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Willingness to Undergo Joint Surgery Following a First-Line Intervention for Osteoarthritis: Data From the Better Management of People With Osteoarthritis Register

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Objective. To assess the proportion of participants reconsidering their willingness to undergo surgery after 3 and 12 months. Secondary aims were to analyze and compare the characteristics of individuals willing and unwilling to undergo joint surgery for osteoarthritis (OA) before a first-line intervention, and to study the association between pain intensity, walking difficulties, self-efficacy, and fear of movement with the willingness to undergo surgery.

Methods. This was an observational study based on Swedish register data. We included 30,578 individuals with knee or hip OA who participated in a first-line intervention including education and exercise.

Results. Individuals willing to undergo surgery at baseline showed a higher proportion of men (40% versus 27%) and more severe symptoms and disability. Respectively, 45% and 30% of the individuals with knee and hip OA who were willing to undergo surgery at baseline became unwilling after the intervention. At the end of the study period (12 months), 35% and 19% of those with knee and hip OA, respectively, who were willing to undergo surgery at baseline became unwilling. High pain intensity, walking difficulties, and fear of movement were associated with higher odds of being willing to undergo surgery at both follow-ups, while increased self-efficacy showed the opposite association.

Conclusion. A first-line intervention for OA is associated with reduced willingness to undergo surgery, with a greater proportion among patients with knee OA than hip OA. Due to its temporal variability, willingness to undergo surgery should be used with care to deem surgery eligibility.

INTRODUCTION

In individuals with long-standing and severe knee or hip osteoarthritis (OA), total joint replacement (TJR) is an effective intervention to reduce pain and disability (1). In the last decades, the use of joint replacement for OA has dramatically increased and its growth is expected to continue, partially driven by the rising prevalence of OA (2–4).

Despite the fact that TJR is a common procedure, there appears to be little consensus regarding the indication for TJR (5,6). Decision-making is complex and based on the interaction of multiple factors, such as patient willingness to undergo surgery and disease severity, but also based on social factors and previous experiences as well as availability (6–12). Patients' willingness to undergo surgery is the strongest predictor for TJR and has been hypothesized to be in part responsible for the high number of TJR procedures deemed as inappropriate and also responsible for the residual pain and disability observable in 1 of 5 patients with a TJR for OA (13,14).

Exercise in combination with education (and weight loss if indicated) is the first-line intervention for hip and knee OA, and both national and international guidelines recommend it. Randomized controlled trials (RCTs) have shown that first-line interventions can postpone surgery for up to 2 years in patients on a waiting list for TJR (15,16). Similarly, observational studies have shown that first-line interventions can shift patients' willingness to undergo surgery in the short term, raising further questions on the use of preferences for TJR in the surgical decision process (17,18). However, very little is known about how often patients with OA reconsider their willingness to undergo surgery after a first-line intervention

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SIGNIFICANCE & INNOVATIONS

- Results from this large cohort show a reduction of 30–45% in willingness to undergo surgery after completion of a first-line intervention and indicate that this reduction is partially maintained up to 12 months. Patients with osteoarthritis undergoing a first-line intervention tend to reconsider their willingness to undergo surgery multiple times, suggesting that the willingness to undergo surgery may not be an optimal indicator to deem eligibility for total joint replacement, especially if the person seeking surgery has not yet undertaken a first-line intervention.
- Pain was significantly associated with the willingness to undergo surgery at both follow-ups, suggesting that a reduction of 1 unit in the pain intensity (measured on a 0–10 numeric rating scale) can lead to 60–80% lower odds of being willing to undergo surgery.
- Walking difficulties appear to be central in determining a person's willingness to undergo surgery and may, in certain cases, be more important than pain, especially when pain is measured on a quantitative scale.

delivered in a clinical context, and whether the change in willingness is maintained in the long term. In fact, RCTs provide useful information to establish causality but are often limited by stringent selection criteria and cannot account for the large variability that characterizes clinical settings. On the other hand, existing observational studies often have small sample sizes and short follow-ups, somewhat limiting the generalizability of results.

To better understand patients' preferences and to improve the decision process leading to surgery, it is fundamental to understand how willingness to undergo surgery may shift at different time points after a first-line intervention for OA and to understand which factors are associated with the shift in willingness to undergo surgery. Therefore, the main aim of this study was to assess the proportion of participants reconsidering their willingness to undergo surgery at 3 and 12 months after taking part in a first-line intervention. Our secondary aims were to compare the characteristics of individuals willing and unwilling to undergo surgery before taking part in a first-line self-management intervention provided nationwide in Sweden and to study the association of symptoms, quality of life, and psychological factors with the willingness to undergo surgery after 3 and 12 months.

