ABSTRACT
One of the most feared complications after total knee arthroplasty (TKA) is periprosthetic joint infection (PJI). As diagnosis of PJI is complicated, imaging techniques such as positron emission tomography (PET), combined with computed tomography (CT), are proposed to be of help in this diagnosis. However, in earlier studies, the role of fludeoxyglucose (18F-FDG) PET in the diagnosis of PJI was investigated, but the results were inconclusive (sensitivity range: 0.22-1.00, specificity range: 0.62-1.00). No clear consensus was found among the studies for PET parameters that could identify PJI, although most studies looked only at intensity and location of the activity in the PET image as parameters. Recent literature suggest that focal uptake patterns in the PET image could identify PJI after TKA. Therefore, in this study is proposed that the existence of focal uptake patterns in the PET images are a predictor of PJI, as we expect that infected cases would lead to more spot-like patterns than non-infected cases.

To test this hypothesis, a retrospective study, using data from medical records at the Maastricht UMC+ for patients in doubt of PJI, was conducted, to test if a measure based on focal intensity spots could better predict infections than measures based on blood values or more conventional PET intensity measures. From the results from this study, it can be concluded that a diagnosis based on solely the presence of focal uptake patterns performed better in the diagnosis compared to only ESR and CRP, but was outperformed by other PET parameters. However, results might have been affected by incorrect PET attenuation correction due to metal artifacts in the CT scan, and this issue will need to be solved before any final conclusions can be drawn. Therefore, a second study was conducted to first implement a sinogram-based metal artifact reduction (MAR) technique for the correction of CT images, and secondly to enhance the attenuation correction for the metal prosthesis. The hypothesis to these goals is that CT based attenuation correction for PET imaging, after MAR and attenuation enhancement of the prosthesis will lead to improved PET images. To test this hypothesis, experiments on a phantom and a cadaveric bone were conducted. Two MAR techniques were studied: 1D spline interpolation and 2D cubic interpolation. From this study can be concluded that both MAR techniques reduced artifacts, but the type of MAR technique, spline or 2D interpolation, does alter the effect on the activity of the PET. In this study the 2D interpolation MAR technique gave a maximum activity concentration closer to the control. The alteration of the Hounsfield units of the prosthesis in the CT images, to enhance attenuation correction for the metal prosthesis, cannot give benefits, as the technical difficulties prohibit the use of Hounsfield units above 3071.