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The role of MRI in facial swelling due to presumed salivary gland disease

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Abstract. 50 consecutive patients presenting with facial swelling thought clinically to be due to salivary gland disease underwent MRI. Examinations were interpreted by one radiologist without access to previous investigations. Records were reviewed to determine the reliability and role of MRI in patient management, and the contribution of other prior or subsequent investigations. MRI findings were verified against operative findings, percutaneous biopsy or clinical follow-up (periods ranging from 8–58 months). A mass was found in 27 patients; in 11 of these patients, disease was extrinsic to the salivary gland. MRI diagnosis of tumour was correct in all patients and MRI was a reliable investigation for planning surgical resection. No mass was found in 23 patients, 8 of whom had normal appearances. Evidence of salivary duct dilatation was seen in 12 patients and fatty infiltration was seen in 3. MRI findings appeared correct in all patients. Prior investigation was undertaken in 29 patients, including orthopantomography, ultrasound and sialography; none provided additional information. Sialography was carried out in three patients after MRI and concurred with MRI in all cases. MRI was an adequate basis for management in all patients and therefore appears to be an effective first line investigation of facial swelling. It is reasonable for patients to undergo preliminary investigation for dental sepsis, this being the most common cause of facial swelling. Further study is required to determine whether MRI can completely replace invasive sialography.

When patients present with lateral facial swelling there is a need to identify the cause of swelling and the organ of origin to direct further management. The differential diagnosis is wide, but salivary disease is frequently expected in practice. However, the clinical findings in facial swelling are essentially non-specific and imaging is the mainstay of clinical investigation [1]. MRI offers a convenient means of facial investigation, with its advantages of superior tissue discrimination, multiplanar facility and lack of radiation hazard [2]. MRI has recently also been shown to be effective in diagnosing salivary gland disorders and has some advantages over traditional techniques [3, 4]. This study was undertaken to evaluate the clinical utility of MRI as a single definitive investigation in patients presenting with facial swelling in whom there was strong clinical suspicion of salivary gland disease.

Patients and methods

50 patients presenting consecutively to the Oral Surgery service with facial swelling in the region of the salivary glands underwent MRI between July 1994 and August 1998. Ages ranged from 12 years to 85 years (mean 52.4 years). There were 23 males and 27 females. Follow-up of patients has been between 8 months and 58 months (mean 14.3 months).

MRI examinations were obtained using a 1.5 T Signa System (General Electric Medical Systems, Milwaukee, WI, USA) and a volume neck coil. All patients underwent the following two sequences: T_1 weighted spin echo sequence in the coronal plane and T_2 weighted fast spin echo sequence in the axial plane. Further sequences were performed according to findings on the above sequences: axial T_1 weighted, coronal T_2 weighted and fat suppressed sequences (Table 1). No patient preparation was required and the only instructions given were to avoid frequent swallowing and movement. Intravenous contrast enhancement was not used in any patients. All cases were reported by one radiologist (SJG) without access to other investigation results. Studies were examined for the presence of a mass as well as signs of other types of salivary disease. For the purpose of the study, a mass was defined as focal space-occupying disease, either within the salivary glands or elsewhere in the face, whatever the probable diagnosis. Note was also

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Table 1. Salivary gland imaging sequences: representative parameters

	Coronal SE/T_1	Axial SE/T_1	Axial FSE/T_2	Coronal FSE/T_2
TR (ms)	500	350	6400	6000
TE (ms)	12	12	100(EF)	100(EF)
FOV (cm)	24	24	24×18	24
Matrix	256/192	256/192	512/256	512/256
NEX	2	2	4	4
Slice thickness (mm)	5	6	5	5
Slice interspace (mm)	1.5	1.5	1	1
No. of slices	12	9+9 (2 acquisitions)	18	12

SE, spin echo; FSE, fast spin echo; FOV, field of view; NEX, number of excitations; EF, effective.

made of the appearances of the parenchyma of the major salivary glands, the calibre of the main parotid and submandibular ducts, and the presence of visible ductules within the glands

