SPECT/CT of Total Ankle Arthroplasty

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KEYWORDS

• Total ankle arthroplasty • Total ankle replacement • SPECT • Imaging
• Prosthetic loosening • Periprosthetic pain • Revision surgery

KEY POINTS

- SPECT/CT can complement clinical examination and radiological imaging in chronic pain after total ankle arthroplasty by providing metabolic information.
- High diagnostic accuracy of SPECT/CT in diagnosing gutter impingement and prosthetic loosening of total ankle arthroplasty has been shown.
- SPECT/CT can provide additional information in inconclusive diagnostic findings and can help to differentiate symptoms in painful total ankle arthroplasty.
- Evidence of diagnostic accuracy of SPECT/CT in periprosthetic joint infection of the ankle is rare but seems to provide additional information.

COMPLICATIONS FOLLOWING TOTAL ANKLE ARTHROPLASTY

With the introduction of second and third-generation total ankle arthroplasty (TAA), concomitant decreasing complication rates and prolonged implant survival there is a significant increase in total ankle replacements over the last decades.[1,2] Despite high patient satisfaction rates, up to 60% of the patients report persistent ankle pain, swelling, and stiffness.[3–5] The need for secondary procedures has been observed in up to 39%[6] and also relatively high failure rates of 10% to 20% within the first 10 years are reported in the literature.[7] Therefore, surgeons must be aware of proper diagnostic evaluation and therapeutic management particularly as the cause of persistent pain can be difficult to identify. Meticulous diagnostic workup is required to find the best conservative or operative treatment, as these reach from specific local debridement and implant retention to revision TAA, arthrodesis or even below-knee amputation.[8,9]

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CAUSES OF ANKLE PAIN AFTER TOTAL ANKLE ARTHROPLASTY

Migratory complications are the most common cause of failure including aseptic loosening and subsidence occurring in 8.7% and 10.7% of primary TAA respectively.[10] Patients mostly describe a deep pain inside the joint on the initiation of weight bearing or after sedentary activity.[11] Mechanical overload or progressive cyst formation also can provoke fractures. Postoperative fractures occur in up to 4% of primary TAA and can cause significant pain.[12,13] Fatigue fractures can cause unspecific deep ankle pain and are sometimes not visible on x-ray and MRI near the joint, especially in the initial phase.[14]

Another common pathology of delayed complications following TAA is the formation of bony overgrowth observed in 63% of total ankle replacements, partially with concomitant impingement.[15] Other authors report an incidence of heterotopic ossifications of about 90%.[16,17] In a recent meta-analysis impingement was found as one of the most frequent postoperative complications occurring in approximately 6% after TAA.[18] Gutter discomfort can result in case of inadequate intraoperative gutter debridement, exacerbated by varus or valgus malalignment or developing ossifications.[19] Rippstein and colleagues also reported impingement between the talar component and the malleoli resulting presumably in medial pain.[20]

Arthrofibrosis and ankle stiffness caused by overstuffing of the ankle with too large implant components or insufficient bone resection of the distal tibia has to be included in the differential diagnosis.[8] Further explanations for persistent ankle pain comprises instability and malposition of prosthetic components.[21] Discomfort of surrounding joints and structures can also be wrongly assigned to the ankle prosthesis. In particular, stiffness of the ankle can intensify pain in the subtalar joint. Degeneration of adjacent joints can develop or become painful.[8] It is mandatory to discern adjacent etiologies of pain from TAA failure or discomfort.

Besides structural and hardware problems, periprosthetic joint infection has to be excluded. This can cause persistent ankle pain affecting 3% to 5% of patients after TAA.[22,23] Especially chronic infections generating moderate symptoms without specific signs of inflammation, normal laboratory values and negative aspirate tend to be misdiagnosed.[24]

It is often difficult to differentiate the cause of pain after TAA clinically. Therefore, imaging modalities are necessary for analysis.

