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Research Article

CLINICAL EVALUATION AND ULTRASONOGRAPHIC CHARACTERIZATION OF CERVICOFACIAL LYMPH NODES

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ABSTRACT

Patient presenting with lymphadenopathy is a common clinical scenario in a dental practice. Greyscale ultrasonography has diverse applications in the field of medicine since 1972. Ultrasonography has gained wide acceptance as a diagnostic aid in the evaluation of cervicofacial lymphadenopathy in various conditions. Cervicofacial lymphadenopathy of the neck is commonly noticed following tooth related infections, oral ulcers and generalized infections. Only presence of a lymphadenopathy can be evaluated clinically. But its contributing reason cannot be always ascertained. Ultrasonography is an imaging method which is safe, painless, does not involve radiation, and is economical. Aim: The present study was devised with an aim of comparing the clinical and ultrasonographic features of cervicofacial lymphadenopathy. Materials and Methods: The subjects for the study were selected from the patients who visited the outpatient section of Oral Medicine and Radiology department with clinically palpable lymph nodes. Seventy patients were included in the study and they were divided into 3 groups; group I (subjects with odontogenic infections), group II (subjects with non odontogenic oral conditions) and group III (subjects with head and neck carcinomas). A detailed case history was recorded and a thorough clinical examination was carried out for all subjects. The cervicofacial lymph nodes were palpated and examined. Ultrasonographic examination of cervicofacial lymph nodes was carried out and recorded. The ultrasonographic features such as number, size, shape, short axis/long axis ratio, border sharpness, hilum, echogenicity, distribution of the internal echoes & intranodal necrosis. The results were tabulated and statistical analysis was done. The statistical analysis was done using chi square test. Result and Conclusion: Most of the subjects considered for the study showed cervicofacial lymphadenopathy associated with odontogenic causes, non-odontogenic causes and head and neck malignancies. The lymph nodes showed varied clinical features. The results obtained for each parameter in the study were highly significant with a p value of <0.000. This study proves that a significant difference is present in the ultrasonographic features between the benign (odontogenic & non-odontogenic) and malignant lymph nodes.

Key words:- Lymph nodes, Ultrasound, Cervicofacial lymph nodes, Odontogenic, Non-odontogenic, Head and neck malignancy.

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INTRODUCTION

Orofacial region is a common anatomic site for the development of lymphadenopathy [1]. Characterizing the lymphadenopathy prior to definitive diagnosis has advantages, which includes segregation of malignant and benign lesions associated with the lymphadenopathy in

whom surgical intervention can be planned accordingly [2].

Although CT and MRI are indispensable tools for diagnosis, are expensive and not universally available [3]. CT exposes the subject to large doses of radiation especially, if repeated follow-up examinations are to be performed. Artifact produced by bone and metal degrade images around the face and have poor contrast between the various soft tissues.

USG reigns as a relatively inexpensive, easily reproducible, non-invasive diagnostic tool that could be repeated several times without any untoward effects and is immune to metal artifacts such as dental restorations [4]. Diagnostic ultrasound employs a transducer (probe) which generates a narrow focus beam. High frequency electrical pulses cause mechanical oscillation of piezoelectric crystals producing ultrasound which is a longitudinal mechanical wave form. This beam is reflected from the tissue, and sent back to the same transducer, which converts the echoes to an image that can be visualized and recorded [5].

Ultrasonography has been widely used in the medical field since 1972 as a diagnostic and therapeutic tool [6]. It could be valuable for the characterization of various swellings such as inflammatory swellings due to dental or skin infections, diseases of salivary glands, lymph node reactions, cysts, tumors etc. in soft tissues of neck and cranio-facial region.

Despite the major role played by ultrasonography as a diagnostic and therapeutic tool in diverse fields of medicine, most of the dentists are oblivious of its utility. High resolution real time ultrasonography enhances the possibility for distinction between benign and malignant lymphadenopathy [7]. Ultrasonography is increasingly being recognized as a noninvasive tool for evaluation of cervical lymph nodes. The sonographic appearance of normal nodes differs from those of abnormal nodes. Sonographic features, which help to identify abnormal nodes are shape, absent hilus, intranodal necrosis, calcification, matting, peripheral hallow and a prominent vascularity. A normal node should be discoid with a hilus, sharp margins, absence of matting, calcification, necrosis or soft tissue edema [8].

Differentiation between tubercular, metastatic and lymphomatous cervical lymph nodes is extremely important from the therapeutic view point. It is also important to make the correct diagnosis at the earliest, because a delayed diagnosis leads to upstaging of malignancy making a curable lesion incurable [9].