MATERIALS AND METHODS

Study design. This was an observational register-based study, and it adhered to the Strengthening the Reporting of Observational Studies in Epidemiology guidelines for observational studies (19). The study was approved by the Regional Ethical Review Board in Gothenburg (1059-16).

Intervention. The Better Management of People with Osteoarthritis (BOA) is a national quality register collecting data of a first-line management program for individuals with hand, hip, and knee OA that started in Sweden in 2008 and is provided in primary care settings. All individuals taking part in the program receive a minimum of 2 theoretical group sessions led by a physical therapist focusing on the disease pathophysiology, on the effectiveness and indication of OA treatments (including surgery, pharmacologic, and nonpharmacologic treatments), and on the benefit of exercise, including self-management advice and strategy to incorporate exercise into daily life (20).

Between 1 and 3 weeks after the education, all the participants are offered the possibility to take part in the exercise phase of the intervention, which consists of a face-to-face session with a physical therapist. In this session, the patients receive a personalized intervention program and the necessary instructions to perform it independently at home (21,22). Thereafter, participants are given the possibility to perform their exercise program on their own or to participate in up to 12 supervised group exercise sessions with a physical therapist, provided 2 times a week for 6 weeks. Further details on the program delivered to the participants recorded in BOA can be found elsewhere (20).

Study sample. The study sample consisted of patients with knee and/or hip OA with data recorded in BOA between September 2008 and December 2016. These patients sought treatment in primary health care in Sweden for knee and/or hip pain and were referred for a standardized core treatment (education and exercises) after a confirmed clinical or radiographic OA diagnosis as recommended by the Swedish National Board of Health and Welfare (23). These guidelines are in line with internationally accepted diagnostic criteria for OA, suggesting that a radiographic examination should only be used in uncertain cases, if the patient is not responding to treatment or when surgical intervention is planned (24,25). Patients were excluded from the program if 1) the joint pain was caused by other diseases or conditions (e.g., sequel hip fractures, chronic widespread pain, inflammatory joint diseases, or cancer), 2) they had received a TJR in 1 of their knees or hips within the previous 12 months, 3) they had other surgery of the knee or hip within the past 3 months, or 4) they were not able to read or understand Swedish. The index joint for the treatment was identified by a physical therapist and based on the patient's medical history and complaints. If >1 joint was affected, the most symptomatic joint was used as the index joint.

For this study, we included all participants who completed the 2 mandatory education sessions, were willing to undergo surgery, as recorded at baseline, and attended both follow-ups at 3 months (between 60 and 150 days from enrollment) and 12 months (between 360 and 450 days from enrollment), or did not attend 1 of the follow-ups because they received a TJR in the index joint. Participants who underwent TJR before the 3-month follow-up were considered as willing to undergo surgery

at the 3-month follow-up. Similarly, patients who underwent TJR after the 3-month follow-up were considered as being willing to undergo surgery at 12 months. For pragmatic reasons, we allowed a 3-month window at the follow-ups to ensure that all the participants were able to attend the follow-ups.

Variables. Willingness to undergo surgery was assessed by the question "Are your knee/hip symptoms so severe that you wish to undergo surgery? (Yes/No)," asked at baseline and both follow-ups. Mean pain intensity during the last week in the most affected joint was evaluated at baseline and follow-ups on a numeric rating scale ranging from 0 (no pain) to 10 (maximum pain) (21). The presence of perceived walking difficulties was assessed by the question "Do you have problems walking as results of your joint problems (Yes/No)" at baseline and both follow-ups. Participants reported their age, sex, and level of education. Body weight and height were self-reported at the first visit, from which the body mass index (BMI) was calculated as kg/m^2.

Participants rated their general health status using the 5-level EuroQol 5-domain (EQ-5D-5L) instrument. For this study, we used the EQ-5D-5L visual analog scale, with a score ranging from 0 (worst imaginable health state) to 100 (best imaginable health state) as a measure of overall health-related quality of life (26,27).

Self-efficacy was assessed by the Arthritis Self-Efficacy Scale (ASES), designed to assess participants' confidence in their ability to manage symptoms of arthritis. The final score ranges 10–100 in 10-point increments, with higher values representing higher self-efficacy. ASES has previously been used to evaluate patient education programs for individuals with arthritis and is validated in Swedish (22,23). In BOA, only the scales assessing self-efficacy for pain and other symptoms have been included. For this study, we used only the scale assessing pain self-efficacy, which was converted into a 1–10 scale with a 1-point increment to facilitate interpretation of the results.

Comorbidities were measured using the Charnley classification, which categorizes individuals into 3 categories: A (unilateral OA of knee or hip), B (bilateral OA in both knees or both hips), or C (OA in multiple joint sites, e.g., hip and knee) and/or the presence of any other disease that affects walking ability (28,29). No other measure of comorbidity was available. Fear of movement was assessed by the question "Are you afraid your joints will be injured by physical training/activity? (Yes/No)."