IMAGING AFTER TOTAL ANKLE ARTHROPLASTY

Plain weight-bearing radiographs are the first imaging tool to evaluate prosthesis and bony alignment with special regard to loosening zones and subsidence of the tibial or the talar component. Furthermore, fractures and osteophytes suggesting gutter impingement can be depicted.[25,26]

Nevertheless, radiographs are often nonpathologic or underrate loosening signs. Hanna and colleagues[27] found 87% of periprosthetic lesions in CT were inadequately characterized in plain radiographs with osteolytic lesions being three times larger on CT than on radiography. Linear lucencies greater than 2 mm are considered to be significant.[28] Bonnin and colleagues[7] reported tibial or talar cysts of about 5 mm in 22% after TAA at an average follow-up of approximately 9 years.

MRI is used for many foot and ankle problemes due to its adequate resolution and excellent soft tissue contrast. But in postoperative state with embedded metal components the value of MRI is limited, though metal-suppression mode is available.[29]

Overall, radiographic abnormalities and complications have been observed in up to 62% after TAA, even if it is not inevitably linked to prosthetic failure or clinical

symptoms.[30] The common limitation of the aforementioned imaging tools is the inability to determine structural findings being symptomatic for the patient. Since revision surgery of TAA is an important psychologic and physical burden for the patient and also leads to high economic costs, unnecessary revision surgeries have to be avoided.[31,32]

BONE SCINTIGRAPHY

Bone scintigraphy enables a functional diagnostic in contrast to radiographs presenting only structural and anatomical conditions. Compared to other nuclear medicine scans such as positron emission tomography (PET), scintigraphy and its variations are cheaper and have a higher availability.[33] After injection the radiopharmaceutical accumulates in metabolically active areas of the skeleton resulting in enhancements in planar bone scintigraphy images. The choice of a specific radiopharmaceutical depends on the analyzed tissue. For Bone, mostly Tc-99-m-labeled diphosphonates are used, for example, methylene diphosphonate, hydroxymethylene diphosphonate, or hydroxyethylene diphosphonate. Binding to hydroxyapatite as part of the inorganic bone matrix, regions of enhanced vascularity and osteoblastic activity can be detected .[34–37] Even a 5% change in bone metabolism induces a corresponding signal in nuclear imaging, whereas in radiographs and CT a bone loss of 40% to 50% is warranted to be detected as lucency zones.[37,38] Therefore, scintigraphy enables early diagnosis of bone dysfunctions and has emerged to an important tool in the diagnostics of metastases with a sensitivity between 85% and 96%, though the detection of purely lytic metastases is limited.[39]

Diagnostic accuracy, especially in infections, was increased up to 70% by triple-phase bone scan. Combination of bone and gallium-67 imaging, a radiotracer accumulating in infections, showed further improved sensitivity and specificity in the diagnosis of infective bony conditions like osteomyelitis and periprosthetic joint infections reaching an accuracy up to 80%. Further improvement in diagnostic accuracy of infections was reached by labeled leukocyte imaging. Pure leukocyte imaging is limited by the natural accumulation of white blood cells in the healthy red bone marrow resulting in false positive diagnoses of osteomyelitis. Combination of leukocyte/marrow imaging finally was shown to have the highest sensitivity and specificity with an overall accuracy of about 90% in diagnosing periprosthetic joint infection compared to bone, gallium/bone, and leukocyte/bone imaging.[24,40]

Despite the relevant results of bone scintigraphy, low spatial resolution, and two-dimensional characteristics result in the inability to exactly localize pathologic enhancements and therefore to carry out a specific diagnosis in anatomically complex structures like the foot.

SPECT AND SPECT/CT

Single Positron Emission Computer Tomography (SPECT), once introduced in the 1960s and 1970s, also uses Tc-99-m-labeled diphosphonates accumulating in regions of enhanced bone metabolism. In contrast to plane scintigraphy, three-dimensional images are generated by one or several rotating gamma-cameras detecting single photons. But even with modern SPECT-cameras the resolution and accurate localization are limited by the lack of anatomical markers.[41,42]

Along with further developments in nuclear medicine, radiological assessment improved enabling high anatomical resolution by multislice CT scans. In 1999, the fusion of SPECT and CT was introduced as hybrid imaging technology joining the high sensitivity of functional imaging and the high specificity of morphologic imaging allowing the correlation of tracer uptake and anatomical landmarks.[43]

