

**Role of ultrasonography as a diagnostic tool in inflammatory swellings of odontogenic origin in orofacial region**

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**Abstract**

Orofacial region is the most common complicated region and is one of the most frequent site for odontogenic and non-odontogenic infections. When affected it is characterized by pain and swelling in the affected area. Conventional radiographs provide limited information of the lesion. This warrants for the use of advanced imaging modalities like CT, MRI, and USG for the diagnosis of inflammatory swellings of odontogenic origin.

**Keywords:** WHO, CT, MRI, USG.

**Introduction**

The human jaw is frequent site for odontogenic or non-odontogenic infections. These swellings may arise from any structure as it is classified by World Health Organization (WHO) as benign, malignant tumors, hamartomas, cysts, vascular malformations, & inflammatory swellings.<sup>1,2</sup>

Because, the dental infection tends to spread into deeper structure at faster rates, they are more likely to involve

facial spaces. It is frequently hard to diagnose the stage and anatomic vicinity of the contamination on both clinical and radiographic examination.<sup>2</sup>

Therefore, it is tough to diagnose the development of abscess and deeply spreaded infections only on the basis of clinical examination and other palpatory findings as it will not provide the complete details of the swellings and so radiological imaging is required.<sup>3</sup>

Some of them are conventional radiographs, CT, MRI. Conventional radiographs are valuable diagnostic aids. However, these plain radiographs will not provide a good definition of the soft tissue. CT gives high amount of radiation exposure to the patient & Magnetic Resonance Imaging is costly, takes much time and not acceptable for every patient. A variant diagnostic technique which is readily available, affordable & non-intrusive is Ultrasonography.<sup>3,4</sup>

Soft tissue imaging has been accepted traditionally as a challenging task. And in the odontogenic infections these facial spaces involved in the deeper structures through oral and cutaneous routes. Ultrasound imaging is a non-invasive method of gaining popularity in all acute stages inflammation of all odontogenic infections. This imaging tool will help in the detection of degree of infection and its exact location.<sup>5</sup>

Ultrasound comprises of two words “ultra” meaning apart or in abundance and “sound” meaning acoustic sound energy. The word US stands for the sound energy beside the audible range. Diagnostic ultrasound uses frequency in range of 1-20MHz.<sup>5,6</sup>

Ultrasound is generated by vibrating piezoelectric crystals using pulses of high energy that leads to mechanical oscillation and sound wave output. So, electrical energy is converted into mechanical energy. Diagnostic ultrasound uses a transducer from which it produces a narrow focus beam. This beam is mirrored

back to the transducer from the tissues which then segregate these echoes into an image which is displayed on screen.<sup>7</sup>

The purpose of this study was to evaluate the efficacy of ultrasonography in inflammatory swellings of odontogenic origin in oro-facial region.<sup>8</sup>

#### **Material and method:**

The protocol of this study was approved by the institutional ethical committee. The study was conducted in 35 patients both male & female who reported to Department of OMDR, with chief complain of pain and swelling in the Oro-facial region. Patients who were clinically diagnosed unilateral inflammatory swellings of odontogenic origin were considered.

Exclusion criteria for this single blind study included patients who reported with systemic disease or immune compromised patients and developmental swellings. Non ambulatory individuals, patients with parotid and submandibular gland swellings were also excluded from the study.

All patients were clinically evaluated for unilateral extra-oral inflammatory swellings of odontogenic origin with completely sterilized instruments. Past medical and dental history was taken. Examination of swelling was done according the criteria by S Das. Inspectory examination included location, shape, size, surface & overlying skin of the swelling and surrounding area and border. All the inspector findings were confirmed and consistency, tenderness, temperature, fluctuancy, compressibility, reducibility, pulsatility, fixity to the skin and translucency was recorded, as part of palpatory examination. Inspection and palpation of lymph nodes in orofacial region was done such as sub mandibular, submental, cervical and other groups in which tenderness, size, shape, fluctuancy were recorded.

On the basis of thorough clinical investigation and the positive findings recorded, the clinical provisional diagnosis was made.

All the patients were then subjected to Department of Radio-diagnosis for ultrasonographic examination carried out using SIEMENS S 2000 ultrasonic equipment with linear transducer probes 14L5 (9-14 MHz) & 9L4 (4-9 MHz).

Different frequencies of ultrasound was used because increase in frequency causes decrease in penetration of the waves. At the same time increased frequency causes increase in resolution. The sonographic features were interpreted according to the criteria given by various authors. The various features noted on ultrasound were:

- Boundary
- Shape
- Internal echo pattern
- Distribution of echoes
- Posterior wall echoes
- Size of the lesion

Diagnosis was made after ultrasound results and treatment was scheduled. Appropriate antibiotic regimen was given to the patient with cellulitis and abscess cases were advised for incision and drainage. After evaluation the results were obtained and tabulated.

