

Metacarpal Fracture Fixation in a Minor Surgery Setting Versus Main Operating Room: A Cost-minimization Analysis

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Background: The objective of this study was to compare the costs of performing metacarpal fracture fixation in minor surgery (MS) versus the main operating room (OR) at a tertiary care center in Calgary, Alberta, from the institutional perspective.

Methods: Data were extracted from the Operating Room Information System and the Business Advisory System by a financial analyst. All data were based on actual expenses from the 2016–2017 fiscal year (US\$). Direct costs included: staffing, supply, day (outpatient) surgery unit, post-anesthesia care unit (PACU), and anesthesia (anesthesiologist and equipment) costs. Surgeon and hardware costs were deemed neutral and excluded from the analysis.

Results: The total cost of metacarpal fixation in MS was \$250, compared to \$2,226 in the OR, after surgeon and hardware costs were excluded. Staffing costs are a major contributing factor to cost by location (\$75 in MS versus \$233 in OR), largely attributable to 0.5 nursing staff per room in MS compared to 3 nursing staff per room in the OR. Supply costs (minor tray, \$94 versus case cart, \$247) are also greater for OR cases. The combined costs for DSU (\$465), PACU (\$435), and anesthesia (\$247) totaled \$1,147 and are only incurred for OR cases.

Conclusions: Repair of metacarpal fractures in MS represents a substantial cost-minimization strategy from the institutional perspective. Staffing and supply costs by location and the additional combined costs of DS, PACU, and anesthesia are all contributing factors. (*Plast Reconstr Surg Glob Open* 2019;7:e2298; doi: 10.1097/GOX.0000000000002298; Published online 3 July 2019.)

INTRODUCTION

Hand fractures are common, with an estimated 1.4 million cases annually in the United States alone.^{1–3} Metacarpal fractures account for approximately 42% of all fractures to the hand.¹ For those requiring operative fixation, the location of metacarpal fracture repair is center dependent. Fixation may be performed in minor surgery (MS) under local anesthesia⁴ or in the main operating room (OR) under a regional block or general anesthesia.² Previous cost-analysis studies have identified that procedures performed under local anesthesia offer a significant economic advantage over those performed in the main OR.^{2,5} Reports comparing the

staffing and supply costs alone² likely underestimate the costs savings for fixation under local anesthesia, as they do not account for the additional cost of the day (outpatient) surgery unit (DSU) and post-anesthesia care unit (PACU) stays required for main OR cases. The DSU (outpatient) is an outpatient surgery unit to which patients are admitted 1–2 hours before their scheduled surgery and to which they return from PACU for their final recovery, discharge instructions, and same-day discharge from hospital.

Despite the ability to repair hand fractures under local anesthesia in MS and possible cost savings associated with this location of repair, fixation in the main OR remains more common in most centers.² At our institution, metacarpal fracture fixation is performed in MS, under local anesthesia with field sterility. The MS suite provides access to 3 minor procedure rooms, 1 mini cesium iodide arm (mini c-arm), Kirschner wires, and modular hand set.

Only a small number of complicated metacarpal fractures (associated nerve or tendon injuries or multiple fractures) are repaired in the main OR at our institution. These complicated cases require hospital admission

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through the DSU (outpatient), fixation in the main OR, and recovery in the postoperative care unit.

The objective of this study was to perform a cost-minimization analysis of performing metacarpal fracture fixation in MS versus the main OR at our tertiary care center in Calgary, Alberta, Canada, from the institutional perspective. The cost-minimization analysis evaluates the cost associated with 2 different treatment algorithms with similar outcomes.² Performed from the health service, or institutional perspective, a cost-minimization model accounts for staff time, medical supplies, and overhead costs such as heating and lighting. It is used to answer the question: is there a cheaper, but equally effective way to care for this patient?⁶ A secondary objective was to identify the factors contributing to the difference in cost of metacarpal fracture fixation by location.

