

Ultrasonography As A Diagnostic Aid In Fascial Space Infections Of Odontogenic Origin

Dr Saima Tariq¹, Dr Altaf Hussain Chalkoo², Dr Zahoor Bhat³,
Dr Rizwan Hamid⁴

^{1,3,4}Post graduate scholar, Oral medicine & Radiology, Govt Dental College Srinagar.

²Prof. and Head, Oral medicine & Radiology, Govt Dental College, Srinagar.

*Corresponding Author: ¹Dr Saima Tariq

ABSTRACT

Objective; The aim of the present study was to evaluate the efficacy of ultrasound in diagnosing fascial space infections of odontogenic origin.

STUDY DESIGN; The study group comprised of 20 subjects of either gender with unilateral fascial space infections of odontogenic origin. After a clinical working diagnosis was made, patients were subjected to USG followed by USG guided aspiration.

RESULTS; The sensitivity and specificity of clinical diagnosis was found to be 91.7% and 62.5% whereas the sensitivity & specificity of ultrasonography for diagnosis of fascial space infections of odontogenic origin was 100%.

CONCLUSION; USG is an effective adjunctive imaging modality for diagnosing fascial space infections of odontogenic origin.

KEYWORDS; Ultrasound, ultrasound guided aspiration, odontogenic

I. INTRODUCTION

One of the common sequelae of poorly controlled odontogenic infections is their spread to fascial spaces of head & neck rather than exiting via oral or cutaneous routes. These fascial spaces are potential spaces unless separated by pus, blood or by surgical manipulation.^{1,2} Along these fascial planes, infection may spread from its dental source to a distant location. This spread of infection can be detrimental as its progression may lead to respiratory obstruction thereby necessitating immediate management.³

Extraoral swellings of odontogenic origin need differentiation of their inflammatory processes as edema, cellulitis and abscess respectively. This differentiation is necessary as edema and cellulitis readily respond to conservative treatment whereas an abscess may require surgical intervention besides conservative measures.⁴ This demarcation is quite difficult based on clinical and conventional radiographic examination alone. Clinical examination mainly involves palpation which practically is of no use in deep seated infections as of submasseteric space infection. Plain radiographs lack the provision of good definition of soft tissues.⁵ Advanced imaging modalities like CT and MRI may be of immense boon but the cost and limited availability limits their use. The need for adjunctive diagnostic aid to correctly identify the stage of infection brings ultrasonography to the forefront as it is cost effective, readily available, non-invasive and a quite sensitive tool.⁶ Use of ultrasonography can aid in the diagnosis of swellings and also in locating the depth of the purulence to allow a more accurate location for an incision and drainage procedure over the traditional blind procedure.⁴

This study was carried out to evaluate the efficacy of ultrasonography in the diagnosis and management of fascial space infections of odontogenic origin and its predictability in detecting the stage of infection.

II. MATERIALS AND METHODS

The study sample consisted of 20 patients, presenting to the Department of Oral Medicine and Radiology with fascial space infections of odontogenic origin, with following inclusion & exclusion criteria;

2.1 Inclusion criteria

1. Subjects presenting with unilateral fascial space infections of odontogenic origin of either gender and irrespective of age.