### **Results**

A total of 35 patients with clinically obvious swellings in head and neck regions were included in the study. In this study patients were between the age of 16-65 years. All the patients underwent ultrasonography for the unilateral inflammatory swellings of odontogenic origin. Ultrasonographic ally the distribution of swelling was found maximum in cases of periapical abscess that was 18 cases (51.5%) followed by 13 cases (37.1%) cellulitis. However, the distribution of swelling was found to be predominantly as periapical abscess 25 cases

(71.4%) followed by cellulitis in 5 cases (14.3%), right mandibular space infection in 3 cases (8.6%) and the least no. of cases seen as buccal space infection that was 2 cases (5.7%).

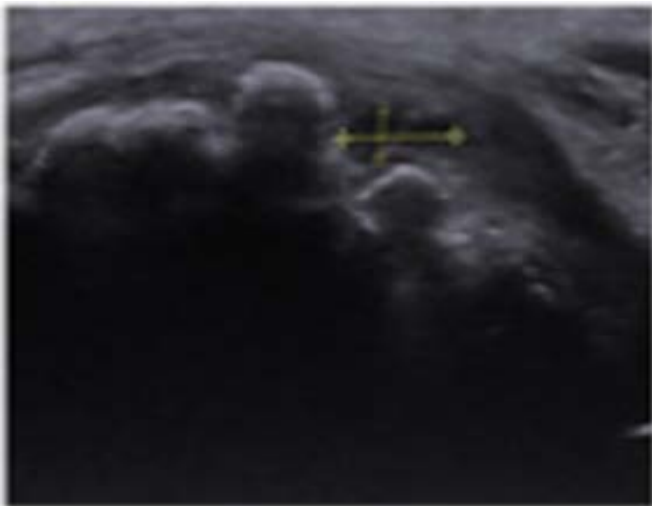
The various ultrasonographic features found in unilateral inflammatory swellings were boundary, shape, echo, architecture, post. echoes and characteristics. A total of 35 cases showed different variations in boundaries of the lesion. In this study we found that predominantly the boundaries found were very clear in 11 (31.4%) followed by ill-defined in 10 (28.6%), relatively clear in 8 (22.9%) and least as partially clear in 6 cases (17.1%). Shape of inflammatory swellings was found to be most as irregular 21(60.0%) followed by oval in 13 (37.1%) & only 1 case (2.9%) as round.

It was found that predominant form of echo pattern found in this study was hypoechoic that was in 30 (85.7%) followed by hyperechoic 2 (5.7%) and anechoic 1 (2.9%), isoechoic 1 (2.9%) and 1 (2.9%) in mixed pattern. In this group the USG architecture of the lesion were either homogeneous or heterogeneous. It was found that predominantly homogeneous architecture was found in 21 cases (60.0%) followed by heterogeneous seen in 14 (40%). The ultrasound presented with the post. Echo pattern predominantly as unenhanced in 26 cases (74.3%) and enhanced in 9 cases (25.7%). The characteristic features of tissues were of solid and mixed type. The mixed appearance was predominantly seen in 28 cases (80.0%) and solid in 7 cases (20.0%).

In these study groups all the unilateral inflammatory swellings were compared with clinical and ultrasonographic findings (Table 9). It was found that a total of 5 cases (38.5%) diagnosed as cellulitis which was confirmed on ultrasonography. Similarly 25 cases (71.4%) were diagnosed as abscess clinically but on ultrasonographic evaluation 18 cases (72.0%) were

confirmed as abscess & 7 cases (28.0%) diagnosed as cellulitis. 2 cases (100%) were diagnosed and confirmed as buccal space infection through both clinical diagnosis and USG. Out of 3 cases of rt. Sub mandibular space infection 2 cases (66.66%) were confirmed and 1 case (33.3%) was diagnosed as cellulitis. All these above data explains that P value is 0.001 which is statistically significant. All the result mentioned in the below tables.

