

Examination of total hip and knee arthroplasty tissues

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Background: Many practices require tissues from hip and knee arthroplasty procedures to be sent for pathologic examination. These examinations rarely provide information beyond the clinical or radiologic diagnosis and rarely alter clinical management. We aimed to determine the rate at which histologic diagnoses based on gross assessment alone or gross plus microscopic assessment correspond with reported clinical diagnoses in patients undergoing total joint arthroplasties and whether the histologic diagnoses alter patient management.

Methods: We retrospectively reviewed arthroplasty cases performed at a high-volume teaching hospital in Manitoba, Canada. The clinical diagnosis was compared with the final pathology report based on gross examination, with or without histologic assessment. The results of the comparison were classified into 3 categories: concordant (same diagnosis), discrepant (different diagnoses without alterations in management) and discordant (different diagnoses resulting in management change). The overall provincial cost for pathologic examination was determined by multiplying the total examination cost by the estimated number of arthroplasty cases.

Results: There were 773 patients in our study sample. The concordant rate was 98.3% (95% confidence interval [CI] 97.1%–99.1%), the discrepant rate was 1.7% (95% CI 0.9%–2.9%) and the discordant rate was 0.0% (95% CI 0%–0.5%) for 773 cases. The pathology diagnosis did not alter patient management in any case. A total of 91.5% of specimens did not require full histologic review and received gross descriptions only. The discrepancy rate was higher in cases that included microscopic examination than in those that received only gross descriptions (15.2% v. 0.4%, $p < 0.001$). The overall provincial cost for pathologic examination was estimated at Can\$304 556.

Conclusion: Submitting routine tissue from arthroplasty procedures to pathology does not affect patient management and therefore provides no value for the health care resources expended in doing so.

Contexte : Beaucoup d'établissements exigent que des tissus soient envoyés pour un examen anatomopathologique après une arthroplastie de la hanche et du genou. Ces examens n'apportent généralement pas d'information nouvelle quant au diagnostic clinique ou radiologique et modifient rarement la prise en charge. Notre objectif était de déterminer le pourcentage de correspondance entre les diagnostics histologiques fondés sur l'inspection grossière uniquement ou sur l'inspection grossière et l'examen au microscope, et les diagnostics cliniques des patients qui subissent des arthroplasties totales. Nous cherchions également à savoir si les diagnostics histologiques modifient la prise en charge.

Méthodes : Nous avons procédé à une analyse rétrospective d'arthroplasties effectuées dans un grand hôpital universitaire du Manitoba, au Canada. Le diagnostic clinique était comparé au rapport final de pathologie fondé sur une inspection grossière, avec ou sans examen histologique. Les résultats de cette comparaison étaient classés en 3 catégories : concordance (même diagnostic), divergence (diagnostics différents, sans modification de la prise en charge) et discordance (diagnostics différents entraînant une modification de la prise en charge). Le coût global pour la province associé aux examens pathologiques a été établi en multipliant le coût total d'un examen par le nombre estimé de cas d'arthroplastie.

Résultats : Notre échantillon comprenait 773 patients. Le taux de concordance était de 98,3 % (intervalle de confiance [IC] de 95 % 97,1 %–99,1 %), le taux de divergence était de 1,7 % (IC de 95 % 0,9 %–2,9 %) et le taux de discordance de 0,0 % (IC de 95 % 0 %–0,5 %). Dans tous les cas, le diagnostic pathologique n'a pas modifié la prise en charge. Au total, 91,5 % des spécimens ne nécessitaient pas d'examen histologique complet et n'ont fait l'objet que d'une inspection grossière. Le pourcentage d'anomalie était plus élevé pour les spécimens analysés au microscope que pour ceux ayant uniquement subi une inspection grossière (15,2 % c. 0,4 %, $p < 0,001$). Le coût total des examens pathologiques pour la province a été estimé à 304 556 \$ CA.

Conclusion : L'analyse pathologique systématique de tissus prélevés lors d'arthroplasties n'entraîne pas une modification de la prise en charge du patient; il n'y a donc pas de valeur associée aux ressources de santé utilisées pour ces examens.

In many hospitals, pathologic specimens at the time of primary hip and knee arthroplasty are routinely sent for gross or microscopic examination regardless of the diagnosis.¹⁻³ The Joint Commission on Accreditation of Healthcare Organizations enforces this practice for most types of specimens, including those from total joint arthroplasties.⁴ There are contrasting views in the current literature about the benefits of histologic examination in joint arthroplasty.

