

# **MR diffusion weighted image in solid head and neck masses in pediatrics**

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## **List of Contents**

<b>Introduction .....</b>	<b>1</b>
<b>Aim of Work .....</b>	<b>4</b>
<b>Review of literatures.....</b>	<b>5</b>
<b>Radiological anatomy of the head and neck regions.....</b>	<b>5</b>
<b>Important Pathological Aspects of Head and Neck Solid</b>	
<b>Masses.....</b>	<b>31</b>
<b>Technique of MRI Examination in Head and Neck .....</b>	<b>70</b>
<b>Role of DWIs in Solid Head and Neck Masses.....</b>	<b>81</b>
<b>Patients and Methods.....</b>	<b>101</b>
<b>Results .....</b>	<b>106</b>
<b>Illustrative cases .....</b>	<b>119</b>
<b>Discussion.....</b>	<b>142</b>
<b>Summary .....</b>	<b>157</b>
<b>REFERENCES .....</b>	<b>161</b>
<b>الملخص العربي .....</b>	<b>-</b>

## List of figure

Figure No.	Title	Page No.
<b>Figure (1):</b>	Triangles of the neck .....	7
<b>Figure (2):</b>	Neck spaces.....	7
<b>Figure (3):</b>	Axial MRI T1WI illustrating Para-phayngeal space. ....	8
<b>Figure (4):</b>	Axial T1WI Parotid space.....	9
<b>Figure (5):</b>	Axial T1WI Pharyngeal mucosal space .....	10
<b>Figure (6):</b>	Axial T1WI Masticator space .....	11
<b>Figure (7):</b>	Visceral space.....	12
<b>Figure (8):</b>	Axial T1WI illustrating infra-hyoid spaces .....	13
<b>Figure (9):</b>	Axial T1WI illustrating carotid space .....	13
<b>Figure (10):</b>	Axial T1WI neck spaces .....	14
<b>Figure (12):</b>	Lymph nodes classification .....	15
<b>Figure (13):</b>	Axial, coronal and sagittal T1WIs orbital structures .....	20
<b>Figure (14):</b>	axial T2 showing basal turns of cochlea and osseous spiral lamina. ....	21
<b>Figure (15):</b>	Sino-nasal region.....	23
<b>Figure (16):</b>	Coronal T2WISino-nasal region.....	24
<b>Figure (17):</b>	Normal oral cavity structures and spaces (at level of the floor of mouth) .....	25
<b>Figure (18):</b>	A: coronal T1WI showing the floor of the mouth. ....	25
<b>Figure (19):</b>	Axial T1WI Submandibular space.....	27
<b>Figure (20):</b>	Axial MRI T1WI showing the normal fat-containing PPF (white arrows). ....	28
<b>Figure (21):</b>	Anatomic relationship of the foramen rotundum and vidian canal. ....	29
<b>Figure (22):</b>	Multiple reactive lymph nodes (arrows) in a 3-year-old child .....	33
<b>Figure (23):</b>	MRI of a patient with NHL showing bilateral lymphoma lesions in the neck region. ....	37
<b>Figure (24):</b>	Axial contrast-enhanced fat-saturated T1-weighted MRI of a patient with nasopharyngeal carcinoma .....	39
<b>Figure (25):</b>	a 13-year-old female with embryonal rhabdomyosarcoma in the orbit. ....	41
<b>Figure (26):</b>	Primary cervical neuroblastoma. ....	43
<b>Figure (27):</b>	Utility of magnetic resonance imaging in the evaluation of dural involvement as demonstrated by coronal fat-saturated contrast enhanced images. ....	45
<b>Figure (28):</b>	NPC. ....	47
<b>Figure (29):</b>	Retinoblastoma in an 11-month-old boy. ....	49

