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Cost-benefit analysis of routine pathology examination in primary shoulder arthroplasty

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Background: The annual number of shoulder arthroplasty procedures is continuing to increase. Specimens from shoulder arthroplasty cases are routinely sent for pathologic examination. This study sought to evaluate the clinical utility and associated costs of routine pathologic examination of tissue removed during primary shoulder arthroplasty cases and to determine cost-effectiveness of this practice.

Methods: This is a retrospective review of primary shoulder arthroplasty cases. Patients whose humeral head was sent for routine pathologic examination were included. Cases were determined to have concordant, discrepant, or discordant diagnoses based on preoperative/postoperative diagnosis and pathology diagnosis. Costs were estimated in 2015 U.S. dollars, and cost-effectiveness was determined by the cost per discrepant diagnosis and cost per discordant diagnosis.

Results: We identified 714 cases of primary shoulder arthroplasty in 646 patients who met inclusion criteria. The prevalence of concordant diagnoses was 94.1%, the prevalence of discrepant diagnoses was 5.9%, and no cases had discordant diagnoses. There were 172 cases that had biceps tendon specimens sent for pathology examination, and none led to a change in patient care. Total estimated costs were \$77,309.34 in 2015 U.S. dollars. Cost per discrepant diagnosis for humeral head specimens was \$1424.09, and cost per discordant diagnosis is at least \$59,811.78.

Discussion/Conclusion: Primary shoulder arthroplasty has a high rate of concordant diagnosis. Discrepant diagnoses were 5.9% in our study, and there were no discordant diagnoses. This study showed limited clinical utility in routinely sending specimens from primary shoulder arthroplasty cases for pathology examination, and calculation using a traditional life-year value of \$50,000 showed that the standard for cost-effectiveness is not met.

Approval was obtained from the Mount Sinai Health System Institutional Review Board: No. 15-0061.

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The number of shoulder arthroplasty procedures has been increasing in the United States throughout the past decade. In the year 2000, there were approximately 14,000 shoulder arthroplasties performed in the United States compared with 47,000 in 2008.²² These statistics are in part due to an aging active population and in part due to an increased use of reverse shoulder arthroplasty, which was approved by the Food and Drug Administration in 2003.²²

Routine histologic examination of specimens of the humeral head obtained during shoulder arthroplasty is typically performed at most hospitals. This practice became standard of care in 1927 in an attempt by the American College of Surgeons to improve patient care and diagnostic accuracy of various procedures in the early years of surgery.¹⁴ The Joint Commission on Accreditation of Healthcare Organizations and the College of American Pathologists also mandate this procedure with few exceptions not including specimens from total joint arthroplasties.^{9,15,17} The necessity of routine pathologic examination of specimens has been studied in knee and hip replacement surgery, spine surgery, and knee and shoulder arthroscopy.^{2,3,5,7,8,10-13,15,16,18,20,21,23,24} The majority of cases resulted in no change in patient management or clinical utility while adding additional costs to the procedure. With the increase in health care costs and the importance of being fiscally responsible, the necessity of routine pathologic examination has been recently questioned in the literature.^{2,3,5,7,8,10-13,15,16,18,20,21,23,24}

To our knowledge, the utility of routine histologic examination of specimens sent during shoulder arthroplasty has not been studied in the literature. The purpose of this study was to examine the clinical value and associated costs of routine histologic examination of tissue removed during primary shoulder arthroplasty cases. Our primary hypothesis was that the rate of discrepancy between the clinical preoperative diagnosis and the histologic postoperative diagnosis would be minimal. Our secondary hypothesis was that routine histologic examination of specimens sent during shoulder arthroplasty would not be a cost-effective practice.

Materials and methods

Clinical value

We performed a retrospective review of cases of primary total shoulder arthroplasty (TSA), reverse total shoulder arthroplasty (RSA), hemiarthroplasty (HHA), and resurfacing procedures at 2 centers. The cases from the first hospital were performed between 2002 and 2015, and the cases at the second hospital were performed between 2006 and 2015. Inclusion criteria were patients who underwent primary shoulder arthroplasty and had the resected humeral head

sent for routine histologic examination. Exclusion criteria were patients undergoing procedures for malignant disease or suspected malignant disease, patients who did not have pathology reports available, and patients who had previous surgery on the ipsilateral shoulder.

The preoperative diagnosis was determined by the operating surgeon based on history and physical examinations as well as imaging studies. In all cases, the intraoperative diagnosis was the same as the preoperative diagnosis. The pathologic diagnoses were made for the gross and the histologic specimen by the pathologist according to the guidelines of the College of American Pathologists.

Diagnoses were considered concordant if there was agreement between the preoperative clinical diagnosis and the pathologic diagnosis, discrepant if there was a disagreement but no change in clinical management, and discordant if there was a disagreement that required a change in clinical management of patients.

Cost

Costs of routine pathologic examination were assessed by determining 2015 per-case hospital costs for decalcification (*Current Procedural Terminology* [CPT] code 88304; \$18.78) and pathologic examination of specimens obtained during shoulder arthroplasty (humeral head specimen CPT code 88304; \$64.99/humeral head plus biceps tendon specimen CPT code 88305; \$101.73). Per-case costs were multiplied by the number of cases to get a total cost estimate.

Results

We identified 714 cases of primary shoulder arthroplasty in 646 patients who met inclusion criteria. Preoperative diagnoses included osteoarthritis, rotator cuff tear arthropathy, rheumatoid arthritis, psoriatic arthritis, avascular necrosis, massive irreparable rotator cuff tear, chronic dislocation, proximal humerus fracture, and post-traumatic arthritis (Table I). The mean age of patients was 69.4 years (range, 27.1-91.8 years); 39.8% of patients were male.

An additional 53 cases of primary TSA, RSA, and HHA in 52 patients were reviewed but excluded from analysis because the humeral head was not sent for pathologic examination. Twenty-nine of these cases were patients who underwent humeral resurfacing arthroplasty and therefore did not have humeral head specimens. Twenty-eight cases of primary shoulder arthroplasty (3 HHA, 15 TSA, and 10 RSA) were excluded for previous surgery, including 12 patients who had previous instability stabilization, 11 patients who had previous open reduction-internal rotation for fracture, 4 patients who had previous rotator cuff repair, and 1 patient who had a previous pectoralis repair.

The prevalence of concordant diagnoses was 94.1% (671 of 714). Prevalence of discrepant diagnoses was 5.9% (42 of 714). There were no cases of discordant diagnoses. Of the

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