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**Role of MRI diffusion tensor imaging in
assessment of response of normal-appearing
white matter in case of multiple sclerosis.**

Thesis

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Radio-diagnosis

By

Mona Mahmoud Hassan Alsherif

M.B. B. Ch., M. Sc

Faculty of Medicine – Ain Shams University

Under Supervision of

Prof. Dr. Eman Soliman

Professor of Radio-diagnosis

Faculty of Medicine, Ain Shams University

Asst Prof. Dr. Remon Zaher Elia

Assistant Professor of Radio-diagnosis

Faculty of Medicine, Ain Shams University

Dr. Mona Ali Mohammed Ali Nagi

Lecturer of Radio-diagnosis

Faculty of Medicine Ain Shams University

Faculty of Medicine

Ain Shams University

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LIST OF CONTENTS

Title	Page No.
List of Contents	I
List of Abbreviations	II
List of Tables	VI
List of Figures.....	VII
Introduction	1
Aim of Work	4
Review of Literature	5
☒ Multiple sclerosis	5
☒ The physical aspect of DT-MRI	16
☒ Role of MRI in multiple sclerosis	22
Patients and Methods	32
Results	36
Representative Cases	47
Discussion.....	64
Summary And Conclusion.....	77
References	80
الملخص العربى	١

LIST OF ABBREVIATIONS

Abb.	Full Term
AD	: Axial diffusivity.
ADC	: Apparent diffusion coefficient.
AHSCT	: Autologous hematopoietic stem cell transplantation.
AQP4	: Aquaporin 4.
CIS	: Clinically isolated syndrome.
CNS	: Central nervous system.
CSF	: Cerebrospinal Fluid.
DEC-FA	: Diffusion-encoded-color fractional anisotropy
DIR	: Double inversion recovery.
DIS	: Dissemination in space.
DIT	: Dissemination in time.
DMTs	: Disease-modifying therapies.
DTI	: Diffusion tensor imaging.
DWIs	: Diffusion-weighted images.
EPI	: Echo planar imaging.
FA	: Fractional anisotropy.
FLAIR	: Fluid-attenuated inversion recovery.
FOV	: Field of view
LME	: Leptomeningeal contrast enhancement.
MAGNIMS	: Magnetic Resonance Imaging in Multiple Sclerosis.
MD	: Mean diffusivity.
MOG	: Myelin-oligodendrocyte glycoprotein.
MPRAGE	: Magnetization-prepared rapid gradient echo.
MS	: Multiple sclerosis.

LIST OF ABBREVIATIONS

Abb.	Full Term
NAWM	: Normal appearing white matter.
NMOSDs	: Neuromyelitis optica spectrum disorders.
NMR	: Nuclear magnetic resonance.
OCB	: Oligoclonal band.
OCT	: Optical coherence tomography.
PD	: Proton density.
PPMS	: Primary progressive MS.
PSIR	: Phase-sensitive inversion recovery.
RD	: Radial diffusivity.
ROI	: Region of interest.
RRMS	: Relapsing-remitting MS.
SE	: Spin echo.
SPMS	: Secondary progressive MS.
TE	: Echo Time.
TR	: Repetition Time.
VEP	: Visual evoked potentials.
WI	: Weight image.
WM	: White matter.

LIST OF TABLES

Table No.	Title	Page No.
Table (1):	McDonald 2010 and 2017 Revised Criteria	7
Table (2):	Optimal imaging sequence suggested for each lesion type .	25
Table (3):	Patients' age data	36

LIST OF FIGURES

Figure No.	Title	Page No.
Fig.(1):	Diagram shows Gradient acquisition scheme according to a Stejskal-Tanner SE echoplanar DW MR imaging experiment.	17
Fig.(2):	Isotropic versus anisotropic diffusion	20
Fig. (3):	Typical appearance of periventricular multiple sclerosis lesions	23
Fig.(4):	Juxtacortical and cortical lesions of multiple sclerosis..	24
Fig.(5):	Infratentorial multiple sclerosis lesions.	27
Fig.(6):	Contrast enhancement of multiple sclerosis lesions	29
Fig.(7):	Maps of MD, FA, and DEC-FA	30
Fig.(8):	ROI-based FA, MD, and ADC measurement in the brain	34
Fig.(9):	Pie chart reveals the distribution of patients according to gender.....	37
Fig.(10):	Pie chart reveals the ratio of FA Affected NAWM and Unaffected NAWM patients of the study group.....	38
Fig.(11):	Pie chart shows the regional distribution of FA reduction in the affected NAWM patients	38
Fig.(12):	Pie chart reveals the ratio of MD Affected NAWM and Unaffected NAWM patients of the study group.....	39
Fig.(13):	Pie chart shows the regional distribution of increased MD in the affected NAWM patients.	40
Fig.(14):	Pie chart reveals the ratio of ADC value affected NAWM and Unaffected NAWM patients of the study group	41
Fig.(15):	Pie chart reveals the Relation of the region of maximum FA reduction to the site of the largest plaque.....	42
Fig.(16):	Pie chart shows the ratio of patients showing brain atrophic changes.....	43
Fig.(17):	Pie chart shows the ratio of cases displaying ≥ 5 definite plaques.....	44
Fig.(18):	Pie chart shows the regional distribution of FA reduction in patients who display ≥ 5 definite plaques	44

