Outcomes of total joint arthroplasty in academic versus community hospitals

Rajiv Gandhi, MS, MD*
Peggy Tso, BHSc*
Aileen Davis, PhD†
Nizar N. Mahomed, MD, ScD*

From the *Division of Orthopedic Surgery, Toronto Western Hospital and University of Toronto, and the †Division of Health Care and Outcomes Research and Arthritis Community Research and Evaluation Unit, Toronto Western Research Institute, and the Department of Health Policy, Management and Evaluation and Rehabilitation Science, University of Toronto, Toronto, Ont.

Accepted for publication
Sept. 3, 2008

Correspondence to:
Dr. R. Gandhi
Department of Orthopaedic Surgery
Toronto Western Hospital
399 Bathurst St. East Wing, 1-439
Toronto ON M5T 2S8
fax 416 603-3437
rajiv.gandhi@uhn.on.ca

Background: Most joint-replacement surgeries are currently performed in community hospitals. We sought to determine whether the functional outcomes of joint-replacement surgery differ between academic and community hospitals.

Methods: We surveyed 471 patients for demographic data, Western Ontario McMaster University Osteoarthritis Index (WOMAC) scores and Medical Outcomes Study Short Form 36 (SF-36) scores at baseline and at 3-month and 1-year follow-up. We assessed patient satisfaction at 1 year with a single survey question.

Results: Community hospital patients (n = 269) were significantly older and had greater comorbidity than academic hospital patients (n = 202; $p < 0.05$). We found no difference in WOMAC scores, SF-36 scores or in patient satisfaction between hospitals at 1-year follow-up ($p > 0.05$). Adjusted analysis showed that patients undergoing surgery in an academic or community hospitals have the same functional outcomes.

Conclusion: There is no significant difference in the functional outcomes of joint-replacement surgery between academic and community hospitals. Further work will involve evaluating cost of care differences between these types of hospitals.

Contexte : La plupart des arthroplasties sont actuellement pratiquées dans des hôpitaux communautaires. Nous avons cherché à déterminer si les résultats fonctionnels de l'arthroplastie diffèrent entre les hôpitaux universitaires et les hôpitaux communautaires.

Méthodes : Nous avons sondé 471 patients pour obtenir leurs données démographiques, les résultats selon l'indice Western Ontario et McMaster sur l'arthrose (WOMAC) et les résultats du questionnaire abrégé 36 (SF-36) de l'étude sur les résultats médicaux au départ et au suivi à 3 mois et à 1 an. Nous avons évalué la satisfaction des patients à 1 an en leur posant une seule question.

Résultats : Les patients des hôpitaux communautaires (n = 269) étaient beaucoup plus âgés et avaient plus de comorbidités que ceux des hôpitaux universitaires (n = 202; $p < 0{,}05$). Nous n'avons constaté aucune différence au niveau des scores WOMAC et SF-36, de même qu'au niveau de la satisfaction des patients entre les hôpitaux au suivi à 1 an ($p > 0{,}05$). L'analyse rajustée a montré que les patients qui ont subi leur intervention dans un hôpital universitaire ou communautaire ont les mêmes résultats fonctionnels.

Conclusion : Il n'y a pas de différences importantes au niveau des résultats fonctionnels de l'arthroplastie pratiquée dans les hôpitaux universitaires et les hôpitaux communautaires. Une étude plus poussée consistera à évaluer les différences au niveau du coût des soins entre ces types d'hôpitaux.

Total joint arthroplasty (TJA) has been shown to be an effective procedure for relieving pain and improving quality of life.[1–3] Literature from both the United States and Canada projects that the number of joint replacements being performed will continue to rise owing to an aging population and a greater proportion of young patients who are undergoing these operations.[4–6]

Most joint-replacement surgeries are currently being performed in community hospitals, and therefore it is important to evaluate patient outcomes from these hospitals.[7,8] Presently, there are few published reports on joint-

replacement surgery outcomes from nonteaching hospitals.[9–13] Moreover, there are few studies evaluating the costs and resource utilization for TJAs performed at academic and community hospitals.[14]

The primary goal of our study was to determine whether patient-reported functional outcomes and satisfaction after hip- and knee-replacement surgery differ between academic and community hospitals.

