

Association of length of hospital stay with delay to surgical fixation of hip fracture

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Background: Previous research has shown increases in length of stay (LOS), morbidity and mortality when the standard for surgical fixation of hip fracture of 48 hours is not met. However, few investigators have analyzed LOS as a primary outcome, and most used time of diagnosis as opposed to time of fracture as the reference point. We examined the effect of time to surgical fixation of hip fracture, measured from time of fracture, on length of hospital stay; the secondary outcome was average 1-year mortality.

Methods: We conducted a retrospective cohort study of patients presenting to 1 of 2 tertiary care centres in St. John's, Newfoundland and Labrador, Canada, with a hip fracture from Jan. 1, 2014, to Dec. 31, 2018. We analyzed 3 groups based on timing of surgical fixation after fracture: less than 24 hours (group 1), 24–48 hours (group 2) and more than 48 hours (group 3). We assessed statistical significance using 1-way analysis of variance.

Results: Of the 692 patients included in the study, 212 (30.6%) were in group 1, 360 (52.0%) in group 2 and 120 (17.3%) in group 3. A delay to surgical fixation exceeding 48 hours was associated with a significantly longer LOS, by an average of 2.9 and 2.8 days compared to groups 1 and 2, respectively ($p = 0.04$); there was no significant difference in LOS between groups 1 and 2. A significant difference in average 1-year mortality was observed between groups 1 (11%) and 3 (26%) ($p = 0.004$), and groups 2 (13%) and 3 ($p = 0.009$).

Conclusion: Surgical fixation beyond 48 hours after hip fracture resulted in significantly increased LOS and 1-year mortality. Further research should be conducted to evaluate reasons for delays to surgery and the effects of these delays on time to surgical fixation as measured from time of fracture.

Contexte : Des recherches ont montré une augmentation de la durée du séjour hospitalier, de la morbidité et de la mortalité lorsque la norme de fixation chirurgicale de la fracture de la hanche de 48 heures n'est pas respectée. Toutefois, peu de chercheurs ont analysé la durée du séjour en tant que paramètre principal, et la plupart ont utilisé le moment du diagnostic plutôt que celui de la fracture comme point de référence. Nous avons examiné l'effet du délai de fixation chirurgicale de la fracture de la hanche, mesuré à partir du moment de la fracture, sur la durée du séjour hospitalier; le paramètre secondaire était la mortalité moyenne à 1 an.

Méthodes : Nous avons procédé à une étude de cohorte rétrospective sur des patients s'étant présentés dans 1 des 2 centres de soins tertiaires de St. John's, à Terre-Neuve-et-Labrador (Canada), avec une fracture de la hanche, du 1^{er} janvier 2014 au 31 décembre 2018. Nous avons analysé 3 groupes en fonction du délai de fixation chirurgicale après la fracture : moins de 24 heures (groupe 1), de 24–48 heures (groupe 2) et plus de 48 heures (groupe 3). Nous avons évalué la portée statistique au moyen d'une analyse de la variance simple.

Résultats : Sur les 692 patients inclus dans l'étude, 212 (30,6%) faisaient partie du groupe 1; 360 (52,0%), du groupe 2; et 120 (17,3%), du groupe 3. Un délai de fixation chirurgicale supérieur à 48 heures était associé à une durée du séjour hospitalier considérablement plus longue, de 2,9 et 2,8 jours en moyenne par rapport aux groupes 1 et 2, respectivement ($p = 0,04$); il n'y avait pas de différence importante de durée du séjour entre les groupes 1 et 2. Une différence significative de la mortalité moyenne à 1 an a cependant été observée entre les groupes 1 (11%) et 3 (26%) ($p = 0,004$), et les groupes 2 (13%) et 3 ($p = 0,009$).

Conclusion : La fixation chirurgicale au-delà de 48 heures après une fracture de la hanche a entraîné une augmentation notable de la durée du séjour hospitalier et de la mortalité à 1 an. D'autres recherches devront être menées pour évaluer les raisons des retards de la chirurgie et leurs effets sur le délai de fixation chirurgicale, mesuré à partir du moment de la fracture.