MATERIALS AND METHOD

A Cross-sectional study was conducted at the Department of Oral Medicine and Radiology, Meenakshi Ammal Dental College and Hospital, Chennai. The Study population consisted of 70 Subjects above the age of 18 years. Individuals were clinically evaluated and only if diagnosed to be a case of cervical lymphadenopathy, they were subjected to ultrasound analysis. The study was approved by the Ethics Research Committee. The patients were divided into 3 groups.

GROUP 1	GROUP 2	GROUP 3
Subjects with odontogenic	Subjects with non-odontogenic	Subjects with Head and neck
infections - 25 subjects.	oral conditions – 25 subjects.	carcinoma – 20 subjects.

Imaging Unit used for the study was The LOGIQ* P6 ultrasound system by GE Healthcare

Inclusion criteria

- Patients within the age range of 18 – 60 years of age.
- Patients with clinical signs, symptoms or history of cervical lymphadenopathy associated with odontogenic infections, non-odontogenic lesions and head and neck malignancy.

Exclusion Criteria

- Patients who have already been treated for odontogenic infections, non-odontogenic lesions and malignancy.
- Patient who failed to give consent for the study

METHOD

Ethical Committee clearance was obtained from Institutional Review Board of Mennakshi Ammal Dental College. All subjects were evaluated with a formulated case history format. This consisted of all parameters to be evaluated clinically and also contained the ultrasonographic parameters to be recorded related to lymph nodes. 70 patients fulfilling the above criteria were informed about the study being conducted and their consent was obtained.

All subjects were examined and oriented with a pillow under the shoulder to keep the neck in an extended position. The lymph nodes were scanned with the LOGIQ P6 ultrasound system (GE Healthcare).

RESULTS

In this study of clinical evaluation and ultrasonographic characterization of cervical lymph nodes, the grey scale sonographic features considered for analysis of cervical lymphadenopathy were as follows:

1. Number of nodes
2. Size of the lymph nodes: assessed by measuring maximal transverse diameter;
3. Shape of the lymph nodes: classified as round and

4. oval
5. Border sharpness: classified as sharp and un-sharp
6. Echogenic hilum; classified as present and absent
7. Internal echogenicity: classified as hypo- or hyperechoic;
8. Internal distribution of echoes: classified as homogenous or heterogenous
9. Nodal necrosis was assessed and recorded whether present or absent.

NUMBER OF NODES:

In our study, clinically 88, 88 and 103 lymph nodes were palpable in the odontogenic, non-odontogenic and malignancy groups respectively. Ultrasonography revealed presence of 435, 589 and 505 nodes respectively. (Table 1 & Graph 1). Mean and standard deviation was calculated for the number of nodes detected in the study. (Table 2).

SIZE OF THE NODES:

Out of the 435 nodes evaluated ultra sonographically in the odontogenic group the largest node had a size of 0.69 cm^2 and smallest measured 0.17 cm^2. In the case of non-odontogenic group where in 589 nodes were evaluated, the largest node was 1 cm^2 and the smallest node was 0.18 cm^2. Malignancy group revealed presence of 505 lymph nodes ultrasonographically out of which the largest measured 1.14 cm^2 and the smallest measured 0.25 cm^2. (Table 3 & Graph 2)

SHAPE OF THE NODES:

Of the 25 subjects in odontogenic group 13 showed presence of oval shaped nodes and 12 showed round shaped nodes. In non-odontogenic group, out of the 25 subjects 18 showed presence of oval shaped nodes and 7 showed round shaped nodes. All 20 patients in the malignancy group showed round shaped nodes. The results were statistically highly significant with a p value <0.01. (Table 4 & Graph 3)

BORDER SHARPNESS OF THE NODES:

71.4% of the study group had sharp borders (35.7 in odontogenic group & 35.7 in non-odontogenic group) and 28.6% (malignancy group) of the study group had un-sharp borders. The results were statistically highly significant with a p value <0.01. (Table 5 & Graph 4)

HILUM OF THE NODES:

71.4% of the study group showed presence of hilum (35.7 in odontogenic group & 35.7 in non-odontogenic group) and 28.6% (malignancy group) of the study group showed absence of hilum. The results were statistically highly significant with a p value <0.01. (Table 6 & Graph 5)

ECHOGENICITY OF THE NODES:

71.4% of the study group had hypoechoic nodes (35.7 in odontogenic group & 35.7 in non-odontogenic group) and 28.6% (malignancy group) of the study group had hyperechoic nodes. The results were statistically highly significant with a p value <0.01. (Table 7 & Graph 6)

