

Cost and safety of inpatient versus outpatient open reduction internal fixation of isolated ankle fractures

Nicholas Pasic, MD
 Jason Akindolire, MD
 Laura Churchill, PhD
 Silvio Ndoja, BSc
 Christopher Del Balso, MD
 Abdel-Rahman Lawendy, MD,
 PhD
 Brent Lanting, MD
 Ryan M. Degen, MD

Accepted Mar. 17, 2021

Correspondence to:

N. Pasic
 Division of Orthopaedic Surgery
 Department of Surgery
 Western University
 1151 Richmond St
 London ON N6A 3K7
 pasicnick@gmail.com

Cite as: *Can J Surg* 2022 April 8; 65(2).
 doi: 10.1503/cjs.016420

Background: As health care shifts to value-based models, one strategy within orthopedics has been to transition appropriate cases to outpatient or ambulatory settings to reduce costs; however, there are limited data on the efficacy and safety of this practice for isolated ankle fractures. The purpose of this study was to compare the cost and safety associated with inpatient versus outpatient ankle open reduction internal fixation (ORIF).

Methods: All patients who underwent ORIF of isolated closed ankle fractures at 2 affiliated hospitals between April 2016 and March 2017 were identified retrospectively. Demographic characteristics, including age, gender, comorbidities and injury-specific variables, were collected. We grouped patients based on whether they underwent ankle ORIF as an inpatient or outpatient. We determined case costing for all patients and analyzed it using multivariate regression analysis.

Results: A total of 196 patients (125 inpatient, 71 outpatient) were included for analysis. Inpatients had a significantly longer mean length of stay than outpatients (54.3 h [standard deviation (SD) 36.3 h] v. 7.5 h [SD 1.7 h], $p < 0.001$). The average cost was significantly higher for the inpatient cohort than the outpatient cohort (\$4137 [SD \$2285] v. \$1834 [SD \$421], $p < 0.001$). There were more unimalleolar ankle fractures in the outpatient group than in the inpatient group (42 [59.2%] v. 41 [32.8%], $p < 0.001$). Outpatients waited longer for surgery than inpatients (9.6 d [SD 5.6 d] v. 2.0 d [SD 3.3 d], $p < 0.001$). Fourteen patients (11.2%) in the inpatient group presented to the emergency department or were readmitted to hospital within 30 days of discharge, compared to 5 (7.0%) in the outpatient group ($p = 0.3$).

Conclusion: In the treatment of isolated closed ankle fractures, outpatient surgery was associated with a significant reduction in length of hospital stay and overall case cost compared to inpatient surgery, with no significant difference in readmission or reoperation rates. In medically appropriate patients, isolated ankle ORIF can be performed safely in an ambulatory setting and is associated with significant cost savings.

Contexte : Dans le cadre de l'évolution des soins de santé vers des modèles fondés sur la valeur, l'une des stratégies des services d'orthopédie consiste à transférer les cas qui s'y prêtent vers des structures de consultation externe et de soins ambulatoires afin de réduire les coûts; cependant, il existe peu de données sur l'efficacité et la sécurité de cette méthode pour les fractures isolées de la cheville. L'objectif de l'étude était de comparer les coûts et la sécurité liés à la réduction ouverte et fixation interne (ROFI) de la cheville en milieu hospitalier et en milieu ambulatoire.

Méthodes : Tous les patients qui ont subi une ROFI pour des fractures fermées isolées de la cheville dans 2 hôpitaux affiliés entre avril 2016 et mars 2017 ont été identifiés rétrospectivement. Les caractéristiques démographiques, notamment l'âge, le sexe, les comorbidités et les variables relatives aux blessures, ont été recueillies. Nous avons regroupé les patients selon qu'ils avaient subi une ROFI en tant que patient hospitalisé ou ambulatoire. Pour chaque patient, nous avons établi les coûts de l'intervention, que nous avons soumis à une analyse de régression multivariée.

