Wide Variation of Surgical Cost Between 6 Fellowship-Trained Trauma Surgeons in the Treatment of Periarticular Lower Extremity Injuries

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Background/Purpose: Improving health care value is of increasing importance in today's challenging economic environment. Variation in procedural patterns among surgeons may be a significant contributor to direct surgical costs. We have hypothesized that despite similar subspecialty training there would be a high variation in direct surgical cost between surgeons in the treatment of bimalleolar ankle and bicondylar tibial plateau fractures. Identification of high-cost items and their critical evaluation would allow for substantial cost savings in the future.

Methods: We developed a novel software tool called a "seismograph," which allowed us to analyze detailed invoice costs of individual surgical procedures. We isolated cases from a single Level I trauma center over a 2-year period using a CPT code search for open treatment of bimalleolar ankle fractures and bicondylar tibial plateau fractures. We excluded cases with more than one procedure occurring in that setting. All costs associated with each procedure such as implants, drapes, disposables, and equipment were identified. Only the definitive procedures were analyzed; if performed, temporary external fixation of fractures was not included in the analysis in order to avoid bias. Macroscopically, the seismograph provided a bird's-eye view of all costs, which highlighted case and surgeon differences and patterns. We then analyzed the data descriptively (means and medians) and compared the direct surgical costs between surgeons using a one-way analysis of variance (ANOVA) after confirming the normal distribution of the available data using the Kolmogorov-Smirnov test.

Results: We identified 134 cases meeting our inclusion/exclusion criteria. The total direct surgical cost for the treatment of 88 bimalleolar ankle fractures was $96,866 and the total cost for the treatment of 46 bicondylar tibial plateau fractures was $148,066. There was a wide variation in direct surgical costs for both injuries between surgeons. The overall mean cost in the treatment of a bimalleolar ankle fracture was $1099, ranging from $613 (mean value per case for the least expensive surgeon) to $2243 (mean value per case for the most expensive surgeon). This difference was statistically significant ($P = 0.009$). However, the median cost, which is a measure that describes 50% of the cases being more expensive and 50% of the cases being less expensive, had a fairly tight range between $598 and $784 for the six evaluated surgeons, indicating that the most expensive cases significantly contributed to the overall cost. The most expensive 25% of the cases resulted in 57% of the overall cost, which was $55,616 compared to $41,250 for the remaining 75% of the cases. The overall mean cost in the treatment of a bicondylar tibial plateau fracture was $3219, ranging from $1839 (mean value per case for the least expensive surgeon) to $4088 (mean value per case for the most expensive surgeon) ($P = 0.064$). The range for the median cost between the six surgeons was substantially wider (Fig. 1) than for ankle fractures with $1826 for the least expensive surgeon and $3989 for the most expensive surgeon indicating a wide range of

surgical treatment patterns between surgeons for a typical case (median). High-price items that substantially raised the mean cost were bone void fillers (calcium phosphate cement and allograft cancellous bone graft), adjunctive external fixators, locking plates, adjunctive mini-fragment locking plates used as either temporary or definitive reduction aids, as well as disposable and single-use items such as taps, company-specific guidewires, cannulated screws, drill bits, certain sutures, and expensive drapes.

Conclusion: This study demonstrated a wide variation in direct surgical cost in the treatment of bimalleolar ankle fractures and bicondylar tibial plateau fractures between six surgeons at the same Level I trauma center. We identified high-price items, some of which can be easily avoided, and some of which should be evaluated for their contribution to patient outcomes in future clinical studies. The use of the "seismograph" tool bears an enormous potential for cost savings as it can be used to critically analyze the cost of other surgical procedures within and outside of orthopaedics.

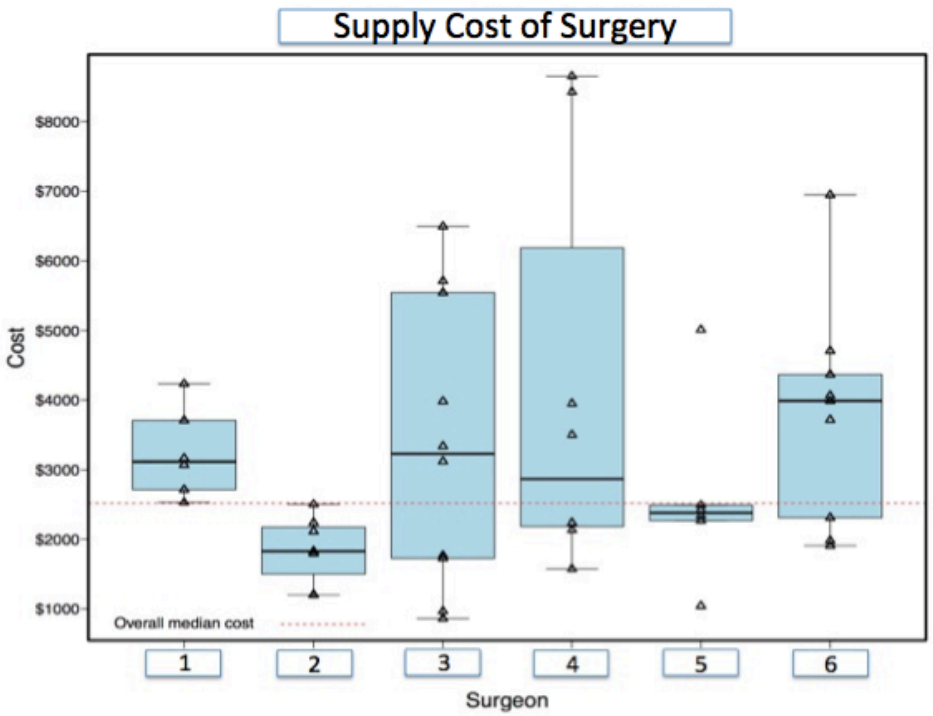

Figure 1: Graphic presentation of cost variation between 6 surgeons. Solid lines represent the median value. The boxes represent the interquartile (25%-75%) range, and the width of the boxes demonstrates variation in cost. A wider interquartile box conveys more variation.

See pages 47 - 108 for financial disclosure information.