

Cost Analysis of Routine Examination of Pathology Specimens Following Ankle Arthroscopy

Colin Burgess, DO¹ , Brandon Petrone, DO¹, Prashant Matai, MBBS¹ , Randy Cohn, MD¹ , and Adam Bitterman, DO¹

Abstract

Background: Routine submission of pathologic specimens for histologic analysis following orthopedic surgery is a common and often required practice in the United States. Prior orthopedic studies have determined that these histologic examinations are of limited cost effectiveness and low clinical value because rarely do the pathology findings alter patient management. The purpose of this study was to evaluate the cost effectiveness and clinical significance of routine histologic examination of tissue specimens removed during ankle arthroscopy.

Methods: Between 2014 and 2018, 408 patients underwent ankle arthroscopy at a multi-center hospital system by 16 different orthopedic surgeons. The available pathology reports from these cases were retrospectively reviewed to determine if the routine histologic examination altered patient care. We compared the preoperative diagnosis to both the postoperative and histologic diagnoses. The total cost for these histologic examinations was estimated using 2017 Medicare physician fees released by the College of American Pathologists. Cost-effectiveness was estimated in 2017 US dollars by cost per discrepant and discordant diagnosis.

Results: Of the 408 patients who underwent ankle arthroscopy, 361 pathology reports were available for review. The prevalence of concordant diagnosis was 98.9% (357/361); the prevalence of discrepant diagnoses was 1.0% (4/361). There were no cases identified with a discordant diagnosis. Total estimated cost for all pathology specimens was \$46 381 in 2017 US dollars. Cost per discrepant diagnosis was \$11 595.

Conclusion: In our study, histologic examination of surgical specimens following ankle arthroscopy had no effect on patient management, yet it increased costs. Routine examination of these pathologic specimens had a low rate of discrepant and/or discordant diagnoses. Based on our results, routine pathologic examination of ankle arthroscopy tissue specimens should be sent solely at the discretion of the orthopedic surgeon as opposed to being a mandated policy.

Level of Evidence: Level IV, case series.

Keywords: arthroscopy, ankle, sports medicine, pathology

Introduction

Ankle arthroscopy is becoming a popular procedure in the field of orthopedics. With continuing technological advances, orthopedic surgeons are able to treat an increasing number of foot and ankle pathologies with arthroscopy. Indications for ankle arthroscopy are expanding as well, both for diagnostic and therapeutic purposes.⁵ Despite previous research advocating against sending routine tissue specimens for pathologic examination following arthroscopy,^{3,7,14} many hospital systems maintain a mandatory policy to send these samples postoperatively. The Joint Commission (TJC) requires that all specimens routinely be sent for pathologic evaluation with certain exceptions. The

clinical staff (ie, surgeon), in consultation with a pathologist, can make an exception on submitting specimens removed from an operative procedure.¹⁰ These exceptions can only be made when there is no compromise in quality of care and when there is an authenticated operative or official report

¹ Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, Plainview, New York, USA

Corresponding Author:

Colin Burgess, DO, Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, 888 Old Country Road, Plainview, New York, NY 11803 USA.

Email: burgesscolinj@gmail.com



that the removal of tissue is documented appropriately. At our hospital system, tissue specimens from orthopedic arthroscopy cases are required to be sent for pathologic examination. The cost of these histologic evaluations can range between \$50 and \$200 per patient depending on the procedure performed.

The purpose of this study was to examine the cost effectiveness and clinical value of sending specimens routinely for histologic examination following ankle arthroscopy. Studies have shown that this is not necessary during similar arthroscopic procedures.^{3,7,14} This tissue consists of shavings obtained from the ankle joint, including but not limited to synovium, debridement from syndesmotic ligaments, cartilage, and loose bodies. With the increasing frequency of ankle arthroscopy, estimating potential cost savings associated with routine pathologic examination of ankle arthroscopy specimens were analyzed.

Methods

Between January 1, 2014, and December 31, 2018, a total of 408 patients underwent ankle arthroscopy at a multicenter hospital system by 16 different orthopedic surgeons. After receiving approval from the institutional review board for our health system, patient data were retrospectively collected by searching the following Current Procedural Terminology (CPT) codes: 29891 (arthroscopy, ankle, surgical excision of osteochondral defect of talus and/or tibia), 29892 (arthroscopically aided repair of large osteochondritis dissecans lesion), 29894 (arthroscopy, ankle, with removal of loose or foreign body), 29895 (arthroscopy, ankle, with partial synovectomy), 29897 (arthroscopy, ankle, limited surgical debridement), 29898 (arthroscopy, ankle, extensive surgical debridement), and 29899 (arthroscopy, ankle, with ankle arthrodesis). There were 47 cases that did not have a pathology report available; these cases were excluded from the analysis. Six of these did not have documentation of a pathology report available for examination. Eleven cases were arthroscopically assisted procedures and the additional 30 were instability cases of which a diagnostic arthroscopy was performed prior to open management.

