ORIGINAL RESEARCH PAPER

Surgery

EFFICACY OF USG IN DETECTION OF FRACTURES IN MAXILLOFACIAL TRAUMA

KEY WORDS: Ultrasonography, ANOVA

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ABSTRACT

INTRODUCTION:
Ultrasonography is an ultrasound based diagnostic imaging technique used for visualizing subcutaneous body structures . In this study , the widely used soft tissue diagnostic tool - the ultrasonogram is compared with routine imaging modalities such as radiographs and CT in the diagnosis of hard tissue discontinuities.

METHODOLOGY
A prospective study was conducted including 20 individuals who had facial bone fractures who reported to the department of oral and maxillofacial surgery, vinayaka mission sankarachariyar dental college from year June 2016 to October 2017.

DISCUSSION:
Descriptive statistics such as ANOVA Test And T - Test were used to compare the results among conventional radiography, CT, and USG.

CONCLUSION:
Ultrasonogram can be used an effective method of investigation in diagnosis of maxillofacial fractures. With proper guidelines for the positioning of the transducer probes and developing specilaised probes for maxillofacial anatomical structures, USG can be an effective alternative diagnostic method.

INTRODUCTION

Maxillofacial trauma implies soft tissue injuries such as burns, lacerations and bruises and hard tissue injuries such as fractures of the facial bones. There are a number of possible causes of maxillofacial trauma such as Motor vehicle accidents , accidental falls , sports injuries, interpersonal violence and work related injuries. As per literature , motor vehicle accidents are the most common cause for fractures.Types of facial injuries can range from injuries of teeth to extremely severe injuries to the maxillofacial region.[1] Fractures of maxillofacial region include maxilla, mandible, nasoethmoid, zygomaticomaxillary, frontal bones which may or may not be associated with head injuries. Mandibular condyle fractures are the most common fractures reported in literature. Diagnosis of maxillofacial fractures are based on clinical and radiographic findings. Radiaographs taken for maxillofacial fractures commonly are Paranasal sinus view, Submentovertex view, PA view mandible , orthopantomograph ,occlusal radiographs, Intra oral periapical. Computed Tomography is a useful diagnostic tool in maxillofacial fractures.[2]

Ultrasonography is an ultrasound based diagnostic imaging technique used for visualizing subcutaneous body structures including tendons, muscles, joints, bone surface, vessels and internal organs for possible pathology or lesions The creation of an image from sound is done in three steps.

1.producing a sound wave
2.receiving echoes and
3.interpreting the echoes.

A sound wave is typically produced by a peizoelectric transducer encased in a housing which can take a number of forms. Strong, short electrical pulses from the ultrasound machine make the transducer ring at the desired frequency.

The frequencies can be anywhere between 2 and 18 MHz. The sound is focused either by the shape of the transducer, or a lens in front of the transducer,or a complex set of control pulses from the ultrasound beam machine.

This focusing produces an arc-shaped sound wave from the face of the transducer. The wave travels into the body and comes into focus at a desired depth. The return sound wave vibrates the transducer and the transducer turns the vibrations into electrical pulses that travel to the ultrasonic scanner where they are processed and transformed into a digital image.[3,4]

In this study , the widely used soft tissue diagnostic tool - the ultrasonogram is compared with routine imaging modalities such as radiographs and CT in the diagnosis of hard tissue discontinuities.

METHODOLOGY

A prospective study was conducted including 20 individuals who had maxillofacial fractures reported to the department of oral and maxillofacial surgery, vinayaka mission sankarachariyar dental college from year June 2016 to October 2017. All age groups both male and female with facial bone fractures were included in this study. Mentally challenged individuals . Those not consenting to be the part of the study. Patients under critical care unit (patients who are unconscious, disoriented, non-ambulatory.) were excluded from the study. Investigations like USG, CT facial bones and X-Rays (OPG, PNS view, Sub-mento vertex, AP skull, Lateral oblique.) were taken. The Routine radiological investigations and CT were evaluated by radiologist of the grade of Professor and compared with USG for the extent and clarity of fracture line by the same faculty.

Evaluation of patients involved a history and clinical examination, followed by ultrasonograph, CT Scans, and conventional radiographs. The history included Demographic data , Chief complaint , History of trauma, Duration of trauma , Etiology of trauma.

