



## Case report

## Diagnosis of Prostate Adenocarcinoma on Routine Pathology After a Primary Total Hip Arthroplasty

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## ABSTRACT

We present a 67-year-old male patient who presented with insidious worsening of right hip pain over a 6-month period with clinical and radiographic evidence of severe osteoarthritis. The patient underwent a primary total hip arthroplasty where the femoral head specimen was sent to pathology as a routine specimen. Pathology results demonstrated metastatic adenocarcinoma of prostate origin. The present case emphasizes the importance of routine pathologic examination of femoral head specimens retrieved during total hip arthroplasty, particularly since this was a clinically unsuspected finding. Although cases like these are rare and the process of routine pathologic examination raises a concern for economic implications, a timely diagnosis of adenocarcinoma provides benefits for the patient, for which cost-benefit ratios are difficult to quantify.

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## Introduction

The subject of routine pathologic examination after primary total joint arthroplasty (TJA) has been up for debate. Suchman et al. [1] performed a database review of 630 hospitals in the United States to determine the number of hospitals still performing routine histological examination of arthroplasty specimens. The authors demonstrated that from 2006 to 2016, routine histological examination of TJA specimens decreased from 50% to 45% for total hip arthroplasty (THA) and from 43% to 38% for total knee arthroplasty. As the proportion of hospitals performing routine pathologic analysis is slowly decreasing, whether due to the cost-conscious environment with new reimbursement models or due to a slowly dying art because of lack of perceived relevance, we should question the trend of abandoning pathologic specimens from our routine perioperative management and its future implications for patient care.

Proponents of routine specimen retrieval following TJA describe the recognition of rare diseases yielded by histologic evaluation. For example, Billings et al. [2] reported the diagnosis of sarcoma in 2 routinely evaluated specimens retrieved during primary THA

although both these patients had a predisposing condition which placed them at higher risk for a secondary malignant tumor. One of the patients had a history of cervical carcinoma and had undergone radiation and chemotherapy. The other patient had reported increasing debilitating pain associated with Paget's disease. Thus, the authors' conclusion was that routine pathologic evaluation of femoral head specimens is important, and particularly so when patients are at higher risk of developing a secondary malignancy. Other authors have noted the more common recognition of osteonecrosis ("avascular necrosis") as well as chronic synovitis suggestive of an underlying inflammatory arthropathy in specimens with the presurgical diagnosis of primary osteoarthritis [3]. Recognition of previously diagnosed hematologic disorders such as well-differentiated lymphocytic lymphoma is also common [3]. While these diagnoses may not have immediate impact on the arthroplasty, they may have implications for future management.

Opponents of routine histological examination often cite the costs, and the cost-benefit ratio, as a deterrent to performing these regularly [4,5]. Kocher et al. [4] performed a cost analysis of routine pathologic examination in a cohort of 1234 cases. They noted the prevalence of discrepant diagnoses was 2.3% and that of discordant cases was 0.1% in this cohort and calculated costs of \$4383 and \$122,728 per case, respectively. They concluded that the diagnoses identified had minimal effect on patient management. Campbell et al. [5] performed a retrospective review of 715 consecutive cases of TJA and found no alteration in patient care resulting from routine

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pathologic examination. Koss et al. [6] performed a cost analysis of 3670 THA and total knee arthroplasty procedures at a single institution and found that all specimens had a concordant diagnosis. Their institution spent \$67,246.88 in routine analysis of TJA specimens by a pathologist; however, it had no change in postoperative patient care plans.

Our institution continues to perform routine histological examination after TJA. The purpose of this report is to illustrate a case in which routine pathologic examination of a femoral head specimen after primary THA provided an unsuspected and timely diagnosis of metastatic prostate adenocarcinoma, prompting further evaluation and expeditious treatment.

Informed consent was obtained from the patient for the publication of this study and accompanying images.

