

Comparison Between The Sensitivity Of Ultrasound and Conventional X-Rays In Diagnosing Nasal Bone Fracture

دراسة مقارنة حساسية فحص السونار والأشعة السينية في تشخيص حالات كسر العظم الأنفي

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الخلاصة:

جريت في مدينة الصدر الطبية في النجف- العراق للفترة من شهر تموز 2011 ولغاية آذار 2012 35 مريض وكانت أعمارهم تتراوح بين 1-45 سنة ومصابين بكسر العظم الأنفي والذين خضعوا للفحص السريري.

الهدف من الدراسة: تقييم دقة جهاز السونار مقابل أشعة () لتشخيص الكسر

طريقة العمل: الأنف جانبيا و جهاز السونار دون معرفة نتائج

النتائج: 35 مريض والذين تم فحصهم بواسطة جهاز السونار والأشعة وكان

المرضى مقسمين 30 5 إناث وكان معدل أعمارهم 18.63 كذلك سجلت الدراسة حساسية جهاز الأشعة ونسبة 60 %

وخصوصية هذا الجهاز ونسبة 86.7 % السريري. وسجلت الدراسة أيضا حساسية جهازا لسونار ونسبة 80 %

وخصوصية هذا الجهاز ونسبة 6.7 % السريري. قد أظهرت الدراسة الحالية مقارنة بين الفحصين من حيث الحساسية

والخصوصية () 80 % 6.7 % 60 % 86.7 % . وأظهرت النتائج توزيع المرضى

المصابين بكسر العظم 54.3 % 37.1 % 11.4 % 14.3 %

(ضرر بيتي حوادث طريق) 34.3 % 11.4 %

54.3 % 37.1 % 62.9 %

الاستنتاج: حساسية في تشخيص كسر العظم الأنفي من أشعة () التقليدية

والإصابة المباشرة هي شيو عا .

التوصيات: فحص السونار لتأكيد حالات كسر الأنف بعد فحصهم سريريا وخصوصا عند الأطفال والرضع

وبتوسعة الدراسة لتشمل متابعة المرضى بعد علاجهم.

Abstract:

A cross-sectional study was conducted in AL- Sadir medical city in AL Najaf-Iraq, during the period between July 2011 to March 2012, 35 patients aged 1 to 45 years with nasal bone fracture who underwent physical examination Aim: To evaluate the sensitivity of ultrasound in the diagnosis of nasal bone fracture in comparison with conventional X ray sensitivity.

Aim of study: to evaluate the sensitivity of ultrasound in the diagnosis of nasal bone fracture versus sensitivity of X-ray.

Patient & method: these patients were examined by conventional lateral nasal bone radiography followed by sonography without knowing the result of x-ray report and physical examination.

Results: In this study a 35 patients who had nasal bone fracture according to physical examination were investigated by sonography and radiography. Of these patients, 30 were men and 5 were women, with mean age of patients was 18.63 years. The current study revealed an x ray sensitivity approaching 60% , specificity was 86.7%. respectively. While the results showed that ultrasonography sensitivity was 80% , specificity was 6.7%. compared with clinical examination. The present study showed comparison of both tests that ultrasonography sensitivity was 80% , specificity was 6.7% while x-ray was 60%, 86.7% . Also the results showed patients gender distribution of the nasal bone fracture with female and male percentage of 14.3% and 85.7% respectively. The results showed depending on trauma type domestic , RTA, and direct, the percentage rate was 34.3%, 11.4% and 54.3 % respectively. Also the results showed

that frontal trauma associated with nasal bone fracture is 62.9% while a lateral trauma associated with nasal bone fracture is 37.1% .

Conclusions : Ultrasound is more sensitive test than x-rays in the diagnosis of nasal bonefracture and males are more exposed to nasal bone fracture than females with direct trauma is the predominant cause for nasal bone fracture.

Recommendation: Using ultrasound to confirm nasal bone fracture after clinical examination especially in children and pregnancy because it safer, cheaper , more sensitive and real time scan& to expanding the study to include follow up of patient after treatment .