<b>Figure (30):</b> US longitudinal section and T2 fat suppressed coronal image showing the sack of marble sign pathognomonic for dermoid cyst .....	51
<b>Figure (31):</b> Immature teratoma .....	52
<b>Figure (32):</b> Thymic gland .....	53
<b>Figure (33):</b> Carotid body tumor. ....	55
<b>Figure (34):</b> Infantile haemangioma on the face with orbital extension. ....	57
<b>Figure (35):</b> Venous malformation adjacent to the left mandible. ....	57
<b>Figure (36):</b> Right posterior triangle Lipoma in T1WI and Fat suppression. ....	58
<b>Figure (37):</b> Neurofibroma. ....	59
<b>Figure (38):</b> Aggressive fibromatosis of the mandible. ....	61
<b>Figure (39):</b> Fibromatosis colli. ....	62
<b>Figure (40):</b> JNA in a 17-year-old male who presented with recurrent epistaxis. ....	63
<b>Figure (41):</b> Antrochoanal polyp .....	65
<b>Figure (42):</b> Pilomatrixoma. ....	66
<b>Figure (43):</b> Risk of malignancy by US. American Thyroid Association Guidelines .....	67
<b>Figure (44):</b> Contrast-enhanced axial MR image shows severe parotitis on left side .....	68
<b>Figure (45):</b> parotid gland primitive neuroectodermal tumor .....	69
<b>Figure (46):</b> Diagnostic Algorithm of Head and Neck Mass. ....	70
<b>Figure (47):</b> Ultrasonography showing enlarged rounded lymph nodes in a lymphoma patient. ....	71
<b>Figure (48):</b> bilateral Warthin tumor in parotid gland (blue arrows). ....	72
<b>Figure (49):</b> MR axial T1 and T2, T1 post contrast axial and coronal showing petrous bone rhabdomyosarcoma. ....	79
<b>Figure (50):</b> MRA (3D/TOF/SPGR) of the neck shows a mass in the carotid bifurcation that splays internal and external carotid artery. Internal jugular vein is pushed out. ....	79
<b>Figure (51):</b> MR perfusion in 16 year old male with angiofibroma. ....	81
<b>Figure (52):</b> A representation of a tumour or tissue displaying heterogeneous cellularity. ....	83
<b>Figure (53):</b> RF gradient sequence .....	84
<b>Figure (54):</b> 10 years old male patient with nasopharyngeal mass reaching the skull base with no intracranial extension. ....	86
<b>Figure (55):</b> A and B: DWI (B 1000). There is high signal in the periventricular white matter and thalami consistent with hypoxic injury. ....	88
<b>Figure (56):</b> Non-hodgkin's lymphoma. ....	91
<b>Figure (57):</b> Venous malformation. ....	92
<b>Figure (58):</b> Images of SCC in the right maxillary sinus. ....	93
<b>Figure (59):</b> Nasal scleroma in a 7-year-old girl, .....	95

<b>Figure (60):</b> Male with squamous cell carcinoma of the hypopharynx and right sided nodal metastases. ....	95
<b>Figure (61):</b> large left sided metastatic node .....	96
<b>Figure (62):</b> Metastatic left level II node.....	96
<b>Figure (63):</b> Benign inflammatory process.....	97
<b>Figure (64):</b> 6 year old boy with rhabdomyosarcoma: .....	97
<b>Figure (65):</b> Pre- and post-reatment SCC with lymph node metastasis.....	98
<b>Figure (66):</b> Left gingivobuccal squamous cell carcinoma. ....	99
<b>Figure (67):</b> Right oral tongue squamous cell carcinoma.....	99
<b>Figure (68):</b> Demographic Characteristics of the study population.....	106
<b>Figure (69):</b> Pie chart showing the anatomical distribution of the lesions .....	108
<b>Figure (70):</b> Bar graph showing the classification of the lesions regarding their nature.....	108
<b>Figure (71):</b> Graph showing the number of the cases according to the histological diagnosis .....	110
<b>Figure (72):</b> Lesion classification by cMRI versus histopathaoloigy. ....	113
<b>Figure (73):</b> Mean ADC value in benign or malignant lesions. Rounded markers represent individual observations. Squared marker represents the mean. Error bars represent the standard error of the mean (SE). ....	114
<b>Figure (74):</b> Receiver-operating characteristic (ROC) curve for discrimination between malignant and benign lesions using the ADC value. ....	115
<b>Figure (75):</b> Lesion classification by ADC value $<1 \times 10^{-3} \text{ mm}^2/\text{sec}$ versus histopathology.....	117

