Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 02, pp.46650-46652, February, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

CASE STUDY

BLACK BONE MRI – A NEW ERA OF PARADIGM SHIFT IN MAXILLO-CRANIO-FACIAL IMAGING

*Dr. Priyanka Baswaraj Lasune

Post Graduate Student of Oral Medicine and Radiology Department Learning in Bangalore

ARTICLE INFO

Article History:
Received 28th November, 2016
Received in revised form
15th December, 2016
Accepted 06th January, 2017
Published online 28th February, 2017

Key words:

Blooming phenomenon, Flip angle,
Echo time, rePetition time, Black bone.

ABSTRACT

Imaging technology has revolutionized over the past few decades and has witnessed immense development, especially in the field of oral and maxillofacial imaging. The development of 'Black bone MRI'signifies anew era of paradigm shift in maxillofacial imaging where thisMRI sequence for imaging cortical bone can be used as a potential replacement for CT. Using alow flip angle with short repetition and echo times, this sequence is optimized to minimize soft tissue contrastand enhance the bone-soft tissue boundary. Furthermore, Black bone MRIeliminates radiation burden to the patients as it is a non-invasive 'radiation-free' method of paediatric diagnoses and adult screening of benign and malignant lesions affecting the maxillofacial region. This paper elaborates this novel gradient echo MRI sequence and highlights the potential of this sequence in maxillofacial imaging.

Citation: Dr. Priyanka Baswaraj Lasune, 2017. "Black bone MRI – A new era of paradigm shift in maxillo-cranio-facial imaging", *International Journal of Current Research*, 09, (02), 46650-46652.

INTRODUCTION

Whilst conventionalMRI is increasingly used for the three dimensional reconstruction of soft tissue. However, the differentiation of bone by using MRI in the field of oral and maxillofacial region is limited. Black bone MRIhas brought a new imaging technology which helps in the three dimensional reconstruction of soft tissue as well as bone in the field of oral and maxillofacial imaging, thereby providing accurate diagnosis and better treatment plan. Furthermore, compared to other conventional radiography, this imaging technology has particular advantageof being a non-ionising and radiation free method. This sequence has been developed in response to growing concerns regarding the harmful effects of radiation and has been specifically developed for the evaluation of craniofacial skeleton. Such adevelopment signifies a new era of paradigm shift in maxillofacial imaging.

Imaging principle

Black bone MRI follows as same as conventional MRI, First the patient should beplaced inside a large magnet.A magnetic field is then applied which principle causes the nuclei of many atom in the body, particularly hydrogen, to align with the magnetic field. The scanner directs a radiofrequency pulse into the patient, causing some hydrogen nuclei to absorb the energy. When the RF pulse is turned off, the stored energy is released from body and detected as a signal in coil in the scanner. This signals is used to construct the MR image. (white and pharoh 1st edition)

Corresponding author:* **Dr. Priyanka Baswaraj Lasune,
Post Graduate Student of Oral Medicine and Radiology Department Learning in Bangalore

Mechanism of BLACK BONE MRI

BlackBone Mri based on the Susceptibility weighted imaging (SWI) is a technique developed by Siemens and it is based on blooming phenomenon. (Haacke *et al*., 2004; Robinson *et al*., 2015) calcium content of bone decreases the magnetization because calcification is strongly diamagnetic compared to applied magnetic field in the bone. So, it reduces the Larmor frequency and causes heterogeneity in the localized magnetic field that leads to intra- and intervoxel dephasing thus causing signal drop-out in the voxel containing calcium as well as adjacent voxels, a phenomenon referred to as "blooming". Henceforth it increases bone and soft tissue contrastbut, it provide low contrast between different soft tissues, thus the low signal bone is easily distinguished from the surrounding soft tissues, can also be reformatted into three-dimensional reconstructions, because although the sequence is two-dimensional, the slice thickness is small and does not cause significant step artefact. The sequence is best run immediately after routine half Fourier acquisition single-shot turbo-spin echo (HASTE).

"BLACK BONE MRI" PARAMETERS (Eley *et al*., 2012)

Image contrast

Image contrast between tissues is directed by extrinsic parameters of a given pulse sequence, such as echo time (TE) and repetition time (TR), which can be adjusted to highlight the required features. These TE and TR produces a bright and dark signal in BLACK BONE MR image. (white and pharoh 1st edition)

Flip angle

The ideal flip angle is the important parameter in black bone mri which suppress signal from both fat and water to provide a uniform soft-tissue contrast and therefore enhances bone soft tissue contrast. The ideal flip angle to effectively suppress signal from both fat and water is 5u. The imaging time for the black bone sequence of an adult skull is approximately 4 min. (Eley *et al*., 2012)

Parameter	Value
Repetition time	8.6 ms
Echo time	4.2 ms
Flip Angle	5
Phase encode	256
Frequency encode	256
Receive bandwidth	31.25
ZIP(zerofill interpolation)	2512
NEX(number of excitations)	2
Slice spacing	-1.2 mm
Slice thickness	2.4 mm
Echo train length	1
Scan field of view	24cm