2.2 Exclusion criteria

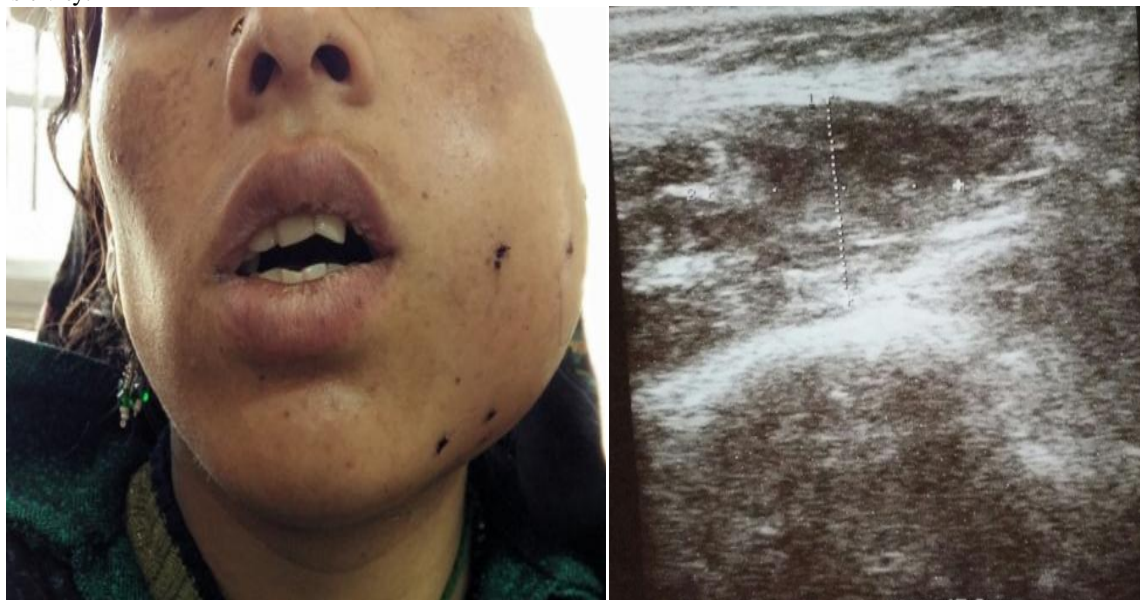
1. Individuals who required immediate emergency management.
 2. Individuals who were non-ambulatory.
 3. Individuals involving fascial spaces of contra lateralside too.
- A detailed clinical examination both intraoral and extraoral was carried out and relevant findings pertaining the origin ,involvement and extension of infection , were noted. These clinical findings were confirmed by radiographic examination which involved either intraoral periapical (IOPA) or panoramic radiographs varying from case to case. After evaluating the clinical and radiographic findings, a working diagnosis was made and noted down.
 - The patients were then subjected to USG examination using a linear array transducer with a frequency of 6-10 MHz in both transverse and axial sections to determine the nature of fascial space infection. Bilateral images from infected and non-infected sides were taken for comparison.
 - The gray scale images were described as follows:³
 - Hyperechoic (brighter)
 - Isoechoic (darker)
 - Anechoic (no internal echoes)
 - Mixed signals

This information was used for staging the infection as follows:

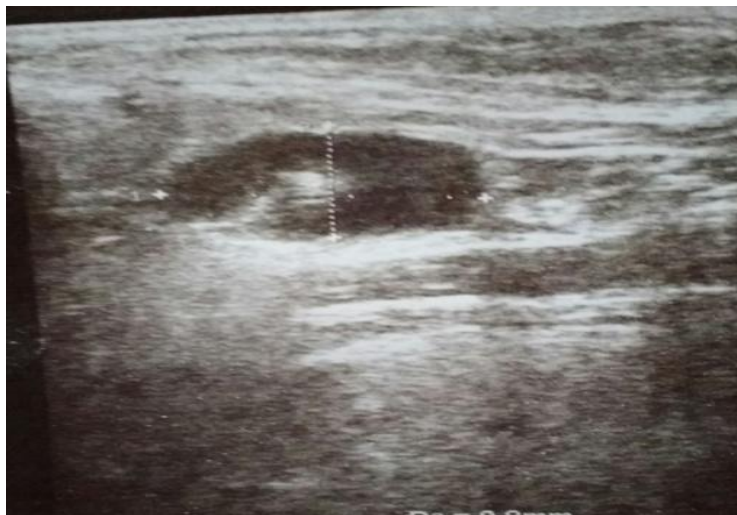
- Edematous changes: The echogenicities of the tissues were isoechoic, similar to the normal or uninfected side but with an increase in the fluid contents.
 - Cellulitis: The echogenicities of the tissues were higher (hyperechoic) than normal because of massive inflammatory infiltration to the infected region.
- Preabscess stage: The echogenicities of the tissues were mixed (hypoechoic and hyperechoic) at the end of cellulitis stage and the beginning of abscess formation stage.
- Abscess stage: The echogenicities of the tissues were absent (anechoic) because of the abscess cavity, which can be solitary or multiple well-defined foci of pus.