Some authors have reported that histologic examination is beneficial because the information provided improves diagnostic accuracy, supports quality assurance, provides documentation of the procedure and may affect the short- or long-term management of the patient.⁵⁻⁹ DiCarlo and colleagues compared clinical and histologic diagnoses in 16 587 total joint arthroplasties and found discrepant rates of 18.8% for 7968 total hip replacements and 9.4% for 8619 total knee replacements, with discordant rates of 5.5% of hip joints and 1.4% of knee joints affecting clinical management.¹⁰ Zwittser and colleagues reported on the retrospective examination of 852 femoral heads; 14 heads (1.6%) were highly suspicious for low-grade B cell lymphoma, changing patient management.⁸ Lauder and colleagues reported on a case of unsuspected non-Hodgkin lymphoma that was discovered after routine histopathologic examination of a femoral head with osteoarthritis.⁷

Other authors have reported that the information gathered from specimens from joint arthroplasty may not provide additional information beyond the clinical or radiologic diagnosis nor alter clinical management and therefore collection of this information is not warranted.^{1,11} The Canadian Orthopaedic Association recently published the following Choosing Wisely recommendation: "Don't routinely request pathological examination of tissue from uncomplicated primary hip and knee replacement surgery undertaken for degenerative arthritis."¹² Campbell and colleagues retrospectively reviewed 715 consecutive joint arthroplasty cases and found no alteration in patient care from routine pathologic examination.¹ Meding and colleagues retrospectively reviewed 951 hip and knee arthroplasty cases and found that pathologic evaluation did not alter postoperative medical or surgical management.¹¹ Lin and colleagues retrospectively reviewed 1247 patients who underwent 1363 routine elective primary total joint arthroplasties and found that routine histologic examination increased medical costs but rarely altered patient management and was not cost effective.⁹ Multiple publications have challenged the value of routine pathologic examination of numerous other tissue types, including intervertebral discs, wrist ganglions, hernia sacs and samples from hallux valgus surgeries and joint replacements.^{6,13-16}

In the current financial climate of accumulating health care costs, institutions are faced with the challenge of finding the right balance between providing high-quality services and ensuring cost effectiveness. One potential approach to reducing costs is to challenge long-standing

practices and to potentially eliminate unnecessary services that provide no added value to patient care. Suboptimal use of pathology services, a lack of clinician awareness and unclear criteria for exclusions from pathology examination contribute to the poor adherence to established regulations and policies.³ Although the regulatory and accreditation framework may not be identical across institutions, select specimen types can be exempted from pathologic examination by a consensus between surgeons, pathologists and health care administrators.

There is currently no uniform practice regarding the examination of tissue excised during procedures that is sent to pathology laboratories.¹⁷ Variations in laboratory assessment include conducting a histologic examination for all tissues, conducting only a gross examination, or conducting neither type of examination. Previous studies have focused on relating the preoperative clinical diagnosis with the postoperative histologic diagnosis. In this study we compared the clinical and pathologic diagnoses in cases where only the gross pathologic examination was performed and in cases in which microscopic review was also conducted, to determine if patient management was affected.^{1,2,7-11,17}

METHODS

We retrospectively reviewed the prospectively collected arthroplasty database to identify all patients who underwent hip or knee arthroplasty at our Canadian high-volume arthroplasty teaching hospital (Concordia Hospital, Winnipeg, Manitoba) between March and August 2013. Data were collected from the case notes, laboratory information system, pathology requisition and radiology report. We included all elective total hip arthroplasty (THA) and total knee arthroplasty (TKA) cases performed in our unit. Exclusion criteria were fractures, revision and partial joint arthroplasty cases.

The clinical diagnosis was determined on the basis of the information available on the submitted pathology requisition and the radiology report. The clinical findings were compared with the diagnostic interpretation of the final pathology report. The final pathologic diagnosis was based on either a gross examination or a combined gross and histologic examination. When the gross examination was sufficient to provide a diagnostic interpretation and no unusual findings were noted, histologic sections were not taken. The comparisons between the preoperative clinical and postoperative pathologic diagnoses were classified into 3 categories: concordant (same diagnosis), discrepant (different diagnoses without alterations in management) and discordant (different diagnoses resulting in a change in management).

A financial assessment of the pathologic examination in the pathology laboratory was performed; this included a cost assessment of labour, including the pathologist's time, and laboratory consumables. We conducted interviews and time studies with front-line staff and managers. The final

assessment did not include transport costs or operating room labour and costs. We broke down consumable costs by time and effort. We calculated the overall provincial cost only for gross pathologic assessments, because all specimens at least had this assessment. The cost of a gross pathologic assessment is estimated at Can\$65 whereas the cost of a histologic examination is estimated at Can\$160. We determined the overall cost for pathologic assessment in the laboratory by multiplying the total cost of pathologic assessment by the number of joint replacements in our study population. We calculated the overall provincial cost for pathologic examination in Manitoba by multiplying the total cost of pathologic assessment by the estimated number of joint replacements carried out in the province.

