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## THE BURDEN OF SECOND HIP FRACTURES: PROVINCIAL SURGICAL HOSPITALIZATIONS OVER 15 YEARS

### ABSTRACT

Background: Second hip fractures account for 15% of all hip fractures. It is not clear if the proportion of hip fracture surgeries due to second hip fracture are constant over time. The objective of this study was to determine if proportion of hip fracture surgeries due to second hip fracture changed over time **by characteristics of patients and their fracture.**

Methods: We obtained 46,341 records of patients over 60 years **of age** hospitalized for hip fracture surgery from 1990-2005 in British Columbia. The proportion of surgeries due to second hip fracture among all surgeries due to any hip fracture were studied. Linear regression tested for trends across fiscal years for women and men.

Results: Second hip fracture accounted for 8.3% of hip fracture surgeries. For women the proportion of second hip fracture surgeries increased linearly with each age decade from 4% to 13% ( $p = 0.001$ ) and across fiscal years ( $p = 0.002$ ). In men the proportion of second hip fracture surgeries was 5% for each age decade between the ages of 60 and 90 years across fiscal years, increasing to 8% for those over the age of 90 years across fiscal years ( $p = 0.20$ ). These sex-specific trends were similar for both pertrochanteric and transcervical fracture type.

Conclusion: Second hip fracture surgeries account for an increasing proportion of hip fracture surgeries and may require more healthcare resources to minimize poorer reported outcomes.

**Future research should determine whether more resources are required to manage these patients and optimize their outcomes.**

**Key words:** Second hip fracture, gender, ageing, surgery, length of stay

## INTRODUCTION

In 2014 the incidence of hip fracture was 521 per 100,000 in Canada.[1] This translated to approximately 22,000 admissions to acute care, of which 90% underwent surgery.[2] Each hip fracture carries an estimated direct healthcare cost of 27,000 Canadian dollars.[3] In fact, hip fractures are estimated to account for 72% of the total cost of fractures.[4,5] Resource allocation for hip fracture surgeries are often based on analyses for first hip fractures alone by excluding patients who presented with a history of prior fracture.[6-9] However, previous reports indicate that second hip fractures account for up to 15% of all hip fractures.[10-19] These second hip fractures are associated with poorer postoperative outcomes including complications,[20] transitions to long term care,[20] and mortality.[21]

Omsland and colleagues reported the number of patients surviving first hip fracture surgery increased over ten years.[22] The risk of second hip fracture persists for at least ten years after first hip fracture.[23] Therefore, increased survival after first hip fracture should lead to an increase in second hip fractures. Yet, it is unknown whether the proportion of patients undergoing hip fracture surgery for second hip fracture changed over time. It is also unknown whether characteristics of patients and their fracture changed over time. The primary objective of this study was to determine if the proportion of hip fracture surgeries due to second hip fracture changed over fifteen years of follow-up in British Columbia, Canada. We also sought to estimate the proportions of second hip fracture over fifteen years of follow-up by characteristics of patients and their second hip fracture.

## METHODS

### Data sources

We retrieved all records of hospitalizations for hip fracture surgery between April 1, 1985 and March 31, 2005 in British Columbia. The data for this study were obtained from the Hospital Separations Database from the Ministry of Health Services of BC, a portion of the Canadian Institute for Health Information Discharge Abstract Database. [24] This database is a linkable, patient-oriented database that captures administrative information on patient demographics, health care and health services for all British Columbia residents. Each hospitalization record has an admission date, separation date, most responsible diagnosis, primary diagnosis, post-admit comorbidity diagnosis, and level of care, as well as sex and date of birth. Diagnoses were coded according to the International Classification of Diseases (ICD), 9th Revision (ICD-9) [25] and surgical treatments were coded according to the Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures.[26] Although the province of British Columbia began using the ICD 10<sup>th</sup> revision (ICD-10) in 2001–2002 the data were converted back to ICD-9 for uniformity. The University of British Columbia Ethics board approved this study.

