Total Knee Arthroplasty versus Education and Exercise: Comparing Patient Outcomes Using Matched Observational Data

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INTRODUCTION:

It is suggested that patient education and exercise programs (EduEx) have the potential to defer and possibly altogether avoid total knee arthroplasty (TKA) in patients with knee osteoarthritis (OA). Only a single randomized controlled trial from Denmark has evaluated this claim. This trial found a clinically meaningful effect in favor of surgery compared to an EduEx program. In this study, we replicate the work using matched observational data from two Canadian prospective cohorts to estimate the treatment effect of EduEx versus TKA in patients with knee OA.

METHODS:

This was an analysis of data from patients with knee OA enrolled in the GLA:D Canada registry (EduEx) and LEAP-OA registry (TKA) at the Schroeder Arthritis Institute (University Health Network; Toronto, Canada). The datasets of patients with complete data from these two cohorts were merged into a single dataset.

A propensity score was estimated for each patient using a logistic regression model (0=non-surgical, 1=surgical) fitted to a range of pre-treatment covariates. These covariates included, age, sex, body mass index, education level (post-secondary school education (yes/no)), employment status (currently working (yes/no)), living alone (yes/no), smoking status (yes/no), medical comorbidities (out of a possible 14 comorbidities), anxiety/depression symptoms (yes/no), bilateral knee symptoms (yes/no), comorbid hip symptoms (yes/no), pain medication use (yes/no), opioid use (yes/no), pain numeric rating scale (NRS) and the Knee injury and Osteoarthritis Outcome Score 12-item version (KOOS-12) pain, function, and quality of life subscales (all scored 0 worst to 100 best). Based on the propensity score, TKA patients were matched to an EduEx patient on a 1:1 ratio using the genetic matching method with a caliper width equal to 0.1 of the standard deviation of the logit of the propensity score. After matching, standardized differences <0.1 in means and proportions were interpreted to indicate balance in pre-treatment covariates between treatment groups.

Between-group differences in improvement (the treatment effect) in pain, function, and quality of life (KOOS-12 subscales) from baseline to 3- and 12-months were estimated using linear mixed models for repeated measures, adjusting for unbalanced pre-treatment covariates, if any, after matching.

The potential impact of unmeasured confounding (a limitation when evaluating treatment effects using observational data) was estimated using the E-value. The E-value is the minimum strength of association that an unmeasured confounder must have with both the treatment and outcome to result in a null estimated treatment effect, where a larger E-value indicates greater robustness to unmeasured confounding.

RESULTS:

A total of 1,442 patients (923 EduEx, 519 TKA) patients were included, of which 522 (261 in each treatment group) were matched. After matching, all pre-treatment covariates were balanced between groups (all standardized differences <0.1). The analysis of treatment effects revealed statistically significant differences in favor of TKA over EduEx for pain (3-months: 12.7, 95% CI 9.7 to 15.8; 12-months: 22.4, 95% CI 19.3 to 25.5), function (3-months: 11.9, 95% CI 8.5 to 15.2; 12-months: 20.6, 95% CI 17.3 to 24.0), and quality of life (3-months: 8.6, 95% CI 5.4 to 11.9; 12-months: 18.0, 95% CI 14.7 to 21.3). All estimated treatment effects at 12-months were clinically significant and robust to unmeasured confounding (E-values ranging from 2.5 for quality of life to 4.4 for pain).

DISCUSSION AND CONCLUSION:

From this well-matched study, we report a clinically significant effect in favor of TKA over EduEx across all outcomes. A randomized controlled trial examining whether EduEx programs lead to deferred or avoided surgeries is warranted. Additionally, future research should explore differences in individual-level (versus group-level) responses to these treatments, with particular consideration of potential sex differences in responses.