Factors and Consequences of Waiting Times for Total Hip Arthroplasty

Itziar Vergara MD, MPH, Amaia Bilbao MSc,
Nerea Gonzalez PhD, Antonio Escobar MD, PhD,
José M. Quintana MD, PhD

Received: 26 April 2010 / Accepted: 20 December 2010 / Published online: 20 January 2011
© The Association of Bone and Joint Surgeons® 2011

Abstract

Background Various priority criteria for waiting lists for THA have been proposed. These criteria, however, are not typically included in clinical practice, resulting in unclear management procedures. Further, the clinical effects of waiting times on subsequent pain control or function are unclear.

Questions/purposes Therefore, we asked (1) what factors affect the waiting time for THA when no prioritization criteria are implemented, and (2) does waiting time influence pain and function after THA?

Patient and Methods We prospectively identified all 1495 patients on a waiting list for THA during a year. Of

these patients, 991 fulfilled the inclusion criteria, and waiting times were available for 695, of whom 527 (76%) responded to a followup questionnaire. Variables included wait time, sociodemographic data, comorbidities, and WOMAC and SF-36 questionnaires, collected preoperatively and 6 months after surgery.

Results The mean wait time was 5 months (SD, 3.0). Patients with lower levels of pain and better function on the WOMAC scale, or better physical function on the SF-36, had longer waiting times. The gains in function were smaller for patients who waited more than 6 months. The likelihood of perceiving a gain greater than the minimal clinically important difference was greater for patients waiting less than 3 months.

Conclusion Only pain and previous function were significant determinants of prioritizing patients on the waiting list. Suboptimal patient selection had clinical consequences in function gain that affect the quality of the clinical care.

Level of Evidence Level II, prognostic study. See the Guidelines for Authors for a complete description of levels of evidence.

The institution of one or more of the authors has received funding from grants of the Fondo de Investigación Sanitaria 98/001-01 to 03. No possible conflicts of interest (eg, funding sources for consultancies or studies of products) exist in this study.

Each author certifies that his or her institution approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained. This study was approved by the ethics review boards of the participating institutions.

The work was performed at seven teaching hospitals of the Basque Health Service.

I. Vergara (✉), A. Bilbao
Basque Foundation for Health Innovation and Research
(BIOEF), Pza. Asúa 1, Sondika, 48150 Bizkaia, Spain
e-mail: vergara@bioef.org

N. Gonzalez, J. M. Quintana
Research Unit, Galdakao-Usansolo Hospital-CIBER
epidemiología y salud pública (CIBERESP), Bizkaia, Spain

A. Escobar
Research Unit, Basurto Hospital-CIBER epidemiología y salud
pública (CIBERESP), Bizkaia, Spain

Introduction

The waiting time for surgery is a substantial health policy concern in several countries that are members of the Organization for Economic Cooperation and Development (OECD) [28]. Setting priorities in a scenario of finite resources is considered a key element for improving the equity of wait-list management by ensuring that patients with the greatest need are treated first [10, 17]. To reduce wait times, some countries, such as Canada and New Zealand, have implemented or proposed guidelines for acceptable wait times for care where defined criteria

and tools are taken in account to properly manage the time patients wait for surgery [3, 18, 21]. A review of initiatives for using priority criteria shows the benefits of their application, such as greater transparency and increased equity of the procedure, driven by clinical need and under physician control [13].

THA is an elective surgery performed for patients with a wide range of symptoms, disabilities, and sociodemographic factors. The ability of THA to improve function and reduce pain is well documented, and priority criteria for management of waiting lists for this surgery have been proposed [13, 17]. Nevertheless, these criteria often are not followed in clinical practice [19, 31], which often results in unclear wait-list management procedures. Whether waiting times influence the quality of life and health outcomes, such as pain, functional capacity, and social function, also is unclear [7].

Therefore, we asked: (1) when no prioritization criteria are implemented, what factors affect the wait time for THA, and (2) does wait time influence pain and function after THA?