### Case history

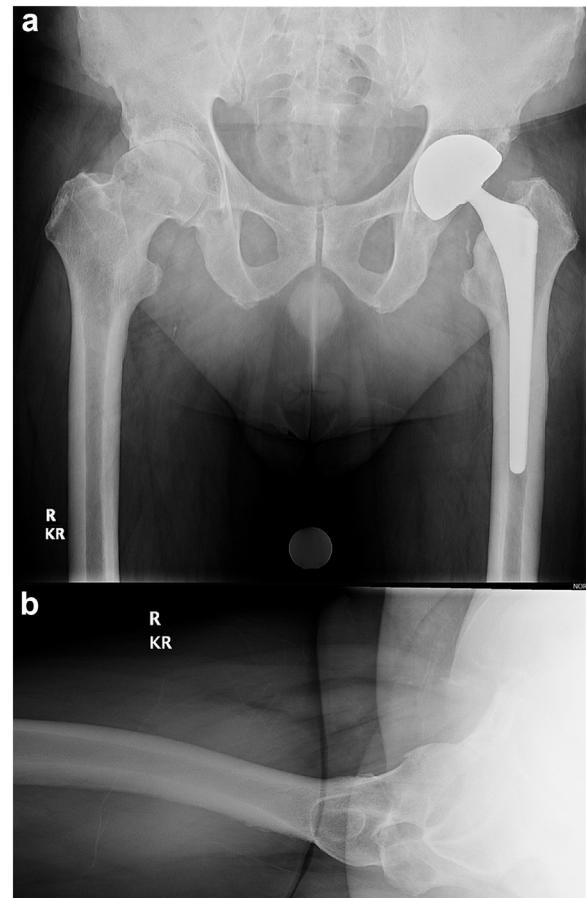
The patient is a 67-year-old man with a past medical history of obesity (body mass index of 32.8), gastroesophageal reflux disease, hypertension, and visual impairment. He presented to the outpatient orthopedic joint reconstruction clinic with the chief complaint of right hip pain. He had previously undergone a left THA in 2013 performed by the senior author and has done well in the interim, walking a mile every day until he started having insidious worsening of right hip pain over the prior 6 months.

On physical examination, the patient had an antalgic gait. He denied pain to the left hip. When examining his right hip, leg lengths were noted to be equal. The skin in the peri-incisional area was intact without cutaneous lesions. The patient denied tenderness over the right greater trochanter. The patient's right hip range of motion was markedly limited and consisted of full extension to 90 degrees of flexion, internal rotation of zero degrees, external rotation of zero degrees, abduction of 20 degrees, and adduction of zero degrees. The patient described significant groin and buttock pain with hip motion. His muscle strength was weak, and tone was normal. There was no instability of the joint. Neurologic and vascular examinations were normal.

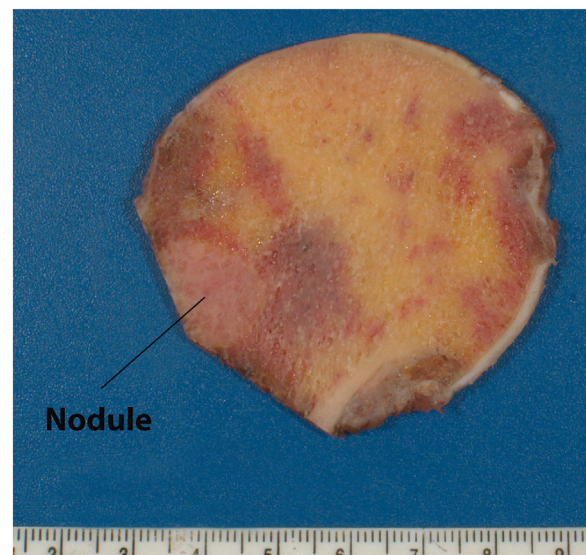
Anteroposterior pelvis and cross-table lateral radiographs were obtained demonstrating severe degenerative joint disease with bone-on-bone apposition of the right hip (Fig. 1).

Based on the patient's history, clinical exam, and radiologic findings, it was determined that the patient was a candidate for a right THA. This was performed without complication, and the patient's femoral head specimen was sent to pathology (Fig. 2). Postoperative radiographs following the right THA can be seen in Figure 3. The patient progressed well with physical therapy and was discharged home on postoperative day 1.