Every year in Canada, about 24 000 hip fractures occur out of hospital.¹ The morbidity and mortality associated with hip fractures is not insignificant. In addition, the associated costs and strain on health care resources are substantial. One of the most important contributors to increased health care costs associated with hip fractures is length of stay (LOS). Therefore, achieving the benchmark of surgical fixation within 48 hours has been set as a priority in an effort to reduce associated morbidity, mortality and LOS.^{1,2}

In 2019, 86% of Canadian patients with a hip fracture had surgical fixation within 48 hours.¹ However, in some lower-income countries, nonsurgical management may be employed. A study conducted in Singapore by Tan and colleagues³ showed that nonsurgical management of hip fractures led to increased LOS and mortality. In contrast, many studies conducted internationally have analyzed the benefits of surgical fixation within 48 hours and shown decreased morbidity, mortality and LOS.⁴⁻⁸ However, fewer studies have analyzed differences in outcomes, including LOS, among who patients undergo surgical fixation less than 24 hours after hip fracture.^{9,10} Furthermore, most investigators have used time of diagnosis, as opposed to time of fracture, as the reference point. In the current study, we analyzed the LOS for patients who underwent surgical fixation less than 24 hours, 24–48 hours and more than 48 hours after hip fracture occurrence.

METHODS

This retrospective cohort study included patients presenting to 1 of 2 tertiary care centres in St. John's, Newfoundland and Labrador, from Jan. 1, 2014, to Dec. 31, 2018. This study was approved by the Newfoundland and Labrador Health Research Ethics Authority and the Newfoundland and Labrador Centre for Health Information.

We included patients with hip fracture (intracapsular or extracapsular) diagnosed by radiographic imaging who underwent surgical fixation and whose first presentation was to 1 of the 2 tertiary care centres in St. John's. Exclusion criteria included nonoperative hip fracture, periprosthetic fracture, pathologic fracture, revision surgery, inadequate electronic documentation, and fracture while in hospital; we also excluded all patients residing more than 50 km outside of St. John's who were eligible for postoperative transfer to local community hospitals.

We reviewed patient electronic medical records as well as the hip fracture database collated by the regional health organization. We collected patient demographic characteristics including age, sex, past medical history (to enable American Society of Anesthesiology [ASA] categorization) and type of surgical procedure. We also obtained data on date of admission, time of fracture, time to surgery, surgical procedure, LOS and 1-year mortality.

Outcomes

The primary outcome measure was LOS in the tertiary care facility, as determined from electronic discharge summaries. We calculated LOS from the time of surgical fixation to the day of discharge. The secondary outcome was average 1-year mortality.

Statistical analysis

We categorized patients into 3 groups on the basis of time to surgical fixation after hip fracture: less than 24 hours (group 1), 24–48 hours (group 2) and more than 48 hours (group 3). The primary outcome analysis was designed to determine whether time to surgical fixation had an effect on LOS in the tertiary care centre. We conducted a power analysis using NCSS power analysis and statistical software (PASS 2020) to determine sample size for the 3 groups. To detect a significant difference among groups at a power of 80% ($\alpha = 0.05$, $\beta = 0.20$), it was determined that a minimum sample size of 110 patients would be required for each group. We conducted data analysis using SSPS 23.0 software (IBM Corp.).

We performed descriptive statistics for the data set. We conducted a Levene test for homogeneity of variance between all groups; the result was not significant ($p > 0.05$). We then conducted 1-way analysis of variance to compare LOS among the 3 groups. Furthermore, to analyze between-group differences individually, we conducted Bonferroni post hoc tests. Results were expressed as mean and standard deviation (SD), and statistical significance was set at $p < 0.05$.

RESULTS

We reviewed the charts of 1220 patients, of whom 692 met the inclusion criteria. There were 212 patients (30.6%) in group 1, 360 (52.0%) in group 2 and 120 (17.3%) in group 3. Characteristics of the 3 groups are presented in Table 1. The average time to surgical fixation was 16.9 (SD 5.7) hours for group 1, 33.7 (SD 7.2) hours for group 2 and 63.5 (SD 18.5) hours for group 3.