## List of table

Table No.	Title	Page No.
<b>Table (1):</b>	Lymph nodes classification .....	14
<b>Table (2):</b>	Causes of lymphadenitis .....	32
<b>Table (3):</b>	Ann Arbor classification .....	36
<b>Table (4):</b>	T2 shine through.....	87
<b>Table (5):</b>	Demographic Characteristics of the study population .....	106
<b>Table (6):</b>	Anatomical distribution of the lesions .....	107
<b>Table (7):</b>	Histopathological classification of the cases .....	109
<b>Table (8):</b>	Results of conventional MRI .....	111
<b>Table (9):</b>	Results of cMRI VS histopathological results.....	112
<b>Table (10):</b>	Diagnostic accuracy of cMRI .....	113
<b>Table (11):</b>	Mean ADC values of benign and malignant lesions.....	114
<b>Table (12)</b>	.....	116
<b>Table (13):</b>	Diagnostic accuracy of ADC $<1 \times 10^{-3} \text{mm}^2/\text{sec}$ derived from ROC curve analysis for the study sample.....	117

## **List of abbreviation**

<b>SMC</b>	: Sternocleidomastoid muscle
<b>LN</b>	: Lymph nodes
<b>CSF</b>	: Cerebro spinal fluid
<b>EAC</b>	: External auditory canal
<b>ICA</b>	: Internal carotid artery
<b>OMC</b>	: Osteomeatal complex
<b>PPF</b>	: Pterygopalatine fossa
<b>NHL</b>	: Non-Hodgkin lymphoma
<b>HL</b>	: Hodgkin lymphoma
<b>EBV</b>	: Epstein Barr virus
<b>RECIST</b>	: Response evaluation criteria in solid tumors
<b>IRECIST</b>	: Immune Response evaluation criteria in solid tumors
<b>US</b>	: Ultrasonography
<b>CT</b>	: Computed tomography
<b>MRI</b>	: Magnetic resonance imaging
<b>DWI</b>	: Diffusion weighted imaging
<b>ADC</b>	: Apparent diffusion coefficient
<b>RMS</b>	: Rhabdomyosarcoma
<b>PNET</b>	: Primitive neuroectodermal tumor
<b>NPC</b>	: Nasopharyngeal carcinoma
<b>CBT</b>	: Carotid body tumor
<b>JNA</b>	: Juvenile angiofibroma
<b>ITF</b>	: infratemporal fossa)
<b>SPF</b>	: sphenopalatine foramen
<b>PMF</b>	: pterygo-maxillary fissure
<b>IOF</b>	: inferior orbital fissure
<b>GA</b>	: General anesthesia
<b>FDA</b>	: Food and drug administration



<b>NSF</b>	: Nephrogenic systemic fibrosis
<b>MRA</b>	: Magnetic resonance angiography
<b>DCE</b>	: Dynamic contrast enhanced
<b>RF</b>	: radiofrequency
<b>ROI</b>	: Region of interest
<b>SCC</b>	: Squamous cell carcinoma
<b>NCI</b>	: National Cancer Institute
<b>ROC</b>	: receiver-operating characteristic
<b>CI</b>	: Confidence interval
<b>PPV</b>	: Positive predictive value
<b>(NPV)</b>	: Negative predictive value
<b>SD</b>	: Standard deviation

## Introduction

A solid head and neck mass is a common finding in pediatric age group. It can present a diagnostic challenge on clinical and radiological levels. Differentiation of benign from malignant pediatric tumors is essential for treatment planning as well as for prognosis of malignant tumors. (*Youssef et al. 2014*)

### **Pediatric Populations are subdivided as follows:**

- ✓ Newborn birth to 1 month of age
- ✓ Infant 1 month to 2 years of age
- ✓ Child 2 to 12 years of age
- ✓ Adolescent 12-21 years of age (*Nelson et al. 2015*)

Although the upper age limit used to define the pediatric population varies among experts, including adolescents up to the age of 21 is consistent with the definition found in several well-known sources. (*Rudolph et al 2011*).

