

# Magnetic resonance imaging of salivary glands: a literature review

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**ABSTRACT** | Salivary glands tumors account for 2-5% of tumors in the head and neck region, possibly being benign or malignant. Magnetic resonance imaging (MRI) presents high soft tissue contrast resolution, thus being an excellent method for salivary gland analysis. The objective of this literature review is to analyze MRI as an evaluation instrument for the diagnosis of salivary glands lesions. Compared to other imaging techniques, MRI can better evaluate the relationship between adjacent anatomical structures, presenting greater sensitivity and specificity.

**DESCRIPTORS** | Magnetic Resonance Imaging; Salivary Glands; Diagnosis.

**RESUMO** | **Imagem por ressonância magnética das glândulas salivares: uma revisão da literatura** • Os tumores das glândulas salivares são responsáveis por 2-5 % dos tumores da região da cabeça e pescoço, podendo ser benignos ou malignos. A Ressonância Magnética (RM) possui uma alta resolução de contraste dos tecidos moles, sendo assim um excelente método para a análise das glândulas salivares. O objetivo dessa revisão de literatura consiste na análise da RM para a avaliação no diagnóstico de lesões das glândulas salivares. Comparando com outras técnicas de imagem, a RM consegue avaliar melhor a relação entre estruturas anatômicas adjacentes e possui maior sensibilidade e especificidade.

**DESCRITORES** | Ressonância Magnética; Glândulas Salivares; Diagnóstico.

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## INTRODUCTION

Volume increase of one or more salivary glands is the most common manifestation of some pathologies such as acute or chronic inflammatory diseases, benign or malignant neoplasms and congenital malformations. When an edema is not accompanied by pain, patients tend to wait a long time before seeking medical or dental help, which enables the substantial growth of the lesion. The clinical diagnosis is complex and can be misleading, therefore, imaging tests are used to help differentiate salivary diseases.<sup>1</sup>

Magnetic resonance imaging (MRI) is known to allow multiplanar analysis of soft tissues with high contrast resolution, being an excellent method for both salivary gland observation and for the diagnosis of various glandular disorders, allowing the three-dimensional analysis of the extension of a lesion and its relationship with adjacent anatomical structures.<sup>2-4</sup>

In salivary gland alterations, MRI can also contribute to the determination of the lesion stage, having the advantage of not exposing the patient to ionizing radiation since it uses electromagnetic fields to generate images.<sup>5</sup>

The objective of this study is to conduct a literature review on the use of MRI and its modalities in the diagnosis of different lesions affecting the salivary glands.

## MATERIAL AND METHODS

This study used MEDLINE and United States National Library (PubMed) databases, choosing articles published between 2006 and 2018. Only publications in English language were searched, using the keywords: “MRI” OR “Magnetic Resonance Imaging” AND “Salivary Glands”. The inclusion criterion adopted were only publications on the use of MRI for evaluation of salivary glands lesions. The initial search found 47 publications and only 19 met the inclusion criterion. Other publications were excluded.

## DISCUSSION

### General considerations

The oral cavity is covered by a mucous membrane that has its moisture maintained by saliva, it protects the oral cavity and teeth, in addition to having an important role in swallowing. Saliva is composed of mucus, water, enzymes, starch and immunoglobulins for defense against infections, being produced by the salivary glands, which release about a liter of saliva per day.<sup>6</sup>

Parotid, submandibular and sublingual glands are considered larger salivary glands, always existing pairs. Smaller salivary glands are dispersed under the mucosa of the respiratory and upper digestive tract, being more concentrated in the oral cavity, lips, palate and tongue.<sup>7</sup> Regardless of the small size, these may suffer the same changes (neoplastic or not) as the larger salivary glands.<sup>1</sup>

Several factors can cause changes in, such as: mumps, sialolithiasis, tumors (benign or malignant), Sjögren's syndrome, radiotherapy, among others. Tumors of salivary glands account for approximately 2-5% of tumors of the head and neck region. They can be located in the sublingual, parotid and submandibular glands, and according to the World Health Organization (WHO), 54-79% of tumors of salivary glands are benign and 21-64% are malignant.<sup>8</sup>