METHODS

Data were extracted from the Operating Room Information System and the Business Advisory System by a financial analyst. All data were based on actual expenses from the 2016–2017 fiscal year and are converted to United States Dollars (based on the yearly average exchange rate of 0.7515 for 2018). Surgeon and hardware costs were deemed neutral and not included in the comparison.

Total MS costs included staffing, supply, and overhead costs. A staffing cost of \$1.67 per minute multiplied by the average procedure time (45 minutes) for cases performed in MS was used to calculate the total staffing cost for metacarpal fixation in MS (\$75). Supply costs were calculated as the average cost of the minor procedure tray used for metacarpal fracture fixation in MS (\$94). Hardware costs were excluded, as they are the same for both MS and main OR cases. Standard hospital overhead rates are included in all MS expense totals.

Total main OR costs included staffing, supply, DSU (outpatient), postoperative care unit, anesthesiology, and overhead costs. Staffing costs were calculated by multiplying the rate per minute of all OR staff (\$5.20) by the

same average procedure time (45 minutes). Supply costs for main OR cases were calculated by adding the cost of the standard case carts pulled for metacarpal procedures (\$247). Anesthesiologist cost was calculated at \$13.71 per 5-minute interval of case time for a total of \$247 for metacarpal fixation cases. Standard DSU (outpatient) and PACU rates per case and hospital overhead rates were added to the main OR total expenses. Figure 3 compares all expenses for both MS and the main OR cases.

RESULTS

After surgeon and hardware costs were excluded, the total cost of metacarpal fixation in MS was \$250, compared to \$2,226 in the main OR (Fig. 1). The cost of staffing was \$75 for a MS case and \$233 in the main OR. Supply cost for a MS tray was \$94, and \$247 for the basic case cart used for main OR fixation. The combined costs for DS (\$465), PACU (\$435), and anesthesia (\$247) totaled \$1,147 and are only incurred for main OR cases.

DISCUSSION

Metacarpal fixation in MS represents significant costs savings, when compared to fixation in the main OR. The largest cost difference is attributable to the costs associated with the perioperative care [DSU (outpatient) and PACU] and anesthesia costs for the main OR. The total perioperative and anesthesia cost of \$1,147 is saved for all metacarpal fixations performed in MS.

Second, the staffing costs by location (\$75 for MS versus \$233 for OR) are greater for main OR cases. The main contributing factor for the staffing cost difference is that MS is staffed with 0.5 nurses per room (1 nurse circulates between 2 rooms), compared to 3 nurses per room in the main OR. It is important to note that the staffing cost difference is likely underestimated in this analysis, as setup and teardown times were not included in the total procedure times used to calculate staffing costs. At our institution, a total of 30 minutes of setup and 30 minutes of teardown

