Impact of patient decision aids on appropriate and timely access to hip or knee arthroplasty for osteoarthritis: a randomized controlled trial


Objective: To evaluate the effectiveness of patient decision aids (PtDA) compared to usual education on appropriate and timely access to total joint arthroplasty in patients with osteoarthritis.

Method: A randomized controlled trial (RCT) with patients undergoing orthopedic screening. Control and intervention arms received usual education; intervention arm also received a PtDA and a surgeon preference report. Wait times (primary outcome) were described using stratified Kaplan-Meier survival curves with patients censored at the time of death or loss to follow-up, and multivariable Cox proportional hazards regression. Secondary outcomes were compared using stratified Cochran-Mantel-Haenszel chi-squared tests.

Results: 343 patients were randomized to intervention (n = 174) or control (n = 169). The typical patient was 66 years old, retired, living with someone, and 51% had high school education or less. The intervention was associated with a trend towards reduction in wait time (hazard ratio (HR) 1.25, 95% confidence interval (CI) 0.99–1.60, P = 0.0653). Median wait times were 3 weeks shorter in intervention than in control at the community site with no difference at the academic site. Good decision quality was reached by 56.1% intervention and 44.5% control (Relative risk (RR) 1.25; 95% CI 1.00–1.56, P = 0.050). Surgery rates were 73.2% intervention and 80.5% controls (RR 0.91: 95% CI 0.81–1.03) with 12 intervention (7.3%) and eight control participants (4.9%) returning to have surgery within 2 years (P = 0.791).

Conclusion: Compared to controls, decision aid recipients had shorter wait times at one site, fewer surgeries, and were more likely to reach good decision quality, but overall effect was not statistically significant.

Trials registration: The full trial protocol is available at ClinicalTrials.Gov (NCT00911638).

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influenced by unrealistic expectations, and expectations subsequently influence satisfaction with joint arthroplasty<sup>8,9–11</sup>. In fact, many patients agree to surgical referral for management of joint pain without adequate knowledge or consideration of their options<sup>9–10</sup>. Interventions are required to realign patients’ expectations and ensure patient preferences inform appropriate use of joint arthroplasty.

Patient decision aids (PtDA) communicate evidence on treatment options in patient-friendly terms and guide patients through a decision making process<sup>11</sup>. Three randomized controlled trials (RCT) have evaluated PtDA effects on patients with osteoarthritis considering hip and/or knee arthroplasty<sup>12–14</sup>. All trials used PtDAs (e.g., digital video-disc and booklet) produced by the Informed Medical Decisions Foundation and one trial<sup>12</sup> included a health coach to help patients navigate the decision making process. Compared to controls, patients in the PtDA group experienced less decisional conflict, felt more informed, and were better prepared for the surgical consultation. As well, orthopedic surgeons in the trial with health coaches reported greater satisfaction, consultation efficiency, and patients asked more relevant questions<sup>12</sup>. Trials of PtDAs for other treatment decisions have increased realistic expectations and achieved choices based on informed patients’ preferences<sup>11</sup>.

PtDAs may also improve timely access to treatment of osteoarthritis. For example, using PtDAs may identify patients who never intend to have surgery by helping them understand their treatment options and clarify their informed preferences before the surgical referral. As well, patients exposed to PtDAs prior to surgical consultation may be better prepared, making the visit more efficient by optimizing the surgeons’ time and the consent process<sup>11,15</sup>. PtDAs can reduce patients’ decisional conflict and those with less decisional conflict are less likely to change their mind or delay decision making<sup>6,17</sup>.

In preparation for this study, we conducted a pilot RCT<sup>14</sup>. Compared to usual care, patients given the PtDA were more knowledgeable (71% vs 47%; P < 0.001) and a higher proportion achieved good decision quality (56% vs 25%; P < 0.001). Given that 13% of patients were on the surgical wait list after 1 year, we determined that subsequent studies would require longer follow-up to evaluate the impact of PtDAs on wait time outcomes.

The overall aim of this study was to evaluate the effectiveness of PtDAs compared to usual education on appropriate and timely access to total joint arthroplasty in patients with osteoarthritis. We hypothesized that PtDAs would influence the quality of decisions and timeliness of joint arthroplasty for those who prefer it and have osteoarthritis severe enough to require it.

