patients with tibial plateau fractures.

Variable	Data (n = 67)
Length of follow-up, yrs, mean (SD; range)	3.5 (1.31; 1.3 to 6.1)
Pre-existing radiological knee OA, mean (SD)	15 (22)
Mechanism of injury, mean (SD)	
Direct blow/crush	3 (5)
Fall from > standing height	17 (25)
Fall from standing height	34 (50)
Road traffic collision	5 (7)
Sport	4 (6)
Twisting injury	2 (3)
Operatively managed	47 (70)
Percutaneous screws	10 (15)
ORIF with plate/s	37 (55)
Schatzker grade, mean (SD)	
I	8 (12)
II	28 (41)
III	12 (18)
IV	9 (13)
V	2 (3)
VI	8 (2)
Loss of reduction during follow-up	16 (24)
Late TKA	3 (5)

OA, osteoarthritis; ORIF, open reduction and internal fixation; SD, standard deviation; TKA, total knee arthroplasty.

Table III. EQ-5D-3L index scores (matched cohort).

Variable	General population (unmatched) Median (IQR)	General population (matched) Median (IQR)	Pre-injury Median (IQR)	General population (matched) vs pre-injury Difference (95% CI); p-value*	One-year post-injury Median (IQR)	General population (matched) vs post-injury Difference (95% CI); p-value*
Total	1.00 (0.76 to 1.00)	0.80 (0.725 to 1.00)	1.00 (0.80 to 1.00)	-0.000001 (-0.12 to 0.00); p = 0.003	0.69 (0.60 to 0.94)	0.09 (0.00 to 0.16); p < 0.001
Sex						
Male	1.00 (0.80 to 1.00)	0.80 (0.69 to 1.00)	0.92 (0.77 to 1.00)	-0.00001 (-0.20 to 0.00); p = 0.261	0.69 (0.52 to 0.90)	0.10 (0.00 to 0.31); p = 0.156
Female	1.00 (0.73 to 1.00)	0.85 (0.73 to 1.00)	1.00 (0.80 to 1.00)	-0.00006 (-0.15 to 0.00); p = 0.005	0.74 (0.62 to 0.91)	0.09 (0.00 to 0.18); p = 0.001
Age, yrs						
55 to 64	0.85 (0.73 to 1.00)	0.85 (0.73 to 1.00)	1.00 (0.80 to 1.00)	-0.00005 (-0.15 to 0.00); p = 0.477	0.69 (0.52 to 1.0)	0.11 (0.00 to 0.24); p = 0.030
65 to 74	0.80 (0.73 to 1.00)	0.81 (0.73 to 1.00)	1.00 (0.85 to 1.00)	-2.69 (-0.15 to 0.00); p = 0.003	0.75 (0.62 to 0.85)	0.09 (0.00 to 0.20); p = 0.012
75 to 84	0.78 (0.69 to 1.00)	0.73 (0.69 to 1.00)	0.80 (0.69 to 1.00)	-0.000007 (-0.20 to 0.04); p = 0.585	0.69 (0.59 to 0.80)	0.07 (-0.07 to 0.31); p = 0.299
Over 85	0.73 (0.62 to 0.85)	0.80 (0.69 to 0.85)	1.00 (086 to 1.00)	-0.15 (-0.31 to 0.12); p = 0.273	0.69 (0.64 to 0.85)	0.03 (-0.27 to 0.31); p = 0.540

*Mann-Whitney U test.
CI, confidence interval; EQ-5D-3L, EuroQol five-dimension three-level; IQR, interquartile range.