Key words: nasal bone fracture, x-ray, ultrasound

INTRODUCTION :

Nasal bone pyramid is a complex structure consisting of two nasal bones and two frontal processes of maxillary bone ⁽¹⁾. Nasal fractures are the most common mid-facial fracture and accounts to 40% of bone fractures in the facial trauma ⁽²⁾. In addition, it is the third most common type of the whole body fractures, after clavicle and wrist fractures. The symptoms usually include edema, crepitus, ecchymoses, deformity, pain, nasal obstruction and epistaxis ⁽³⁾.The extent of injury depends on amount of force, strength of blow to nose, direction of the force and object that inflicted injury ⁽⁴⁾.

Kucik *et al* (2004) mentioned that fractured nasal bones diagnosis depends on the clinical examination, which is easier in the first 3 hours after injury. Radiological evaluation for fractured nasal bones is not usually helpful with a high incidence of false positive results because of the misinterpretation of normal suture lines or developmental thinning of the nasal bones. Its also difficult to distinguish old fractures from new ones on plain films, because only 15% of nasal bone fractures heal by ossification, also plain film limited by their inability to detect cartilaginous injuries which more prevalent in pediatric cases , but it provides a medico legal documentation for nasal fracture ⁽⁵⁾.Nasal X-ray is usually recommended. However, it has the disadvantage of low-test sensitivity and a low-test specificity, while the clinical examination in experienced hands may be more valuable ⁽²⁾. High-resolution ultrasonography now offers a promising diagnostic imaging option ⁽⁶⁾.

High-resolution ultrasonography can be used as an accurate technique for evaluating nasal bone fracture, and conventional radiography can be replaced by high-resolution ultrasonography⁽¹⁾.Also recorded that ultrasonography can be considered an alternative to radiography, with equivalent diagnostic performance. While Fouad *et al* (2009) found that ultrasonography is superior to conventional X-ray, so that ultrasonography can be a useful tool for the diagnosis of nasal fractures.

Nasal bone fracture is one of the most common fractures among the facial bones in patients with a maxillofacial injury ⁽⁸⁾. It involves 39% of maxillofacial bone fractures ⁽⁹⁾. This fracture is more common in men than women by a ratio of 2 to 1 ⁽¹⁰⁾.Nasal bone fracture is common between 15–25 years of age but after 60 years, a second peak in incidence is observed.⁽¹¹⁾ In general, young people are more susceptible to fractures and displacement but in the elderly, comminuted fractures are more common⁽¹²⁾.

Almost 80% of nasal bone fractures occur between the middle third and the inferior part of the nose ⁽¹³⁾. Many studies have shown that radiography cannot be used accurately for the routine evaluation of nasal bone fractures, Studies show that radiographic investigations were negative in 25% of patients with nasal bone fracture who needed surgical operation⁽¹⁴⁾.

In regard to nature of injury; most fractures results from laterally applied forces, over 66 % in a serious reported. By contrast, fractures following injures accounted for 13 % in

this series ⁽¹⁵⁾. General force is required to fracture the nose with a blow directed from the front as the nasal cartilage behave like shock absorbers.

In regard to pattern of fracture; nasal fractures can also be subdivided into three broad categories that characterize the patterns of damage sustained with increasing force. This classification has some practical utility as each category of fracture requires a different method of treatment ⁽¹⁶⁾.

Classification of Nasal Fractures:

-Class 1: fractures are the results of low – moderate degrees of force and hence the extent of deformity is usually not marked. The simplest form of a class 1 fracture is the depressed nasal bone. The fractured segment usually remains in position due to its inferior attachment to the upper lateral cartilage which provides an element of recoil. The nasal septum is generally not involved.

-Class 2: fractures are the results of greater force and are often associated with significant cosmetic deformity. In addition to fracturing the nasal bone, the frontal process of the maxilla and septal structures are also involved.

The ethmoid labyrinth and adjacent orbital structures remain intact. As a rule of thumb, if the nasal dorsum is deviated laterally greater than half the width of the nose (grade 2 or greater fracture) then septal fracture must also be present.

-Class 3: Fractures are the most severe nasal injuries encountered and usually results from high velocity trauma. They are also termed naso-orbito-ethmoid fractures and often have associated fractures of maxillae. The external buttresses of the nose give way and the ethmoid labyrinth collapses on itself. This causes the perpendicular plate of the ethmoid to rotate and the quadrilateral cartilage to fall backwards. These movements cause a classic (pig like) appearance to the patient, with a foreshortened saddled nose and nostrils facing more anteriorly, like the snout of a pig. ⁽¹⁷⁾.

