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# The effect of surgical factors on early patient-reported outcome measures (PROMS) following total knee replacement

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**Patient-reported outcome measures (PROMs) are increasingly being used to assess functional outcome and patient satisfaction. They provide a framework for comparisons between surgical units, and individual surgeons for benchmarking and financial remuneration. Better performance may bring the reward of more customers as patients and commissioners seek out high performers for their elective procedures. Using National Joint Registry (NJR) data linked to PROMs we identified 22 691 primary total knee replacements (TKRs) undertaken for osteoarthritis in England and Wales between August 2008 and February 2011, and identified the surgical factors that influenced the improvements in the Oxford knee score (OKS) and EuroQol-5D (EQ-5D) assessment using multiple regression analysis. After correction for patient factors the only surgical factors that influenced PROMs were implant brand and hospital type (both  $p < 0.001$ ). However, the effects of surgical factors upon the PROMs were modest compared with patient factors. For both the OKS and the EQ-5D the most important factors influencing the improvement in PROMs were the corresponding pre-operative score and the patient's general health status. Despite having only a small effect on PROMs, this study has shown that both implant brand and hospital type do influence reported subjective functional scores following TKR. In the current climate of financial austerity, proposed performance-based remuneration and wider patient choice, it would seem unwise to ignore these effects and the influence of a range of additional patient factors.**

The modern NHS aims to 'put quality at the heart of everything it does'.<sup>1</sup> As patients and clinicians do not always agree on what constitutes a good result following surgery,<sup>2</sup> patient-reported outcome measures (PROMs) are increasingly being used to supplement more traditional methods of assessing outcome.<sup>3</sup> Since 2008 the Department of Health (DoH) has routinely collected PROMs for NHS-funded elective hip and knee replacements performed in England and Wales to complement existing information, such as patient safety and clinical outcomes.<sup>1,4</sup> PROMs assess the effectiveness of care solely from the patient's perspective.<sup>4</sup> They can be used to evaluate the quality of care delivered by the providers of elective procedures, benchmark their performance, assess the efficacy and cost-effectiveness of different approaches to care, empower commissioners contracting services and guide patient choice.<sup>1,4</sup> Furthermore, the NHS has indicated its intention to link payments to PROMs data, possibly through payment by results (PbR) or the Commission for Quality and Innovation (CQUIN) payment

framework.<sup>1</sup> Although this is currently being considered it has not, as yet, been implemented for orthopaedics in the United Kingdom.

By understanding PROMs clinicians and managers can instigate strategies to achieve the best outcomes and improve standards. Although it is well known that a variety of patient factors influence outcome,<sup>5-8</sup> there may be little the surgeon can do to influence them apart from improving patient selection. Failure to appreciate this could lead to certain centres being unfairly penalised by the case-mix of the populations they serve. However, surgeons might be able to mitigate this risk by exercising greater autonomy over a number of factors and techniques employed at the time of surgery that are known to affect outcome.

Previous studies comparing the impact of specific surgical techniques and design characteristics of knee prostheses have failed to demonstrate superior functional outcomes with any one technique or design.<sup>9-13</sup> We have therefore examined national PROMs data linked to the National Joint Registry for England and Wales (NJR) to establish which surgical factors influence improvements in PROMs following

**Table III.** Mean Oxford knee scores (OKS) and EuroQol-5D (EQ-5D) scores (with 95% confidence intervals) analysed by implant brand