### Inclusion/exclusion criteria

A total of 74,940 records of hospitalization for hip fracture surgery between April 1, 1985 and March 31, 2005 were retrieved. A total of 2,298 records of potentially pathological hip fractures were excluded by identifying patients with at least one hospitalization record that was cancer related (most responsible diagnosis ICD-9 code 140–239, or diagnosis type 162, 174, 185, 189, 203, 196–198). A further 5,708 records that were complication related (most responsible diagnosis 996–999), orthopaedic aftercare related (most responsible diagnosis V57, V58, V63-

V68, V71) or with levels of care other than acute (level of care code D, E, I, L, R, or S) were also excluded.

### **Construction of care episodes**

A hip fracture care episode was defined as the surgical management of a hip fracture from admission to discharge from hospital. Multiple records of hip fracture with readmission within one day were considered as hospital transfers and treated as a single episode. 59,523 care episodes from the 66,934 records of hospitalization were constructed. 1,371 of these care episodes were excluded, 761 which occurred within 90 days and were related to the preceding care episode, 399 with a length of stay of three days or less, 140 with patients less than 60 years of age as a condition of our data request, and 71 related to a third or later hip fracture.

Care episodes related to first and second hip fractures were identified within each patient using the unique provincial health numbers. To reduce the possibility of classifying a second hip fracture as a first hip fracture a ‘wash-out’ and ‘look back’ strategy was adopted. Hip fracture surgeries from April 1, 1985 to March 31, 1990 were excluded to prevent misclassification.[27] For those presenting with hip fracture from April 1, 1990 onwards, records from April 1, 1985 were reviewed for previous hip fracture admissions. These two rules led to the exclusion of 11,877 hip fracture surgeries. The final cohort was comprised of 46,341 patients aged 60 years or older with hip fracture care episodes between April 1, 1990 and March 31, 2005. We then designated the earliest hip fracture care episode as the first hip fracture, and the next hip fracture care episode as the second hip fracture.

## **Statistical analysis**

We compared characteristics of first and second hip fracture surgeries, including the patient's sex, age at hip fracture, and subtype of hip fracture. Two subtypes of hip fracture were defined by diagnosis: transcervical fractures (ICD-9 codes 820.0, 820.1, 820.8 and 820.9) and pertrochanteric fractures (ICD-9 codes 820.2 and 820.3). Hip fractures of unspecified type (ICD-9 codes 820.8 and 820.9) were classified as transcervical fractures to account for the change in coding from ICD-9 to ICD-10 in 2001.

The proportions of second hip fracture surgeries among all hip fracture surgeries were studied. These proportions were estimated by sex, across age groups, by fracture type, and across fiscal years. The proportion of pertrochanteric subtype among second hip fractures was compared between sexes using the chi-square test. Linear regression was used to test for linear trends across age decades and fiscal years for men and women.

All analyses were completed using SAS 9.2 software (SAS System version 9.2 for Windows, SAS Institute Incorporation, Cary, NC, USA, 2002–2003).

## **RESULTS**

Between April 1, 1990 and March 31, 2005, 46,341 hip fracture surgeries occurred among patients 60 years and older in British Columbia, Canada. One in twelve hip fracture surgeries was for a second hip fracture (8.3%, 95% confidence interval [CI]: 8.1, 8.6).

There were differences in the distributions of fracture type, age and sex between first and second hip fractures (Table 1). More patients had pertrochanteric fracture type at second (52%) compared to first hip fracture surgery (47%). More patients were over the age of 80 years at

second (74%) compared to first hip fracture surgery (62%). More patients were women at second (81%) compared to first hip fracture surgery (72%).