In clinical presentation; key issues to be considered when determining history include: ⁽³⁾

Details of how the injury was sustained, nasal obstruction, change in appearance, epistaxis, hyposmia, rhinorrhoea, visual disturbance, diplopia, epiphora, altered bite, loose teeth, trismus.

On examination; key issues to be considered when examining a patient include:

- 1- Deviation, depression, step deformities.
- 2- mobility, crepitus, specific areas of point tenderness.
- 3- generalized swelling.
- 4- skin laceration.
- 5- septal fracture / haematoma / abscess / perforation.
- 6- mucosal laceration ⁽⁴⁾.

Investigation :

The need for nasal x –rays is controversial and in many places it is actively discouraged. Unlike other fractures, nasal x-rays are not required in order to make the diagnosis or aid subsequent reduction. In a prospective study undertaken by (Illum *etal*) ⁽¹⁵⁾, it was concluded that x-rays were not cost effective. Their only possible utility is proof of injury in subsequent litigation. If there is clinical evidence of a more serious facial injury a computerized tomography (CT) scan should be acquired. Samples of any rhinorrhea must be collected in those with suspected cerebrospinal fluid (CSF) leak and tested for B₂ transferrin ⁽¹⁸⁾.

Ultrasound is a sound with a frequency greater than 20,000 cycle/sec (Hertz). Medical sonography employs frequencies between 1 megahertz (MHz) and 20 MHz . These high frequencies are produced by subjecting a special ceramic material, piezoelectric crystal, to a short-voltage spike. A group of synthetic piezoelectric materials called (ceramic ferroelectric) have replaced the piezoelectric crystal materials that were used earlier. Although PZT (Lead Zirconate Titante) is currently the most widely used materials, research suggests that certain plastic polymers may soon replace these synthetic ceramic in the construction of ultrasound transducers.⁽²¹⁾

A transducer: is advice that can convert one form of energy into another. Ultra sonic transducers are used to convert an electric signal into ultra sonic energy that can be transmitted into tissues and to convert ultrasonic energy reflected back from the tissues into electric signal .

The most important component is a thin(a approximately 0.5 mm) piezoelectric crystal element located near the face of the transducer .The front and back faces of the crystal are coated with a thin conducting film to ensure good contact with two electrodes that will supply the electric field used to strain the crystal .The term strain refers to deformity of the crystal caused when a voltage is applied to the crystal ⁽⁵⁾.

AIM OF THE STUDY :

To evaluate the sensitivity of ultrasound in the diagnosis of nasal bone fracture versus sensitivity of x-ray .

PATIENTS AND METHOD:

This cross-sectional study was carried out from July 2011 to March 2012 in AL Sader Medical city in AL-Najaf. Informed written questioner was obtained from all the patients.(Appendix 2-1).

The study group consisted of 35 patients with nasal bone fracture who were investigated by an otolaryngologist by physical examination for a medical or legal indication and their age ranged between 1-45 years. Patients were then examined by conventional radiography and sonography. Physical examination was considered as the gold standard for the diagnosis of nasal bone fracture. All patients were investigated radiographically by a lateral view x-ray at the beginning. The results were evaluated by a experienced radiologist .

The reports were then recorded as either “positive” or “negative” according to the existence of nasal bone fracture. Then, patients were examined by sonography. Sonographic examinations were done by another radiologist who was blinded to the results of radiography or physical examination, using a Siemens ultrasound machine and a 7.5 MHz linear probe. All sonographic examinations were performed by a radiologist who was expert in soft tissue and musculoskeletal imaging. The radiologists were informed of the primary diagnosis without knowing the physical examination and also of each other’s diagnostic reports. Patients were examined in the supine position and in right, left and longitudinal views for evaluating the right and left side, the lateral wall and the dorsum of the nose (Fig. 2-3). The positive criterion for sonographic observation was cortical disruption of the nasal pyramid, Soft tissue edema and subperiosteal hematoma were also examined as a possible predictor to differentiate an acute from a chronic fracture.

The negative and positive likelihood ratios (LR- and LR+), specificity (Sp), sensitivity (Se), NPV and PPV with their 95% confidence interval were calculated and used for determining the diagnostic accuracy.

Radiographic preparation (X-ray).