Patients and Methods

We obtained data through a prospective observational study performed in seven public teaching hospitals of the Basque Health Service (Osakidetza). Osakidetza provides universal public health coverage to 2 million residents of the Basque Country, an autonomous region in northern Spain. All participating hospitals have similar populations and offer similar levels of technical performance. The participating health professionals were blinded to the study's objectives and goals. All 1495 patients on wait lists to undergo primary THA attributable to hip OA between March 1999 and March 2000 were eligible (Fig. 1). We excluded patients with severe comorbidities, such as cancer, terminal diseases, or psychiatric conditions, which rendered them unable to participate or to complete the questionnaires. We also excluded patients whose main diagnosis was not hip or knee OA, or who did not undergo surgical intervention 1 year after study enrollment. Of the 1495 patients, 991 fulfilled the inclusion criteria, and 817 (82.4%) agreed to participate in the study. The clinical records of 799 of the 817 patients (97.8%) were accessible. Information regarding waiting times was available for 695 (88.2%) patients, of whom 527 (75.8%) responded to the followup questionnaire (Fig. 1). The mean wait time was 5.07 months (SD, 2.98) (Table 1). This study was approved by the ethics review boards of the participating institutions.

We assessed all patients preoperatively and at 6-month followup, the time during which most improvements

Fig. 1 The graph shows patient recruitment and losses.

occur [12]. We collected data from the patients' hospital medical records. To retrieve data from the medical records, we developed specific data-collection questionnaires that included the length of time on a surgical wait list, sociodemographic data, main clinical diagnosis, comorbidities (all those included in the Charlson comorbidity index) [6], previous bone disorders (eg, Perthes disease, coxa vara, congenital subluxation), bone quality (defined by the classification of Singh et al. in two categories: normal, 4°, 5°, and 6°; deficient, 1°–3° [29]), and the American Society of Anesthesiologists (ASA) surgical risk [27]. Recognizing the complexity of assessing waiting time and to assure consistency of the data, we did not account for the time from when the symptoms began or the time from initiation of primary care to secondary care, but rather considered only the time spent on the wait list. All patients on the wait list for THA received a letter with a brief explanation of the study and requested their voluntary participation. Those who agreed to participate were mailed the SF-36 [30] and WOMAC questionnaires [4]. Patients who did not respond after 15 days received a reminder phone call, and those who were still nonresponders received a reminder letter including the questionnaires. Six months after surgery, patients received the same questionnaires. The followup for nonresponders was the same as described previously.

The SF-36 [30] is a generic, health-related instrument for measuring the quality of life. The 36 items cover eight

Table 1. Characteristics of the sample

Characteristics	Number of patients with valid data	Number of patients with characteristic*	Percentage of patients with characteristic*
Age, mean (SD)	695	69.04	8.85
Gender, women	695	342	49.21
Previous hip surgery	689	156	22.64
Previous bone disorder	694	393	56.63
Bone quality	695		
Normal		570	82.01
Low		125	17.99
Surgical risk	695		
Low (ASA I-III)		680	97.84
High (ASA IV)		15	2.16
Charlson comorbidity index	695		
0		403	57.99
1		192	27.63
Greater than or equal to 2		100	14.39
Months with symptoms, mean (SD)	671	46.49	60.58
Current situation	668		
Living alone		79	11.83
Living accompanied		589	88.17
Person of support during recovery	680		
No		68	10.00
Yes		612	90.00
WOMAC preintervention, mean (SD)			
Pain	692	54.23	18.71
Functional limitation	692	64.93	16.82
Stiffness	688	58.38	23.33
SF-36 preintervention, mean (SD)			
Physical function	688	21.97	20.83
Role physical	610	12.27	28.74
Bodily pain	690	31.84	25.28
General health	685	59.15	19.66
Vitality	664	42.43	23.61
Social function	687	55.75	31.59
Role emotional	604	70.06	43.23
Mental health	659	59.70	23.23
Waiting time, months, mean (SD)	695	5.07	2.98
Waiting time categorized (months)	695		
Less than 3 months		181	26.04
3 to 6 months		280	40.29
More than 6 months		234	33.67

* Data are given as frequency and percentage unless otherwise stated; SD = standard deviation.

domains (physical function, physical role, bodily pain, general health, vitality, social function, emotional role, and mental health) and can be incorporated into two physical and mental summary scales. The SF-36 scores range from 0 to 100, with a higher score indicating better health status. The SF-36 was translated into Spanish and validated in

Spanish populations. Alonso et al. described the measurement properties [1].

