CT and MRI Correlation of Salivary Gland Pathology

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Abstract:
Back ground:
Neoplasm of the major salivary glands constitute less than 3% of all tumors in the body, many people have an illness related to the salivary glands at some time in their lives, differentiating benign from malignant conditions of salivary glands is vital in management of salivary gland pathologies by clinicians, Cross sectional Imaging modalities such as CT scan or MRI are regularly used for the diagnosis of pathologies involving salivary glands, particularly neoplastic lesions, to evaluate the efficacy of the CT scan and the MRI in identifying and differentiating malignant neoplasm from benign lesions, the aim of this study was correlate CT AND MRI findings in different neoplastic lesions involving salivary glands and evaluate efficacy of CT and MRI in differentiating benign neoplastic lesions from malignant lesions.
Materials and Methods:
In this prospective study, a total of 50 patients who were referred to department of radio diagnosis from department of ENT and general surgery with swelling and/or tenderness in the neck and parotid region were included in the study.
Patients presenting to radiology department having neck swellings not confined to salivary gland regions were excluded from the study along with patients with patients with pace makers, metal implants in their bodies, foreign bodies in their eyes and those having claustrophobia.
Lesions were categorized based on margins and concomitant lymphadenopathy and presence of extensions in surrounding tissue on CT and intensity of lesions on T2 weighted imaging was considered as an additional criterion to decide nature of lesion on MRI in addition to irregular margin , lymphadenopathy.
Results:
Out of 50 patients in this study, 70 % were male and 30 % were female. Youngest patient was 14 day-old and oldest patient was 77-year-old, majority of the patients were adults with highest number of them in the age group of 31-40 years (20 %), among our patients 46 patients (92%) showed benign lesions and 4 patients (8%) showed malignant lesions, pleomorphic adenoma was the most common neoplasm (42 %, 21 patients) identified followed by warthin tumour (14%, 7 patients) and
Conclusion:
CT and MRI are very helpful in identification and characterization of various pathologies involving salivary glands, however MRI examination is more sensitive in differentiating malignant lesions from benign conditions.
Key words: salivary gland neoplasms, MRI,

I. Introduction

Neoplasm of the major salivary glands constitute less than 3% of all tumors in the body,[1] many people have an illness related to the salivary glands at some time in their lives. The process may be self-Limited, such as with viral parotitis or mumps, but in others it may be a relapsing and remitting illness, such as chronic sialoadenitis secondary to Sialolithiasis. Still others may be evaluated for what is thought to be a salivary gland mass but is actually a mass peripheral to the glands, such as a lymph node. Very rarely, a nonnodal extra glandular lesion such as a schwannoma, masseteric hypertrophy, or other pseudo mass may be mistaken for a glandular process, even by experienced otorhinolaryngologists. Hence imaging plays a major role in evaluation of neck swellings in general and salivary gland pathologies in particular, cross sectional imaging examinations are regularly performed and it is important to differentiate benign conditions from malignancy. The aim of theof this study was to correlate CT and MRI findings in salivary gland pathologies and evaluate their efficacy in in differentiating benign neoplastic lesions from malignant lesions.

II. Materials and Methods

The present study was conducted at shri MP shah medical college during a period from September 2017 to September 2019 with written approval of ethical Committee and standard procedures.

Study Population:
Patients of various age groups referred todepartment of radio diagnosis from department of the ENT and department of General surgery with complaints swelling and or tenderness in neck and parotid region are included in the study

Sample Size:
A total of 50 patients having swelling and/or tenderness were included.

Inclusion criteria:
1. All the symptomatic Patients referred to radiology department for MRI scan of salivary gland pathology.
2. Already diagnosed cases of specific salivary gland lesion which need further radiological investigation for better tissue characterization and extension.
3. Only those patients fulfilling above mentioned inclusion criteria and willing to Participate in study.

Exclusion criteria:
1. Patients presenting to radiology department having neck swellings not confined to salivary gland regions.
2. Patients with pace makers, metal implants in their bodies, foreign bodies in their eyes and those having claustrophobia.

Methods of collecting data:
A. Clinical: all the patientswere subjected to detailed clinical history and examination as outlined in proforma.
B. Investigation: Routine blood investigation was documented in needy patients: Complete hemogram, which includes Hb, total and differential count, erythrocyte sedimentation rate.
C. Radiological investigation:

Magnetic Resonance lmaging technique
• MRI of the neck was done in a dedicated neck coil sufficient in size to cover the patient from the level of base of skull to T1 vertebral body.
•In order to obtain high-quality images, the patient were instructed not to talk or move and if possible, to minimize swallowing. If possible, the patient should not fall asleep, as snoring often degrades image quality.
•For the routine MR examination, sagittal T1-weighted, spin-echo localizer images were obtained. Axial T1-weighted and fast spin-echo, T2-weighted images are then obtained through the field of interest. A coronal and axial STIR sequence also provides an additional orthogonal view.
•Sections 4 or 5 mm thick, with a 1-mm interstice gap, are mandatory to prevent volume averaging. Proper acquisition parameters are also essential for optimal imaging of the pharynx.
• An 200 to 240-mm F CV with smaller matrix (256 x 256) without a phase wrap artifact as this will help increase the signal-to-noise ratio of this smaller region. Pre-saturation pulses are also helpful to reduce the often troublesome phase-encoding flow artifact.