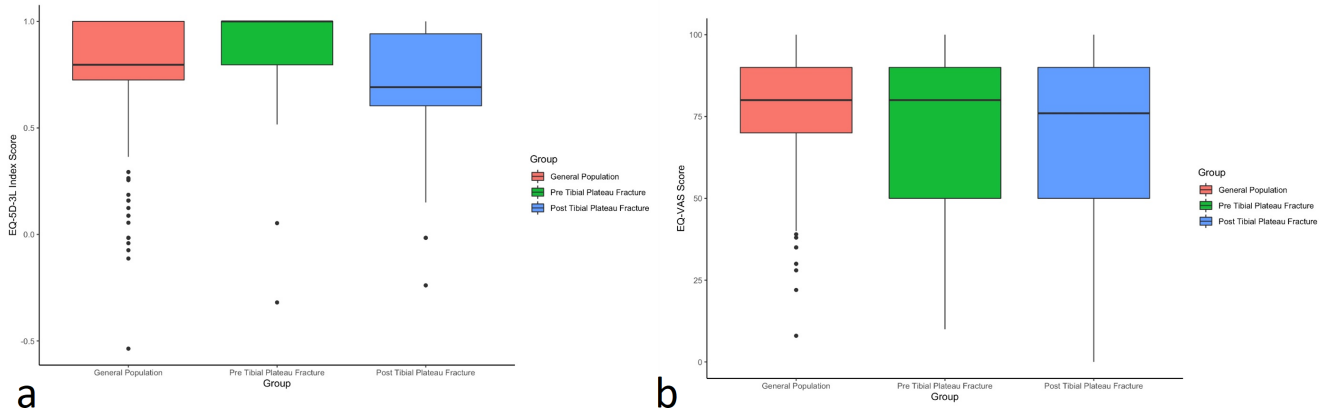

Fig. 3

EuroQol five-dimension three-level (EQ-5D-3L): a) index, and b) visual analogue scale scores recalled prior to tibial plateau fracture (TPF), following TPF, and propensity score-matched general population.

depression) was obtained in all. Three of 67 patients went on to late total knee arthroplasty (TKA).

Primary outcome. Compared to controls (age, sex, and deprivation-matched general population), TPF patients had significantly greater recalled pre-fracture EQ-5D-3L scores and significantly worse post fracture scores (Table III, Figure 3, and Figure 4)). This was specifically the case for females and those in the younger age groups examined (60-74). The mean difference in EQ-5D-3L score between the matched control group and patients after TPF was 0.09 (0.00 to 0.16 95% CI) (p < 0.001)(Figure 4), which exceeds the MCID reported for knee patients of 0.085.[13] A decline in EQ-5D in excess of the MIC of 0.105 was present in 36/67 TPF patients (53.7%).[13]

Recalled pre-injury scores differed between cases and controls specifically in mobility and pain/discomfort domains (Table IV and Figure 3). After TPF all EQ-5D-3L domains other than anxiety/depression were significantly worse compared to controls (Table IV).

Secondary outcomes. There were no significant differences in the EQ-VAS between TPF cases and general population controls either for recalled pre-injury scores or post fracture scores (Table V and Figure 3). The only significant difference was between post-fracture cases aged 65 to 74 years, and matched controls where a mean deficit of 8 points was present in the TPF cohort (Table V).

Across the TPF cohort, all PROMs declined significantly from recalled pre-fracture status to post-fracture levels (p