Methods

We performed a case–control study from previously and prospectively collected data to compare patient outcomes for joint-replacement surgery after patient participation in a home-based or inpatient rehabilitation program.[15] The original study collected data from 10 randomly selected hospitals across the Greater Toronto Area (GTA; 5 academic and 5 community hospitals). All hospitals were considered to be high-volume centres, performing at least 500 hip- or knee-replacement surgeries each year. All surgeons from the academic hospitals had arthroplasty fellowship training, and all surgeons from all 10 hospitals had been practising in the field for 5 years or more. The study involved patients aged 19 years or older who were undergoing primary hip- or knee-replacement surgery.

We recorded baseline demographic data, including age, sex, diagnosis and comorbidity; comorbidity was defined by the 14 categories of chronic illness adapted from the Cumulative Illness Rating Scale.[16,17] The scale covers the domains of cardiac, vascular, hematological, respiratory, otorhinolaryngological and ophthalmological, upper gastrointestinal, lower gastrointestinal, hepatic and pancreatic, renal, genitourinary, musculoskeletal and tegmental, neurologic, endocrine, metabolic and breast, and psychiatric systems. We assessed patients' functional status and quality of life preoperatively and at 3 months and 1 year postsurgery based on the Western Ontario McMaster University Osteoarthritis Index (WOMAC)[18] and the Medical Outcomes Study Short Form 36 (SF-36),[19–21] respectively.

We assessed patient satisfaction at 1 year postsurgery with a single question scored on a 4-point Likert scale: "How satisfied were you with the results of your surgery?" We collapsed responses of "very satisfied" and "somewhat satisfied" into a "satisfied" group, and we collapsed responses of "somewhat dissatisfied" and "very dissatisfied" into a "not satisfied" group.

We compared continuous data such as age, body mass index (BMI), comorbidities, SF-36 and WOMAC scores between groups using Student *t* tests. Means and standard deviations are reported for all continuous variables. Categorical data such as sex and satisfaction are reported with frequencies, and we compared groups using the Fisher exact test.

We performed multivariate linear regression modelling to determine the impact of hospital status on 1-year WOMAC and SF-36 scores. We created separate models for each dependent variable; the relevant covariates entered in the models were age, sex, BMI, comorbidities and the relevant preoperative score.

A minimally clinically significant change on the WOMAC score has been defined as a change of 7.4 points with a standard deviation (SD) of 14 by Bellamy and colleagues.[22] A sample size of 471 patients in our study, assuming a type I error rate of 5%, yielded 99% power to detect this difference.

We performed all statistical analyses with SPSS version 13.0 (SPSS Inc.). Beta coefficients for regression modelling and their 95% confidence intervals (CI) are reported. All reported *p* values are 2-tailed with an α of 0.05.

Results

In our study, there were 202 patients from the academic hospitals and 269 patients from the community hospitals. Three-month follow-up data were available for 384 of 471 (81.5%) patients. In total, 228 of the 384 (75.1%) participants who had complete 3-month follow-up data also had complete 1-year follow-up data.

Patients with complete data did not differ significantly from those with incomplete data for age, sex, comorbidity, baseline total WOMAC or total SF-36 scores.

The patients from the community hospitals were older by 3.2 years and had significantly greater comorbidities than the patients from the academic hospitals ($p < 0.05$) There were no differences in sex distribution between groups (Table 1).

We found no differences in mean WOMAC and SF-36 scores preoperatively, at 3 months or at 1 year postsurgery between the 2 groups of patients (Table 2). Similarly, we found no significant difference in patient satisfaction between patients at academic and community hospitals at 1 year, with 95.3% and 95.8% reporting satisfaction, respectively (Table 2).

Linear regression modelling showed that hospital status was not a significant predictor of a better 1-year total WOMAC scores or SF-36 scores adjusting for age, sex, comorbidity and the relevant preoperative score (Table 3).

Table 1. Comparison of demographic characteristics of patients who underwent hip- or knee-replacement surgery at an academic or community hospital

Characteristic	Academic, *n* = 202	Community, *n* = 269	*p* value
Age, mean (SD) yr	65.1 (11.5)	68.3 (9.2)	0.001
Male sex, %	59	64	0.18
Comorbidity, mean (SD) no.	1.1 (1.2)	1.8 (1.5)	< 0.001
Rheumatoid arthritis, %	7.5	8.9	0.53

SD = standard deviation.