DISTRIBUTION OF INTERNAL ECHOES OF THE NODES:

71.4% of the study group had homogenous distribution of internal echoes (35.7 in odontogenic group & 35.7 in non-odontogenic group) and 28.6% (mali gnancy group) of the study group had heterogeneous distribution of internal echoes. The results were statistically highly significant with a p value <0.01. (Table 8 & Graph 7)

NECROSIS OF THE NODES:

71.4% of the study group showed absence of nodal necrosis (35.7 in odontogenic group & 35.7 in non-odontogenic group) and 28.6 (malignancy group) of the study group showed presence of nodal necrosis. The results were statistically highly significant with a p value <0.01. (Table 9 & Graph 8).

Table 1. Distribution of lymph nodes detected on clinical and ultrasonographic examination

Groups	Clinically detected nodes	Ultrasonographically detected nodes
Odontogenic	88	435
Non-Odontogenic	88	589
Malignancy	103	505

Table 2. Mean of the number of nodes detected

	Ultrasonographically Detected Nodes			
	Clinically Palpable Nodes			
	MEAN	**SD**	**MEAN**	**SD**
Odontogenic	3.4	1.41	17.4	7.53
Non-Odontogenic	3.44	1.21	23.56	6.85
Malignancy	4.85	1.68	25.25	7.95

Table 3. Size of the nodes in the study group

Groups	Smallest (cm^2)	Largest (cm^2)
Odontogenic	0.17	0.69
Non-odontogenic	0.18	1
Malignancy	0.25	1.14

Table 4. Distribution of study subjects based on shape of nodes

	Odontogenic	Non-Odontogenic	Malignancy	Total	Pearson Chi Square	P Value
Oval	13	18	0	31	24.283	0.000
Round	12	7	20	39		
Total	25	25	20	70		

Table 5. Distribution of study subjects based on border sharpness

	Odontogenic	Non-Odontogenic	Malignancy	Total	Pearson Chi Square	P Value
Sharp	25	25	0	50	70.000	0.000
Unsharp	0	0	20	20		
Total	25	25	20	70		

Table 6. Distribution of study subjects based on presence or absence of hilum

	Odontogenic	Non-Odontogenic	Malignancy	Total	Pearson Chi Square	P Value
Present	25	25	0	50	70.000	0.000
Absent	0	0	20	20		
Total	25	25	20	70		

Table 7. Distribution of study subjects based on echogenicity

	Odontogenic	Non-Odontogenic	Malignancy	Total	Pearson Chi Square	P Value
Hypoechoic	25	25	0	50	70.000	0.000
Hyperechoic	0	0	20	20		
Total	25	25	20	70		

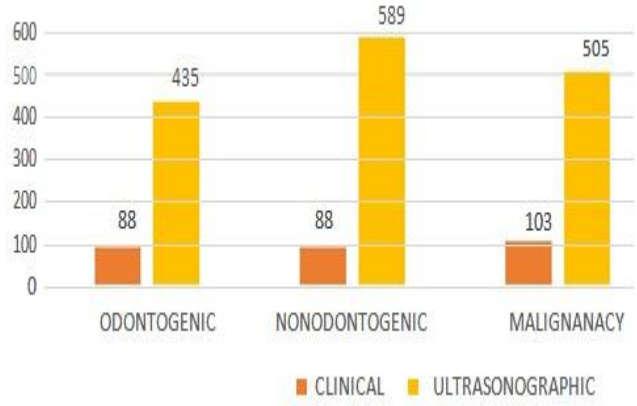
Table 8. Distribution of study subjects based on internal echos

	Odontogenic	Non-Odontogenic	Malignancy	Total	Pearson Chi Square	P Value
Homogenous	25	25	0	50	70.000	0.000
Heterogenous	0	0	20	20		
Total	25	25	20	70		

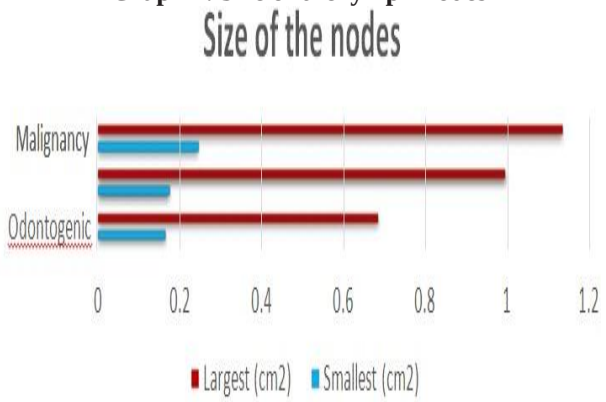
Table 9. Distribution of study subjects based on nodal necrosis