Résultats : Au total, 196 patients (125 patients hospitalisés et 71 patients ambulatoires) ont été inclus dans l'analyse. La durée moyenne de séjour des patients hospitalisés était significativement plus longue que celle des patients ambulatoires (54,3 h [écart-type (É.-T.) 36,3 h] contre 7,5 h [É.-T. 1,7 h], $p < 0,001$). Les coûts moyens étaient significativement plus élevés pour la cohorte des patients hospitalisés que pour celle des patients ambulatoires (4137 \$ [É.-T. 2285 \$] c. 1834 \$ [É.-T. 421 \$], $p < 0,001$). Les fractures unimalléolaires de la cheville étaient plus nombreuses dans le groupe des patients ambulatoires que dans celui des patients

hospitalisés (42 [59,2 %] c. 41 [32,8 %], $p < 0,001$). Les patients ambulatoires ont attendu plus longtemps pour être opérés que les patients hospitalisés (9,6 j [É.-T. 5,6 j] c. 2,0 j [É.-T. 3,3 j], $p < 0,001$). Quatorze patients (11,2 %) du groupe des patients hospitalisés se sont présentés aux urgences ou ont été réadmis à l'hôpital dans les 30 jours suivant leur congé, contre 5 (7,0 %) pour le groupe des patients ambulatoires ($p = 0,3$).

Conclusion : Dans le traitement des fractures fermées isolées de la cheville, la chirurgie ambulatoire a été associée à une réduction significative de la durée d'hospitalisation et du coût global par rapport à la chirurgie hospitalière, sans différence significative des taux de réadmission ou de réintervention. Lorsque la situation médicale le justifie, la ROFI de la cheville peut être effectuée en toute sécurité dans un cadre ambulatoire et permet de réaliser d'importantes économies.

Ankle fractures represent one of the most common orthopedic injuries, accounting for about 10% of all musculoskeletal injuries^{1,2} and more than half of all foot and ankle injuries.¹⁻³ International trends suggest that the incidence of ankle fractures will continue to rise along with an increasing average population age.⁴ A considerable proportion of ankle fractures are ultimately managed surgically with open reduction internal fixation (ORIF). Ankle ORIF can be performed on an inpatient or outpatient basis. Conventionally, inpatient ORIF is seen as the standard of care for patients who have experienced polytrauma with concomitant injuries and open fractures, and those with multiple medical comorbidities. However, for patients with isolated closed ankle fractures with few medical comorbidities, treatment pathways are often poorly defined. Hospital admission is frequently required to facilitate treatment if access to ambulatory operating room time is not readily available. This availability issue may be more prevalent in Canada and other publicly funded health care systems, where the use of private surgical centres is less common.

The decision regarding inpatient versus outpatient ORIF has important financial implications⁵ that are particularly relevant in the current health care climate, with an increasing focus on cost-effectiveness and bundled payments for surgical procedures.⁶ Canada remains one of the biggest spenders in health care in the Organisation for Economic Co-operation and Development: in 2019, health care spending reached 11.6% of the gross domestic product, or almost \$7000 per person.⁷ In addition, nursing inpatient services represent almost 20% of hospital spending in Canada.⁷ This is the largest share of hospital spending by functional area and thus a rationale for favouring outpatient over inpatient surgery whenever feasible.

There is ample evidence supporting the safety and efficacy of outpatient surgery in different orthopedic procedures, including total joint arthroplasty and spine surgery,⁸⁻¹⁰ but there is a relative paucity of evidence in the setting of orthopedic trauma or foot and ankle surgery. Neither of the studies that we identified were conducted in a publicly funded single-payer health care system.^{11,12} As such, we aimed to compare the cost and resource use associated with inpatient and outpatient ankle ORIF at a Can-

adian academic tertiary care institution. In addition, we aimed to report on the safety and appropriateness of outpatient care by reporting on postoperative emergency department visits, readmissions and 30-day complications, as well as reoperation rates. We hypothesized that outpatient ankle surgery is a cost-effective and safe option for isolated closed ankle fractures.

METHODS

After obtaining approval from the Western University Delegated Health Sciences Research Ethics Board, we performed an electronic chart review to identify our study cohort. We identified all patients who underwent ORIF for an acute ankle fracture at 1 of 2 hospitals between April 2016 and March 2017. The inclusion criteria included all isolated closed ankle fractures that underwent ORIF of a lateral malleolus, bimalleolar or trimalleolar fracture. The exclusion criteria included open fracture, polytrauma, bilateral ankle fractures, and fractures requiring temporary external fixation or a staged procedure owing to traumatic soft-tissue swelling or injuries.