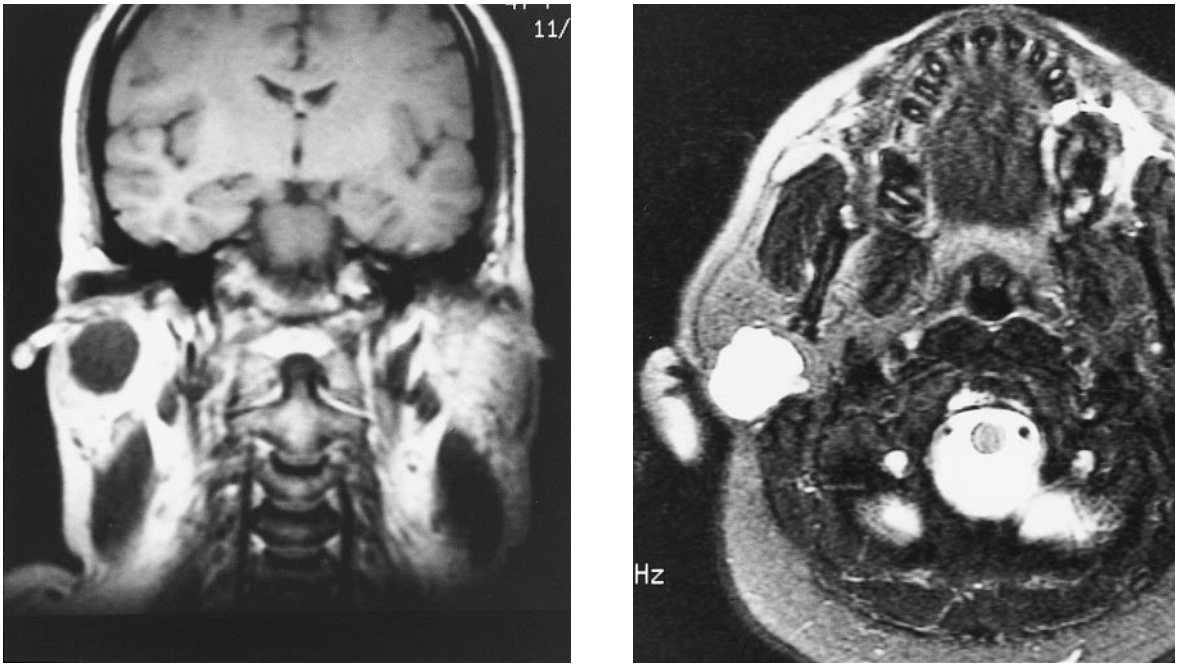
Clinical records were reviewed to determine clinical action resulting from MRI, in particular the results of biopsy or histological examination of resected specimens. Where a definitive diagnosis was not available, the clinical course during the follow-up period was noted. Investigations performed at the request of the clinician before and subsequent to MRI were reviewed retrospectively.

Results

Findings at MRI

27 of 50 patients were found to have a mass as defined in this study. 16 patients had masses intrinsic to the salivary glands (Figure 1) and 11 patients had extrinsic masses (Figure 2). The final diagnoses are shown in Table 2. Detection of space-occupying disease was correct in all 27 patients who were found to have a mass. The final diagnosis was established by surgery in 16 patients and by percutaneous biopsy in 3. One patient refused surgery and one patient's surgery was deferred owing to a major cerebrovascular accident. Five patients had masses on MRI consistent with reactive enlargement of perigland-ular lymph nodes (Figure 3). These masses were treated conservatively, resolved clinically and have not recurred to date. One patient with only masseter hypertrophy remains under clinical review.

23 patients had no mass on MRI; 8 of these had a normal gland and were discharged back to general practitioner care; 7 have not re-presented



(a) (b)

Figure 1. Intrinsic parotid tumour. (a) Coronal T_1 weighted spin echo image shows a well defined, low signal intensity lesion confined to the superficial lobe of the right parotid gland. (b) Axial T_2 weighted high resolution image with fat suppression shows high signal intensity and confirms the site of the mass in the superficial lobe. Superficial parotidectomy showed a pleomorphic adenoma.

Figure 2. Extrinsic neoplasm. The patient presented with swelling around the left submandibular gland. Axial T_2 weighted image shows multiple extrinsic masses (arrows) with smaller lesions contralaterally. Biopsy showed non Hodgkin's lymphoma.