**Method**

**Design**

A prospective multicenter, parallel group, single blind, two-arm RCT with equal randomization (1:1), was conducted based on the Ottawa Decision Support Framework<sup>16</sup>. This framework asserts that decision support tailored to unresolved decisional needs (i.e., inadequate knowledge, unrealistic expectations, unclear values, inadequate support) improves decision quality defined as informed choice based on patient preferences. Patients whose decisional needs are unresolved are more likely to delay decisions, change their mind, feel regret, express dissatisfaction, and blame the practitioner for poor outcomes<sup>16,17</sup>. In compliance with the Helsinki Declaration, participating hospitals’ Research Ethics Boards approved this study. We made two changes from the trials registry protocol to the current study: (1) follow-up data collection was expanded to include email; and (2) decisional regret was not measured due to surgical wait time variability. Cost-effectiveness and quality of life will be reported elsewhere.

**Setting**

Patients were recruited from two orthopedic screening clinics in Eastern Ontario, Canada (i.e., academic teaching hospital and large community hospital). Patients were asked to self-report pain, stiffness, and function using the validated Western Ontario and McMaster Universities Osteoarthritis (WOMAC) Index<sup>15</sup>. A sports medicine physician (site 1), advanced practice physiotherapist (site 2), or nurse practitioner (site 2) assessed surgical candidacy using the 7-item Western Canada Wait List Hip Knee Priority Tool mapped onto three guideline criteria indicating minimally appropriate for considering joint arthroplasty (moderate to severe pain, moderate to severe functional limitations, abnormal radiographic findings)<sup>15,20</sup>. At both clinics, appropriate patients were given standard hospital information on joint replacement surgery (i.e., preparation for surgery, recovery after surgery, discharge plans). This standard written information did not include surgical benefits and harms, alternative options, or anything that could support decision making. Appropriate patients were then referred to an orthopedic surgeon (7 surgeons at site 1; 6 at site 2).

**Participants**

Eligible adults aged 18 or over had moderate or severe hip or knee radiographic osteoarthritis and were determined at the orthopedic screening clinic to be appropriate for surgical consultation about joint arthroplasty<sup>9</sup>. Patients with inflammatory arthritis, previous joint arthroplasty surgical consultation, or osteotomy were ineligible. In addition, patients were excluded if they had non-corrected hearing or visual impairment, were unable to read or understand English, or did not have access to a television with a VCR or DVD player.

**Interventions**

The intervention group received standard patient education, a PtDA and a preference report for the surgeon. The PtDAs were titled Treatment choices for hip osteoarthritis and Treatment choices for knee osteoarthritis; 50-min videos and booklets produced by the Informed Medical Decisions Foundation. Both PtDAs met the International Patient Decision Aid Standards criteria by making explicit the decision and providing evidence-based information on treatment options, benefits and risks, and related probabilities<sup>14</sup>. They included patients’ testimonials (e.g., describing treatment options, their decision making process experiences, and outcomes) that help patients clarify their values associated with option outcomes. Additional details are available at [https://decisionaid.ohri.ca/cochinvent.php](https://decisionaid.ohri.ca/cochinvent.php). Patients’ knowledge, values, preferred treatment choice, and decisional conflict were assessed using a questionnaire formatted as a user-friendly leaflet. These findings were combined with patients’ clinical assessment results to create a one-page preference report for the surgeon<sup>14</sup>.

The control intervention consisted of standard patient education and surgeons received a half-page summary of patients’ clinical assessment findings only.

**Procedures**

Eligible patients met with a research assistant who obtained written consent, demographic information and the WOMAC Index and Hip and Knee Replacement Priority Criteria Tool results<sup>15,20</sup>. These baseline data were used to populate the surgeon’s clinical
summary report. To ensure concealment, call-in telephone software was used to obtain randomized allocation. Patients were stratified by affected joint (hip/knee) and site. They were then randomized to the control or intervention group. The allocation schedule was computer-generated centrally by a statistician, using block randomization, with randomly varying block lengths of 4, 6, or 8. To minimize bias after allocation, patients reviewed the information (i.e., PtDA plus usual education or usual education only) at home, were not informed of the other intervention, and did not have contact with orthopedic screening clinic practitioners during the 2 weeks post clinic visit when measures were collected. Although the research assistant was not blinded to group allocation, the primary outcome was objective and used clinic data.

