

Magnetic resonance dacryocystography: comparison between conventional surface coils and microscopic coils*

Ressonância magnética das vias lacrimais: estudo comparativo entre bobinas de superfície convencionais e microscópicas

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Abstract **OBJECTIVE:** Magnetic resonance imaging has been utilized in the evaluation of the lacrimal apparatus with some advantages over conventional dacryocystography. The present study was aimed at acquiring high-resolution images utilizing microscopic coils for evaluating typical structures of the lacrimal apparatus as compared with the findings observed with conventional surface coils. **MATERIALS AND METHODS:** Five asymptomatic volunteers with no history of epiphora were submitted to high-field magnetic resonance imaging with microscopic and conventional surface coils, and STIR sequence after instillation of saline solution. The definition of normal anatomic structures of lacrimal apparatuses was compared utilizing conventional and microscopic surface coils. Based on a consensual scoring system, the mean values for each structure were calculated by two observers. **RESULTS:** In 90% of cases, higher scores were attributed to images acquired with the microscopic coil. On average, a 1.17 point increase was observed in the scoring of anatomic structures imaged with the microscopic coil. Additionally, a subjective improvement was observed in the signal-to-noise ratio with the microscopic coil. **CONCLUSION:** Magnetic resonance dacryocystography with microscopic coils is the appropriate method for evaluating the lacrimal apparatus, providing images with better quality as compared with those acquired with conventional surface coils.

Keywords: Magnetic resonance imaging; Lacrimal apparatus; Dacryocystography; Microscopic coil.

Resumo **OBJETIVO:** A ressonância magnética tem sido utilizada para avaliar as vias lacrimais, com vantagens em relação à dacriocistografia por raios-X. O objetivo deste trabalho é obter imagens de alta resolução utilizando bobinas de superfície microscópicas para avaliação de estruturas normais das vias lacrimais, comparando com o aspecto observado utilizando-se bobinas de superfície convencionais. **MATERIAIS E MÉTODOS:** Cinco voluntários assintomáticos, sem histórico de lacrimejamento, submeteram-se a ressonância magnética de alto campo, com bobinas de superfície (convencional e microscópica), com seqüência STIR após instilação de soro fisiológico. A identificação das estruturas anatômicas normais das vias lacrimais foi comparada utilizando-se as duas bobinas. Mediante uso de um sistema de escore, um valor médio de cada estrutura foi calculado por dois examinadores, consensualmente. **RESULTADOS:** Em 90% das vezes houve aumento do escore, atribuído à estrutura anatômica no estudo com a bobina microscópica. Em média, houve aumento de 1,17 ponto no escore, por estrutura anatômica visualizada, quando se utilizou a bobina microscópica. Observou-se, ainda, melhora subjetiva da relação sinal-ruído ao se utilizar a bobina microscópica. **CONCLUSÃO:** A dacriocistografia por ressonância magnética com bobinas microscópicas é um método adequado para o estudo das vias lacrimais, resultando em imagens de melhor qualidade quando comparada ao uso de bobinas de superfície convencionais.

Unitermos: Imagem por ressonância magnética; Vias lacrimais; Dacriocistografia; Bobina microscópica.

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INTRODUCTION

Lacrimal drainage system disorders present an estimated prevalence of 3%⁽¹⁾, representing a relatively frequent complaint among ophthalmological patients. Epiphora – an overflow of tears due to obstruc-

tive causes – may be caused by inflammation, tumors, trauma, surgery, radiotherapy or congenital alterations. The evaluation of the lacrimal pathways includes clinical evidences (intubation and irrigation) and imaging studies.

Imaging methods available for evaluating the lacrimal pathways include: dacryocystography with conventional radiography, dacryoscintigraphy (nuclear medicine), computed tomography dacryocystography, and magnetic resonance imaging (MRI) dacryocystography.