Patient position:
Patient in a supine position within head and neck coil. Head is immobilize with cushion. Centre the laser beam one inch below the chin,

Planning of sequences:
Localizer is taken in all three planes**.**
Coronal reference line:
Plan the coronal slices on sagittal plan. Position the block parallel to cervical spine. In the axial plane place, the position block parallel to sternoclavicular joint. FOV extending from frontal sinus to clavicle.
Sagittal reference line:
Plan the coronal slices on sagittal plan. Position the block parallel to cervical spine. In the axial plane place, the position block parallel to midline of neck. FOV extending from frontal sinus to clavicle.
Axial reference line:
Planning the axial slices done on sagittal plane. Position the slice block perpendicular to cervical spine in sagittal and coronal plane. FOV extending from frontal sinus to clavicle.

Statistical Methods:
Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean 1: SD (Min-Max) and results on categorical measurements are presented in Number (%),

Diagnostic statistics viz. Sensitivity, Specificity, PPV, NPV and Accuracy have been computed to find the correlation of MRI with pathological findings.

COMPUTED TOMOGRAPHY IMAGING TECHNIQUE
- A CT scan machine uses special X ray machine to take detailed picture of organs and tissues inside the body.
- CT scans of the neck provide more details on neck injuries, tumors and other diseases than other types of X Ray.
- CT can also bone, soft tissues and blood vessels in the same picture.

EQUIPMENT:
Dual source 16 slice computed tomography scanner (BRIGHT SPEED, GL HEALTH CARE, UK)
Position – Supine, neck entered in gantry, gantry straight up. Scanning parameters:
Helical, thin overlapping slices 0.625 mm thick, 200 mA, 120 Kv"Boneplus" and "standard" algorithm.

III. Results
TABLE-1
AGEINCIDENCE

SRno	AGE	No.ofcases	Percentage(%)
1.	0-10	3	6
2.	11-20	4	8
3.	21-30	8	16
4.	31-40	11	23
5.	41-50	9	18
.6.	51-60	11	21
7.	61-70	3	6
8.	71-80	1	2
	TOTAL	50	100

Inourstudy,theincidenceof salivaryglandpathologywashighestincasesof agerangeof31-40yearsand51-60years.

TABLE-2
Noofbenignandmalignantcasesaccordingto agegroup

AGE	No.ofbenigncases	Percentage(%)	No.ofmalignantcases	Percentage(%)
0-10	3	6.5		
11-20	4	8.6		
21-30	8	17.39		
31-40	10	21.73	1	25
41-50	9	19.56		
51-60	8	17.39	3	75
61-70	3	6.5		
71-80	1	2.17		
TOTAL	46	100	4	100

Inourstudy,majorityofbenignlesionwasfoundin31-40yearsofageandmajorityofmalignantcasesfoundin51-60yearsofagegroup.

TABLE-3
SEX INCIDENCE

SEX	No. ofcases	Percentage(%)
MALE	35	70
FEMALE	15	30
TOTAL	50	100

Thegenderdistributioninourstudyshowsmalepredominance.35 males(70%)and15females (30%)wereaffectedandmalefemaleratiowas1.5:1.

TABLE-4

DISTRIBUTIONOFLESIONSINSALIVARYGLAND

LOCATION	No. ofcases	Percentage(%)
PAROTID	34	68
SUBMANDIBULAR	15	30
SUBLINGUAL	1	2
TOTAL	50	100

Inour study,majorityof lesionsarefound in parotidgland (78%), next commoninvolvementis of submandibular gland(30%)andthe leastinvolvement wasofsublingual gland(2%).

TABLE-5

DISTRIBUTIONOFINTRAPAROTIDLESIONSINSUPERFICIALANDDEEPLOBES

Lobe	No. ofcases	Percentage(%)
SUPERFICIAL	19	55.88
DEEP	3	8.8
BOTH	12	35.29
TOTAL	34	100

Abovetableshowsmajorityoflesionsinparotidglandinvolvessuperficiallobewith55.88%.