A USG based diagnosis was made after interpretation of images by the radiologist.

Following USG diagnosis, under aseptic conditions USG guided intraoperative aspiration was performed in all cases. The patient was placed in the supine position with head tilted towards unaffected side. After visualising the abscess cavity using ultrasound, a 20 gauge needle mounted on 10ml disposable syringe was inserted perpendicular to the scanning plane. The aspirate was collected and sent for microbiological culture sensitivity.



SUBMANDIBULAR & BUCCAL SPACE INFECTION USG Showing a hypoechoic lesion



Hypoechoic submandibular lymph node



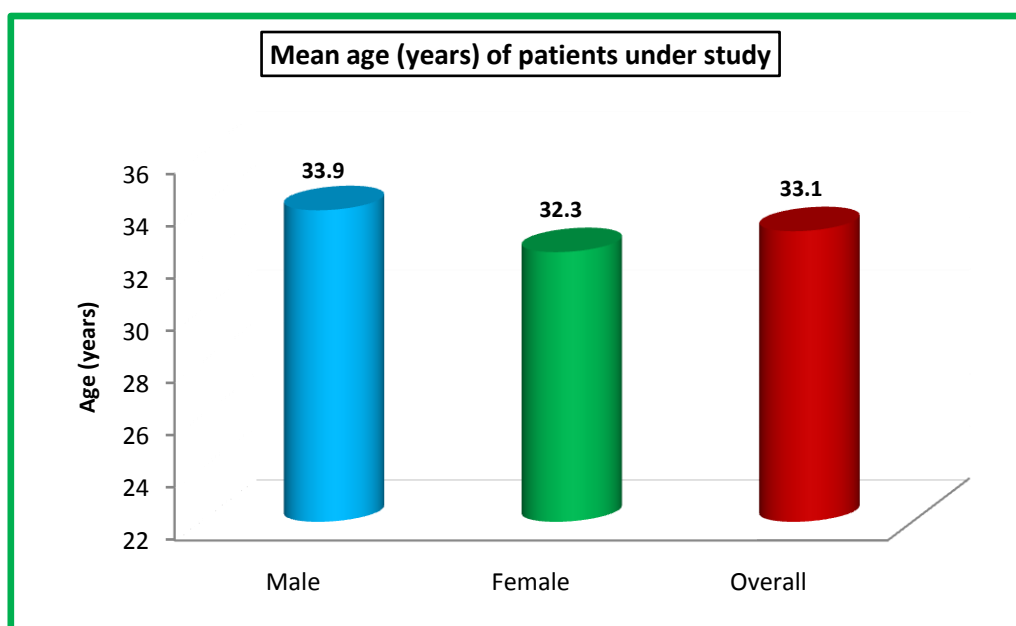
BUCCAL SPACE INFECTION (CELLULITIS) HYPERECHOIC LESION WITH INCREASED VASCULARITY



III. RESULTS

Among 20 subjects included in the study, 10 were males with a mean age of 33.9 years & 10 females with a mean age of 32.3 years.

