

# Variations in treatment of femoral neck fractures in Alberta

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**Objectives:** To examine, in the province of Alberta, temporal trends, regional variations in treatment options and in-hospital death rates after a femoral neck fracture. **Design:** A retrospective cohort study. **Patients:** Six years' data were abstracted from the Alberta Morbidity File, the Alberta Health Stakeholder File and the Alberta Health Care Claims File. Patients were included if they were Alberta residents, aged 65 years or older, had sustained a femoral neck fracture and had undergone internal fixation, hemiarthroplasty or total hip arthroplasty. **Main outcome measures:** Death rates, arthroplasty rates and hospital stay. **Results:** In-hospital death rates were similar across hospitals, with risks being higher for men, patients aged 80 years or older and those with more comorbid conditions. Arthroplasty rates varied from 58% to 77% among hospitals, and hospital stays associated with arthroplasty were significantly longer than those associated with internal fixation. The chance of undergoing arthroplasty varied from hospital to hospital by gender and by the number of comorbid conditions. **Conclusion:** Regional variations suggest lack of agreement among Alberta's surgeons as to how best to treat femoral neck fractures.

**Objectifs :** Analyser, dans la province de l'Alberta, les tendances temporelles, les variations des options de traitement selon les régions et les taux de mortalité à l'hôpital après une fracture du col du fémur. **Conception :** Étude de cohorte rétrospective. **Patients :** On a abrégé six années de données tirées de l'Alberta Morbidity File, de l'Alberta Health Stakeholder File et de l'Alberta Health Care Claims File. Les patients ont été inclus s'ils étaient résidents de l'Alberta, s'ils avaient 65 ans ou plus, s'ils avaient subi une fracture du col du fémur et s'ils avaient subi une réduction interne, une hémiarthroplastie ou une arthroplastie totale de la hanche. **Principales mesures de résultats :** Taux de mortalité, taux d'arthroplastie et durée du séjour à l'hôpital. **Résultats :** Les taux de mortalité à l'hôpital étaient semblables dans tous les hôpitaux, les risques étant plus élevés chez les hommes, les patients âgés de 80 ans ou plus et ceux qui avaient une comorbidité. Les taux d'arthroplastie ont varié de 58 % à 77 % entre les hôpitaux et les séjours à l'hôpital associés à une arthroplastie ont été beaucoup plus longs que ceux qui ont découlé d'une réduction interne. La chance de subir une arthroplastie a varié d'un hôpital à l'autre selon le sexe et le nombre de problèmes de comorbidité. **Conclusion :** Les variations régionales indiquent que les chirurgiens de l'Alberta ne s'entendent pas sur la meilleure façon de traiter les fractures du col du fémur.

Femoral neck fractures make up approximately half of the estimated 1.26 million hip fractures occurring annually worldwide.<sup>1</sup> Unless the patient is very ill, a femoral neck fracture is repaired surgically. The type of procedure depends, in part,

on whether the fracture is displaced or not. For an undisplaced fracture, internal fixation is recommended. To repair a displaced fracture, patients usually undergo hip arthroplasty — either a hemiarthroplasty (HA) or a total hip arthroplasty (THA). Ap-

proximately 64% of femoral neck repairs involve hip arthroplasties, 90% of these being hemiarthroplasties and the remaining 10% being total hip arthroplasties.<sup>1</sup> It is generally assumed that better outcomes result from arthroplasty than from internal

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fixation, although the superiority of one treatment over another has not been clearly documented.<sup>2</sup> In fact, one outcome study comparing internal fixation with hip arthroplasty reported that mobility, institutionalization, perceived health, hospital readmission and risk of death were similar for patients in both treatment groups, and, overall, arthroplasty patients were not doing well 1 year after their hip fracture.<sup>3</sup> Recently, however, the trend has been toward more arthroplasties.

