SPECT-CT In Identifying Periprosthetic Pathology Following Painful Total Ankle Replacement

Jeffrey Christensen, DPM, FACFAS, Ryan Schwanke, DPM, Drew Bekins, DPM
Swedish Medical Center, Seattle, WA

Statement of Purpose

Total ankle arthroplasty (TAA) has become an effective treatment modality for severe arthropathies of the ankle joints.[1-4] Patients are able to regain function and mobility of a natural joint while also alleviating the patients symptoms of pain and reducing the rates of adjacent joint arthritis when compared to ankle fusion. However, these devices are not without fault and pain post operatively is difficult to discern. The purpose of this review is to quantify the utility of single photon emission computed tomography (SPECT) for patients experiencing pain following TAA after plain imaging did not demonstrate pathology associated with patient's pain.

Literature Review

Pain following TAA can be difficult to assess based purely on plain film imaging, with the two most common sources of pain post operatively being gutter impingement and aseptic loosening and each having their own different modalities of treatment. Higher sensitivity and specificity imaging is needed to identify pathology and guide treatment.[2,5-10] With utilization of SPECT which overlays helical CT images with that of a radionucleotide scan, areas of pain have been quantified and correlated with the imaging results demonstrating increased uptake at sites of pain in other areas of total joint replacement.[11-14] The utility of this has been found to be superior to that of MRI and surrounding bone marrow edema.

Methodology & Hypothesis

A retrospective review was performed on a single surgeons (J.C.) patients whom have undergone TAA and are experiencing postoperative pain at different time segments post operatively whom had a negative infectious workup including laboratory markers (ESR, CRP, CBC), had also failed other conservative measures including physical therapy, bracing and NSAID use, and plain imaging that is non descript for distinct pathology leaving the diagnosis undetermined. The utilization of SPECT imaging was then further pursued in seventeen patients experiencing pain following TAA and were included in this review.

Results

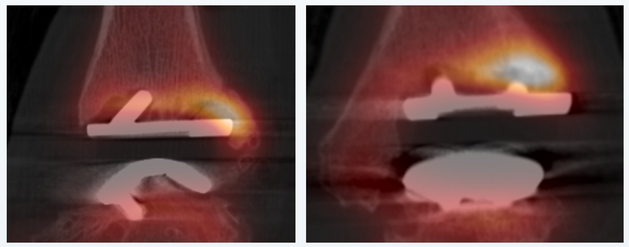

Figure 1: Sagittal and coronal images of a semi-constrained device with evidence of tibial component loosening

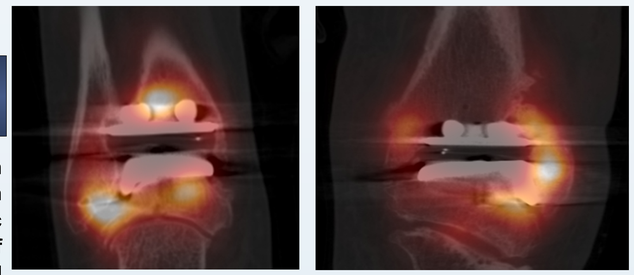

Figure 2: Coronal images of mobile-bearing devices with evidence of lateral gutter impingement

Figure 3: Plain film radiographs of fig.2 (right)

Results

The average age of the patients was 62 years old. Ten females and seven males were included. Fourteen of the seventeen had mobile-bearing devices, three of the seventeen had semi-constrained devices. Of the semi-constrained devices, one had a short-stem and two had a long-stem.

All seventeen patients had some sort of ankle pathology identified on SPECT-CT. Fourteen of the seventeen had evidence of gutter impingement. Ten of the fourteen had lateral gutter impingement, four of the fourteen had medial gutter impingement, and three had medial and lateral gutter impingement.

Table 1: Summary of results

Implant Type	Lateral gutter impingement	Medial gutter impingement	Talar component loosening	Tibial component loosening
Mobile-bearing devices	8/14	5/14	4/14	4/14
Semi-constrained devices	2/3	2/3	2/3	2/3

Ten of the seventeen had evidence of aseptic component loosening. Six of the ten had talar component loosening, four of the ten had tibial component loosening, and two had both talar and tibial component loosening. Findings are summarized in tables 1 & 2.

Table 2: Summary of patient specific findings

Patient	Age	Sex	Implant Type	SPECT-CT Findings
1	74	F	Mobile-bearing	Lateral gutter impingement
2	68	F	Mobile-bearing	Talar component loosening
3	64	M	Semi-constrained, short-stem	Tibial component loosening
4	67	F	Mobile-bearing	Medial gutter impingement
5	58	F	Mobile-bearing	Medial gutter impingement
6	58	F	Semi-constrained, long-stem	Medial and lateral gutter impingement, Talar component loosening
7	72	F	Mobile-bearing	Lateral gutter impingement
8	73	F	Mobile-bearing	Lateral gutter impingement
9	65	F	Mobile-bearing	Medial and lateral gutter impingement, Tibial component loosening
10	66	M	Mobile-bearing	Lateral gutter impingement, Tibial component loosening
11	54	F	Mobile-bearing	Lateral gutter impingement, Talar and tibial component loosening
12	47	M	Mobile-bearing	Medial gutter impingement
13	70	M	Mobile-bearing	Lateral gutter impingement, Talar component loosening
14	57	M	Semi-constrained, long-stem	Medial and lateral gutter impingement, Talar and tibial component loosening
15	53	M	Mobile-bearing	Lateral gutter impingement, Tibial component loosening
16	53	F	Mobile-bearing	Talar component loosening
17	58	M	Mobile-bearing	Medial gutter impingement