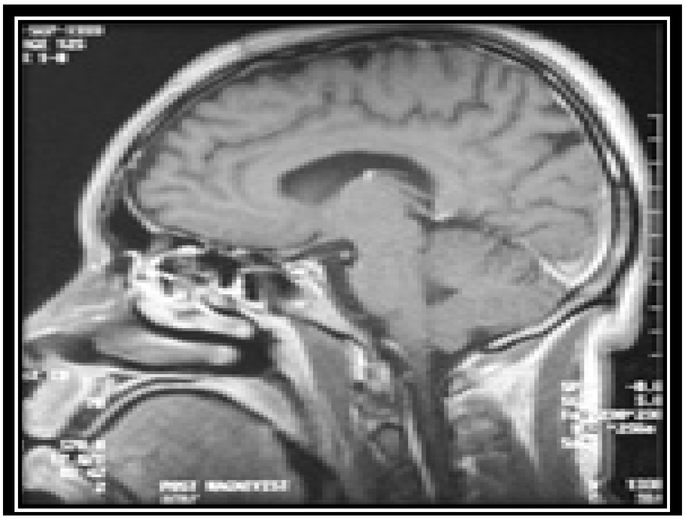

Figure 1. Conventional mri

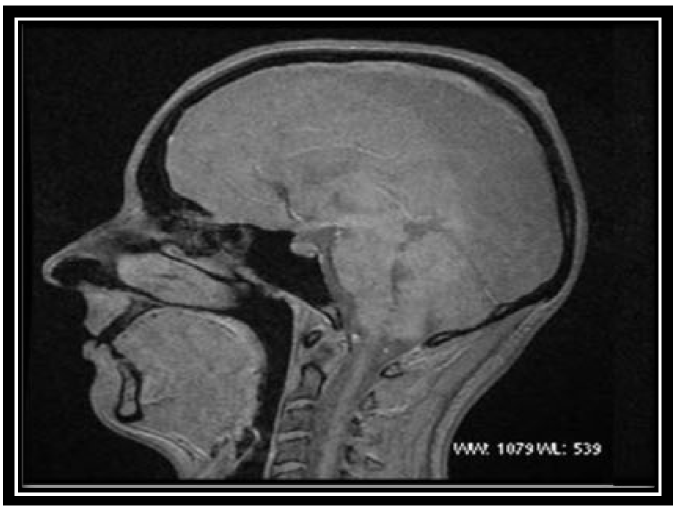

Figure 2. Sagittal section of Black bone mri Representing skull bone appears as hypointense structure

In this black bone MRI sequence, (Figure 1) the gradient echo sequence is optimized to minimize soft tissue contrast and enhance the bone- soft tissue boundary,by using a short echo time and repetition time with a low flip angle and volume acquisition, resulting in short imaging time. The ideal flip angle, (Figure 2) effectively supresses the soft tissue signals (fat and water) and,enhances bone and soft tissue boundaries as a result, skull bone appears as dark and is identifiable from the surrounding soft tissues, which almost appear as uniformly grey. (Eley *et al*., 2012)

Application

- Alternative to cbct which uses imaging radiation.
- Identification of fracture of facial skeleton.
- Identification of Cephalometric landmark. (Eley *et al*., 2013)

Others

- Imaging of arteries, including thereof head and neck to examine occlusion, aneurysms, or arteriovenous malformation.
- Accurate distinction, between normal and prematurely fused sutures.
- Assessment of spinal abnormalities, bony abnormalities in myelomeningocele, scoliosis, segmentation anomalies and sacrococcygeal teratoma.
- Identification extension of benign and malignant lesion.

Advantages

- Radiation free method.
- Of great value in young and pregnant patients.
- Improved cost-effectiveness.

Limitation

- Inability to depict interfaces between bone and air, particularly when evaluating the craniofacial skeleton.

However, this is not an issue pre-natally because, there is no air-bone interface such as the mastoid region and paranasal sinuses.

- Metal foreign body produces artefact which produces degradation of image quality.
- Claustrophobia. (Vanel, 2003)

Conclusion

The 3D reconstructed images of the craniofacial skeleton created from “Black Bone Mri” offers a potential alternative to single modalities used ionising radiation. Thus this imaging sequence is in its stage of infancy and mandate further studies, Black Bone Mri definitely marks an era of paradigm shift in maxillofacial imaging.

REFERENCES

Eley KA, McIntyre AG, Watt-Smith SR, Golding SJ. 2012. ‘‘Black bone’’ MRI: a partial flip angle technique for radiation reduction in craniofacial imaging. *Br J Radiol*., 85: 272–8.

Eley KA, Watt-Smith SR, Golding SJ. 2013. “Black Bone” MRI: A potential nonionizing method for three-dimensional cephalometric analysis—a preliminary feasibility study. *Dentomaxillofac Radiol*, 42: 20130236.

Eley, K A. *et al*. 2012. Black bone’’ MRI: a potential alternative to CT when imaging the head and neck: report of eight clinical cases and review of the Oxford experience *The British Journal of Radiology*, 85, 1457–1464

HaackeEM, Xu Y, Cheng YC, ReichenbachJR. 2004. Susceptibility weighted imaging (SWI). *MagnReson Med*., 52: 612–18.

Robinson AJ, Blaser S, Vladimirov A, Drossman D, Chitayat D, Ryan G. Foetal 2015. “Black bone” MRI: utility in assessment of the foetal spine. *Br J Radiol*., 88:20140496.

Vanel, D. 2003. MRI of bone metastases: the choice of the sequence. Cancer Imaging, 4:30–5.

White and pharoh .textbook of oral radiology. First edition.

****