**Case 1:** Ultrasonographic features of abscess.



Ultrasonographic Features	Inflammatory Swellings
Boundary of inflammatory Swellings in USG	Very clear
Shape of Inflammatory Swellings in USG	Irregular
Echo Intensity of Inflammatory Swellings	Hypoechoic
USG Architecture of Lesions of Inflammatory Swellings	Heterogeneous
Posterior Echoes in Inflammatory Swellings	Unchanged
USG characteristic of Tissues in Inflammatory Swelling	Mixed
Size of the lesion	6 x 3 mm

**Case 2:** Ultrasonographic features of buccal space abscess.



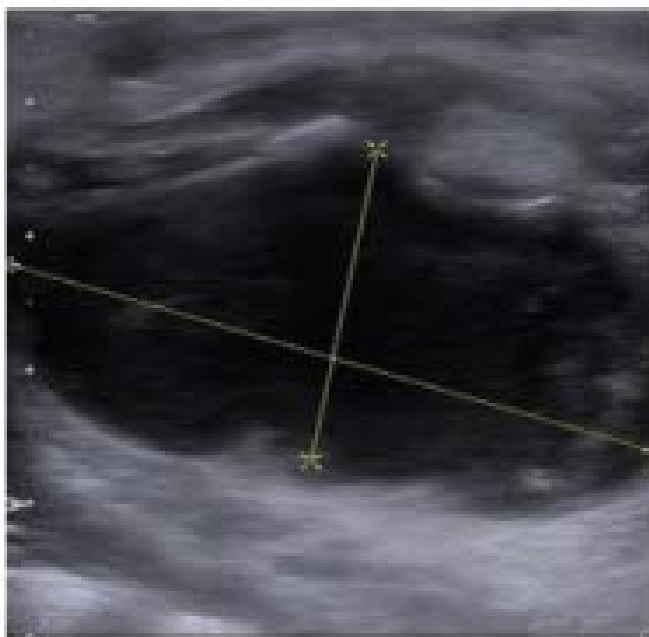
Ultrasonographic Features	Inflammatory Swellings
Boundary of inflammatory Swellings in USG	Ill defined
Shape of Inflammatory Swellings in USG	Irregular
Echo Intensity of Inflammatory Swellings	Hypoechoic
USG Architecture of Lesions of Inflammatory Swellings	Homogeneous
Posterior Echoes in Inflammatory Swellings	Unchanged
USG characteristic of Tissues in Inflammatory Swelling	Mixed
Size of the lesion	9.7 x 7.4 mm

**Case 3:** Ultrasonographic features of cellulitis.



Ultrasonographic Features	Inflammatory Swellings
Boundary of inflammatory Swellings in USG	Ill defined
Shape of Inflammatory Swellings in USG	Irregular
Echo Intensity of Inflammatory Swellings	Hypoechoic
USG Architecture of Lesions of Inflammatory Swellings	Heterogeneous
Posterior Echoes in Inflammatory Swellings	Unchanged
USG characteristic of Tissues in Inflammatory Swelling	Solid
Size of the lesion	-

Case 4: Ultrasonographic features of submandibular space abscess.



Ultrasonographic Features	Inflammatory Swellings
Boundary of inflammatory Swellings in USG	Ill defined
Shape of Inflammatory Swellings in USG	Irregular
Echo Intensity of Inflammatory Swellings	Hypoechoic
USG Architecture of Lesions of Inflammatory Swellings	Heterogeneous
Posterior Echoes in Inflammatory Swellings	Unchanged
USG characteristic of Tissues in Inflammatory Swelling	Mixed
Size of the lesion	38.1 X 32.4mm

## Discussion

Most of the inflammatory swellings which is due to dental diseases occurs either in or around the jaws. In some of the inflammatory swellings such as space infection, diseases of salivary glands, chronic inflammation, abscess formation etc. conventional radiographs do not provide exact origin, type and nature of swellings. It requires additional advanced investigations such as CT, MRI, USG etc.

Most of the inflammatory lesions can be detected and differentiated by ultrasound which provides an accurate information<sup>2 8 31</sup> It has several advantages like it is non-ionizing, noninvasive, inexpensive. It does not causes any health problem and can be repeated as often as necessary.

The present study was carried out in Dept. of OMDR, TMDCRC and Dept. of Radiodiagnosis, TMMCRC. In the present study it was observed that the predilection of female was predominant then male with the age group of 17-60 years which is same as the studies done by Sharma M et al<sup>8</sup>. 2014, Gudi S et al<sup>14 36</sup>. 2013, Pandey P K et al 2011<sup>17</sup> & Mukhi P V et al 2012<sup>14</sup>. It was also found that the distribution of clinically diagnosed swellings was more in periapical abscess 25(71.4%), then cellulitis 5 (14.3%) & less no. of cases in right. Mandibular space infection 3 (8.6%) and buccal space infection 2(5.7%) which is identical to the studies done by Sharma M et al 2014.