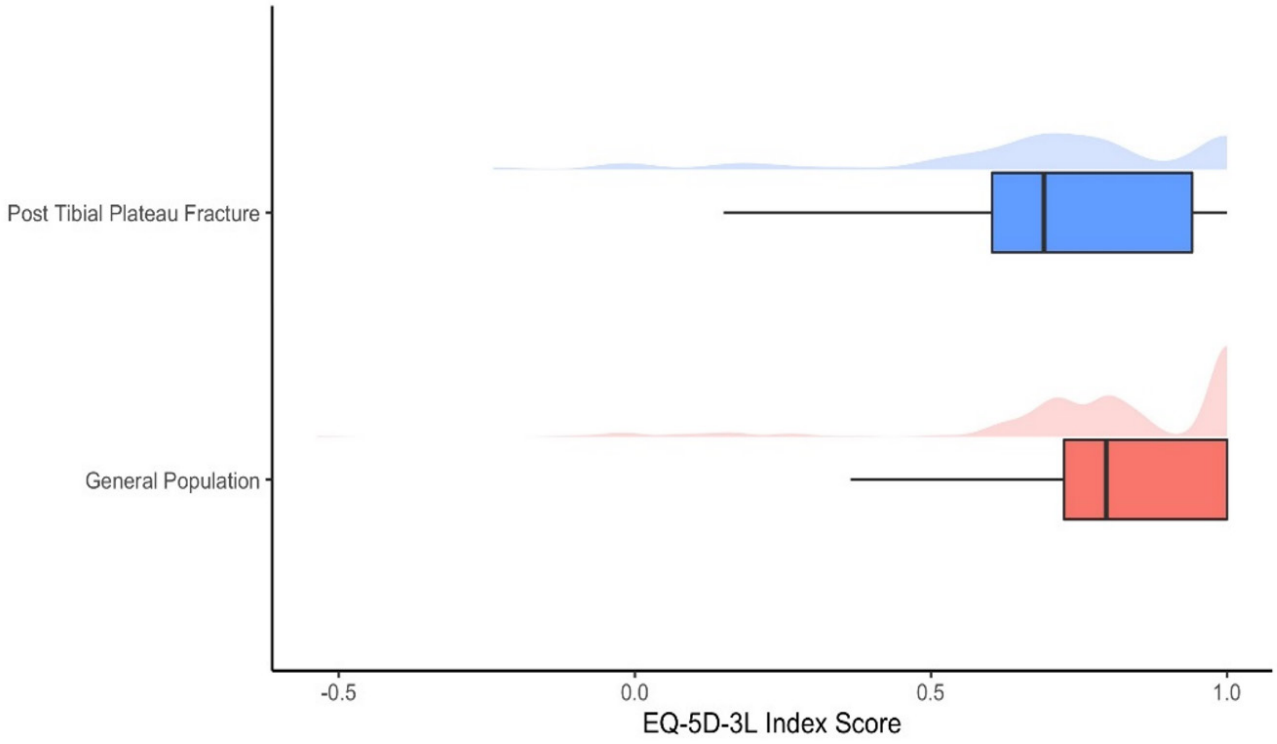

Fig. 4

EuroQol five-dimension three-level (EQ-5D-3L) index distributions following tibial plateau fracture compared to propensity score-matched population.

< 0.001, Wilcoxon signed rank): median OKS difference -7 (IQR -1 to -15); median LEFS difference -10 (-2 to -26); and median EQ-5D difference -0.140 (0 to -0.309) (Figures 3 and 5). A decline in OKS exceeding the 7 point individual MIC for the OKS was present in 31/64 (48.4%), and 23/45 (51.1%) reported a decline on LEFs in excess of the individual MIC for the LEFS of 9. Absolute postoperative PROMs scores did not correlate with length of follow-up, however, differences between pre and postoperative LEFS scores did correlate with length of follow-up: longer time from fracture correlated with greater difference (Pearson correlation -0.295; p = 0.049, R^2 linear 0.087).

There were no significant differences in any of the PROMs measured, or the differences therein after fracture, between those managed operatively and nonoperatively (p > 0.05). Overall, 38/65 patients (58.5%) were satisfied or very satisfied following management of their tibial plateau fracture and 27 were unsure or dissatisfied. There was no significant difference in satisfaction between those managed with and without surgery.

Of the 12 elements of their fracture care measured the most important to patients was getting back to their own home, having a stable knee, and returning to normal function with a pain-free knee (Figure 2). Overall, 60% of patients reported that it was very important to avoid TKA and 42% that it was very important to avoid any surgery. Almost half of respondents wanted to avoid weight-bearing restrictions.

Fixation. Of patients who underwent fixation for displaced fractures, 26/46 (57.8%) were satisfied or very satisfied with their outcome. Of those who experienced a radiological loss of reduction after fixation, 7/11 (64%) were dissatisfied with their outcome compared to 12/34 (35%) whose reduction was maintained, though this was not significant (p = 0.098, chi-squared test). Of patients with bicondylar fractures, 5/7 were dissatisfied compared to 14/38 with unicondylar injuries, though again this did not reach statistical significance (p = 0.089, chi-squared test). There were no statistically significant differences in EQ-5D, OKS, LEFS or satisfaction between patients who had undergone fixation (for unstable or displaced fractures) and those with stable undisplaced or minimally displaced fractures who had been managed nonoperatively.