The pathology reports from the remaining 361 cases were retrospectively reviewed by 2 junior orthopedic residents to determine if the histologic examination altered patient care. Each histologic examination was completed by a board-certified pathologist and documented in their report. They were not blinded to the preoperative diagnosis. We compared the postoperative diagnosis from the surgeon's operative report to the histologic diagnosis completed by the pathologist. These reports were compared to determine if any discrepant or discordant diagnoses were present that altered patient management. A discrepant diagnosis was defined as a difference between pathology report and postoperative diagnosis that did not alter patient management. A discordant diagnosis was a difference in diagnosis that did lead to alterations in patient care.

Table 1. List of Preoperative Diagnoses.^a

| Preoperative Diagnosis | Total |
|-------------------------------------|-------|
| OCD | 89 |
| Tenosynovitis | 88 |
| Instability | 48 |
| Impingement | 39 |
| Post-traumatic OA | 33 |
| Osteoarthritis | 30 |
| Internal derangement | 22 |
| Loose body | 19 |
| Enthesopathy | 5 |
| Painful hardware | 3 |
| Pilon fracture | 3 |
| Medial malleolus fracture | 2 |
| Tarsal tunnel syndrome ^a | 2 |
| Bone cyst | 1 |
| Osteomyelitis | 1 |
| Synovial chondromatosis | 1 |
| Traumatic arthrotomy | 1 |

Abbreviations: OA, osteoarthritis; OCD, osteochondral dissecans.

^aTarsal tunnel syndrome is defined as compression of the tibial nerve or its branches as it passes underneath flexor retinaculum at level of the ankle or distally.

Table 2. Reasons for Cases Without Pathology Reports.

| Reason for No Report | Total |
|---|-------|
| Instability cases with diagnostic arthroscopy prior to open treatment | 30 |
| Arthroscopically assisted fracture or open procedure | 11 |
| No pathology report available | 6 |

The total cost for these histologic examinations were estimated using 2017 Medicare physician fees released by the College of American Pathologists. We used the CPT codes 88304 (surgical pathology gross and microscopic, non-fracture) and 88311 (decalcification) to provide the approximate cost per pathologic examination. Each specimen underwent both gross and histologic examination. Cost-effectiveness was estimated in 2017 US dollars by cost per discrepant and discordant diagnosis.

Results

The most common preoperative diagnosis was an osteochondral defect (23%), followed by tenosynovitis (Table 1). In some cases (ie, preoperative diagnosis of tarsal tunnel), arthroscopy was used as a diagnostic tool to evaluate intra-articular pathology prior to open treatment. Four histologic reports differed from the postoperative diagnosis. All 4 were discrepant diagnoses (1.11%) and none were discordant. The histologic report was concordant to the preoperative diagnosis in 357 cases (98.9%). Forty-seven cases did not have pathology reports available (Table 2).

Three of the patients were found to have pigmented villonodular synovitis (PVNS). Two of these cases had a

postoperative diagnosis of synovitis and the third had a postoperative diagnosis of tenosynovitis. One patient had a histologic diagnosis of synovial chondrometaplasia, differing from their postoperative diagnosis of loose body and synovitis. None of these 4 diagnoses had any effect on patient management. A post hoc power calculation based on our sample size and rate of discordant/discrepant diagnoses revealed 59.3% power to detect a 1.1% rate of discrepant diagnoses.

Utilizing the Medicare Physician Fee Schedule released in November 2016 by the College of American Pathologists, the cost of each pathologic specimen examination was estimated to be \$128.48. This included gross and microscopic examination in addition to decalcification. The total estimate for the 361 histologic examinations was \$46 381 in 2017 US dollars. The cost per discrepant diagnosis was estimated at \$11 595 (total cost estimate for all histologic examinations divided by 4 discrepant diagnoses).

Discussion

Routine pathologic examination of tissue specimens from ankle arthroscopy demonstrated minimal cost-effectiveness because of low prevalence of discrepant or discordant diagnosis. These pathologic examinations did not alter patient care and increased the cost. We believe that routine pathologic examination of ankle arthroscopy tissue specimens should only be performed on a per case basis at the discretion of the orthopedic surgeon. We recommend these specimen examinations should not be mandatory for every case.