Film format: (18x24cm) or (8x10 inch). While Source imaging distance (SID) : 105cm and Generating setting including : Focus (44 kv) , mAs (6.3).

Position : Prone – remove any braces ,dental prostheses ,etc. the side of the head is contact with the table- the ipse-lateral arm should be stretched out alongside the body – the opposite arm is angled to provide support- the median plane of the skull is parallel to the plane of the film.

Centre : To the root of the nose. While Radiation protection : Lead apron.(Siemens AG).⁽²³⁾.

Statistical Analysis :

Data collected from the patients' history, examination, intraoperative findings, X-ray and ultrasonography findings entered to soft wear SPSS (version 10). The descriptive statistical analysis includes sensitivity, specificity, positive predictive value and negative predictive value compared the clinical, intraoperative diagnosis and X-ray findings with ultrasonography.

RESULTS

In this study, 35 patients who had nasal bone fracture by physical examination were investigated by sonography and radiography. Of these patients, 30 were men and 5 were women. The mean age of patients was 18.63 years. Also the results showed distribution of patients depending on gender that the nasal bone fracture in female and male was 14.3% and 85.7% respectively .(Figure 1).

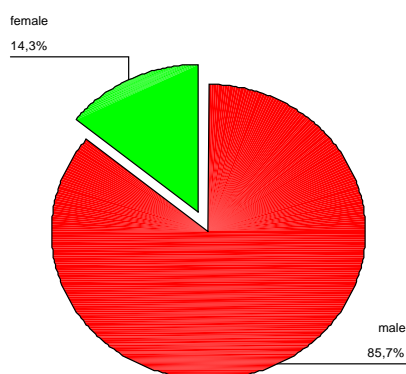


Figure (1) Gender distribution of Nasal bone fracture.

TYPE OF TRAUMA

While the results showed trauma type (Domestic ,RTA, Direct) with percentage rate was 34.3%, 11.4% and 54.3 % respectively. Also the results showed direction of trauma (lateral , frontal) with percentage was 37.1% and 62.9% respectively.(Figure 2,3)

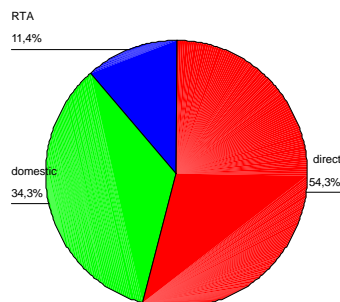


Figure (2) : Type of trauma in nasal bone fracture.

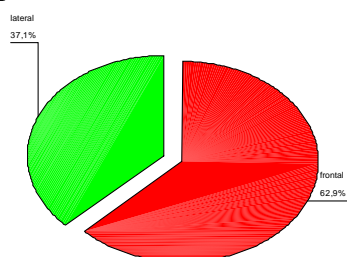


Figure (3) : The direction of trauma in nasal bone fracture.

3.Sensitivity and Specificity :

Table (1) The sensitivity and specificity of X-ray as compared with clinical examination.

		Clinical Examination		Total
		+ve	-ve	
X-ray	+ve	12	2	14
	-ve	8	13	21
Total No. of patients		20	15	35

Table (1), The Results Showed That X-Ray Sensitivity Was 60% & Specificity Was 86.7%., Compared With Clinical Examination .

-Sensitivity= 60%.

-Specificity= 86.7%..

Table (2) The sensitivity and specificity of ultrasound

Test		Clinical Examination		Total
		+ve	-ve	
U/S	+ve	16	14	30
	-ve	4	1	5
Total patients	No. of	20	15	35

While in table (2), the results showed that ultrasonography sensitivity was 80% , specificity was 6.7%., compared with clinical examination .

Sensitivity= 80%

-Specificity= 6.7%

Table (3) The sensitivity and specificity of companied Ultrasound and X-ray examination.

Test	Sensitivity %	Specificity%
X-ray	60	86.7
U/S	80	6.7

In table (3) and figure (4),showed comparison of the results of both tests that ultrasonography sensitivity was 80% , specificity was 6.7%, while X-ray was 60%, 86.7 respectively.