Due to the combined presentation multimodality SPECT/CT is a useful tool to precisely localize main pathologies in diffuse pain symptoms, especially in anatomically complex regions like the foot. SPECT/CT was found to provide additional information compared to planar scintigraphy and therefore can influence further management.[44] Correlation of spatial diagnostics and pain generation was confirmed by pain relief after injections guided by pathologic tracer uptake.[45,46]

Regarding the amount of radioactivity administered, SPECT has generally a lower effective dose than PET. The effective dose of bone scintigraphy for an adult is approximately 3-4 mSv. The additional CT adds less than 0.1 mSv.[33]

SPECT-CT IN ORTHOPEDIC INDICATIONS

Painful Total Hip and Knee Arthroplasty and Lower Back Pain

SPECT-CT is already an established tool in orthopedics. Its use has been shown very beneficial in low back pain and after total joint arthroplasty.[42] SPECT/CT has been established as a second-line tool in the diagnostic regime of periprosthetic disorders in hip and knee showing high diagnostic accuracy.[47] Hirschmann and colleagues[48] evaluated SPECT/CT after totoal knee arthroplasty (TKA) in a prospective study analyzing 100 patients. Findings of SPECT/CT influenced further therapy in 85% and matched intraoperative diagnoses in 97%. Particularly, femoral loosening and patellafemoral osteoarthritis have been found in SPECT/CT with a specificity of 100%. The benefit of hybrid imaging in diagnosing implant loosening and patellofemoral osteoarthritis has been confirmed by Murer and colleagues[49] reporting a sensitivity and specificity for aseptic loosening of 95% and 100% respectively. For patellofemoral osteoarthritis, a sensitivity of 96.5% and a specificity of 96.2% were found. This high diagnostic accuracy for implant loosening has been affirmed in a meta-analysis by Barnsley and colleagues comparing SPECT/CT arthrography with plane bone scintigraphy and ^{18}F-FDG-PET.[50] Based on imaging findings and assured diagnosis a standard localization scheme presenting typical pathology-related uptake patterns was described.[51] Likewise, Mathis and colleagues[52] identified special activity patterns in SPECT-CT corresponding to component-positioning of TKA, instability, and patella-related problems. Patella mal tracking based on tibial malrotation resulting in specific tracer enhancements has been described before.[53] Therefore, biomechanical malfunction can be revealed emphasizing the effect of implant position on surrounding biologic structures. In unicondylar knee arthroplasty SPECT/CT has been proven to deliver additional diagnostic findings in case of implant loosening and osteoarthritis in the other compartments of the knee.[54] Besides clinical advantages, also economic profits are described. Van der Wyngaert found that SPECT/CT is highly cost-saving and superior to standard CT or MARS-MRI (Metal Artifact Reduction Sequence) in painful TKA.[55]

Similarly, SPECT/CT in painful total hip arthroplasty (THA) has been evaluated in diagnosing aseptic loosening showing a diagnostic accuracy up to 100%[56,57] and therefore outperforming MRI.[58] Comprising a multiplicity of causes for persistent periprosthetic pain a lower diagnostic efficacy of 61% has been reported for THA[59] compared to the diagnostic accuracy of 97% in TKA.[48] This unequal diagnostic accuracy has been confirmed by Arican and colleagues.[60] Nevertheless, SPECT/CT has been proven to deliver specific imaging characteristics for several pathologies in painful THA[61] including aseptic loosening,[62] symptomatic heterotopic ossification,[63] periprosthetic fractures[64] and tendinopathies[61]

Distinction between aseptic and septic loosening is difficult as both pathologies are characterized by diffuse tracer enhancements at the bone/implant interface particularly in the first year after implantation due to an individual basic tracer acquisition.[40]

Therefore, SPECT/CT is recommended to rule out but not to confirm periprosthetic joint infection based on it's high negative predictive value. SPECT/CT using Tc-99m-labeled antigranulocyte antibody had a sensitivity of 89% and a specificity of 73% resulting in a positive predictive value of 57% and a negative predictive value of 94% in diagnosing infections in TKA and THA.[65] Nevertheless, hybrid imaging of white blood cells and bone marrow has been shown to have the highest diagnostic accuracy of about 90%.[66]