The WOMAC [4], a disease-specific, self-administered questionnaire was developed to study patients with hip or knee OA. It has a multidimensional scale comprising 24 items grouped into three dimensions: pain (five items),

stiffness (two items), and physical function (17 items). The final WOMAC score is determined by adding the aggregate scores for each dimension. Data are standardized to a range of values from 0 to 100, with 0 representing the best health status and 100 the worst health status. A reduction in the overall score represents an improvement. The original questionnaire is reliable, valid, and sensitive to the changes in the health status of patients with hip or knee OA [2, 18]. The WOMAC questionnaire was translated and validated in Spain [11].

For the statistical analysis, the unit of study was the patient. When two interventions were performed in one patient during the recruitment period, we selected the first THA performed. The descriptive statistics included frequency tables, means, medians, and SDs. We compared the time spent on the wait list with sociodemographic and clinical characteristics, and the baseline WOMAC and SF-36 domains using the nonparametric Wilcoxon or Kruskal-Wallis tests. We initially used univariable general linear models to identify sociodemographic and clinical factors and the baseline WOMAC and SF-36 domains associated with waiting times. Owing to the nonnormal distribution of the dependent variable “waiting time”, we performed a log transformation. After adjusting by hospital, we performed a multilevel multivariable analysis with mixed models to identify the importance of each factor. Independent variables included in the multivariable analysis were those identified as having a *p* value less than 0.15 in the univariable analysis and hospital. To interpret the previous parameters estimated, we performed exponential transformation. We used the general linear model to study the effect of waiting times on changes in WOMAC domains from preoperatively to 6 months postoperatively, adjusting for corresponding preoperative scores and clinical characteristics. For these analyses, we categorized waiting times into three groups: less than 3 months, 3 to 6 months, and greater than 6 months. We performed multivariable logistic regression models to evaluate the effect of time on a wait list with the likelihood of exceeding the minimal clinically important difference (MCID) for WOMAC domains, adjusting for corresponding baseline scores and clinical characteristics. MCID reflects the smallest change in the level of function that signifies an important improvement for the individual patient.

The MCID improvement, implying relief or improvement, in the WOMAC pain and function domains has been defined as a decrease of 30 points or more, whereas the MCID improvement in the WOMAC stiffness domain has been defined as an increase of 25 points or more [25]. We performed statistical analyses using SAS for Windows statistical software, version 9.1 (SAS Institute Inc, Cary, NC, USA).

Results

We found differences in the length of the waiting time regarding the degree of pain ($p = 0.005$), function ($p = 0.002$), and stiffness ($p = 0.016$). Patients with lower levels of severity had longer waiting times. Patients with better physical function ($p = 0.041$), physical role ($p < 0.001$), and social function ($p = 0.003$) waited longer for surgery. We observed differences ($p < 0.001$) in waiting times regarding the hospital in which the surgery was performed, with times varying from 2 months (SD, 0.92) to 6 months (SD, 3.48). The number of comorbidities and other social factors had no relationship to the wait times (Table 2). After adjusting for hospital in the multivariable model, only pain and function level remained significant in determining the waiting time. Thus, patients with the least pain and better function at the time of inclusion waited longer. After performing the exponential transformation of the beta parameter to facilitate interpretation, patients with pain levels from 0 to 40 points on the WOMAC scale spent 1.13 times longer ($p = 0.029$) on a wait list than patients with a pain level exceeding 40 points; patients with better function (0–40 points in functional limitation item of the WOMAC scale) spent 1.22 times longer ($p = 0.020$) than patients with worse function (greater than 40 points) (Table 3).

The functional capacity was poorer ($p = 0.025$) among patients who waited longer than 6 months for surgery (Table 4). This remained significant after adjusting for the baseline values of the analyzed variable and other covariables that could affect the final health outcome of the surgery, such as age and bone quality. A progressive reduction in the percentage of patients surpassing the MCID associated with the increase of waiting time was observed. Among patients waiting less than 3 months, 87 (74%) surpassed the MCID, patients waiting between 3 and 6 months had a lower MCID of 68% (146), and patients waiting more than 6 months had an even lower MCID of 52% (94) ($p < 0.001$). The likelihood of perceiving a gain greater than the MCID was lower (OR, 0.47; $p = 0.006$) for patients waiting more than 6 months when compared with the MCID for patients waiting less than 3 months. We observed no effects of other WOMAC domains.