The average LOS was 12.6 (SD 6.1) days for group 1, 12.7 (SD 7.3) days for group 2 and 15.5 (SD 10.1) days for group 3 ($F = 3.643$, $p = 0.03$) (Figure 1). When LOS was further analyzed with the Bonferroni post hoc analysis, a significant difference of 2.9 days was found between groups 1 and 3 ($p = 0.04$). A clinically significant difference of 2.8 days was also found between groups 2 and 3 ($p = 0.04$). However, no significant difference in LOS was found between groups 1 and 2 ($p > 0.99$).

The average 1-year mortality rate was 11% for group 1, 13% for group 2 and 26% for group 3 ($F = 5.847$, $p = 0.003$) (Figure 2). The post hoc analysis showed significant differences between groups 1 and 3 ($p = 0.004$) and between groups 2 and 3 ($p = 0.009$). No significant differences were found between groups 1 and 2 ($p > 0.99$).

Table 1. Characteristics of patients with hip fracture by time to surgical fixation

Characteristic	Time to fixation, h; no. (%) of patients*			p value
	< 24 n = 212	24–48 n = 360	> 48 n = 120	
Age, mean ± SD, yr	79.8 ± 10.1	80.5 ± 10.3	80.3 ± 10.4	0.1
Sex				0.2
Female	158 (74.5)	280 (77.8)	85 (70.8)	
Male	54 (25.5)	80 (22.2)	35 (29.2)	
ASA score, mean ± SD	3.15 ± 0.43	3.17 ± 0.42	3.20 ± 0.47	0.1
Procedure				0.3
Hemiarthroplasty	98 (46.2)	166 (46.1)	64 (53.3)	
Total hip arthroplasty	8 (3.8)	17 (4.7)	6 (5.0)	
Dynamic hip screw	33 (15.6)	49 (13.6)	17 (14.2)	
Cephalomedullary nail	71 (33.5)	125 (34.7)	31 (25.8)	
Closed reduction percutaneous pinning	2 (0.9)	3 (0.8)	2 (1.7)	

ASA = American Society of Anesthesiology; SD = standard deviation.
*Except where noted otherwise.

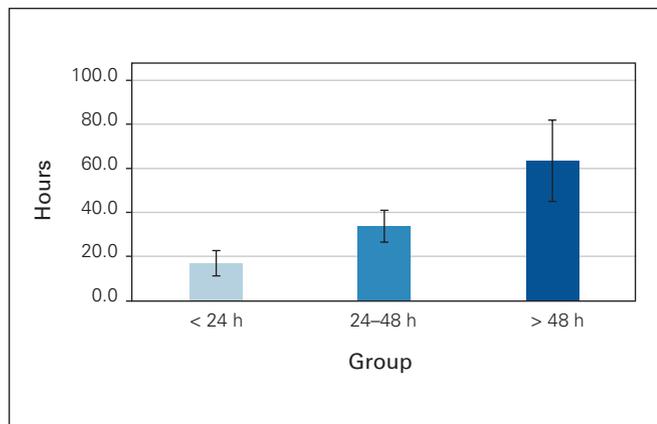


Fig. 1. Average length of postoperative stay for patients who underwent fixation less than 24 hours after fracture, 24–48 hours after fracture and more than 48 hours after fracture. Error bars represent standard deviations.

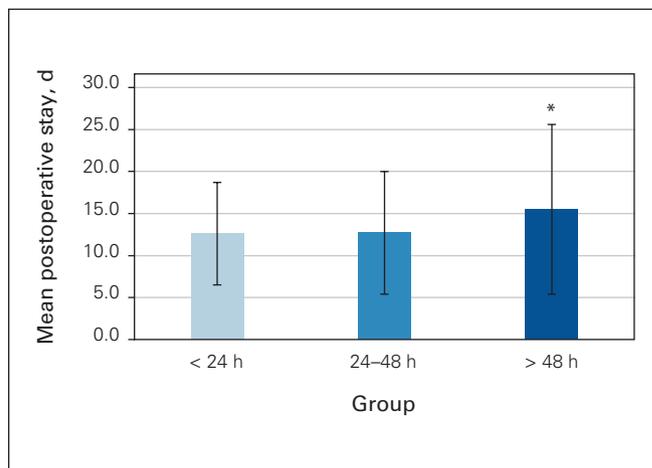


Fig. 2. Average 1-year mortality rate for the 3 groups. Error bars represent standard deviations.*Significant difference compared to the other groups ($p < 0.01$).

