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Original Research Article

Comparative evaluation of the efficacy of clinical diagnosis, conventional radiography and ultrasonography (usg) in the diagnosis of odontogenic lesions – A short study

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ABSTRACT

Background: Several imaging techniques are adopted by clinicians in day-to-day practice amongst which clinical diagnosis and conventional radiography are been relied on mostly. However, owing to the high radiation exposure and other shortcomings of computed tomography or MRI, Ultrasonography has emerged as an effective method of choice for diagnosis.

Materials and Methods: 40 patients were selected for the study among the patients visiting the department at the Department of Dentistry, NRS Medical College and Hospital. All the patients of the study group were examined clinically and radiographically followed by Ultrasonography and Color Doppler was performed by ultrasound machine (SIEMENS- G50) Collected data were analysed by means of statistical software Statistical Package for Social Sciences STATA-15. ANOVA test was done to compare the Radiographical diagnosis and USG, further association has been checked between two variables.

Results: It was observed that USG diagnosis had a sensitivity and specificity of 100% & 86.9% respectively with an accuracy of 98.6% compared to clinical diagnosis & had a sensitivity and specificity of 100% & 86.9% respectively with an accuracy of 98.6% compared to radiographic diagnosis.

Conclusion: Real-time USG with high frequency transducers can suggestively enhance the assessment of various head and neck pathological lesions and can thus be used as a supplement in clinical examination of patients to deduce a confirmatory diagnosis.

1. Introduction

The Maxillofacial region being a common anatomic site for the development of infections, cysts and tumors of odontogenic or non-odontogenic origin leads to difficulty in the diagnostic process owing to the diversity of the lesions and various problems while obtaining adequate images of the involved bones.It is thus essential to diagnose the accurate information of pathological nature of lesion prior to the management.[1]

Clinical diagnosis is abetted by the various diagnostic modalities including chair side investigations, radiography, biochemical investigations etc. Various imaging paraphernalia and procedures do exist in the medical market to facilitate the clinician in their day-to-day practice amongst which conventional radiography has been unanimously adopted as it is referred to as the physician's first diagnostic aid. Owing to the high exposure to radiation in this procedure, new imaging techniques like computed

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tomography (CT) and magnetic resonance imaging (MRI) were introduced that provided appreciated evidence. However, these techniques also had certain limitations with respect to high radiation exposure and were quite expensive for routine use in clinical practice.[2] Thus, the advent of Ultrasonography (USG) assisted the clinicians owing to its benefits of wide availability, non-ionizing and non-invasive technique, easy-to-use, cost-effective and easily reproducibility or repeatability. This method can be performed without the application of heavy sedation, has no effect on the general health of an individual and could be repeated as and when required.[3] Even though in recent years, it has been applied in the orofacial areas, it is still not used routinely in the diagnostic procedure for day-to-day clinical practice. USG could be extraordinarily helpful in recognizing, distinguishing and measuring the on-screen nodes in various jaw lesions including the inflammatory swellings due to dental and skin infections, salivary glands disorders and lymph node reaction due to inflammation or metastasis, cysts and cystic components, neoplasms and the post-operative internal tomography of oral tissues.[3] It has been observed that in dentistry, the possible application of USG has been discovered and utilized only in very few researches. Hence, a need was felt to conduct a study to determine the potential usefulness of ultrasonography as a complimentary diagnostic tool for odontogenic lesions of the head and neck and to assess the diagnostic capability of ultrasonography the same.

2. Materials and Methods

40 patients were selected for the study among the patients visiting at the department of dentistry with extra-oral swelling within the time period between January 2023 to February 2023. They were selected through clinical examination and proper detailed case history was recorded. Those who fulfilled the requirements based on exclusion and inclusion criteria were included in study.

2.1. Inclusion criteria

Patients with head and neck swelling were included irrespective of the age, sex, and socio-economic status

2.2. Exclusion criteria

1. Patients who were not willing to participate in the study were excluded from study.
2. Patients with severe illness, lunatic and uncooperative patients were excluded.
3. Swelling owing to head and neck trauma were excluded.
4. Patients with intraoral swelling with no obvious extra-oral swellings were excluded.

All the patients of the study group were examined clinically and radiographically and a detailed examination was done using conventional diagnostic instruments under direct and indirect light and findings were recorded in a detailed case history format. A provisional diagnosis of each case was made depending solely upon the findings of history and clinical examination. After clinical examination was made, all the selected patients were advised for conventional intraoral and extraoral radiography. All the patients were radiographed to confirm the clinical diagnosis. Intraoral periapical radiograph (IOPAR), occlusal, orthopantomogram (OPG), Lateral oblique of ramus or body of mandible, paranasal sinus (PNS) views were taken where relevant. Radiographs were thoroughly interpreted and diagnosis was made. After clinical and radiological diagnosis was made, all the selected patients were taken to the department of general radiology at the State Medical College and Hospital, Kolkata for ultrasonography.