Discussion

Wait times before surgery are a major health-policy concern. Setting priorities is considered a key element for improving the equity of wait-list management. The questions we addressed were: (1) when no prioritization criteria are implemented, what factors affect the waiting time for

Table 2. Univariate analysis of the influence of studied variables on time on the wait list

Variables	Number of patients	Time on wait list (months)			Logarithm of time on wait list p value [†]
		Mean (SD)	Median	p value*	
Previous hip surgery				0.150	0.196
No	533	4.95 (2.89)	4.47		
Yes	156	5.42 (3.25)	4.75		
Previous bone disorder				0.102	0.010
No	301	4.75 (2.43)	4.40		
Yes	393	5.31 (3.33)	4.60		
Months with symptoms				0.098	0.148
Less than 12	189	4.92 (2.96)	4.07		
12–24	168	4.73 (2.72)	4.17		
24–54	150	5.34 (3.14)	4.86		
Greater than 54	164	5.36 (3.10)	5.04		
WOMAC preintervention [‡]					
Pain (P)				0.005	0.007
0 ≤ P < 40	182	5.68 (3.30)	5.54		
40 ≤ P < 60	290	4.98 (2.78)	4.57		
60 ≤ P < 80	166	4.82 (2.95)	4.21		
80 ≤ P ≤ 100	54	4.36 (2.71)	3.68		
Functional limitation (FL)				0.002	0.002
0 ≤ FL < 40	57	6.53 (3.68)	6.74		
40 ≤ FL < 60	189	4.97 (2.74)	4.57		
60 ≤ FL < 80	305	4.96 (2.90)	4.40		
80 ≤ FL ≤ 100	141	4.83 (3.03)	4.24		
Stiffness (ST)				0.016	0.023
0 ≤ ST < 40	175	5.68 (3.27)	5.72		
40 ≤ ST < 60	153	4.97 (2.88)	4.40		
60 ≤ ST < 80	246	4.87 (2.75)	4.29		
80 ≤ ST ≤ 100	114	4.78 (3.03)	4.14		
SF-36 preintervention [‡]					
Physical functioning (PF)				0.041	0.131
0 ≤ PF < 20	423	4.90 (2.85)	4.40		
20 ≤ PF < 40	174	5.26 (3.45)	4.52		
40 ≤ PF ≤ 100	91	5.51 (2.59)	5.55		
Role physical (RP)				< 0.001	< 0.001
0 ≤ RP < 20	493	4.85 (2.87)	4.27		
20 ≤ RP < 40	38	6.25 (2.38)	6.19		
40 ≤ RP ≤ 100	79	5.87 (3.89)	5.26		
Social functioning (SF)				0.003	0.013
0 ≤ SF < 20	102	4.96 (2.89)	4.22		
20 ≤ SF < 40	155	4.59 (2.96)	4.11		
40 ≤ SF < 60	91	4.75 (2.67)	3.94		
40 ≤ SF < 80	159	5.71 (3.35)	5.59		
80 ≤ RP ≤ 100	180	5.18 (2.81)	5.24		
Hospital				< 0.001	< 0.001
1	126	4.41 (2.28)	3.91		
2	77	3.95 (3.10)	3.12		
3	31	2.08 (0.92)	1.97		
4	116	6.17 (3.48)	6.05		

Table 2. continued

Variables	Number of patients	Time on wait list (months)			Logarithm of time on wait list p value [†]
		Mean (SD)	Median	p value*	
5	138	6.09 (2.84)	5.93		
6	54	4.07 (2.69)	3.32		
7	153	5.36 (2.67)	5.13		

N = 695; SD = standard deviation; * nonparametric Wilcoxon or Kruskal-Wallis test; [†]t-test or ANOVA; [‡]only significant parameters have been included in the table.

Table 3. Multivariate analysis of selected variables on time on wait list

Variables	β parameter	p Value	Exponential of β parameter
Intercept	0.59	<0.001	
WOMAC pain			
0–40 vs. > 40	0.12	0.029	1.13
WOMAC functional limitation			
0–40 vs. > 40	0.20	0.020	1.22

* After adjustment by hospital (n = 695).

THA, and (2) does waiting time influence pain and function after THA?