Any kind of surgery was considered, e.g., meniscectomy, osteotomy, partial joint replacement, and TJR. Considering that the joint that received replacement could not be considered as the index joint for the treatment, none of the reported index joints had received TJR before enrolling in the program. However, participants who received TJR in the contralateral joint >12 months prior to enrollment could be included in the program. At baseline, participants were asked if they had previously sought care for their joint problem, but no information on the treatment sought was collected.

Self-reported radiographs prior to enrollment were recorded and divided into 4 categories: no radiographs, radiographs received >6 months before enrollment, radiographs received <6 months before enrollment, or does not know. Previous consultations with a physical therapist for the problems in the index joint were self-reported by the participants (yes/no). No information regarding treatments received was recorded. Participants were also asked to report whether they were on a waiting list for receiving joint surgery at the time of enrollment (yes/no). No data were available for the 3- and 12-month follow-up.

Statistical analysis. To account for differences linked to the affected joint, all the analyses were performed separately for patients with hip and knee OA. Normality was assessed through visual inspection of histograms and assessment of Q-Q plots. We used the independent *t*-test to compare characteristics of patients willing and unwilling to undergo surgery at baseline. The chi-square test and Z test with Bonferroni correction were used for categorical variables and to assess the proportion of crossovers from willing to undergo surgery at baseline to unwilling to undergo surgery at the various follow-ups. Alpha level was set at 0.05.

Logistic regression models were used to study the association between pain intensity, walking difficulties, self-efficacy, and fear of movement with the willingness to undergo surgery. Separate models were built to study the association between the independent variables and the dependent variable at 2 time points, 3 months and 12 months. In the first model, we studied the association at 3 months between pain, walking difficulties, self-efficacy, and fear of movement with the participant's willingness to undergo surgery. In the second model, we studied the association at 12 months between pain, walking difficulties, self-efficacy and fear of movement with the participant's willingness to undergo surgery. The analyses were adjusted for sex, age, BMI, willingness to undergo surgery at the previous follow-up, pain intensity at the previous follow-up,

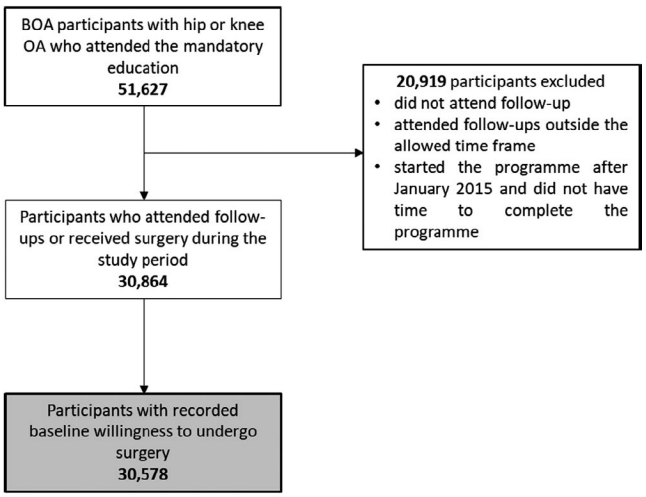

Figure 1. Participant selection flow chart. BOA = Better Management of People with Osteoarthritis; OA = osteoarthritis.

previous surgery (index and contralateral), level of education, previous care sought for the joint problem, previous consultation with a physical therapist, previous radiographs, and whether the participant was on a waiting list for joint surgery. Results are presented as odds ratios with 95% confidence intervals. All statistical analyses were conducted using SPSS software, version 25.0.

RESULTS

From 2008 to 2016, 51,627 individuals with hip or knee OA were recorded in the BOA register and were eligible for this study, of whom 30,578 filled the inclusion criteria (knee OA: 20,649; hip OA: 9,929) (Figure 1 and Table 1).

