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Trends in implementation of evidence-based hip fracture management in a major Canadian city

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Abstract

Aims: The importance of hip fracture care has resulted in an abundance of hip fracture management literature. The degree this evidence is incorporated into clinical practice is unknown. We examined 5 trends in hip fracture management: arthroplasty versus fixation, total hip arthroplasty (THA) versus hemiarthroplasty (HA), cemented versus uncemented femoral stem fixation, short versus long cephalomedullary nail (CMN) fixation, and time from admission to surgery. Our primary aim was to understand and assess hip fracture management trends in relation to pertinent literature.

Methods: Data were collected from acute hip fractures in patients aged 50 years or older who presented from 2008 to 2018. *ICD-10* diagnostic codes were assigned using preoperative radiographs. Surgical management was confirmed using intraoperative and postoperative radiographs and split into 6 categories: (1) short CMN, (2) long CMN, (3) cannulated screws, (4) dynamic hip screw, (5) HA, and (6) THA. Appropriate statistical tests were used to analyze trends.

Results: In 4 assessed trends, hip fracture management aligned with high-level evidence. This was the case for a trend toward arthroplasty for displaced femoral neck fractures, increased use of THA relative to HA, increased use of short relative to long CMNs, and consistent decrease in surgical wait times. Despite the literature highlighting the disadvantages of uncemented femoral stems, our data demonstrated increased use of uncemented femoral stems.

Conclusion: Evidence to guide orthopaedic practice is constantly emerging but may not be effectively used by clinicians. Our findings demonstrate the successes and failures of integrating evidence into hip fracture management and highlight that orthopaedic surgeons have an ongoing responsibility to strive for evidence-based practice.

Keywords: orthopaedic trauma, hip fracture management, evidence-based practice, surgical, trends

1. Introduction

Hip fracture care is a major public health concern given the global aging population and exponential increase in hip fracture incidence observed in older patients.[1] In Canada, the annual incidence of hip fractures in individuals older than 85 years is 3.06% for female patients and 1.73% for male patients.[2] Hip fractures can have devastating consequences often leading to prolonged hospital stays, immobility, and in many cases, permanent dependence.[3] Moreover, the 1-year mortality for hip fractures in adults older than 50 years is estimated to be between 22% and 30%.[4]

Treating patients with hip fracture in publicly funded health care systems can be challenging because clinicians aim to deliver high-quality care with a finite amount of resources. Thus, orthopaedic surgeons rely heavily on evidence-based medicine to ensure optimal management for patients with hip fracture. Fortunately, there is a plethora of research in this regard, but this abundance can also make it difficult for clinical practice to keep pace with emerging evidence.[3,5–7] Our retrospective review aimed to determine whether best evidence for hip fracture management was incorporated into clinical practice between 2008 and 2018 at our study sites. In particular, we focused on five areas of surgical management of hip fractures that have garnered significant attention in the literature in recent years:

1. Fixation versus arthroplasty for displaced femoral neck fractures
2. Hemiarthroplasty (HA) versus total hip arthroplasty (THA) for intracapsular femoral neck fractures
3. Cemented versus uncemented femoral stems for HA in displaced femoral neck fractures
4. Short versus long cephalomedullary nail (CMN) fixation for intertrochanteric hip fractures
5. Minimizing surgical wait times for hip fractures.

We hypothesized that in the above five categories, the data we collected from an institutional database would demonstrate integration of evidence published between 2008 and 2018.

2. Methods

This study was approved by the local university research ethics board (Conjoint Health Research Ethics Board [CHREB] at the University of Calgary, Study ID Number: REB18-0777).

2.1. Patient Data Selection

Data from patients aged 50 years or older with acute hip fracture presenting to the four major adult hospitals in a major