	Odontogenic	Non-Odontogenic	Malignancy	Total	Pearson Chi Square	P Value
Absent	25	25	0	50	70.000	0.000
Present	0	0	20	20		
Total	25	25	20	70		

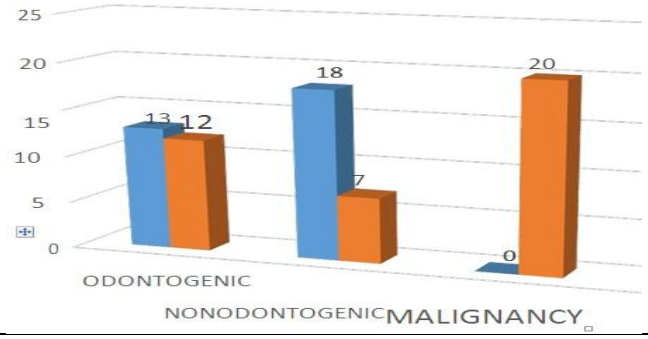
Graph 1. Distribution of Lymph Nodes Detected on Clinical and Ultrasonographic examination



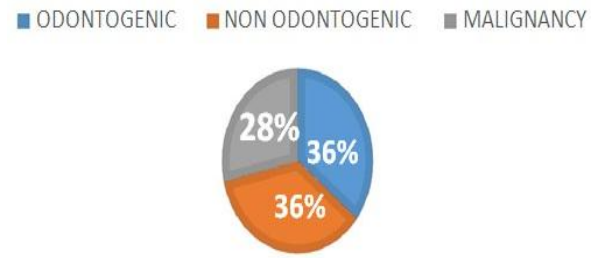
Graph 2. Size of the lymph nodes



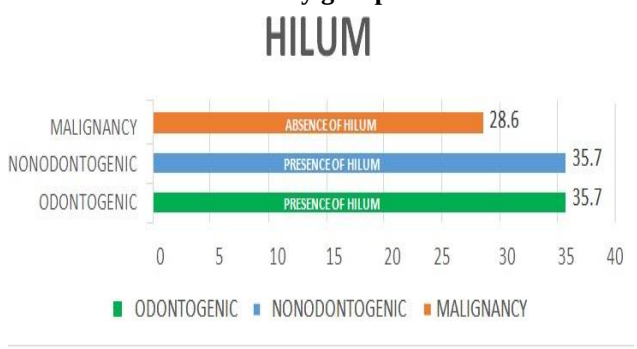
Graph 3. Shape of nodes observed in the study groups



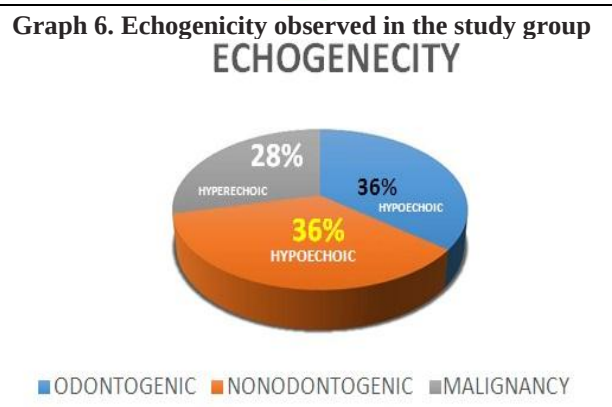
Graph 4. Border sharpness observed in the study group



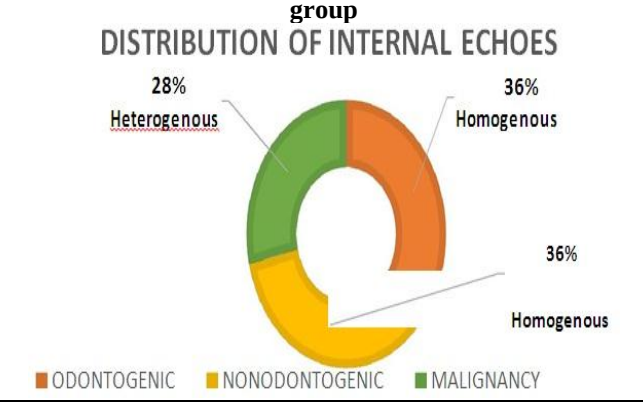
Graph 5. Presence or absence of hilum observed in the study group