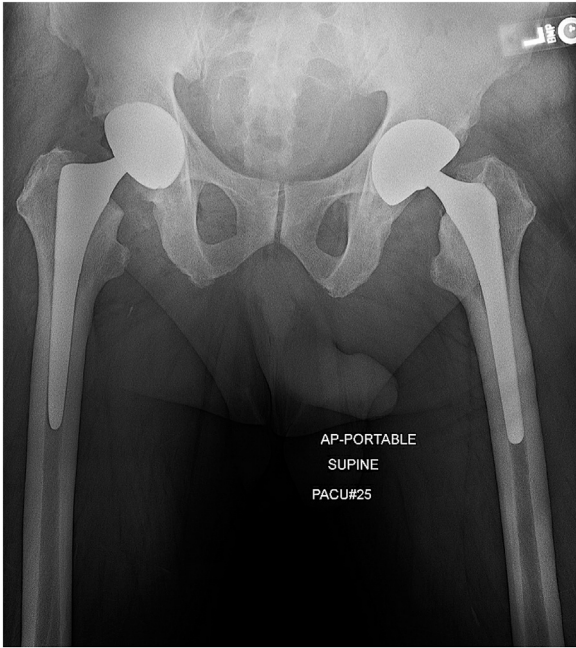
Histopathologic examination was performed, and besides showing features of severe osteoarthritis, it also showed metastatic adenocarcinoma with morphologic features suggestive of prostate origin, including epithelial cells with prominent central nucleoli forming glands (Figs. 4 and 5). An immunohistochemical stain for prostate-specific antigen (PSA) was strongly positive (Fig. 6), while stains for CK7, CK20, CD20, and TTF1 were negative. These immunohistochemical findings provide additional support for the diagnosis of metastatic prostate adenocarcinoma. Retrospective review of the preoperative imaging studies (Fig. 1) shows ill-defined areas of sclerosis in the femoral head and neck, but even with knowledge of the final diagnosis, the radiographic findings are consistent with osteoarthritis and are not suggestive of metastatic carcinoma. The patient was immediately informed of the results by the surgeon, and at the patient's request, the diagnosis was confirmed with an outside pathologist. The patient was urged to speak to his internist as soon as possible and was referred to urology for further management.



**Figure 1.** (a) Anteroposterior (AP) pelvis and (b) cross-table lateral radiographs demonstrating severe degenerative joint disease with bone-on-bone apposition, subchondral sclerosis, and osteophyte formation of the right hip. The patient is status post left THA with components in maintained alignment and no acute osseous abnormality noted.

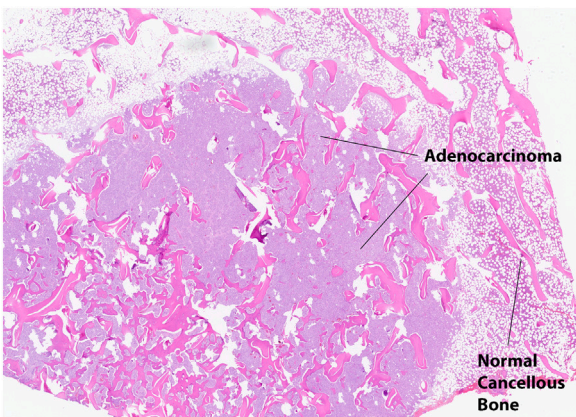


**Figure 2.** The gross specimen consisted of a distorted femoral head with a slightly flattened articular surface with eroded articular cartilage. A spherical region of pink cancellous bone is noted at the femoral neck resection margin that was subsequently found to represent metastatic adenocarcinoma.

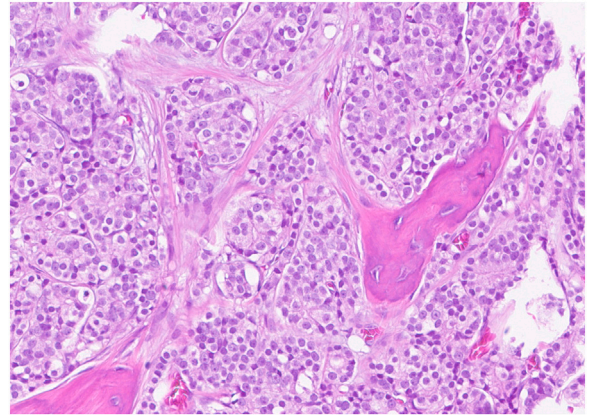


**Figure 3.** Immediate postoperative AP radiograph demonstrating bilateral THAs, new on the right. Alignment and appearance of components are satisfactory, without hardware complication, periprosthetic fracture, or dislocation.