The third common application field of SPECT/CT in orthopedics is chronic lower back pain. A high incidence of asymptomatic degenerative changes can interfere with the cause of pain complicating the detection of the underlying pathology.[67] Sensitivity of SPECT/CT in detecting facet arthropathy has been confirmed by high success rates in pain relief after facet infiltrations guided by SPECT/CT imaging.[68] Accordingly, this imaging tool is also beneficial in determining segments for spine fusion.[67] Also in vertebral fractures SPECT/CT is able to reveal acute fractures in a multiply affected osteoporotic spine resulting in a significant higher satisfaction rate after vertebroplasty compared to preoperative planar bone imaging.[69] Considering enhanced basic tracer uptake up to 1 year after surgical therapy in the back area, SPECT/CT is also used to reveal causes of persistent pain comprising hardware loosening, pseudarthrosis, adjacent instability, active degeneration of facet joint, sacroiliac joints and discs. According to aseptic loosening after THA and TKA, SPECT/CT shows a high diagnostic accuracy with a sensitivity of 100% and a specificity of 89.7% in diagnosing hardware loosening after lumbar fusion.[70]

SPECT/CT IN FOOT AND ANKLE

SPECT/CT is gaining in importance in foot and ankle surgery delivering additional information in the diagnostic work up of different pathologies.[71] Recently, Eelsing and colleagues[72] systematically reviewed the added value of SPECT/CT in the management of foot and ankle pain reporting an overall improvement in diagnostics compared to clinical examination and plain radiography in 60%. Change of further management is described in 62% leading to an improvement of pain symptoms in 92%. Besides radiography and clinical evaluation, also MRI, planar bone scintigraphy and CT and SPECT only have been outperformed in diagnostic accuracy by hybrid imaging in SPECT/CT. Mohan and colleagues[44] developed a diagnostic algorithm rating SPECT/CT as a useful tool in patients with conditions of assumed bone pathology rather than soft tissue discomforts. Here, SPECT/CT has been shown to provide additional information in 80% of the patients and led to more accurate localization of pathologies in 64% of cases compared to plain scintigraphy influencing therapeutic management in about 50%. Accordingly, the most relevant applications of SPECT/CT in foot and ankle pain include osteoarthritis, malalignments, osteochondral lesions, stress fractures, symptomatic accessory bones, tarsal coalition, diabetic feet, and postoperative pain.[26,73] Since the anatomy of the midfoot is highly complex, localization of active osteoarthritis is quite difficult. Advantages of SPECT/CT in localizing symptomatic changes with high inter- and intra-rater reliabilities have been reported.[74,75] SPECT/CT-guided injections in symptomatic degenerative pathologies in the ankle, hindfoot, and midfoot resulted in pain improvement in 86% to 88%[45,46] and SPECT/CT-guided management showed symptom improvement in more than 90% of patients particularly in Lisfranc- and Chopart-joints.[75] Osteochondral lesions (OCL) are a common cause of ankle pain since both chronic ankle instability and acute ankle sprains can result in osteochondral lesions of the talus. Nevertheless, there are also asymptomatic osteochondral lesions. Like in osteoarthritic changes, also in OCL SPECT/CT shows a high correlation between tracer uptake and pain, confirmed by

pain reductions after local anesthesia injection based on SPECT/CT findings.[76] Meftah and colleagues[77] compared SPECT/CT with MRI in characterizing talar OCL. They highlighted early detection of OCL and accurate assessment of lesion size in SPECT/CT resulting in an optimized preoperative planning and postoperative management in case of persistent pain.