Table 1. Characteristics of the BOA participants*

Characteristic	Included (n = 30,578)		Excluded (n = 21,049)	
	No.	Value	No.	Value
Age, years	30,578	66.7 ± 9.0	20,987	65.4 ± 9.7
Body mass index	30,081	27.8 ± 4.8	20,515	28.2 ± 4.9
Pain (0–10)	30,509	5.3 ± 1.9	20,897	5.3 ± 2.0
ASES pain (1–10)	29,947	6.3 ± 1.9	19,886	6.3 ± 1.9
EQ-5D-5L VAS (1–100)	24,605	67.1 ± 19.0	18,083	65.8 ± 19.5
Sex, %				
Men	9,274	30.3	6,424	30.6
Women	21,304	69.7	14,563	69.4
Willingness to undergo surgery, %				
No	22,700	74.2	15,567	76.1
Yes	7,878	25.8	4,884	23.9
Comorbidities, %				
Charnley class A	11,761	38.5	7,830	37.3
Charnley class B	6,036	19.8	3,809	18.1
Charnley class C	12,743	41.7	9,320	44.5
Fear of movement, %				
No	25,895	84.4	16,925	82.3
Yes	4,798	15.6	3,629	17.7
Walking difficulties, %				
No	5,939	19.2	3,910	18.8
Yes	24,482	80.8	16,930	81.2
Education, %				
Primary school	10,622	34.4	7,060	33.8
High school	10,997	36.9	7,982	38.2
University	8,871	29.1	5,845	28.0
Previous care sought for the joint problem, %				
No	877	2.9	682	3.3
Yes	29,502	97.1	20,188	96.7
Previous radiographs index joint, %				
No	6,345	20.8	4,540	21.6
Yes, >6 months	9,756	32.0	6,570	31.3
Yes, <6 months	14,132	46.4	9,675	46.1
Does not know	225	0.7	186	0.9
Previous physical therapist consultation (index joint), %				
No	16,053	52.7	11,593	55.3
Yes	14,433	47.3	9,363	44.7
Previous surgery index joint, %				
No	26,717	87.6	18,203	86.7
Yes	3,799	12.4	2,789	13.3
Surgery contralateral, %				
No	27,218	89.4	18,791	89.7
Yes	3,227	10.6	2,147	10.3
Waiting list for joint surgery (index joint), %				
No	29,697	97.6	20,549	98.2
Yes	721	2.4	374	1.8
Surgery during study period, %				
No	26,314	86.1	–	–
Before 3 months	78	0.3	–	–
Between 3 and 12 months	4,186	13.7	–	–

* Values are the mean ± SD unless indicated otherwise. ASES = Arthritis Self Efficacy Score; BOA = Better Management of People with Osteoarthritis; EQ-5D-5L = 5-level EuroQol 5-domain instrument; VAS = visual analog scale.

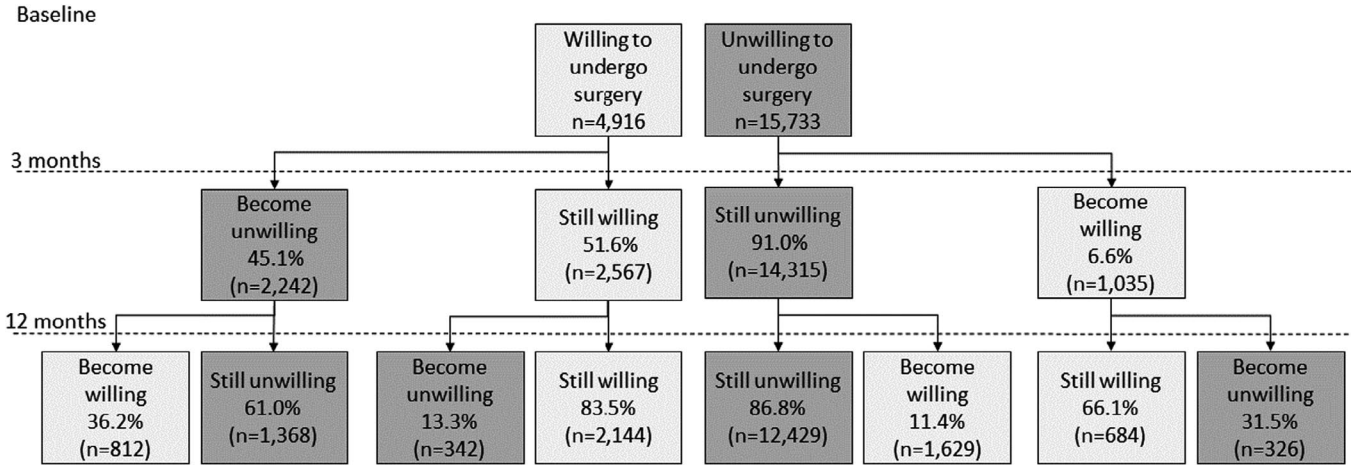

Figure 2. Proportion of individuals with knee osteoarthritis reconsidering their willingness to undergo surgery at 3 and 12 months from the intervention. Percentages are reported separately for individuals willing to consider surgery at baseline and for those unwilling to consider surgery. Percentages represent the proportion of individuals from the level above who either changed or did not change their mind at the follow-up. A percentage that does not reach 100% indicates individuals without willingness to undergo surgery recorded at follow-up.

Shift in willingness to undergo surgery. At baseline, 4,916 participants (24%) with knee OA and 2,962 (30%) with hip OA were willing to undergo surgery. Of these, 45.1% of those with knee OA (n = 2,242) and 30 % of those with hip OA (n = 901) became unwilling after 3 months. At 12 months, 61% of those with knee OA (n = 1,368) and 45.3% of those with hip OA (n = 408) who became unwilling were still unwilling. Among the individuals unwilling to undergo surgery at baseline, 6.6% of those with knee OA (n = 1,035) and 11.8% of those with hip OA (n = 820) became willing at 3 months. At 12 months, 66.1% of those with knee OA (n = 684) and 80.5% of those with hip OA (n = 660) who became willing were still willing to undergo surgery.