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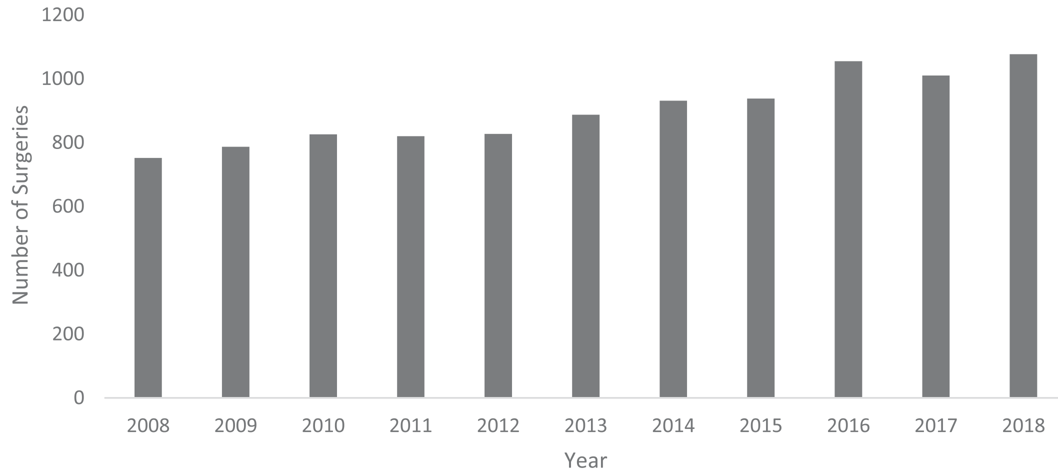

Figure 1. Number of acute hip fracture surgeries by year.

Canadian city—one Level I trauma center and three Level IV trauma centers—between January 1, 2008, and December 31, 2018, were collected from a local database using surgical procedure code (Appendix A, Supplemental Digital Content, http://links.lww.com/OTAI/A73). Final analysis included 9860 acute hip fractures. All cases were assigned an *International Classification of Diseases-10* (ICD) diagnostic code[8] after reviewing preoperative radiographs. Analysis was then limited to three *ICD-10* diagnostic code groups (S721, S720, and S722) for comparison. Method of surgical management was confirmed using the intraoperative and initial postoperative radiographs and broadly split into six categories: (1) short CMN, (2) long CMN, (3) cannulated screws, (4) dynamic hip screw, (5) HA, and (6) THA. Data extraction also included the following parameters: age, sex, diagnosis, use of cement, surgical booking data, and time of procedure.

2.2. Statistical Analysis

Poisson regression was used to test for trends in surgical management over each year. To compare relative rates of different procedures, a bootstrap analysis was conducted. For each bootstrap weight, yearly weighted counts of each procedure were computed, and Poisson regression models fit on each procedure count versus year. 95% bootstrap percentile confidence intervals were computed on the delta between count ratios from respective models. If an interval did not contain 0, then the difference in rates between procedures was deemed significant at $\alpha = 0.05$. Linear regression was used to test for trends in average surgical wait times (defined as the difference between when a surgery was booked and the start of procedure) over each year. Surgical booking time was chosen instead of emergency room triage time to capture the average surgical wait times strictly as a result of increased operative workload. To analyze the amount of hip fracture surgery that occurred within 36 hours of surgical booking (the provincial guideline for hip fracture wait times), the Cochran–Armitage trend and binary logistic regression tests were used. The results are presented as crude rates and percentage comparison (% ± 95% confidence interval [CI]). All descriptive statistics, multivariable Poisson, linear regression models, and other analyses were performed using SAS v9.4 (SAS Institute, NC).

3. Results

Our data set consisted of 9860 acute hip fractures over an 11-year period. Overall, hip fracture volumes increased at an average rate of 3.50% per year since 2008, with 43.22% (n = 1077) more hip fractures presenting in 2018 compared with 2008 (n = 752) (Fig. 1). Most of the included hip fractures occurred in women (69.44%, n = 6846) and were most common in individuals aged 80–89 years (40.10%, n = 3.954) (Table 1).

3.1. Fixation for Femoral Neck Fractures

Cannulated screw fixation comprised 8.27% (n = 815) of the overall hip fracture cohort and had an average annual decrease of 1.50% (CR = 0.985; 95% CI, 0.964–1.007; $P = 0.179$). Dynamic hip screw fixation comprised 12.82% (n = 1264) of the overall hip fracture cohort and showed an average annual decrease of 7.40% (CR = 0.926; 95% CI, 0.909–0.942; $P < 0.001$).

3.2. Total Hip Arthroplasty Versus Hemiarthroplasty

In contrast to the decreased rates of fixation, the use of both THA and HA for hip fracture increased annually 18.10% on average for THA (CR = 1.181; 95% CI, 1.147–1.216; $P < 0.001$) and 2.50% on average for HA (CR = 1.025; 95% CI, 1.014–1.035; $P < 0.001$). Although 87.13% (n = 3573) of arthroplasty procedures for hip fracture was HA throughout the study period, the relative increase in THA for hip fracture was larger than that of HA. In 2008, 4.73% of arthroplasty procedures (n = 14) for femoral neck fracture was THA; by 2018, this amount had increased to 20.36% (n = 91) (Fig. 2). Bootstrap analysis revealed that the increase in THA procedures relative to HA to be significant ($\alpha = 0.05$).