MRI dacryocystography is currently an excellent diagnostic method for evaluating the lacrimal pathways, with potential advantages, considering the absence of ionizing radiation which minimizes the risk for development of cataract. MRI provides high contrast resolution for soft tissues imaging, with instillation of saline solution or diluted gadolinium, and combining the non-invasiveness with the capability of evaluating functional alterations. Traditionally, surface coils have been utilized for acquisition of diagnostic images. However, with the introduction of the so called microscopic coils, i.e., surface coils with reduced diameter, allowing a better resolution of superficial structures and, consequently, an improvement in the signal-to-noise ratio, the authors considered studying normal structures of the lacrimal system in asymptomatic individuals, comparing the results with those obtained with conventional surface coils.

MATERIALS AND METHODS

A prospective study was developed with five asymptomatic volunteers (ten lacrimal pathways) – two women and three men with ages ranging between 29 and 33 years (mean, 31.2 years). These individuals were submitted to magnetic resonance imaging in an Intera 1.5T (Philips Medical Systems; Best, The Netherlands) with conventional surface coils (C1 – 160 mm) and microscopic coils (47 mm). Initially, images were acquired with C1 surface coils utilized in the majority of clinical applications which require imaging of superficial structures. Afterwards, images were acquired with another type of surface coil called “microscopic coil”, characterized by reduced in-

ner diameter (< 5.0 cm). Because of this features, microscopic coils result in a significant increase in the signal of superficial structures, with improvement of the signal-to-noise ratio, providing lower voxels without affecting the images quality. The coil utilized in the present study (*microscopic coil* – Philips Medical Systems; Best, The Netherlands) has a 47 mm inner diameter. STIR (TR = 3800 ms / TE = 90 ms / TI = 180 ms / 1.8 mm thickness) T2-weighted sequences were performed after instillation of two drops of saline solution every minute into both conjunctival sacs during five minutes. The same sequence was performed with the two different coils at five-minute and ten-minute acquisition intervals. The anatomical definition of the different structures included in the lacrimal system (superior lacrimal canaliculi, lacrimal sac, and nasolacrimal duct) was subjectively evaluated by consensus between two observers (a radiologist specialized in

head and neck, and a general radiologist) and rated according to a scoring system. The scoring system utilizes the following visualization rating scale: 0 – nonvisualization; 1 – poor visualization; 2 – good visualization; 3 – optimum visualization of the structure.

RESULTS

The radiologists’ consensual evaluation is summarized on Table 1.

In 36 of the 40 (90%) structures evaluated, a mean 1.17 point increase was observed in the score assigned to the images in the study of each anatomical structure with the microscopic coil as compared with the C1 surface coil. Only 10% (four anatomical structures – two nasolacrimal ducts in case 2 and two lacrimal sacs in case 5) of the whole sample did not present any increase in the score assigned to images acquired with the microscopic coil. A sub-

Table 1 Consensual scoring attributed by two observers to the identification of lacrimal pathways, according to the coil utilized.

	Case 1		Case 2		Case 3		Case 4		Case 5											
	C1		M		C1		M		C1		M									
	R	L	R	L	R	L	R	L	R	L	R	L								
Superior lacrimal duct	2	1	3	2	0	0	2	2	1	1	3	3	0	0	2	1	1	2	3	3
Inferior lacrimal duct	2	1	3	2	0	1	2	2	1	1	3	3	1	0	2	1	2	2	3	3
Lacrimal sac	2	2	3	3	2	2	3	3	2	2	3	3	2	2	3	3	3	3	3	3
Nasolacrimal duct	2	2	3	3	2	2	2	2	1	1	3	2	1	0	2	1	1	2	2	3

C1, conventional surface coil; M, microscopic surface coil; R, right; L, left.