Besides degenerative changes and sterile inflammatory pathologies, SPECT/CT was also used in diagnosing and observing progress of osteomyelitis in diabetic feet showing a high sensitivity up to 90% but a lower specificity of 56%.[78,79] Dual isotope scanning using Tc-99-m-labeled HDP and In-111-labeled white blood cells reached a higher accuracy with a sensitivity of 95% and a specificity of 94% than bone scan or leukocyte scanning alone.[80]

Though limited diagnostic value in soft tissue pathologies, the use of SPECT/CT in impingement, Achilles tendinitis, and plantar fasciitis has been reported.[81,82] Showing a similar sensitivity but a slightly higher specificity compared to MRI,[83] SPECT/CT can provide additional findings particularly in inconclusive symptoms and diagnostic results.[84]

Overall, SPECT/CT is recommended in complex ambiguous foot pathologies delivering additional information for treatment optimization.[26,71,85]

SPECT/CT IN PAINFUL TOTAL ANKLE ARTHROPLASTY

Managing chronic ankle pain after total ankle replacement is challenging since cause of pain is diverse. Limitations of radiography, CT, and MRI have been described before. Especially, imaging findings do not necessarily accord to clinical symptoms. High rates of tibial and talar cyst formations without indication for revision surgery are reported in the literature.[86,87]

Correlation of sensitive functional evaluation and specific structural imaging may help to overcome these limitations. Patients undergone prior surgery with retained metal implants and presumably suffering from bony pathologies rather than soft tissue disorders have been shown to mostly benefit from SPECT/CT.[44,88]

Accordingly, the diagnostic value of SPECT/CT in periprosthetic ankle pain has been confirmed by high congruence of imaging findings and intraoperative diagnosis. Mertens and colleagues[89] reported a concordance rate of 95.8% developing a localization scheme of periprosthetic tracer uptake according to the validated Bruderholz localization scheme for knee replacements.[51] Similarly, Gurbani and colleagues[90] found consistent findings between SPECT-CT and clinical or intraoperative findings in 89.2% and 92.9% respectively. In contrast, MRI findings were consistent with clinical findings in 36.8% and in 57.9% of the cases in which MRI and SPECT/CT were performed. The most common findings in SPECT-CT were aseptic loosening and impingement. Further diagnoses were malalignment, cyst formation, subtalar arthritis, and infection.

Nevertheless, the use of SPECT/CT after TAA is limited by the lack of information about periprosthetic tracer uptake in asymptomatic patients. A certain level of physiologic uptake after TAA is known, but the degree of this and changes over time have not been described.[90] In THA increased enhancement is described up to 2 years post-implantation depending on the use of bone cement and implant surface.[91] Some authors recommend serial imaging for detection of pathologic changes in tracer uptake, whereas persistent tracer enhancement has been reported in some segments 12 to 24 month after hip arthroplasty without any evidence of pathologic cause. Persistent tracer uptake beyond 1 year after implantation was more frequent in porous-coated hip replacement than in cemented implants reflecting a normal healing

process.[92] Since total ankle replacements are mainly noncemented types having rough surfaces, prolonged periprosthetic tracer enhancement is conceivable. Equally, postsurgical tracer uptake is reported for total knee arthroplasty with individual time course.[93] Within the first 12 to 18-months differentiation between aseptic and septic loosening therefore has been proven to be difficult.[94] Because of those inconsistent periprosthetic uptake patterns a general orientation on knee and hip replacements does not seem to be reliable. Therefore, a specific evaluation of basal tracer uptake after ankle replacements is necessary. Mertens and colleagues[89] also found a persistent diffuse uptake surrounding asymptomatic total ankle prosthesis 2.5 years after implantation.