Statistical analysis

We used the χ^2 test to look for statistical significance between concordant, discrepant and discordant groups for clinical and histologic assessment. We also compared groups that had gross assessment only and groups that had both gross and histologic assessment. Values of $p < 0.05$ were considered statistically significant for all tests.

RESULTS

A total of 773 patients met the inclusion criteria. There were of 426 TKA and 347 THA specimens. Table 1 shows the frequency of concordant, discrepant and discordant clinical and pathologic findings. The TKA specimens had a 97.7% (95% confidence interval [CI] 95.7%–98.9%) concordant rate and a 2.3% (95% CI 1.1%–4.3%) discrepant rate. The

Table 1. Frequency of concordant, discrepant and discordant clinical and pathologic findings for hip and knee joint arthroplasty specimens

Specimen	No. of cases; type of finding			Total
	Concordant	Discrepant	Discordant	
TKA	416	10	0	426
THA	344	3	0	347
Total	760	13	0	773

TKA = total knee arthroplasty; THA = total hip arthroplasty.

Table 2. Frequency of concordant, discrepant and discordant clinical and pathologic findings (gross examination only v. gross plus histologic examinations) for hip and knee joint arthroplasty specimens

Specimen	No. of cases; type of examination and type of finding						Total
	Gross examination only			Gross plus histologic examinations			
	Concordant	Discrepant	Discordant	Concordant	Discrepant	Discordant	
TKA	388	1	0	29	9	0	427
THA	316	2	0	27	1	0	346
Total	704	3	0	56	10	0	773

TKA = total knee arthroplasty; THA = total hip arthroplasty.

THA specimens demonstrated a 99.1% (95% CI, 97.5%–99.8%) concordant rate and a 0.9% (95% CI 0.2%–2.5%) discrepant rate. All specimens overall demonstrated a 98.3% (95% CI 97.1%–99.1%) concordant rate and a 1.7% (95% CI 0.9%–2.9%) discrepant rate. The discordant rate among all 773 cases was 0.0% (95% CI 0.0%–0.5%); therefore, the pathology diagnostic report did not alter clinical management for any of the patients. Of the 13 discrepant cases, the pathology report findings not seen on imaging included chronic synovitis, pseudogout in addition to underlying osteoarthritis, rheumatoid arthritis and avascular necrosis.

Table 2 shows the frequency of concordant, discrepant and discordant clinical and pathologic findings (gross examination only v. gross plus histologic examination) for THA and TKA specimens. Most of the specimens (707; 91.5%) were examined by gross pathologic assessment alone. Of these, 388 (99.7%) of the TKA cases were concordant and 1 (0.3%) was discrepant. Among the 318 THA cases, there were 2 (0.6%) discrepancies. A full histologic examination was completed in 66 (8.5%) cases. Twenty-nine (76.3%) of the 38 TKA cases were concordant and 9 (23.7%) were discrepant, while 27 (96.4%) of the 28 THA cases were concordant and 1 (3.6%) demonstrated a discrepancy. Overall, the histologic examination produced a higher number of discrepant cases than gross examination alone (15.2% v. 0.4%; $p < 0.001$).

Table 3 shows the frequency of concordant, discrepant and discordant clinical and pathologic findings for the different tissue types that were submitted. Of the 66 cases submitted for histologic examination, 30 (45.5%) of the specimens were comprised of soft tissue, fibroconnective tissue around the joint and synovium, only. In the remaining cases, the histologically examined material comprised bone and soft tissue together (22; 33.3%) or bone only (14; 21.2%).

Of the 14 cases in which only bone was submitted for histologic assessment, 13 (92.9%) were concordant and 1 (7.1%) was discrepant. Twenty-three (76.7%) of the soft tissue-only cases were concordant and 7 (23.3%) were discrepant. Of the 22 cases that were composed of bone and soft tissue together, 20 (90.9%) were concordant and 2 (9.1%) were discrepant.

The overall laboratory cost for pathologic examination was estimated at Can\$156 515 for the 773 patients in the study sample, for whom 707 specimens were examined by gross pathologic assessment only and the remainder were examined by both gross pathologic and histologic assessment.