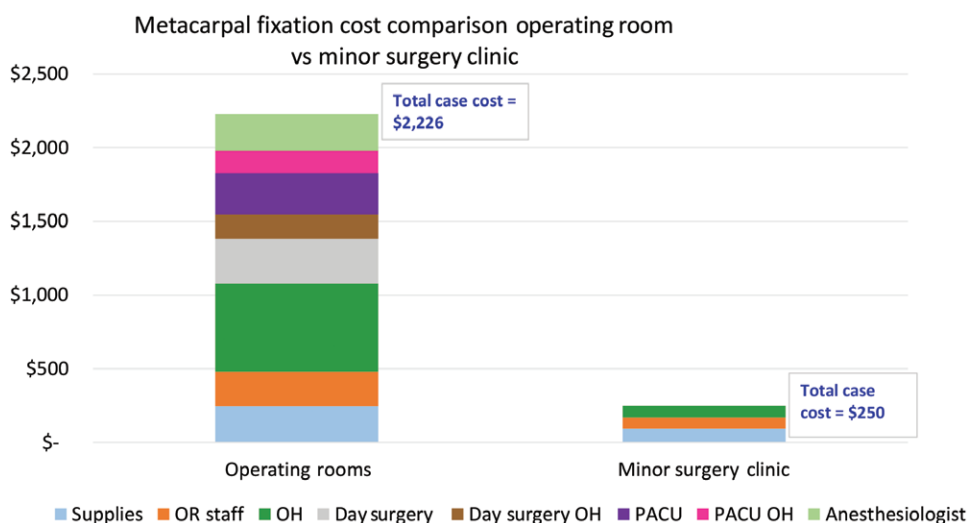


Fig. 1. Comparison of the total costs of performing metacarpal fixation in minor surgery to the main operating room (US\$). OH indicates hospital overhead.



Fig. 2. An example of field sterility, with 4 sterile towels.



Fig. 3. An example of a patient prepped using full sterility.

are added for all main OR cases, which would account for an additional \$312 of staffing cost alone. The efficiency inherent in the MS model allows for a higher volume of cases to be done in an average work day compared to the main OR (estimated 8–10 in MS compared to 3–4 in the main OR). Furthermore, many centers require hand trauma patients to be admitted to hospital before they are eligible to be booked on the emergency surgery waiting list. The potential additional cost of hospital admission while awaiting surgery that may be incurred at some centers was not accounted for in the model and would further increase the cost of performing fixation in the main OR.

Last, supply costs are greater for main OR cases (\$247 versus \$94), as the MS procedure trays include only the basic instruments required for metacarpal fixation, whereas the standard case carts pulled for main operating cases are large and contain a number of instruments, many of which may not be required for straightforward metacarpal fixation. Hardware costs were considered neutral, so were not included in the totals for MS or main OR supply costs.

This study was limited to metacarpal fracture fixation only. However, because the cost of hardware was excluded from the analysis, the cost savings would be similar for all cases with a similar operating time (phalangeal fracture fixation, flexor tendon repair, finger revision amputation, and digital nerve repair). Because the largest cost difference was for staffing costs, which are time-based, the longer the procedure is, the greater the cost savings would be. Although this was a single-center study, similar cost savings have been identified at other centers performing fracture fixation in MS, confirming its generalizability.²

A limitation of a cost-minimization model is that it assumes similar outcomes between treatment measures. Anecdotally, our institution has not seen a difference in functional outcomes or complication rates between fixation performed in the main OR and MS. We are currently participating in a prospective multicenter cohort study to compare infection rates of k-wire fixation in the MS setting compared to the main OR to further assess the safety of metacarpal fracture fixation in MS. Although infection was not the focus of this particular study, we have been us-

ing field sterility (Fig. 2) rather than full sterility (Fig. 3) to fix fractures in minor procedure rooms in several hospitals at our center for over 30 years with negligible infection rates. There is a growing body of evidence supporting no difference in infection rates or functional outcomes with fracture fixation using field sterility in other centers.^{7–9}

While this cost analysis was performed from the institutional perspective, it is important to acknowledge that in the MS model, surgeon's time is spent performing hand blocks, although it is the anesthesiologist who provides the general anesthetics in the main OR. From the surgeon's perspective, the time spent in performing the hand block would be uncompensated time. Furthermore, surgeons must be comfortable with a wide variety of local anesthetic techniques. As MS is only staffed with 0.5 nurses per room, surgeons may have to operate without help instantly available.

CONCLUSIONS

Repair of metacarpal fractures in MS represents a substantial cost-minimization strategy from the institutional perspective. Staffing and supply costs by location and the additional combined costs of DS, PACU, and anesthesia are all contributing factors. The total cost for metacarpal fixation in the main OR (\$2226) represents a nearly 10-fold increase in cost compared with those performed in MS (\$250). From an institutional perspective, increasing the use of MSs where hand fracture fixation and other minor procedures can be performed under local anesthesia may represent a significant cost-minimization strategy.

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