Some limitations of this study were related to the study design. First, missing data are a key limitation of a prospective cohort design. Approximately 25% of patients who fulfilled the eligibility criteria and completed the baseline questionnaires did not respond to the followup questionnaires 6 months after THA. These losses occurred despite sending two mailed reminders and contacting nonresponders by telephone. We observed no differences in the relevant variables when we compared the responders and nonresponders. Thus, although a bias may be present owing to missing data, it is likely to be minor, and we believe that the results can be generalized to the entire sample. In addition, we had a relatively large sample of patients who underwent THAs, and we used well-known

and validated patient-reported outcomes (the generic, health-related, quality of life SF-36 and the specific WOMAC questionnaire). Second, there are many aspects of a patient's wait for a surgical procedure, such as the waiting time from referral by the family physician to consultation with the specialist or the time from the decision date to operate to the actual surgery. To ensure accuracy of data, we focused on the second date that was recorded as an administrative procedure. It also is possible that waiting only 6 months to assess the impact of a THA may have introduced bias. Although some studies report that improvement is seen at 6 months [8, 9, 12, 25], some suggest a longer followup period is needed [20]. Third, the WOMAC provides valuable information and is considered the correct instrument for evaluating changes in studies such as ours [15, 26]. However, it also has some inherent problems, such as with ceiling or floor effects. When working with the WOMAC and other instruments, showing clinically meaningful changes, not just statistically significant changes, is crucial. Therefore, we used the MCID of the WOMAC [25]. However, even the MCID must be used carefully and not as an absolute measure, as there are several practical problems in estimating that parameter [16]. Fourth, the patients' educational status and current job position were addressed directly through a questionnaire; therefore, the data were based on patients' answers. This is considered a potential limitation in the way these variables were assessed. Fifth, our results may not be

Table 4. Influence of waiting time on WOMAC

Variables	Change in WOMAC functional limitation score [†]		Change in WOMAC functional limitation score greater than or equal to 30 [‡]	
	β parameter	p value	OR (95% CI)	p value
Intercept	−22.36	0.006	–	–
Time on wait list (months)				
3–6 vs. less than 3	−2.27	0.268	0.72 (0.42, 1.24)	0.237
Greater than 6 vs. less than 3 months	−4.79	0.025	0.47 (0.27, 0.81)	0.006
WOMAC functional limitation preintervention	0.67	< 0.001	1.06 (1.04, 1.07)	< 0.001

OR = odds ratio; CI = confidence interval; – = not applicable; [†]multivariate general linear model considering change in WOMAC functional limitation score as dependent variable; [‡]multivariate logistic regression model considering change in WOMAC functional limitation exceeding the minimal clinically important difference.

generalizable beyond the participating hospitals. The factors affecting waiting time for THA are local findings and cannot be extrapolated to other locations. Nevertheless, a previous study [24] emphasized the hazards of not having clear, explicit criteria to apply to patients assigned to a wait list for cataract extraction. A similar problem applies to this study. However, our observations and those of Quintana et al. [24] also emphasize the detrimental effects of assigning patients to a wait list without using explicit criteria. This is an issue of quality of care and equity in patient access to health care.

Patients on wait lists for THA to treat OA had a range of waiting times, with a mean of approximately 6 months for the analyzed period; this score was close to the mean of the OECD countries [28]. Several factors have been reported to explain variations in wait times for elective surgery, including demand factors, quality of life, or pain and disability [5, 22, 32]. We found several factors related to quality of life that decreased when adjusted by other related variables, resulting in the ultimate determination of the waiting time: the degree of pain and function. Pain and function are crucial criteria in the prioritization process for THA [13]. As previously reported [17, 22], the prioritization process should be based on broader criteria. Our findings showed a lack of effect of factors, such as age, comorbidities, and other social aspects (work situation and the availability of help during recovery), which potentially could be highly relevant in determining waiting times. The outstanding differences in the waiting times recorded at the participating hospitals, given the other similarities of the hospitals, probably are related to differences in management procedures of wait lists. In those hospitals, no protocols for managing the wait lists are implemented, and surgeons use various prioritization criteria in their decision-making processes [32].