We grouped patients based on whether they were treated surgically as an inpatient or outpatient. Patients treated as outpatients present to the hospital from home the day of surgery and return home that same day after meeting criteria for safe discharge. The decision as to inpatient versus outpatient treatment was made at the discretion of the treating surgeon, largely dependent on access to ambulatory operating room time and patient comorbidities. At 1 of the 2 hospitals, patients with ankle fractures are typically managed as inpatients, whereas at the other, there is a slight predilection to manage these patients as outpatients owing to greater availability of ambulatory operating room time. Both hospitals are capable of providing both inpatient and outpatient care.

Preoperative patient characteristics collected included age, sex, body mass index and American Society of Anesthesiologists (ASA) score. Operative and postoperative data, including preoperative consultations from other services (medicine or anesthesia), time to surgery, operating time and length of hospital stay, were also recorded. Charts were screened for postoperative

complications, readmissions and emergency department visits within 30 days after surgery.

Statistical analysis

We compared variables between the inpatient and outpatient groups using a 2-sample *t* test for continuous variables and χ^2 test for multiple categorical variables. Continuous variables were expressed as mean and standard deviation (SD), and categorical variables, including 30-day readmissions and return emergency department visits, were reported as absolute values and percentages. We assessed the effect of inpatient versus outpatient status on 30-day readmissions and return emergency department visits both using a 2-sample *t* test and via a logistic regression analysis.

RESULTS

A total of 196 patients were included for analysis, 125 in the inpatient group and 71 in the outpatient group. The demographic and clinical characteristics of the 2 groups are presented in Table 1. There were no differences between groups in age, body mass index or ASA score. The inpatient cohort had a higher proportion of females than the outpatient cohort (75 [60.0%] v. 31 [43.7%], $p = 0.03$).

Surgical variables for the 2 groups, including fracture pattern and number of malleoli requiring ORIF, time to surgery, operating time and length of hospital stay, as well as 3-day readmissions and postoperative complications, are summarized in Table 2. The outpatient group had a greater proportion of isolated unimalleolar injuries and a smaller proportion of bimalleolar or trimalleolar injuries ($p < 0.001$). The mean operating time was 9 minutes shorter in the outpatient group than in the inpatient group

(50.4 [SD 27.8] min v. 59.8 [SD 23.6] min, $p < 0.001$). The mean length of stay was sevenfold greater in the inpatient group than in the outpatient group (54.3 [SD 36.3] h, v. 7.5 [SD 1.7] h, $p < 0.001$). The mean cost associated with inpatient surgery was significantly greater than that for outpatient surgery (\$4137 [SD 2285] v. \$1834 [SD 421], $p < 0.001$). However, those in the outpatient group were 1 week further removed from their injury at the time of surgery than those in the inpatient group (9.6 [SD 5.6] d v. 2.0 [SD 3.3] d, $p < 0.001$).

There was a nonsignificant trend toward a higher 30-day readmission rate in the inpatient group than in the outpatient group (3.2% v. 0.0%, $p = 0.3$). Four patients, all in the inpatient group, were readmitted. Two patients required revision ankle ORIF, 1 required irrigation and débridement for infection, and 1 required medical management of *Clostridioides difficile* colitis. The most common reasons for return to the emergency department were pain control, cast concerns and wound concerns.

DISCUSSION

Use of health care resources continues to be a large focus as care shifts to value-based models. Within orthopedics, one strategy has been to transition appropriate cases to outpatient or ambulatory settings as an increasingly popular method of providing cost-effective care. There is literature to support this strategy across orthopedic subspecialties, including arthroplasty, spine surgery, and foot and

Table 1. Demographic and clinical characteristics of patients who underwent open reduction internal fixation of acute ankle fracture as an inpatient or outpatient

Characteristic	No. (%) of patients*	
	Inpatient <i>n</i> = 125	Outpatient <i>n</i> = 71
Age, mean SD, yr	42.0 ± 17.5	44.2 ± 16.0
Sex		
Female	75 (60.0)	31 (43.7)
Male	50 (40.0)	40 (56.3)
Body mass index, mean ± SD	29.1 ± 6.0	31.1 ± 5.7
Preoperative consultation†	1 (0.8)	6 (8.4)
ASA score		
I	33 (26.4)	21 (29.6)
II	56 (44.8)	41 (57.7)
III	34 (27.2)	8 (11.3)
IV	2 (1.6)	1 (1.4)

ASA = American Society of Anesthesiologists; SD = standard deviation.
*Except where noted otherwise.
†Medicine or anesthesia.