Another study was done by Tariq S et al 2018<sup>19 36</sup> who reported that clinical diagnosis of abscess 14(70%) was found and cellulitis in 6 (30%) cases which is similar to present study. In our study we found less no. of cases seen in buccal space and rt. sub mandibular space infection which is not in compliance with the study done by Sharma M et al 2014<sup>20 38</sup> who mentioned that buccal space is the second most commonly involved clinically.

Similarly, it was observed that distribution of swelling through ultrasonography was predominantly seen as periapical abscess (51.5%) followed by cellulitis (37.1%) and least no. of cases in both buccal and sub. Mandibular space inf. (5.7%) respectively which is similar to the studies done by Nawaz K et al 2015<sup>20 35</sup> documented that on ultrasonography most of the cases were found to be abscess (8 cases) and remaining as cellulitis (2 cases) which is in accordance to our study. Another study was done by Sharma M et al 2014<sup>12 30 31</sup> who reported that USG findings showed abscess (46.7%) and cellulitis (33.3%) which is similar to our study. Tariq S et al. 2018 reported that USG showed more cases as abscess (60%) and 40% in cellulitis which in harmony with our study. It was observed that various USG features of inflammatory swellings were recorded in which the boundary was seen to be very clear (31.4%) predominantly followed by ill defined (28.6%), relatively clear (22.9%) and partially clear (17.1%) in harmony with the study done by Chandak R et al 2011<sup>21</sup> mentioned that more no. of swellings showed boundary as relatively clear (51.4%) followed by very clear (34.2%) but in our study most of the cases showed very clear type.

Similarly, another study done by Bhardwaj D et al 2017<sup>26 29</sup> documented that more no. of cases showed relatively clear (60.0%) followed by very clear (24.0%) which is similar to our study. In our study it was found that irregular shape of the swelling was predominantly seen (60%) followed by oval (37.1%) and round (2.9%) which is in agreement to the studies done by Kishore et al 2020<sup>25</sup> stated that more no. of cases were irregular in shape (62.8%) followed by oval shape (10%) which is in harmony to our study. Another study was done by Bhardwaj D et al 2017<sup>26 28</sup> reported that irregular shape of USG showed (48%) then, oval shape (20%) which is

in correlation to our study. A study was done by Chandak R et al 2011<sup>21 27</sup> documented that irregular shape (42.8%) was predominant followed by oval shape (37%) which is in accordance to our study. It was observed that USG echo pattern of inflammatory is found to be predominant as hypoechoic (85.7%) followed by hyperechoic (5.7%) and anechoic, isoechoic and mixed showed as (2.9%), which is in harmony with the studies done by Kishore M et al 2020<sup>11</sup> reported that hypoechoic echo pattern was more predominant than hyperechoic which is similar to our study. Another study was done by Tariq S 2018<sup>19</sup> who stated that hypoechoic appearance is seen in more cases than hyperechoic which is in correlation with our study.

In the present study we found various USG architecture of all the inflammatory swellings in which homogeneous type was more (60%) than heterogeneous (40%) which is similar to the studies done by Tariq S et al 2018 who stated that homogeneous type is more predominant than heterogeneous type which is similar to our study. Another study was done by Chandak R et al 2011<sup>21 22</sup> who reported that homogeneous type of architecture is more (65.4%) which is in harmony with our study. It was found that USG showed posterior echoes as unchanged in most cases (74.3%) followed by enhanced in (25.7%) cases which is harmony to the studies done by Kishore M et al 2020<sup>26</sup> stated that posterior echoes were mostly unchanged (74.2%) and (14.2%) as enhanced which is similar to our study. It was found that ultrasound characteristic of tissues were mostly mixed (80%) and solid type (20%) which is same the study done by Bhardwaj D et al 2017<sup>21</sup> who reported that predominantly tissue characteristic is of solid type (36%) and mixed (12%) which is not in agreement with our study.



All the inflammatory swellings were compared with clinical and USG findings where it was found that ultrasonographic appearance was more predominant in periapical abscess (72%) followed by cellulitis (28%), buccal space infection (100%) and right sub mandibular space infection as (66.66%) respectively which is statistically significant with P value 0.001.

**Conclusion**

The orofacial region is the most common site for development of odontogenic and non-odontogenic infections. Due to the different varieties of lesions occurring in this region, their diagnosis becomes a complex process. Several pathologies may manifest in head and neck region which clinically appears as swellings such as inflammatory & non-inflammatory type.