The patient was seen at his 6-week postoperative visit and was doing well from a surgical standpoint. At that time, he confirmed that he did not have a diagnosis of adenocarcinoma prior to his right THA, thus demonstrating that the pathology specimen was the first indication of prostate adenocarcinoma. His serum PSA had been 2.0 in 2019 and was found to be 13.0 after receiving the diagnosis of metastatic adenocarcinoma. No interim PSA levels had been obtained. Subsequent imaging studies by his oncologist have detected computerized tomographic evidence of metastases in the skull and rib. He is currently being treated by his oncologist with enzalutamide daily and leuprolide once a month, and his latest PSA level is 1.0. The patient and his family are thankful that the metastatic carcinoma was detected during routine pathology for his hip,



**Figure 4.** This low-magnification histology image shows a spherical nodule of hypercellular tissue representing metastatic adenocarcinoma surrounded by essentially normal cancellous bone. Although the central part of the nodule shows sclerotic new bone, the trabecular bone around the periphery of the nodule is of similar density as the adjacent uninvolved bone, illustrating why it was difficult to visualize on radiographs (hematoxylin and eosin [H&E] stain, 6× magnification).



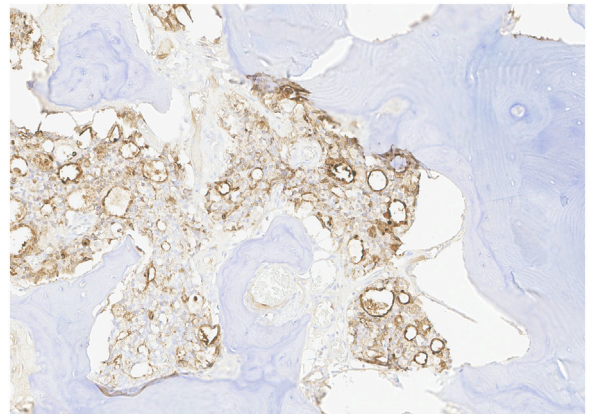
**Figure 5.** Higher magnification showing pleomorphic epithelial cells with round nuclei and prominent central nucleoli forming primitive glands. These morphologic features are diagnostic of metastatic adenocarcinoma and quite typical of prostate origin (H&E stain, 200× magnification).

and his wife commented that the THA and pathologic evaluation of the femoral head “saved his life.”

### Discussion

We present a case report of a patient who underwent primary THA, in which routine pathologic examination of a femoral head specimen provided an unsuspected and timely diagnosis of prostate adenocarcinoma. Although discordant cases are rare, diagnoses such as these are important to the individual patients involved. This case is an example where quality of care would have been compromised if we had abandoned our routine practice of femoral head specimen histopathologic examination.

There are 2 main opposing arguments to routine histopathology after TJA. The first is the argument of cost-effectiveness. The argument made by peer-reviewed papers dealing with cost-effectiveness lies on the premise that if a practice is not cost-effective, it should be abandoned in order to save money. This is despite the fact that histopathologic analysis constitutes a very small percentage of the overall cost of a TJA [4,7]. Holbrook et al. [7] performed a retrospective review of 1213 primary total joints and found the cost of histologic examination per specimen to be \$48.56, making up 0.31% of the total cost of an arthroplasty. Furthermore,



**Figure 6.** Immunohistochemical stain for prostate-specific antigen (PSA). The brown reaction product represents positive stain. Adjacent cancellous bone is stained pale blue (100× magnification).

there is little attention paid to the actual and potential benefits of these services, some of which can be difficult to quantify in monetary terms. A recent study by Liow et al. [8] retrospectively analyzed routine histologic findings of 3200 femoral head specimens from patients who underwent primary THA. The authors found 140 (4.4%) discrepant cases and 5 (0.2%) discordant cases. The authors found that routine histopathology revealed 1 unsuspected malignancy out of 640 femoral heads (5 of 3200). The total cost for histopathologic screening was \$614,664.80. However, the incremental cost-utility ratio was \$49,569.74 per quality-adjusted life year gained through perioperative screening, which costs less than the World Health Organization's recommended cost-effectiveness threshold of \$159,000 per quality-adjusted life year in the United States [9]. Thus, this indicates that routine femoral head histopathology in patients undergoing primary THA provides useful clinical information that may be cost-effective when attempting to quantify the quality of a human life. However, the threshold for cost-effectiveness is difficult to quantify because cost-effectiveness is a value judgment that depends on several factors including the entity determining the threshold, how the entity values money and outcomes (and compromising one for the other), and the resources available.