Case sheet proforma

Name :
Age :
Sex :
Occupation :
Address :
Ph.no :

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Chief complaint :
History of presenting illness :
General examination :
Extra oral examination :
Intra oral examination :
Provisional diagnosis :

Investigations
- USG
- CONVENTIONAL RADIOGRAPHS
- OPG
- PA View
- PNS view
- Submento vertex
- Lateral oblique
- CT

Final Diagnosis :
Treatment plan :
Treatment done'

MANDIBULAR FRACTURE

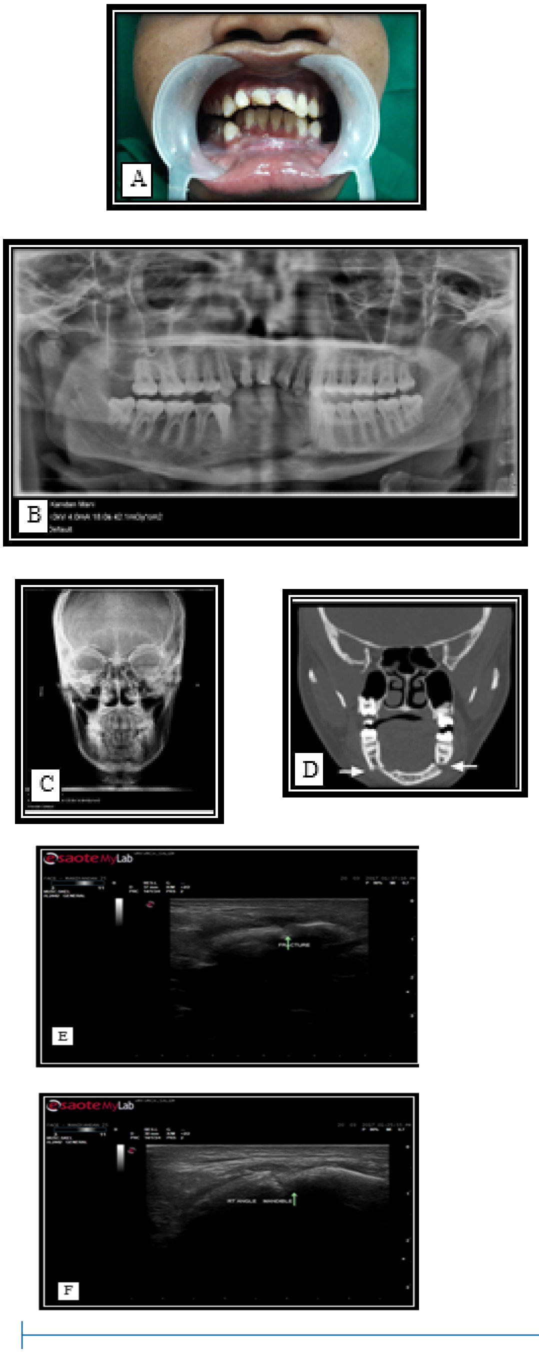


FIG (1). A) Clinical Picture , B) OPG , C) PA SKULL view , and D) CT bilateral parasymphysis fracture , E) USG Parasymphysis fracture , F) USG – Angle fracture