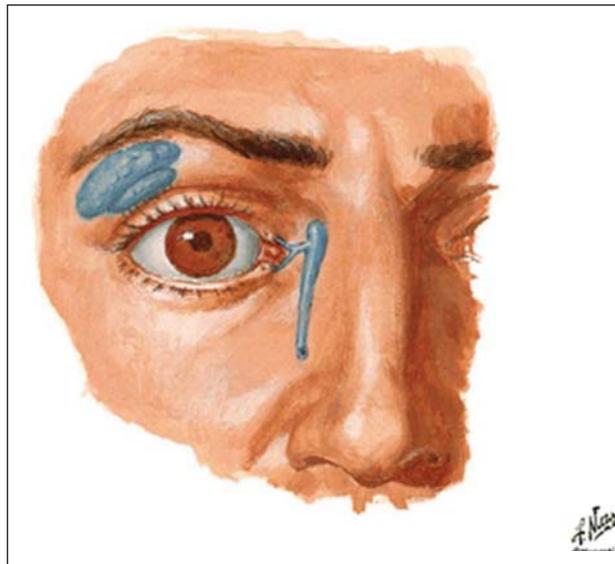


Figure 1. Normal anatomy of lacrimal pathways. Lacrimal ducts, lacrimal sac and nasolacrimal duct can be observed. (Source: Netter F. Atlas de anatomia humana. 8ª ed. New Jersey; Artmed; 1996).

jective improvement was observed in the signal-to-noise ratio for the whole sample in the comparison between images acquired with microscopic coil and with conventional surface coil.

DISCUSSION

Epiphora (abnormal overflow of tears due to obstruction of lacrimal pathways) is a frequent complaint⁽¹⁾ in ophthalmologic

offices (about 3% of ambulatory visits). Data about level and type of obstruction play a significant role in the definition of the best therapeutic strategy to be adopted (dacryocystorhinostomy, dacryocystoplasty, nasolacrimal stent or antibiotics irrigation). Additionally to the clinical evaluation, an imaging method should be utilized for this purpose.

The principles of dacryocystography with conventional radiography were first described by Ewing in 1909 and, up to recently, this was the method most frequently utilized in the evaluation of the lacrimal system. Despite providing an excellent anatomical delineation, this technique is relatively invasive and involves certain risks such as iatrogenic trauma and post-catheterization stenosis, besides the harmful effects of the ionizing radiation on the crystalline lens, without offering any functional information, considering that the contrast agent is administered under pressure by a syringe/catheter.

Dacryoscintigraphy is an alternative method for evaluating functional alterations of the lacrimal pathways. However, the following disadvantages of this method should be considered: the low spatial resolution for orbital soft tissues imaging and crystalline lens exposure to radiation.

Despite representing an important alternative in the study of lacrimal pathways, computed tomography dacryocystography also presents relative disadvantages connected with the utilization of ionizing radiation and the potential conjunctival irritation caused by the iodinated contrast agent.

MRI has been reported in the literature as a feasible method for evaluating the lacrimal pathways. The main advantages in relation to the other methods are: non-invasiveness, absence of ionizing radiation, (instillation rather than catheterization), anatomical and functional evaluation, and feasibility of simultaneous bilateral evaluation. Either T1- or T2-weighted sequences can be utilized for images acquisition⁽²⁻⁷⁾. In the first case, a gadolinium solution acts as a contrast agent; on T2-weighted sequences, likewise in the present study, the 0.9% saline solution is the medium that allows the identification of the lacrimal pathways.

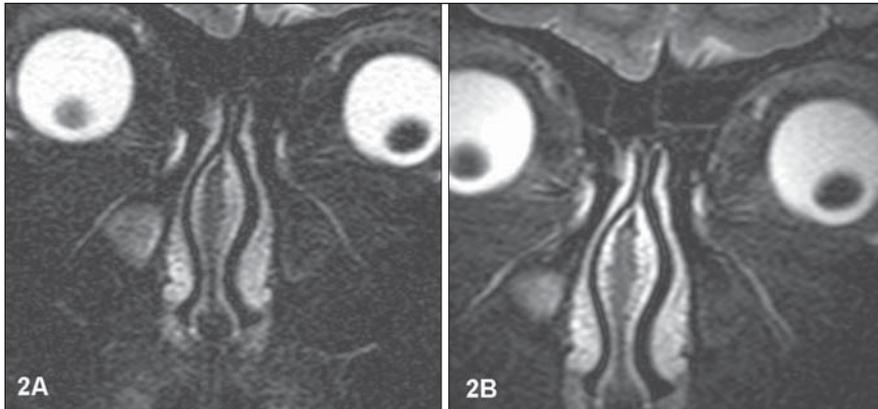


Figure 2. Case 1. A better definition of superior and inferior lacrimal ducts as well as lacrimal sac is observed on images acquired with microscopic coil (2B), as compared with those acquired with the conventional surface coil (2A).