Table 2. Surgical variables, outcomes and costs

Variable	No. (%) of patients*		<i>p</i> value
	Inpatient	Outpatient	
Treatment			< 0.001
Isolated/unimalleolar	41 (32.8)	42 (59.2)	
Bimalleolar	68 (54.4)	22 (31.0)	
Trimalleolar	16 (12.8)	7 (9.9)	
Time to surgery, mean ± SD, d	2.0 ± 3.3	9.6 ± 5.6	< 0.001
Length of stay, mean ± SD, h	54.3 ± 36.3	7.5 ± 1.7	< 0.001
Operative time, mean ± SD, min	59.8 ± 23.6	50.4 ± 27.8	0.01
30-day readmission	4 (3.2)	0 (0.0)	0.3
Reoperation	2 (1.6)	0 (0.0)	0.5
Return visit to emergency department	10 (8.0)	5 (7.0)	0.4
Pain control	3 (2.4)	3 (4.2)	
Cast concern	3 (2.4)	1 (1.4)	
Superficial infection	2 (1.6)	0 (0.0)	
Medication overdose	1 (0.8)	0 (0.0)	
Shortness of breath	1 (0.8)	0 (0.0)	
Wound concern	0 (0.0)	1 (1.4)	
Cost, mean ± SD, \$	4137 ± 2285	1834 ± 421	< 0.001

SD = standard deviation.
*Except where noted otherwise.

ankle surgery.^{8-11,13-17} Patient-reported outcomes, satisfaction rates and complication rates comparable to those in the inpatient setting have been reported, in addition to substantial cost savings. The findings of the present study are similar: outpatient ankle ORIF was associated with a significantly shorter length of hospital stay, cost savings of more than 50%, and no difference in postoperative complications compared to inpatient ankle ORIF, despite a longer period from initial injury to surgery. As such, we conclude that outpatient ankle ORIF represents a safe, cost-effective option for management of isolated closed ankle fractures. Unimalleolar ankle fractures seem particularly amenable to outpatient surgery based on the observed low complication rates in this subcategory.

In this retrospective cohort study, there was an average savings of \$2303 per case associated with outpatient surgery. Furthermore, the mean length of hospital stay was more than 7 times greater for the inpatient cohort than for the outpatient cohort. This is important in today's medical climate, with the increasing use of bundled payments, as well as the relative scarcity of available inpatient beds that many single-payer public health care hospitals face. In a 2001 study from the United Kingdom, James and colleagues¹⁸ determined costs accrued by admitted patients with ankle fractures awaiting surgery. After adjustment for inflation, the cost per day of an acute trauma bed was Can\$560. Therefore, before arrival in the operating room, inpatients in our study accumulated over \$1000 more in costs than outpatients with regard to surgical inpatient services alone. On the other hand, it is worth considering the costs associated with increased time between the initial injury and definitive surgery in the outpatient group. In our study, on average, outpatients underwent surgery more than 9 days after their fracture, which was 1 week later than the inpatient cohort, and delayed their recovery and ability to return as a productive member of the workforce.