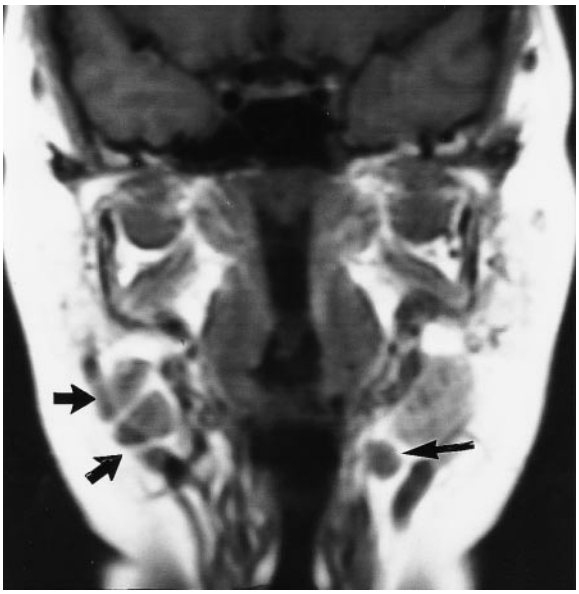


Figure 3. Reactive lymphadenopathy. Patient presented with right facial swelling. MRI showed multiple, mildly enlarged lymph nodes on the right and also contralaterally (arrows) and in the jugular groups. Symptoms settled on conservative management.

after 14–39 months follow-up; the remaining patient settled on conservative treatment but re-presented 7 months later with symptoms suggestive of sialadenitis and is scheduled for surgery on symptomatic grounds. 12 patients had intraglandular salivary duct dilatation (Figures 4 and 5) and 3 patients had fatty infiltration of the gland (Figure 6).

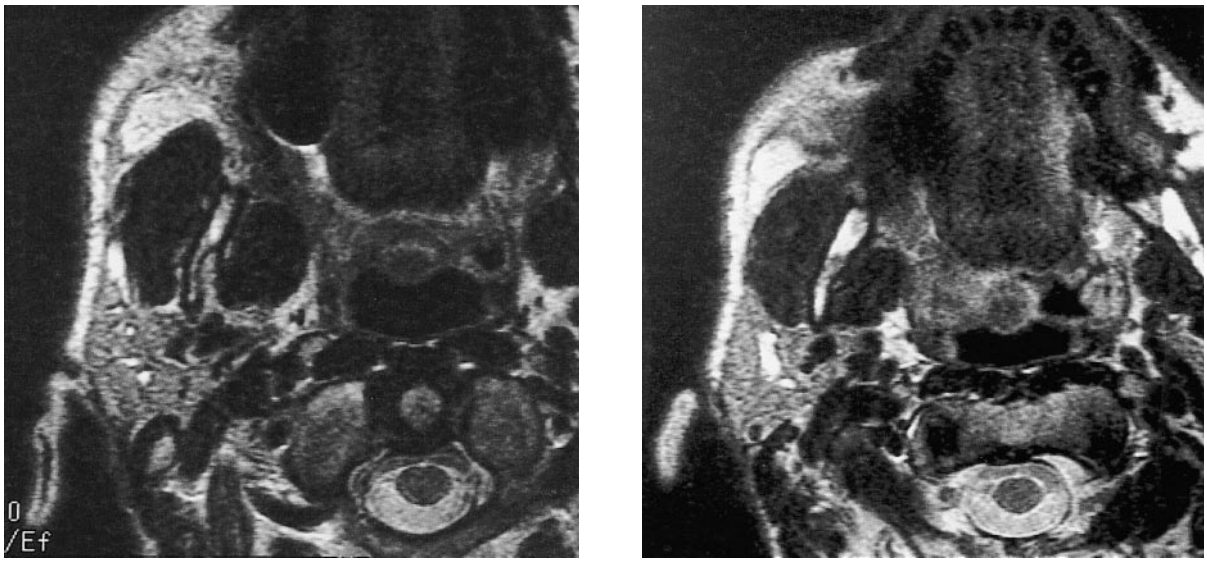
4 of 12 patients with salivary duct dilatation on MRI underwent resection on symptomatic grounds, confirming the diagnosis of sialadenitis in all; 1 of these had a sialogram prior to surgery, which confirmed duct dilatation and showed intraductal calculus (Figure 5). In one patient the MRI findings indicated a superficial abscess, confirmed by drainage. The remaining seven patients with intraglandular duct dilatation received symptomatic treatment for sialadenitis and responded satisfactorily.