Discussion

The results of our study show that there is no difference in functional outcomes, quality of life or satisfaction between patients undergoing hip- or knee-replacement surgery in an academic institution versus a community hospital in the GTA. This finding is consistent with that of others who have shown that clinical outcomes of joint-replacement surgery are no different between academic and community hospitals.[11–13]

Table 2. Comparison of preoperative, 3-month and 1-year WOMAC and SF-36 scores, and 1-year satisfaction scores of patients who underwent hip- or knee-replacement surgery at an academic or community hospital

Test; time	Hospital; mean (SD) score		
	Academic, *n* = 202	Community, *n* = 269	*p* value
WOMAC			
Preoperative			
Total	46.2 (16.9)	45.9 (16.5)	0.83
Function	35.9 (13.6)	35.6 (13.4)	0.77
Pain	10.3 (3.7)	10.3 (4.0)	0.85
3-month follow-up			
Total	19.5 (13.7)	20.2 (14.1)	0.61
Function	15.9 (11.0)	16.4 (11.3)	0.63
Pain	3.6 (3.5)	3.8 (3.3)	0.61
1-year follow-up			
Total	15.6 (13.2)	14.4 (13.0)	0.50
Function	12.7 (10.4)	12.1 (10.4)	0.64
Pain	2.9 (3.4)	2.4 (3.0)	0.20
SF-36			
Preoperative			
Total	85.3 (14.0)	83.0 (15.5)	0.13
Physical component	29.9 (9.0)	31.9 (7.9)	0.02
Mental component	55.4 (11.3)	51.1 (12.6)	0.001
3-month follow-up			
Total	93.1 (14.6)	92.6 (15.4)	0.79
Physical component	38.2 (10.2)	39.2 (9.3)	0.28
Mental component	54.9 (10.2)	53.4 (11.1)	0.18
1-year follow-up			
Total	96.5 (14.7)	97.4 (16.1)	0.64
Physical component	42.2 (9.9)	43.2 (10.1)	0.43
Mental component	54.3 (9.3)	54.2 (10.6)	0.95
Satisfied with surgery, %	95.3	95.8	0.83

SD = standard deviation; SF-36 = Medical Outcomes Study Short Form 36;[19–21] WOMAC = Western Ontario McMaster University Osteoarthritis Index.[18]

Table 3. Linear regression modelling reporting β coefficients for predicting 1-year WOMAC scores

Variable	β coefficient (95% CI)	*p* value
Hospital type	0.04 (–3.49 to 3.57)	0.98
Sex	2.63 (–1.11 to 6.38)	0.17
Comorbidity	–0.06 (–1.46 to 1.33)	0.93
Age	0.06 (–0.12 to 0.24)	0.53
Preoperative WOMAC score	0.22 (0.11 to 0.34)	< 0.001

CI = confidence interval; WOMAC = Western Ontario McMaster University Osteoarthritis Index.[18]

The costs of care have been shown to be higher in teaching hospitals than in nonteaching hospitals.[23–26] One group reported a 22% increase in resource consumption for joint-replacement surgery in an academic hospital versus a nonacademic hospital.[14] One hypothesis proposed to explain these increased costs is that the patients treated in an academic centre have greater medical comorbidities.[25] Our study demonstrated the opposite finding, in that the patients from the community hospitals had greater medical comorbidities than the patients from the academic hospitals.

One of the strengths of our paper is that we collected data from 10 different hospitals (5 academic and 5 community), which increases the external validity of our study. One potential limitation of our study is that the 1-year response rate was only 228 of 384 (75.1%), despite 2 follow-up phone calls from research staff. However, we found no difference between responders and nonresponders in terms of age, sex, comorbidity or baseline WOMAC or SF-36 scores, and we believe our conclusions remain valid and generalizable.

In conclusion, we have shown that there are no differences in functional outcomes for joint-replacement surgery when performed in academic or community hospitals. Future work will be directed toward understanding the differences in resource utilization between these types of hospitals with the goal of improving the efficiency of care while maximizing resident education, clinical outcomes and patient satisfaction.

Competing interests: None declared.

Contributors: All authors designed the study. Drs. Davis and Mahomed acquired the data, which all authors analyzed. Dr. Gandhi and Ms. Tso wrote the article, which Drs. Davis and Mahomed reviewed. All authors approved publication.

References

1. Shields RK, Enloe LJ, Leo KC. Health related quality of life in patients with total hip or knee replacement. *Arch Phys Med Rehabil* 1999;80:572-9.