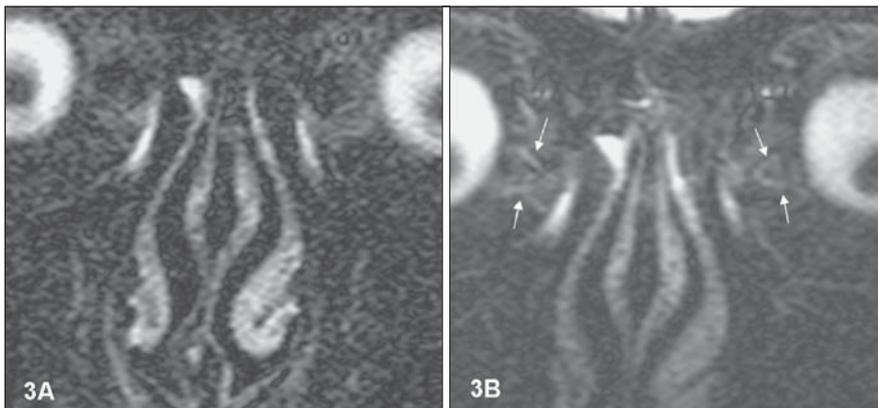


Figure 3. Case 2. In this case, lacrimal ducts were hardly identified on images acquired with conventional surface coil (3A). On images acquired with microscopic coil, lacrimal ducts could be better visualized (arrows).

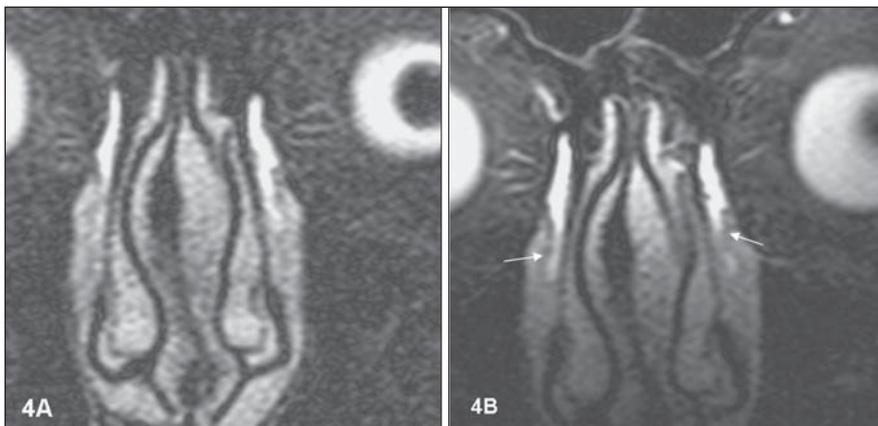


Figure 4. Case 3. All the lacrimal system structures, including nasolacrimal ducts (arrows), could be better visualized with the microscopic coil (4B). Also, a better signal-to-noise ratio could be observed.