Two of three patients diagnosed by MRI as having fatty infiltration underwent no further procedures and remained asymptomatic after 30 months and 37 months, respectively. The other patient had sialography, which supported the diagnosis, and remains asymptomatic. Overall, MRI was correct in diagnosing or excluding neoplasm. Diagnosis of inflammatory disease also appeared reliable, although MRI may have failed to diagnose sialadenitis in one patient initially presenting with facial swelling and who presented again after 7 months with symptoms more characteristic of active sialadenitis.

Table 2. Findings at MRI in patients with a mass, plus final diagnosis

Intrinsic mass (n=16)		Extrinsic mass (n=11)	
(Final) diagnosis	No. of patients	(Final) diagnosis	No. of patients
Pleomorphic adenoma	8	Presumed reactive lymphadenopathy	5[c]
Presumed pleomorphic adenoma	2[a]	Ranula	2
Carcinoma	2	Lymphoma	1[b]
Lymphadenopathy	2	Liposarcoma	1
Adenolymphoma	1	Branchial cyst	1
Lymphoma	1[b]	Masseter hypertrophy	1

[a]An 85-year-old woman had findings characteristic of a pleomorphic adenoma but was unwilling to undergo surgery and the mass remains unchanged after 48 months. A 75-year-old man with similar findings had a major cerebrovascular accident, leading to cancellation of surgery.
[b]Diagnosis was established by needle biopsy.
[c]Five patients with characteristic findings settled spontaneously and have not re-presented after 12, 23, 23, 35 and 39 months, respectively.



(a) (b)

Figure 4. Axial high resolution T_2 weighted images showing (a) dilated intraglandular ductules and (b) a short segment of dilated proximal main duct in a patient with persistent right facial swelling. Superficial parotidectomy carried out on symptomatic grounds confirmed chronic sialadenitis.

Results of investigations before MRI

29 patients had an investigation or procedure performed prior to MRI. Orthopantomography was performed in 20 patients to exclude calculi and dental pathology, both common causes of facial pain and swelling. No abnormalities were found in the patients in this study.

Ultrasound was performed on three patients. One patient showed an abscess of the right parotid gland with dilated ducts; MRI confirmed the ultrasound findings. In another patient ultrasound suggested a benign tumour, but MRI showed focal dilatation of ducts consistent with sialadenitis. The swelling settled and the patient remains well after 23 months. The third patient complained of a right pre-auricular mass; ultrasound and MRI both detected a pleomorphic adenoma, subsequently confirmed histologically.

Figure 5. High resolution T_2 weighted image showing intraglandular main duct dilatation proximal to a well defined signal void (arrow), which was also shown on T_1 weighted images. Sialography confirmed duct obstruction due to calculus at this point.

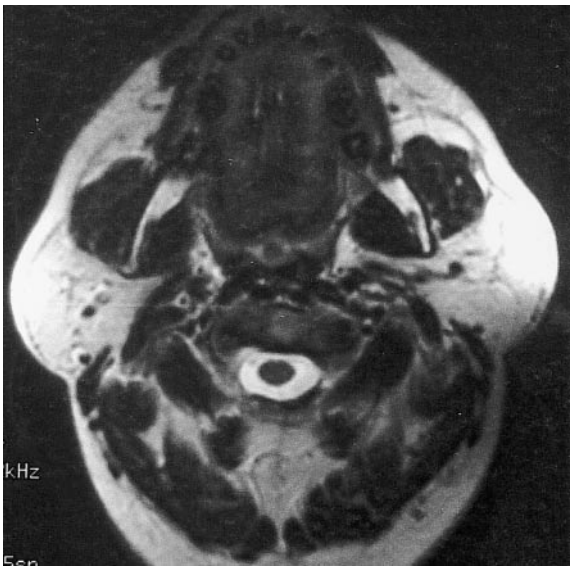


Figure 6. Fatty infiltration of both parotid glands. T_2 weighted image showing uniform enlargement of both glands, with no evidence of duct dilatation and signal intensity comparable with that of fat.