Table 1: Age distribution of patients as per gender				
Age (years)	No.	Mean	SD	Range
Male	10	33.9	9.87	18-47
Female	10	32.3	10.54	22-55
Overall	20	33.1	9.97	18-55

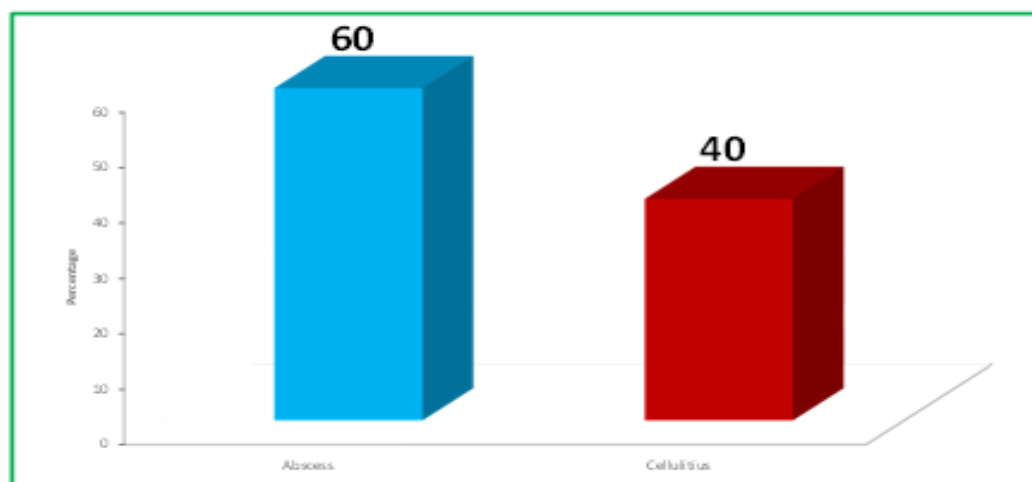


Buccal and submandibular spaces (8 spaces each, 36.4%) were most commonly involved spaces followed by canine (4 spaces, 18.2%) and submasseteric space (2 spaces, 9.1%) respectively.

Table 2: Ultrasonography results of fascial space involvements					
Fascial Space Involved	Clinical Findings		USG Findings		Types of fascial spaces
	No.	%age	No.	%age	
Submandibular space	8	36.4	8	36.4	Superficial
Submental space	0	0.0	0	0.0	Superficial
Buccal space	8	36.4	8	36.4	Superficial
Canine space	4	18.2	4	18.2	Superficial
Submasseteric space	2	9.1	2	9.1	Superficial

Ultrasonography showed that out of 20 cases abscess was found in 12 cases (60%) and cellulitis in 8 cases (40%). None of our cases had edema. Abscess presented mostly as well defined homogenous hypoechoic lesion whereas cellulitis presented as ill-defined heterogenous hyperechoic lesion.

USG findings in study patients



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Table 3: USG Findings In Abscess Cases

Patient No.	Space Involved	Edge Definition	Pattern	Intensity
CaseNo 1	L submasseteric	Ill-Defined	Homogenous	Hypoechoic
CaseNo 2	L submandibular	Well Defined	Homogenous	Hypoechoic
CaseNo 5	L buccal &submandibular	Well Defined	Homogenous	Hypoechoic
CaseNo 8	R canine space	Well Defined	Homogenous	Hypoechoic
CaseNo 9	L submandibular	Ill-Defined	Homogenous	Hypoechoic
CaseNo 10	L caninespace	Well Defined	Homogenous	Hypoechoic
Case No 11	L submasseteric	Well Defined	Homogenous	Hypoechoic
CaseNo 12	R buccal space	Well Defined	Homogenous	Hypoechoic
CaseNo 13	L buccal &submandibular	Well Defined	Homogenous	Hypoechoic
CaseNo 15	R submandibular	Well Defined	Homogenous	Hypoechoic
CaseNo 18	R canine space	Ill-Defined	Homogenous	Hypoechoic
Case 19	L submandibular	Ill-Defined	Homogenous	Hypoechoic

Table 4: USG Findings In Cellulitis Cases

Patient No.	Space Involved	Edge Definition	Pattern	Intensity
CaseNo 3	L buccal	Ill Defined	Heterogenous	Hyperechoic
CaseNo 4	L submandibular	Ill Defined	Heterogenous	Hyperechoic
CaseNo 6	R buccal	Ill Defined	Heterogenous	Hyperechoic
CaseNo 7	L buccal	Ill Defined	Heterogenous	Hyperechoic
CaseNo 14	L buccal	Ill Defined	Heterogenous	Hyperechoic
CaseNo 16	R canine	Ill Defined	Heterogenous	Hyperechoic
CaseNo 17	L buccal	Ill Defined	Heterogenous	Hyperechoic
CaseNo 20	R submandibular	Ill Defined	Heterogenous	Hyperechoic