TABLE-6

FREQUENCYOFSALIVARYGLANDLESIONSBYMRI

SRNO	MRIDiagnosis	No.ofcases	Percentage(%)
1.	PLEOMOROHICADENOMA	21	42
2.	WARTHINTUMOR	7	14
3.	LIPOMA	1	2
4.	SIALOADENITIS	8	16
5.	RANULA	1	2
6	SJOGREN	1	2
7.	PAROTITIS	3	6
8	ABSCESS	2	4
.9	LYMPHOMA	2	4
11.	MALIGNANTMASS	2	4
12	BENIGNLESION	2	4
	TOTAL	50	100

Inour study,majorityof patientshavingthe benign solidlesions pleomorphicadenoma (42%), the next commonlesionwassialoadenitis consisted(16%)ofcases andthirdcommon lesionwasWarthintumor (14%).
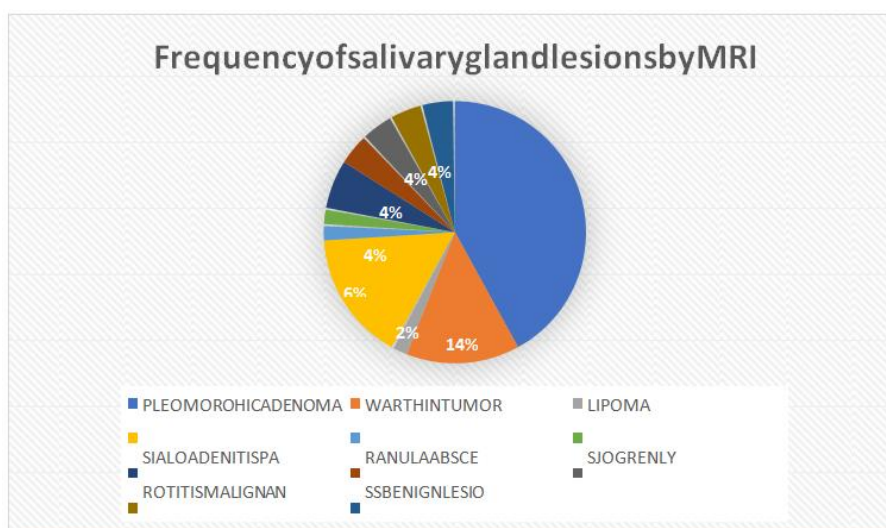
TABLE-7

FREQUENCYOFSALIVARYGLANDLESIONSBY CTscan.

SRNO	MRIDiagnosis	No.ofcases	Percentage(%)
1.	PLEOMOROHICADENOMA	21	42
2.	WARTHINTUMOR	7	14
3.	LIPOMA	1	2
4.	SIALOADENITIS	8	16
5.	RANULA	1	2
6	SJOGREN	1	2
7.	PAROTITIS	3	6
8	ABSCESS	2	4
.9	LYMPHOMA	2	4
11.	MALIGNANTMASS	2	4
12	BENIGNLESION	2	4
	TOTAL	50	100

Inour study,majorityof patientshavingthe benign solidlesions pleomorphicadenoma (42%), the next commonlesionwassialoadenitis consisted(16%)ofcases andthirdcommon lesionwasWarthintumor (14%).
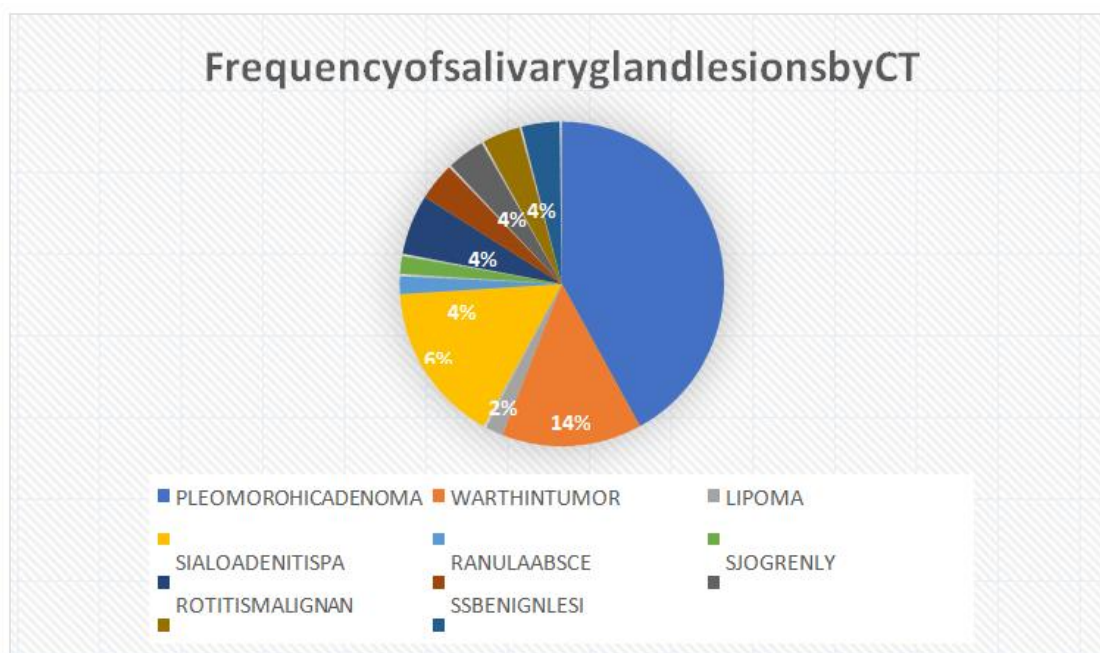