SPECT/CT IN ASEPTIC LOOSENING AND CYST FORMATION AFTER TOTAL ANKLE ARTHROPLASTY

Although being the most common cause of TAA failure, diagnosing implant loosening is often impeded by asymptomatic cyst formation or lucency lines. On the other hand, aseptic loosening may often be misdiagnosed. In a recent study, high incidences of medial talar prosthesis loosening or poor bony ongrowth not diagnosed in conventional radiographs have been identified in SPECT/CT.[21] Loosening of TAA has been described to affect the talar component in only 11%.[30] Mason and colleagues[21] found insufficient talar component integration with enhanced tracer uptake in 12 of 14 patients with negative radiograph findings. Accordingly, the authors claim that the incidence of talar loosening might be underestimated in routine diagnostics presumably due to the complex structure of the talar part of the prosthesis. As well, Gurbani and colleagues[90] found aseptic loosening in 11 of 28 patients undergoing revision surgery. In 2 patients both tibial and talar components were affected showing tracer uptake both at the tibial and the talar interface. The other 9 revisions only showed talar loosening with tracer enhancement only beneath the talar component. Nevertheless, Gurbani and colleagues also assumed loosening in 2 of 28 cases not confirmed intraoperatively resulting in a false positive rate of 15%. In a comparable study, Mertens and colleagues[89] found aseptic loosening in 25% (5 out of 22) affecting only the tibial component. They suggested a localization scheme based on the one of TKA.[51] Thereby, the tibia component was divided into 8 areas (anterior medial, anterior central, anterior lateral, posterior medial, posterior central, posterior lateral, tibia shaft, and tibia tip) and the talus into 9 areas. Activity was scored on a 5-point scale (1 = no increased uptake, 3 = moderate increased uptake, 5 = marked increased uptake). Hereby, a concordance rate between SPECT/CT imaging and intraoperative findings of 95.8% has been achieved. **Fig. 1** shows radiographs, CT-scans, and SPECT-CT images in a patient with cyst formation and subsequent fracture and prosthetic loosening. Overall, the use of hybrid imaging with SPECT/CT can increase the sensitivity of diagnosing aseptic loosening after TAA.

SPECT/CT IN GUTTER IMPINGEMENT AFTER TOTAL ANKLE ARTHROPLASTY

Gutter impingement structurally presents with talomalleolar degeneration and gutter ossification.[95] If plain radiographs or CT-scans are not conclusive, nuclear imaging with SPECT/CT can help to confirm diagnosis showing an enhanced tracer uptake at the gutters medially or laterally.[19] Mertens and colleagues[89] diagnosed gutter impingement in 12 of 22 analyzed TAA by detecting a significantly enhanced tracer uptake at the gutters. As well, Gurbani and colleagues[90] found gutter impingement with enhanced tracer uptake localized at the gutters in 7 of 28 revision surgeries. Specific treatment comprising infiltrations, debridement, and analgesics resulted in pain relief

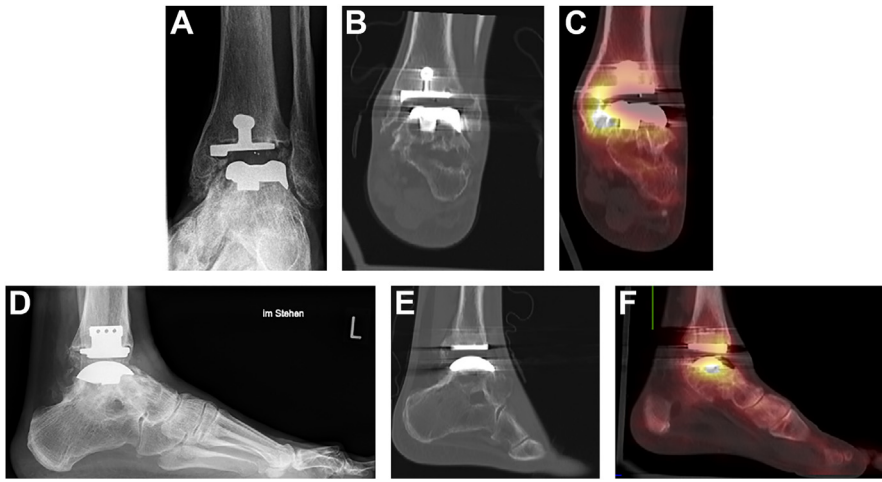

Fig. 1. Talar cyst formation and subsequent prosthetic loosening after total ankle arthroplasty. A 50-year-old man presented in our clinic with acute pain 8 years after implantation of total ankle prosthesis (Tornier Salto) and subtalar arthrodesis. (*A*, *D*): Conventional radiographs showed tibial stress shielding without other abnormalities. (*B*, *E*): CT imaging reveals talar cyst formation. (*C*, *F*): To exclude prosthetic loosening, SPECT/CT was performed depicting high grade osteolysis with tracer enhancement presumably in talar bone (Fig. 1B, C, E, F). Acute pain was likely due to acute osteolytic fracture. Therapy options comprised cyst filling and revision of the talar component or arthrodesis of the ankle joint.

in 90% to 100%. Also in other studies pain relief after appropriate debridement of the gutters is described in 84% of affected patients with symptomatic gutter impingement.[96] Therefore, using SPECT/CT can help to introduce a specific therapy and avoid unnecessary revision surgeries.