COMPARISON OF CLINICAL DIAGNOSIS AND ULTRASONOGRAPHIC DIAGNOSIS

Table: Comparison of clinical working diagnosis and ultrasonographic diagnosis by crosstabs				
Clinical Working Diagnosis	Ultrasonographic Diagnosis			P-value
	Abscess	Cellulitis	Total	
Abscess	11 (78.6%)	3 (21.4%)	14	0.018
Cellulitis	1 (16.7%)	5 (83.3%)	6	
Total	12 (60%)	8 (40%)	20	

On comparing the findings of clinical diagnosis with USG diagnosis, 11 (78.6%) of 14 diagnosed cases of abscess showed a positive correlation. 3 (21.4%) diagnosed cases of abscess were found to be cellulitis on USG.

In cases of cellulitis out of 6 cases diagnosed clinically 5 (83.3%) showed a positive correlation whereas 1 (16.7%) was found to be abscess on USG.

The overall correlation between clinical diagnosis & USG diagnosis showed a statistical significance, with a P value of 0.018.

COMPARISON OF CLINICAL WORKING DIAGNOSIS AND USG GUIDED INTRAOPERATIVE ASPIRATION

A clinical diagnosis of abscess was made in 14 (70%) cases and cellulitis in 6 (30%) cases out of 20 subjects included in the study whereas USG guided intraoperative aspiration showed abscess in only 12 cases (60%) and cellulitis in 8 cases (40%) respectively.

On comparing the results of two, only 11 (78.6%) diagnosed cases of abscess showed a positive correlation. 3 cases (21.4%) diagnosed as abscess clinically were found to be cellulitis on USG guided intraoperative aspiration. Similarly in case of cellulitis positive correlation was found only in 5 cases (83.3%) out of 6 clinically diagnosed cases of cellulitis. 1 case (16.7%) with a diagnosis of cellulitis was found to be abscess on USG guided intraoperative aspiration.

The overall correlation between clinical diagnosis and USG guided intraoperative diagnosis shows a statistical significance, with a P value of 0.018.

The sensitivity and specificity of clinical diagnosis was found to be 91.7% and 62.5% respectively with a positive predictive value of 78.6 and a negative predictive value of 83.3.

Table: Comparison of clinical working diagnosis and 'USG guided intra operative aspiration' by crosstabs				
Clinical Working Diagnosis	USG Guided Intra Operative Aspiration			P-value
	Abscess	Cellulitis	Total	
Abscess	11 (78.6%)	3 (21.4%)	14	0.018
Cellulitis	1 (16.7%)	5 (83.3%)	6	
Total	12 (60%)	8 (40%)	20	