The proportion of hip fracture surgeries due to second hip fracture changed during the study period. This proportion was higher in women (9.3%; 95% CI: 8.9, 9.6) than men (5.8%; 95% CI: 5.4, 6.2). For women the proportion increased significantly ( $p = 0.002$ ) from 7.4% ( $n = 135$ ) in 1990 to 9.0% ( $n = 220$ ) in 2004 (Table 2). For men the proportion did not increase significantly ( $p = 0.20$ ) but varied from 3.7% ( $n = 24$ ) in 1990 to 5.3% ( $n = 47$ ) in 2004 (Table 2).

For women the proportion of second hip fracture surgeries increased linearly with each age decade from 4% to 13% ( $p = 0.001$ ) and across fiscal years (Figure 1). In men the proportion of second hip fracture surgeries was 5% for each age decade between the ages of 60 and 90 years across fiscal years, increasing to 8% for those over the age of 90 years across fiscal years ( $p = 0.20$ ) (Figure 1). These sex-specific trends were similar for both pertrochanteric and transcervical fracture type (Tables 2 and 3).

## DISCUSSION

One in twelve hip fracture surgeries was for second hip fracture. This proportion increased over fifteen years of follow-up in British Columbia, Canada. Older women accounted for the increasing proportion of second hip fracture surgeries over time.

We previously reported among survivors the risk of second hip fracture persists for at least ten years after first hip fracture.[23] Here we demonstrate that this risk led to an increase in the proportion of second hip fracture surgeries over time. In keeping with earlier literature our study reported that second hip fractures account for 8.3% of all hip fracture surgeries. [28-31] We also report patients presenting with second hip fracture are more likely to be older, women, and with

perthrochanteric fractures than those presenting with first hip fracture. [28-31] There was an increase in the proportion of hip fracture patients undergoing surgery for second hip fracture over time. The proportion of women undergoing surgery for second hip fracture grew from 8% to 10% over the 15 fiscal years, while for men the proportion remained stable at 6%. Viewing demographic aging in combination with higher mortality rates for men following hip fracture, men may have had fewer individuals susceptible to a second hip fracture.[32,33]

Poorer postsurgical outcomes are seen following second hip fracture when compared to first hip fracture.[15,28] Second hip fracture is associated with excess mortality above that anticipated for an increase in age.[21] Excess mortality after hip fracture surgery is associated with factors inherent to the patient and complications of their injury and treatment.[34,35] To prevent complications and death, patients with second hip fracture may require a more aggressive treatment approach, and more healthcare resources, than patients with first hip fracture.[36] For those that survive, patients with second hip fracture are less likely to regain prefracture function and more likely to transition to long term care than patients after first hip fracture.[20]

We previously reported the risk of second hip fracture is similar for men and women who remain alive after first hip fracture.[23] However, more men than women die following first hip fracture.[32] Here, we demonstrate that women account for a higher proportion of second hip fracture surgeries than men. Further, similar to Omsland and colleagues we note these women were older as from the age of 60 to 90 years the proportion of second hip fracture surgeries relative to all hip fracture surgeries increased linearly by each age decade.[33]

We conducted a secondary analysis of hospitalization records with a limited number of variables for adjustment. Data on hip fractures sustained before 1985 were not available. To avoid



misclassifying first fractures as second ones, we employed a “wash-out” strategy by excluding cases from 1985 to 1990, expecting it would account for most second fractures. A second hip fracture may have been misclassified as a first hip fracture. However, the probability of misclassifying a hip fracture decreases with time after known first hip fracture.[33] Data on the type of surgery was not available. Arthroplasty is more commonly prescribed for patients with transcervical hip fractures.[37] Arthroplasty influences the risk of death with greater blood loss, infections and anesthetic complications than internal fixation.[38,39] However, there were fewer transcervical hip fractures among patients undergoing surgery for second hip fractures. We demonstrate an increasing proportion of hip fracture surgeries due to second hip fracture. Data on health care resource utilization was not available. Further, the data did not provide indication of osteoporosis therapy.

