The Effect of Knee Replacement in Self-Reported Participation and Gait Speed: The MOST Study and the Osteoarthritis Initiative

Maxwell JL[1], Felson DT[1], Niu J[1], Wise B[2], Nevitt MC[3], Singh J[4], Frey-Law L[5], Neogi T[1]
[1]Boston University, Boston, MA; [2]University of California, Davis; [3]University of California, San Francisco; [4]University of Alabama, Birmingham; [5]University of Iowa, Iowa City

BOSTON UNIVERSITY

Background

- Participation is an ICF domain defined as restrictions in involvement in “life situations” such as personal shopping, housework, visiting friends
- Despite the escalating incidence of total knee replacement, little research has examined post-surgical participation-related outcomes

BOSTON UNIVERSITY

Background

- There appear to be modest improvements in mean participation after knee replacement[1,2]
- Approximately one-third of subjects after knee replacement have participation restrictions[2]
- Possibility of confounding by indication or population norms

BOSTON UNIVERSITY

[1] Davis, et al 2011, [2]Maxwell, et al 2013

Purpose

- To examine whether participation restrictions differed among persons following knee replacement compared to a similarly matched group with symptomatic knee osteoarthritis (SxOA)
- To determine whether this relationship is similar for gait speed, acting as a proxy to performance and mobility-based activity/participation
- Both participation and gait speed are associated with morbidity and mortality

BOSTON UNIVERSITY

Methods: Study Samples

- The Multicenter Osteoarthritis Study (MOST) is a longitudinal cohort of older adults with or at risk of knee osteoarthritis (OA) from IA and AL.
  - Self-reported and performance based measures collected at 0, 30, 60, 84 month clinic visits
- The Osteoarthritis Initiative is a longitudinal cohort of older adults with or at risk of knee osteoarthritis (OA) from 4 U.S. communities.
  - Visits at 0, 12, 24, 36, 48, 60, 72 months

BOSTON UNIVERSITY

Methods: Inclusion Criteria

- No knee replacement before enrollment
- Only 1 knee replacement during study period
- Participation and gait speed data collected at least 12 months after the index visit.

BOSTON UNIVERSITY

Outcomes: Self-Reported Participation

- Instrumental Limitation Subscale of the Late Life Function and Disability Instrument (LLDI-IL)
  - Measured at each visit in MOST and at 48 and 72 months in OAI
- 12 items related to instrumental activities
  - Entertaining in ones' home, doing personal shopping, attending appointments
- Each item scored 1-5 on Likert-type scale
  - 5= not limited at all
  - 1= completely limited
  - Scores summed and converted to 100 point scale
  - Continuous scores and cut-point of <69 defined as participation restriction

BOSTON UNIVERSITY

Outcomes: Gait Speed

- Participants walked down a straight indoor hallway
- Time taken to walk 20 meters recorded then converted to speed in meters/sec

BOSTON UNIVERSITY

Statistical Analyses: Descriptive and Unadjusted

- Matched 4 subjects with SxOA at the pre-knee replacement visit to each subject with a knee replacement
- Determined and compared the means for each outcome with t-tests and the proportion with participation restriction in each group by chi-sq
- Estimated the effect of knee replacement status (yes/no) on participation restriction and gait speed using Poisson regression with GEE

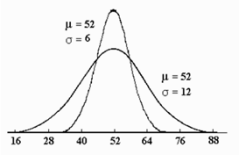
BOSTON UNIVERSITY

Statistical Analysis-Propensity Score Approach

MOST

- Determined association of demographic and clinical variables in each cohort with having a knee replacement
- Calculated a "propensity score" for the probability of each subject (in either group) having a knee replacement based on their covariate profile
- Matched 1:1 a knee replacement subject to a SxOA subject by propensity score

BOSTON UNIVERSITY



Adjusted Analysis (Matched by Propensity Score)

- We determined the mean participation score and gait speed and the proportion with participation restriction for each knee replacement group and again tested the differences
- We estimated the effect of knee replacement status (yes/no) on participation restriction and gait speed using Poisson regression with GEE

BOSTON UNIVERSITY

Results- Propensity Score Variables

Variable	Variable
Age	Presence of widespread pain
Sex	Pack year history of smoking
Race	Clinic Site
Employment/Income	SF-12 Role Mental score
Depressive symptoms	History of high glucose
Use of analgesics	Use of chondroitin
Use of COXII inhibitors	Use of narcotics
Systolic Blood Pressure	History of heart failure
SF-12 role physical score	History of stroke
Pre-index gait speed	Diastolic blood pressure
Pre-index participation	History of diabetes
Worse WOMAC Physical Function	Worse WOMAC pain score
Worse WOMAC total score	Increased body mass index
Educational attainment	History of knee injection
Marital status	