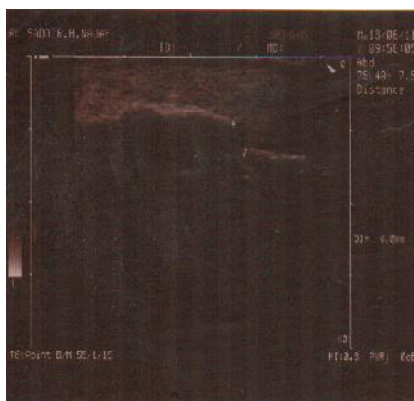
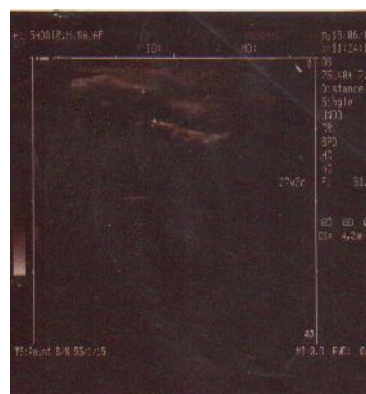
**A****B****C**

Figure (4): Lateral view of the nose (A) and ultrasound image (B&C)in apatient with a fractured nasal dorsum.

DISCUSSION

Ultrasound is a form of energy that consists of high frequency mechanical vibrations not audible to the human ear⁽³¹⁾. It is a non-invasive diagnostic procedure and does not produce ionization. It is rapid and painless and has no known deleterious

biological effect⁽³²⁾. When it was introduced to head and neck medicine, it was restricted to the imaging of superficial structures of the head and neck and was thought to have a limited role in bony lesions⁽³³⁾. Following improvements in ultrasound technology and the advent of high resolution ultrasonography, it is now being used routinely in the examination and diagnosis of bone pathology⁽³⁴⁾.

Ultrasound facilities are widely available, at any level of health care⁽³⁵⁾. The cost of investigation is comparatively cheap, it is less dependent on patient cooperation and the technical sensitivity of patient positioning is minimal, ultrasonographic imaging can be done in real-time, allowing dynamic and three-dimensional imaging⁽³⁶⁾. The equipment is portable enough to be moved into the operating room for intraoperative imaging and the evaluation of fracture reduction⁽³⁷⁾.

Depending on gender distribution the results showed that the male more exposure for nasal bone fracture (External trauma) than females with percentage rate was 85.7 % and 14.3 % respectively, this may be due to nature of work for males and also to fight and this results is agreement with⁽¹¹⁾.

Also the results showed depending on direction and type of trauma was direct frontal with percentage rate 54.3 % and 62.9% respectively, these results may due to that the commonest trauma occurs by direct (boxing, fighting or falling from high place) this results is agreement with⁽²⁹⁾.

In regard to sensitivity and specificity; diagnosis of fracture nasal bone is usually done clinically early after trauma. However, with development of edema, accurate evaluation can be difficult⁽¹⁾. Because of the low sensitivity of radiography, the diagnosis of nasal bone fracture is usually performed by physical examination⁽²⁴⁾. Ultrasonography has been recommended for such evaluation that Thiede *et al* (2005), were recommended a 10MHz probe for diagnosis of the fracture nasal bone with clear view. If ultrasound is performed using such a small part applicator, as the first imaging modality in cases of suspected facial fractures by an experienced investigator, the visualization of fracture lines can avoid conventional imaging⁽²⁵⁾.

In our study, we used 7.5 MHz ultrasound probe, that give us a clear view of the surface with easy diagnosis of fracture nasal bones and we found that the sensitivity of sonography was 80% in diagnosing nasal bone fracture is more than radiography which was 60 %, the results of this study were similar to those from⁽²⁶⁾ who used a 5–7.5 MHz probe, and also were similar to the studies of Danter *et al* (1996) who reported a Sensitivity of 83% and a Specificity of 50% using a 20-MHz sonography probe compared to physical examination⁽²⁷⁾.

Also we found that Ultrasonography is considered as an alternative to radiography, with equivalent diagnostic performance in evaluation of the nasal pyramid and It can locate fracture line with high accuracy and this results is agreement with⁽²⁸⁾.

Adeyemo and Akadiri (2011) found that ultrasonography has shown very high accuracy for the detection of nasal bone fractures with sensitivity ranging from 90% to 100%, specificity of 98–100% when they examined 171 patients⁽³⁸⁾.

While Gurkov *et al* (2009) showed that high sensitivity (98 and 88% for US and XR, respectively) when they examined 80 patients⁽⁶⁾.