Within 2 weeks of recruitment, the research assistant telephoned participants to obtain their answers to the hip–knee osteoarthritis decision quality, decisional conflict, preferred treatment option, and preparation for decision making instruments. This information was added to the surgeon’s clinical summary report to create a preference report for surgeons. Participants were contacted by telephone 6 months after recruitment to administer the decisional conflict questionnaire and determine whether they had seen the orthopedic surgeon, and if so, whether they had chosen surgery or alternative non-surgical options. Participants were contacted again at 12, 18, and 24 months to determine if they had a surgical consultation and whether they had chosen surgery or non-surgical options. Surgeon consultation and surgery dates were collected from the clinic records.

Sample size

The sample size was calculated for total wait times and informed by our pilot study. We determined that 155 patients were needed per group, followed for 2 years, to detect a clinically important difference of 8 weeks in mean total wait times using a two-sided t-test at the 5% level of significance with 80% power, assuming a common standard deviation (SD) of 25 weeks. The clinically important difference of 8 weeks was chosen after discussion with clinical experts on the research team. To account for 10% loss to follow-up, our target enrolment was 173 patients per group.

Outcomes

The primary outcome was the wait times calculated by the researcher on the electronic decision support tool. The median wait times with 95% confidence intervals (CIs) were calculated for each group. To assess the statistical significance of the PtDA on the primary outcome, we used multivariable Cox proportional hazards regression controlling for site and joint (hip or knee). Results were expressed as hazard ratios (HRs) with 95% CI. The proportional hazards assumption was tested using martingale residuals. Patients were censored at the end of the study, at the time of death, or loss to follow-up.

Dichotomous secondary outcomes (e.g., proportions reaching good decision quality, surgery rates, congruence between patients’ choice and their values, SURE test) were compared between groups using Cochran–Mantel–Haenszel chi-squared tests, controlling for site. The Breslow–Day test for homogeneity was used to examine heterogeneity across sites. The relative difference in proportions between the intervention and control arms was calculated as Relative Risk (RR) with 95% CIs; if important qualitative interaction was detected, separate RR estimates were calculated for each site.

The predicted probability of surgery, used to calculate good decision quality and congruence between patients’ choice and values, was calculated for each patient using a logistic regression equation. The equation was derived using the approach in

Outcomes instruments

Hip-knee osteoarthritis decision quality instrument was used to assess patients’ decision quality with multiple-choice questions examining knowledge (18 items) and values (7 items). This instrument is reproducible and demonstrates discriminant, content, and predictive validity. The 5-item screen knowledge score was used in the decision quality calculation and a sub-set of three questions for determining realistic expectations of outcomes. These 5-items measure knowledge relevant to surgery and have high reproducibility with total knowledge score (Pearson correlation coefficients $>$0.92, $P < 0.001$).

Decisional conflict scale, measured using the SURE tool version, assessed patients’ perception of feeling sure, informed, supported, and clear about what mattered most. The SURE tool showed adequate internal consistency (Kuder–Richardson 20 coefficient of 0.7) and was significantly correlated with the original Decision Conflict Scale.

For Preparation for decision making scale, 4 of the original 10 items were used given their relevance to International Patient Decision Aid Standards for evaluating decision processes. These items discriminated between patients who were and were not prepared for decision making. Discrimination values for these items were excellent, ranging from 2.1 to 3.4.

Data management and statistical methods

All data were analyzed using SAS v. 9.3. The primary outcome (wait time from screening to implementation of the definitive choice) was described using Kaplan–Meier survival curves for each site; the median wait times with 95% confidence intervals (CIs) were calculated for each group. To assess the statistical significance of the PtDA on the primary outcome, we used multivariable Cox proportional hazards regression controlling for site and joint (hip or knee). Results were expressed as hazard ratios (HRs) with 95% CI. The proportional hazards assumption was tested using martingale residuals. Patients were censored at the end of the study, at the time of death, or loss to follow-up.