With a lack of clear criteria on which to base a decision, a surgeon's preference for HA or internal fixation to repair a displaced femoral neck fracture may depend largely upon the importance the surgeon places on reoperation or function.<sup>4</sup> This has led to large regional variations in procedures used. In Europe, percentages of arthroplasty repair for femoral neck fracture ranged from almost zero in 2 Swedish hospitals<sup>5</sup> to over 80% in Rotterdam, The Netherlands,<sup>5</sup> and Toulouse, France.<sup>6</sup> One Canadian study reported a huge variation in the proportions of femoral neck fractures treated by HA (9%–83%) and total hip replacement (0.5%–38%) across counties in Ontario, with most of the variation being attributable to individual hospitals.<sup>7</sup>

Femoral neck fractures have been referred to as the "unresolved orthopedic fracture."<sup>8</sup> Compared with internal fixation, arthroplasty is more costly and requires a longer operating time. Justifying these additional costs demands evidence linking arthroplasty with improved patient-defined outcomes such as function, health perception and pain.

This study compares arthroplasty rates for femoral neck fractures across both time and hospitals and investigates the extent to which treatment variations can be explained by patient and physician characteristics. Understanding current treatment variations is a first step to developing a treatment protocol that will result in the best care for the hip fracture patient.

## Methods

### *Selection of participants and variables*

Data examined in this study were collected by Alberta Health for 6 fiscal years, 1993/94–1998/99. Alberta is divided into 17 regions, and each region is responsible for the delivery of health services to its residents. Apart from the provider information, all data were abstracted from the Alberta Morbidity File, which contains information on each hospital discharge. For this study, we obtained the following patient information from this database: sex, date of birth, regional health area of residence, date of hospital admission, date of hospital discharge and whether or not the patient died in the hospital. Based on the the clinical modification of the International Classification of Diseases, 9th revision (ICD-9CM) codes, we identified patients who had a femoral neck fracture and the number of serious medical conditions (comorbidities) for each study participant from hospital separation records containing 16 diagnosis fields. A patient was identified as having a serious medical condition if the hospital separation contained one of the diagnoses found to have a significant impact on health status.<sup>9,10</sup> For each patient, the number of comorbidities was the total number of serious medical conditions on the hospital separation record.

Another variable collected from this file was the surgical procedure performed in repairing the hip fracture, based on the ICD procedure codes. Finally, the following information from this file was used to link all the patient information to the provider information: a unique patient identification number (i.e., the Anonymous Stakeholder Number [ASN]), the date of the procedure and a hospital identification number, which indicated the hospital in which the procedure was performed.

To contribute to our understand-

ing of the variations in rates, we included some physician characteristics. The provider information (surgeon's year of graduation, workload and sex) was abstracted from the Alberta Health Care Claims file and the Alberta Health Stakeholder file, and was linked to the patient information via the ASN of the patient, hospital identification number and date of procedure. Unfortunately, the health provider information was not available for 1993/94 and was incomplete for the other study years because of problems with linking the data.

The codes used to identify patients suffering from a femoral neck fracture were those used in similar studies:<sup>7,11</sup> any patient with a discharge diagnosis corresponding to the ICD-9CM categories 820–820.2 was eligible for inclusion in the study. A diagnosis of hip fracture has been shown to be accurately coded in hospital separation abstracts.<sup>12</sup> Although these codes do not distinguish between displaced and undisplaced femoral neck fractures, internal fixation is the generally accepted treatment for an undisplaced femoral neck fracture.

Inpatient procedure codes of these patients were classified into THA (code 8151), partial hip arthroplasty (code 8152) and internal fixation (codes 7855 — no reduction, 7915 — closed reduction and 7935 — open reduction), according to the ICD procedures. To compensate for the possibility of an HA being miscoded as a THA, procedure codes 8151 and 8152 were combined to form the arthroplasty group.<sup>13</sup> Patients included in this study were residents of Alberta and had one of the discharge diagnoses and inpatient procedures of interest. Patients were excluded if their treatment did not include one of these procedures.

Although internal fixation is generally recommended for patients under the age of 65 years, the appropriate treatment for patients between the ages of 65 and 85 years is debatable.<sup>14</sup> For this reason, we confined

our analysis to patients aged 65 years and over.