Ultrasonography has the advantages of being a rapid procedure for evaluation, no radiation hazard is implicated, so can be suitable during pregnancy. It is a less expensive tool and no cooperation from the patient is usually needed ⁽⁵⁾.

CONCLUSIONS

1. 1-Ultrasound is more sensitive than x-ray in diagnosing of nasal bonefracture in acute trauma setting.
2. Males more exposed to nasal bone fracture than females .
3. Direct trauma (boxing) is the commonest cause of nasal bone fracture.

Difficulties :

A-Patient with acute painful state and such scan may be more tender that make the patient in cooperative specially the children .

B-Difficulty in detecting non displaced fractures.

C- Detailed bony imaging may be precluded in acute situations with extensive facial edema and emphysema.

RECOMMENDATIONS

1-Usingultrasound to support nasal bone fracture after clinical examination especially in children and pregnancy because itmore safer, cheaper, more sensitive and real time scan.

2- Expanding the study to include follow up of patient after treatment.

REFERENCES

- 1-Thiede, O; Krömer, J.H; Rudack, C; Stoll, W; Osada ,N. and Schmä, F. (2005). Comparison of ultrasonography and conventional radiography in the diagnosis of nasal fractures. Arch Otolaryngol Head Neck Surg .;131:434-9.
- 2-Kucik, C.J ; Clenney, T and Phelan J.(2004). Management of acute nasal fractures. Am.Fam Physician.. 70(7): 1315-20.
- 3-Michael, G.(1997). Fractures of the facial skeleton. Scott Brown'sOtolaryngology. Sixth edition. 4/16/1-4/16/31.
- 4- Hirai, T; Manders, E.K; Nagamoto, K. and Saggars, G.C. (2009). Ultrasonicobservation of facial bone fractures: report of cases
- 5- Phelps, P.D. (1997).Radiology of the nose and paranasal sinuses. In ScottBrown'sOtolaryngology, , vol. 4, sixth edition.
- 6-Gurkov, R. Clevert, D.and Krause, E. (2009). Sonography versus plain X- rays in diagnosisof nasal fractures. Am J. Rhinol.; 23(2): 238-243.
- 7-Fouad,T.R.;Rifaat,M.; Madian ,Y. and Abed Al-Hameed ,A.(2009).Utilization of ultrasound imaging for diagnosis of fracture nasal boneejentas ,10: 54-57.
- 8- Hwang, K.; You, S.H.; Kim, S.G.and Lee, S.I.(2006). Analysis of nasal bone fractures; a six-year study of 503 patients. J Craniofac Surg;17(2):261-4.
- 9- Lundin, K.; Ridell, A.and Sandberg ,N.(1973). One thousand maxillofacialand related fractures at the ENT-clinic in Gothenberg. A two-year prospectivestudy. Acta Otolaryngol;75:359-61.
- 10-Fraioli, R.E.; Branstetter, B.F. and Deleyiannis, F.W.(2008). Facialfractures: beyond Le Fort: Otolaryngol Clin North. Am . Feb;41(1):51-76.