The College of American Pathologists requires that tissue removed during surgery be sent routinely for histologic examination.¹² This recommendation originated in a 1927 report published by the American College of Surgeons that aimed to increase the diagnostic accuracy of surgeons in the operating room.¹³ Currently they do allow for exemptions to be made based on individual hospital policies; however, at our institution it remains mandatory to send tissue samples after arthroscopy. When examining histologic specimens postoperatively, there have been studies giving general recommendations for this practice. Raab published the argument that in order to be cost effective, at least 1 in every 2000 histologic specimens should have a clinical implication altering patient care.¹⁶ This study was not exclusive to orthopedic procedures and included general surgery pathology specimens as well.

There have been numerous studies in the orthopedic literature documenting the low prevalence of management-altering diagnoses received from pathology reports. Multiple studies have involved arthroscopic shavings and their limited clinical significance and cost-effectiveness for examination by a pathologist. Kirkley et al⁷ examined 1036 knee arthroscopy surgeries and found only 1 (0.1%) case of discordant diagnosis with an estimated cost of \$234 147. Additionally, Greene et al investigated 3797 knee arthroscopies and found 27 (0.7%) discrepant diagnoses, with only 1 (0.026%) discordant diagnosis. Their cost per discordant

diagnosis was estimated at \$371 810.³ With regard to shoulder arthroscopy, McClain et al¹⁴ retrospectively reviewed 2144 pathology reports and found no discrepant or discordant diagnoses. Their total cost estimate was \$160 543.

In arthroplasty literature, there have been numerous studies documenting the limited cost effectiveness of sending removed bone/cartilage specimens for routine examination. One study reviewed 1388 consecutive hip and knee arthroplasty patients, revealing that the surgeon's combined preoperative and intraoperative diagnosis agreed with the histologic report in 100% of cases.¹¹ There were 11 discrepancies between pre- and intraoperative diagnosis; however, the surgeon correctly identified the disparities in the operating room in all 11 incidents. Kocher et al⁸ studied 1234 total joint replacements, finding only 1 discordant diagnosis and 28 discrepant diagnosis (0.1% and 2.3%, respectively) with an estimated cost of \$122 728 per discordancy. Another similar study retrospectively reviewed 951 total joint arthroplasties, revealing a 2.8% discrepancy between postoperative diagnosis and histologic report.¹⁵ However, none of these conflicting reports altered patient management as they all had a postoperative diagnosis of osteoarthritis with a pathologic report that showed avascular necrosis. One larger study examined 16 587 total joint arthroplasties and found a slightly higher rate of discrepant and discordant diagnoses between operative and pathologic diagnoses. There was an 18.8% discrepancy in total hip arthroplasty and 9.4% discrepancy in total knee arthroplasty.² In addition, they found a discordant diagnosis in 5.4% of total hips and 1.4% in total knees. They noted that their increased rates could be due to more in-depth pathologic examination at their institution compared to other facilities.

Howard et al retrospectively reviewed 714 primary shoulder arthroplasty cases to evaluate for any discrepancies with pathologic diagnosis after evaluation of the humeral head. They found discrepant diagnoses in 5.9% of cases, with no discordant diagnoses noted.⁴ Their estimated cost for discrepant diagnosis in 2015 US dollars was \$1424. There is a documented case report of non-Hodgkin lymphoma diagnosed after primary total shoulder arthroplasty. It involved a 54-year-old woman with a history of long standing rheumatoid arthritis who had received prolonged immunosuppressive therapy.¹ They recommended that any patient with a history of significant immunosuppression should have surgical specimens sent for pathologic review.

In this study, we had a total of 4 patients with discrepant diagnoses. Three had a histologic diagnosis of PVNS and 1 had a diagnosis of synovial chondrometaplasia. PVNS is a rare, benign neoplastic disease of synovium of joints. Synovectomy alone is standard management of PVNS around the ankle.⁹ Synovial chondrometaplasia is a benign, abnormal growth of the synovium that can lead to formation of nodules within a joint. It can also be referred to as synovial chondromatosis. Treatment for this consists of excision of loose bodies or nodules in addition to synovectomy.⁶ Neither of

these diagnoses altered patient management in the post-operative period. As this study was retrospective in nature, it is impossible to determine if there was an incorrect pre-operative diagnosis that lead to the different histologic diagnosis postoperatively. It is also possible that these were recognized intraoperatively by the surgeon and confirmed on the histologic examination. Again, we are unable to confirm either because of the retrospective data collection.