Conventional sialography was performed in three patients. The sialography examination was normal in one patient in which masseter hypertrophy was suggested by MRI. In the other two patients, cannulation of the duct was unsuccessful and MRI showed a normal gland. In one case this finding was confirmed by excision on symptomatic grounds; the other patient settled on conservative treatment. CT sialography had been performed on one patient prior to referral to the Oxford Oral Surgery service. Results of this investigation were normal, although a pleomorphic adenoma was shown by MRI and confirmed by surgery. Overall, no imaging procedure provided relevant information not obtained by MRI.

Eight patients underwent needle biopsy at presentation prior to MRI. In five patients this correctly demonstrated Hodgkin's disease in one case, two pleomorphic adenomas, a carcinoma, and one case of no abnormal tissue. The three other biopsies were unrewarding in patients subsequently shown to have pleomorphic adenoma, carcinoma and sialadenitis.

Action after MRI

Surgery was recommended on the basis of the MRI findings alone in 23 patients and no further investigation was undertaken.

Sialography after MRI in three patients showed salivary duct disease in two and fatty infiltration in one. All concurred with the MRI findings and did not alter the decision to adopt conservative management. A further three patients underwent needle biopsy. In two of these patients MRI suggested lymphoma, which was confirmed by needle biopsy. The third biopsy was carried out with drainage in a patient shown to have an abscess.

No active treatment was recommended on the basis of the MRI findings in 21 patients and no further investigation followed. All these patients have remained well for 10–41 months, except one patient who, having settled initially, re-presented 4 months later and is awaiting surgery.

Overall, the MRI findings were correct in all patients and alone would have provided a suitable basis for management.

Discussion

This study suggests that MRI may be an effective single investigation for determining the cause of facial swelling in patients in whom there is reasonable clinical suspicion of salivary gland disease. The primary concern of the clinician in such patients is to exclude a focal mass arising either from the salivary glands or elsewhere in the lateral face. Our study has concurred with others in demonstrating that MRI can definitively diagnose or exclude a mass and can define its intraglandular or extraglandular site [3–5]. This study also makes the new observation that MRI may be effective as a sole investigation in the diagnosis of inflammatory causes of facial swelling. This is important as the traditional clinical division of salivary disease into unremitting progressive masses and intermittent inflammatory swelling is not reliable in clinical practice [1].

The MRI features of a salivary gland mass can support a clinical diagnosis but cannot alone make a definitive histological diagnosis. Some benign and malignant tumours are known to have specific signal characteristics, but overlap exists and specific diagnosis is difficult [3, 6]. Our experience concurs with this; the role of imaging is to detect disease and to define its extent. Percutaneous needle biopsy may provide a specific diagnosis and may be carried out at presentation. However, as our study illustrates, needle biopsy guided by clinical palpation is subject to sampling error. If biopsy of a suspected mass yields negative findings, MRI may be used to demonstrate or exclude a mass. If biopsy gives a positive diagnosis, imaging may still be required to stage disease and plan resection or radiotherapy. Accurate localization of a parotid lesion is important as the surgical approach varies according to whether the lesion is in the deep or superficial lobe and whether or not invasion has occurred [7]. MRI can definitively provide this information and allow proper planning of the operation [8].

Controversy exists over the ability to image the facial nerve and its branches in relation to tumours. Teresi et al [9] reported that MRI could depict the facial nerve as a curvilinear structure of low signal intensity within the parotid gland on T_1 weighted images. This was challenged by Thibault et al [10]. In our experience, MRI does not depict the facial nerve in sufficient detail to define the relationship of parotid masses to the nerve. Rather, MRI is used to suggest that a tumour is in the deep or superficial lobe on the basis of its location relative to the putative course of the facial nerve.