In particular, stepwise backwards elimination was used to identify independent variables from the seven values items on the Hip-Knee Osteoarthritis Decision Quality Instrument. The predicted probability of surgery was calculated as $1 + \exp(-5)\{1 + (0.5327 + (-0.1569 \times \text{ValueQ11}) + (0.1115 \times \text{ValueQ14}) + (0.2843 \times \text{ValueQ17}) \} \times \text{ValueQ11}$. Where $\text{Q11}$ was avoiding surgery, $\text{Q14}$ was avoiding prescription pain medication, and $\text{Q17}$ was avoid pain remaining the same. Good decision quality was then calculated as a dichotomous indicator, defined as scoring $>$66% on the knowledge test and having a predicted probability $>$0.5 for a patient with...
surgery or predicted probability <0.5 for a patient without surgery. The mean knowledge test scores and Preparation for Decision Making were compared between the two groups using the two-sample t-test. Fisher’s exact test was used in the case of small expected number of events. Tests were conducted at the two-sided 5% level of significance.

Results

Participant flow

Between May 2008 and October 2009, 343 participants were randomized to the intervention (n = 174) or usual care (n = 169) and followed for 2 years (Fig. 1). Common reasons for ineligibility were mild osteoarthritis, previous arthroplasty, and language barriers. Baseline data were available for only 167 in each arm and findings were analyzed based on participants’ original assigned groups. The typical participant was 66 years old, retired, living with someone else, and 51% had high school education or less (Table I). Participants were considering knee arthroplasty (n = 242) or hip arthroplasty (n = 92). There was no statistically significant baseline differences between the groups based on demographic characteristics or osteoarthritis severity that were self-reported or practitioner-reported.

At the end of the 2-year follow-up (October 2011), there were 165 intervention group participants and 163 controls included in the primary outcome analysis. In the intervention group, two participants were missing wait time data and five were ineligible because they were awaiting MRI results for diagnosis, had a meniscal tear, underwent osteotomy, did not have osteoarthritis, or VCR was broken. In the control group, three were missing wait time data, one was having hip resurfacing not total hip arthroplasty, and two were ineligible because one was treated at a non-participating hospital and another was recruited for knee osteoarthritis but surgeon treated hip osteoarthritis resulting in the participant receiving the wrong PtDA/questionnaires.

Primary outcome

The Kaplan–Meier estimate of the median time from recruitment to off the wait list across both sites was 16.9 weeks for the intervention group (n = 165; 95% CI: 15.6, 20.0) and 20.6 weeks for the control group (n = 163; 95% CI: 17.3, 23.4); wait times for 27 in the intervention and 32 in the control arms were censored. The site-specific median wait times were 15 weeks (95% CI 11.3–16.7) in intervention vs 18 weeks (95% CI 16.0–20.6) in control at the community site (Fig. 2), and 27.9 weeks (95% CI 20.9–35.4) in intervention vs 28.0 weeks (95% CI 19.9–38.0) in control at the academic site (Fig. 3). The Cox proportional hazards regression analysis controlling for site and joint yielded HR = 1.25 (95% CI 0.99–1.60, P = 0.0653) (an HR greater than 1 indicates shorter wait time).

Secondary outcomes

Good decision quality, defined as informed choice that matched their values, was achieved by 87 (56.1%) in the intervention and 69 (44.5%) in the control groups (RR 1.25; 95% CI: 1.00, 1.56, P = 0.050) (Table II). Mean total knowledge score for the intervention group was 12.4 out of 18 (SD 2.79) compared to 11.0 (SD 3.25) control group (P < 0.001).

Realistic expectations were statistically significantly higher for the intervention compared to control groups for correctly knowing the proportion of patients post-arthroplasty who would be able to walk with less pain after surgery (79.5%; 67.1%) and have serious complications from surgery (80.1%; 57.3%) (Table II). Both groups scored poorly on the number of months for full recovery (9.6%; 5.7%).