Our findings are consistent with those of studies conducted in the US. Bettin and colleagues¹¹ reported that costs were more than 31.6% lower with outpatient versus inpatient surgery in the treatment of isolated ankle fractures at a level 1 trauma hospital. In a retrospective review of a large insurance claims database, Malik and colleagues¹² identified even greater cost savings, almost 41%, in the outpatient surgery group. In addition, multiple studies have shown rates of revision surgery and complications associated with hospital admission for ankle ORIF that are equal to or higher than those for outpatient surgery, which provides further support for outpatient management.^{13,14,16-18} Furthermore, there is ample evidence that outpatient surgery is not only safe and cost-effective, but is also associated with outcomes that are at least equivalent to those with inpatient surgery.^{4,14,19,20} Retrospective analysis of a National Surgical Quality Improvement Program database showed that patients who had isolated ankle fracture repair performed as an outpatient procedure had

lower overall complication rates than inpatient cohorts.⁸ Similarly, a retrospective study evaluating 256 outpatient and 226 inpatient ankle ORIF procedures over a 5-year period at a US level 1 trauma centre showed a threefold decrease in the rate of postoperative complications and of unplanned surgical revisions in the outpatient group.¹⁷ The trauma centre had a well-established institutional protocol of managing isolated ankle fractures on an outpatient basis, with defined care pathways to facilitate access to ambulatory operating room resources.

If a paradigm shift is to occur in treating isolated closed ankle fractures, judicious patient selection will be required. Fractures in patients with multiple comorbidities, high ASA scores or high-energy mechanisms, and those with residual displacement after attempted reduction would be more amenable to inpatient surgery.²¹⁻²³ In a recent Canadian study, Wolfstadt and colleagues¹⁹ reported on the development of an outpatient care pathway in ambulatory fracture surgery. Over 2 years, interventions put into place increased the proportion of patients managed as outpatients substantially, from 1.6% to 89.1%. That study illuminated some of the difficulties associated with providing outpatient care. Most notably, education tailored to allied health care professionals in the postanesthesia care unit and the emergency department was crucial to implementation of this change. In addition, policy changes regarding the logistics of booking outpatient cases, as well as increased access to an urgent daytime operating room were important initiatives. Until outpatient surgery centres become readily available in Canada, there will continue to be a need to streamline outpatient fracture procedures.

Limitations

This study was a retrospective review, and the decision to manage as an inpatient or outpatient was made by the treating surgeon. Consequently, the results may not be generalizable to all patients, as there may be those with comorbidities or grossly unstable fracture patterns who are not fit for discharge and outpatient treatment. In addition, the results are limited to 2 hospitals; however, this ensures the accuracy of the costing data and comparable surgical decision-making between sites. The results are limited to financial implications and complication rates associated with inpatient versus outpatient surgery; the study did not consider functional outcome measures. In addition, the societal implications of delayed treatment, thereby delaying recovery, by 1 week are unknown. Future studies should include this additional time in their costing models to evaluate whether it carries any significant implications.

CONCLUSION

In the treatment of isolated closed ankle fractures in a publicly funded, single-payer health care system, outpatient

surgery was associated with a significant reduction in length of hospital stay and overall case cost compared to inpatient surgery. In addition, there was a nonsignificant trend toward fewer return visits to the emergency department or readmission within 30 days of discharge with outpatient surgery. In medically appropriate patients, isolated ankle ORIF can be performed on an outpatient basis as it represents a safe and economically superior alternative to inpatient treatment.

Affiliations: From the Division of Orthopedic Surgery, Department of Surgery, Western University, London, Ont. (Pasic, Akindolire, Ndoja, Del Balso, Lawendy, Lanting, Degen); and the Fowler Kennedy Sport Medicine Clinic, Western University, London, Ont. (Churchill, Degen).

Competing interests: None declared.

Contributors: S. Ndoja, A.-R. Lawendy, B. Lanting and R. Degen designed the study. N. Pasic, J. Akindolire, S. Ndoja, C. Del Balso and A.-R. Lawendy acquired the data, which N. Pasic, J. Akindolire, L. Churchill, C. Del Balso and A.-R. Lawendy analyzed. N. Pasic wrote the manuscript, which all authors critically revised. All authors gave final approval of the article to be published.