### Statistical analysis

In comparing arthroplasty rates over time, age- and sex-adjusted provincial rates were calculated for each year, employing direct standardization using the 1998/99 fiscal year as the standard. Because some patients underwent more than 1 procedure during the study period, the denominator of the rate could consist of the number of procedures (procedure-based) or the number of patients (patient-based). Since revisions were coded differently, these patients were treated as having had new hip fractures. This prompted us to calculate procedure-based arthroplasty rates.

To attain stable estimates when examining variations in arthroplasty and death rates across hospitals, data for the entire study period (1993–1999) were combined, and the analysis included only those hospitals performing hip surgeries over all 6 years. To assess whether age- and sex-adjusted arthroplasty or death rates varied significantly across hospitals, each hospital's rate was compared to the overall combined rate. The combined rate was a weighted average over hospitals selected, with the weight being the inverse variance of the estimated rate for each hospital.

To ensure stable estimates of arthroplasty rates among providers, surgeons performing at least 20 hip repair procedures over the 6 years were included in the analysis. A cut-off of 20 was chosen in order to retain at least 85% of the procedure information for each hospital. To compare rates across all physicians, a  $T^2$  statistic was calculated.<sup>15</sup> The variation in rates by the surgeon's year of graduation was examined using an  $F$  statistic,<sup>15</sup> dividing the year of graduation into 3 groups: 1975 or earlier, 1976 to 1983 and 1984 or later. We also analyzed the arthroplasty rates by volume of surgeries. Volume was categorized according to the median

value as low ( $\leq 50$  procedures) or high ( $> 50$  procedures), and arthroplasty rates were categorized as low ( $\leq 71\%$  [the provincial rate]) or high ( $> 71\%$ ). A  $\chi^2$  test then compared the association of these 2 variables.

The dependent variables examined included: whether or not arthroplasty (HA and THA) was performed and whether or not the patient died in the hospital. The input variables we considered were many of those examined in previous studies and found to be significantly associated with the dependent variables.<sup>7,11</sup> Although the association of these variables with the death rate may be clear, their relationship to arthroplasty may be less obvious. Research has shown that bone quality influences a surgeon's decision regarding arthroplasty,<sup>16</sup> and to some extent both age and sex are proxies for bone quality. The number of medical conditions would be associated with function and rehabilitation potential, other concerns when considering a hip arthroplasty.<sup>4</sup> The continuous input variables were categorized on the basis of graphical analysis as follows: the patient's age was classified into 2 groups: younger than 80 years or 80 years and older; the number of serious medical conditions was dichotomized into 2 or fewer versus 3 or more serious medical conditions.

Although length of hospital stay was not included as an input variable, we considered it an outcome of interest in this study and examined the association with the dependent variables. Because the average hospital stay was 15 days, length of hospital stay was divided into 15 days or fewer days versus 16 days or more.

Using the SAS Logistic Analysis (version 7, SAS Institute, Cary, NC), multiple logistic regression was used to examine the odds of death and the odds of having a hip arthroplasty on the included independent variables (age, gender, and number of serious medical conditions). For the arthroplasty analysis, 10 separate logistic regressions were done, 1 for each hospital, and the results were compared

to an overall value to assess the consistency of risk estimates across hospitals. For the mortality analysis, 8 logistic regression analyses were done: data from hospitals G, I and J had to be combined due to low rates. Individual logistic regressions could not be done on these 3 hospitals because they had too few outcomes. The results from the 8 regressions were then compared to an overall risk estimate.

## Results

### Temporal trends

Over the fiscal years 1993/94 to 1998/99, 5296 older Albertans sustained a total of 5476 femoral neck fractures. Of these, 4475 seniors (associated with 4593 procedures) were included in the study because they underwent at least 1 of the treatment procedures under consideration. Their average age was 81 years and 3284 (73%) were women. The average age of the 821 excluded patients was 81 years and 597 (73%) of them were women.