Graph 6. Echogenicity observed in the study group



Graph 7. Distribution of internal echoes in the study group



Graph 8. Presence or absence of nodal necrosis in the study group

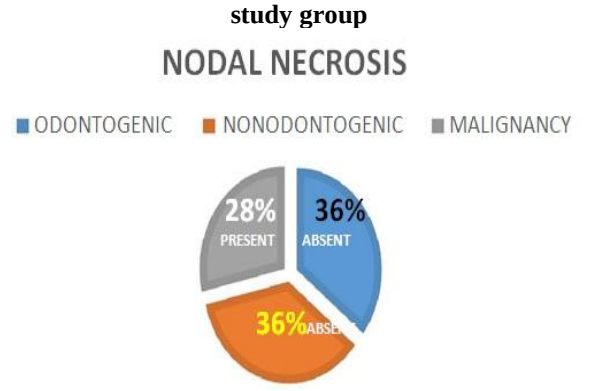


Figure 1. A - Lymph node less than 1 cm^2

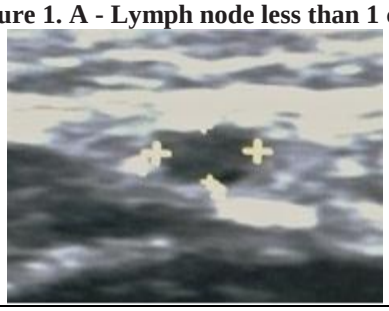


Figure 1. B - Lymph node more than 1 cm^2

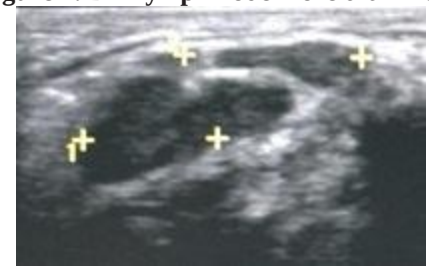


Figure 2. A - Round shaped lymph nodes

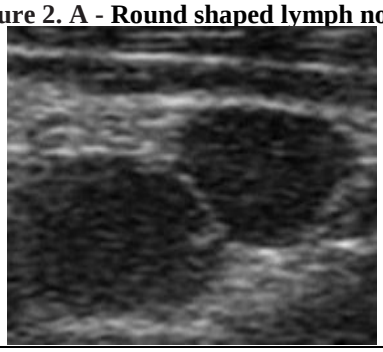


Figure 2. B - Oval shaped lymph node

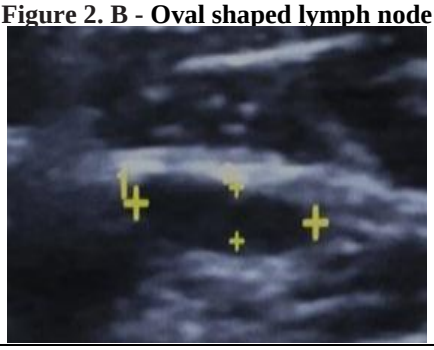


Figure 3. A - Lymph node exhibiting unsharp border

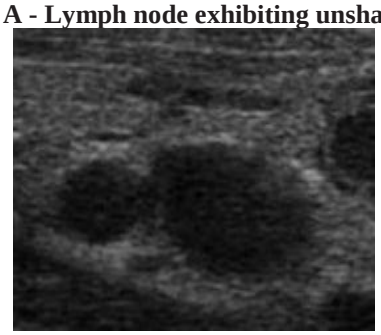


Figure 3. B - Lymph node exhibiting sharp border

Figure 4. A - Lymph node exhibiting preserved hilum

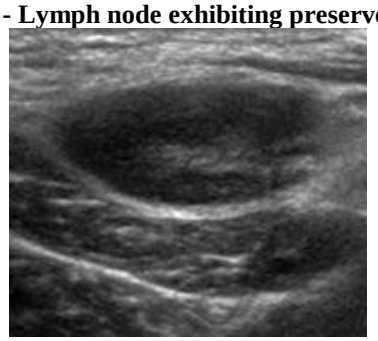


Figure 4. B - Lymph node exhibiting destruction of hilum

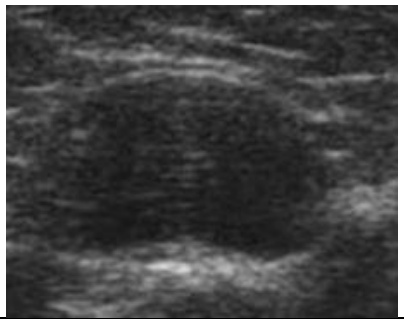


Figure 5. A - Hyperechoic lymph node

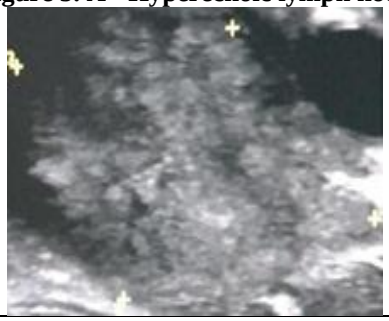


Figure 5 B - Hypoechoic lymph node

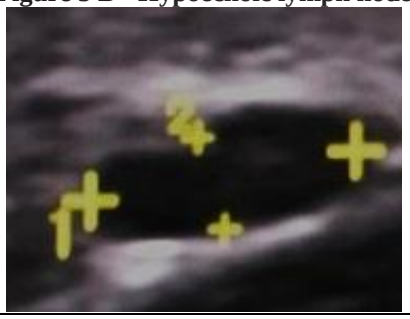


Figure 6. A - Heterogenous distribution of echoes

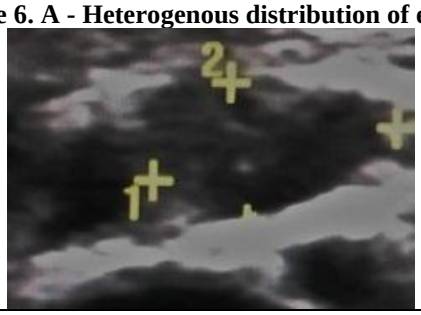


Figure 6. B - Homogenous distribution of echoes

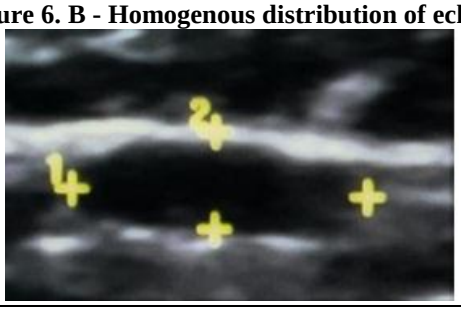
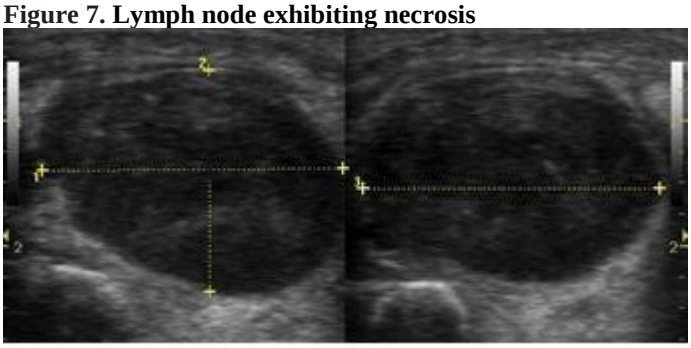


Figure 7. Lymph node exhibiting necrosis



DISCUSSION