3.3. Cemented Versus Uncemented Hemiarthroplasty

While incidence of HA increased overall during the study timeline, the rate of cemented HA decreased at an annual

Table 1

Age distribution of acute hip fracture cases.

Age	Percentage
50–59	6.74
60–69	13.27
70–79	21.32
80–89	40.10
90–99	18.03
100+	0.54

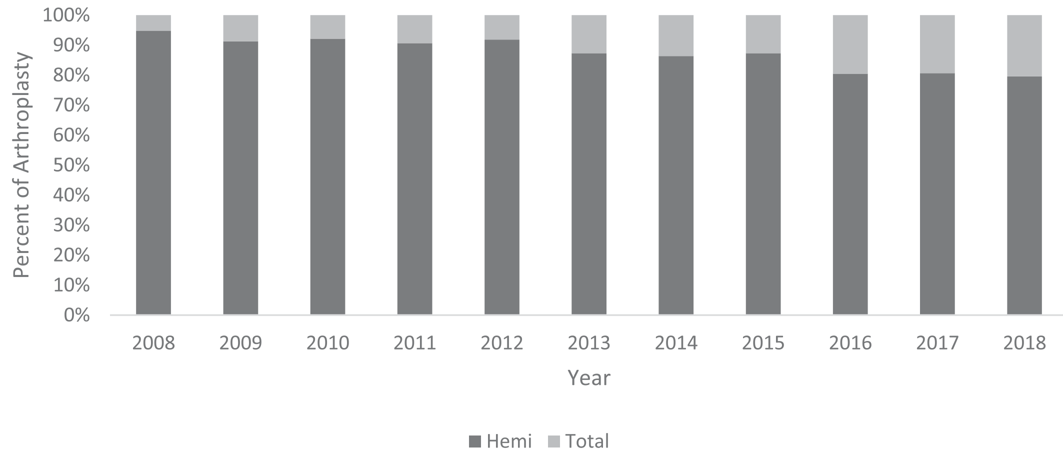

Figure 2. Percent breakdown of hemiarthroplasty versus total arthroplasty per year.

average rate of 7.20% (CR = 0.928; 95% CI, 0.915–0.942; $P < 0.001$). Conversely, the frequency of uncemented HA increased at an annual average of 15.10% (CR = 1.151; 95% CI, 1.133–1.170; $P < 0.001$). Of note, most of the HA was cemented until 2014, when uncemented HA procedures (58.94%, n = 211) surpassed cemented HA (41.06%, n = 147) as the most common method of femoral stem fixation of HA for hip fracture, a trend that continued to the end of the study period (Fig. 3).

3.4. Short Versus Long Cephalomedullary Nail Fixation

Use of both short and long CMNs increased over time, with a 9.00% average annual increase for short CMNs (CR = 1.090; 95% CI, 1.075–1.105; $P < 0.001$) and a 6.60% average annual increase for long CMNs (CR = 1.066; 95% CI, 1.049–1.083; $P < 0.001$). In 2008, 52.48% of CMNs (n = 106) were short CMNs. By 2018, this number had increased to 61.28% (n = 296). Bootstrap analysis revealed the increase in short CMNs use relative to long CMNs to be significant at $\alpha = 0.05$ (Fig. 4).

3.5. Surgical Wait Times

Using multiple linear regression, we found that mean surgical wait times decreased at an annual average of 14.4 minutes per year ($P < 0.001$). Furthermore, the average wait time was less than 24 hours throughout the entire study period (Table 2). Cochran–Armitage trend and binary logistic regression models revealed significantly more surgery occurred within a 36-hour window later in the study period ($P < 0.001$). The frequency distribution demonstrated that 82.80% of surgery occurred within 36 hours. Maximum surgical wait time also decreased substantially over the 10-year study period. As of 2016, maximum surgical wait times did not exceed 72 hours (Table 2).

