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Objective:

Rheumatoid Arthritis is an inflammatory disease causing degenerative changes in joints including the temporomandibular joint (TMJ). Currently, structural imaging is used to detect pathologic alterations in the TMJ. Molecular imaging techniques offer an alternative that might demonstrate inflammatory changes in the joint prior to the structural breakdown. To address this possibility we compared PET/CT scans of the TMJ using FDG and NaF taken in cohorts of RA and healthy control subjects.

Method:

Eighteen patients diagnosed with RA (mean age 55±12.1years: 4 females and 14 males) were included in the test group. Eighteen age-, sex- and race-matched healthy control subjects were selected from the CAMONA clinical trial. PET/CT images were acquired 180-minute post-intravenous administration of FDG and NaF (2.2 MBq/kg). OsirX[®] MD v.9.0 software was used for image analysis. For FDG analysis, regions of interest (ROIs) were manually assigned per anatomical boundaries using a closed polygon tool. The first ROI of the mask was assigned on the trans-axial CT slice with the first evidence of the glenoid fossa up to two to three slices inferiorly. The ROI followed the anatomy of TMJ. Averaged SUVmean and SUVmax were used to semi-quantify FDG and NaF uptake in the joint. The average SUVmean was calculated as TMJ metabolism/ROI_{total-volume} with TMJ metabolism = ∑ (Slice SUVmean * slice ROI_{volume}). For NaF, A three-dimensional ball tool of 1.5 cm was used to assign ROIs with the head of the mandibular condyle located at the center including the osseous compartment of the joint extending inferiorly to the neck of the condyle. The average SUVmean of the right and the left TMJ was determined (Fig1, Fig 2). For normalization, a Target to Background Ratio (TBR) was calculated for each subject by dividing the average SUVmean by SUVmean uptake in superior vena cava. For statistical analysis, the student's t-test and regression analysis were used. The severity of RA was assessed by determining the serum C reactive protein level (DAS-28 CRP) and erythrocyte sedimentation rate (DAS-28 ESR) for each subject.

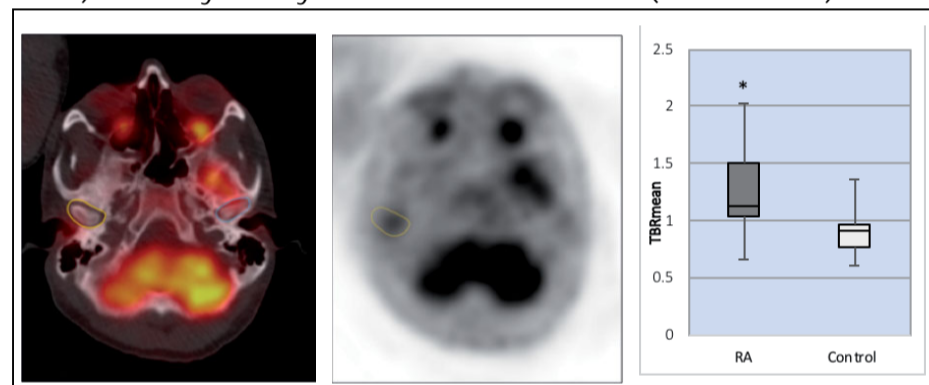


Figure 1. FDG uptake analysis: ROI was manually drawn following the anatomical boundaries of the TMJ and is shown as it appears on the trans-axial slice in the fused (a) and the PET (b) images. The panel to the right (c) is a box plot of the average TBRmean of the RA compared to the control group.

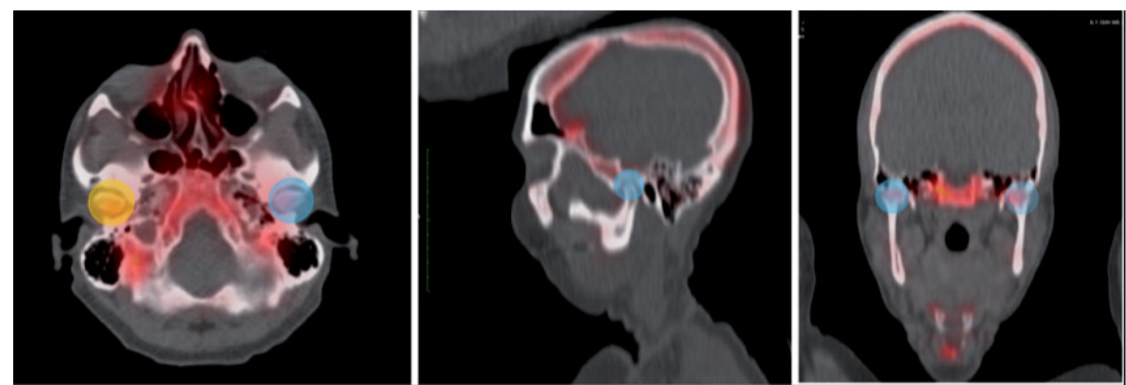


Figure 2: NaF analysis: ROI including the osseous compartment of TMJ in axial, sagittal and coronal slice of a fused PET/CT scan.