Evidence has suggested that pain increases and function deteriorates with longer wait times [22]. A wait time exceeding 12 months from consultation to surgery may adversely affect the 12-month outcomes after THA [13, 14, 24]. Based on our results, long wait times are not free from adverse effects and have irreversible effects on the results of the therapeutic intervention. Our data suggest a relevant effect of the suboptimal management of a wait list for surgery for OA. These procedures somehow have resulted in simplification of the criteria by which patients are prioritized. As a result, only pain and function level, both important factors, are considered in the decision-making process for prioritization, and many relevant factors that determine the appropriateness of the therapeutic intervention, such as those related to patient quality of life and socioeconomic factors, are disregarded. Therefore, implementation of procedures that allow selection and prioritization processes based on good practice criteria for

THA surgical wait lists would be in the best interests of patients in the participating hospitals. This study does not offer new insights to improve the prioritization criteria for this type of surgery, but provides evidence that failing to apply some prioritization procedure to surgical wait-list management has consequences for control and functional capacity. Nevertheless, at this time, various priority criteria tools have been published, such as those proposed by Quintana et al. [23] or Naylor et al. [19]. These management procedures would permit application of the most convenient treatments at the most convenient times based on patients' physical condition and socioeconomic factors. Optimal patient selection will increase the overall quality of the clinical care, the overall health outcomes of patients after THA, and the equity of the service provided.

Acknowledgments We thank I. Vidaurreta, A. Higuelmo, and A. Rodriguez for data retrieval and data entry and the Research Committee of the Galdakao Hospital. We are grateful for the support of the staff members of the various services, research, and quality units, and the medical records sections of the participating hospitals. We also acknowledge the editorial assistance provided by Lynda Charters.

References

1. Alonso J, Prieto L, Anto JM. [The Spanish version of the SF-36 Health Survey (the SF-36 health questionnaire): an instrument for measuring clinical results][in Spanish]. *Med Clin (Barc)*. 1995;104:771–776.
2. Angst F, Aeschlimann A, Steiner W, Stucki G. Responsiveness of the WOMAC osteoarthritis index as compared with the SF-36 in patients with osteoarthritis of the legs undergoing a comprehensive rehabilitation intervention. *Ann Rheum Dis*. 2001;60:834–840.
3. Arnett G, Hadorn DC; Steering Committee of the Western Canada Waiting List Project. Developing priority criteria for hip and knee replacement: results from the Western Canada Waiting List Project. *Can J Surg*. 2003;46:290–296.
4. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol*. 1988;15:1833–1840.
5. Birrell F, Johnell O, Silman A. Projecting the need for hip replacement over the next three decades: influence of changing demography and threshold for surgery. *Ann Rheum Dis*. 1999; 58:569–572.
6. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40: 378–383.
7. Conner-Spady BL, Johnston GH, Sanmartin C, McGurran JJ, Noseworthy TW; Saskatchewan Surgical Care Network/Western Canada Waiting List Project Research and Evaluation Working Group Committee. A bird can't fly on one wing: patient views on waiting for hip and knee replacement surgery. *Health Expect*. 2007;10:108–116.
8. Davis AM, Agnidis Z, Badley E, Kiss A, Waddell JP, Gross AE. Predictors of functional outcome two years following revision hip arthroplasty. *J Bone Joint Surg Am*. 2006;88:685–691.