TABLE-8

FREQUENCYOFSALIVARYGLANDLESIONSBYPATHOLOGICALEXAMINATION

SRNO	MRIDiagnosis	No.ofcases	Percentage(%)
1.	PLEOMOROHICADENOMA	18	36
2.	WARTHINTUMOR	8	16
3.	LIPOMA	1	2
4.	SIALOADENITIS	8	16
5.	RANULA	1	2
6	SJOGREN	1	2
7.	PAROTITIS	3	6
8	ABSCESS	2	4
.9	LYMPHOMA	2	4
11.	MALIGNANTMASS	2	4
12	BENIGNLESION	2	4
	TOTAL	50	100

Inour study,majorityof patientshavingthe benign solidlesions pleomorphicadenoma (36%), the next commonlesionwassialoadenitis consisted(16%)ofcases andWarthintumor (16%).
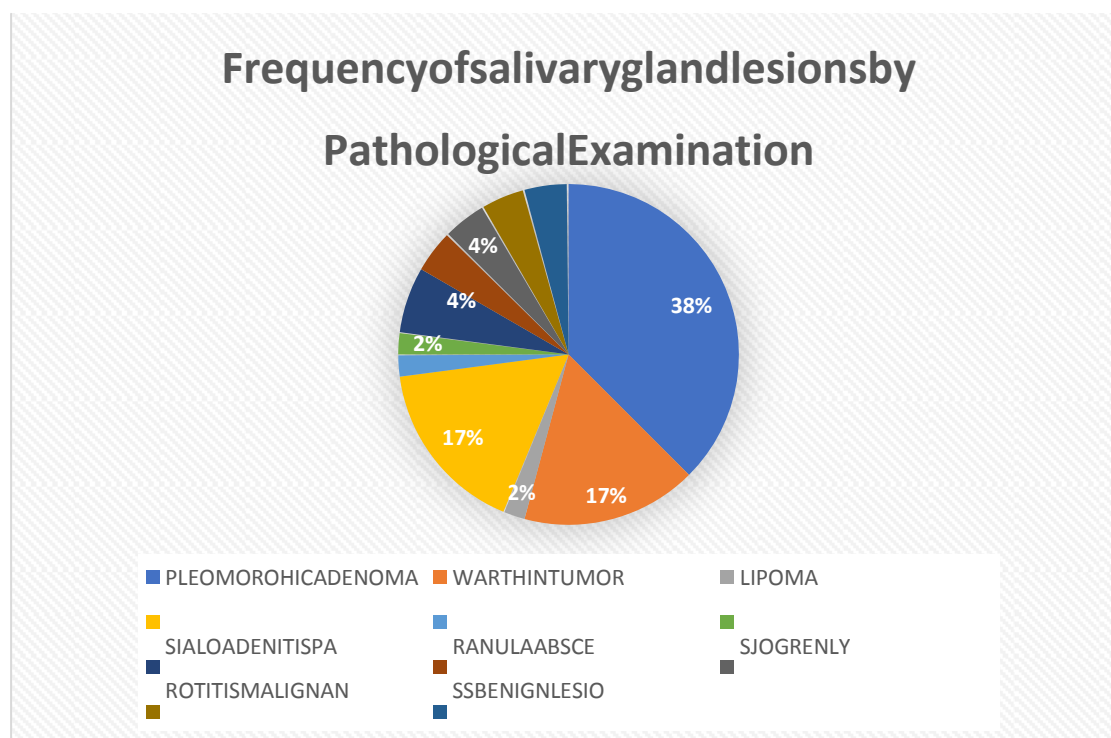

Frequencyofsalivaryglandlesionsby PathologicalExamination

Legend:
- PLEOMOROHICADENOMA
- WARTHINTUMOR
- LIPOMA
- SIALOADENITISPA
- RANULAABSCE
- SJOGRENLY
- ROTITISMALIGNAN
- SSBENIGNLESIO

TABLE-9
NUMBEROFBENIGNANDMALIGNANTLESIONSINSALIVARYGLANDSACCORDINGTOMRIFINDINGS

Lesion	No. ofcases	Percentage(%)
BENIGN	46	92
MALIGNANT	4	8
TOTAL	50	100

Inourstudymajorityoflesionswerebenign92%of allcases.

