Magnetic resonance imaging: a useful tool to distinguish between keratocystic odontogenic tumours and odontogenic cysts

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Abstract

In contrast to odontogenic cysts, keratocystic odontogenic tumours often recur and require more aggressive surgical treatment, so we tried to find features that distinguished between them on magnetic resonance imaging (MRI). Without knowing the diagnosis, two radiologists reviewed intensity (low, intermediate, or high) and homogeneity (homogeneous or heterogeneous) of signals in short-tau-inversion-recovery (STIR), T1- and T2-weighted, and fat-suppressed, contrast-enhanced MRI in 20 consecutive patients with oval, radiolucent lesions of the mandible on panoramic radiography, and who were subsequently confirmed histopathologically to have either an odontogenic cyst or a keratocystic odontogenic tumour ($n = 10$ in each group). Fisher's exact test was statistically significant at $p < 0.05$. Delineation of a contrast-enhanced wall of a cyst with high signal intensity distinguished odontogenic cysts (9/10 and 8/10, respectively) from keratocystic odontogenic tumours (3/10, $p = 0.02$, and 1/10, $p = 0.01$, respectively). One radiologist found odontogenic cysts were more likely to be homogeneous on unenhanced T1-weighted images (odontogenic cysts 9/10, keratocystic odontogenic tumours 3/10, $p = 0.02$) and one on contrast-enhanced MRI, when the cyst wall was enhanced (odontogenic cysts 7/9, keratocystic odontogenic tumours 0/3, $p = 0.01$). There were no other significant distinguishing features on MRI. In conclusion, the signal intensity of the enhanced wall seems to be a feature on contrast-enhanced MRI that differentiates odontogenic cysts from keratocystic odontogenic tumours.

Introduction

Cyst-like lesions of the jaw, often detected incidentally on panoramic radiographs, are common in maxillofacial surgery.

Depending on the lesion's dimension and topography in relation to features like locularity, involvement or resorption of teeth, or characteristics of the lesion's border, various diagnoses may be considered. Key differential diagnoses are odontogenic cysts, keratocystic odontogenic tumours, and ameloblastomas, non-odontogenic cysts, other odontogenic neoplasms, or simple bone cysts.[1,2] Preoperative assessment is important for planning treatment and management, but hardly possible if solely based on conventional radiographs and computed tomography (CT).[1–4] An additional imaging

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technique that is becoming increasingly important in oral and maxillofacial surgery is magnetic resonance imaging (MRI), which has already been evaluated for differentiating between ameloblastomas and keratocystic odontogenic tumours.[5–8] While dynamic, contrast-enhanced MRI has the potential to show the density of microvessels as a marker of proliferative or inflammatory activity in tissue, it has also been shown to contribute little to the differential diagnosis of odontogenic tumours, except for odontogenic fibromas and myxomas.[7] Diffusion-weighted MRI may help to characterise the contents of odontogenic cysts and tumours, as pure cystic liquids would restrict free Brownian motion of water molecules to a lesser degree than matrix structures within a solid or partly solid tumour.[8] Other studies on MRI have included a larger variety of cystic lesions such as radicular cysts, dentigerous cysts, pseudocysts, dermoid cysts, nasopalatine cysts, and nasolabial cysts.[9–11]

Differentiation between ameloblastomas and keratocystic odontogenic tumours seems to be promising,[5–8] but there is to our knowledge little evidence so far about whether it is possible to discriminate between keratocystic odontogenic tumours and odontogenic cysts.

Because of the possible value of preoperative discrimination between them, we tried to establish specific features of MRI that would distinguish between them. The development of odontogenic cysts in different sites follows the same pathogenetic principles of epithelial proliferation, inflammatory reaction, and development of a gradually expanding cystic cavity, so odontogenic cysts have similar walls on histopathology, with differences only in the respective degree of epithelial proliferation and inflammatory reaction.[12]

We therefore expected that MRI would delineate the active cyst wall from its liquid contents with potentially strong contrast enhancement, whether it was caused by proliferation of tissue or an inflammatory reaction. In turn odontogenic tumours, if solid or partly solid and partly cystic, would be expected to be less homogeneous, with little or no delineation of an active cyst wall. We have therefore attempted to disprove the hypothesis that MRI would be unable to distinguish between odontogenic cysts and keratocystic odontogenic tumours.

Patients, material, and methods

Selection of patients

We retrospectively studied 20 patients who had had contrast-enhanced MRI between May 2009 and November 2011 for further diagnosis of oval radiolucent lesions of the mandible. After MRI, resection and histopathological examination confirmed the diagnoses of keratocystic odontogenic tumours and odontogenic cysts ($n = 10$ in each group). The institutional ethics committee approved the study protocol, and all data were anonymised.

MRI imaging protocol

MRI examinations were made on a 1.0-T clinical unit (Magnetom Harmony; Siemens, Erlangen, Germany), a 1.5-T clinical unit (Magnetom Vision; Siemens, Erlangen, Germany), or a 3.0-T clinical unit (Philips Achieva 3.0T; Philips medical systems, Hamburg, Germany). Axial T1- and T2-weighted images, and axial and coronal fat-suppressed short-tau-inversion-recovery (STIR) images, were obtained for all patients with optimal variables. After intravenous injection of a standard dose of gadolinium-DTPA (Magnevist; Bayer Schering, Berlin, Germany), frequency-selective fat-suppressed T1-weighted images were acquired in the axial and coronal planes. The thickness of sections was 4 mm.

Analysis of images

Two radiologists (UGML (investigator 1) and MP (investigator 2)), who were unaware of the definitive histopathological results, evaluated the MRI independently. As regarding the signal intensity, a signal from the connective tissue on unenhanced T1-weighted and T2-weighted images was interpreted as low, a signal from the musculature on unenhanced T1-weighted images as intermediate, and one from the cerebrospinal fluid on T2-weighted images as high. Both signal intensity and homogeneity were assessed on STIR images, T1-weighted images, T2-weighted images, and contrast-enhanced T1-weighted images of the lesions' walls and their centres. Additionally, the raters had to assess locularity and the diameter of the wall, and then decide if the contents of a lesion were of cystic, solid, or mixed character. Walls less than 1 mm thick were defined as thin. Outcome variables (Tables 1–3) were rated as being present (1) or absent (0) on a standard form.

Statistical analysis

The significance of differences in the outcome variables between keratocystic odontogenic tumours and odontogenic cysts was assessed using a two-tailed Fisher's exact test either in 2×2 or 3×2 contingency tables.[13] Lesions with a predominantly high signal intensity were distinguished from those with low or intermediate intensities because this distinction would be the one most likely to be used in clinical practice.

Inter-rater reliability was calculated using Cohen's kappa coefficient and Spearman's rank correlation coefficient with the help of IBM SPSS for Windows (Version 20.0, IBM Corp, Armonk, NY). To assess the inter-rater reliability by rank correlation, an ordinal scale was established based on the signal intensity (low = 1, intermediate = 2, high = 3). Probabilities of less than 0.05 were accepted as significant.