The head and neck masses includes benign and malignant lesions. The most common benign masses are Hemangioma, Venous malformation, Neurofibroma, Pleomorphic adenoma, Inflammatory nodes, Tuberculous lymph node, Scleroma and Fibroma. (*Abdel Razek et al. 2009*)

The most common pediatric head and neck malignancies include non-Hodgkin lymphoma, Hodgkin lymphoma, rhabdomyosarcomas, thyroid malignancies, nasopharyngeal

carcinomas, salivary glands malignancies and neuroblastomas. (*Chadha and Forte 2009*)

The head and neck are regions that present both high anatomical and functional difficulties, making the precise diagnosis and staging of regional tumors a challenging task. (*Barbero et al. 2013*)

A variety of imaging techniques can help in characterization of pediatric head and neck masses. Ultrasound has a role in cystic lesions but cannot determine the nature of solid masses, CT is associated with radiation exposure. (*Abdel Razek et al. 2009*)

MR sequences provide very accurate information about tumor size and morphology and thanks to T2 high resolution sequences which clearly depict in most cases both location and morphological characteristics of tumors in head and neck regions. (*Barbero et al. 2013*)

Different routine pulse sequences of MR imaging cannot accurately differentiate benign from malignant tumors. Biopsy is commonly used, but it is invasive and may give false results. (*Abdel Razek et al. 2009*)

Diffusion weighted echo-planer MR imaging is a completely non-invasive technique for evaluation of the motion of microscopic water in tissues. The extent of translational

diffusion of molecules measured in the human body is referred to as the apparent diffusion coefficient (ADC). (*Youssef et al. 2014*)

The ADC is expected to vary according to the cellular density of the lesion. (*Abdel Razek et al. 2009*)

In normal tissues or in areas exhibiting vasogenic edema, the motion of water molecules is not limited and no restricted diffusion is noted. In tissues with cytotoxic edema or in highly cellular regions there is diffusion restriction and low ADC value. (*Shah et al., 2008*)

The lower ADC value of the malignant lesions is explained by difference in histopathological features of benign and malignant tumors. Malignant tumors have enlarged nuclei, hyperchromatism and angulation of nuclear contour and they show hypercellularity. These histological characteristics reduce the extracellular matrix and the diffusion space of water protons in the extracellular and intracellular dimensions with a resultant decrease in ADC. (*Youssef et al. 2014*)

In the head and neck region, DWI has demonstrated usefulness in differentiating benign and malignant solid lesions and characterization of neck lymph nodes. (*Elshahat et al. 2013*)

## **Aim of Work**

The aim of the work is to assess the clinical usefulness of the ADC calculated from DW MR images in the characterization of the head and neck masses in pediatrics.

## **Review of literatures**

### **Radiological anatomy of the head and neck regions**

**T**he neck region consists of two fascial layers; the superficial and the deep cervical fascia. The former is a thin layer of connective tissue between the dermis and the deep cervical fascia. It contains the platysma muscle, vessels, LNs and nerves. Teratoma, vascular malformations, lipoma, plexiform neurofibroma, keloid, scar and subcutaneous fat fibrosis are the most common lesions (*Meuwly et al 2005*)

The deep cervical fascia consists of four layers which share in the formation of the boundaries of the supra and infra-hyoid deep neck spaces (*Hoppe et al 2014*)

The first one is the investing fascia which completely surrounds the neck then splits enclosing both the sternocleidomastoid and trapezius muscles. Then the pretracheal fascia encloses the contents of the visceral space. Then the paravertebral fascia encloses the paraspinal together with the prevertebral muscles to form the pre-vertebral space (*Morton et al 2011*)

The latter is divided into alar fascia anteriorly and true pre-vertebral fascia posteriorly. Eventually the carotid sheath

surrounds the carotid arteries, the internal jugular vein and the vagus nerve (Alnoury and Lotfy 2010)The neck region is divided into two major triangles to facilitate the understanding of its regional anatomy: (fig1-1)

### **Anterior Triangle:**

- The anterior triangle of the neck is bordered by the sternocleomastoid muscles (SCMs) and the mandible.
- The anterior triangle is divided into the suprahyoid and infrahyoid regions by the hyoid bone
- The suprahyoid region is divided into the submandibular and submental triangles by the mylohyoid muscle.
- The infrahyoid region is divided into the carotid and muscular triangles by the superior belly of the omohyoid muscle.
- The carotid triangle contains the carotid sheath (*Rayahi et al 2015*)

### **Posterior triangle:**

- The posterior triangle is bordered by the SCMs, trapezius and clavicle.
- The inferior belly of the omohyoid muscle divides the posterior triangle into the superior and inferior regions.