Surgery rates were 120 of 164 (73.2%) for intervention and 132 of 164 (80.5%) for control (RR = 0.91; 95% CI: 0.81, 1.03, P = 0.121) (Table III). Within 2 years, 12 patients in the intervention group (7.3%) and eight from the control group (4.9%) that chose non-surgical options returned to the surgical wait list (P = 0.791). Table III shows changes in patients’ preferred treatment option post-intervention or after seeing the surgeon.

Perceptions of the decision making process. Post-intervention and before consultation with the surgeon, significantly more patients in the intervention arm than in the control arm felt informed (93.6% vs 79.6%, P < 0.001) and had clarity about which benefits and risks mattered most to them (88.5% vs 79.6%, P = 0.044) (Table IV). There were no statistically significant differences in the proportions of patients feeling supported (P = 0.277) or feeling sure about the best choice (P = 0.235). There were no statistically significant differences between groups in the proportions of patients achieving 4 out of 4 on the SURE test prior to the surgeon visit (P = 0.347) or after consultation with the surgeon (6 months) (P = 0.306).

Post-intervention and prior to the consultation, the intervention compared to control groups were more likely to know that the decision depended on their values (4.4 vs 4.0 out of 5; P = 0.003) and felt more prepared to talk to their surgeon about what matters most to them (4.5 vs 4.1; P = 0.014) (Table V). There were no statistically significant differences between groups for recognizing that a decision needed to be made or thinking about how involved they wanted to be in making that decision.

Discussion

Our study sought to examine the effects of a PtDA on appropriate and timely access to hip or knee arthroplasty for patients with osteoarthritis. Controlling for site (academic vs community hospital) and joint (hip or knee), a non-statistically significant trend was observed whereby the PtDA decreased the time to removal from the wait list for patients given the PtDA (P-value = 0.0653). Hence, the PtDA reduced wait times for patients on the surgery waiting list by removing the patients that do not want surgery or do not need surgery as observed in the lower proportion of patients in the PtDA group electing to have surgery. The effect of the PtDA varied between the sites: at the community site patients given the PtDA waited 3 weeks less from screening to definitive choice; however, at the academic site, there was no difference in wait times. The substantial heterogeneity across the sites needs to be explored. Despite the lack of statistical significance in decision quality, there was a 12% improvement in those exposed to the PtDA and significantly more patients had realistic expectations on two important outcomes of joint arthroplasty (i.e., pain relief when walking, serious surgical complications).

This study was conducted in two different clinics that were established to screen out patients with milder osteoarthritis, and as expected, most patients in the study had more severe osteoarthritis and were appropriate for considering surgery. Our findings indicate a trend in that a higher proportion of patients exposed to the PtDA achieved decision quality and waited fewer weeks. However, the PtDA may have greater effect and discrimination aimed at patients with earlier stages of osteoarthritis and may help them consider their non-surgical options. When non-surgical therapies have yielded limited success and pain becomes unmanageable, total joint arthroplasty is an effective surgical procedure.
Fig. 1. CONSORT trial flow diagram.

Excluded (n=1124)
- Not meeting inclusion criteria (n=956)
- Declined to participate (n=123)
- Lack of time (n=45)

Assessed for eligibility (n=1467)

Randomized (n=343)

Excluded (n=2)
- 1 refused consent
- 1 unable to complete baseline questionnaires

Allocated to intervention (n=174)

Allocated to usual care (n=169)

Received patient decision aid (n=172)

Received usual care (n=169)

2 week follow-up

Discontinued (n=6)
- 5 requested withdrawal
- 1 ineligible (VCR broken)

Discontinued (n=7)
- 6 requested withdrawal
- 1 ineligible (hip resurfacing)

Unreachable (n=7)

Unreachable (n=3)

Completed (n=159)

Completed (n=129)

6 month follow-up

Discontinued (n=4)
- 3 requested withdrawal
- 1 died

Discontinued (n=11)
- 9 requested withdrawal
- 1 switched hospitals
- 1 died

Unreachable (n=31)

Unreachable (n=19)

Completed (n=131)

Completed (n=132)

12 month follow-up

Discontinued (n=1)
- requested withdrawal

Discontinued (n=3)
- requested withdrawal

Unreachable (n=135)

Unreachable (n=24)

Completed (n=126)

Completed (n=124)

