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A Comparison of Relative Value Units in Primary Versus Revision Total Knee Arthroplasty

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ABSTRACT

Background: In total knee arthroplasty (TKA), revision cases are often technically more challenging, and require more operative time and aftercare than primary cases. These time and effort differences should therefore be appropriately compensated for when using the relative value unit (RVU) system. Therefore, the purpose of this study is to compare the mean (1) RVUs; (2) operative times; and (3) RVU/min; and (4) perform an individualized idealized surgeon annual cost difference analysis for primary vs revision TKA. **Methods:** Current Procedural Terminology code 27447 identified 165,439 primary TKA patients, while Current Procedural Terminology code 27487 identified 8081 revision TKA patients from the National Surgical Quality Improvement Program database. The mean RVUs, operative times, and RVU/min were calculated. Dollar amount per minute, per case, per day, and year were also calculated. Student's t-test, with a cut-off *P*-value of <.05, was used in order to identify any statistical differences in mean RVUs, operative times, and RVU/min.

Results: The mean RVUs for primary TKA was 22, while for revision TKA was 27 ($P < .001$). The mean operative time for primary TKA was 94 minutes, while for revision TKA was 149 minutes ($P < .001$). The mean RVU/min for primary TKA was 0.26, while for revision TKA was 0.22 ($P < .001$). The dollar amounts calculated for primary vs revision TKA were per minute (\$9.33 vs \$7.90), per case (\$877.12 vs \$1176.43), per day (\$4385.60 vs \$3529), and projected a \$137,008.70 annual cost difference.

Conclusion: Orthopedic surgeons are reimbursed at a higher rate per minute for primary cases compared to revision TKA (0.26 vs 0.22, $P < .001$). The annual difference can amount to nearly \$140,000. Orthopedic surgeons can use this information to better understand the dynamics of their time, compensation, and ultimately, their practice. Furthermore, it can be argued that there needs to be a shift to increase the RVU per unit time for revision TKAs.

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Relative value units (RVUs) are a key component of the fee-for-service reimbursement model used by the Centers for Medicare and Medicaid Services [1]. Each procedure performed by a physician is assigned a Current Procedural Terminology (CPT) code, which has a predefined number of RVUs assigned. These RVUs are a combination of physician work, practice expense, and malpractice assessments. The physician work segment is by far the

largest component. RVUs are used to determine the effort or difficulty in a procedure and thus the rate of compensation. Higher RVU numbers usually indicate increased case complexity, length of time needed to complete a certain procedure, and/or more effort needed preoperatively and for aftercare [2]. The RVUs are then multiplied by both the geographic practice cost indices, which vary across the country, and a conversion factor to ultimately determine compensation. Despite the careful assessment of RVUs, there are conflicting studies regarding the ability of RVUs to accurately depict time and effort of procedures across many subspecialties, such as pediatric, general, and spine surgery [3–8].

Lorio et al [9] performed a Rasch analysis to estimate what the work RVU for performing minimally invasive sacroiliac joint arthrodesis should be. The group found the current RVU valuation

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Table 1
Primary vs Revision Total Knee Arthroplasty.

	Primary TKA Mean (Range, SD)	Revision TKA Mean (Range, SD)	P-Value
Total (n)	165,439	8081	
RVU	22 (21–23; SD 1.3)	27 (26.9–27.1; SD 0.05)	<.001
Time (min)	94 (30–475; SD 36)	149 (30–475; SD 61)	<.001
RVU/min	0.26 (0.04–0.8, SD 0.1)	0.22 (0.06–0.9; SD 0.1)	<.001

SD, standard deviation.

of 9.03 to be undervalued, and proposed an RVU of 14.23 instead. Bunn et al analyzed the work required and physician reimbursement for primary and revision total knee arthroplasty (TKA). The group found a 51% increase in percent effort for performing revision vs primary TKA but only a 29% increase in Medicare reimbursement [10]. Additionally, Tokarski et al [11] evaluated 651 primary and revision total joint arthroplasties. This group found a potential 32% decrease for revision, and 50% decrease for complex revision reimbursement when compared to primary arthroplasty. These differences were found when taking into consideration the added work, such as operative time, returns to the operating room, and complications.