Some have found gadolinium enhancement to be of benefit in the delineation of tumours, especially if used with fat suppression sequences [11], while others have detailed signal characteristics of specific tumour types [12, 13]. Sharafuddin et al [14] suggested that enhanced images should not be obtained in a routine parotid imaging protocol owing to simultaneous enhancement of both tumour and normal parotid parenchyma, resulting in decreased lesion conspicuity. We did not use enhancement in our study and appear to have

obtained information sufficient for clinical management.

MRI is accurate in detecting masses but its ability to demonstrate ductal disease, calculi and fatty infiltration is less well accepted [15]. Our study suggests that MRI may demonstrate main or branch duct dilatation as evidence of inflammatory duct disease or duct obstruction. In this study, MRI detected all cases of inflammatory salivary gland disease except possibly one. With the use of increasingly higher resolution scanners, good demonstration of the abnormal salivary duct system will probably become more common and may prove, as this study suggests, an alternative to invasive sialography. Our four-sequence protocol has proved effective in investigating masses and ductal disease.

The role of other techniques in relation to MRI needs to be considered. CT can accurately distinguish between intrinsic and extrinsic salivary tumours, and can also be used to stage tumours of the parotid [16]. The ability of CT to image the ductal system is limited, and inflammatory disease may produce no abnormal appearances [17]. CT sialography is now seldom performed as it adds no additional information [7].

CT also involves a radiation dose. MRI does not use ionizing radiation, and this is a valuable advantage when imaging young patients or those with potentially non-malignant disease. Some patients are unsuitable for MRI, but the major limiting factor of MRI at present is its cost relative to other modalities. However, evaluating imaging costs is a complex issue and high productivity MRI units can achieve costs comparable with those of conventional techniques [2, 18].

Ultrasound offers an alternative to MRI. It is also radiation-free, is less expensive and is more widely available. Ultrasound is an effective means of diagnosing superficial tumours in the face and is also capable of detecting calculi, although it has drawbacks in evaluating complex lesions depending on the precise extent and location, and its ability to demonstrate ductal disease is not established [19, 20]. An effective ultrasound service also depends on the availability of an operator skilled in facial examination, but ultrasound may prove to have an important role if treatment of salivary calculi by lithotripsy becomes established.

Sialography is the conventional method of demonstrating inflammatory duct disease or salivary calculi and it represents an appropriate first line investigation in patients in whom clinical suspicion of these conditions is very strong.[†] However sialography is not an effective method of demonstrating masses peripheral to the salivary glands, is invasive and involves radiation dose, and has technical limitations [21]. Where a range of diagnoses is possible, it is therefore arguable that a technique that is not specific to one organ should be used first. If MRI is used for this purpose, sialography may be reserved for secondary investigation of patients in whom MRI shows no focal mass and no definite signs of duct disease, especially as the relative sensitivities of MRI and sialography to fine degrees of duct change are not yet established.

When patients present with facial swelling, the clinician has the choice of investigating with a technique that will cover all possibilities, or proceeding through a diagnostic "work-up". We believe it is reasonable to rule out dental pathology, even in the absence of overt dental signs, as this is a common cause of facial swelling. Thereafter, MRI can be a highly effective means of obtaining the information necessary for clinical management in the majority of patients. The clinical context within which this study was conducted is as follows. (a) Where MRI demonstrated a mass, resection or biopsy was indicated, except where MRI indicated probable reactive lymphadenopathy in which case the patients were treated conservatively in the first instance. (b) Clearly benign findings, such as masserter hypertrophy or fatty infiltration of parotid glands, were treated conservatively. (c) Where MRI showed dilatation of main and intraglandular ducts in keeping with sialadenitis, sialogogue therapy was instituted, followed by therapeutic resection in cases of failed treatment. (d) Calculi detected by MRI or by palpation were treated by surgical removal. (e) Patients with normal MRI findings but a strong clinical suspicion of sialadenitis were treated with sialogogues, invasive sialography being reserved for cases of failed treatment.

Within this clinical setting, MRI proved in this study to be an effective single investigation sufficient for the management of all patients. It was notable that no additional procedures performed either before or subsequent to MRI provided useful information or altered management. Our institution has now introduced a policy of MRI as a first line investigation, subject to further audit. Given the significant advantages of MRI over the other available techniques, there appears to be a case for a cost and benefit study of this approach.

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