Our study is limited by the relatively small number of cases, with only 361 ankle arthroscopy cases having pathology reports available for review. The majority of the 47 cases that did not have a pathology report were arthroscopically assisted procedures. There were 30 instability cases that were treated open following a diagnostic arthroscopy. Eleven were arthroscopically assisted open reduction internal fixation for distal tibia fractures and 6 that did not have documentation of pathology being sent for examination. Despite the small number of pathology reports, we did not identify any patients with a discordant diagnosis in our patient population. Based on previous studies analyzing cost effectiveness and clinical implications, our patient population did not meet the criteria for routine sending of histology specimens. We estimated a cost-per-discrepant diagnosis of \$11 595, with a total estimated cost for all pathologic examinations at \$46 381. These costs are slightly lower compared to the findings in previous studies, which range from \$1424 to \$371 810 for discordant diagnoses.

In conclusion, histologic examination following routine ankle arthroscopy was not cost-effective according to our results. There was also a very low chance for any findings that would alter patient care in the perioperative period. Based on our results, we recommend that routine submission of pathology specimens following ankle arthroscopy not be mandatory. It is not cost effective and does not lead to any clinical implications on patient care. These specimens should be sent at the discretion of the surgeon.




Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. ICMJE forms for all authors are available online.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Colin Burgess, DO,  <https://orcid.org/0000-0003-0026-7904>
Prashant Matai, MBBS,  <https://orcid.org/0000-0001-8024-7748>
Randy Cohn, MD,  <https://orcid.org/0000-0001-9876-1497>

References

- Arredondo J, Worland RL, Sinnenberg RJ, Qureshi GD. Non-Hodgkin's lymphoma as an unexpected diagnosis in a shoulder arthroplasty. *J Arthroplasty*. 1999;14(1):108-111.
- DiCarlo EF, Klein MJ. Comparison of clinical and histologic diagnoses in 16,587 total joint arthroplasties. *Am J Clin Pathol*. 2014;141(1):111-118.
- Greene JW, Pa TZ, Deshmukh A, Cushner FD, Scuderi GR. Routine examination of pathology specimens cost-effectiveness analysis. *J Bone Joint Surg*. 2014;96(11):917-921.
- Howard DR, Kazemi N, Rubenstein WJ, et al. Cost-benefit analysis of routine pathology examination in primary shoulder arthroplasty. *J Shoulder Elbow Surg*. 2017;26(4):674-678.
- Hsu AR, Gross CE, Lee S, Carreira DS. Extended indications for foot and ankle arthroscopy. *J Am Acad Orthop Surg*. 2014;22(1):10-19.
- Imhoff A, Schreiber A. Synovial chondromatosis. *Orthopade*. 1988;17(2):233-244.
- Kirkley A, Adlington J, Wall R, Griffin S, Guiraudon C. The cost-effectiveness of routine pathology consultation in knee arthroscopy. *Arthroscopy*. 1998;14(7):690-695.
- Kocher MS, Erens G, Thornhill TS, Ready JE. Cost and effectiveness of routine pathological examination of operative specimens obtained during primary total hip and knee replacement in patients with osteoarthritis. *J Bone Joint Surg Am*. 2000;82(11):1531-1535.
- Korim MT, Clarke DR, Allen PE, Richards CJ, Ashford RU. Clinical and oncological outcomes after surgical excision of pigmented villonodular synovitis at the foot and ankle. *Foot Ankle Surg*. 2014;20(2):130-134.
- Laboratory Services. The Joint Commission. http://www.jointcommission.org/standards_information/jcfaqdetails.aspx?StandardsFaqId=295&ProgramId=47. Published 2008. Accessed October 24, 2019.
- Lawrence T, Moskal JT, Diduch DR. Analysis of routine histological evaluation of tissues removed during primary hip and knee arthroplasty. *J Bone Joint Surg*. 1999;81(7):926-931.
- Lott R, Tunnicliffe J, Sheppard E, et al. Practical guide to specimen handling in surgical pathology. *Coll Am Pathol*. 2015:1-53.
- MacEachern M. *A Manual of Hospital Standardization 1926*. American College of Surgeons. <https://archive.org/details/HospitalStandardizationManual1926>. Published 1927. Accessed July 22, 2019.
- McClain RE, Hotari CD, Scribner CL, Detrisac DA. The clinical value of histologic examination in shoulder arthroscopy. *J Bone Joint Surg*. 2008;90(2):281-283.
- Meding JB, Ritter MA, Jones NL, Keating EM, Faris PM. Determining the necessity for routine pathologic examinations in uncomplicated total hip and total knee arthroplasties. *J Arthroplasty*. 2000;15(1):69-71.
- Raab SS, Slagel DD, Robinson RA. The utility of histological examination of tissue removed during elective joint replacement. a preliminary assessment. *J Bone Joint Surg*. 2016;80(3):331-335.