Table IV. Summary of EQ-5D-3L index domain scores (matched cohort).

EQ-5D-3L component	Level	General population, n (%)	Pre-operation, n (%)	p-value (general population vs pre-injury)*	Post-operation, n (%)	p-value (general population vs post-injury)*
Mobility	1	224 (66.9)	56 (83.6)	0.007	30 (46.2)	0.005
	2	110 (32.8)	10 (14.9)		35 (53.8)	
	3	1 (0.3)	1 (1.5)		0 (0.0)	
	Problems	111 (33.1)	11 (16.4)		35 (53.8)	
Self-care	1	317 (94.6)	61 (91.0)	0.323	50 (76.9)	< 0.001
	2	16 (4.8)	6 (9.0)		14 (21.5)	
	3	2 (0.6)	0 (0.0)		1 (1.5)	
	Problems	18 (5.4)	6 (9.0)		15 (23.0)	
Usual activities	1	259 (77.3)	54 (80.6)	0.840	28 (43.1)	< 0.001
	2	70 (20.9)	12 (17.9)		32 (49.2)	
	3	6 (1.8)	1 (1.5)		5 (7.7)	
	Problems	76 (22.7)	13 (19.4)		37 (56.9)	
Pain/discomfort	1	168 (50.1)	45 (67.2)	0.037	18 (28.6)	0.006
	2	147 (43.9)	20 (29.9)		41 (65.1)	
	3	20 (6.0)	2 (3.0)		4 (6.3)	
	Problems	167 (49.9)	22 (32.9)		45 (71.4)	
Anxiety/depression	1	256 (76.4)	59 (88.1)	0.095	50 (76.9)	0.489
	2	75 (22.4)	8 (11.9)		13 (20.0)	
	3	4 (1.2)	0 (0.0)		2 (3.1)	
	Problems	79 (23.6)	8 (11.9)		15 (23.1)	

Problems = level 2 + 3.
*Chi-squared test.
EQ-5D-3L, EuroQol five-dimension three-level.

Table V. EQ-VAS scores (matched cohort).

Variable	General population (unmatched), median (IQR)	General population (matched), median (IQR)	Pre-injury, median (IQR)	General population (matched) vs pre-injury, difference (95% CI); p-value*	One-year post-injury, median (IQR)	General population (matched) vs post-injury, difference (95% CI); p-value*
Total	80 (70 to 90)	80 (70 to 90)	80 (50 to 90)	1.50 (-4.0 to 8.0); p = 0.613	76 (50 to 90)	4.0 (-8.0 to 10.0); p = 0.215
Sex						
Male	80 (70 to 90)	80 (70 to 85)	63 (49 to 95)	6.00 (-10.0 to 25.0); p = 0.570	75 (42 to 93)	0.000007 (-10.0 to 25.0); p = 0.751
Female	80 (70 to 90)	80 (70 to 90)	80 (60 to 90)	0.00003 (-4.0 to 7.0); p = 0.718	76 (55 to 90)	4.00 (0.00 to 10.0); p = 0.209
Age, yrs						
55 to 64	80 (70 to 90)	85 (70 to 90)	80 (45 to 98)	0.00003 (-10.0 to 18.0); p = 0.883	90 (50 to 96)	0.000009 (-9.0 to 16.0); p = 0.840
65 to 74	80 (70 to 90)	80 (70 to 90)	80 (60 to 90)	0.000006 (-5.0 to 8.0); p = 0.775	76 (53 to 88)	8.00 (0.00 to 1.40); p = 0.07
75 to 84	75 (60 to 85)	75 (58 to 80)	65 (53 to 88)	0.00005 (-11.0 to 19.0); p = 0.946	71 (63 to 90)	-6.00 (-20.0 to 9.0); p = 0.568
Over 85	70 (50 to 80)	62 (50 to 88)	76 (55 to 83)	4.99 (-40.0 to 57.0); p = 0.865	76 (56 to 83)	6.13 (-40.0 to 54.0); p = 0.865

*Mann-Whitney U test.
CI, confidence interval; EQ-VAS, EuroQol visual analogue scale; IQR, interquartile range.