Overall, 34.8% of the individuals with knee OA (n = 1,710) and 19.0% of those with hip OA (n = 564) who were willing to undergo surgery at baseline became willing during the study period and were unwilling at 12 months. On the other hand, 14.7% of those with knee OA (n = 2,313) and 26.8% of those with hip OA (n = 1,871) changed from being unwilling to consider surgery at baseline to be willing at the 12-month follow-up. Levels of pain, self-efficacy, and quality of life at the 3 follow-ups in relation to willingness are reported in Supplementary Tables 1 and 2 (available on the *Arthritis Care Research* website at http://onlinelibrary.wiley.com/doi/10.1002/acr.24486/abstract) and Figures 2 and 3.

Baseline comparison and factors associated with willingness to undergo surgery. Baseline characteristics of the included participants in Table 2 show that more individuals with hip OA than knee OA were willing to consider surgery at baseline.

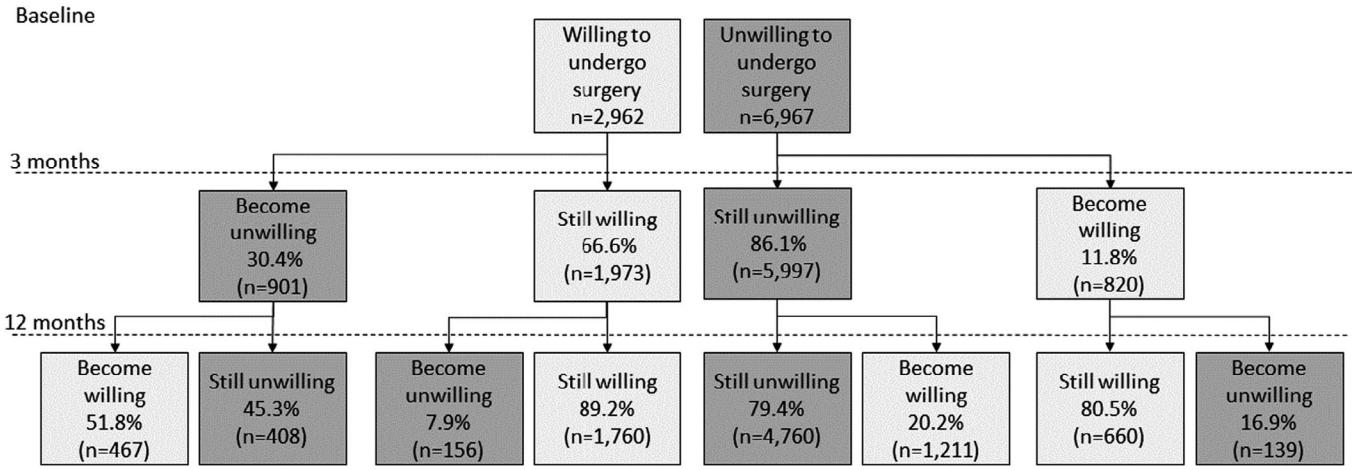

Figure 3. Proportion of individuals with hip osteoarthritis reconsidering their willingness to undergo surgery at 3 and 12 months from the intervention. Percentages are reported separately for individuals willing to consider surgery at baseline and for those unwilling to consider surgery. Percentages represent the proportion of individuals from the level above who either changed or did not change their mind at the follow-up. A percentage that does not reach 100% indicates individuals without willingness to undergo surgery recorded at follow-up.

Table 2. Baseline characteristics of BOA participants based on the affected joint and willingness to undergo surgery*