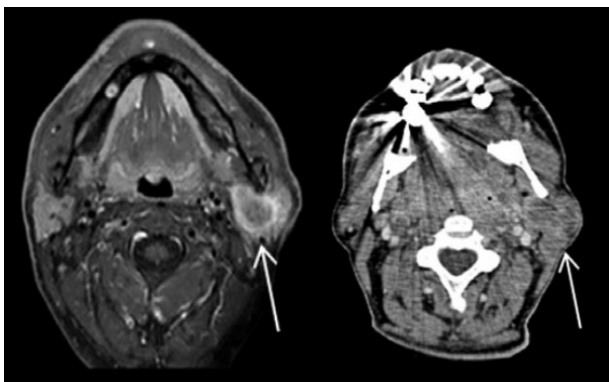
Considering the wide range of diseases that can affect the salivary glands, choosing the best imaging diagnosis method is critical, considering the cost, use of ionizing radiation, accuracy, reliability and patient satisfaction.<sup>6</sup>

In children and pregnant women, ultrasonography (US) is the exam of choice, especially in lesions involving the superficial part of the parotid gland. Computed tomography (CT) is the method used for patients with suspected inflammatory diseases, such as abscesses, calculi, dilation of the major salivary duct, and acute inflammation. MRI is the chosen method for patients with palpable masses and neoplastic suspensions.<sup>7</sup>

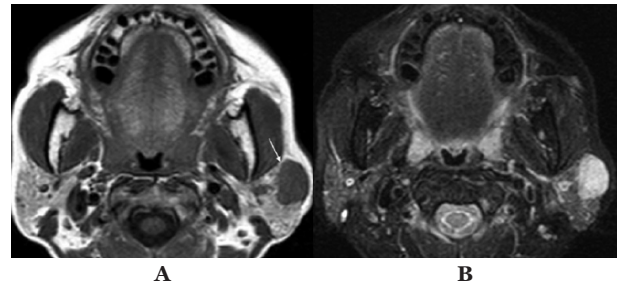
A recent meta-analysis compared US, CT and MRI for clinical differential diagnosis in patients with salivary gland tumors. They concluded that MRI is the image examination with the highest sensitivity and specificity, recommending its use for differential diagnosis between benign (Figure 1) and malignant salivary gland tumors (Figures 2, 3, 4).<sup>1,9-11</sup>



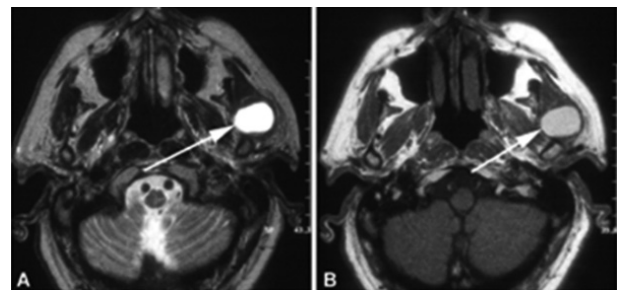
**Figure 1** | T2 axial MRI showing a case of pleomorphic adenoma, well-circumscribed, T2-bright left parotid gland.  
Source: Heaton, C.M. et al., 2013, p. 3057.<sup>12</sup>



**Figure 2** | Squamous cell carcinoma on the left parotid gland on MRI (left) and CT (right).  
Source: Afzelius et al., 2016, p. 5.<sup>6</sup>



**Figure 3** | Malignant lymphoma on the left parotid gland (A) T1 weighted image with a hypointense mass and a well-defined border. (B) T2 weighted image with fat suppression showing a mass with homogeneous high signal intensity.  
Source: Lam P.D. et al., 2015, p. 9.<sup>13</sup>



**Figure 4** | Salivary duct carcinoma case. Axial T2 (A) of a 73 year-old male. The lesion is well delineated and hyperintense on T1-weighted images (B).  
Source: Thoeny, H.C. et al., 2007, p. 59.<sup>7</sup>