- 11-Murray, J.A.M and Maran, A.G.D.(2008). A pathological classification of nasal fracture. *Injury*;17:338-344.
- 12-Dingman, R.O.(1964). The management of facial injuries and fracture of the facial bone: reconstructive plastic surgery, Philadelphia: WB Saunders;
- 13-Pilija, V. Buljick, M.Mihalj, M. Savovic, S.and Stojiljkovic, G.(2005). Classification and qualification of nose injuries-clinical and forensic aspects: *Med.Pregl.* Jan-Feb;58(1-2):33-6.
- 14-Damman, F.(2007). Imaging of paranasal sinuses today. *Radiology* Jul;47(7):576, 578-83.
- 15- Illum, P., Kristensen, S. Jorgensen, K. and Brahe, C.(1984). Role of fixation in the treatment of nasal fractures. *Clinical Otolaryngology*. 8:191-195.
- 16-Frodel, J.L.(1994). Management of Nasal fracture in central facial injuries: Indication for calvarial bone grafting. *Arch.Otolaryngol Head Neck Surg*. 121:307.
- 17-Rohrich, R.J. and Adams, W.P.(2000). Nasal fractures management: minimizing secondary nasal deformities. *Plast. Reconstr. Surg.*:106:266.
- 18-Logan, M. Odriscoll, K. and Masterton, J.(1994). The utility of nasal bone radiographs in nasal trauma. *Clinical Radiology*. 49:192.
- 19- Kellman, R.M.(2010). Maxillofacial Trauma. In: Cumming Otolaryngology (Head & Neck Surgery). 5th ed. Mosby. Pp:319-323.
- 20- Palmer, P.E.S.(2002). Manual of Diagnostic Ultrasound. WHO. Delhi-51. P:15.
- 21- Curry, T.H.; Dowdey, J.E. and Murry, R.C.(1990). Christensen's Physics of Diagnostic Radiology .4th ed. Lippincott Williams & Wilkins. Philadelphia. pp:362-371.
- 22- Isadore, M. and Rachal, F.M. (1959). Radiographic Positioning & related anatomy. 2nd ed.
- 23- Radiography Aid for Diagnostic Radiology. Medical Engineering Group of Siemens AG. P:10.
- 24- Hong, H.S. Cha, J.G. Paik, S.H. Park, S.J. Park, J.S and Kim, D.H. (2007). High resolution sonography for nasal fracture in children. *AJR Am J Roentgenol*;188:W86-92.
- 25- Friedrich, R.E. Heiland, M. and Bartel S.(2003). Potentials of ultrasound in the diagnosis of mid facial fractures. *Clinical oral investigations*, vol.7. number 4, p. 226-229.
- 26- Beck, A. Murer, J. and Mann, W.(1992). Sonographische diagnose von nasenbefrakturen. *Otolaryngologie In: verhandlungsbericht der deutschengesellschaft fur halsnasen- ohrenheilkunde, kopt hals - chirurgie* stuttgart, Germany: thieme -verlag:68.
- 27- Danter, J. Klinger, M. Siegert, R. and Weerda, H. (1996). Ultrasound imaging of nasal bone fractures with 20 MHZ ultrasound scanner. *HNO*;44(6):324-8.
- 28- Kwon, T.K. Cha, J.H. and Kim YW. (1995). The role of ultrasound in the diagnosis of fractured nasal bone. New York NY. Kuglar publication Amsterdam.
- 29- Pollock, R.A.(1992). Nasal trauma : Pathomechanics and surgical management of acute Injuries . *Clin. Plast. Surg.* 19:133.
- 30- T.W Sadler .(1990). Embryology of nose and paranasal sinuses. *Langman's medical embryology* 6th ed.. WILLIAMS & WILKINS p. 321-322. *Otolaryngology online* .
- 31- Lauria, L; Curi, M.M; Chammas, M.C; Pinto, D.S and Torloni, H.(1996). Ultrasonography evaluation of bone lesions of the jaws. *Oral Surg*;82:351-357.

- 32-Akisuki ,H;Yoshida, H and Michi, K.(1990).Ultrasonographic evaluationduring reduction of zygomatic arch fractures. J. Craniomaxillofac Surg.;118:263–266.
 - 33- Whaites, E and Cawson, R.A.(1996). Essential of dental radiography andradiology. 2nd ed.. London: Churchill Livingstone;p. 193–195.
 - 34-Adeyemo, W.L; Ogunlewe, M.O and Ladeinde, A.L.(2006). Ultrasound as adiagnostic aid in head and neck lesions. Niger Postgrad Med J.;13:147–152.
 - 35-Jank, S; Ermschhoff, R; Strobl, H; Etzeldorfer, M; Nicasi, A and Norer B. (2004).Effectiveness of ultrasound in determining medial and lateral orbitalwall fractures with a curved-array scanner. J. Oral Maxillofac Surg.;62:451– 455.
 - 36-Lata ,A.C; Marcuzzi, D.W and Forrest, C.R.(1993). Comparison of real-time ultrasonography and coronal computed tomography in the diagnosis of orbital fractures. Can Assoc Radiol.;44:371–376.
 - 37-Akisuki, H; Yoshida, H and Michi, K.(1990). Ultrasonographic evaluationduring reduction of zygomatic arch fractures. J. CraniomaxillofacSurg.;118:263–266.
 - 38-Adeyemo,W.L and Akadiri,O.A.(2011). A systematic review of thediagnostic role of ultrasonography in maxillofacial fractures. InternationalJournal of Oral & Maxillofacial Surgery.Vol.40.NO.7,PP: 655-661
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