STUDY OF SUITABILITY OF SPRITE PULSE SEQUENCE FOR DENTAL MRI

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Purpose/Introduction

MRI has been traditionally used to study soft tissue. Currently, the most used technique to obtain teeth images is projection radiography or cone beam computer tomography (CBCT) [1]. The main disadvantage of these methods is that they involve ionizing radiation. Typical MRI pulse sequences are not appropriate to catch signal from short T_2* tissues, such as bones or teeth, because their relaxation times are of the order of the gradient rise time. However, there are pulse sequences, such as UTE, ZTE [2] or SPRITE [3], which seem more suitable for these kinds of tissues. In this work, we have implemented SPRITE pulse sequences in order to study the advantages they can provide for obtaining teeth images compared to typical pulse sequences, such as Gradient Echo [4].

Subjects and Methods

SPRITE (Single-Point Ramped Imaging with T_1 Enhancement) sequences allow visualizing tissues with T_2* below 100µs, so they are suitable for teeth imaging (T_2* of teeth is between 12µs–1ms for dentin [5] and 4–240µs for enamel [6]). This is possible since the RF pulse is applied at the same time that gradients, avoiding having to turn on the gradients after every RF pulse.

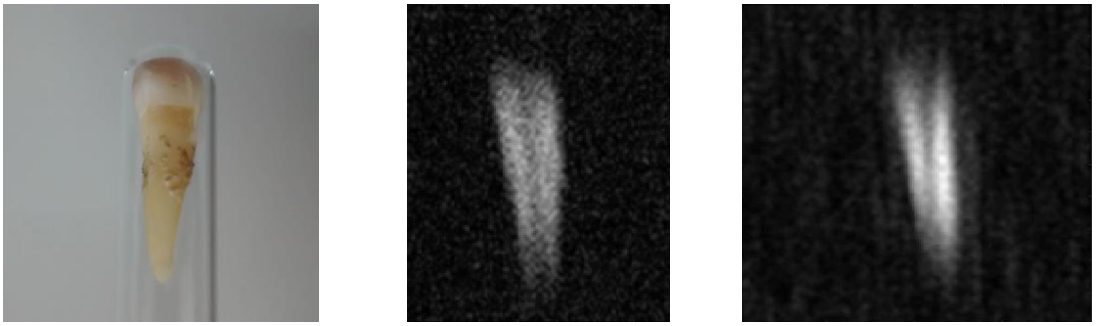
Dental samples were examined ex vivo using a low-cost tabletop MRI with a low magnetic field (B_0=0.33T) [7]. All the pulse sequences programming, as well as the system control, has been implemented in MATLAB [8] and C/C++.

Results

Images of a premolar tooth were obtained using Gradient Echo and SPRITE sequences. Several essays were performed in order to find the proper pulse parameters for each sequence. Fig.1.b shows the results of an 80x80 Gradient Echo image (50 scans, TE=223.43µs and TR=100.48ms) whose acquisition required 7 minutes. Fig.1.c shows a 100x100 SPRITE image (1 scan, TE=80.46µs and TR=427.27ms) which required 40 minutes. Signal-to-noise ratio (SNR) obtained for both images were, respectively, 0.9286 and 3.045 [9].

Discussion/Conclusion

SPRITE sequences provide better SNR with much less averaged scans, so they are an interesting option to image teeth since short T_2* problems have less influence. Another advantage of this kind of sequence is that it is much more silent than Gradient Echo due to the use of ramped gradients. Its main drawback is the long acquisition time, so parallel imaging or fast k-space sampling (spiral, conical, etc.) should be implemented in order to reduce it [10][4].



(a) (b) (c)

Figure 1: (a)Optical image of premolar tooth; (b)Gradient Echo image 80x80 50 scans; (c)SPRITE image 100x100 scans.

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