TABLE-10
DISTRIBUTIONOFLESIONSAMONGSALIVARYGLANDS

SRNO	MRIdiagnosis	Parotidgland	Submandibularglands	Sublingualgland
1.	PLEOMORPHICADENOMA	16	1	1
2.	SIALOADENITIS		8	
3.	WARTHIN	8		
4.	ABSCESS		2	
5.	LYMPHOMA	1	1	
6.	LIPOMA	1		
7.	RANULA		1	
8.	PAROTITIS	3		
9.	SJOGREN	1		
10.	MALIGNANTLESION	1	1	
11.	ADENOMA	1	1	
12.	BENIGNLESION	2	0	
	TOTAL	34	15	1

Abovetableshowsmajorityofsalivaryglandlesionswerefoundinparotidgland(34cases)andsecondcommonestinvolvementisofsubmandibulargland(15cases)andleastinvolvementofsublingualgland (1case).

TABLE-11
DISTRIBUTIONOFBENIGNANDMALIGNANTLESIONSAMONGSALIVARYGLAND

Lesion	Parotidgland	Submandibulargland	Sublingualgland
BENIGN	32	13	1
MALIGNANT	2	2	
TOTAL	34	15	1

Abovetableshowsmajorityofbenignandmalignantlesionswerefoundinparotidgland.

TABLE-12
DISTRIBUTIONOFSIALOADENITISAMONGSALIVARYGLANDS

Salivaryglands	No. ofcases	Percentage(%)
PAROTID	-	-
SUBMANDIBULAR	8	100
SUBLINGUAL	-	-
TOTAL	8	100

Abovetableshowsmajorityinflammatorylesionsinvolvesubmandibulargland.

TABLE-13
DISTRIBUTIONOFPLEOMORPHICADENOMAAMONGSALIVARYGLANDS

Salivaryglands	No. ofcases	Percentage(%)
PAROTID	16	88.88
SUBMANDIBULAR	1	5.5
SUBLINGUAL	1	5.5
TOTAL	18	100

Abovetableshowsmajorityofpleomorphicadenomainvolvesparotidgland(88.88%)

TABLE-14
DISTRIBUTIONOFMALIGNANTMASSAMONGSALIVARYGLANDS

Salivaryglands	No. ofcases	Percentage(%)
PAROTID	2	50
SUBMANDIBULAR	2	50
SUBLINGUAL	-	-
TOTAL	4	100

Abovetableshowsmajorityofmalignantmasslesionsinvolvesparotid(50%)andsubmandibulargland(50%).

TABLE-15
DISTRIBUTIONOFLESIONSAMONGSALIVARYGLANDSACCORDINGTOMARGINS

Margins	Malignant	Percentage	Benign	Percentage
IRREGULAR	1	25	-	-
REGULAR	2	50	45	97.82
ILLDEFINED	1	25	1	2.17
TOTAL	4	100	46	100

Abovetableshowsmajorityofregularlymarginatedlesionsarebenign(97.82%)and(50%)malignantlesionshaveregular margin.

TABLE-16
DISTRIBUTIONOFLESIONSAMONGSALIVARYGLANDSACCORDINGTOLYMPHADENOPATHY

Lesions				
Withlymphadenopathy	Malignant	Percentage	Benign	Percentage
	3	75	30	65.21
Withoutlymphadenopathy			16	34.78
	1	25		

Abovetableshowsmajorityofmalignantlesionsareassociatedwithlymphadenopathy. (75%)

TABLE-17
EVALUATIONOFINTENSITYOFLESIONINT2W1

T2INTENSITY	No. ofcases	Percentage(%)
HYPOINTENSE	5	10
HYPERINTENSE	45	90
TOTAL	50	100

Inourstudymajority oflesionsappear hyperintense(90%)onT2WI.

TABLE-18
CHARACTERISTICOFLESIONONT2WI

SRNO	MRIDiagnosis	HYPOINTENSE	HYPERINTENSE
1.	PLEOMOROHICADENOMA		21
2.	WARTHINTUMOR	4	3
3.	LIPOMA	1	
4.	SIALOADENITIS		8
5.	RANULA		1
6	SJOGREN		1
7.	PAROTITIS		3
8	ABSCESS		2
.9	LYMPHOMA		2
11.	MALIGNANTMASS		2
12	BENIGNLESION		2
	TOTAL	5	45

AbovefindingsshowsthatmajorityofbenignandmalignantlesionsarehyperintenseonT2WI.

TABLE-19
EVALUATIONOFINTENSITYOFLESIONINT2W1

T2INTENSITY	Pathologicalmalignant Pathologicalbenign		Total
HYPOINTENSE		5	5
HYPERINTENSE	4	41	45
TOTAL			50

Inourstudymostofthebenign (41cases)andmalignant(4cases) lesionsarehyperintenseonT2WIand5cases are hypo intense onT2WI.