18 month follow-up

Discontinued (n=4)
- requested withdrawal

Discontinued (n=2)
- requested withdrawal

Unreachable (n=41)

Unreachable (n=36)

Completed (n=116)

Completed (n=110)

24 month follow-up

Discontinued (n=0)

Discontinued (n=0)

Unreachable (n=49)

Unreachable (n=38)

Completed (n=108)

Completed (n=108)

Analyzed for primary outcome
(n=165)

Analyzed for primary outcome
(n=163)

Excluded from the analysis (n=7)
- 2 no data for primary outcome
- 5 ineligible (awaiting MRI results, meniscal tear, osteotomy, not OA, VCR broken)

Excluded from the analysis (n=6)
- 1 no data for primary outcome,
- 2 ineligible (recruited for knee and treated for hip, switched hospitals)
- 1 withdrawn in error at 2 week follow-up (hip resurfacing)
values, and felt better prepared for the surgical consultation. These findings were similar to our pilot study evaluating the PtDA alone and another study that prepared patients with the same PtDA plus decision coaching12,14 thereby questioning use of coaching as a more expensive intervention29. However, a systematic review of 44 studies revealed that patients’ capacity to participate in decision making was most strongly influenced by lack of knowledge on options and their preferences, as well as power imbalances30. PtDAs have consistently improved knowledge and helped patients clarify their preferences but little is known about ways to address power imbalances within the patient-surgeon consultation. Patients have suggested that nurses could address this power-imbalance by listening to their preferences and ensuring physicians know their preferences30. In our study, we used the 1-page preference report to communicate patients’ knowledge and preferences to the surgeon together with their osteoarthritis severity.

Table I
Characteristics of participants in each arm

<table>
<thead>
<tr>
<th></th>
<th>Intervention group (n = 167)</th>
<th>Control group (n = 167)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years), mean (SD)</td>
<td>66.1 (9.8)</td>
<td>66.9 (9.8)</td>
</tr>
<tr>
<td>Joint</td>
<td>Hip</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>Knee</td>
<td>120</td>
</tr>
<tr>
<td>HKPT* (total 80), mean (SD)</td>
<td>45.6 (13.8)</td>
<td>45.5 (13.2)</td>
</tr>
<tr>
<td>WOMAC* (total 96), mean (SD)</td>
<td>56.7 (17.3)</td>
<td>53.9 (16.0)</td>
</tr>
<tr>
<td>Sex</td>
<td>Men</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>89</td>
</tr>
<tr>
<td>BMI, mean (SD)</td>
<td>31.0 (6.5)</td>
<td>31.8 (6.1)</td>
</tr>
<tr>
<td>Language</td>
<td>English</td>
<td>163</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>4</td>
</tr>
<tr>
<td>Education</td>
<td>Less than high school</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>High/technical school</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>College</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>University</td>
<td>48</td>
</tr>
<tr>
<td>Living arrangements</td>
<td>Alone</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>With someone else</td>
<td>128</td>
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<tr>
<td>Employment</td>
<td>Full time</td>
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<tr>
<td></td>
<td>Part time</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Retired</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>Long term disability</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Unemployed</td>
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<tr>
<td>Household income</td>
<td>&lt;$20,000</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>to $39,999</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>to $59,999</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>to $79,999</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>to $99,999</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>&gt;$100,000</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>no response</td>
<td>9</td>
</tr>
<tr>
<td>Change in household income</td>
<td>Yes</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>134</td>
</tr>
<tr>
<td></td>
<td>No response</td>
<td>145</td>
</tr>
</tbody>
</table>

Notes: Frequencies, unless otherwise indicated. The typical Canadian income for elderly over 65 years was $58,000 during study recruitment.
HKPT = Hip-Knee Priority Tool; BMI = Body Mass Index.
WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.
* Higher scores indicate higher severity of osteoarthritis.

