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Financial Analysis of Treating Periprosthetic Joint Infections at a Tertiary Referral Center

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ABSTRACT

Background: Periprosthetic joint infection (PJI) is a significant challenge to the orthopedic surgeon, patient, hospital, and insurance provider. Our study compares the financial information of self-originating and referral 2-stage revision hip and knee surgeries at our tertiary referral center for hip or knee PJI over the last 4 years.

Methods: We performed an in-house retrospective financial review of all patients who underwent 2-stage revision hip or knee arthroplasty for infection between January 2008 and August 2013, comparing self-originating and referral cases.

Results: We found an increasing number of referrals over the study period. There was an increased cost of treating hips over knees. All scenarios generated a positive net income; however, referral hip PJIs offered lower reimbursement and net income per case (although not statistically significant), whereas knee PJIs offered higher reimbursement and net income per case (although not statistically significant).

Conclusion: With referral centers treating increased numbers of infected joints performed elsewhere, we show continued financial incentive in accepting referrals, although with less financial gain than when treating one's own hip PJI and an increased financial gain when treating referral knee PJIs.

Periprosthetic joint infection (PJI) is a significant challenge to the orthopedic surgeon, patient, hospital, and insurance provider [1-7]. As the number of total hip and knee arthroplasties has increased, the number of revision procedures for hip and knee arthroplasties has also increased [8,9]. The treatment of revisions for infections requires a greater amount of hospital and surgeon resources than noninfectious revisions [4,10].

Aside from the burden these infections place on the surgeon and, more importantly, on the patient, PJIs also have a significant financial impact on all parts of the health system [3,4,7,10]. Recently, the Centers for Medicare and Medicaid Services initiated regulations for stopping reimbursement for certain hospital-acquired conditions (HACs) [11]. According the to the 2013 fiscal year final HAC list, surgical site infections after certain orthopedic procedures—specifically 996.67 (infection and inflammatory reaction due to other internal orthopedic device, implant, and graft) and 998.59 (other postoperative infection)—will not be reimbursed [12]. At present, the HAC list only includes infection of the shoulder, elbow, neck, and spine. However, this could change, thereby further influencing the financial impact of PJI of the knee and hip.

Reimbursement is often poor for patients referred with PJIs to high-volume tertiary referral centers [3,4]. In recent years, referrals of patients with PJIs to tertiary referral centers have increased and seemingly will continue to increase [4].

Since 2007, the number of prosthetic joint infections referred to our tertiary referral center has increased. We felt the need to analyze the cost effectiveness of treating our own infections and those referred from outside facilities. Our goal was to compare all 2-stage revision hip and knee surgeries for the treatment of PJIs performed in our facility over a 4-year period by analyzing the charges, costs to the hospital, and reimbursement for each case.

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Methods

After institutional review board approval, we performed a retrospective review of all patients who underwent 2-stage revision total knee or hip arthroplasty for infection at our institution between January 1, 2008 and August 31, 2013. To gather cases performed, we performed a database search using *International Classification of Diseases, Tenth Revision, Clinical modification* codes for revision total hip and knee arthroplasties (81.53, 81.55, 00.70-00.73, and 00.80-00.84). We also searched for periprosthetic hip or knee infection using the *International Classification of Diseases, Tenth Revision,* code 996.6. Finally, we searched for *Current Procedural Terminology* codes associated with removal of hip or knee prosthesis with or without placement of antibiotic spacer (27090, 27091, 27488); revision of total hip arthroplasty (27132, 27134); revision total knee arthroplasty (27487); and insertion, removal, or removal with reinsertion of nonbiodegradable drug implant (11981, 11982, 11983). To augment the database search, all surgery schedules were meticulously searched to ensure no case was excluded.

We then performed a detailed chart and financial review of each patient's chart. We separated cases into hips vs knee and referral vs self-originating surgeries, indicating whether the index surgery was performed at an outside facility or at our facility, respectively. Chart review elucidated whether the patient underwent 2-stage revision, 1-stage revision, irrigation and debridement (I&D) with or without polyethylene exchange, or other procedure. Because we were interested in comparing referral 2-stage revision cases to self-originating 2-stage revisions where the index surgery was performed at our institution, we excluded all patients who did not complete the second stage total joint revision after placement of antibiotic spacer.