Results/conclusions:

The FDG average SUVmean of RA patients was 1.18±0.47 compared to 1.09±0.27 in healthy controls (p=0.48). FDG TBRmean for the test group was (1.21±0.33) compared to 0.91±0.2 in controls,(p=0.003.) No correlation was found between FDG uptake and DAS28-CRP or DAS28-ESR. The NaF average SUVmean was significantly higher in RA patients than healthy control subjects (2.4±0.8 versus 1.9±0.4, p=0.02)(Fig.3). Similarly, the TMJ TBRmean was also higher in RA patients relative to healthy controls (4.2±2.1 versus 2.7±0.9, p=0.01)(Fig.4) A significant positive correlation was found between TBRmean and DAS28-CRP (r=0.49, p=0.03), while there was not a significant correlation with DAS28-ESR (r=0.37, p=0.12).

Our results illustrate the potential value of using FDG- and NaF-PET/CT for evaluation of TMJ disorders and other inflammatory conditions within the oral cavity. Since this approach yields structural images along with data that can be quantified it provides more information than conventional structural imaging techniques. The RA patients appeared to have significantly higher metabolic activity in the TMJ relative to the healthy control subjects. The degree of NaF uptake in the TMJ correlated with biochemical parameters of RA disease severity based on DAS28-CRP and DAS28-ESR scores. Thus, the results suggest that NaF uptake does have the capacity to detect inflammatory changes prior to overt structural breakdown of the joint. In the future, this could allow for earlier and more efficacious treatment of degenerative disorders affecting the TMJ. Furthermore, NaF-PET/CT might also serve as a means of objectively assessing treatment outcomes especially those aimed at regeneration of damaged components of the TMJ.

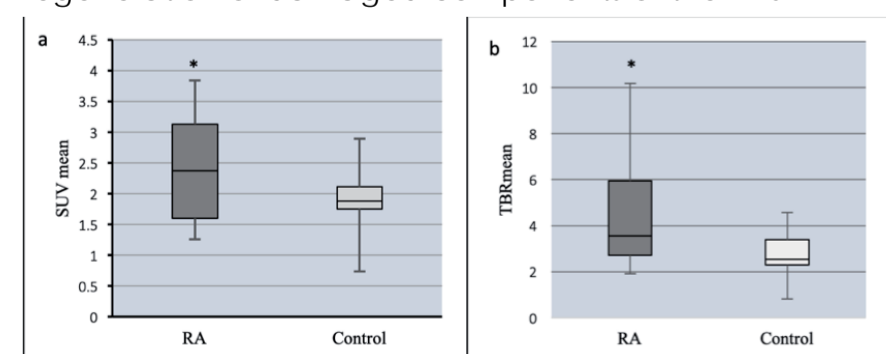


Figure.3 The comparison of NaF uptake between RA and Healthy control

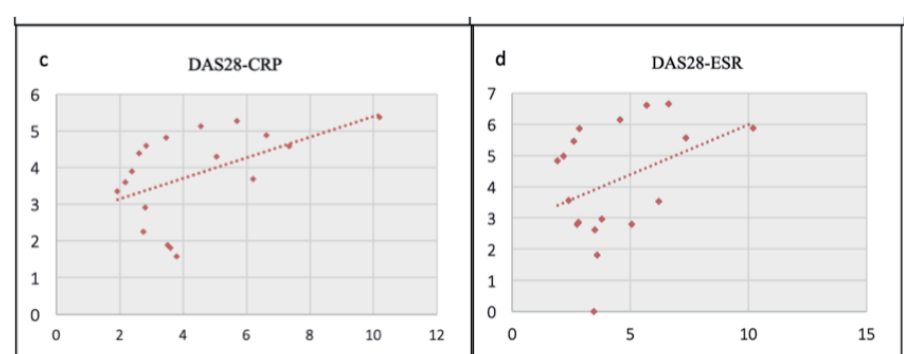


Figure.4 Correlation of NaF uptake and DAS28-CRP/DAS28-ESR

Reference:

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