

A Cost Comparison of Two Commonly Used Techniques for Revision Total Knee Arthroplasty

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Abstract

Most total knee revision implants use intramedullary stems and fall into one of two categories: all-cemented or hybrid fixation (combination of articular surface cementing and stem diaphyseal press fit). We hypothesized that while both techniques will provide rigid fixation, the costs associated with each technique will be different. Total knee revisions done from 2019 to 2021 in a large health system were identified by CPT code. Single component exchange, megaprosthesis and revision for periprosthetic fracture were excluded due to effect on costs. Revisions done for infection were excluded in first stage and included for the second stage. The cohort was divided into two groups: all-cemented and hybrid fixation. A Mann-Whitney test and analysis was then performed on total cost, cement cost, and use of a cone or sleeve. Sixty-seven patients were enrolled in the hybrid group and 129 in the all-cemented group. The hybrid group median cost was \$25,463. Offset connectors median cost was \$6,066 when used and were used 52.24% of the time. Metaphyseal cones or sleeves were used 46.27% of the time and median cost of \$6,054. The cemented group median cost was \$22,984 and offset connectors were used only 1.55% of the time with a median cost of \$1,591. Metaphyseal cones were used 45.74% and had a median cost of \$5,522. Statistical analysis revealed no significant difference between the two groups in median total cost (\$25,463 vs \$22,984, $p=0.22$). Cement costs were significantly higher in all-cemented group (\$565.0 vs \$333.7, $p<0.0001$). Total costs for revisions using cones were significantly higher (\$28,138 vs \$19,404, $p<0.0001$). Hybrid technique costs are more expensive by \$2,479 than an all-cemented technique, but not to statistical significance. Offset connectors were used 52% of the time in hybrid technique and only 2% in all-cemented technique. Cement costs are higher by \$231 in the all-cemented group. There is a statistically significant increase in cost by \$8,734 when cones or sleeves are used. Special attention should be given to the usage of offset connectors, cones, and sleeves when performing revision total knee arthroplasty.

Introduction

Based on recent National Inpatient Sample, rates of primary TKA in the United States in 2025, 2030, and 2040 are projected to reach (in thousands) 652, 850 and 1429 respectively (1). These numbers represent 110%, 182%, and 401% increases in annual primary TKAs (1). With an increase in primary total knee surgery will come an increase in revision surgery. Increasing incidence requires data to support clinical decisions about which implant and fixation type best suits each revision TKA. Costs associated with surgery have generally focused on primary total knee arthroplasty. In revision surgery, there

can be a varying amount of bone loss which may require different implant options to provide rigid bony fixation. These implants include different style femoral and tibial components, metaphyseal cones and sleeves, intramedullary stems, and offset connectors which can connect the femoral prosthesis to the stem. Most techniques fall into two general categories which are used to address the varying amount of bone loss: all-cemented or hybrid fixation (which is a combination of articular surface cementing and stem diaphyseal press fit). We evaluated the costs associated with each technique and compared the two groups using modern pricing structures in a major health system. With an increase in revision surgery predicted at 182% over the next 9 years, this cost data will be critical to surgeons making educated decisions during surgery (2). We hypothesized that while both techniques will provide the rigid internal fixation necessary for revision surgery, the costs associated with each implant will be different (3).

Methods

This study utilized a retrospective design and chart review. All total knee revisions done from 2019 to 2021 in a large multifacility health system were identified by CPT code, 27247. Any single component exchange, megaprosthesis, and revision done for periprosthetic fracture were excluded due to their influence on cost. A fellowship-trained adult reconstructive surgeon evaluated the radiographs to ensure an intramedullary stem was used. Any revision done for the purpose of first stage in a single-stage infection revision was excluded because they receive different implants than the ones being studied, while the second stage reimplantation of a two-stage infection revision was included because it requires the same implants as other indications for revision. Only the implant cost itself was included in the analysis. The cohort was then divided into two groups: all-cemented and hybrid fixation. The database of costs was analyzed using Microsoft PowerBi, where each component of the final implant was recorded. A Mann-Whitney test was performed on total cost and cement cost for both groups. A subgroup analysis compared the groups that used a cone or sleeve from those revisions which did not use a cone or sleeve.

Results

A total of 67 patients in the hybrid group and 129 patients in the cemented group were included in the final analysis. The median implant cost for the hybrid group was \$25,463, with the majority of the costs coming from the femoral component build, with a median cost of \$11,472 and accounting for 45.3% of the overall price of the implant (Table 1). Offset connectors had a median price of \$6,066 when used and were used 52.24% of the time. Metaphyseal cones and sleeves were used 46.27% of the

time and had a median cost of \$6,054, accounting for 28.3% of the total price when used (Table 1).

The cemented group median cost was \$22,984 with most of the costs coming from the femoral component build which had a median cost of \$11,342 and accounted for 47.8% of the overall price (Table 1). Offset connectors were used only 1.55% of the time in the all-cemented group. Metaphyseal cones were used 45.74% of the time and had a median cost of \$5,522 when used (Table 1).

