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Surface coil in the magnetic resonance imaging of the orbital vessels anatomy

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ABSTRACT

In this paper, we demonstrate a capability of surface coil magnetic resonance imaging in the review of orbital blood vessels anatomy. Surface coil allows a better detection of small anatomic structures including vessels such as ophtalmic artery and its branches, and also orbital veins, particularly superior and inferior ophtalmic veins with accompanying branches. The best results are obtained by the use of T1 sequences with short TE and TR.

Keywords: orbital vessels, anatomy, MRI, surface coil

The orbit is amenable to radiological investigation by several methods (1). Besides standardized echography, computed tomography (CT) and magnetic resonance imaging (MRI) have become the most important tools for the evaluation of orbital anatomy and pathology (2). In most medical centers, CT is still the method of choice for orbital imaging because of low costs and excellent depiction of orbital and paraorbital osseous anatomy. The resolution in CT within the orbit has been shown to be sufficient to demonstrate structures such as ophtalmic artery and some of its branches, ie. the superior ophtalmic vein, frontal, or oculomotor nerves (3,4). Compared with CT, orbital MRI provides a better soft-tissue contrast resolution, particularly when the small-diameter surface coil is used. Surface coils allow high-resolution imaging of the orbit by increasing the signal-to-noise ratio (SNR) (5,6). Because there is no exposure to ionizing radiation, MRI is an excellent tool for anatomical studies in vivo.

The aim of study was to demonstrate the potential of surface coils in view of normal anatomic structures in the eye sockets and its advantages, in comparison to the standard coil.

METHODS

Ten healthy subjects (ages 32 to 56 years) were examined (n=20 orbits). The study was approved by the Ethical Committee of the Medical Faculty in Sarajevo. Magnetic resonance imaging of the orbit was performed on 1,5 Tesla scanner (Magnetom Impact, Siemens, Germany) using surface coil with a diameter of 7,5 and 10 cm (Figure 1). T1 images were obtained using spin-echo sequences with TE=15 msec and TR=440-520 msec in axial, coronal and oblique-sagittal sections. Thinner sections (2 to 3 mm) are preferable. The field of view ranged between 140x140 mm with 256x256 matrix and 230x230 mm with 512x512 matrix.

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FIGURE 1. Surface coils with a dimeter of 10 cm (1), 7.5 cm (2) and double phase array surface coil (3)

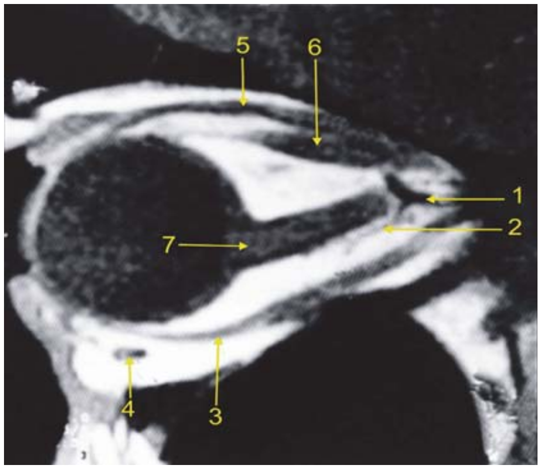

FIGURE 2. Oblique-sagittal T1 magnetic resonance imaging (up-gaze, male, 39 years). 1-Ophtalmic artery, 2- Central retinal artery, 3-Inferior rectus, 4-Inferior oblique, 5- Levator palpebrae superioris, 6-Superior rectus, 7-Optic nerve

RESULTS

Arteries

On sagital images, the intraorbital part of the ophthalmic artery appears at the lateral side of the optic nerve (Fig. 2). In this position ophthalmic artery branches to the central retinal artery. The central retinal artery is the most important branch of the ophthalmic artery. It pierces the optic nerve inferomedially about 12-15 mm posterior to the globe (Figure 2).

Axial images show the further course of the ophtalmic artery. Distal to the lateral knee, it crosses the optic nerve, and courses forward to the medial angle of eye. At the crossing with the optic nerve, the ophtalmic artery gives off posterior ciliary arteries on the both sides of the optic nerve (Figure 3). The vessel that runs posteriorly from the medial side of the ophtalmic artery represents the posterior ethmoidal artery (Figure 3). On the axial sections in the level of trochlea, the curved anterior ethmiodal artery is noted (Figure 4). Inferior to the trochlea, we can see that ophtalmic artery terminates in the dorsal nasal artery (Figure 3).