4. Discussion

The overall trends in hip fracture management in our cohort mirror high-level studies in the literature with most of the patients with hip fracture being women older than 65 years.[1,2] Therefore, surgical management of hip fractures in our cohort should not have deviated significantly from the literature based on patient demographics alone. When considering our five categories of interest

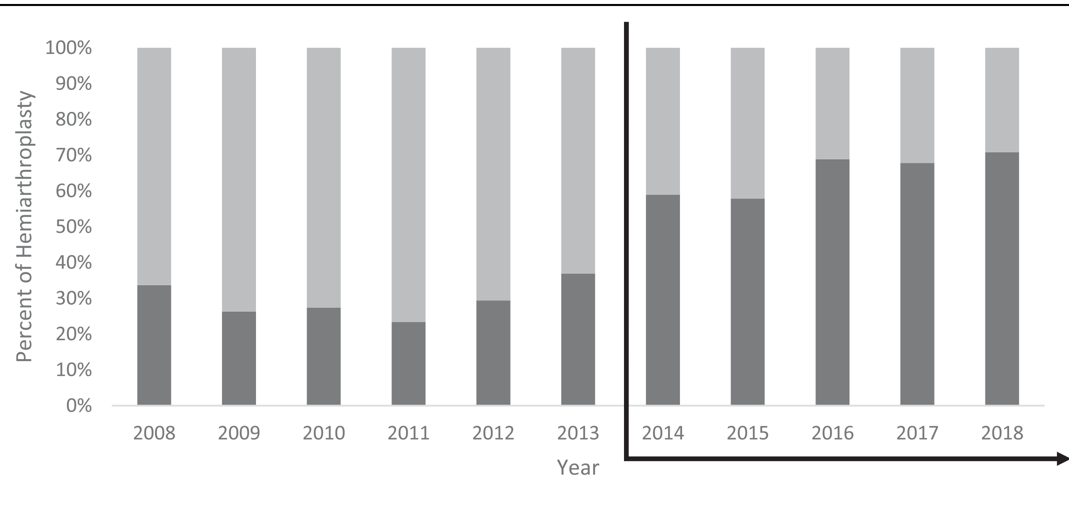

Figure 3. Percent breakdown of cemented versus uncemented hemiarthroplasty per year.

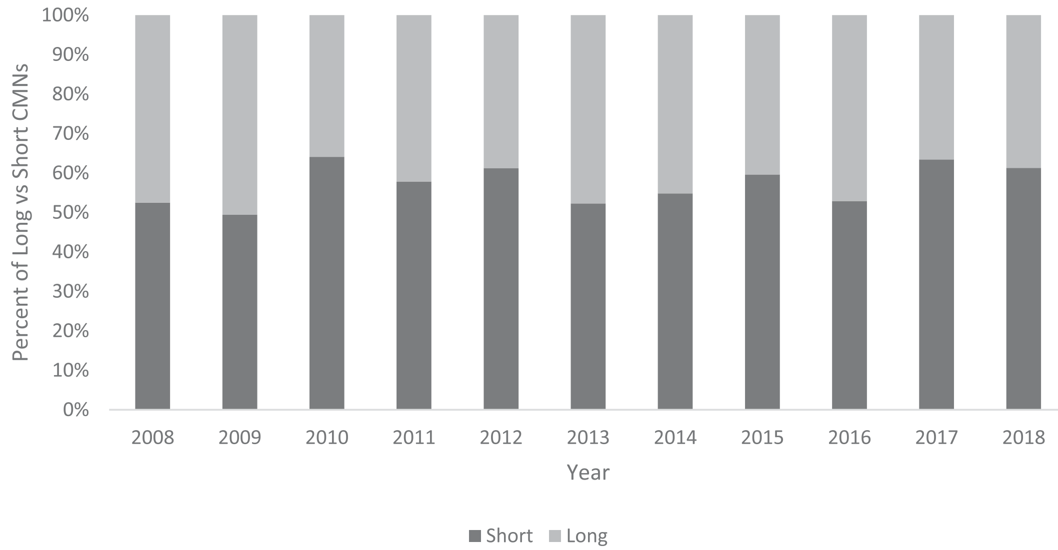

Figure 4. Percent breakdown of short versus long cephalomedullary nails per year.

(arthroplasty vs. fixation, THA vs. HA, cemented vs. uncemented femoral stem fixation, short vs. long CMN, and time to hip fracture surgery), our data trended with evidence-based recommendations in four of the five categories, albeit to varying degrees.