Discussion

Following TPF, patients aged over 60 years experience a statistically and clinically significant decline in their HRQoL compared to age, sex, and deprivation matched controls. This difference was greatest in females, and those in the 60- to 74-year age group. All PROMS (EQ-5D-3L, OKS, and LEFs) declined significantly after TPF compared to recalled pre-injury levels with approximately half of patients reporting declines in excess of the clinically meaningful differences for these scores. However,

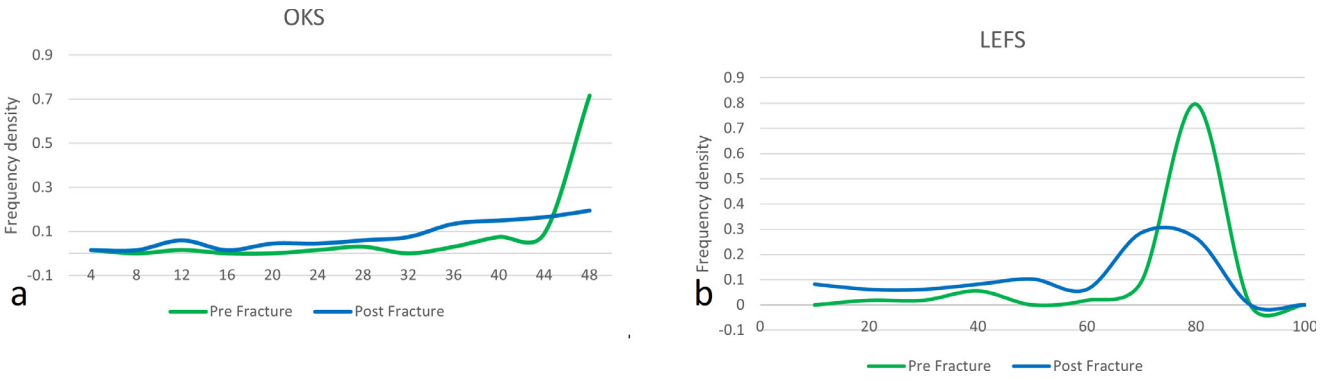

Fig. 5

Patient-reported outcome measures recalled prior to fracture and following tibial plateau fracture in patients aged ≥ 60 years, including those managed both operatively (n = 47) and nonoperatively (n = 20): a) knee specific Oxford Knee Score, and b) lower limb specific Lower Limb Function Scale.

recalled pre-injury EQ-5D indices were significantly better than matched controls, suggesting that recall may not be a reliable way of obtaining baseline values following fracture. Whether recalled preinjury scores are accurate or not, they do reflect the patient's perception of worsened function after injury with a longer duration from injury associated with greater differences. Despite this, over half were satisfied with the outcome of their injured knee, with no differences between those who had required surgery and those who had not.

Measuring PROMs after fracture is important to ensure quality and to counsel patients and manage expectations. However, there is debate about which PROMs are most appropriate to assess the outcome of fracture management. Previous studies of functional outcomes following TPF specifically have used a number of different PROMs. Gonzalez et al[19] reported Short Musculoskeletal Functional Assessment (SMFA) scores at one and > five years in 138 patients with operatively managed TPFs. They reported a statistically significant improvement in mean scores in all SMFA domains except pain from one- to > five-year follow-up. Clinically important thresholds for the SMFA are not provided nor are distributions of the scores or whether any patients deteriorated over this time frame, making interpreting the clinical significance difficult. Dattani et al[20] compared the psychometric qualities of the Western Ontario McMaster Osteoarthritis (WOMAC), SMFA, and the 36-Item Short Form (SF-36) questionnaires following TPF. These authors found that the SF-36, a generic health measure, was the most responsive instrument when assessing functional outcomes in patients with TPFs. In fact, it has been suggested that using a joint or limb specific score, such as the SMFA, or OHS or OKS, is redundant if using a robust measure of HRQoL, such as SF-36 or EQ-5D, to measure outcomes after lower limb fracture.[7,21]