On the coronal images in the level of the anterior orbita, supratrochlear and supraorbital vessels with accompanying nerves are visible.

Veins

The trunk of the superior ophtalmic vein starts posterior to the reflected part of the superior oblique tendon and courses from anteromedially to posterolaterally (Figure 5). In contrast, superior ophtalmic vein crosses with lesser obliquity, enabling the distiction from the ophtalmic artery. Proximal to the junction with the lacrimal vein, superior ophtalmic vein

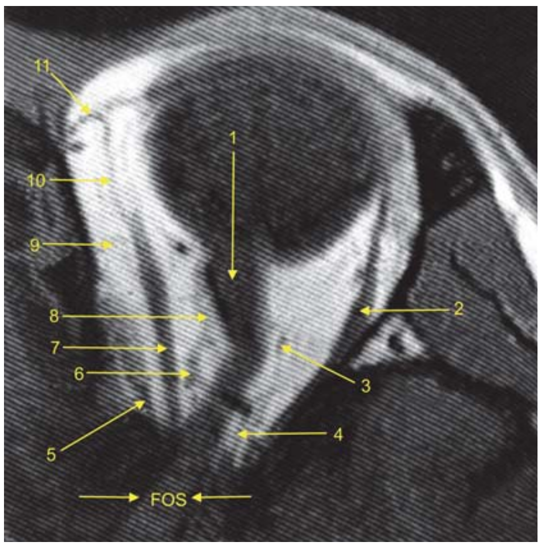

FIGURE 3. T1 axial image (male, 41 years). 1-Optic nerve, 2-Lateral rectus, 3-Long posterior ciliary artery, 4-Meningeal reccurens artery, 5-Superior oblique, 6-Ophtalmic artery, 7-Medial rectus, 8-Long posterior ciliary artery, 9-Anterior ethmoidal artery, 10-Ophtalmic artery, 11-Dorsal nasal artery, FOS-Fissura orbital superior

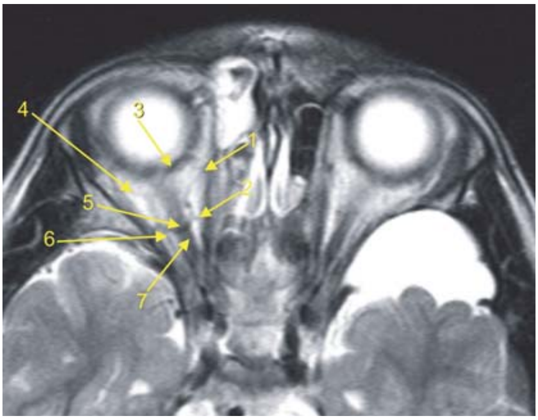

FIGURE 4. T2 axial image (male, 36 years). 1- Anterior ethmoidal artery, 2-Posterior ethmoidal artery, 3-Superior ophtalmic vein, 4-Lacrimal vein, 5-Ophtalmic artery, 6- Superior ophtalmic vein, 7-Optic nerve

runs posteriorlly to the superior orbital fissure.

The inferior ophtalmic vein lies on the orbital floor between the lateral and inferior rectus (Figure 6). It communicates through the inferior orbital fissure with the pterygoid venous plexus in the pterygopalatine fossa. The medial and lateral collateral veins can be seen on axial images in the level of the inferior orbita (Figure 5).

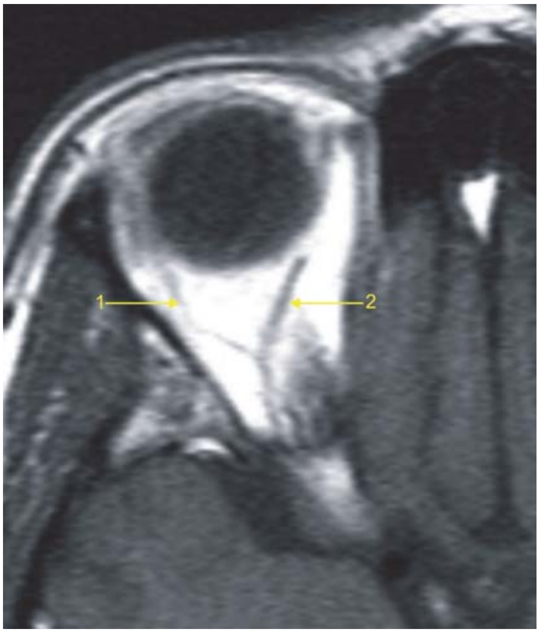

FIGURE 5. T1 axial image (male, 45 years). Standard head coil. 1-Lacrimal vein, 2-Superior ophtalmic vein

The vorticose veins can be seen in adequate sections, expecially on parasagittal section laterally to the anterior part of the optic nerve.