Overall, 231 (5.2%) of the 4475 seniors died in the hospital. The provincial in-hospital age- and sex-adjusted death rate showed little variation between 1993 and 1999, fluctuating between 4% and 6% annually (Table 1).

Of the 4593 hip repair procedures examined, 3264 (71%) were arthroplasties. After adjusting for age and sex, the proportion of arthroplasties performed in Alberta remained fairly stable between 1993 and 1999, ranging from 68% (1994/95) to 73% (1996/97–1997/98). Although there was some variation in the proportion of men who underwent hip arthroplasty each year, there was no evidence of a time trend. Between 68% and 70% of women underwent a hip arthroplasty each year.

### Preliminary analysis

All of the patient characteristics were assessed for their association

with in-hospital death and hip arthroplasty (Table 2). Men, those aged 80 years or older, and seniors with 3 or more comorbidities appeared to be at increased risk of in-hospital death. Arthroplasties were more commonly performed in older patients and those with 3 or more medical conditions.

There was a significant association between length of hospital stay and arthroplasty: a larger proportion of patients with a long hospital stay underwent arthroplasty than internal fixation ( $p < 0.001$ ). We did not compare length of stay by hospital because of differences in health care delivery among regions. For example, in regions with a subacute care system, patients are usually discharged to a subacute care facility after 9 to 10 days. In regions without a subacute care system, patients had longer hospital stays. Mortality and length of hospital stay appeared to be unrelated (Table 2).

**Variation among hospitals**

Although 18 hospitals performed at least 1 hip procedure between 1993 and 1999, this analysis was restricted to the 10 hospitals in which hip repairs were done in all of the 6

years (Table 3). Combined, these 10 hospitals performed 92.4% (4276) of all procedures under consideration in this study.

**Arthroplasty**

Six-year age- and sex-adjusted arthroplasty rates were tabulated both by individual hospital and combined (72%): 1 hospital's rate was high (76.6%), and 3 other hospitals performed fewer arthroplasties than

expected (ranging from 57.8% to 60.8%) (Table 1). To investigate whether older patients, women and those with more comorbidities were equally likely to undergo hip arthroplasties in each hospital, we compared each hospital's rate with an overall rate. With respect to comorbidity, those with 3 or more medical conditions were more likely to undergo a hip arthroplasty, and the chances were higher at Hospital A (odds ratio [OR] = 2.4) than the

**Table 2**  
**Characteristics of Patients Who Underwent Hemiarthroplasty (HA) and Total Hip Arthroplasty (THA) (1993-1999)**

Characteristic	Patients, no. (and %)	HA and THA, %	In-hospital death, %
All	4475	71	5
Age, yr			
65-79	1922 (2.9)	67	3.2
≥ 80	2553 (57.1)	74	6.6
Gender			
Female	3284 (73.4)	72	4
Male	1191 (26.6)	69	8
Comorbid conditions, no.			
< 3 (%)	2180 (48.7)	66	1.4
≥ 3 (%)	2294 (51.3)	76	8.6
Length of hospital stay, d			
<16	3274 (73.2)	69	4.7
≥16	1200 (26.8)	77	6.0
Patients with repeat procedures			
2	117 (2.6)	71	1.3
3	1 (0.0)	N/A	N/A
Data on comorbid conditions and length of hospital stay were missing for 1 patient.			