SPECT/CT IN PERIPROSTHETIC FRACTURES AFTER TOTAL ANKLE ARTHROPLASTY

Occult periprosthetic fractures after TAA affect up to 4% of patients after primary TAA.[12,13] Mertens and colleagues[89] describe diagnosing periprosthetic fractures after TAA with SPECT/CT. Diagnosis of periprosthetic fracture was met in 5 of 22 scans showing focal enhancement in SPECT/CT. Structural fracture lines were obvious in CT-scans without nuclear imaging in 3 patients. Two cases did not show any cortical abnormality and were treated as stress fractures. Generally, stress fractures are mainly diagnosed by MRI depicting the osseus edema more sensitive than other imaging modalities. Since its use is limited nearby metal implants, SPECT/CT was shown to be advantageous.[14] Most common localization of periprosthetic fractures in the ankle is the medial malleolus.[18] There is a multiplicity of differential diagnoses in this area comprising gutter impingement or tendinopathies. Nevertheless, after appropriate therapy of temporary immobilization in 4 patients and screw fixation in 1 patient pain relief is reported confirming correct diagnosis in the before mentioned study.[89]

SPECT/CT IN DIAGNOSING OSTEOARTHRITIS OF ADJACENT JOINTS AFTER TOTAL ANKLE ARTHROPLASTY

The hindfoot is anatomically and biomechanically complex since tibiotalar, subtalar, and Chopart-joints are close together and abnormalities in one of them can lead to

increased load and wear in the other joints. Initial subtalar osteoarthritis can progress, especially in case of tibiotalar stiffness after TAA.[8] Gurbani and colleagues[90] evaluated the use of SPECT/CT in painful TAA and found symptomatic subtalar osteoarthritis in 2 of 33 patients. Diagnosis based on structural changes in the subtalar joint in CT scan and corresponding tracer enhancement in SPECT can identify these findings as symptomatic. Subtalar arthrodesis was performed and led to significant improvement in pain symptoms. Advantages of SPECT/CT in identifying active osteoarthritis particularly in the midfoot are described above. **Fig. 2** shows the ability to differentiate active