Lymph nodes are vital immunologic organs distributed widely throughout the body and linked by lymphatic vessels [11]. Cervical lymphadenopathy is a common presenting symptom and sign for a variety of diseases, ranging from subtle infections to life threatening Head & Neck malignancies. It is well accepted that clinical examination alone cannot be considered as a diagnostic tool to justify the involvement of cervical lymph nodes especially deep or small nodes. Cervical nodal involvement in head and neck malignancies influences therapeutic decision. The role of ultrasound in the assessment of cervical lymphadenopathy is well established.

Imaging techniques play a very important role in diagnosing head and neck pathologies especially those involving deeper soft tissues. Lymphadenopathy is one such condition where critical evaluation becomes mandatory not only to assess the severity of the disease but also to determine disease prognosis and proper treatment planning. Clinical examination of cervical lymph nodes is important in such patients but mostly remains difficult owing to their diverse location and multiple numbers. Ultrasound has higher sensitivity (96.8%) than palpation (73.3%) for detection of cervical lymph nodes. CT and MRI can be used for evaluation of lymph nodes, but they are less sensitive than ultrasound in detecting nodes <5mm in diameter, whereas ultrasound can detect nodes even less than 2mm in diameter [9].

Gray-scale sonography is widely used in the evaluation of the number, size, site, shape, borders, matting, adjacent soft-tissue edema, and internal architectures of cervical lymph nodes.