**Table 1**  
**Age and Sex Adjusted Arthroplasty and Death Rates (1993/94-1998/99)**

Hospital	Ratio of arthroplasty rate by yr to 6-yr arthroplasty rate						6-yr arthroplasty rate†	6-yr death rate†
	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99		
A	0.98	0.97	1.01	0.91	0.81	1.01	72.6 (562)	6.7 (553)
B	1.02	0.94	1.01	1.00	1.00	0.92	76.6* (633)	5.5 (611)
C	1.01	0.99	1.07	1.09	0.98	0.80	74.5 (493)	5.5 (473)
D	0.91	0.90	0.95	1.04	1.08	0.93	74.6 (862)	5.1 (844)
E	0.93	1.00	1.09	0.95	0.95	0.92	71.7 (696)	4.0 (675)
F	1.07	1.21	0.93	1.16	1.10	0.90	57.8* (293)	3.0 (286)
G	1.12	0.86	0.75	1.01	0.86	0.76	69.0 (189)	3.5 (182)
H	1.08	0.93	0.95	1.03	0.95	0.88	78.3 (150)	6.9 (147)
I	1.01	0.96	1.03	0.99	1.12	0.99	60.8* (318)	4.3 (317)
J*	0.52	0.83	1.00	0.87	1.17	1.09	59.7* (80)	5.5 (78)
Alberta	0.98	0.94	0.99	1.01	1.01	1.00	72.0 (4593)	—
Alberta death rate (no. of patients)†	6.4 (728)	4.1 (676)	4.0 (771)	6.0 (826)	5.9 (800)	5.3 (750)	—	4.8 (4475)

\*Significantly different from the overall rate of 72%  
†The numbers in parentheses indicate the number of arthroplasties and no. of patients at risk for death.

other 9 hospitals (OR = 1.5). Whereas women and men had approximately equal chances of undergoing hip arthroplasty in most hospitals (OR = 1.2), there were significant variations among hospitals; that is, arthroplasty was less likely for women admitted to Hospital A (OR = 0.6) and more likely for women admitted to Hospital G (OR = 3.2) (Table 4). The patient's age appeared to be unrelated to the chances of undergoing a hip arthroplasty.

#### *In-hospital death rate*

The 6-year age- and sex-adjusted in-hospital death rates were compared across hospitals (Table 1). Again, we compared each hospital's rate to the overall rate. In most hospitals, patients aged 80 years and older were at approximately twice the risk of death as younger patients (OR = 1.84). The risk was higher for those admitted to Hospital B, where the risk of death for older patients was more than 5 times greater than the risk for younger patients (OR = 5.57). Whereas women and men had approximately equal risks of death in most hospitals (OR = 0.708), this risk was reduced by almost 75% for women in Hospital E (OR = 0.289) (Table 5). Although having 3 or more comorbid conditions was highly associated with in-hospital death (overall OR = 5.64), the geographic variation was found to be insignificant.

#### *Provider results*

We had provider information on 3238 (83.8%) of the 3863 procedures performed between 1994 and 1999 in Alberta. Fifty-six of the 88 providers performed 20 or more hip procedures between 1994 and 1999, and these surgeons were accountable for 3019 (78.2%) procedures done during the 5-year period. Most of their procedures were done in the hospitals performing procedures dur-

**Table 3**

#### Number of Procedures by Hospital and Regional Health Area (1993–1999)

Hospital	Regional Health Authority	Procedures, no.	Patients, no.	In-hospital deaths, no.	Surgeons performing $\geq 20$ procedures, no.
A	A	562	555	35	7
B	A	633	612	33	8*
C	A	493	473	25	7*
D	B	862	845	42	13*
E	B	696	675	26	10*
F	C	293	283	14	5
G	D	189	183	6	2
H	E	150	146	11	2
I	F	318	315	14	3*
J	G	80	78	4	1

\* Some surgeons performed a few procedures at other regional hospitals, but the bulk of the procedures were performed at the specified hospital.