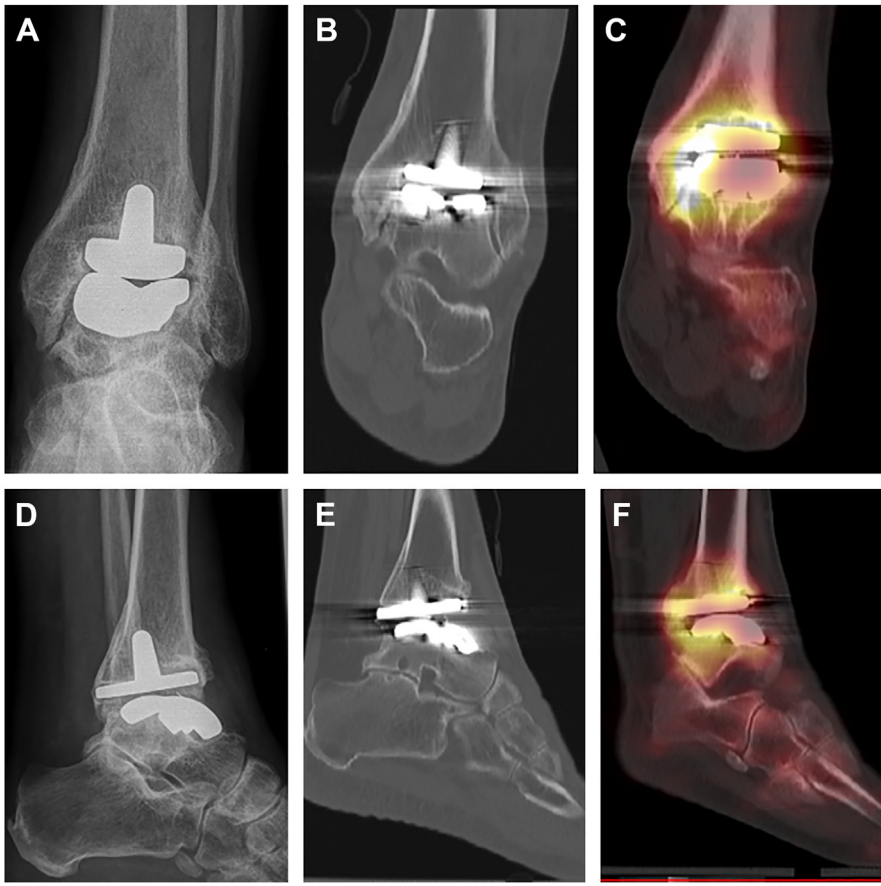

Fig. 2. Aseptic prosthetic loosening. A 56-year-old man presented with pain at rest and under stress 8 years after implantation of total ankle prosthesis. Clinical examination was inconclusive to differentiate prosthetic loosening and subtalar osteoarthritis. (*A*, *D*): Radiographs showed talar cyst formation assuming prosthetic loosening and incipient osteoarthritis in the posterior part of the subtalar joint. (*B*, *E*): Also CT-scans show both periprosthetic loosening zones and subtalar degenerative changes. For preoperative decision making regarding the need of arthrodesis both in the ankle and subtalar joint, SPECT/CT was performed. (*C*, *F*): Hybrid imaging showed prosthetic loosening both of the tibial and talar component with relevant tracer enhancement. There was no tracer enhancement of subtalar joint. Removal of total ankle prosthesis and arthrodesis with autologous interposition bone graft was planned.

osteoarthritis in adjacent joints structurally seen in x-ray imaging from prosthetic disadvantages like aseptic loosening.

SPECT/CT IN PERIPROSTHETIC JOINT INFECTION AFTER TOTAL ANKLE ARTHROPLASTY

Studies dealing with the use of SPECT/CT in periprosthetic joint infection of the ankle are rare and controversial. While implant infection has been confirmed by additional gallium scan by Gurbani and colleagues,[90] in another study, ankles being positive for infection in labeled white blood cell-scans proofed to be false positive.[89] Finally, Henry and colleagues[9] recommend using SPECT/CT in the diagnostic work up of painful total ankle replacement after exclusion of infection following Musculoskeletal Infection Society (MSIS) criteria[97] of periprosthetic joint infections. Since these criteria have been developed regarding hip and knee replacements, they are not optimized for ankle replacements. Furthermore, in case of chronic situations without obvious clinical symptoms, normal laboratory values, and dry arthrocentesis additional diagnostics is necessary to detect infection. Here, SPECT/CT could provide additional information.

SUMMARY

SPECT-CT has been shown to be a valuable tool for orthopedic surgeons. In painful total ankle replacements studies have shown high diagnostic accuracy influencing further management. Although information on the diagnostic value of SPECT/CT in diagnosing osteoarthritis of adjacent joints is rare, daily clinical use and confident cases show its value. While its clinical value in diagnosing impingement and implant loosening has been confirmed, the accuracy of SPECT/CT in diagnosing periprosthetic joint infection of the ankle is still controversial. Nevertheless, SPECT-CT has to be interpreted with caution, as basal tracer uptake surrounding TAA components can occur especially in high-demand patients and in the first years after implantation.

CLINICS CARE POINTS

- SPECT/CT can complement clinical examination and radiological imaging in chronic pain after total ankle arthroplasty by providing metabolic information
- High diagnostic accuracy of SPECT/CT in diagnosing gutter impingement and prosthetic loosening of total ankle arthroplasty has been shown in the literature
- SPECT/CT can provide additional information in inconclusive diagnostic findings and can help to differentiate symptoms caused by prosthesis or periprosthetic discomforts
- Evidence of diagnostic accuracy of SPECT/CT in periprosthetic joint infection of the ankle is rare but seems to provide additional information in clinical and imaging work up
- Basal tracer enhancement has to be considered for the interpretation of imaging findings

DISCLOSURE

The authors have nothing to declare regarding this study.

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