Normal and reactive lymph nodes are usually found in submandibular, parotid, upper cervical, and posterior triangle regions. On gray-scale sonography, normal and reactive nodes tend to be hypoechoic compared with adjacent muscles and oval except for submandibular and parotid nodes, which are usually round, and have an echogenic hilus. The upper limit in minimal axial diameter of normal and reactive nodes is 9 mm for subdigastric and submandibular nodes and 8 mm for other cervical nodes.

Metastatic nodes are usually hypoechoic, round, and without echogenic hilus. Coagulation necrosis, which appears as a demarcated echogenic focus may be found in metastatic nodes. Lymph nodes with cystic necrosis are suggestive of malignancy and intranodal cystic necrosis is common in metastatic nodes of squamous cell carcinomas. A proven metastatic lymph node with ill-defined borders may suggest extracapsular spread and patients may have a poor prognosis [1].

In the present study, it was observed that ultrasonographic features like number, size, shape, border sharpness, hilum, echogenicity, distribution of internal echoes and intra nodal necrosis were significant in differentiating benign lymph nodes in odontogenic infections, non-odontogenic conditions and malignant lymph nodes in head and neck cancer.

Number of lymph nodes:

Clinical examination is subjective and highly inaccurate in the assessment of cervical lymphadenopathy. Ultrasonogram is superior to clinical examination as it can detect 21% of nodes undetected by clinical examination.

In our study, clinically 88, 88 and 103 lymph nodes were palpable in the odontogenic, non-odontogenic and malignancy groups respectively. Ultrasonography revealed presence of 435, 589 and 505 nodes respectively. This result is in accordance with those of Ophellia D'Souza *et al.* (1993) & Venkatesh Jayaraman *et al.* (2013) [16,17].

- **Size of lymph nodes:**

Nodal size is useful in clinical practice, in subjects with known malignancy. When the size of lymph nodes increases on serial ultrasonographic examination it is said to be highly suspicious for metastasis. A progressive change of nodal size is also useful to monitor the treatment response of the subjects with malignancy [11, 13, 20, 21].

In the present study, out of the 435 nodes evaluated ultrasonographically in the odontogenic group the largest node had a size of 0.69 cm^2 and smallest measured 0.17 cm^2. In the case of non-odontogenic group where in 589 nodes were evaluated, the largest node was 1 cm^2 and the smallest node was 0.18 cm^2. Malignancy group revealed presence of 505 lymph nodes ultrasonographically out of which the largest measured 1.14 cm^2 and the smallest measured 0.25 cm^2. This result is in accordance with that obtained by Papakonstantinou *et al.* (2009) [18].

- **Shape of the nodes**

Normal and reactive lymph nodes are usually oval in shape whereas malignant lymph nodes and tuberculous lymph nodes tend to be round. Although pathologic lymph nodes are usually round occasionally normal submandibular and parotid lymph nodes can also be round in shape [13, 16, 18, 20, 22]

In the current study results, Of the 25 subjects in odontogenic group 13 showed presence of oval shaped nodes and 12 showed round shaped nodes. In non-odontogenic group, out of the 25 subjects 18 showed presence of oval shaped nodes and 7 showed round shaped nodes. All 20 patients in the malignancy group showed round shaped nodes. The results were statistically highly significant with a p value <0.01. The results of our study are in accordance with Andrej Lyshchik *et al*. (2007), Papakonstantinou *et al*. (2009), Gary J. Whitman *et al*. (2011), Venkatesh Jayaraman *et al*. (2013), Reshma VJ *et al.* (2014) & Ionela Genes *et al.* (2014) [11,13, 16,18,22].

- **Border sharpness of nodes:**

Normal lymph nodes have unsharp borders. This is related to the associated oedema and inflammation of surrounding soft tissues. Malignant lymph nodes on the other hand tend to have sharp borders, due to the fact that tumour infiltration causes an increase in the difference of acoustic impedance between intra nodal region and surrounding tissues. An unsharp border may be found in tuberculosis lymph nodes, and again this is related to the associated oedema and inflammation of the surrounding soft tissues. Malignant lymph nodes in advanced stages may also show an ill- defined border, indicating extracapsular spread and this has shown to reduce the survival rate of the subjects by 50% [1, 10, 11, 13, 18, 19, 22].

Present study results showed that, 71.4% of the study group had sharp borders (35.7 in odontogenic group & 35.7 in non- odontogenic group) and 28.6% (Malignancy group) of the study group had un-sharp borders. The results were statistically highly significant with a p value <0.01. This is in accordance with the results of Ahuja *et al*. (2008); Papakonstantinou *et al. (2009)* [10,18].