**Table 4**

#### Logistic Regression Results to Predict Likelihood of Arthroplasty ( $n = 4276$ )

Hospital	Characteristic					
	Age		$\geq 3$ Comorbid conditions		Gender	
	OR	Estimate (SE)	OR	Estimate (SE)	OR	Estimate (SE)
A	1.6*	0.490 (0.197)	2.4*†	0.86 (0.198)	0.6*†	-0.51 (0.233)
B	1.4	0.362 (0.19)	1.5*	0.38 (0.198)	1.5	0.389 (0.22)
C	1.9*	0.663 (0.21)	1.3	0.27 (0.21)	1.1	0.129 (0.24)
D	1.2	0.163 (0.158)	1.3	0.26 (0.159)	1.2	0.222 (0.173)
E	1.3	0.265 (0.174)	2.1*	0.72 (0.175)	1.3	0.24 (0.195)
F	1.2	0.183 (0.259)	1.5	0.39 (0.25)	1.8*	0.602 (0.28)
G	1.6	0.5 (0.322)	1.0	0.02 (0.33)	3.2*†	1.15 (0.364)
H	0.9	-0.143 (0.407)	2.3*	0.83 (0.425)	0.5	-0.69 (0.457)
I	1.4	0.358 (0.236)	0.9	-0.12 (0.297)	1.1	0.07 (0.25)
J	1.00	-0.02 (0.46)	1.2	0.22 (0.46)	1.0	0.00 (0.51)
Overall	1.36	0.32 (0.065)	1.5	0.428 (0.115)	1.2	0.175 (0.277)

\*Statistically significant at 0.05 level for each separate regression  
†Statistically significant at 0.05 level from the overall rate  
OR = odds ratio, SE = standard error.

**Table 5**

#### Logistic Regression Results to Predict Mortality

Hospital	Age		Comorbid conditions		Gender	
	OR	Estimate (SE)	OR	Estimate (SE)	OR	Estimate (SE)
A	1.39	0.328 (0.368)	9.52*	2.25 (0.74)	0.65	-0.436 (0.366)
B	5.57*†	1.72 (0.545)	3.33*	1.2 (0.419)	0.556	-0.588 (0.395)
C	2.11	0.747 (0.467)	6.45*	1.86 (0.627)	0.47	-0.695 (0.435)
D	1.81	0.595 (0.347)	13.31*	2.589 (0.729)	0.53	-0.63 (0.328)
E	1.09	0.086 (0.435)	10.048*	2.307 (0.747)	0.289*†	-1.24 (0.412)
F	7.095	1.95 (1.06)	5.244*	1.66 (0.78)	0.292*	-1.23 (0.57)
H	1.37	0.314 (0.68)	5.61*	1.72 (0.805)	0.50	-0.69 (0.659)
G, I, J	4.21*	1.437 (0.629)	5.34*	1.675 (0.483)	0.51	-0.675 (0.437)
Overall	1.84	0.608 (0.561)	5.64	1.73 (0.311)	0.708	-0.346 (1.48)

\*Statistically significant at 0.05 level for the separate regression  
†Statistically significant at 0.05 level from the overall rate  
OR = odds ratio, SE = standard error.

ing all 6 years (Table 2). Of the 56 surgeons, 54 were men, 24 had graduated before 1975, 19 between 1975 and 1983, and 13 between 1984 and 1991. With arthroplasty rates ranging from 31% to 86%, there was significant variation across surgeons ( $T^2 = 163.68$ ,  $p < 0.001$ ). There were too few female surgeons to examine the effect of physician's sex on arthroplasty rates. There was no significant variation in rates by the surgeon's year of graduation ( $p > 0.19$ ) (Fig. 1). Also, there did not seem to be any significant association between the arthroplasty rate and the volume of surgical procedures ( $p = 0.618$ ).

## Discussion

In this study we examined temporal trends in Alberta and regional variations in treatment options and the in-hospital death rate after a femoral neck fracture. This study was unique in examining provider information and in conducting separate hospital-based analyses. In general, we found no indication of a time trend, although important regional variations in arthroplasty rates emerged. The choice of arthroplasty over internal fixation appeared to vary across hospitals and hence across surgeons affiliated with hospitals. We were not able to pinpoint the factors that influenced surgeons. However, the variation was explained by some patient characteristics, and the rele-

vance of these characteristics varied from hospital to hospital and hence from surgeon to surgeon.

Overall, the mortality and arthroplasty rates were similar to those reported by others. Compared with a 1-month death rate of 7%,<sup>17</sup> we noted an in-hospital death rate of 5.2%, despite the somewhat shorter average time period (approximately 2 wk).