To diagnose all the swellings, clinical examination must be joined with other investigations such as conventional radiography and advanced imaging technique like CT, MRI, and USG etc. The CT causes heavy radiation exposure and MRI is expensive in cost. The ultrasonography is the most widely accepted imaging technique which is noninvasive, inexpensive, causes no radiation exposure free of metal artifacts and can be done as often as required. USG has got added advantage and it analyzes the above features which cannot be revealed through clinical examination alone. Hence, USG is a best imaging modality coupled with the clinical examination for diagnosing inflammatory swellings of orofacial region.

Table 1: Sonographic Features

Gray scale Sonographic Features	Inflammatory Swellings	No.	Percentage
Boundary	Very Clear	11	31.4
	Relatively Clear	8	22.9
	Partially Clear	6	17.1
	Ill Defined	10	28.6
Shape	Oval	13	37.1
	Irregular	21	60.0
	Round	1	2.9
Echo Intensity	Anechoic	1	2.9
	Iso Echoic	1	2.9
	Hypo Echoic	30	85.7
	Hyper echoic	2	5.7
	Mixed	1	2.9
Architecture	Homogenous	21	60.0
	Heterogenous	14	40.0
Post. Echoes	Enhanced	9	25.7
	Unchanged	26	74.3
Characteristic of Tissues	Solid	7	20.0
	Mixed	28	80.0

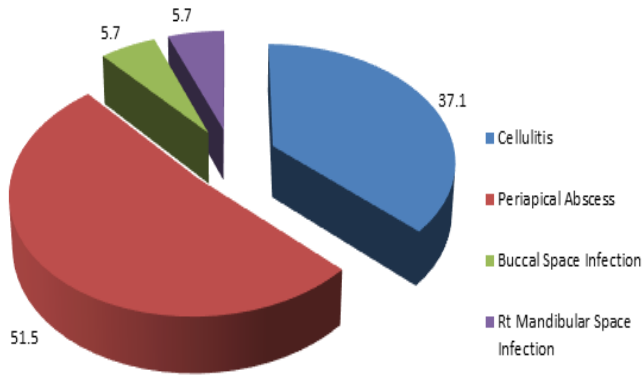
Table 2: Comparison of Diagnosis Based On Clinical Findings and Ultrasonography

		Clinical Diagnosis				Chi Square Value	P Value
		Cellulitis	Periapical Abscess	Buccal Space Infection	Rt Mandibular Space Infection		
Ultrasonography	Cellulitis	5	7	0	1	102.980	0.001 (Significant)
		100.0%	28.0%	0.0%	33.3%		
	Periapical Abscess	0	18	0	0		
		0.0%	72.0%	0.0%	0.0%		
	Buccal Space Infection	0	0	2	0		
		0.0%	0.0%	100.0%	0.0%		
Rt Mandibular Space Infection	0	0	0	2			
	0.0%	0.0%	0.0%	66.66%			

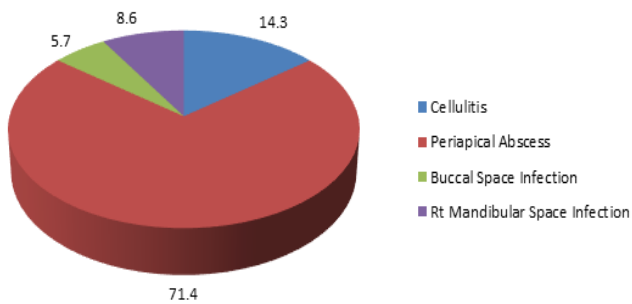
Table 3: Sensitivity, Specificity and Other Parameters Of Ultrasonography

	Value	95% CI
Sensitivity	91.43%	76.94% to 98.20%
Specificity	94.29%	80.84% to 99.30%
Positive Likelihood Ratio	16.00	4.15 to 61.69
Negative Likelihood Ratio	0.09	0.03 to 0.27
Positive Predictive Value (*)	94.12%	80.58% to 98.40%
Negative Predictive Value (*)	91.67%	78.80% to 97.02%
Accuracy (*)	92.86%	84.11% to 97.64%

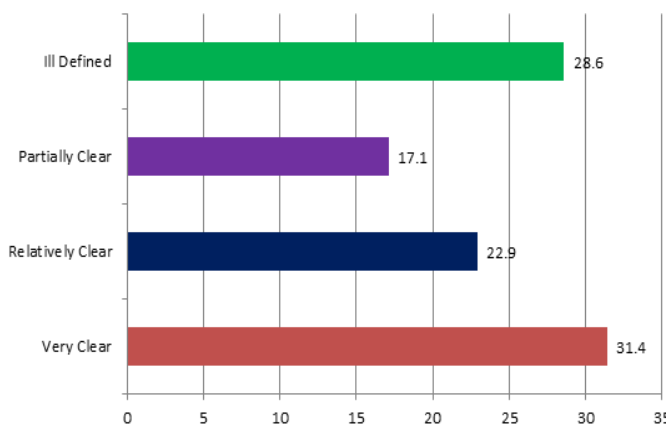
Graph 1: distribution of type of swellings based on clinical diagnosis.



