

Assessment of Cortical Bone Resorption and Acute Inflammation in Parodontitis

A-K. Bracher¹, M. Mess^{1,2}, A. Bornstedt¹, E. Hell³, J. Ulrici³, B. Haller², and V. Rasche¹

¹Department of Internal Medicine II, University Hospital of Ulm, Ulm, Germany, ²Department of Operative Dentistry, Periodontology and Pedodontics, University of Ulm, Ulm, Germany, ³Sirona Dental Systems, Bensheim, Germany

Background

Assessment of acute inflammation and chronic bone resorption is the basic information required for the diagnosis, staging and therapy monitoring of parodontitis. Currently, bone resorption is being assessed by panoramic X-ray imaging and the degree of inflammation is measured by probing. Main limitation of the current techniques is the lack of accurate data on the 3D structure of the lesions and bone resorption, which are supposed to especially improve monitoring of bone restoration therapy. The objective of this feasibility study was to investigate the applicability of MRI for the assessment of the 3D structure of the resorption of the cortical bone in chronic parodontitis patients and the applicability of MRI for the visualization of acute inflammation processes.

Methods and Materials

Twenty patients were enrolled in this feasibility study. According to the clinical investigation several patient suffered from acute parodontitis with related acute inflammation and all patients showed different degrees of chronic parodontitis with respective different degrees of bone resorption. All patients had multiple dental fillings (including amalgam, gold, ceramic and composite fillings), crowns and bridges. All patients underwent the same MRI protocol. After the preparation scans (quick survey scan in three orthogonal stacks, followed by the measurement of the coil sensitivity pattern) high resolution multi-slice T1-weighted multi-spin echo images of either side of the jaw were acquired in para-sagittal orientation. Acquisition parameters were as: TE/TR = 8.1ms/625ms, number of spin echoes n = 8, spatial resolution $\square r = 0.4 \times 0.4 \times 1$ (APxFHxRL), and a bandwidth bw = 240Hz. In the patient with acute inflammation a multi-slice T2-weighted multi-spin echo sequence with fat suppression was additionally acquired in para-axial orientation. Acquisition parameters were as: TE/TR = 80ms/2000ms, number of spin echoes n = 8, spatial resolution $\square r = 0.4 \times 0.4 \times 2$ (APxFHxRL), and a bandwidth bw = 320Hz. For all patients additional dental X-ray imaging was performed within 2 weeks prior or after the MRI examination.

Results

The MRI protocol could be completed in less than 30 minutes in all patients. No patient had to be excluded due to limited image quality caused by the dental fillings. Acute inflammation as well as bone resorption could be clearly identified (Fig. 1). The investigated T1W sequence generated sufficient contrast (Fig. 1d) between spongy bone (short T1 - bright signal), cortical bone (ultrashort T2 - almost signal void), and the saliva (long T2, medium T1 - medium intense signal). In all patients, the three-dimensional (3D) course of the cortical bone could be nicely delineated and the bone resorption could be clearly identified. In direct comparison with the panoramic X-ray data, the multi slice MRI data appeared to enable a more precise assessment of the 3D geometry of the bone resorption. Acute inflammation could be nicely assessed by visualization of the related oedema with the T2W sequence (Fig. 1b). As in the chronic case, in direct comparison with the X-ray, the tomographic MRI approach enabled an improved assessment of the degree and especially the distribution of the inflammation. Furthermore, MRI enables the identification of acute inflammation before obvious changes in the XR occur (fig. 2). This may be especially useful in pain patients for identification of the culprit lesion.

Discussion

MRI can be applied for the assessment of acute parodontitis as well as for the assessment of bone resorption caused by chronic parodontitis. The more accurate geometrical assessment of the 3D structure of the inflammation and especially the bone resorption may facilitate improved diagnosis and treatment monitoring in parodontitis.

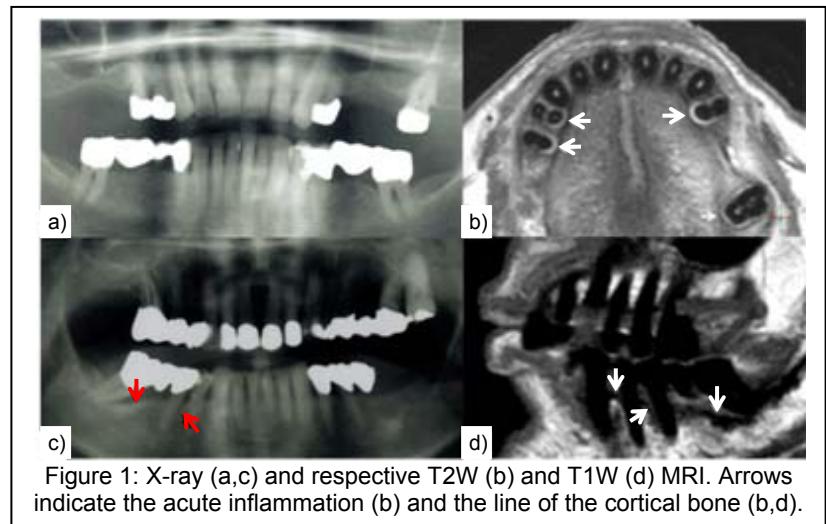


Figure 1: X-ray (a,c) and respective T2W (b) and T1W (d) MRI. Arrows indicate the acute inflammation (b) and the line of the cortical bone (b,d).

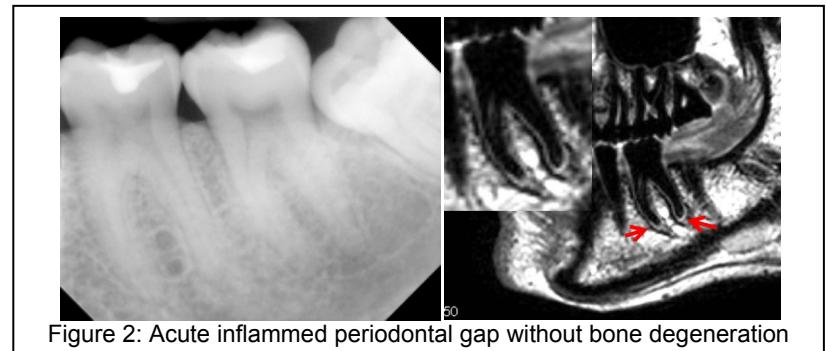


Figure 2: Acute inflamed periodontal gap without bone degeneration