Because of the controversy regarding the accuracy of assigned RVU values in other subspecialties, the goal of this study is to analyze the accuracy of the RVU reimbursement system in orthopedics; specifically for primary and revision TKA. These procedures can differ by complexity and length of operative time, as well as amount of effort needed to prepare as well as take care of these patients postoperatively. Specifically, we compared (1) mean RVUs per CPT code; (2) mean operative time; (3) mean RVU per minute, and (4) extrapolated that data to perform an individualized idealized surgeon annual cost difference analysis in order to identify differences in reimbursement for a physician's operative time.

Methods

Database

The American College of Surgeons, National Surgical Quality Improvement Program database from January 1, 2008 to December 31, 2015 was used to identify primary and revision TKAs. This database contains demographics, operative time, and RVU data, as well as many another variables [12]. Institutional Review Board deemed this study exempt because these data are de-identified and publically available.

Current Procedural Terminology Codes

Medical, surgical, and laboratory procedures are CPT coded. The code links procedures or services to physician reimbursements. CPT code 27447 identifies primary TKAs, while CPT code 27487 identifies revision TKAs.

Primary Total Knee Arthroplasty Patient Selection

A total of 166,138 primary TKAs were identified. Only cases with operative times between 30 and 480 minutes were included for analysis as the greater majority of cases (over 99%) fall within this range. Additionally, using this inclusion criteria, only a few cases (approximately 0.4%) were excluded from analysis; most being negative, zero, or extreme times (ie, 1435 minutes for primary TKA). This yielded 165,439 (99.6%) primary TKAs.

Table 2
Annualized Cost Analysis for Primary vs Revision TKA.

	Primary TKA	Revision TKA
RVU/min	0.26	0.22
\$/min	\$9.33	\$7.90
\$/case	\$877.12	\$1176.43
Cases/d	5	3
\$/d	\$4385.60	\$3529.29
Daily cost difference	\$856.30	
Annualized cost differences	\$137,008.70	

Revision Total Knee Arthroplasty Patient Selection

Because revision TKAs can have varying difficulties, CPT code 27487, which specifically codes for revision of the femoral and entire tibial component, was used. A total of 8126 revision TKA cases were identified. The same inclusion criteria for primary cases was yielding 8081 (99.4%) revision TKAs.

Annual Cost Difference Analysis

The difference in individual physician reimbursement for performing primary vs revision TKA was calculated. A hypothetical 8-hour work day, an estimated 160 operative days per year, and one operating room were analyzed. Based on mean operative times, either 5 primary or 3 revisions can be completed each day. Although for some surgeons, when taking into account factors such as operating room turnover time and practice volume, performing 5 primary or 3 revision TKAs is less likely, these daily case numbers were used based on an idealized 8-hour surgeon operating day and mean operative time model. The Centers for Medicare and Medicaid Services reported that RVU to dollar conversion factor of \$35.8887/RVU was used to calculate a dollar amount per minute and case. This amount was then multiplied by the number of cases performed each day, yielding a daily reimbursement. Further calculations resulted in an annualized difference for performing only primary TKAs.

Variables Analyzed: Relative Value Units, Operative Time

Variable name "WORKRVU" was used to identify the work RVUs. Work RVU defined the RVUs. Even though RVUs are specific to a particular CPT code, their values are continuously updated, which is why a range existed over time. Variable name "OPTIME" was used to identify the total operative times.

Data Analysis

Variables were extracted and entered into an Excel spreadsheet (2013 Microsoft Office Professional Plus, Redmond, WA). Mean RVU, operative time (minutes), and RVU/min for each cohort were calculated. Student's t-test, with a cut-off P-value of <.05, was used in order to identify any statistical differences. All statistical analyses were performed using SPSS version 24 (International Business Machine Corporation, Armonk, NY).

Results

Mean Relative Value Units

The mean RVUs for primary TKA were 22 (range 21–23, ± 1.3). The mean RVUs for the revision TKA were 27 (range 26.9–27.1, ± 0.05). There was a statistically significant higher RVU assigned to the revision TKA than the primary TKA ($P < .001$).

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