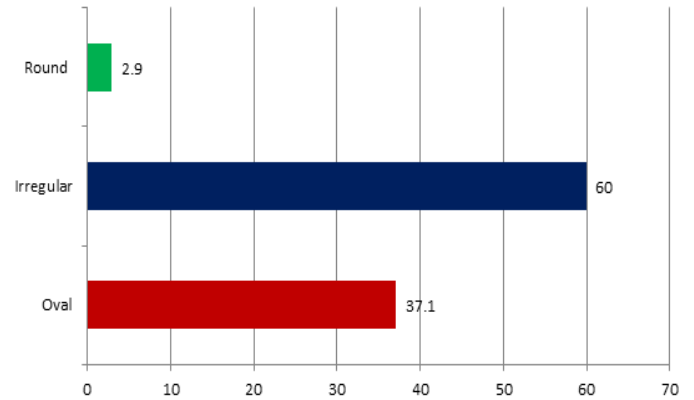
Graph 2: distribution of swellings based on ultrasound.



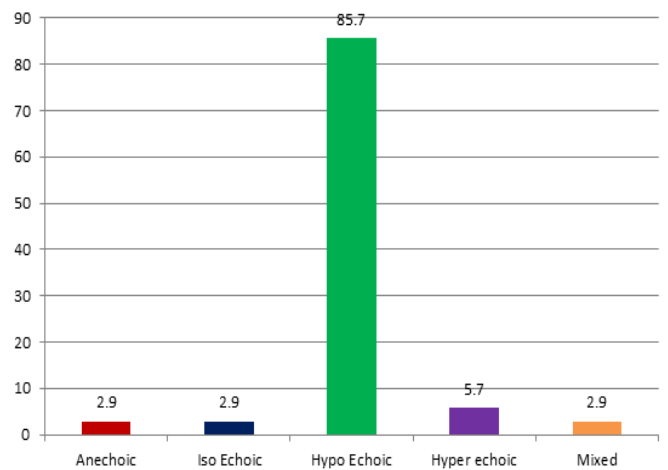
Graph 3: boundary of inflammatory swellings in usg.



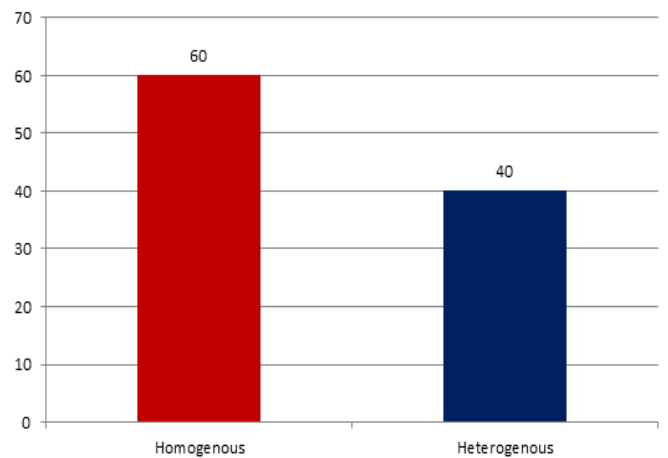
Graph 4: shape of inflammatory swellings in usg.



Graph 5: echo intensity of inflammatory swellings.

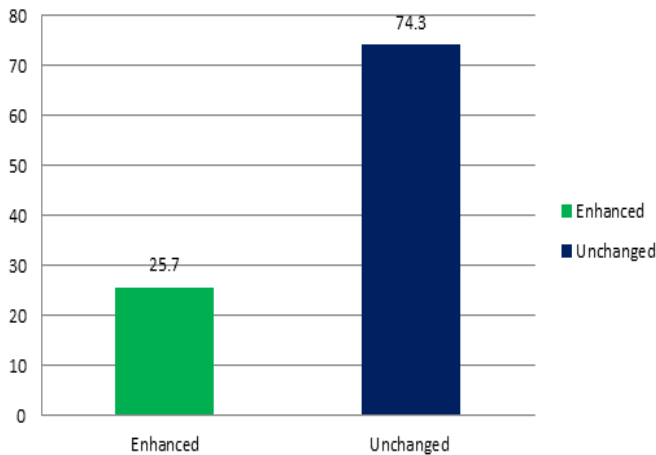


Graph 6: USG architecture of lesion in inflammatory swelling.