DISCUSSION

This study showed that a delay to surgical fixation of hip fractures of greater than 48 hours resulted in an increased LOS. We were unable to show an advantage in terms of LOS when we compared patients with time to fixation of less than 24 hours to those with time to fixation of 24–48 hours. A significant increase in 1-year mortality was associated with fixation after 48 hours.

Increased LOS with hip fracture fixation beyond 48 hours after diagnosis has been well documented.^{11–14} In a systematic review, Khan and colleagues⁴ found that surgery performed within 48 hours was associated with decreased LOS, mortality and complications. Nikkel and colleagues⁵ reported that decreased LOS was associated with decreased 30-day mortality. Other studies

have shown an association between surgical fixation within 48 hours and decreased mortality.^{6–8}

There are fewer studies analyzing surgical fixation less than 24 hours after admission, and they have yielded conflicting results regarding mortality. Fu and colleagues¹⁰ concluded that surgery performed less than 24 hours after admission was associated with reduced LOS. However, those authors looked at a composite outcome, “extended LOS” (defined as > 6 d). We examined the time frame of 24–48 hours from fracture to surgical fixation and found no difference between this group and patients who had fixation less than 24 hours after hip fracture. Orosz and colleagues⁹ showed reduced LOS for patients who had surgery within 24 hours after admission, but they compared this group to patients who underwent surgery more than 24 hours after admission, which would include our group 2 (24–48 h).

The HIP ATTACK Investigators¹⁵ conducted an international multicentre randomized controlled trial to analyze the effect of even more accelerated surgery (< 6 h) and found that it was not superior to standard care in terms of the coprimary outcomes of mortality and a composite of major complications. The trial had the added strength of analyzing differences in delay between fracture and presentation between the 2 groups, which were found to be similar. Unlike the current study, however, a significant reduction in LOS was observed. This difference was seen when comparing surgery within 6 hours versus standard care, which was not assessed in the current study.

Issues affecting time to surgical fixation include optimization of medical comorbidities, decreased available operating time, delayed presentation to hospital and determination of surgical fitness.^{16–18} Although the gold standard for time to surgical fixation is within 48 hours, there are many factors, both patient and hospital, that can influence time to surgery.

Limitations

Strengths of the current study include the measuring of time to surgical fixation from time of fracture as opposed to time of admission. Most previous studies showed reduced LOS with surgical fixation less than 48 hours after admission.^{11,19,20} However, few studies measured time from the fracture itself to surgery.^{6,15} Measuring from the time of fracture may have important implications for optimizing treatment. Another strength is that patients from rural areas were excluded. This is important as there is a protocol in place at the tertiary care centres that ensures that patients return to the referring site 48 hours after surgery is completed, which would have skewed the data. Furthermore, the inclusion of the analysis of ASA scores between groups ensured that all groups were similar in terms of comorbid status, thus decreasing the potential confounding effects on LOS.

Our study also has limitations. The study population was limited to patients at 2 hospitals servicing the province. In addition, unlike Simunovic and colleagues,²¹ we did not analyze the relation between time to surgery and postoperative complications. Furthermore, we did not look at specific postoperative reasons for increased LOS.

CONCLUSION

This study showed that LOS was increased significantly when time to surgical fixation exceeded 48 hours from time of fracture. This was not seen when we compared patients who had surgery less than 24 hours after fracture and those who had surgery 24–48 hours after fracture. Significantly greater 1-year mortality was observed with surgical fixation beyond 48 hours after fracture, but no difference was seen between patients who underwent surgery

less than 24 hours after fracture and those who had surgery within 24–48 hours. These findings support not only the gold standard of fixation within 48 hours but also measurement of time from fracture occurrence rather than time from diagnosis. As increased LOS translates into increased health care costs, further research should be conducted to evaluate reasons for delays to surgery and the effects of these delays on time to surgical fixation measured from time of fracture.

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Contributors: All authors designed the study. J. Murphy, J. Loh and N.C. Stone acquired the data, which J. Murphy and J. Loh analyzed. J. Murphy wrote the manuscript, which all authors critically revised. All authors gave final approval of the article to be published.

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