## CONCLUSION

The results of this study indicate that second hip fracture accounted for 8.3% of all hip fracture surgeries in British Columbia from 1990 to 2005. Over fifteen years this proportion increased linearly for women and remained stable in men. Future research should determine whether more healthcare resources are required to manage these patients and optimize their outcomes.

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**Table 1.** Characteristics of 46,341 episodes of hip fracture in British Columbia, Canada 1990–2004. Data were obtained from the Hospital Separations Database from the Ministry of Health Services of BC, a portion of the Canadian Institute for Health Information Discharge Abstract Database.

Characteristic	Hip fracture episode			
	First (n=42,475)		Second (n=3,866)	
Sex				
Women	30588	(72.0)	3119	(80.7)
Men	11262	(26.5)	693	(17.9)
Unknown	625	(1.5)	54	(1.4)
Age group (years)				
60-69	4069	(9.6)	197	(5.1)
70-79	12105	(28.5)	813	(21.0)
80-89	19476	(45.9)	1938	(50.1)
90+	6825	(16.1)	918	(23.7)
Fracture subtype				
Pertrochanteric	19907	(46.9)	2013	(52.1)
Transcervical	22486	(52.9)	1853	(47.9)
Unknown	82	(0.2)	0	(0)
Fiscal period of discharge*				
1990–1995	15626	(36.8)	1293	(33.4)
1996–1999	11580	(27.3)	1083	(28.0)
2000–2004	15269	(35.9)	1490	(38.5)
Hospital length of stay				
<1 week	8707	(20.5)	576	(14.9)
1 to 2 weeks	13199	(31.1)	1293	(33.4)
>2 weeks	20569	(48.4)	1997	(51.7)

\*As an example, fiscal year 1990 refers to April 1990 to March 1991.

**Table 2:** Number (and proportion) of second hip fractures by age and hip fracture subtype for women. Data were obtained from the Hospital Separations Database from the Ministry of Health Services of BC, a portion of the Canadian Institute for Health Information Discharge Abstract Database.

Fiscal year*	Petrochanteric					Transcervical				
	60-69	70-79	80-89	90+	All age groups	60-69	70-79	80-89	90+	All age groups
1990	4/208 (1.9)	13/581 (2.2)	37/748 (4.9)	24/295 (8.1)	78/1832 (4.3)	0/208 (0.0)	20/581 (3.4)	31/748 (4.1)	6/295 (2.0)	57/1832 (3.1)
1991	3/189 (1.6)	17/596 (2.9)	33/826 (4.0)	22/318 (6.9)	75/1929 (3.9)	2/189 (1.1)	16/596 (2.7)	35/826 (4.2)	13/318 (4.1)	66/1929 (3.4)
1992	4/198 (2.0)	17/620 (2.7)	32/907 (3.5)	28/328 (8.5)	81/2053 (3.9)	6/198 (3.0)	29/620 (4.7)	47/907 (5.2)	21/328 (6.4)	103/2053 (5.0)
1993	4/174 (2.3)	25/631 (4.0)	44/948 (4.6)	22/359 (6.1)	95/2112 (4.5)	2/174 (1.1)	18/631 (2.9)	43/948 (4.5)	18/359 (5.0)	81/2112 (3.8)
1994	3/172 (1.7)	24/636 (3.8)	61/1013 (6.0)	19/327 (5.8)	107/2148 (5.0)	3/172 (1.7)	24/636 (3.8)	36/1013 (3.6)	12/327 (3.7)	75/2148 (3.5)
1995	4/159 (2.5)	22/629 (3.5)	55/1023 (5.4)	31/376 (8.2)	112/2187 (5.1)	2/159 (1.3)	20/629 (3.2)	49/1023 (4.8)	25/376 (6.6)	96/2187 (4.4)
1996	5/169 (3.0)	20/657 (3.0)	56/1089 (5.1)	24/356 (6.7)	105/2271 (4.6)	4/169 (2.4)	21/657 (3.2)	64/1089 (5.9)	18/356 (5.1)	107/2271 (4.7)
1997	2/159 (1.3)	22/612 (3.6)	58/1112 (5.2)	30/384 (7.8)	112/2267 (4.9)	4/159 (2.5)	26/612 (4.2)	51/1112 (4.6)	27/384 (7.0)	108/2267 (4.8)