- **Hilum of the nodes:**

The echogenic hilus is mainly the result of multiple medullary sinuses, each of which acts as an acoustic interface, which partially reflects the ultrasound waves and produces an echogenic structure. Fatty infiltration makes the hilus more obvious in ultrasononography. On ultrasonographic examination the echogenic hilus appears as a hyperechoic linear structure and is continuous with the adjacent fat. Neck lymph node with a maximum transverse diameter greater than 5mm shows an echogenic hilus. The incidence of echogenic hilus increases with age which is probably related to the increased fatty deposition in the lymph nodes of elderly individuals [6, 9,11-19,21,22].

Our study results proved that, 71.4% of the study group showed presence of hilum (35.7 in odontogenic group & 35.7 in non- odontogenic group) and 28.6% (Malignancy group) of the study group showed absence of hilum. The results were statistically highly significant with a p value <0.01. The results were in accordance with the results of Vassallo et al. (1992, Sophie Leboulleux *et al.* (2007), Gary J. Whitman *et al.* (2011), Reshma VJ *et al.* (2014), Mohamed Hefeda *et al.* (2014) & Sindhoori Komma *et al.* (2014).

Echogenicity of nodes:

Malignant lymph nodes are predominantly hypoechoic when compared to adjacent soft tissues except in case of metastatic lymph nodes of papillary carcinoma of thyroid which are commonly hyperechoic. In malignant diseases, the process involves infiltration of the nodes by malignant cells which is more likely to result in early distortion of internal nodal architecture showing as heterogeneity on ultrasound. Tuberculous lymph nodes tend to be hypoechoic which is related to intranodal cystic necrosis [9,16,17,20,22].

In our study, 71.4% of the study group had hypoechoic nodes (35.7 in odontogenic group & 35.7 in non-odontogenic group) and 28.6% (Malignancy group) of the study group had hyperechoic nodes. The results were statistically highly significant with a p value <0.01. The results are in accordance with those of Ying and Ahuja *et al*. (2003), Reshma *et al*. (2014) & Ionela Genes *et al*. (2014) [1,20,22].

- **Distribution of internal echoes:**

According to the results of our study, 71.4% of the study group had homogenous distribution of internal echoes (35.7 in odontogenic group & 35.7 in non-odontogenic group) and 28.6% (Malignancy group) of the study group had heterogeneous distribution of internal echoes. The results were statistically highly significant with a p value <0.01. This is in accordance with the results of Reshma VJ *et al*. (2014) [22].

- **Nodal necrosis:**

Lymph nodes with intranodal necrosis, regardless of their size are pathologic. Necrosis may manifest itself as a true cystic area within the lymph node (cystic necrosis) or present as an area of hyperechogenicity within a lymph node (coagulation necrosis) [1,9,16-19,22].

We in our study concluded that, 71.4% of the study group showed absence of nodal necrosis (35.7 in odontogenic group & 35.7 in non-odontogenic group) and 28.6% (Malignancy group) of the study group showed presence of nodal necrosis. The results were statistically highly significant with a p value <0.01. This is in accordance with the results of Ophellia D'Souza1 *et al.* (1999), Anil T. Ahuja *et al*. (2005). Reshma VJ *et al*. (2014), Papakonstantinou *et al*. (2009), Sindhoori Komma *et al*. (2014) & Ionela Genes *et al*. (2014) [1,19,22,19,20].

CONCLUSION

Gray-scale sonography is an efficient and reliable tool in classifying regional lymph nodes. However, it is not routinely being used as a preliminary diagnostic modality in head and neck region. Its application in the recent past has shown promising results. It is simple, inexpensive, non-invasive and easily reproducible with minimal patient discomfort. Being a chairside and outpatient procedure, it can be used by dentists for the evaluation of cervical lymphadenopathy. Evaluating the metastases in lymph nodes of the neck has a major role in determining the prognosis and treatment of head and neck cancer.

Present study depicted that features specific for benign lymphadenopathy are oval/round shape, sharp borders, presence of echogenic hilum, hypoechoic nodes, homogenous distribution of internal echoes and absence of nodal necrosis. Whereas those suggestive of malignant spread are round in shape, un-sharp borders, absence of echogenic hilum, hyperechoic nodes, heterogenous distribution of internal echoes and presence of nodal necrosis Clinical examination is effective only in evaluating the superficial lymph nodes. Whereas ultrasound helps in detecting and characterizing the deep-seated lymph nodes.

Future studies with inclusion of parameters such as determining the correlation of ultrasonographic features of lymph nodes with clinical staging and histopathological grading of lymph node metastasis can be carried out to firmly establish the significance of ultrasound in detection and characterization of cervical lymph nodes.

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