Ultrasonography and Color Doppler was performed by ultrasound machine (SIEMENS- G50) by C5.2, 10.5 (high resolution) probes according to the depth of swelling. Features like size, shape, echo intensity, ultrasound architecture, presence of necrosis and calcification, posterior-echos characteristics of tissues, evaluate blood flow within or surrounding the examined swelling was considered in describing the ulrasonographic images. The probe was positioned outside the mouth over the lesion. The probe position was changed several times in order to obtain an adequate number of transverse scans (axial plane) and longitudinal scans (sagittal plane) to define the swelling. The thin anterior buccal bone and possible fenestration allowed ultrasound images to be obtained in all cases and the echo characteristics (hypoechoic/anechoic) of the lesions to be determined. All lesions were measured in three planes, i.e., anteroposterior, superoinferior and mesiodistal and the dimensions recorded. Colour Doppler was applied to each examination to detect blood flow and RI, PI value were noted only where indicated. Biopsy and histopathological investigations or other advanced diagnostic methods i.e., MRI, MR angiogram, Computed tomography, culture and sensitivity test, blood investigations were performed were performed where required for confirmation for diagnosis. The result of radiographic (RD) and ultrasonographic (USG) interpretation was compared with the result of clinical diagnosis (CD).

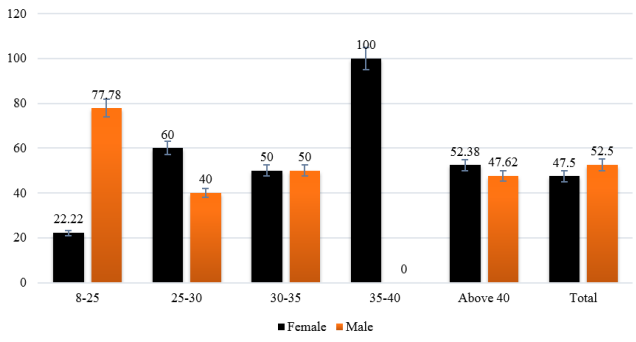
2.3. Statistical analysis

Data was collected and recorded and numeric outcome was generated from the dummy tables. Data were expressed as numbers (%), mean ± SD where appropriate. Collected data were analysed by means of statistical software Statistical Package for Social Sciences STATA-15. ANOVA test was done to compare the Radiographical diagnosis and USG,

further association has been checked between two variables.

3. Results

The total distribution of females and males were 47.5% and 52.5% respectively. Graph 1 represents the patients' distribution with respect to gender and age. It was seen that 22.22% females and 77.78% males b, belonged to the age group of 8-25; 60.0% females and 40.0% males belonged to 25-30 years; 50.0% female and 50.0% males were in the age group of 30-35 years, only females were present within 35-40 years and are and 52.38% females and 47.62% males were above 40 years of age. Table 1 represents the percentage distribution of clinical diagnosis; Table 2 represents percentage distribution of radiographical diagnosis andTable 3 shows the percentage distribution of USG diagnosis.Table 4 represents the comparison between RD, USG and CD. However, RD distributed among FN (17.24%) FP (18.97%) TN (13.79%) and TP (50.0%) respectively. USG distributed among FN (1.72%) FP (6.9%) TN (24.14%) and TP (67.24%) respectively. CD are distributed only FP (29.31%) and TP was (70.69%). Table 5 shows that clinical diagnosis had a sensitivity and specificity of 86.6% & 77.8% respectively, whereas USG diagnosis had a sensitivity and specificity of 100% & 86.9% respectively with an accuracy of 98.6%. Table 6 depicts that radiographical diagnosis had a sensitivity and specificity of 89.7% & 78.3% respectively whereas USG diagnosis had a sensitivity and specificity of 100% & 86.9% respectively with an accuracy of 98.6%. Table 7 represents ANOVA test comparison between radiographical and USG diagnosis. ANOVA test showed that there was significant association between USG based diagnosis and Radiographical diagnosis with p=<0.001. Significant results and Mean score of the diagnosis showed that Radiographical diagnosis was 11.10 and USG diagnosis was 16.6 Further, it showed that USG diagnosis could be considered better the radiographical diagnosis.