2. Jones CA, Voaklander DC, Johnston DW, et al. Health related quality of life outcomes after total hip and knee arthroplasties in a community based population. *J Rheumatol* 2000;27:1745-52.

3. Hawker G, Wright J, Coyte P, et al. Health-related quality of life after knee replacement. *J Bone Joint Surg Am* 1998;80:163-73.

4. Kurtz S, Ong K, Lau E, et al. Projections of primary and revision hip and knee arthroplasty in the United States 2006 to 2030. *J Bone Joint Surg Am* 2007;89:780-5.

5. Canadian Institute for Health Information (CIHI). *Canadian Joint Replacement Registry (CJRR) total hip and knee replacements in Canada* 2003. Available: http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=media_22jan2003_e (accessed 2009 Aug 24).

6. Jain NB, Higgins LD, Ozumba D, et al. Trends in epidemiology of knee arthroplasty in the United States, 1990-2000. *Arthritis Rheum* 2005;52:3928-33.

7. Coyte PC, Wright JG, Hawker GA, et al. Waiting times for knee-replacement surgery in the United States and Ontario. *N Engl J Med* 1994;331:1068-71.

8. Coyte PC, Hawker G, Croxford R, et al. Rates of revision knee replacement in Ontario, Canada. *J Bone Joint Surg Am* 1999;81:773-82.

9. Perkins TR, Gunckle W. Unicompartmental knee arthroplasty: 3- to 10-year results in a community hospital setting. *J Arthroplasty* 2002;17:293-7.

10. Rajasekhar C, Das S, Smith A. Unicompartmental knee arthroplasty. 2- to 12-year results in a community hospital. *J Bone Joint Surg Br* 2004;86:983-5.

11. Robinson RP. The impact of resident teaching on total hip arthroplasty. *Clin Orthop Relat Res* 2007;465:196-201.

12. Thompson R, Kane RL, Gromala T, et al. Complications and short-term outcomes associated with total hip arthroplasty in teaching and community hospitals. *J Arthroplasty* 2002;17:32-40.

13. Woolson ST, Kang MN. A comparison of the results of total hip and knee arthroplasty performed on a teaching service or a private practice service. *J Bone Joint Surg Am* 2007;89:601-7.

14. Lavernia CJ, Sierra RJ, Hernandez RA. The cost of teaching total knee arthroplasty surgery to orthopaedic surgery residents. *Clin Orthop Relat Res* 2000;380:99-107.

15. McGlasson R. *Total Joint Network: an integrated model of care for total joint replacement*. Toronto (ON): Ministry of Health and Long-Term Care; July 2006.

16. Linn BS, Linn MW, Gurel L. Cumulative illness rating scale. *J Am Geriatr Soc* 1968;16:622-6.

17. Miller MD, Paradis CF, Houck PR, et al. Rating chronic medical illness burden in geropsychiatric practice and research: application of the Cumulative Illness Rating Scale. *Psychiatry Res* 1992;41:237-48.

18. Bellamy N, Buchanan WW, Goldsmith CH, et al. 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;15:1833-40.

19. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992;30:473-83.

20. McHorney CA, Ware JE Jr, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Med Care* 1993;31:247-63.

21. McHorney CA, Ware JE Jr, Lu JF, et al. The MOS 36-item Short-Form Health Survey (SF-36): III. Tests of data quality, scaling assumptions, and reliability across diverse patient groups. *Med Care* 1994;32:40-66.

22. Bellamy N, Kean WF, Buchanan WW, et al. Double blind randomized controlled trial of sodium meclofenamate (Meclomen) and diclofenac sodium (Voltaren): post validation reapplication of the WOMAC Osteoarthritis Index. *J Rheumatol* 1992;19:153-9.

23. Sloan FA, Feldman RD, Steinwald B. Effects of teaching on hospital costs. *J Health Econ* 1983;2:1-28.

24. Sloan FA, Valvona J. Uncovering the high cost of teaching hospitals. *Health Aff (Millwood)* 1986;5:68-85.

25. Iezzoni LI, Shwartz M, Moskowitz MA, et al. Illness severity and costs of admissions at teaching and nonteaching hospitals. *JAMA* 1990;264:1426-31.

26. Zimmerman JE, Shortell SM, Knaus WA, et al. Value and cost of teaching hospitals: a prospective, multicenter inception cohort study. *Crit Care Med* 1993;21:1432-42.