ZYGOMA FRACTURE

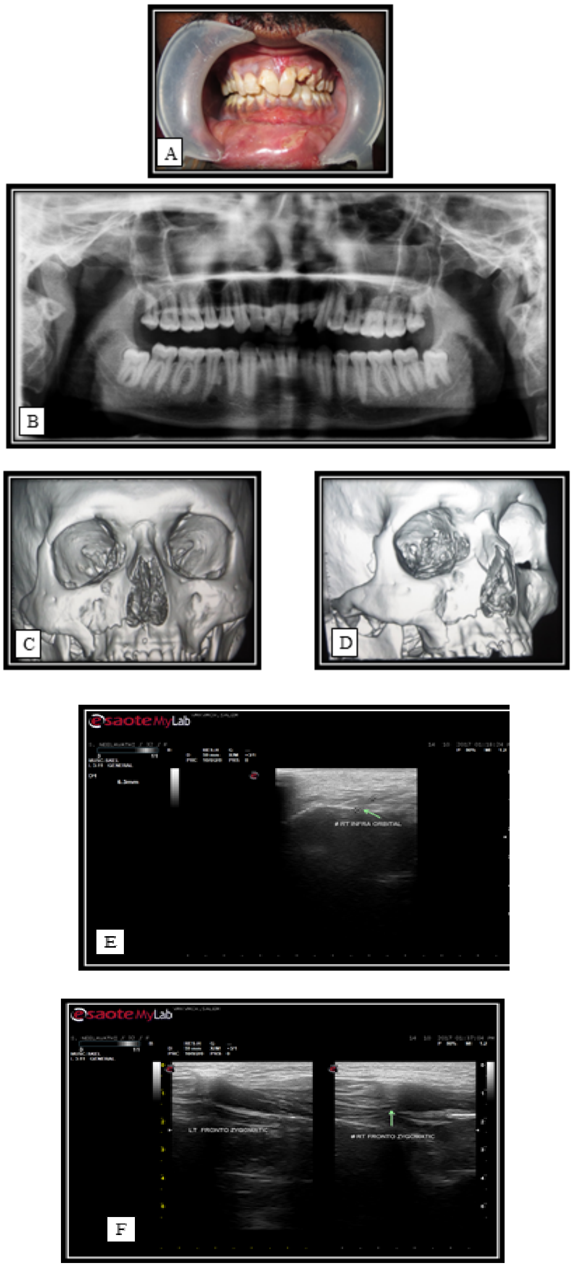


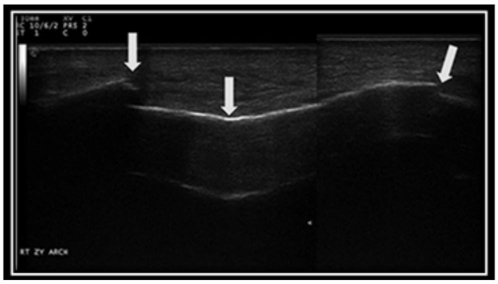
FIG (2). A) Clinical Picture B) OPG C) and D) CT ImageE) USG - Infraorbital fracture and F) USG – Zygomatic fracture

Technique

Patients had undergone ultrasonographic examination of the maxillofacial fractures with a Saote My Lab Scanner ultrasound system with 7.5 MHz small linear transducer was used. The patients' head was turned to the opposite side while he or she was being examined in the supine position. After application of sterile gel, the probe was placed over the traumatized area to locate the fracture and its whole length was evaluated. Any interruption in the continuity of the white line of the contour, including displacement was considered as fracture. Same procedure carried out on the opposite side.Fractures of maxilla, zygoma and mandible were identified as interruption in white line.

SAOTE MY LAB SCANNER

TRANSDUCER PROBE POSITIONING



USG IMAGE OF FRACTURE LINE

RESULTS

Sensitivity = TP/ (TP+FN)*100
Specificity = TN/(TN+FP)*100
Positve predictive value = TP/(TP+FP)
Neg Predictive = TN/(TN+FN)
TP – True positive
TN- True negative

CT	Test + (Seen)	Test _(Not seen)	
Frac	Tp15	FN0	15Sensitivity
No Frac	FP0	15TN	15Specificity
	15Positive predictive value	15Negative Predictive	30

Accuracy -30/30=100%
Sensitivity – 15/15 = 100
Specificity – 15/15 = 100
PDF - 15/15 = 100
NPV -15/15 = 100

Conventional Radiographs	Test +	Test _	
Frac	TP14	FN1	15Sensitivity
No Frac	FP1	14TN	15Specificity
	15Positive predictive value	15Negative Predictive	30

Accuracy -29/30=100%
Sensitivity – 14/15 = 93.33
Specificity – 14/15 = 93.33
PDF - 14/15 = 93.33
NPV -14/15 = 93.33

USG	Test +	Test _	
Frac	TP15	FN0	15Sensitivity
No Frac	FP0	15TN	15Specificity
	15Positive predictive value	15Negative Predictive	30

Accuracy -30/30=100%
Sensitivity – 15/15 = 100
Specificity – 15/15 = 100
PDF - 15/15 = 100
NPV -15/15 = 100

Statistical Analysis

Descriptive statistics were used to compare the results among conventional radiography, CT, and USG. ANOVA Test And T - Test were Used and The Results Were Tabulated.