All inhospital costs per each admission are reported. We used individual encounter numbers for each admission to acquire insurance status for the admission and all inhospital costs, charges, and reimbursements/revenue associated with I&D if performed, placement of antibiotic spacer, and revision total joint arthroplasty. Costs, charges, and reimbursements associated with outpatient therapy (such as intravenous antibiotics, home health, skilled nursing facility, and so forth) are not included in these data as they are billed as a separate entity and not included in the hospital's bundled payment. Patient's requiring skilled nursing placement in the immediate perioperative period fell into 1 of the 2 categories. Those discharged before postoperative day 3 had their placement included within their bundled charge without any additional reimbursement for the provider. Patients discharged after postoperative day 3 incurred a separate charge for their stay that was separate from the original bundled charge. Hospital charges, costs, and reimbursements/revenue were adjusted to 2013 dollars using the seasonally adjusted consumer price index published by the Bureau of Labor Statistics.

Statistics

Statistical analysis of all groups was performed using an unpaired exact Wilcoxon analysis. Paired groups were analyzed using a paired Student *t* test.

Results

Surgical procedures were performed on 113 patients with 114 total joint infections between January 1, 2008 and August 31, 2013. Of these, there were 44 total hip arthroplasties and 70 total knees arthroplasties with infections.

Of the total hip infection cases, 19 were referred, and 25 were self-originating. Of these, 16 referral patients and 12 self-originating patients underwent 2-stage revision for their total hip infections.

Of the total knee infection cases, 36 were referred, and 34 were self-originating. Of these, 23 referral patients and 15 self-originating patients underwent 2-stage revision for their total knee infections.

Figure 1 details reasons for cases being excluded from the study.

In the self-originating hip group, 7 patients underwent I&D at our institution before removal of hardware and subsequent revision. In the referral hip group, 2 patients underwent I&D before removal of prosthesis and subsequent revision at our facility. Five referral hips underwent washout before presenting to our facility.

The self-originating knee group included 5 patients who underwent I&D at our institution before removal of prosthesis and subsequent revision, whereas the referral knee group had 3 performed at our facility. Five referral knees underwent washout before presenting to our facility.

All Admissions Combined

When we combined all admissions and inhospital procedures (I&D if performed, removal of hardware/antibiotic spacer placement, and final revision), we found no statistical difference in the average inhospital charges, average inhospital cost to the hospital, reimbursement, or average net income for treating self-originating total hip infections vs referral total hip infections (Table 1). Despite the lack of significance, there was a higher average reimbursement ($15,608 more, 29% increase) and in turn net income ($16,114 more, 110% increase), associated with treating our own hip infections vs referral hip infections. The referral hip group had 3 cases of loss of income vs 0 in the self-originating group. However, there were not enough data to calculate significance. Reimbursement percentage based on overall charges was 26% in the referral hip group vs 35% in the self-originating hip group. Average net income per index case in the hip referral group was $14,599 and $30,713 for the self-originating group.

When we combined all admissions and inhospital procedures for the knee groups, we found no statistical difference in the average inhospital charges, average inhospital cost to the hospital, average reimbursement, or average net income for treating self-originating total knee infections vs referral total knee infections (Table 1). The referral knees, however, had an average increased reimbursement ($2,654 more, 5.87% increase) and in turn net income ($3,206 more, 34.4% increase) compared with self-originating knee infections, despite there not being significance. The referral knee group included 4 cases of loss of income vs 3 in the self-originating group ($P = .9$). Reimbursement percentage based on overall charges was 27.4% in the referral knee group vs 25.9% in the self-originating knee group. Average net income per index case in the knee referral group was $12,522 and $9,315 for the self-originating group.

Two-Stage Admissions Only

Because some patients had I&Ds at our institution and others did not, we performed an analysis of the removal of hardware/antibiotic spacer placement and revision procedures only to achieve a more direct comparison (Table 2). In this analysis, we found no statistical difference in the average inhospital charges, average inhospital cost to the hospital, reimbursement, or average net income for treating self-originating total hip infections vs referral total hip infections ($P > .37$). We did find a 35% increased reimbursement ($18,681 more) and a 131% increased net income ($19,022 more) associated with treating our own hip infections. In this analysis, there were 4 cases of loss of income in the referral