Fig. 2. Stratified Kaplan–Meier analysis showing time to removal from wait list at the community site.
Fig. 3. Stratified Kaplan–Meier analysis showing time to removal from wait list at the academic site.
Patients were followed for 2 years after exposure to a PtDA about joint arthroplasty which allowed us to measure whether or not patients who initially chose non-surgical options subsequently changed their mind and returned to the surgery wait list. Although it was not statistically significant, we found an initial decrease in surgical rates in the PtDA group compared to controls (73% vs 81%) and fewer patients who subsequently changed their mind to have surgery in the PtDA group (7%) or control group (5%). Previous trials indicate that PtDAs can moderate surgical rates by addressing values-choice concordance33,34. Values clarification is easier and more transparent for patients compared to other values clarification approaches such as conjoint analysis12. Our decision quality findings are consistent with our pilot study14 and in the same direction as the meta-analysis in the Cochrane study reported that half of patients screened at site 1 were referred back to primary care because their osteoarthritis did not meet the surgical appropriateness criteria (e.g., pain and functional limitations interfere with their quality of life despite use of conservative treatment)9.

A higher proportion of patients reached good decision quality in the PtDA group compared to controls who received usual education only. Decision quality is the gold standard measure for determining PtDA effectiveness21. It is calculated using a composite score that accounts for being informed (knowledge score) and achieving decision quality, and in the same direction as the meta-analysis in the Cochrane.

Table II
Patients who achieved decision quality, knowledge, and realistic expectations

<table>
<thead>
<tr>
<th></th>
<th>Intervention n = 156</th>
<th>Control n = 158</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good decision quality: decision matches features of options that matter most to the informed patient</td>
<td>87 (56.1%)</td>
<td>69 (44.5%)</td>
<td>0.050</td>
</tr>
<tr>
<td>Hip-knee decision quality instrument Screener*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over time, without surgery, what usually happens to the pain from hip (knee) osteoarthritis?</td>
<td>140 (90.3%)</td>
<td>144 (91.1%)</td>
<td>0.803</td>
</tr>
<tr>
<td>After hip (knee) replacement surgery, about how many months does it take most people to get back to doing their usual activities?</td>
<td>15 (9.6%)</td>
<td>9 (5.7%)</td>
<td>0.191</td>
</tr>
<tr>
<td>About how many people who have hip (knee) replacement surgery will have the same hip (knee) replaced again in less than 15 years?</td>
<td>40 (25.6%)</td>
<td>38 (24.2%)</td>
<td>0.769</td>
</tr>
<tr>
<td>If 100 people have hip (knee) replacement surgery, about how many will have less hip (knee) pain when walking after surgery?</td>
<td>124 (79.5%)</td>
<td>106 (67.1%)</td>
<td>0.013</td>
</tr>
<tr>
<td>Out of 100 people who have hip (knee) replacement surgery, about how many will have a serious complication (e.g., death, life-threatening blood clots, infection, heart attack) within the 3 months after surgery?</td>
<td>125 (80.1%)</td>
<td>90 (57.3%)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* Entries are frequency (%) correct answers.
1 Questions assessing realistic expectations.

Table III
Patient preferences post-intervention and post-surgical consultation, and actual choice implemented

<table>
<thead>
<tr>
<th>Patient preferences post-intervention</th>
<th>Intervention (n = 156)</th>
<th>Control (n = 157)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>105 (67.3)</td>
<td>123 (78.3)</td>
<td>0.063</td>
</tr>
<tr>
<td>Non-surgery</td>
<td>21 (13.5)</td>
<td>11 (7.0)</td>
<td></td>
</tr>
<tr>
<td>Unsure</td>
<td>30 (19.2)</td>
<td>23 (14.7)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient preferences post-surgical consultation (6 months)</th>
<th>Intervention (n = 127)</th>
<th>Control (n = 127)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>104 (81.9)</td>
<td>111 (87.4)</td>
<td>0.543</td>
</tr>
<tr>
<td>Non-surgery</td>
<td>20 (15.8)</td>
<td>14 (11.0)</td>
<td></td>
</tr>
<tr>
<td>Unsure</td>
<td>3 (2.4)</td>
<td>2 (1.6)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actual choice implemented</th>
<th>Intervention (n = 164)</th>
<th>Control (n = 164)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>120 (73.2)</td>
<td>132 (80.5)</td>
<td>0.121</td>
</tr>
<tr>
<td>Non-surgery</td>
<td>44 (26.8)</td>
<td>32 (19.5)</td>
<td></td>
</tr>
</tbody>
</table>

* Entries are frequency (%).