Content licence: This is an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY-NC-ND 4.0) licence, which permits use, distribution and reproduction in any medium, provided that the original publication is properly cited, the use is noncommercial (i.e., research or educational use), and no modifications or adaptations are made. See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

References

- White T, Bugler K. Ankle fractures. In: Tornetta P 3rd, Ricci WM, Ostrum RF, et al, editors. *Rockwood and Green's fractures in adults*, 9th ed. Vol 2. Philadelphia: Wolters Kluwer; 2020;2822-76.
- Shibuya N, Davis ML, Jupiter DC. Epidemiology of foot and ankle fractures in the United States: an analysis of the National Trauma Data Bank (2007 to 2011). *J Foot Ankle Surg* 2014;53:606-8.
- Jupiter DC, Hsu ES, Liu GT, et al. Risk factors for short-term complication after open reduction and internal fixation of ankle fractures: analysis of a large insurance claims database. *J Foot Ankle Surg* 2020; 59:239-45.
- Kannus P, Palvanen M, Niemi S, et al. Increasing number and incidence of low-trauma ankle fractures in elderly people: Finnish statistics during 1970-2000 and projections for the future. *Bone* 2002;31: 430-3.
- Rammelt S. Management of ankle fractures in the elderly. *EFORT Open Rev* 2017;1:239-46.
- Rana AJ, Bozic KJ. Bundled payments in orthopaedics. *Clin Orthop Relat Res* 2015;473:422-5.
- Health spending. Ottawa: Canadian Institute for Health Information; 2019. Available: <https://www.cihi.ca/en/health-spending/> (accessed 2020 Mar. 9).
- Pugely AJ, Martin CT, Gao Y, et al. Outpatient surgery reduces short-term complications in lumbar discectomy: an analysis of 4310 patients from the ACS-NSQIP database. *Spine* 2013;38:264-71.
- Gonzalez T, Fisk E, Chiodo C, et al. Economic analysis and patient satisfaction associated with outpatient total ankle arthroplasty. *Foot Ankle Int* 2017;38:507-13.
- Aynardi M, Post Z, Ong A, et al. Outpatient surgery as a means of cost reduction in total hip arthroplasty: a case-control study. *HSS J* 2014;10:252-5.
- Bettin C, Nelson R, Rothberg D, et al. Cost comparison of surgically treated ankle fractures managed in an inpatient versus outpatient setting. *J Am Acad Orthop Surg* 2019;27:e127-34.
- Malik AT, Quatman CE, Khan SN, et al. Outpatient versus inpatient surgical fixation of isolated ankle fractures: an analysis of 90-day complications, readmissions, and costs. *J Foot Ankle Surg* 2020;59:502-6.
- Konrath G, Karges D, Watson JT, et al. Early versus delayed treatment of severe ankle fractures: a comparison of results. *J Orthop Trauma* 1995;9:377-80.
- Qin C, Dekker RG, Blough JT, et al. Safety and outcomes of inpatient compared with outpatient surgical procedures for ankle fractures. *J Bone Joint Surg Am* 2016;98:1699-705.
- Qin C, Dekker RG, Helfrich MM, et al. Outpatient management of ankle fractures. *Orthop Clin North Am* 2018;49:103-8.
- Stull JD, Bhat SB, Kane JM, et al. Economic burden of inpatient admission of ankle fractures. *Foot Ankle Int* 2017;38:997-1004.
- Weckbach S, Flierl MA, Huber-Lang M, et al. Surgical treatment of ankle fractures as an outpatient procedure. A safe and resource-efficient concept? [article in German]. *Unfallchirurg* 2011;114:938-42.
- James LA, Sookhan N, Subar D. Timing of operative intervention in the management of acutely fractured ankles and the cost implications. *Injury* 2001;32:469-72.
- Wolfstadt JI, Wayment L, Koyle MA, et al. The development of a standardized pathway for outpatient ambulatory fracture surgery: to admit or not to admit. *J Bone Joint Surg Am* 2020;102:110-8.
- Breederveld RS, van Straaten J, Patka P, et al. Immediate or delayed operative treatment of fractures of the ankle. *Injury* 1988;19:436-8.
- Murray AM, McDonald SE, Archbold P, et al. Cost description of inpatient treatment for ankle fracture. *Injury* 2011;42:1226-9.
- Westacott DJ, Abosala AA, Kurdy NM. The factors associated with prolonged inpatient stay after surgical fixation of acute ankle fractures. *J Foot Ankle Surg* 2010;49:259-62.
- Miller AG, Margules A, Raikin SM. Risk factors for wound complications after ankle fracture surgery. *J Bone Joint Surg Am* 2012;94: 2047-52.