	Knee OA, unwilling (n = 15,733)		Knee OA, willing (n = 4,916)			Hip OA, unwilling (n = 6,967)		Hip OA, willing (n = 2,962)		
	No.	Value	No.	Value	*P*	No.	Value	No.	Value	*P*
Age	15,733	66.6 ± 8.9	4,916	66.0 ± 9.2	<0.001†	6,967	67.3 ± 9.0	2,962	67.3 ± 9.0	0.941
Body mass index	15,467	27.9 ± 4.8	4,837	29.3 ± 4.9	<0.001†	6,862	26.6 ± 4.3	2,915	27.6 ± 4.5	<0.001†
Pain (0–10)	15,696	4.9 ± 1.9	4,907	6.4 ± 1.6	<0.001†	6,953	4.9 ± 1.9	2,953	6.5 ± 1.5	<0.001†
ASES pain (1–10)	15,402	6.8 ± 1.7	4,823	5.4 ± 1.8	<0.001†	6,814	6.5 ± 1.7	2,908	5.0 ± 1.8	<0.001†
EQ-5D-5L VAS (0–100)	12,677	70.3 ± 17.8	3,860	60.0 ± 19.7	<0.001†	5,712	69.0 ± 17.9	2,356	56.9 ± 19.8	<0.001†
Sex, %										
Men	4,196	26.7	1,985	40.4	<0.05†	1,892	27.2	1,201	40.5	<0.05†
Women	11,537	73.3	2,931	59.6	<0.05†	5,075	72.8	1,761	59.5	<0.05†
Charnley class, %										
A	6,354	40.4	1,624	33.3	<0.05†	2,719	39.0	1,064	35.9	<0.05†
B	3,759	23.9	1,192	24.2	<0.05†	798	11.5	287	9.7	<0.05†
C	5,604	35.6	2,092	42.6	<0.05†	3,437	49.3	1,610	54.4	<0.05†
Fear of movement, %										
No	13,445	85.8	3,727	76.3	<0.05†	6,117	88.2	2,394	81.3	<0.05†
Yes	2,221	14.2	1,156	23.7	<0.05†	819	11.8	550	18.7	<0.05†
Walking difficulties, %										
No	3,879	24.8	268	5.5	<0.05†	1,679	24.2	113	3.8	<0.05†
Yes	11,763	75.2	4,631	94.5	<0.05†	5,248	75.8	2,840	96.2	<0.05†
Education, %										
Primary school	5,175	33.0	1,945	39.7	<0.05†	2,310	33.3	1,192	40.3	<0.05†
High school	5,683	36.2	1,852	37.8	<0.05†	2,420	34.9	1,042	35.3	>0.05
University	4,831	30.8	1,105	22.5	<0.05†	2,213	31.9	722	24.4	<0.05†
Previous care sought for joint problem, %										
No	488	3.1	51	1.0	<0.05†	296	4.3	42	1.4	<0.05†
Yes	15,134	96.9	4,939	99.0	<0.05	6,604	95.7	2,907	98.6	<0.05†
Previous radiographs index joint, %										
No	3,631	23.2	486	9.9	<0.05†	1,899	27.4	329	11.1	<0.05†
Yes, >6 months	5,204	33.2	1,687	34.3	>0.05	1,992	28.8	873	29.5	>0.05
Yes, <6 months	6,711	42.8	2,705	55.0	<0.05†	2,976	43.0	1,740	58.9	<0.05†
Does not know	119	0.8	36	0.7	>0.05	57	0.8	13	0.4	<0.05†
Previous physical therapist consultation (index joint), %										
No	8,432	53.7	2,392	48.8	<0.05†	3,756	54.1	1,473	49.9	<0.05†
Yes	7,257	46.3	2,512	51.2	<0.05†	3,284	45.9	1,480	50.1	<0.05†
Previous surgery index joint, %										
No	13,306	84.7	3,692	75.2	<0.05†	6,833	98.4	2,886	97.6	<0.05†
Yes	2,398	15.3	1,217	24.8	<0.05†	113	1.6	71	2.4	<0.05†
Surgery contralateral, %										
No	14,117	90.1	3,991	81.6	<0.05†	6,531	94.1	2,579	87.4	<0.05†
Yes	1,548	9.9	899	18.4	<0.05†	407	5.9	373	12.6	<0.05†
Waiting list for joint surgery (index joint), %										
No	15,555	99.4	4,526	92.4	<0.05†	6,879	99.4	2,737	92.8	<0.05†
Yes	96	0.6	370	7.6	<0.05†	44	0.6	211	7.2	<0.05†
Surgery during study period, %										
No	15,028	95.5	3,667	74.6	<0.05†	6,102	87.6	1,517	51.2	<0.05†
Yes	705	4.5	1,249	25.4	<0.05†	865	12.4	1,445	48.8	<0.05†

* Values are the mean ± SD unless indicated otherwise. Knee OA participants total: n = 20,649; hip OA participants total: n = 9,929. ASES = Arthritis Self Efficacy Score; BOA = Better Management of People with Osteoarthritis; EQ-5D-5L = 5-level EuroQol 5-domain instrument; OA = osteoarthritis; VAS = visual analog scale.
† Statistically significant.