1998	3/165 (1.8)	15/589 (2.5)	74/1149 (6.4)	27/461 (5.9)	119/2364 (5.0)	4/165 (2.4)	28/589 (4.8)	55/1149 (4.8)	27/461 (5.9)	114/2364 (4.8)
1999	4/162 (2.5)	14/601 (2.3)	68/1190 (5.7)	35/403 (8.7)	121/2356 (5.1)	3/162 (1.9)	20/601 (3.3)	50/1190 (4.2)	28/403 (6.9)	101/2356 (4.3)
2000	3/160 (1.9)	20/617 (3.2)	65/1149 (5.7)	40/423 (9.5)	128/2349 (5.4)	5/160 (3.1)	24/617 (3.9)	62/1149 (5.4)	24/423 (5.7)	115/2349 (4.9)
2001	4/168 (2.4)	21/625 (3.4)	65/1284 (5.1)	28/441 (6.3)	118/2518 (4.7)	5/168 (3.0)	29/625 (4.6)	85/1284 (6.6)	27/441 (6.1)	146/2518 (5.8)
2002	2/131 (1.5)	14/551 (2.5)	50/1176 (4.3)	36/484 (7.4)	102/2342 (4.4)	5/131 (3.8)	14/551 (2.5)	67/1176 (5.7)	25/484 (5.2)	111/2342 (4.7)
2003	4/172 (2.3)	17/596 (2.9)	61/1213 (5.0)	48/540 (8.9)	130/2521 (5.2)	5/172 (2.9)	24/596 (4.0)	72/1213 (5.9)	35/540 (6.5)	136/2521 (5.4)
2004	3/185 (1.6)	20/564 (3.5)	51/1241 (4.1)	40/468 (8.5)	114/2458 (4.6)	3/185 (1.6)	15/564 (2.7)	73/1241 (5.9)	15/468 (3.2)	106/2458 (4.3)
All years	52/2571 (2.0)	281/9105 (3.1)	810/16068 (5.0)	454/5963 (7.6)	1597/33707 (4.7)	53/2571 (2.1)	328/9105 (3.6)	820/16068 (5.1)	321/5963 (5.4)	1522/33707 (4.5)

\*As an example, fiscal year 1990 refers to April 1990 to March 1991.

**Table 3:** Number (and proportion) of second hip fractures by age and hip fracture subtype for men. Data were obtained from the Hospital Separations Database from the Ministry of Health Services of BC, a portion of the Canadian Institute for Health Information Discharge Abstract Database.