## Magnetic resonance imaging

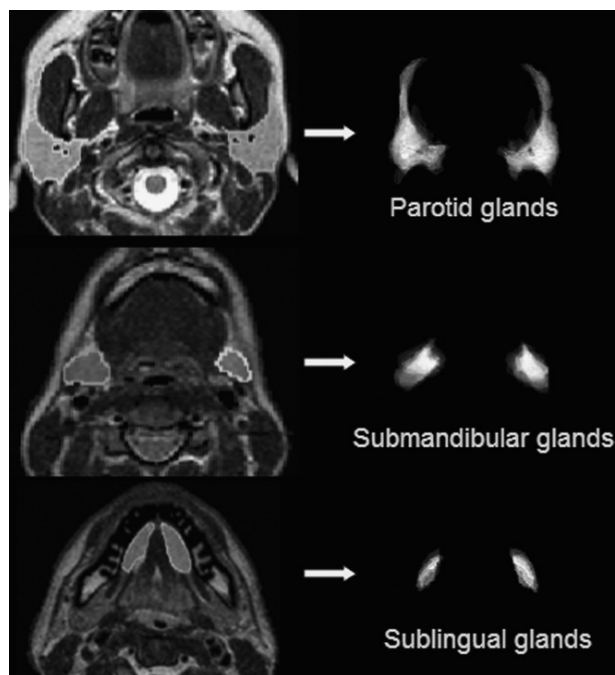
Magnetic resonance imaging is a well-known imaging exam for its high contrast resolution of soft tissues, being a particularly excellent method for evaluating the salivary glands (Figure 5). Due to its multiplanar capacity, MRI demonstrates the relationship between adjacent anatomical structures to a superior extent than either CT or US.<sup>1</sup>

It MRI is also important in the evaluation of major salivary gland diseases, particularly of neoplastic ones. In cases of large tumors (>3 cm) or of tumors located on the deep lobe of the parotid gland, MRI is superior to US in providing the delimitation of the lesion.<sup>6</sup> Unlike US, MRI is also capable of showing tumors in the minor salivary glands, being a valuable complement for surgery planning.<sup>1</sup>

MR sialography is used to evaluate the ductal system of the major salivary glands (Figure 6) without requiring the use of intravenous/ductal contrast

agents via highly fluid-sensitive sequences, so it can also be performed in patients with acute sialadenitis.<sup>6</sup>

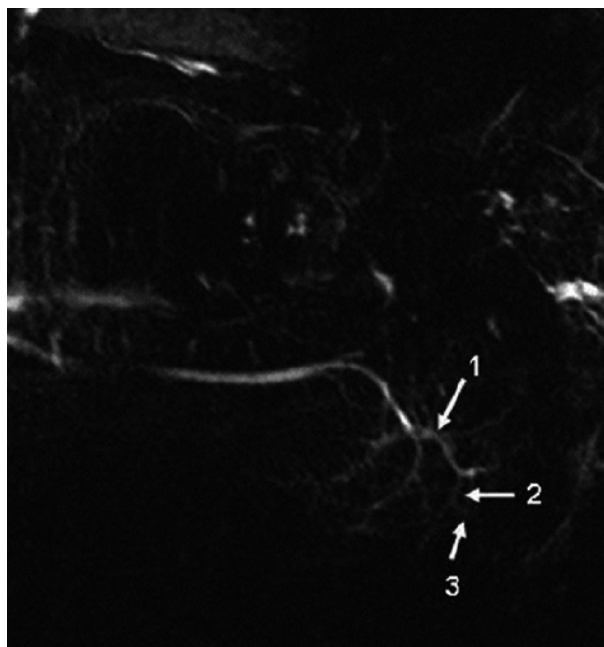
MRI has several applications in the evaluation of the salivary glands. Literature presents



**Figure 5** | T2 segmentation images of salivary glands.

Source: Saito N. et al., 2013, p. 274.<sup>14</sup>

numerous studies comparing the use of MRI to other imaging tests in the diagnosis and evaluation of salivary glands. Some of these are summarized in Table 1.