DISCUSSION

We performed a retrospective review of 773 patients undergoing hip and knee arthroplasty in a single major

Table 3. Frequency of concordant, discrepant and discordant clinical and pathologic findings for different tissue types

Type of finding	No. of cases; tissue type			Total
	Bone only	Soft tissue only	Bone and soft tissue	
Concordant	13	23	20	56
Discrepant	1	7	2	10
Discordant	0	0	0	0
Total	14	30	22	66

Canadian academic institution over 6 months. The concordance rate between clinical and pathologic findings was very high for joint arthroplasty tissue specimens, with no discordant findings for any specimens. Although the rate of discrepant findings between clinical and pathologic assessments was low overall, higher rates of discrepancy were observed when tissues underwent microscopic and gross assessment as opposed to gross assessment alone. Pathologic assessment of soft tissue produced a higher rate of discrepant findings than did assessment of bone alone or of soft tissue in combination with bone. The pathology diagnostic report did not alter clinical management for any of the patients.

The utility of routine pathologic examination of hip and knee arthroplasty specimens has been discussed in the literature by several authors. Some studies have indicated that unexpected findings may occasionally be revealed by histology;^{7,8,11} others have concluded that routine pathologic examination of these specimens is not a cost-effective approach.^{1,2,10,17,18} This debate highlights the dichotomous relationship between pathology and clinical disciplines. The ultimate objective of a pathologic examination is to provide a diagnosis and critical information to guide treatment and patient management. This is the case with biopsies and excisions of suspected neoplastic or premalignant lesions or specific benign entities (samples from gastrointestinal, gynecologic, genitourinary, endocrine, brain, skin and other lesions), where pathology plays an essential role in the clinical investigation by providing a specific diagnosis and crucial information necessary for optimal patient management. In other clinical scenarios, the diagnosis is made preoperatively on the basis of clinical and radiologic findings before sampling (ganglion, osteoarthritis, hernia sac), and the pathologist is only needed to confirm the diagnosis and report any unexpected findings. The pathologic examination in these situations is expected to provide quality assurance for patient care rather than determine patient management. Although the role of pathology has never been questioned when the pathologic diagnosis is required to direct treatment, the added value of pathologic examination and its cost-effectiveness have been questioned when it is used as a tool to confirm a clinical diagnosis that has already been made with a high level of certainty.

In this study, the histologic examination produced a higher number of discrepant cases than gross examination

alone (15.2% v. 0.4%). Interestingly, when bone only was submitted for histologic assessment, the ratio of discrepant cases did not increase. In contrast, when soft tissue was examined microscopically, with or without bone, the ratio of discrepant cases increased. In these cases, the histologic assessment added minor findings to the results of the gross examination. Overall, the histologic examination did not produce any discordance, nor did it affect patient management. Our findings confirm that neither a gross description nor a combined gross and microscopic pathologic examination adds substantial clinical value and indicate the need to finally change outdated existing protocols. Given that we did not identify a single discordant case in our study, it is difficult to support the role of pathologic examination as a quality assurance measure. Although some authors argue that routine pathologic examination is necessary for quality assurance;^{7,8,18} others do not find it justified or practical.^{1-3,17,18} An alternative approach can be a gross examination in the operating room by the surgeon with photographic documentation of the typical changes, which can serve as a quality assurance measure.²

In the current fiscal environment, it is necessary to revisit and challenge practices in which pathology does not influence patient management. Health care costs have been continually increasing, and laboratories are under pressure to fiscally keep up with increasing demands for molecular tests and predictive markers in the era of personalized medicine. Recognizing and eliminating superfluous spending and making educated, evidence-based decisions will allow funds to be redirected to more appropriate needs in the health care system.

The overall laboratory cost for pathologic examination was estimated at Can\$156 515 for our study population. Provincially, 1820 primary hip and 2268 primary knee replacement cases were performed in the 2013/14 fiscal year;¹⁹ an estimated \$304 556 was spent on the examination of specimens in hip and knee joint arthroplasty cases during this fiscal year. In the published literature, the average cost of the routine pathologic examination of THA and TKA specimens ranged from US\$102 to US\$200.^{1,17,18} Considering the aging population, the increasing number of THAs and TKAs being done and the ongoing option of pathologic examination for any case deemed to be unusual by the surgeons, the estimated projected savings by discontinuing the routine pathologic examination of these specimens would be Can\$250 000 to Can\$350 000 annually. These resources could be reallocated to meet other demands in our health care system to provide added value to patients. In our Canadian health care system, this information has been shared with orthopedic surgeons and incorporated into provincial arthroplasty care guidelines, operating room procedures have been modified to directly dispose of these tissues and ways have been explored to redirect these resources into increased THA and TKA surgery volumes.

CONCLUSION

Our study found that almost all of the histologic diagnoses were consistent with the reported clinical diagnoses for our population of patients undergoing THA and TKA, on the basis of gross assessment alone or both gross and microscopic assessment. The routine submission of tissue from THA and TKA cases for pathologic examination does not change patient management. Given that our study has confirmed that routine pathologic examination of THA and TKA specimens is not cost effective, a process has been implemented to capture these savings at our institution.

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Competing interests: None declared.

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