Fiscal year*	Petrochanteric					Transcervical				
	60-69	70-79	80-89	90+	All age groups	60-69	70-79	80-89	90+	All age groups
1990	2/115 (1.7)	3/228 (1.3)	6/240 (2.5)	0/63 (0.0)	11/646 (1.7)	3/115 (2.6)	5/228 (2.2)	3/240 (1.3)	2/63 (3.2)	13/646 (2.0)
1991	2/105 (1.9)	2/201 (1.0)	9/236 (3.8)	4/77 (5.2)	17/619 (2.7)	2/105 (1.9)	4/201 (2.0)	6/236 (2.5)	3/77 (3.9)	15/619 (2.4)
1992	3/113 (2.7)	5/230 (2.2)	9/278 (3.2)	3/84 (3.6)	20/705 (2.8)	1/113 (0.9)	5/230 (2.2)	7/278 (2.5)	2/84 (2.4)	15/705 (2.1)
1993	4/122 (3.3)	7/237 (3.0)	11/281 (3.9)	1/90 (1.1)	23/730 (3.2)	3/122 (2.5)	7/237 (3.0)	8/281 (2.8)	4/90 (4.4)	22/730 (3.0)
1994	6/110 (5.5)	13/228 (5.7)	7/328 (2.1)	4/79 (5.1)	30/745 (4.0)	4/110 (3.6)	4/228 (1.8)	12/328 (3.7)	0/79 (0.0)	20/745 (2.7)
1995	3/124 (2.4)	8/215 (3.7)	7/316 (2.2)	5/92 (5.4)	23/747 (3.1)	1/124 (0.8)	8/215 (3.7)	9/316 (2.8)	2/92 (2.2)	20/747 (2.7)
1996	0/119 (0.0)	11/279 (3.9)	13/344 (3.8)	4/93 (4.3)	28/835 (3.4)	5/119 (4.2)	3/279 (1.1)	7/344 (2.0)	6/93 (6.5)	21/835 (2.5)
1997	6/96 (6.3)	4/246 (1.6)	8/338 (2.4)	6/89 (6.7)	24/769 (3.1)	4/96 (4.2)	8/246 (3.3)	5/338 (1.5)	6/89 (6.7)	23/769 (3.0)

1998	5/111 (4.5)	6/269 (2.2)	8/379 (2.1)	8/101 (7.9)	27/860 (3.1)	2/111 (1.8)	13/269 (4.8)	13/379 (3.4)	1/101 (1.0)	29/860 (3.4)
1999	4/109 (3.7)	5/248 (2.0)	9/369 (2.4)	1/108 (0.9)	19/834 (2.3)	2/109 (1.8)	8/248 (3.2)	7/369 (1.9)	2/108 (1.9)	19/834 (2.3)
2000	4/96 (4.2)	7/259 (2.7)	16/384 (4.2)	7/122 (5.7)	34/861 (3.9)	3/96 (3.1)	4/259 (1.5)	16/384 (4.2)	9/122 (7.4)	32/861 (3.7)
2001	4/114 (3.5)	14/266 (5.3)	12/365 (3.3)	4/128 (3.1)	34/873 (3.9)	3/114 (2.6)	4/266 (1.5)	5/365 (1.4)	1/128 (0.8)	13/873 (1.5)
2002	3/102 (2.9)	8/263 (3.0)	14/404 (3.5)	1/126 (0.8)	26/895 (2.9)	1/102 (1.0)	7/263 (2.7)	13/404 (3.2)	7/126 (5.6)	28/895 (3.1)
2003	4/137 (2.9)	4/293 (1.4)	16/387 (4.1)	9/138 (6.5)	33/955 (3.5)	2/137 (1.5)	9/293 (3.1)	11/387 (2.8)	5/138 (3.6)	27/955 (2.8)
2004	4/113 (3.5)	7/258 (2.7)	9/365 (2.5)	7/145 (4.8)	27/881 (3.1)	2/113 (1.8)	7/258 (2.7)	5/365 (1.4)	6/145 (4.1)	20/881 (2.3)
All years	54/1686 (3.2)	104/3720 (2.8)	154/5014 (3.1)	64/1535 (4.2)	376/11955 (3.1)	38/1686 (2.3)	96/3720 (2.6)	127/5014 (2.5)	56/1535 (3.6)	317/11955 (2.7)

\*As an example, fiscal year 1990 refers to April 1990 to March 1991.

**Figure legends**

**Figure 1.** Proportion of second hip fractures by fiscal year and age at hip fracture, among women and men. Horizontal lines represent average annual proportion of second hip fractures for each age group. A significant linear trend for increasing proportion of second hip fractures by fiscal year and age was seen for women ( $p = 0.002$ ) but not men ( $p = 0.20$ ). Data were obtained from the Hospital Separations Database from the Ministry of Health Services of BC, a portion of the Canadian Institute for Health Information Discharge Abstract Database.