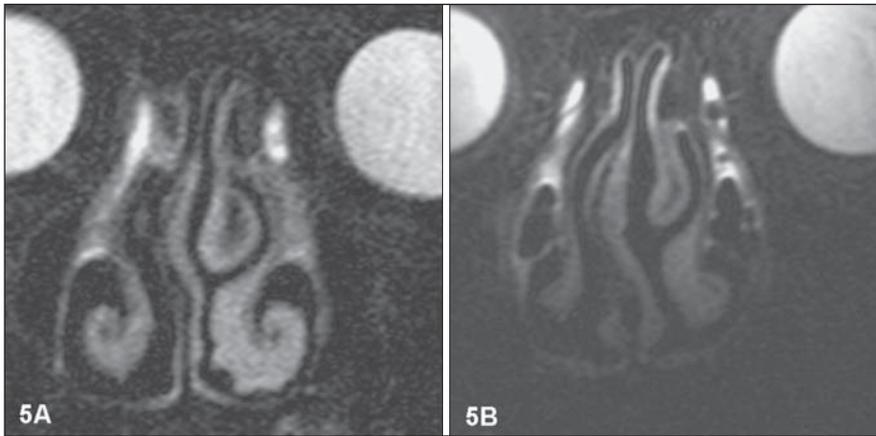


Figure 5. Case 4. In this case, motion artifacts impaired the identification of the lacrimal system structures. Even so, the benefit of the utilization of microscopic coil is clearly observed (**5B**), allowing the identification of lacrimal ducts which otherwise could not be visualized with the conventional surface coil.

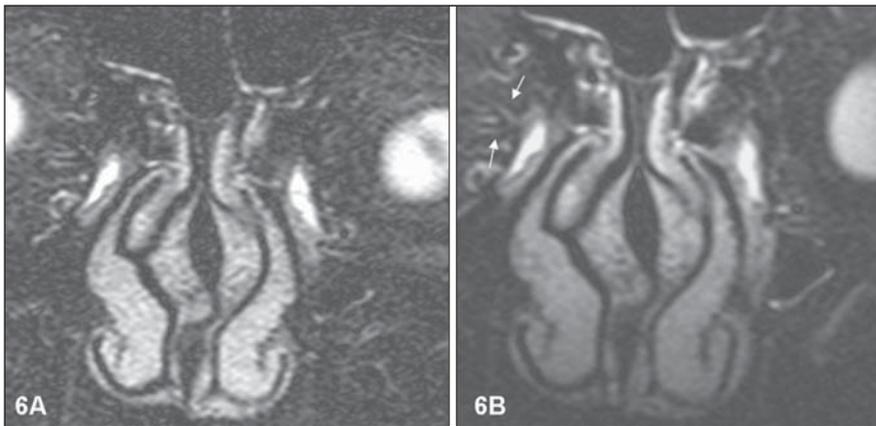


Figure 6. Additionally to the better signal-to-noise ratio, the study with microscopic coil (**6B**), has allowed a better characterization of lacrimal ducts at right (arrows).

Surface coils allow high-quality imaging of superficial anatomical structures like the normal lacrimal pathways structures. Conventional surface coils, with larger diameters, can provide images with a non-optimum signal-to-noise ratio, utilizing very thin slices. In the present protocol, 1.8 mm-thick slices presented a poor signal-to-noise ratio with the conventional coil. Despite the fact that the majority of structures could be visualized with this coil, their visualization was rated as non-optimum.

Several studies in the literature report an improvement of the signal-to-noise ratio with the utilization of microscopic coils for

evaluating several structures of different tissues such as knee ligaments and menisci⁽⁸⁾ and pathological cervical lymph nodes⁽⁹⁾. The present study is compatible with these reports, considering that all the lacrimal system structures were better characterized in the evaluation with the microscopic coil, even in the presence of artifacts (motion artifacts, for example). This aspect is particularly relevant if the identification of lacrimal ducts is considered. Considering their small caliber, sometimes the visualization of these structures with conventional surface coils is limited⁽²⁾. In the present study, the lacrimal ducts character-

ization improved with the utilization of the microscopic coil. This finding allows the authors to consider the possibility of improvement in the diagnosis of lacrimal pathways obstruction, especially high (pre-saccular) obstructions. However, further studies with symptomatic individuals would be necessary to confirm this hypothesis.

CONCLUSION

Magnetic resonance imaging dacryocystography utilizing microscopic coils is the appropriate method for identifying normal structures of the lacrimal pathways, resulting in higher-quality images as compared with images acquired with conventional surface coils.

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