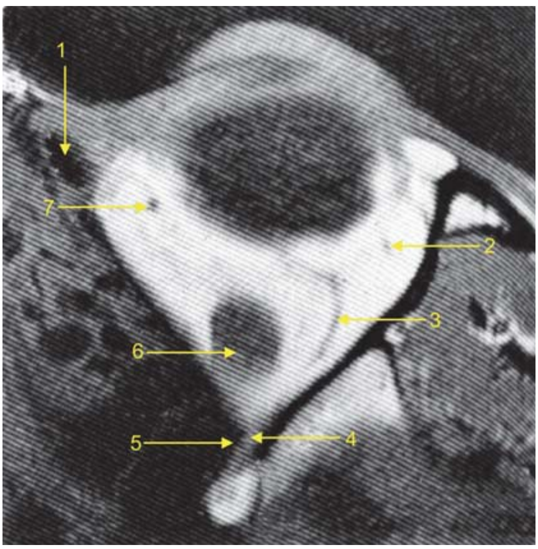

FIGURE 6. T1 axial image (female, 32 years). 1-Lacrimal sac, 2-Lateral collateral veins, 3-Inferior ophtalmic vein 4-Orbitalis muscle, 5-Fissura orbitalis inferior, 6-Inferior rectus, 7-Medial collateral veins

DISCUSSION

The fat content of the orbit is responsible for the excellent contrast in orbital MRI. It allows a better detection of small anatomic structures including vessels and nerves (7). Orbital fat is hyperintense on T1 images, and other structures such as muscles, vessels and nerves are hypointense. Blood vessels appear dark on T1 images because of the signal void of flowing blood. In our images, vessels were usually darker than other structures such as muscles and nerves. Generally, arteries showed a curved course compared with more straight veins. These facts, together with detailed knowledge of orbital anatomy on human specimens, allowed the identification of various vascular structures on MRI (8-10). The highest spatial resolution is achieved with surface coil (5,6,11). We have demonstrated that surface coil MRI on clinical magnetic resonance unit is capable of imaging the anatomy of the vessels in the orbit with sufficient details. The best results is obtained by the use of T1 sequences with short TE and TR.

CONCLUSION

Imaging of the orbit necessitates sophisticated techniques because of its anatomical complexity. An understanding of normal anatomy will allow a better appreciation of proximity of normal structures to pathological processes. A potential clinical application of high-resolution orbital MRI will be the evaluation of orbital vascular lesions. The ability of anatomical details in the orbit will be important for orbital surgery.

CONFLICT OF INTEREST

The author declares no conflict of interest

REFERENCES

1. Aviv RI, Casellman J. Orbital imaging. Part 1. Normal anatomy, Clinical radiology. 2005; 60:279-287
2. Conneely MF, Hacein Bey L, Jay WM. Magnetic resonance imaging of the orbit.Semin Ophtalmol, 2008; 23(3):179-89
3. Ettl A, Salomonowitz E, Koornnef L. Magnetic resonance imaging of the orbit: Basic principles and anatomy, Orbit. 2000 Dec; 19(4):211-237
4. Wirtschafter JD, Berman EL, McDonald CS. Clinical Neuro-Orbital Anatomy, American Academy of Ophtalmology. 1992, San Francisco
5. Nayak BK, Desai S, Maheshwari S. Interpretation of magnetic resonance imaging of orbit: Simplified for ophthalmologists (Part I). J Clin Ophthalmol Res 2013;1:29-35
6. Ehman RL. MR imaging with the surface coils, Radiology. 1985;157:549-550
7. Lee AG, Brazis PW, Garrity JA, White M. Imaging for neuro-ophthalmic and orbital disease. Am J Ophthalmol 2009;138:852-62
8. De Potter P, Shields JA, Shields C. MRI of the eye and orbit, Lippincott. 1995; Philadelphia
9. Bilaniuk LT. Orbital vascular lesions. Role of imaging, Radiol Clin North Am. 1999; 37(1):169-81
10. Simha A, Irodi A, David S. Magnetic resonance imaging for the ophthalmologist: A primer. Indian J Ophthalmol 2012;60:301-10
11. Atlas SW, Bilaniuk LT, Zimmermann RA. Orbit: Initial experience with surface coil spin echo MR imaging at 1,5 T, Radiology. 1987; 164:501-509