Graph 1: Distribution of patient by gender and age

Table 1: Percentage distribution of clinical diagnosis

Clinical dignosis	Sample	Percentage
Dentigerous Cyst	14	36.0
Ameloblastoma	4	10.0
Antibioma	1	2.5
AOT	2	5.0
Cellulitis	3	7.5
Consolidated Abscess	1	2.5
Fibro-Osseous Lesion	2	5.0
OKC	2	5.0
Space Infection	11	27.5
Total	40	100

Table 2: Percentage distribution of radiographical diagnosis

Radiographical diagnosis	Sample	Percentage
Dentigerous Cyst	6	15.0
Ameloblastoma	3	7.5
Benign Fibro-Osseous Lesion Mandible	1	2.5
Cystic	7	17.5
Fibro-Osseous Lesion	1	2.5
Myxoma	1	2.5
NAD	8	20.0
Odontome	1	2.5
OKC	1	2.5
Pa Abscess	10	25.0
PCD	1	2.5
Total	40	100

Table 3: Percentage distribution of USG diagnosis

USG diagnosis	Sample	Percentage
Ameloblastoma	3	7.5
Cellulitis	3	7.5
Consolidated Abscess	2	5.0
Cystic	12	27.5
Ludwig's angina	1	2.5
NAD	11	27.5
Space Infection	9	22.5
Total	40	100

Table 4: Comparison between radiographical diagnosis (RD), ultrasonographic diagnosis (USG) and clinical diagnosis (CD)

Diagnosis	RD	USG	CD
FN	17.24	1.72	
FP	18.97	6.9	29.31
TN	13.79	24.14	
TP	50.0	67.24	70.69

Table 5: Comparison of clinical and USG diagnosis

Sensitivity analysis	Clinical diagnosis (%)	USG diagnosis (%)
Sensitivity	86.8	100
Specificity	77.8	86.9
Positive predictive value	58.3	88.1
Negative predictive value	98.5	100
Likelihood ratio	8.5	68
Diagnostic Accuracy	86.7	98.6

Table 6: Comparison of radiographical diagnosis and USG diagnosis (%)

Sensitivity analysis	Radiographical diagnosis (%)	USG diagnosis (%)
Sensitivity	89.7	100
Specificity	78.3	86.9
Positive predictive value (PPV)	58.9	88.1
Negative predictive value (NPV)	88.4	100
Likelihood ratio	7.2	68
Diagnostic Accuracy	88.4	98.6

Table 7: ANOVA test comparison between radiographical diagnosis and USG diagnosis

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]	P value
Radiographical Diagnosis	40	11.10	0.16	2.52	12.19	13.12	<0.001
USG Diagnosis	40	16.6	0.12	6.07	11.29	15.06	
Combined	80	5.5	0.14	2.82	15.02	16.25	
Diff		-0.62	1.05		-2.77	1.53	

4. Discussion

The maxillofacial region consists of a wide variety of lesions with complex diagnostic abilities and thus it is essential to attain a precise diagnosis of the specific condition prior to the commencement of any kind of treatment protocol. Hence, this study was undertaken to look for an investigative technique which can be easily available, inexpensive, easy repeatable, non-invasive with real time monitoring without radiation. Ultrasonography (USG) has proven to exhibit all the benefits and is more superior to conventional radiographic techniques. The sonographic images are identified with respect to echoes and are denoted as hypoechoic, hyperechoic and anechoic images. It is established that a mass is hypoechoic if it has an intensity lower than that of the adjacent tissue and if a mass is hyperechoic it consists of higher intensity whereas isoechoic images are obtained for masses with intensity similar to the adjacent tissue. The appearance of hypoechoic masses is darker while the hyperechoic masses appear rather bright, and the isoechoic ones have a similar appearance. A calcified mass appears hyperechoic and a clear fluid or blood appears anechoic as was described by Bagewadi SB et al. (2010).[4]

There are several imaging modalities that are essential for the diagnosis of head and neck pathology. With the advent of advanced techniques, such as ultrasonography (USG), computerized tomography (CT) and magnetic resonance imaging (MRI) therapeutic dilemma has reduced in the field of diagnostic radiology.[5] Although, CT and MRI are efficient in indicating the various pathologies of the head and neck region, the anatomic area involved usually governs the selection of the technique to be used. However, apart from the various advantages, both these methods are relatively expensive and owes a risk of ionizing radiation in routine practice.[6] Hence, USG gained more popularity and acceptance owing to the advantages like utilization of harmless non-ionizing radiation, extensive availability, simple procedure, cost-effectiveness and absence of artifacts due to metallic restorations. USG provides a good opportunity to articulate an appropriate treatment plan without repeated harmful exposure to the patients. The precise demonstration of the presence, stage and extent of any pathology is conceivable with USG that impacts the suitability of the treatment protocol.[7] The technique plays an inevitable role in recognizing orofacial swellings with vivid etiologies.[4] Odontogenic pathologies of the head and neck region requires proper evaluation and treatment due to the predicament of the exact lesion type and their respective etiology that would need surgical intervention or could be managed acceptably with only palliative or supportive care.[8] Hence, The present study was undertaken to assess the possible usefulness and capability of USG for diagnosing odontogenic lesions of the head and neck.