A recent study of outcomes following open fractures determined that the domains that are important to patients and should therefore be included in a core outcome set for open fractures include 'Walking, gait and mobility', 'Being able to return to life roles', 'Pain or discomfort' and 'Quality of life'.[22] Using COSMIN methodology, this group of six patients, eight healthcare professionals and 11 research methodologists went on to recommend that the EQ-5D five-level (5L) and LEFS should be used in future research trials, audit and clinical assessment, of open fractures.[23] The current study employed both EQ-5D and LEFS, and though it does not include open fractures, TPFs in the elderly are considered complex fractures according to the NICE definition (joints broken into multiple pieces),[4] and it is reasonable to assume that similar domains are important to patients. The 3L as opposed to the 5L version of the EQ-5D was used because there is currently no validated EQ-5D-5L valuation set for the UK population.[24]

The current study has identified and quantified a significant HRQoL deficit following TPFs both compared to unaffected propensity matched controls, and compared to recalled pre-fracture function. This is consistent with other studies. Using the SF-36 generic heath measure in 182 patients with TPFs, Ramoutar et al[25] showed that by five years, neither patients with complex bicondylar TPFs (n = 46), nor those with isolated unicondylar fractures (n = 136), had returned to baseline levels, though steep improvements were noted from six to 12 months. The current study examined PROMs at a minimum of 1.3 years and a mean of 3.5 years, a time period after the anticipated rapid recovery phase during which PROMs are more variable.

In addition to identifying the need to provide patients with expected recovery times for functional recovery and return to life roles after complex fractures, a recent priority setting partnership involving patients, carers, and clinicians identified within its top ten priorities the need to determine what is important to patients recovering from complex fractures.[5] Of the 12 elements of their fracture care examined in the current study, the most important to patients was getting back to their own home, having

a stable knee, and returning to normal function. What is important to patients is not always aligned with what is important to clinicians. For example, though most trauma surgeons consider TKA for plateau fracture as a failure, only 60% of older adults in the current study said that it was very important of them to avoid TKA, with 42% stating it was very important to avoid any surgery at all. Almost half wanted to avoid weightbearing restrictions, however, and this is an important aspect of modern fracture care. A recent national survey of weightbearing restrictions following lower limb fracture surgery found that only 13.7% of consultants allowed unrestricted weightbearing after surgical fixation of proximal tibial fractures in the elderly.[26]

Limitations of this study include its retrospective nature. As examined and discussed, recalled prefracture scores likely overestimate baseline prefracture functioning and lead to bias when comparing against current scores. Though the number of patients lost to follow-up was small, a significant proportion of these older adult patient declined to participate, which may contribute to responder bias. The 5L version of the EQ-5D may be more discriminating and is less prone to ceiling effects,[13] which may result in an underestimation of the deterioration in HRQoL. The 3L version was used here to allow comparison with HSE data, and it is this comparison against expected scores from controls which is novel. The propensity score-matched group may have included individuals who had sustained tibial plateau fractures. The absolute incidence of TPFs implies this would be few, and matching in a 5:1 ratio was performed to limits any effect of this. The qualitative questions were developed by the research team, and have not been previously validated.

Quantifying the HRQoL burden of fractures is important both to counsel patients and manage expectations of outcomes from day one, and to provide evidence for the resources to manage these patients. The current study has demonstrated that over half of patients aged ≥ 60 years experience deficits in both HRQoL and joint-specific functional outcome scores in excess of the clinically important differences for these scores following TPF, whether they have unstable fractures treated with fixation or stable fractures managed nonoperatively. On average, using the EQ-5D-3L, this deficit was 0.09 points compared to age, sex, and deprivation matched peers. Recalled pre-fracture scores were higher than would expected for the general population and may increase this perceived difference in pre- and post-fracture functioning.

Take home message

- More than half of patients aged ≥ 60 years experience a significant decline in health-related quality of life after tibial plateau fracture that exceeds the EuroQol five-dimension minimal important change compared to age, sex, and deprivation- matched controls.

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