COMPARISON OF ULTRASONOGRAPHIC DIAGNOSIS AND USG GUIDED INTRAOPERATIVE ASPIRATION

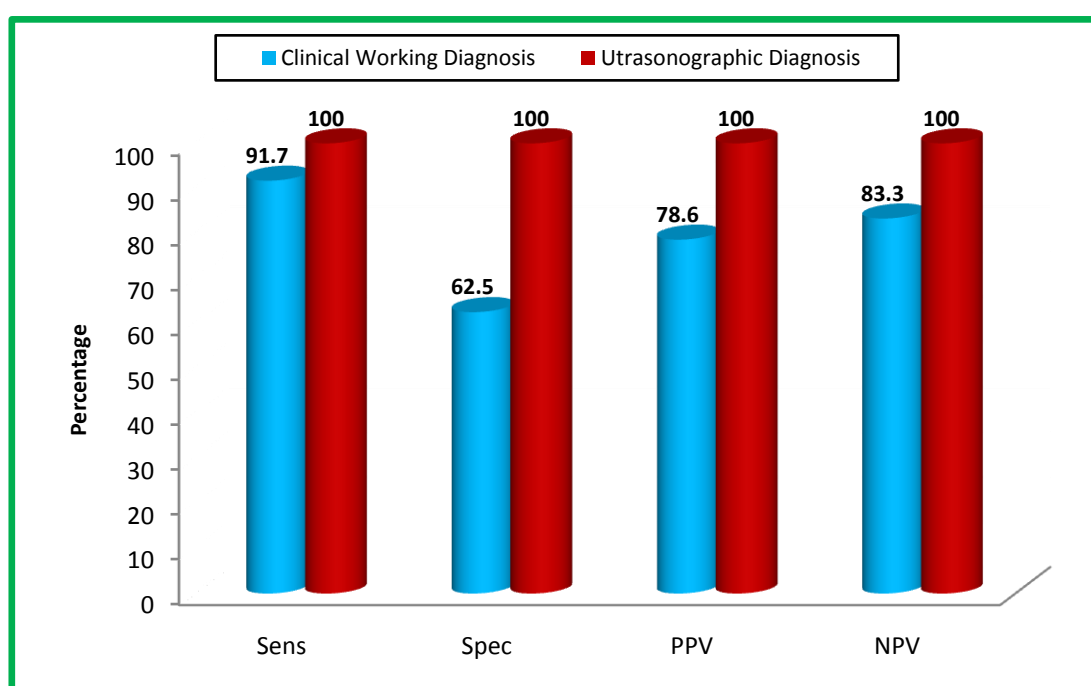
Out of 20 cases included in the study, Ultrasonography showed abscess in 12 (60%) cases and cellulitis in 8 (40%) cases.

Comparison of USG diagnosis with USG guided intraoperative aspiration, showed a positive correlation in all the 12 cases of abscess and 8 cases of cellulitis.

The results were highly statistically significant with a P value of <0.001 which indicates that the sensitivity & specificity of ultrasonography for diagnosis of fascial space infections of odontogenic origin was 100%.

Table: Comparison of ultrasonographic diagnosis and 'USG guided intra operative aspiration' by crosstabs				
Utrasonographic Diagnosis	USG Guided Intra Operative Aspiration			P-value
	Abscess	Cellulitis	Total	
Abscess	12 (100%)	0 (0.0%)	12	<0.001
Cellulitis	0 (0.0%)	8 (100%)	8	
Total	12 (60%)	8 (40%)	20	

Table: Diagnostic accuracy of clinical working diagnosis and ultrasonographic diagnosis				
	Sens	Spec	PPV	NPV
Clinical Working Diagnosis	91.7%	62.5%	78.6%	83.3%
Utrasonographic Diagnosis	100%	100%	100%	100%



IV. DISCUSSION

Odontogenic infections are one of the major sources of fascial space infections in the head and neck region 1,2. Evaluation and management of patients with acute odontogenic infections can be difficult due to the dilemma of whether there is, in fact, an abscess requiring surgical intervention or a cellulitis that can be managed satisfactorily with only supportive care. Use of ultrasonography can aid in the diagnosis of swellings and also in locating the depth of the purulence to allow a more accurate location for an incision and drainage procedure over the traditional blind procedure.

The purpose of the study was to evaluate the efficacy of USG and USG guided aspiration with clinical examination alone in diagnosing stages of cellulitis and abscess in patients with fascial space infections of odontogenic origin as correct diagnosis is important for appropriate management. However, it has been suggested that the two conditions (abscess and cellulitis) may coexist making diagnosis difficult which in turn may lead to missed abscesses and/or unnecessary invasive procedures. Failure to diagnose correctly may lead to inappropriate or delayed therapy which in turn can lead to medical complications, extra emergency department, and increased costs.⁴

Out of 20 subjects included in our study, 10 were males with a mean age of 33.9 years and 10 females with a mean age of 32.3 years. These findings are in contrast to findings of Shah et al where 12 patients were males and 8 females⁷