The present study shows the comparison between clinical (CD), radiological (RD) and ltrasonographic (USG) diagnosing capabilities with portraying false negative, false positive, true negative and true positive score of

17.24%, 18.97%, 13.79% and 50.0% respectively. The same scores with USG were 1.72%, 6.9%, 24.14% and 67.24% respectively and with CD gave a false positive score of 29.31% and true positive score of 70.69% [Table 4]. ANOVA analysis depicted that there was significant association between USG based and Radiographical diagnosis with p=<0.001 thus showing that USG diagnosis could be better than the radiographical diagnosis for the odontogenic pathological lesions. The present study showed that USG diagnosis had a sensitivity and specificity of 100% & 86.9% respectively with an accuracy of 98.6% when compared to clinical diagnosis and the same values of sensitivity and specificity were 100% & 86.9% respectively with an accuracy of 98.6% when compared to radiographical diagnosis. [Tables 5 and 6]. These results were in accordance to the findings of several previously reported studies like that conducted by Ralf Siegert (1987)[9] in which USG portrayed a slightly higher (82%) sensitivity than the clinical diagnosis (69%) for the diagnosis of inflammatory swellings, which was congruent to the present study findings. In another similar study by Srinivas K et al. (2009),[10] the sensitivity and specificity of clinical diagnosis over USG was 96% and 100% respectively. Chandak R et al. (2011)[11] showed a sensitivity and specificity of 85.7% in clinical diagnosis while that in USG the sensitivity and specificity was 97.1% and 100% respectively. Sanghar J et al. (2012)[12] showed from their study that the sensitivity of USG diagnosis was 92% and specificity was 100%. The authors stated that USG serves as an additional modality in the diagnosis of odontogenic lesions and can also facilitate to identify and reveal the various stages of the lesion, thus inducing the therapeutic possibilities of treatment and management.

Pallagatti S et al. (2012)[13] also showed that the diagnostic accuracy of USG was much better than other diagnostic modalities and enlisted the various advantages of the technique describing its rapidness, simplicity, wide availability, cost-effectiveness, painless, and easily repeatability without much hazard to the patients. They stated that jawbone lesions, particularly unilocular ones being difficult to diagnose owing to their analogous radiographic appearance require an additional diagnostic modality for the final confirmed lesion. Hence, USG serves an alternative, with no radiation exposure to help in the diagnostic procedure.[14] On comparison of USG with computed tomographic (CT) scans, the latter causes greater exposure of the patient to large doses of radiation with additional risk of streak artifacts and poor contrast between the different soft tissues. At times in cases wherein CT might provide an incomplete picture, ultrasonography a valuable alternative.[15] On the other hand, magnetic resonance imaging (MRI) is a lengthy and time taking process for image acquisition. Individuals with cardiac pacemakers, neurostimulator units and intraocular foreign bodies etc are at high risk in the high static magnetic field. Thus, in USG, the real-time imaging is simple, reproducible, and convenient to use. The equipment is relatively cheap when compared to other advanced imaging modalities. Ultrasound images can be quickly developed with few artifacts and has high acceptability ratio amongst patients and can be easily stored or retrieved.[13]

Puri N et al. (2018)[16] suggested from their study that USG safe and efficient to be used for the diagnosis of head and neck lesions portraying a diagnostic accuracy of 100% in cystic lesion of the maxillofacial region. Similarly, Shah JS et al. (2017)[17] showed that in cystic swellings, USG had a sensitivity of 85.7%, specificity of 100%, PPV of 100%, NPV of 95.8%, and accuracy of 96.67%. According to a systematic review done by Musu D et al. (2016),[18] it was documented that USG can be successfully applied for the diagnosis of infective and/or inflammatory lesions, cysts, non-odontogenic/odontogenic tumors, and arteriovenous malformations when compared to the conventional histopathological analysis.