1. Comparison fortheage distributionforthesalivaryglandlesions.
Inour study50patients rangingfrom 0to 80years,inityoungestpatient is14daysoldand oldestis
77yearsoldwithmaximumpatients arefoundbetween31to 40yearsandbetween51to 60years. Majority
ofbenignlesionwasfoundin31-40years of ageandmajority of malignant casesfoundin51-60 yearsof agegroup.
Thesefindingsare compatiblewithstudydoneinKarnatakainstituteofmedicalscience,Hubali,Karnatakaby
Dr.salapathi.[2]
Whichshowsbenignlesions occurredbetweenageof 20-60yearsandmajorityofmalignant lesionoccurred>40 years
patient.
Forallagegroupbenigntumors aremorecommon thanmalignanttumors.

| SRno	AGE	No.ofcases	Percentage (%)	No.ofcases-dr.salapa thistudy	Percentage (%)
1.	0-10	3	6	0	0
2.	11-20	4	8	9	9.3
3.	21-30	8	16	20	20.8
4.	31-40	11	22	15	15.6
5.	41-50	9	18	18	18.7
.6.	51-60	11	22	16	16.6
7.	61-70	3	6	18	18.8
8.	71-80	1	2	0	0
	TOTAL	50	100	96	100

2. Comparison of benign and malignantlesions of salivaryglands:

Inour study group 46 patients are foundwithbenignlesions and4are found tohavemalignant lesions.Of thebenignentities, therewere18(36%)pleomorphicadenomas,8(16 %) warthintumor, 8(16%)sialoadenitis, 2(4%)abscess,4(8 %)malignantmass.These findings arecompatible withastudy of84patients donebyA. Christeetal[3].

| SRNO	MRIDiagnosis	OURSTUDY	Percentage(%)	CHRISTE	Percentage(%)
1.	PLEOMOROHICADENOMA	18	36	29	34
2.	WARTHINTUMOR	8	16	17	20
3.	SIALOADENITIS	8	16	3	4
8	ABSCESS	2	4	0	0
11.	MALIGNANTMASS	4	8	9	10.71
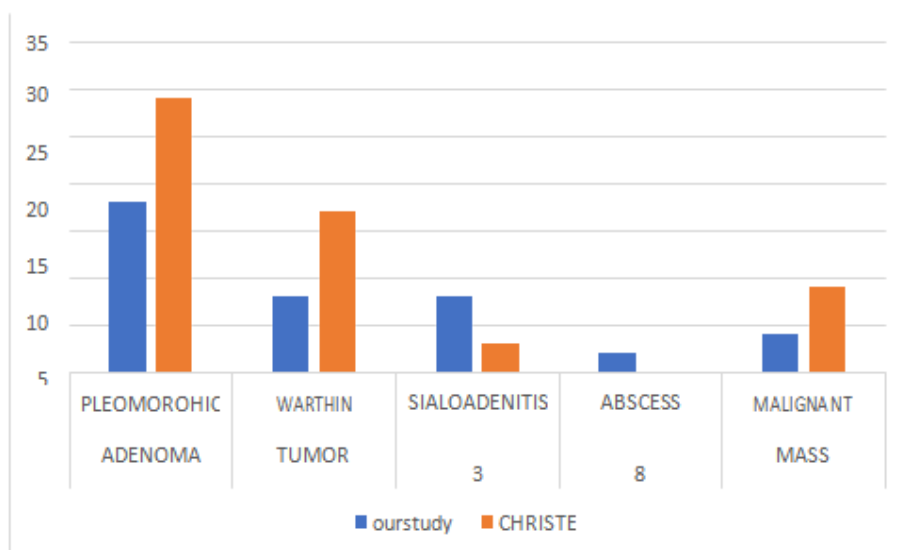
3. Evaluation andcomparison ofT2signal intensityasa predictorofbenignand malignantlesionstudy.

T2INTENSITY	Pathologicalmalignant		Pathologicalbenign	
	Ourstudy	Zohreh	Ourstudy	Zohreh
HYPOINTENSE	-	24	5	5
HYPERINTENSE	4	3	41	51
TOTAL	4	27	45	56