Submandibular and buccal spaces(36.4%) were most commonly involved primary spaces. The lower molars, primarily second and third molars have roots which are below the attachment of mylohyoid muscle, and the lingual cortical plate is thinner as compared to the buccal cortical plate. Odontogenic infections from these teeth will perforate the lingual cortical plate in most cases, resulting in submandibular facial space infection. Infections from maxillary molar teeth and mandibular first molar will result in buccal facial space infection. The roots of permanent maxillary molars are above the attachment of buccinator muscle while the roots of mandibular permanent first molar are below the attachment of buccinator muscle. In the maxilla the buccal cortical plate is thinner than the palatal plate and fenestration in the buccal cortical plate favors the spread of infection to the buccal space.⁸ A different pattern was found by Mohit et al where submandibular space (34.8%) was involved mostly followed by buccal space (23.2%)⁹, Rega et al ;submandibular 30%and buccal space 27.5%¹⁰ and Labriola et al ;submandibular 20%and buccal space 20%¹¹.

In the present study out of the 20 study subjects, a clinical working diagnosis of abscess and cellulitis was rendered in 14 (70%) cases and 6 (30%) cases, respectively. On USG & USG-guided intraoperative aspiration abscess was found to be in 12 (60%) cases and cellulitis in 8 (40%) cases. This is in accordance with the findings of Squire et al⁴ but contrast to higher incidence of cellulitis cases found by Pelgel et al⁶.

Out of 14 cases diagnosed clinically as abscess a positive correlation was found in only 11(78.6%) cases on USG. 3(21.4%) of the cases diagnosed as abscess clinically were found to be cellulitis on USG&USG guided aspiration. A higher incidence of diagnosing abscess clinically in comparison with diagnosing cellulitis is also in accordance with study conducted by Aarthi et al¹².

In case of cellulitis, out of 6 cases diagnosed clinically as cellulitis only 5(83.3%) proved to be cellulitis on USG. 1 case (16.7%) was found to be abscess on USG&USG guided aspiration.

The overall correlation between clinical diagnosis, USG&USG guided aspiration diagnosis showed a statistical significance, with a P value of 0.018.

out of 20 cases, clinically, a correct diagnosis was made in 16 cases. The sensitivity and specificity of clinical diagnosis was found to be 91.7% and 62.5% respectively with a positive predictive value of 78.6 and a negative predictive value of 83.3. These findings emphasize the importance of sound clinical knowledge in diagnosing fascial space infections. Similar results were noted with various other studies.^{13,14}

Comparison of USG diagnosis with USG guided intraoperative aspiration, showed a positive correlation in all the 12 cases of abscess and 8 cases of cellulitis. The results were highly statistically significant with a P value of <0.001 which indicates that the sensitivity & specificity of ultrasonography for diagnosis of fascial space infections of odontogenic origin was 100%. These findings are in accordance with Bassony et al³ & Mohit et al.⁹

A study was performed in 1987 by Ralf Siegert¹⁵ in which; USG seemed to show a slightly higher (82%) sensitivity than the clinical diagnosis (69%). When looking at the diagnosis of inflammatory swellings USG seemed to be clearly superior to the clinical diagnosis. Chandak et al (2011)¹⁶ stated that clinical diagnosis had a sensitivity and specificity of 85.7% whereas sonographic diagnosis had a sensitivity of 97.1% and specificity of 100%. Srinivas K et al 2009¹⁷ stated that the sensitivity of clinical criteria over ultrasonographic diagnosis was 96% with a specificity of 100%.

V. CONCLUSION

USG is an effective adjunctive diagnostic aid in the management of fascial space infections of odontogenic origin. By correctly identifying the stage of infections, it averts unnecessary surgical procedure of drainage.

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***Corresponding Author: ¹Dr Saima Tariq**

^{1,3,4}Post graduate scholar ,Oral medicine & Radiology , Govt Dental College Srinagar .