Similarly, Zope SR et al. (2018)[19] demonstrated a 100% congruency between clinical and ultrasonographic diagnosis in their study including cysts, abscess and sialadenitis. They showed the reliability of USG to be 97% in diagnosing all the cases when compared to histopathological or clinical diagnosis. The present study was also found to be analogous to the studies conducted by Abdelsalam TA et al. (2019)[20] and Adamu YM et al. (2022).[21]

In this study ultrasonographic picture of the abscess was hypoechoic, homogenous or heterogenous because of its pus or inflammatory exudate content and the findings were consistent with the findings of Srinivas K et al (2009).[10] However, it exhibited an irregular walled boundary echo on grayscale with no internal vascularity.

In the present study, cystic lesion diagnosis was made for 7 cases (17.5%) out of 40 according to conventional radiography. One case was diagnosed as juvenile fibro-osseous lesion due to its mixed radiopaque and radiolucent appearance. The conventional radiographs were able to demonstrate the location and extent of pathology with well-defined radiolucency and a sclerotic margin or any involved teeth. But in radiographs, though the condition of the inferior border of mandible could be seen due to 'peripheral egg shell effect' but lingual and cortical plates could not be appreciated with internal content of the pathology.

All these cases underwent USG it was found that cystic lesions were present in around 12 (27.5%) cases. Ultrasonography showed all the pathology involving either the body of mandible or ramus and angle of mandible. The exact measurement of the lesion and the depth of the pathology were measured on grayscale. Under grayscale USG, lesion appeared as 'well defined expansile bony lesion, focal or diffuses cortical plate thinning, erosion, and breach in continuation of cortical plates

with no internal vascularity, soft tissue component'. Internal cavity appeared anechoic. These findings were analogous to that obtained by Mojdeh Mehdizadeh and his colleagues who found 6 cystic lesions produced anechoic area with smooth contour, well-defined margins and were without vascularization.[22] Bagewadi BS et al. (2010)[4] showed anechoic internal echo pattern, with homogeneously distributed internal echoes in radicular cyst, where dentigerous cysts exhibited anechoic to focal hyperechogenicity with heterogeneously distributed internal echoes. The focal hyperechogenicity in the anechoic area of the dentigerous cysts was the tooth portion which helps to differentiate between radicular cyst and dentigerous cyst ultrasonographically and the odontogenic keratocyst exhibited hypoechoic internal echo pattern with homogeneously distributed internal echoes might be due to its cholesterol contents.[23] The anechoic appearance occurs due to complete transmission of US wave through the liquid content without any reflection or refraction while the border appears well-defined; hyperechoic due to attenuation of sound waves back from the bone margin and hypoechoic when cysts become infected and the content of the lesion produces echoes.[11,23] In the present study, individual lesions exhibited different appearance on conventional radiography. The Fibro-osseous lesion depicted mixed radiopaque and radiolucent appearance displacement of mandibular canal which was similar to the findings by Prabhu S et al. (2013).[24]

USG gave provisional diagnosis of ameloblastoma that were confirmed by histopathology, in 3 cases where a large sized heterogenous bony expansile often mutisepted cystic lesion were observed in body and ramus of mandible either with thinning of cortical plates or erosion of inner and outer plates on grayscale. These findings were consistent with Bagewadi BS et al (2010).[4] who found 3 benign odontogenic tumors had hyperechoic to anechoic internal echo pattern with heterogeneously distributed internal echoes ultrasonographically. There was 100% congruency between radiographical and ultrasonographic diagnosis in cases of ameloblastoma.

The present study revealed the efficiency of USG in the diagnosis of several maxillofacial lesions with diagnostic accuracy of 98.6%, when compared with clinical and radiographical analysis. Hence, USG when collectively is used with clinical, radiographical and histopathological techniques, serves to be an appreciated adjunct for the diagnosis of maxillofacial pathology. Real-time USG with high frequency transducers can suggestively enhance the assessment of various head and neck pathological lesions and can thus be used as a supplement in clinical examination of patients to deduce a confirmatory diagnosis.

5. Conclusion

USG has provided good results in general medicine however, there are very fewer studies on maxillofacial pathologies. Ultrasonographic examinations that have relatively high sensitivity and specificity, should implemented, and widely used for the clinical examination maxillofacial lesions to aid in the final diagnosis and further treatment of the patients. With advancement of technology, USG has come up with more technical inventions which makes the images more comprehensible and precise. Since the present study consisted of a small sample size, further studies are recommended to be carried out with larger sample for the differential diagnosis of head and neck lesions and this would enable to modify and postulate a definitive treatment protocol for delivering optimum patient care.

6. Source of Funding

None.

7. Conflicts of Interest

There are no conflicts of interest.

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