	OurStudy	Zohreh	OurStudy	Zohreh
Hyper intense	4	3	41	51
Hypo intense	0	24	5	5

Hypo intense   Hyper intense

PathologicalmalignaNT   PathologicalBenign
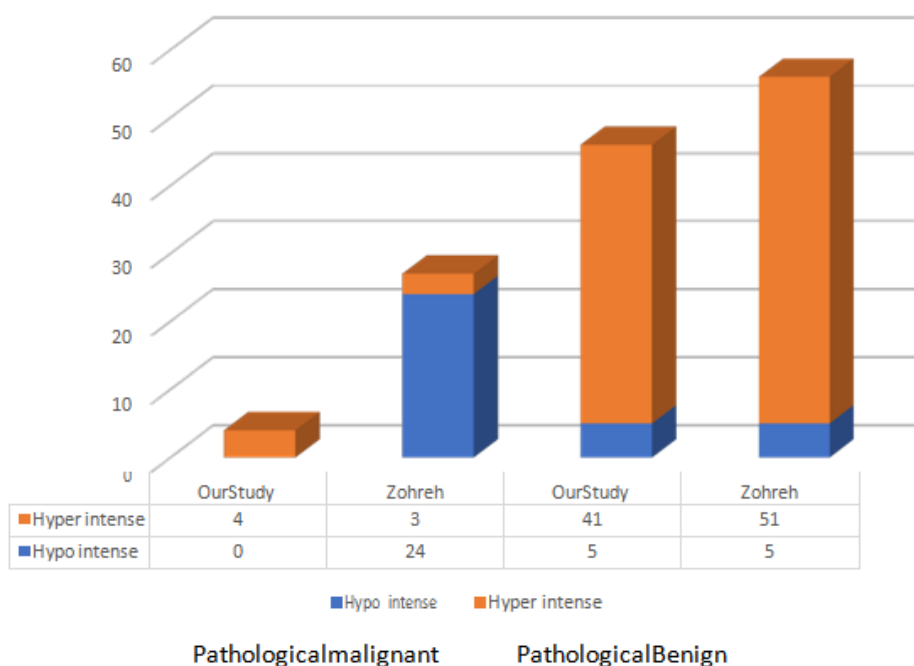
4   Evaluation andcomparison ofirregularmarginas apredictorofbenign and malignantlesionstudy.

Margins	Malignant		Benign	
	Ourstudy	Amin	Ourstudy	Amin
IRREGULAR	1 25%	16 83%	-	12 17%
REGULAR	2 50%	11 10%	45 97.82%	45 90%
ILLDEFINED	1 25%	0	1 2.1%	0
TOTAL	4	27	46	57
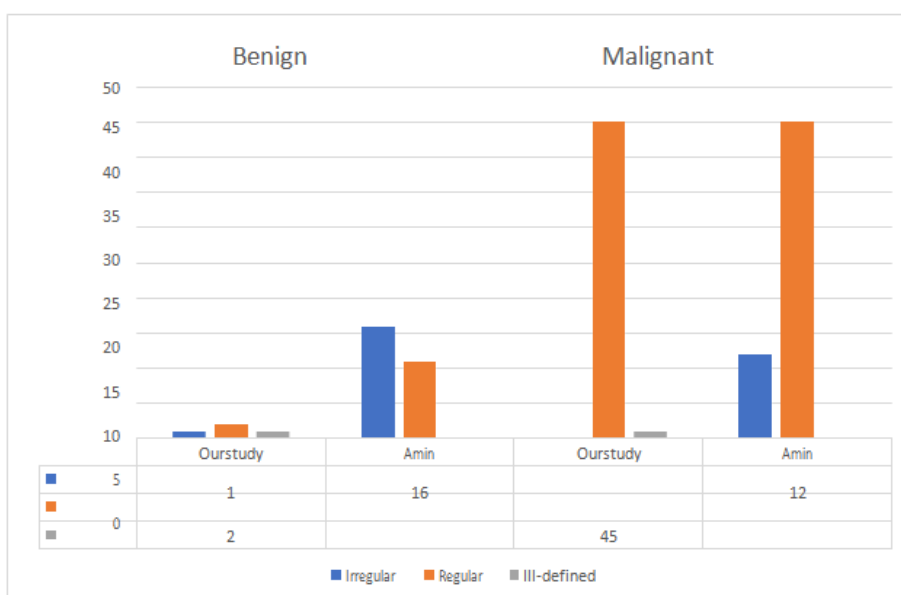
5.Evaluationandcomparison oflymph nodes as a predictor ofbenignandmalignant lesionstudy.