BOSTON UNIVERSITY

Black text- both cohorts, Red text- MOST, Green text- OAI

Results: Sample Characteristics, pre-index

Variable	Unmatched Whole Sample (Crude)		Propensity Score** Matched Sample	
	KR subjects (n=371)	Non- KR subjects (n=1484)	KR subjects (n=321)*	Non-KR subjects (n=321)
Age, years, mean (SD) % < 65 years	66.6 (8.0) 40	63.8 (8.4) 54	66.5 (8)	66.2 (8.3)
% Female	63	63	62	60
% White	85.7	76.4	88	89
BMI, kg/m^2, mean (SD)	31.3 (6.1)	31.4 (6.0)	31.2 (6)	31.3 (6.3)
Depressive score, range 0-16, mean (SD)	7.5 (7.1)	8.0 (8.2)	7.1 (6.9)	6.4 (6.1)
% with ≤ 1 Comorbidity	73	76	100	100
Knee pain, range 0-20, mean (SD)	7.8 (3.9)	6.8 (3.6)	6.2 (4.5)	6.0 (4.3)
Participation, mean (SD)	72.4 (13.6)	74.2 (15.1)	73.2 (13.2)	72.3 (13.6)
Gait speed, m/s, mean (SD)	1.13 (0.21)	1.20 (0.22)	1.14 (0.2)	1.20 (0.2)

Results: Sample Characteristics, pre-index

Variable	Unmatched Whole Sample (Crude)		Propensity Score** Matched Sample	
	KR subjects (n=371)	Non- KR subjects (n=1484)	KR subjects (n=321)*	Non-KR subjects (n=321)
Age, years, mean (SD) % < 65 years	66.6 (8.0) 40	63.8 (8.4) 54	66.5 (8)	66.2 (8.3)
% Female	63	63	62	60
% White	85.7	76.4	88	89
BMI, kg/m^2, mean (SD)	31.3 (6.1)	31.4 (6.0)	31.2 (6)	31.3 (6.3)
Depressive score, range 0-16, mean (SD)	7.5 (7.1)	8.0 (8.2)	7.1 (6.9)	6.4 (6.1)
% with ≤ 1 Comorbidity	73	76	100	100
Knee pain, range 0-20, mean (SD)	7.8 (3.9)	6.8 (3.6)	6.2 (4.5)	6.0 (4.3)
Participation, mean (SD)	72.4 (13.6)	74.2 (15.1)	73.2 (13.2)	72.3 (13.6)
Gait speed, m/s, mean (SD)	1.13 (0.21)	1.20 (0.22)	1.14 (0.2)	1.20 (0.2)

Results: Sample Characteristics, pre-index

Variable	Unmatched Whole Sample (Crude)		Propensity Score** Matched Sample	
	KR subjects (n=371)	Non- KR subjects (n=1484)	KR subjects (n=321)*	Non-KR subjects (n=321)
Age, years, mean (SD)	66.6 (8.0)	63.8 (8.4)	66.5 (8)	66.2 (8.3)
% < 65	40	54		
% Female	63	63	62	60
% White	85.7	76.4	88	89
BMI, kg/m², mean (SD)	31.3 (6.1)	31.4 (6.0)	31.2 (6)	31.3 (6.3)
Depressive score, range 0-16, mean (SD)	7.5 (7.1)	8.0 (8.2)	7.1 (6.9)	6.4 (6.1)
% with ≤ 1 Comorbidity	73	76	100	100
Knee pain, range 0-20, mean (SD)	7.8 (3.9)	6.8 (3.6)	6.2 (4.5)	6.0 (4.3)
Participation, mean (SD)	72.4 (13.6)	74.2 (15.1)	73.2 (13.2)	72.3 (13.6)
Gait speed, m/s, mean (SD)	1.13 (0.21)	1.20 (0.22)	1.14 (0.2)	1.20 (0.2)