Table 3. Factors associated with the willingness to undergo surgery at the 3-month and 12-month follow-ups*

Factors measured	Knee OA (n = 20,649)	Hip OA (n = 9,929)
3-month follow-up		
Pain (0–10)	1.61 (1.54, 1.67)†	1.70 (1.61, 1.80)†
EQ-5D-5L VAS (0–100)	1.00 (0.99, 1.01)	0.99 (0.99, 1.00)
Fear of movement (y/n)	1.49 (1.21, 1.82)†	1.56 (1.15, 2.10)†
ASES pain (1–10)	0.73 (0.70, 0.75)†	0.69 (0.66, 0.73)†
Walking difficulties (y/n)	3.46 (2.85, 4.20)†	4.03 (3.04, 5.35)†
12-month follow-up		
Pain (0–10)	1.79 (1.71, 1.88)†	1.86 (1.74, 1.99)†
EQ-5D-5L VAS (0–100)	0.99 (0.99, 1.00)	0.99 (0.99, 1.00)
Fear of movement (y/n)	1.51 (1.23, 1.85)†	1.43 (1.02, 2.00)†
ASES pain (1–10)	0.79 (0.76, 0.83)†	0.76 (0.71, 0.80)†
Walking difficulties (y/n)	3.55 (2.83, 4.47)†	5.25 (3.61, 87.63)†

* Values are the odds ratio (95% confidence interval). Analyses are adjusted for sex, age, body mass index, willingness to undergo surgery at the previous visit (baseline/3-month), pain at the previous visit (baseline/3-month), previous surgery (either knee or either hip), and education. Values for dichotomous variables are reported for the presence of the factor (absence used as reference category). ASES = Arthritis Self Efficacy Score; EQ-5D-5L = 5-level EuroQol 5-domain instrument; OA = osteoarthritis; VAS = visual analog scale.
† Statistically significant.

Individuals willing to consider surgery were on average younger and had higher BMI, higher baseline pain, lower self-efficacy, and lower quality of life compared to those who did not consider surgery. In addition, patients willing to undergo surgery more often had a Charnley score of C and walking difficulties, more often had consulted a physical therapist in the past, more often had received radiographs in the index knee in the last 6 months, more often had received surgery in the index or contralateral joint, and were more often on a waiting list to receive surgery in the index joint.

Table 3 shows that, regardless of the joint affected (hip or knee), patients with higher pain, fear of movement, and walking difficulties at 3 months had higher odds of being willing to undergo surgery at 3 months. By contrast, individuals with a higher level of self-efficacy at 3 months had lower odds of becoming willing to undergo surgery. Similarly, regardless of the joint affected (hip or knee), patients with a higher level of pain, fear of movement, and walking difficulties at 12 months had higher odds of becoming willing to undergo surgery at 12 months. Having a higher level of self-efficacy and quality of life at 12 months was associated with lower odds of becoming willing to undergo surgery at 12 months (Table 3).

DISCUSSION

In this study conducted in >30,000 individuals with knee or hip OA, we showed that 30% to 45% of the patients willing to undergo surgery no longer considered surgery as a therapeutic option after receiving a first-line intervention (3 months) including exercise and education. On the other hand, 7% to 12% of those who were not willing at baseline changed their mind. Overall, 35% of the patients with knee OA and 19% of those with hip OA willing to undergo surgery at baseline were no longer considering surgery at 12 months. Overall, >90% of the individuals included in this study had previously sought care for the joint problem, with roughly 50% who consulted a physical therapist in the past and 50% who received radiographs in the 6 months before the intervention. However, <3% of the participants were on a waiting list for surgery, suggesting that the sample may represent a population with moderate symptomatology accessing a first-line intervention after having previously undergone other treatments.

As expected, those individuals willing to undergo surgery at baseline appeared to have an overall worse disease severity, lower quality of life, and lower self-efficacy, regardless of the joint affected by OA. Nonetheless, many of these participants reconsidered their position about surgery. Due to the design of the study, little can be said about the influence of the provided intervention on the desire for surgery. However, our results show that improvement in OA symptoms and walking difficulties are associated with higher odds of becoming unwilling to undergo surgery. Worsening pain may instead explain the reconsiderations shown between the 3- and 12-month follow-ups, when no treatment was delivered, and the effect of the intervention is expected to subside (see Supplementary Tables 1 and 2, available on the *Arthritis Care & Research* website at http://onlinelibrary.wiley.com/doi/10.1002/acr.24486/abstract) (30,31). Prolonged adherence to an exercise regime, longer interventions, booster sessions, or digitally delivered programs may thereby minimize reconsideration about surgery in the months following the intervention (32,33).

Individuals unwilling to consider surgery at baseline appear to be less prone to become willing after receiving the intervention. Differences in baseline characteristics may help to explain the results. Individuals unwilling to undergo surgery at baseline appeared to have less severe symptoms and showed higher levels of self-efficacy, which was associated with lower odds of desiring surgery and has been linked to better outcomes from self-management interventions (34,35). Nevertheless, certain individuals unwilling to consider surgery changed their mind after the treatment or at 12 months. These individuals seem to have experienced an overall worsening of the symptoms, which may have led them to consider surgery as a therapeutic option for their joint problems (see Supplementary Tables 1 and 2, available on the *Arthritis Care & Research* website at http://onlinelibrary.wiley.com/doi/10.1002/acr.24486/abstract) (36).