The findings of each diagnostic modality were compared with the diagnosis based on clinical examination and intraoperative findings. The accuracy, sensitivity and specificity of CT in detecting fracture was 100%, 100% and 100% respectively. The accuracy, sensitivity and specificity of conventional radiographs in detecting fracture was 100%, 93.33% and 93.33% respectively. The accuracy, sensitivity and specificity of USG in detecting fracture was 100%, 100% and 100% respectively.

INVESTIGATOR 1

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
CT	15	1.00	.000	.000	1.00	1.00	1	1
Conventional radiographs	15	.93	.258	.067	.79	1.08	0	1
USG	15	1.00	.000	.000	1.00	1.00	1	1
Total	45	.98	.149	.022	.93	1.02	0	1

ANOVA

	Sum of Squares	df	Mean Square	F	P
Between Groups	.044	2	.022	1.000	.376
Within Groups	.933	42	.022		
Total	.978	44			

INVESTIGATOR 2

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
CT	15	1.00	.000	.000	1.00	1.00	1	1
Conventional radiographs	15	.93	.258	.067	.79	1.08	0	1
USG	15	.87	.352	.091	.67	1.06	0	1
Total	45	.93	.252	.038	.86	1.01	0	1

ANOVA

	Sum of Squares	df	Mean Square	F	P
Between Groups	.133	2	.067	1.050	.359
Within Groups	2.667	42	.063		
Total	2.800	44			

T-Test, Investigator 1

	Method	N	Mean	Std. Deviation	Std. Error Mean
Fracture score	CT	15	1.00	.000(a)	.000
	USG	15	1.00	.000(a)	.000
Fracture score	CT	15	1.00	.000	.000
	USG	15	.87	.352	.091

a t cannot be computed because the standard deviations of both groups are 0.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Fracture score	Equal variances assumed	4.639	.040	1.000	28	.326	.07	.067	-.070	.203
	Equal variances not assumed			1.000	14.000	.334	.07	.067	-.076	.210
Fracture score	Equal variances assumed	4.639	.040	1.000	28	.326	.07	.067	-.070	.203
	Equal variances not assumed			1.000	14.000	.334	.07	.067	-.076	.210

T-Test , Investigator 2

	Method	N	Mean	Std. Deviation	Std. Error Mean
Fracture score	CT	15	1.00	.000(a)	.000
	USG	15	1.00	.000(a)	.000
Fracture score	CT	15	1.00	.000	.000
	USG	15	.87	.352	.091

t cannot be computed because the standard deviations of both groups are 0.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Fracture score	Equal variances assumed	12.033	.002	1.468	28	.153	.13	.091	-.053	.319
	Equal variances not assumed			1.468	14.000	.164	.13	.091	-.062	.328

Group Statistics

	Method	N	Mean	Std. Deviation	Std. Error Mean
Fracture score	Conventional radiographs	15	.93	.258	.067
	USG	15	1.00	.000	.000
Fracture score	Conventional radiographs	15	.93	.258	.067
	USG	15	.87	.352	.091

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Fracture score	Equal variances assumed	4.639	.040	-1.000	28	.326	-.07	.067	-.203	.070
	Equal variances not assumed			-1.000	14.000	.334	-.07	.067	-.210	.076
Fracture score	Equal variances assumed	1.463	.237	.592	28	.559	.07	.113	-.164	.297
	Equal variances not assumed			.592	25.688	.559	.07	.113	-.165	.298

Descriptive statistics such as ANOVA Test And T - Test were used to compare the results among conventional radiography, CT, and USG. ANOVA Test And T - Test were used and the results were tabulated.

As per our results , the accuracy, sensitivity and specificity of CT in detecting fracture was 100%, 100% and 100% respectively. The accuracy, sensitivity and specificity of conventional radiographs in detecting fracture was 100%, 93.33% and 93.33% respectively. The accuracy, sensitivity and specificity of USG in detecting fracture was 100%, 100% and 100% respectively.