While reducing costs is important, particularly in an era of bundled payment reimbursement models by insurers, histological study serves multiple purposes in addition to immediate patient care. As discussed by Kocher et al. [4], as well as an editorial by Bullough and Dorfman [10], the histological examination of tissue facilitates, and is the gold standard of, quality assurance. Our current understanding about degenerative joint diseases has been derived from routine pathologic evaluation of specimens. The research value and educational value are difficult to quantify monetarily but should not be disregarded.

Besides patient protection from clinically occult diseases, reasons for pursuing routine pathologic examination include (1) to guard practitioners from claims of a "failure to diagnose," (2) to prevent fraud and abuse claims against a surgeon or an institution regarding sham surgery, (3) for facility accreditation reasons, (4) to provide histologic correlation with radiographic findings as part of trainee education, (5) as a "watchdog" for potentially unnecessary surgery as advocated by The Joint Commission, and (6) recognition of potential complications of new procedures, such as devices or other preparations that have bypassed formal clearance by the Food and Drug Administration (eg, synovial granulomas typical of viscosupplementation, pseudotumors associated with metal-metal and modular implants, and so on). None of these reasons are cost-effective, however, because of their benefit to the patient and society; collecting the information is worth its overall minuscule cost.

The second argument against routine histopathology is to perform "selective" specimen retrieval. Lu et al. [11] retrospectively reviewed 162 elective THA cases and found that clinical, radiological, and pathologic diagnoses were all concordant. Based on their small sample size, the authors concluded that clinicians can safely decide which specimens are for disposal based on clinical and radiological information. They, however, make an important clause that for cases with unusual clinical or radiological features, specimens should be submitted for pathology examination. The first flaw with this reasoning is that many of the discrepant diagnoses in histologic examinations are not only clinically unsuspected findings but also grossly unsuspected findings. Our case report is an example in which neither the presurgery radiographic findings nor the gross specimen suggested an occult finding. Therefore, if a diagnosis can only be made by using the microscope, how would anyone know which particular TJA to select for histology? The

second flaw with this logic is that even if "selective histologic testing" could somehow be implemented in only those specimens needing it, the baseline abilities of pathologists to undertake the histologic interpretations would be hindered by the fact that they were not seeing the requisite number of "nonselected" specimens in order to formulate and maintain baseline competency in histologic diagnoses of TJA specimens.

## Summary

Routine pathologic examination of a femoral head specimen provided an unforeseen diagnosis of prostate adenocarcinoma in a patient who underwent primary THA. However, there are multiple factors that need further study. For example, variations may exist between regions, hospital types, and experience of pathologists with musculoskeletal specimens, which may drive the practice of routine pathologic examination. Large tertiary referral centers, such as ours, may find it beneficial to perform routine pathologic examination given the relatively higher rate of complex or unusual cases. Furthermore, the benefits conferred from histopathologic examination are difficult to quantify from a true cost-benefit analysis. How does one put a dollar amount on the timely diagnosis and treatment of adenocarcinoma in this patient, for instance? We hope that this case report illustrates the utility of routine histopathologic diagnosis in making a significant impact on patient lives.

## Conflicts of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: T. W. Bauer is deputy editor for research for JBJS (2002-present) and is a co-editor of JBJS Case Connector (2015-present). G. H. Westrich receives royalties and research support as a principal investigator from Stryker and Exactech; is in the speakers' bureau of or gave paid presentations for Ethicon; is a paid consultant for Stryker, Ethicon, and Exactech; and is a board member of the Eastern Orthopedic Association.

For full disclosure statements refer to <https://doi.org/10.1016/j.artd.2022.02.025>.

## Informed patient consent

Complete written informed consent was obtained from the patient for the publication of this study and accompanying images.

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