Overall, our results are in line with a study showing a similar rate of reconsideration (30% became unwilling, 6% became willing) after 6 weeks of participation in a digital self-management program based on the BOA program (17). Despite the fact that both of the studies are observational and cannot establish causality, results from an RCT have shown that >60% of the patients eligible for surgery who received a 12-week first-line intervention decided not to undergo surgery up to the 2-year follow-up (1,15). A recent study analyzing the willingness to undergo surgery in individuals

with knee OA from the Osteoarthritis Initiative cohort showed a lower rate of reconsideration, with 16% of the participants becoming more willing to undergo surgery and 14% becoming less willing over a 2-year period where no structured intervention was provided (37). However, analyzed together, these results suggest that first-line interventions have the potential to reduce willingness to undergo surgery in a large part of the OA population, including individuals eligible for TJR and those with more moderate symptoms. Caution in the interpretation is needed, considering that the individuals who decide to undergo treatment for their problems may be more prone to reassess therapeutic options than those who are not seeking care.

Pain was significantly associated with the willingness to undergo surgery at both follow-ups, suggesting that a reduction of 1 unit in the pain intensity can lead to 60–80% lower odds of being willing to undergo surgery. However, the presence of walking difficulties also showed a strong association, increasing by 3–5-fold the odds of being willing to undergo surgery. Despite the fact that pain is often considered the most important factor driving care-seeking behavior, qualitative evidence showed that patients with OA often consider the use of quantitative measures of pain to deem eligibility to surgery to be inappropriate due to the inability of these scales to capture the real impact of pain on a person's life (38). Thus, measures of walking difficulties and physical disabilities may help to capture the experience of a person with OA, explaining their strong association with the willingness to undergo surgery. Thus, addressing perceived walking difficulties may lead to less surgery consideration.

Among the other factors analyzed, quality of life was not associated with the willingness to undergo surgery. Factors external to the joint disease may influence the quality of life without necessarily impacting the willingness to undergo surgery. On the other hand, higher levels of self-efficacy reduced the odds of being willing to undergo surgery. Focusing on function and participation rather than solely on symptom reduction may further reduce surgery consideration.

Patients with hip OA appear to benefit less from first-line interventions when compared to patients with knee OA (30,33,39,40). In this study, 30% of the individuals with OA who were willing to undergo surgery changed their mind after the treatment. However, those with hip OA were less likely to become unwilling to undergo surgery and more often received TJR during the study time than patients with knee OA. In addition, 26% of the individuals with hip OA who were unwilling to undergo surgery at baseline became willing by the end of the study period, while only 19% made the opposite shift. This trend is reverted in individuals with knee OA. Despite the differences in the rate of reconsideration, all the analyzed factors showed a similar association with the willingness to undergo surgery across the joints, suggesting that differences in the rate of surgery reconsideration are likely due to joint-specific differences in pain, symptom reduction, and surgery indication.

Some limitations need to be discussed. First, this was an observational study and, therefore, the effect of the treatment on the willingness for surgery cannot be asserted. In addition, several individuals did not have data recorded for 1 or both of the follow-ups and could not be included in the study. The exclusion of these individuals may have influenced our findings and should be taken into account when interpreting the results. Second, we do not know whether the patients who were willing to undergo surgery would be deemed eligible for surgery at the end of the intervention. This lack of information on surgery eligibility implies that reconsideration may not result in a direct change in the number of surgical procedures. However, individuals unwilling to undergo surgery have been shown to be less likely to receive TJR than those who are willing (14). Third, individual decision-making on important health care concerns such as surgery is complex and cannot be explained solely by the factors investigated in this study. Individuals at a later stage of the disease may have different expectations from an intervention than individuals at earlier stages. The limited information regarding the stage of the diseases (e.g., disease duration, date of diagnosis) may thus limit the applicability of these results. Finally, cultural differences between countries may exist and may somewhat limit the generalizability of the results outside Sweden.

Results from this large cohort show reduced willingness to undergo surgery by 30% to 45% after completion of a first-line intervention and show that this reduction is partially maintained for up to 12 months. Walking difficulties appear to be central in determining a patient's willingness to undergo surgery and may be as important as pain, especially when pain is measured on a quantitative scale. Finally, individuals' preferences are key in the care process of every disease and should always be considered. However, willingness to undergo surgery should be used with care in the decision process leading to surgery, in light of its temporal variability, especially if the patient seeking surgery has not yet undertaken a first-line intervention.

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AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Dr. Dell'Isola had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study conception and design. Dell'Isola, Jönsson, Rolfson, Cronström, Englund, Dahlberg.

Acquisition of data. Jönsson, Rolfson.

Analysis and interpretation of data. Dell'Isola.

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