Lesions	Malignant		Benign	
	Ourstudy	Eberhardstennert	Ourstudy	Eberhardstennert
Withlymphadenopathy	3 75%	22 83%	30 65.21%	4 9%
Without lymphadenopathy	1 25%	5 17%	16 34.78%	55 91%
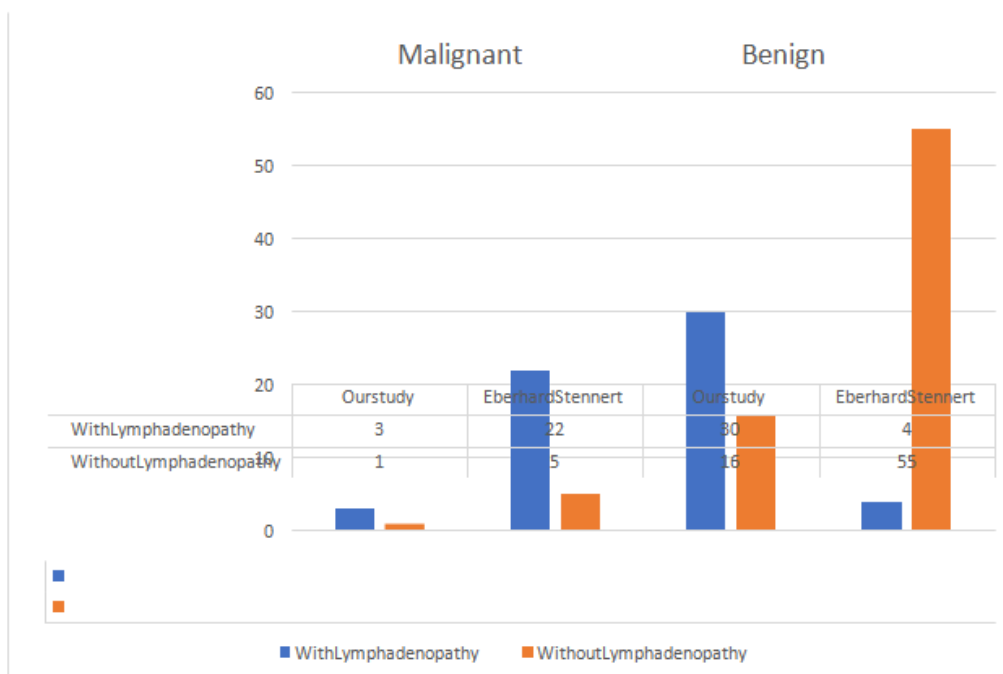
IV. Discussion

The present study is conducted over 2 years (2017-2019) of 50 patients in department of radio diagnosis, Guru Gobind Singh hospital, Jamnagar.

Majority of patients are from the age group of 30-40 and 50-60 years and their percentages are 44 %.

Further classification of age distribution is based on major pathologies was done. There are total 46 benign lesions and 4 malignant lesions. Benign lesions of salivary glands are noted to be more common in the age group 30-40 years making 10 out of 11 benign lesions. Most of the malignant lesions are noted in more 50-60 years' age group.

Structural distribution of lesions demonstrates majority of lesions in parotid gland are benign accounting 32 lesions out of 34 lesions and 2 lesions are malignant. Similarly, majority of submandibular lesions are benign accounting 13 lesions out of 15 lesions and 2 lesions are malignant. However, the percentage of malignancy is higher in submandibular gland as compared to parotid gland suggestive of smaller the gland higher the chance of lesion being malignant.

The present study shows majority of lesions are unilateral, which are 44 out of 50 cases and 6 are bilateral. The most benign and malignant cases are unilateral.

The study shows male predominance both for benign and malignant lesions.

Most benign and malignant salivary gland lesions can be discriminated by their appearance on MR imaging using a standard neck protocol 4.

Most of the benign lesion found is pleomorphic adenoma and majority of them shows classic T2 bright signals. Similarly, the other benign lesions like warthin tumor, cyst and venous malformation also shows T2 bright signals.

The specific signs predictive of malignancy on MRI are:

- **AlowsignalintensityonT2WI.**

LowSIonT2-weighted imagesisauseful indicator for malignancywithSensitivity-100% Specificity-97.3%PPV-92.8%

NPV-100%and

- **Presenceofill-definedmargin**.
Thepresence of ill-defined marginsinMRimaging isauseful indicatorformalignancywith
Sensitivity-84.62%Specificity-94.59%PPV-84.62%
NPV-100%

- **Presenceofextensionsinsurroundingtissue.**
ThepresenceofextensionsinMRimagingisausefulindicatorfor malignancywithSensitivity-76.92%
Specificity-91.89%PPV-96.92%
NPV-91.89%and

- **Lymphadenopathy**
The presenceoflymphadenopathyinMRimaging isausefulindicatorformalignancy with
Sensitivity-92.31%Specificity-78.38%PPV-60.00%
NPV-96.67%

V. Conclusion

Salivary gland pathologies are very common in clinical practice and constitute a significant portion of patients with swelling and tenderness in cervical region, CT and MRI are vital in identification and characterization of various pathologies involving salivary glands,

CT scan is important identifying the presence of benign or malignant lesions and their extent and relation with surrounding structures, and however MRI examination is able identifying for smaller lesions and more equipped to delineate the nature of the lesions because of its ability to differentiate different types of soft tissues in this study based on presence of irregular margins, extension into surrounding tissue, concomitant lymphadenopathy and hyperintensity on T2WI.

This study shows MRI examination although expensive is more sensitive in differentiating malignant lesions from benign conditions, this study recommends using MRI in evaluating salivary lesions.

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