**Figure 6** | Submandibular gland ducts by MR sialography. 1: primary, 2: secondary, and 3: tertiary branches.

Source: Karaca Erdogan N. et al., 2013, p. 2.<sup>15</sup>

**Table 1** | MRI use for diagnosis and evaluation of various diseases.

Author/year	Objective	Study design	Conclusions
Habermann et al. (2007) <sup>16</sup>	To compare different field strengths monitoring physiologic changes due to oral stimulation of parotid glands by using diffusion-weighted (DW) echo-planar imaging (EPI).	27 healthy volunteers were examined with a DW-EPI sequence at 1.5T and 3T before and after oral stimulation with commercially available lemon juice.	DW-EPI MR imaging allows monitoring of physiologic changes due to oral stimulation of parotid glands by using DW imaging with high correlation between 1.5T and 3T.
Kakimoto et al. (2009) <sup>17</sup>	To investigate CT and MR imaging features of pleomorphic adenoma in the head and neck area.	50 pleomorphic adenomas from 50 patients which were all histopathologically diagnosed. The CT and MR images were retrospectively evaluated.	It was possible to detect the capsule in pleomorphic adenoma using MR images. Pleomorphic adenomas in the head and neck area should be evaluated with MR images.
Habu et al. (2010) <sup>18</sup>	To evaluate the clinical significance of dynamic magnetic resonance (MR) sialographic images in prognostic evaluation of saline solution irrigation of the parotid gland for the treatment of xerostomia.	Morphologic findings and functional parameters were evaluated using dynamic MR sialography before saline solution irrigation of the parotid gland for xerostomia therapy in 17 patients.	The study suggests that dynamic MR sialography might be useful for the prognostic evaluation of saline solution irrigation of the parotid gland for the treatment of xerostomia.

continua...

**Tabela 1** | continuação

Author/year	Objective	Study design	Conclusions
Matsuzaki et al. (2012) <sup>19</sup>	To evaluate the diagnostic value of dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) for minor salivary gland tumors in the oral cavity.	32 patients with minor salivary gland tumors were examined preoperatively using DCE-MRI.	DCE-MRI parameters of minor salivary gland tumors contributed little to their differential diagnosis compared to those for major salivary gland tumors.
Ying Liu et al. (2015) <sup>11</sup>	To compare US, CT, and MRI for clinical differential diagnosis in patients with salivary gland tumor (SGT).	Systematic review and meta-analysis	CT is recommended, as it is an effective imaging tool for differential diagnosis in patients with primary SGT, and MRI is suggested for differential diagnosis between benign and malignant SGTs due to its highest sensitivity and specificity.
Kojima et al. (2017) <sup>20</sup>	To analyze the diagnostic performance of the MRI imaging findings of the major glands to discriminate between patients with and without Sjögren's syndrome.	Retrospectively analyzed the correlation between the MRI imaging and histopathological findings obtained from 69 patients with clinically suspected Sjögren's syndrome.	The presence of multiple high-signal-intensity spots on an MR sialogram in the parotid gland should be considered the best diagnostic indicator for Sjögren's syndrome.
Loimu et al. (2017) <sup>21</sup>	To evaluate the usefulness of diffusion-weighted magnetic resonance imaging (DW-MRI) in assessing the post-RT salivary gland function in patients with head and neck cancer (HNC).	20 HNC patients scheduled for bilateral neck chemoradiotherapy with weekly cisplatin underwent DW-MRI and salivary gland scintigraphy prior to and at a mean of six months after completing the treatment.	DW-MRI seems a promising tool for the detection of physiological and functional changes in major salivary glands after RT.

Although MRI is an excellent imaging diagnostic instrument, it presents some disadvantages: low availability, requires good patient cooperation to avoid moving artefacts, has long acquisition time and has contraindications (such as pacemakers, cerebrovascular cramps, or claustrophobia).<sup>1</sup>

## CONCLUSION

When comparing CT and US to MRI, MRI can better analyze the relationship between adjacent anatomical structures and having greater sensitivity and specificity. Therefore, MRI is excellent in evaluating the differential diagnosis between benign and malignant salivary gland tumors.

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