Discussion

Our study has demonstrated that SPECT-CT imaging is useful in identifying pathology that can be difficult to visualize on plain radiographs. Although not specifically looked at in this study, comparisons revealed findings on SPECT-CT that were not found on plain film x-rays. This led to a more accurate diagnosis and allowed for better treatment of the patients.

Total ankle replacement has been shown to be a beneficial treatment option for patients with painful end-stage ankle arthritis.[1-4] As our understanding of the ankle joint has continued to grow, we have created new techniques and new devices that has increased the longevity of this treatment. This has increased it's use in the podiatric and orthopedic communities.[1] As we increase the volume of procedures, we have also increased the volume of complications. While some of these complications can be obvious, many times the exact cause of pain following a total ankle replacement is unknown.

Plain radiographs are a useful first step in helping diagnose a painful total ankle replacement joint. However, many times these images do not give an obvious answer. Studies have shown that plain radiographs have poor accuracy in measuring prosthetic migration and alignment of the prosthesis (Braito). SPECT-CT offers several advantages over traditional imaging studies. CT imaging allows for accurate views of the implant-bone interface that cannot be easily seen on plain radiographs and that would be obscured on MRI. Additionally, the overlying radionucleotide scan allows visualization of areas with increased bone metabolism.

References

1. Terrell RD, Montgomery SR, Pannell WC, et al. Comparison of Prac Comparison of Practice Patterns in Total Ankle Replacement and Ankle Fusion in the United States. Foot & Ankle Int. 2013;34(11)1486-1492.
2. Haddad SL, Coetzee JC, Estok R, et al. Intermediate and long-term outcomes of total ankle arthroplasty and ankle arthrodesis. A systematic review of the literature. J Bone Joint SurgAm. 2007;89:1899-1905.
3. Krause FG, Windolf M, Bora B, et al. Impact of complications in total ankle replacement and ankle arthrodesis analyzed with a validated outcome measurement. J Bone Joint Surg Am. 2011;93:830-839.
4. Saltzman CL, Mann RA, Ahrens JE, et al. Prospective controlled trial of STAR total ankle replacement versus ankle fusion: initial results. Foot Ankle Int. 2009;30:579-596.
5. Schuberth JM, Babu NS, Richey JM, Christensen JC. Gutter Impingement After Total Ankle Arthroplasty. Foot Ankle Int 2013 34: 329
6. Noelle S, Egidy CC, Cross M, et al. International Orthopaedics. 2013;37:1789-1794.
7. Labek G, Todorov S, Iovanescu L, et al. Outcome after total ankle arthroplasty-results and findings from worldwide arthroplasty registers. International Orthopaedics. 2013;37:1677-1682.
8. Sadoghi P, Liebensteiner M, Argreiter M, et al. Revision Surgery After Total Joint Arthroplasty: A Complication-Based Analysis Using Worldwide Arthroplasty Registers. The Journal of Arthroplasty. 2013; 1329-1332.
9. Shirzad K, Viens NA, DeOrior JK. Arthroscopic Treatment of Impingement after Total Ankle Arthroplasty: Technique Tip. Foot & Ankle Int. 2011;32:727-729.
10. Kurup, HV; Taylor, GR: Medial impingement after ankle replacement. International Orthopaedics. 32:243 – 246, 2008.
11. Hirschmann MT, Konala P, Iranpour F, et al. Clinical value of SPECT/CT for evaluation of patientswith painful knees after total knee arthroplasty—a new dimension of diagnostics? BMC Musculoskeletal Disord. 2011;12:36.
12. Hirschmann MT, Iranpour F, Konala P, et al. A novel standardized algorithm for evaluating patients with painful total knee arthroplasty using combined single-photon emission tomography and conventional computerized tomography. Knee Surg Sports Traumatol Arthrosc. 2010;18(7):939.
13. Hirschmann MT, Henckel J, Rasch H. SPECT/CT in patients with painful knee arthroplasty-what is the evidence? Skeletal Radiol. 2013:42:1201-1207.
14. Hirschmann MT, Iranpour F, Davda K, et al. Combined single-photon emission computerized tomography and conventional computerized tomography (SPECT/CT):clinical value for the knee surgeons? Knee Surg Sports Traumatol Arthrosc..2010;18:341-345.
15. Buck FM, Hoffmann A, Hofer B, Pfirrmann CWA, Allgayer B. Chronic medical knee pain without history of prior trauma: correlation of pain at rest and during exercise using bone scintigraphy and MR imaging. Skeletal Radiol. 2009;38(4):339–47.
16. Braito et al. Poor accuracy of plain radiographic measurements of prosthetic migration and alignment in total ankle replacement. J Orthop Surg. 2015; 10:71.