When considering arthroplasty versus fixation, our finding of increased use of arthroplasty for displaced femoral neck fracture may demonstrate clinical integration of recent literature indicating that arthroplasty (rather than internal fixation) reduced the risk of revision surgery.[3,9] While the rate of arthroplasty increased overall, our rate of THA for fracture increased relative to HA, which is in line with several studies that show higher levels of postoperative function for patients managed with THA compared with HA.[3,10–12]

With regard to cemented versus uncemented femoral stems for HA, our data paradoxically trended toward doing more uncemented HA. This practice is in contrast to several studies that show higher rates of failure, infection, and intraoperative and postoperative periprosthetic fracture with uncemented HA.[13–15] There are several possibilities for explaining this trend away from cemented HA such as unfamiliarity with cementing technique, increased operating time, distrust of the pertinent literature, or anecdotal experience with adverse events while using cement (ie, cardiopulmonary complications). Although not examined in this article, there is an anecdotal preference at our study site to select uncemented femoral stems for HA in both trauma and elective surgery. An area of future research could be to survey orthopaedic surgeons locally and nationally to better understand the rationale for preferring uncemented HA for fracture in the face of high-quality evidence to the contrary and comparing the use of cemented HA in trauma versus elective cases to appreciate if this preference persists in different patient populations.

With regard to CMN fixation of intertrochanteric hip fractures, several recent studies have shown short CMNs to be more cost-effective than long CMNs with lower reoperation rates, decreased OR time, and reduced blood loss while not compromising patient outcomes, regardless of the fracture pattern.[16–19] The use of short CMNs increased relative to long CMNs in our data set, although this was the least marked trend of our group comparisons (Figs. 2, 3, 4). This may reflect the recency of the literature showing similar outcomes with short and long CMNs, and it may be prudent to review institutional data from 2019 to 2020 to see whether the trend toward short CMNs became more pronounced in recent years.

With regard to surgical wait times, our data showed a consistent decrease in mean surgical wait time across the 11-year data collection period (Table 2). We also found overall adherence to current guidelines which recommend hip fracture surgery be performed within 24–48 hours of hospital admission based on a reduction in postoperative mortality and length of hospital stay, minimization of postoperative complications, and improvement in functional outcomes.[20–23] Minimizing hip fracture surgical wait times has been a major focus locally, so it is encouraging to see a consistent decrease in surgical wait times over the 11-year data collection period.

While our database study has many strengths, we also note several limitations. First, our results do not account for population growth over time. While we attempted to mitigate this effect by reporting percentages and intergroup comparisons, some of the absolute increases in count over time may be partially attributed to population growth and aging. In addition, our study may underestimate the wait times experienced by patients with hip fracture, given that we used surgical booking time to calculate time to surgery rather than emergency room triage time.

When considering the degree and rate that new evidence is translated to clinical practice, there are numerous variables to consider such as the quality and breadth of literature, the strength

Table 2

Mean surgical wait time (SWT) for all hip fractures.

Year	Mean SWT (hours)	SD (hours)	Minimum SWT (hours)	Maximum SWT (hours)
2008	22.79	16.01	0.67	141.08
2009	20.67	12.81	0.73	71.09
2010	21.06	13.17	0.97	99.30
2011	22.37	13.64	1.35	97.53
2012	21.89	13.60	1.10	72.20
2013	20.33	13.77	1.18	152.14
2014	19.75	11.86	1.00	82.87
2015	21.72	12.57	1.12	77.13
2016	19.81	10.76	2.30	64.50
2017	19.33	9.62	1.37	57.60
2018	20.12	9.94	1.20	59.13

and rationale for each recommendation (equivocal vs. significant reduction in patient harm or cost), and the time frame in which each recommendation was published and subsequently gained widespread acceptance. Not all of the literature surrounding hip fracture management can be as straightforward as the benefit of decreasing time to surgery. Furthermore, the pendulum will continue to swing given industry innovation, broadening surgical indications, and as the volume of pertinent literature increases. Case in point, since 2018 (the end of data collection for this study), some high-quality studies emerged that challenge previous research used to guide hip fracture management. Notably, the HEALTH trial showed no significant difference between HA and THA based on rate of reoperation and patient death at 2 years postoperatively.[5] It can be argued that longer follow-up may be less likely to favor clinical equipoise especially given that patients as young as 50 years were randomized to HA, thus illustrating the point that even the highest quality research can leave room for significant debate.

In conclusion, clinicians have a responsibility to critically analyze and integrate research into their practice. This occurred with varying levels of success at our study sites between 2008 and 2018. Evidence-based changes in practice can be attributed to many factors including strong surgical leadership and individual practitioner attentiveness to literature, however can be affected by potential hesitancy to change practice (specifically in the context of cemented HA). It is important that researchers and clinicians understand and strive to eliminate the barriers that prevent best evidence from being incorporated into modern orthopaedic practice. Future research at our study sites could include exploration of the factors that facilitate and prevent integration of best available evidence into practice to design a targeted approach to knowledge translation. We are both encouraged and challenged to continue to monitor trends in hip fracture research and adjust orthopaedic clinical practice when warranted by high-quality evidence.

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