Table IV
SURE test items post-intervention and at 6 months (post-surgeon consultation)

<table>
<thead>
<tr>
<th>SURE test items</th>
<th>Post-intervention</th>
<th>6 months Post-surgeon</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feels SURE about best choice</td>
<td>110/156 (70.5)</td>
<td>115/126 (91.3)</td>
<td>0.086</td>
</tr>
<tr>
<td>Knows the benefits and harms of each option</td>
<td>146/156 (93.6)</td>
<td>122/126 (96.8)</td>
<td>0.101</td>
</tr>
<tr>
<td>Clear about which benefits and risks matter most</td>
<td>138/156 (88.5)</td>
<td>121/126 (96.0)</td>
<td>0.396</td>
</tr>
<tr>
<td>Has enough support and advice to make choice</td>
<td>133/156 (85.3)</td>
<td>120/126 (95.2)</td>
<td>0.438</td>
</tr>
<tr>
<td>TOTAL 4 out of 4</td>
<td>104/156 (66.7)</td>
<td>109/126 (86.5)</td>
<td>0.306</td>
</tr>
</tbody>
</table>

* Significant qualitative interaction by site.
review of PtDA trials that showed a 51% improvement in informed values-based choices using various measures\textsuperscript{11}. Our study addresses concerns that a previous trial did not reflect usual practice or include typical patients\textsuperscript{15}. For our study, patient recruitment occurred in a pre-surgical screening clinic that is usual practice for referral to orthopedic specialists in our community. Our eligibility criteria were inclusive. As a result, half of our participants had high school education or less and half had household incomes at or below the median income ($58,000) for couples aged 65 or older in Canada. Although the video feature of the PtDA we used made it easier to reach individuals with lower education and lower health literacy\textsuperscript{16}, we did not assess participants’ health literacy.

**Limitations**

Several limitations must be considered when interpreting the results of this trial. There was potential for self-report bias given that decision quality components, decisional conflict, and preparation for decision making are all patient reported. However, for the primary outcome of wait times, patient reported data was triangulated with data from the clinic records. Although we provided surgeons with a patient preference report summarizing patients’ clinical data together with their knowledge, values for outcomes of options, and preferences, we did not measure if surgeons looked at the report or its influence on the consultation. Finally, this was a pragmatic trial in that we did not aim to standardize the usual clinical flow across sites but rather evaluated the effectiveness of the PtDA within two sites. However, accounting for two sites increased variability in the findings.

**Conclusions**

Using PtDAs for patients with osteoarthritis considering hip or knee arthroplasty appears to have optimized the surgical referral by enhancing patients’ knowledge, ensuring realistic expectations of outcomes of options, and helping patients be clear about what matters most. However, despite having a trend towards shorter wait time in the PtDA group, this was observed at only one site and the overall effect was not statistically significant. Further research is required to measure the effect of PtDAs with the one-page preference report for surgeons on shared decision making within the consultation.

**Contributions**

All the authors were involved in designing the study, revising the article for critically important intellectual content, and approving the final version submitted. SB coordinated the study including recruitment and data collection. MT conducted the analysis.

**Role of the funding source**

This work was supported by funding and access to the PtDA from the not-for-profit Informed Medical Decisions Foundation (Grant #0099-1). Funding for graduate students was from the Faculty of Health Sciences, University of Ottawa. The study sponsors had no involvement in the study design, collection, analysis and interpretation of data; in the writing of the manuscript; or in the decision to submit the manuscript for publication.

**Competing interest statement**

The authors (DS, MT, PT, IT, AO, MPP, LB, DM, GH) declare that they have no conflict of interests. GFD is a paid consultant for Stryker Corporation advising on total and partial knee replacement. At the time of the study, the Informed Medical Decisions Foundation that provided funding for the study had a licensing agreement with Health Dialog, a commercial company who markets PtDA and health coaching. The funders were not involved in the study design, data collection, analysis, interpretation of data, or writing of the report.

**Acknowledgments**

Val Hum assisted in recruiting patients to participate in the study.

**References**