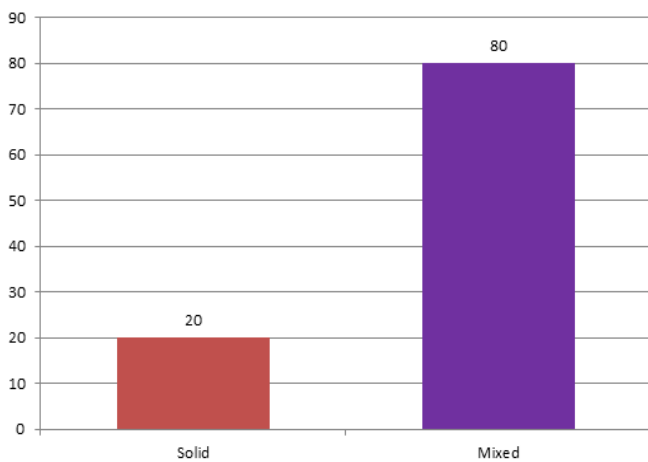




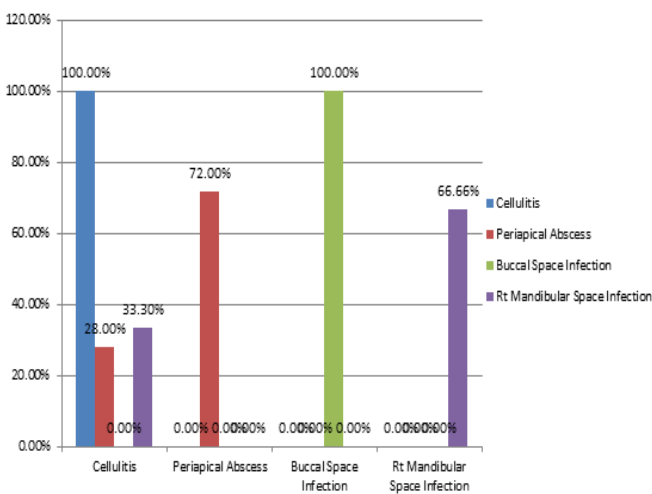
Graph 7: posterior echoes in inflammatory swellings.



Graph 8: USG characteristic of tissues in inflammatory swellings.



Graph 9: comparison of diagnosis based on clinical findings and USG.



## References

1. Bhardwaj D, Efficacy of ultrasonography in head and neck swellings & compare with Histopathological & Clinical Diagnosis, IOSR Journal of Dental & Medical Sciences , March 2017, Vol 16, Issue 3;PP 104-106
2. Sharma M, Ultrasonographic evaluation of facial space infections of odontogenic origin, Journal of Oral & Maxillofacial Radiology, January-April 2014, Vol 12, Issue 1.
3. Garg S, Ultrasonography as a diagnostic tool in orofacial swelling, J Indian Acad Oral Med Radiol 2017;29: 200-4.
4. Srinivas K, Ultrasonographic evaluation of inflammatory swellings of buccal space, Indian J Dent Res, 20(4), 2009.
5. Alok A, Ultrasonography: A boon in dentistry, SRM Journal of Research in Dental Science,2019;10; 98-104.
6. Garg S , Ultrasonography as a Diagnostic tool in Orofacial Swellings, J Indian Acad Oral Med Radiol ,2017, 29: 200-4.
7. Nawaz K K , Role of ultrasound as a diagnostic tool in Superficial Facial Space Infection, International Journal Of Scientific Study, August 2015, Vol 3; Issue 5.
8. Joshi P S, Ultrasonography- A diagnostic modality for oral and maxillofacial disease, Contemporary Clinical Dentistry, July- Sept 2014; Vol 5, Issue 3.
9. R Chandak, An evaluation of efficacy of ultrasonography in the diagnosis of head and neck swellings, Dentomaxillofacial Radiology Radiology (2011) 40,213-221.
10. Aarthi Nisha V, The role of Colour doppler ultrasonography in the diagnosis of facial space infection- A cross sectional study, Journal of