Implant*	Pre-operative	Post-operative	Change
<b>NexGen (n = 3283)</b>			
OKS	18.9 (18.6 to 19.1)	35.1 (34.8 to 35.5)	16.2 (15.9 to 16.6)
EQ-5D	0.409 (0.398 to 0.420)	0.730 (0.722 to 0.739)	0.323 (0.310 to 0.333)
<b>PFC (n = 8287)</b>			
OKS	18.7 (18.5 to 18.8)	33.9 (33.7 to 34.1)	15.2 (15.0 to 15.4)
EQ-5D	0.396 (0.389 to 0.403)	0.708 (0.702 to 0.714)	0.312 (0.305 to 0.320)
<b>Genesis 2 (n = 1818)</b>			
OKS	19.3 (18.9 to 19.6)	33.6 (33.2 to 34.1)	14.3 (13.9 to 14.8)
EQ-5D	0.425 (0.410 to 0.440)	0.707 (0.694 to 0.719)	0.282 (0.266 to 0.299)
<b>AGC (n = 2398)</b>			
OKS	19.4 (19.1 to 19.7)	34.2 (33.8 to 34.6)	14.9 (14.5 to 15.2)
EQ-5D	0.429 (0.416 to 0.442)	0.715 (0.704 to 0.726)	0.286 (0.272 to 0.300)
<b>Triathlon (n = 1896)</b>			
OKS	19.6 (19.2 to 19.9)	34.4 (34.0 to 34.9)	14.8 (14.4 to 15.3)
EQ-5D	0.436 (0.422 to 0.451)	0.725 (0.713 to 0.737)	0.289 (0.274 to 0.304)
<b>Other (n = 5009)</b>			
OKS	19.1 (18.9 to 19.3)	33.3 (33.3 to 33.9)	14.5 (14.2 to 14.8)
EQ-5D	0.407 (0.398 to 0.416)	0.702 (0.694 to 0.709)	0.294 (0.285 to 0.304)
<b>Total (n = 22 691)</b>			
OKS	19.0 (18.9 to 19.1)	34.1 (33.9 to 34.2)	15.1 (14.9 to 15.2)
EQ-5D	0.409 (0.405 to 0.414)	0.712 (0.708 to 0.716)	0.303 (0.298 to 0.307)

\* NexGen (Zimmer), PFC (DePuy), Genesis 2 (Smith & Nephew), AGC (Biomet), Triathlon (Stryker)

change in OKS is predicted to decrease by -0.66 points; thus an increase in the pre-operative OKS of 10 points predicts a reduction of -6.6 points in the OKS improvement. The corresponding size effect for patients with the best and worst general health is 8.1 points. This puts into context the differences seen between the best and worst implant brands (1.7) and hospital types (1.8). It must, however, be noted that the effects of each variable on the predicted improvement in PROMs are additive, meaning that the effects of brand and hospital type are the same irrespective of changes in the other variables.

## Discussion

This study is the largest analysis so far of national data assessing the potential influence of surgical factors on PROMs. After examining the same PROMs data used by health agencies when making decisions about health-care provision, we found that the only surgical factors influencing improvement in PROMs were implant brand and hospital type. However, the effects attributable to these factors were small in comparison to those associated with a range of patient factors, whose effect on improving PROMs was more pronounced.

The use of PROMs is becoming an established means of assessing and comparing trusts and surgeons. In the current climate of transparency and accountability, the results of the NJR and PROMs are in the public domain. Patients are

becoming far more educated, particularly with the ability to access internet resources, and are therefore becoming more selective with regard to who will perform their joint replacement.<sup>18</sup> This potential increase in the power of patients to choose provides the motivation to improve outcomes, track productivity and foster inter-unit competition. In addition, PROMs data are soon to be used for ranking, reimbursement and the identification of outliers, with individual surgeons' outcomes displayed alongside those of other surgeons performing the same procedure.<sup>19</sup> Consequently, these measures carry potentially substantial financial weight. If PROMs data are used for benchmarking and comparison, any advantage (even theoretical) becomes desirable in a competitive world, regardless of whether these changes reflect clinically significant changes in a patient's function. However, incentivising institutions and individuals based on outcome measures becomes more difficult to defend if the gain in clinical benefit is unclear.<sup>20</sup>

Previous studies examining the impacts of surgical factors on functional outcomes have investigated patellar resurfacing,<sup>11,21</sup> bearing type (mobile *vs* fixed),<sup>10,22</sup> tibial component design (metal-backed *vs* all polyethylene),<sup>23</sup> meniscus type (cruciate retaining *vs* posterior stabilised),<sup>12</sup> computer navigation,<sup>13,24</sup> minimally invasive surgery, high-flexion knee systems,<sup>25</sup> gender-specific knee systems<sup>26</sup> and implant type.<sup>27-29</sup> None of these has demonstrated a clear functional advantage over the others. Implants and their