Fig.(19): Pie chart shows the Ratio of patients showing T1 black holes..	45
Fig.(20): Pie chart shows a ratio of ≥ 2 focal regions of FA reduction in patients who display T1 black holes.....	46
Fig.(21): control case	47
Fig.(22) to Fig.(23): Case 1	48-49
Fig.(24) to Fig.(25): Case 2	50-51
Fig.(26) to Fig.(26): Case 3	52-53
Fig.(27) to Fig.(28): Case 4	54-55
Fig.(29) to Fig.(30): Case 5	56-57
Fig.(31) to Fig.(32): Case 6	58-59
Fig.(33) to Fig.(34): Case 7	60-61
Fig.(35) to Fig.(36): Case 8	62-63

INTRODUCTION

Several methods have been proposed, mainly using conventional MR modalities like T1, FLAIR, or T2 images and enhanced MRI to delineate lesions. Enhanced MRI is reported as the most sensitive measure of short-term MS activity and is widely used to monitor disease evolution, either natural or modified by treatment (**Uysal . Ender, et al., 2007**).

Trials have shown that an early diagnosis can make a big difference to the efficacy of MS drug treatments. Non-conventional MR techniques are becoming increasingly important in preclinical and clinical trials as companies move forward in developing disease-modifying therapies (DMTs)(**Commowick. Olivier, et al.,2008**).

Diffusion MRI is one of the non-conventional MRI techniques used for the assessment of multiple sclerosis. During typical diffusion periods, water molecules move in the brain on average over distances bouncing, crossing, or interacting with many tissue components such as cell membranes, fibers, or macromolecules. The overall effect observed in a diffusion MRI reflects on a statistical basis as the displacement distribution of water molecules present within a voxel (**Mori and Van Zijl, 2002**).

In WM fiber tracts, organized bundles of axonal membranes and myelin sheaths present substantial barriers to diffusion, especially in directions perpendicular to that of the fibers. The architecture of the axons in parallel bundles, and their myelin sheaths, facilitate the diffusion of the water molecules preferentially along their main direction. Such preferentially oriented diffusion is called anisotropic diffusion (directionally dependant) (**Mori and Van Zijl,2002**).

The 3-D imaging of anisotropy is an extension of diffusion MRI. If a series of diffusion gradients are applied that can determine at least 3 directional vectors, it is possible to calculate, for each voxel, a tensor that describes the 3-dimensional shape of diffusion. The fiber direction is indicated by the tensor's main eigenvector. This vector can be color-coded, yielding cartography of tracts' position and direction. The brightness is weighted by the fractional anisotropy which is a scalar measure of the degree of anisotropy in a given voxel. (**Lazar et al., 2003**).

Imaging findings include the apparent diffusion coefficient (ADC) which is a measure of the magnitude of molecular motion divided by overall diffusivity, and fractional anisotropy (FA), which is the measure of the portion of the diffusion tensor that results from anisotropy (i.e, a measure of the directionality of the molecular motion of water); Mean diffusivity (MD) or trace is a scalar measure of the total diffusion within a voxel. These measures are commonly used clinically MRI (**Lazar et al., 2003**).

AIM OF WORK

To evaluate the role of DTI in the examination of the brain white matter that shows normal appearance on conventional MRI sequence in a patient with M.S, thus assessing its ability to detect early abnormalities at diffusion level.

Review of Literature

Multiple sclerosis

Multiple sclerosis (MS) is an immune-mediated, inflammatory demyelinating disease of the central nervous system (CNS) that leads to irreversible disability and currently is estimated to affect 1 million people in the United States and more than 2 million people globally (**Goldschmidt and McGinley,2021**).

In 85% of patients, MS starts with a clinically isolated syndrome (CIS), a first clinical episode of CNS demyelination. A CIS can remain a single event but can also be followed by the relapsing disease MS. Multiple sclerosis is diagnosed based on clinical or magnetic resonance imaging (MRI) evidence of dissemination in space (DIS) and time (DIT). The diagnostic criteria for MS evolved over the years to diagnose MS earlier and more easily (**Mescheriakova et al, 2018**).

The diagnosis of MS is primarily clinical and is dependent on the demonstration of neurologic signs and symptoms after white matter lesions. To distinguish MS from other conditions with similar neurologic manifestations, several criteria including McDonald criteria have been proposed. (**Huang et al, 2017**).