Do Patient-Reported Outcome Measures Change with Different Polyethylene Design and Thicknesses in Primary Total Knee Arthroplasty? A Prospective Cohort Analysis from a Tertiary Academic Center

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INTRODUCTION:

There is limited research on patient-reported outcomes (PROMs) of pain and function evaluating collective differences among cruciate-retaining (CR), posterior stabilized (PS), ultra-congruent (UC), or varus-valgus constrained (VVC) polyethylene designs with different implant thicknesses in primary total knee arthroplasty (TKA). Therefore, the purpose of this comprehensive prospective analysis was to evaluate pain, function, knee-related quality of life (QOL), and global physical health differences between 1) 4 polyethylene implant designs and 2) polyethylene thickness (9-13mm versus ≥14mm) in patients undergoing primary TKA.

METHODS:

A prospective cohort of 4,225 primary TKAs (July 2015-June 2018) was included (**Figure 1**). Some 2,459 patients had CR-TKA (58.2%), 1,501 had PS-TKA (35.5%), 110 had UC-TKA (2.6%), and 155 had VVC-TKA (3.67%). A total of 3,875 patients (91.7%) had a polyethylene thickness between 9-13 mm; 350 patients (8.3%) had a thickness ≥ 14mm. Included PROMs were Knee injury and Osteoarthritis Outcome Score (KOOS)-pain and KOOS-Physical Function Short form (PS), KOOS-QOL, and Veterans Rand-12 Physical Component Score (VR-12-PCS). Multivariate regression models (proportional odds models) were built to predict improvements in each PROM at 1-year postoperative.

RESULTS:

Final analysis comprised of 4,225 patients with patient details reported in **Table 1**. A total of 2,459 patients had CR-TKA (58.2%), 1,501 had PS-TKA (35.5%), 110 had UC-TKA (2.6%). In total, 155 had VVC-TKA (3.67%). Some 3,875 patients overall (91.7%) had polyethylene thickness between 9-13mm while 350 patients (8.3%) had thickness ≥14mm; 83.7% of patients with higher thickness polyethylene (≥14mm) were used in either PS (56.6%) or CR (27.1%)-TKA.

KOOS-Pain

There was no difference in KOOS-pain at 1 year among the 4 polyethylene designs (p>0.05). After adjusting for confounders, the odds of achieving minimum clinically important improvement (MCID) among patients with polyethylene thickness ≥14 mm were 33% higher than patients with polyethylene thickness of 9-13 mm (**Figure 2**).

KOOS-PS

There was no difference in KOOS-PS at 1 year among the four polyethylene designs (p>0.05). After adjusting for confounders, the odds of MCID attainment among patients with polyethylene thickness ≥14 mm were 24% higher than that of patients with polyethylene thickness 9-13mm (odds ratio (OR)=1.24, 95% confidence interval (CI)=[1, 1.55]). Odds of MCID attainment among patients with valgus deformities were 39% higher than patients without deformity (OR=1.39, 95% CI= [1.16, 1.66]) (**Figure 3**).

KOOS-QOL

Patients with UC-TKA had 37% lower odds of MCID attainment at 1 year vs. patients with CR-TKA (OR=0.63, 95% CI= [0.43, 0.91]). There was no difference between polyethylene thickness and KOOS-QOL (p=0.139) (**Figure 4**).

VR-12 PCS

Patients with UC-TKA had approximately half the odds of MCID attainment vs. patients with CR-TKA (OR=0.54, 95% CI= [0.38,0.78]). Similar to KOOS-QOL, there was no difference between polyethylene thickness and global health outcomes (p=0.12). The odds of patients with either varus-fixed or correctable deformity achieving MCID were 16% and 25% higher, respectively, than patients without deformity (p=0.038, p=0.006, respectively) (**Figure 5**).

DISCUSSION AND CONCLUSION:

Patients undergoing primary-TKA with 4 different polyethylene designs and varying thicknesses all had PROMs improvement with minimal superiority of one design. Nearly 50% of the thicker polyethylene cohort had greater preoperative deformities and higher improvement compared to the thinner polyethylene group. Physicians can utilize these results in surgical decision making and setting patient expectations.