Seventy-one percent of femoral neck fractures were treated with arthroplasty. Although this proportion was slightly higher than the 64% reported in an American study (1986–1989),<sup>17</sup> our result seemed reasonable, as the proportion of arthroplasties was shown to have increased between 1986 and 1992.<sup>17</sup>

The significant regional variation in arthroplasty rates was supported by comparable findings in Ontario.<sup>7</sup> The authors of this study noted that the regional variations could not be explained by hospital caseload or by whether the hospital served primarily an urban or rural population. Although both the American and Ontario studies observed that older patients and women were more likely to undergo hip arthroplasty, we found the relevance of these characteristics varied by hospital. Across hospitals, the chances of a patient undergoing a hip arthroplasty were increased for older patients (OR = 1.36), and varied by hospital, by gender and by whether or not patients had 3 or more coexisting medical conditions.

This study had limitations, one being the inability to distinguish between displaced and undisplaced fractures. In the absence of information on displaced versus undisplaced fractures, we assumed that the proportions of displaced fractures were equal across the hospitals. Therefore, the observed differences were still attributable to treatment variations.<sup>5,11</sup> We lacked clinical information on bone quality<sup>16</sup> and functional mobility,<sup>4</sup> which have been reported to have an impact on the surgeon's treatment choice. As the Ontario authors noted, however, if surgeons were consistently basing their decisions on clinical factors, there should be more similarity across hospitals.

In the Ontario study, the authors concluded that large treatment variations across regions were indicative of a lack of professional consensus regarding the best treatment for displaced femoral neck fractures. With the findings in Alberta being comparable to those of Ontario, we are led to the same conclusion. In fact, there may be confusion on how best to treat femoral neck fractures in general. We found treatment variations across some hospitals (and consequently surgeons in Alberta) that were not explained by the surgeon or patient characteristics we considered. To ensure that each patient is receiving the most appropriate treatment, it is important to understand how treatment decisions are being made. A surgical protocol needs to be developed, based on outcomes associated with each treatment. Whereas the incidence of in-hospital mortality was low, the geographic variations warrant further investigation on an individual hospital basis. Since long-term mortality appears to be unrelated to treatment choice,<sup>2</sup> we suggest that other outcomes may be more relevant to consider when making a treatment decision. Functional outcomes, quality of life, reoperation rates and long-term care placement remain to be examined. In linking the surgical procedure to these pa-

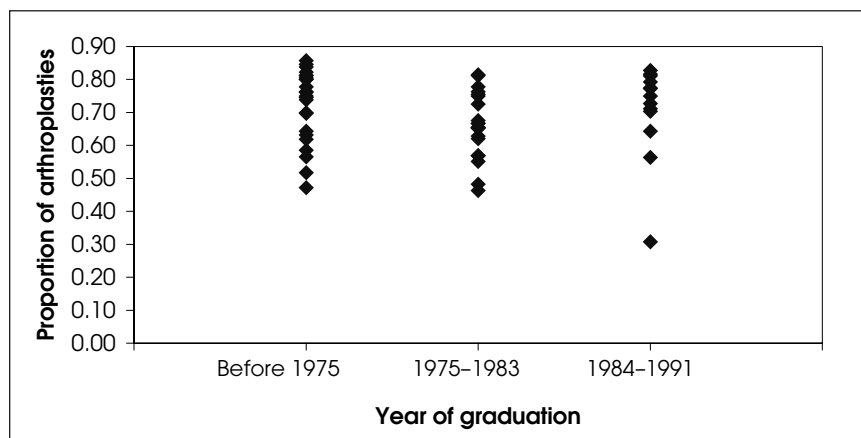
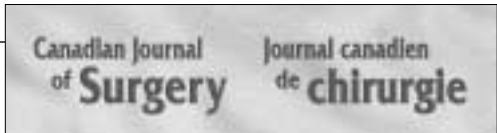


FIG. 1. Arthroplasty rates for each of the 56 surgeons by year of graduation.

tient-defined outcomes, we can maximize the patient's chances of recovery and quality of life.

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