- Clinical and diagnostic research, 2013, May, Vol-7(5): 962-967.
11. Loyer E M, Imaging of Superficial Soft tissue infection- Sonographic Finding in cases of cellulitis & abscess, AJR 1996;149-152.
  12. Shah A, Evaluation of ultrasonography as a diagnostic tool in management of head and neck facial space infection: A clinical study, National Journal of Maxillofacial Surgery, Vol 6, Issue 1, Jan-June 2015.
  13. Bagewadi S B, Ultrasonography of swelling in orofacial region, Journal of Indian Academy of Oral Medicine & radiology, January-March 2010; 22(1), 18-26.
  14. Squire B T, Abscess- Applied Bedside Sonography for convenient Evaluation of superficial Soft Tissue Infections, ACAD EMERG MED, July 2005, Vol.12, No. 7.
  15. Evirgen S, Review on the application of ultrasonography in dentomaxillofacial region. World Radiol 2016, January, 8(1); 50-58.
  16. Gudi S S, Ultrasound guided drainage of sub massetric space abscess, Annals of Maillofacial Surgery, Jan-June 2013, Vol 3, Issue 1.
  17. Sanghar J, Efficacy of ultrasonography in the diagnosis of inflammatory swellings of odontogenic origin, Journal of Indian Academy of oral medicine and radiology, April-June 2012;24(2), 98-101.
  18. Palaskar J N, Role of ultrasonography in dentistry, Journal of Ida North West Delhi Branch, Feb 2015, Vol 1, Issue 1.
  19. Mukhi P U, The use of ultrasonography in diagnosis & management of superficial fascial space infections, Indian Journal of Dental Research, 23(3),2012.
  20. Sngetha P, Ultrasonographic characterization of Jaw swellings- A systemic review IOSR Journal of Dental and Medical Sciences.
  21. Pandey P K, Evaluation of ultrasonography as a diagnostic tool in maxillofacial space infection, J Oral Maxillofac Res 2011, Oct-Dec, Vol 2, No. 4.
  22. Tariq S, Ultrasonography As a Diagnostic Aid In Fascial Space Infection of Odontogenic Origin, International Journal Dental and Medical Sciences Reasearch, Vol 2, Issue 4 (Ap- 2018).
  23. Padda S, Ultrasonographic evaluation of superficial space infection, Journal of Oral & Maxillofacial Radiology/ Sept- December 2016, Vol 4, Issue 3.
  24. Sharma S, Ultrasound as a diagnostic boon in Dentistry- A review, International Journal of Scientific Study, May 2014, Vol 2
  25. Venkataraman S S, The role of diadnostic ultrasound as a new diagnostic aid in oral & maxillofacial surgery ,Journal of Pharmacy & Bioallied, Vol 4, August 2012, Part 1.
  26. Goel S, Ultrasonography with colour doppler in the diagnosis of periapical lesions, Indian journal of Radiology and imaging, Nov 2011, Issue 4.
  27. Tyal U S, Effect of Soft tissue Ultrasound in the management of Cellulitis in the Emergency department, ACAD EMERG MED, April 2006, Vlo 13, No. 4.
  28. Kishore M, Efficacy of ultrasound in the Diagnosis of Swellings of orofacial region- An original Research, J Indian Acad Oral Med & Radiology, 2020, 32:107-14.
  29. Chandar V V, Utility of ultrasonography as adjunct to diagnosis in certain orofacial lesions over the clinical & radiological evaluation- A comparative study, Journal of Indian Academy of Oral Medicine and Radiology, Jan-March 2009, Vol 21, Issue 1.

30. Sato N W, Advanced Clinical Usefulness of Ultrasonography for Diseases in Oral & Maxillofacial Regions, International Journal of Dentistry, Vol 10.
31. Shah S J, Clinical Application of Ultrasonography in diagnosing head & neck swellings, J Oral Maxillofac Radiol 2017,5: 7-13.
32. Evirgen S, Review on the applications of ultrasonography in dentomaxillofacial region, World J Radiol 2016, January 28;8(1), 50-58.
33. Hayashi T, Application of ultrasonography in dentistry. Jpn Dent Sci Rev 2012, 48(1); 5-13.
34. Swetarchi et al, Maxillofacial Applications of ultrasonography, Journal of Dental Sciences & Rehabilitation, April- June 2016;7(2), 74-77.
35. Vivekananda R G,Raj Shekhar P, Ultrasonographic imaging of orofacial diseases- A review. Ann Essence Dent: 2011; 3:100-4.
36. Bhosle G R, Greyscale ultrasonography as a new diagnostic aid in oral & maxillofacial surgery, Journal of Indian Dental Association 1992;62:165-67.
37. Dhamera A et al. Ultrasonographic evaluation of inflammatory changes in masseter muscle, JIAOMR,2011 23(4), 576-578.
38. Tiwari B, Ultrasonography & colour doppler indiffrential diagnosis of periapical cyst & granuloma. Journal of Contemporary Dentistry 2014, 4(1): 17-21.