The statistical analysis revealed no significant difference between the two groups in median total cost (\$22,984 vs \$25,463, $p=0.22$) (Figure 1). Cement costs were significantly higher in all-cemented groups (\$565.0 vs \$333.7, $p<0.0001$). The total costs for revision surgery using cones were significantly higher than costs without cones (\$28,138 vs \$19,404) (Figure 2).

Revision Component	Hybrid Median Cost	% Usage	Cemented Median Cost	% Usage
Total prosthesis	\$25,463.00	100%	\$22,984.00	100%
Femoral component	\$11,471.85	100%	\$11,342.00	100%
Tibial component	\$5,987.50	100%	\$5,587.00	100%
Cone/sleeve	\$6,054.00	46%	\$5,522.00	46%
Cement	\$333.68	100%	\$565.00	100%
Stems	\$4,222.00	100%	\$3,880.00	100%
Augments	\$3,001.10	67%	\$3,102.00	81%
Offset connectors	\$6,065.70	52%	\$1,591.00	2%
Polyethylene	\$2,671.60	100%	\$2,672.00	100%

Table 1. Total costs of hybrid and cemented components

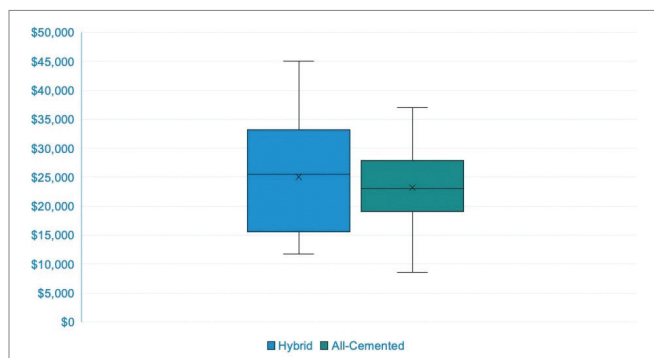


Figure 1. Median costs of hybrid and all-cemented fixation

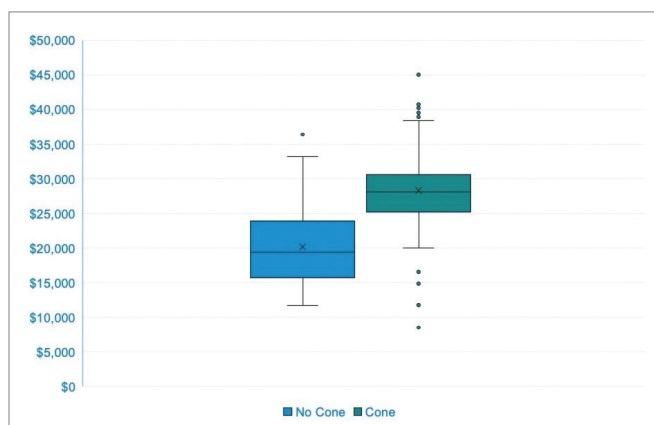


Figure 2. The use of cones significantly increases cost of rTKA

Discussion

Both hybrid and all-cemented techniques provide stable implant fixation in the setting of bone loss during revision total knee arthroplasty but have different costs. The median hybrid technique costs are more expensive by \$2,479 than an all-cemented revision TKA, but not enough to show statistical significance. This conclusion is based on using offset connectors approximately half the time and usage over that number could increase total cost more. The femoral component build is the most expensive part of the total implant and accounts for nearly half the total cost. Surgeons can note that both techniques provide a statistically similar cost to the health care payor. Using cement in the all-cemented technique, while proving to be more expensive statistically, only increased the cost by \$231 and should not be considered a detriment to usage. There is a statistically significant increase in cost when cones or sleeves are used by \$8,734 on either hybrid or all-cemented fixation, demonstrating that they can be a powerful driver of total cost.

Conclusion

As the rates of TKA revisions rise and economic conditions deteriorate around the world, special attention should be given to the total cost of the implant, including usage of offset connectors, cones, and sleeves when determining which technique to use during revision total knee arthroplasty.

Acknowledgments

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References

1. Singh JA, Yu S, Chen L, Cleveland JD. Rates of Total Joint Replacement in the United States: Future Projections to 2020-2040 Using the National Inpatient Sample. *The Journal of Rheumatology*. 2019;46(9):1134-1140.
2. Rassir R, Nolte PA, van der Lugt JCT, Nelissen RGHH, Sierevelt IN, Verra WC. No differences in cost-effectiveness and short-term functional outcomes between cemented and uncemented total knee arthroplasty. *BMC Musculoskeletal Disorders*. 2020;21(1).
3. Schwartz, A, Farley K, Guild G, Bradbury, T. Projections and Epidemiology of Revision Hip and Knee Arthroplasty in the United States to 2030. *J Arthroplasty*. 2020 Jun;35(6S):S79-S85.