Results: Sample Characteristics, pre-index

Variable	Unmatched Whole Sample (Crude)		Propensity Score** Matched Sample	
	KR subjects (n=371)	Non- KR subjects (n=1484)	KR subjects (n=321)*	Non-KR subjects (n=321)
Age, years, mean (SD)	66.6 (8.0)	63.8 (8.4)	66.5 (8)	66.2 (8.3)
% < 65	40	54	41	42
% Female	63	63	62	60
% White	85.7	76.4	88	89
BMI, kg/m², mean (SD)	31.3 (6.1)	31.4 (6.0)	31.2 (6)	31.3 (6.3)
Depressive score, range 0-16, mean (SD)	7.5 (7.1)	8.0 (8.2)	7.1 (6.9)	6.4 (6.1)
% with ≤ 1 Comorbidity	73	76	100	100
Knee pain, range 0-20, mean (SD)	7.8 (3.9)	6.8 (3.6)	6.2 (4.5)	6.0 (4.3)
Participation, mean (SD)	72.4 (13.6)	74.2 (15.1)	73.2 (13.2)	72.3 (13.6)
Gait speed, m/s, mean (SD)	1.13 (0.2)	1.20 (0.2)	1.14 (0.2)	1.20 (0.2)

Results: Sample Characteristics, pre-index

Variable	Unmatched Whole Sample (Crude)		Propensity Score** Matched Sample	
	KR subjects (n=371)	Non- KR subjects (n=1484)	KR subjects (n=321)*	Non-KR subjects (n=321)
Age, years, mean (SD) **% < 65**	66.6 (8.0) 40	63.8 (8.4) 54	66.5 (8) 41	66.2 (8.3) 42
% Female	63	63	62	60
% White	85.7	76.4	88	89
BMI, kg/m^2, mean (SD)	31.3 (6.1)	31.4 (6.0)	31.2 (6)	31.3 (6.3)
Depressive score, range 0-16, mean (SD)	7.5 (7.1)	8.0 (8.2)	7.1 (6.9)	6.4 (6.1)
% with ≤ 1 Comorbidity	73	76	100	100
Knee pain, range 0-20, mean (SD)	7.8 (3.9)	6.8 (3.6)	6.2 (4.5)	6.0 (4.3)
Participation, mean (SD)	72.4 (13.6)	74.2 (15.1)	73.2 (13.2)	72.3 (13.6)
Gait speed, m/s, mean (SD)	1.13 (0.2)	1.20 (0.2)	1.14 (0.2)	1.20 (0.2)

Results- Self-Reported Participation

	Unmatched Whole Sample	Propensity-score Matched sample
Participation score*, mean (SD) KR Non-KR Mean difference, p-value	 74.8 (15) 73.3 (15) 1.6, p=0.08	 75.3 (15) 72.8† (14 2.5, p=0.03
% with Participation Restrictions** KR Non-KR Difference in proportions, p-value	 33.2 35.7 -2.5, p=0.39	 35 41 6.0, p=0.08
Association between KR status and participation restrictions RR (95% CI) (referent=non-KR)	0.93 (0.79, 1.10)	0.84 (0.69, 1.03)

*Higher scores=better participation **Participation Restrictions < 69/100

Results- Gait Speed

	Unmatched Whole Sample	Propensity-score Matched sample
Gait Speed (m/s), mean(SD)		
KR	1.14 (0.2)	1.10 (0.2)
Non-KR	1.18 (0.2)	1.12 (0.2)
Mean difference, p-value	-0.04, p<0.01	-0.02, p=0.5

BOSTON UNIVERSITY

Limitations

- May be residual confounding or little confounding
  - Missing data precluded use of some variables associated with knee replacement in the propensity score (e.g. kidney failure)
  - Variables in propensity score are associated with exposure, but not outcome and therefore may not truly be confounders
- Bilateral knee replacements not included in these analyses
- Gait speed over long distances (e.g. 6MWT) may be better measure of participation-related mobility and may yield effects
- Can't generalize about SxOA group as matched to knee replacement subjects

BOSTON UNIVERSITY

Conclusions

- Knee replacement resulted in higher participation scores and a lower proportion of subjects with participation restriction compared with a matched group of subjects with SxOA.
- There appears to be a weak protective effect of knee replacement on participation ≥ 1 year following the procedure compared to those with symptomatic knee OA, but not for gait speed
- Propensity score matching methods provide confidence that results are not limited by confounding by indication

BOSTON UNIVERSITY

Acknowledgements

MOST is funded by NIH and NIA. NIH Felson:U01 AG18820, Nevitt: U01 AG19069, Torner: U01 AG18832, Lewis: U01 AG18947

AMERICAN COLLEGE OF RHEUMATOLOGY RESEARCH AND EDUCATION FOUNDATION

Funding for this project was provided by the American College of Rheumatology Research and Education Foundation Rheumatology Scientist Development Award

ENACT is funded by a NIDRR Rehabilitation Research and Training Center (RRTC) grant: H133B100003

BOSTON UNIVERSITY

Thank You. Questions?

BOSTON UNIVERSITY