The ANOVA description shows the mean value between groups with 1st investigator was 0.022 and within groups was 0.022 which gives a p value (.376) more than 0.005. The mean value between groups with 2nd investigator was 0.067 and within groups was 0.063 ,which gives a p - value (.376) more than 0.005. and hence there was no significance in ANOVA Test. T- test was tabulated comparing CT with USG and conventional radiographs with USG . T test cannot be computed because the standard deviations of both groups are 0, showing no significance between groups.

DISCUSSION

Takashi Hirai et al (1996)3 described this method for the observation of relatively deep areas. So, in this study the usefulness of echography in examining facial bone fractures was evaluated and compared with other diagnostic measures. From our study,we found out, ultrasonic echography as an instant, non-invasive method for the observation of hard tissues also. Takashi Hirai et al discussed about the use of ultrasonography as an instant, non-invasive method and observation of deep areas. Echography can be used to diagnose even minimal fractures especially in cases where only the conventional radiograph was available and the image is often unclear.

The plane radiographs obtained in emergency settings are frequently of minimal diagnostic value . Fractures of the mandibular symphysis,body, and angles are easily identified clinically; subcondylar fractures,however are not directly accessible for clinical examination. The evaluation of suspected dislocated subcondylar fractures with the aid of ultrasonography is reliable,highly sensitive and specific, and cost-effective. Kleinheitz et al(1999)5,6 Diagnostic studies,such as computed tomography scans, are sometimes not useful for the evaluation of mandibular fractures, since cuts are performed too superiorly. The plane radiographs obtained in emergency settings are frequently of minimal diagnostic value. Fractures of the mandibular symphysis,body, and angles are easily identified clinically; subcondylar fractures,however are not directly accessible for clinical examination.The evaluation of suspected dislocated subcondylar fractures with the aid of ultrasonography is reliable,highly sensitive and specific, and cost-effective.

The limitations of the study is the small sample size. The fractures that were assessed in the study were uncomplicated fractures with minimal edema. The USG is an useful tool for detection of fractures , but the reliability of this diagnostic tool can be ascertained only on studying its efficacy in a large sample including different types of maxillofacial fractures. The detection of fractures involving bones which are located at depth like the ethmoid, ptrygoid , base of skull by the USG is questionable.

CONCLUSION

Based on our study, we conclude that ultrasonography is a safe investigation method in diagnosing maxillofacial fractures. It is an inexpensive and an alternative modality of investigation method to reduce the radiation exposure as in case of conventional radiographs and Computerised tomography . Ultrasonography is an easier method for positioning the patient , especially the patients with cervical spine injuries and in case of pregnant women. Main drawbacks include limited penetration into bone and gas filled structures, less spatial resolution at deep tissues and lack of expertise in using USG as a diagnostic aid.

Ultrasonogram can be used an effective method of investigation in diagnosis of maxillofacial fractures. Especially in mandibular fractures. With proper guidelines for the positioning of the transducer probes and developing specilaised probes for maxillofacial anatomical structures, USG can be an effective alternative diagnostic method.

REFERENCES

1. Angelopoulos C ; Anatomy of the maxillofacial region in the three planes of section. Dent Clin North Am. 2014 Jul58(3):497-521. doi: 10.1016/j.cden.2014.03.001.
2. Ceallaigh PO, Ekanaykaee K, Beirne CJ, et al; Diagnosis and management of common maxillofacial injuries in the emergency department. Part 1: Advanced trauma life support. Emerg Med J. 2006 Oct23(10):796-7.
3. Takashi Hirai et al: Ultrasonic observation of facial bone fractures: Report of cases. J Oral maxillofac surg.54:776-779,1996.
4. Akisuki H et al; Ultrasonographic evaluation during requetion of zygomatic arch fractures. J Cranio-maxillofac surg 118: 263-566.1990.
5. Kleinheinz et al.Ultrasonographic versus conventional diagnostic procedures in dislocated subcondylar mandibular fractures.J Craniomaxillofac trauma. 3(2):40-2, 1997.
6. Kleinheinz et al. Indications for treatment of subcondylar mandibular fractures. J Craniomaxillofac Trauma 5(2):17-23,1999.