9. Dawson J, Fitzpatrick R, Murray D, Carr A. The problem of 'noise' in monitoring patient-based outcomes: generic, disease-specific and site-specific instruments for total hip replacement. *J Health Serv Res Policy*. 1996;1:224–231.
10. Edwards RT, Boland A, Wilkinson C, Cohen D, Williams J. Clinical and lay preferences for the explicit prioritisation of elective waiting lists: survey evidence from Wales. *Health Policy*. 2003;63:229–237.
11. Escobar A, Quintana JM, Bilbao A, Azkarate J, Guenaga JJ. Validation of the Spanish version of the WOMAC questionnaire for patients with hip or knee osteoarthritis: Western Ontario and McMaster Universities Osteoarthritis Index. *Clin Rheumatol*. 2002;21:466–471.
12. Fortin PR, Clarke AE, Joseph L, Liang MH, Tanzer M, Ferland D, Phillips C, Partridge AJ, Bélisle P, Fossel AH, Mahomed N, Sledge CB, Katz JN. Outcomes of total hip and knee replacement: preoperative functional status predicts outcomes at six months after surgery. *Arthritis Rheum*. 1999;42:1722–1728.
13. Fortin PR, Penrod JR, Clarke AE, St-Pierre Y, Joseph L, Belisle P, Liang MH, Ferland D, Phillips CB, Mahomed N, Tanzer M, Sledge C, Fossel AH, Katz JN. Timing of total joint replacement affects clinical outcomes among patients with osteoarthritis of the hip or knee. *Arthritis Rheum*. 2002;46:3327–3330.
14. Hajat S, Fitzpatrick R, Morris R, Reeves B, Rigge M, Williams O, Murray D, Gregg P. Does waiting for total hip replacement matter? Prospective cohort study. *J Health Serv Res Policy*. 2002;7:19–25.
15. Hawker G, Melfi C, Paul J, Green R, Bombardier C. Comparison of a generic (SF-36) and a disease specific (WOMAC) (Western Ontario and McMaster Universities Osteoarthritis Index) instrument in the measurement of outcomes after knee replacement surgery. *J Rheumatol*. 1995;22:1193–1196.
16. Hays RD, Woolley JM. The concept of clinically meaningful difference in health-related quality-of-life research: how meaningful is it? *Pharmacoeconomics*. 2000;18:419–423.
17. McCormick AD, Parry BR. Waiting time thresholds: are they appropriate? *ANZ J Surg*. 2003;73:926–928.
18. McConnell S, Kolopack P, Davis AM. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC): a review of its utility and measurement properties. *Arthritis Rheum*. 2001;45:453–461.
19. Naylor CD, Williams JJ. Primary hip and knee replacement surgery: Ontario criteria for case selection and surgical priority. *Qual Health Care*. 1996;5:20–30.
20. Nilsson AK, Lohmander LS. Age and waiting time as predictors of outcome after total hip replacement for osteoarthritis. *Rheumatology (Oxford)*. 2002;41:1261–1267.
21. Noseworthy TW, McGurran JJ, Hadorn DC; Steering Committee of the Western Canada Waiting List Project. Waiting for scheduled services in Canada: development of priority-setting scoring systems. *J Eval Clin Pract*. 2003;9:23–31.
22. Ostendorf M, Buskens E, van Stel H, Schrijvers A, Marting L, Dhert W, Verbout A. Waiting for total hip arthroplasty: avoidable loss in quality time and preventable deterioration. *J Arthroplasty*. 2004;19:302–309.
23. Quintana JM, Aróstegui I, Azkarate J, Goenaga JJ, Elexpe X, Letona J, Arcelay A. Evaluation of explicit criteria for total hip joint replacement. *J Clin Epidemiol*. 2000;53:1200–1208.
24. Quintana JM, Escobar A, Arostegui I, Bilbao A, Azkarate J, Goenaga I, Arenaza JC. Health-related quality of life and appropriateness of knee or hip joint replacement. *Arch Intern Med*. 2006;166:200–226.
25. Quintana JM, Escobar A, Bilbao A, Arostegui I, Lafuente I, Vidaurreta I. Responsiveness and clinically important differences for the WOMAC and SF-36 after hip joint replacement. *Osteoarthritis Cartilage*. 2005;13:1076–1083.
26. Salaffi F, Carotti M, Grassi W. Health-related quality of life in patients with hip or knee osteoarthritis: comparison of generic and disease-specific instruments. *Clin Rheumatol*. 2005;24:29–37.
27. Schneider AJ. Assessment of risk factors and surgical outcome. *Surg Clin North Am*. 1983;63:1113–1126.
28. Siciliani L, Hurst J. Tackling excessive waiting times for elective surgery: a comparative analysis of policies in 12 OECD countries. *Health Policy*. 2005;72:201–215.
29. Singh M, Nagrath AR, Maini PS. Changes in trabecular pattern of the upper end of the femur as an index of osteoporosis. *J Bone Joint Surg Am*. 1970;52:457–467.
30. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36), I: conceptual framework and item selection. *Med Care*. 1992;30:473–483.
31. Woolhead GM, Donovan JL, Chard JA, Dieppe PA. Who should have priority for a knee joint replacement? *Rheumatology (Oxford)*. 2002;41:390–394.
32. Wright JG, Coyte P, Hawker G, Bombardier C, Cooke D, Heck D, Dittus R, Freund D. Variation in orthopedic surgeons' perceptions of the indications for and outcomes of knee replacement. *CMAJ*. 1995;152:687–697.