Identification of Nasal Bone Fracture by Ultrasonography Versus Plain Lateral X-Ray View

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ABSTRACT:

BACKGROUND:

Although a physical examination is regarded as the gold standard for diagnosis of nasal bone fracture, adequate imaging of a nasal fracture is often required because of the legal consequences that can result from the injury's cause.

OBJECTIVE:

The aim of the present study is to compare the validity of ultrasonography versus plain lateral X-ray view of nasal bone in diagnosing different classes of nasal bone fracture.

METHODS:

This randomized clinical trial study included ١١٧ patients presented with trauma to nose who consulted Otolaryngology Department at Aljamhory Teaching Hospital, Mosul, Iraq for the period from August ٢٠٠٨ to May ٢٠٠٩.

The results of plain lateral X-ray view and ultrasonography of the nasal bone were compared with the clinical findings after oedema has subsided completely which is the gold standard for evaluating the results.Moreover, accuracy rate, sensitivity, specificity, positive predictive and negative predictive values of both plain lateral X-ray view and ultrasonography were calculated.

RESULTS:

The accuracy rate, sensitivity, specificity, positive predictive and negative predictive values of plain lateral X-ray view in diagnosing nasal bone fracture were ٧٦,٦٪, ٨١,٨٪, ٦٢,٥٪ ,٨٥,٧٪ and ٥٥,٥٪ respectively. Moreover, the accuracy rate, sensitivity, specificity, positive predictive and negative predictive values of utrasonography in diagnosing nasal bone fracture were ٩٦,٦٪, ٩٧,٩٪, ٩٠,٩٪ ,٩٧,٩٪ and ٩٠,٩٪ respectively.

CONCLUSION:

The use of ultrasounography in the diagnosis of different classes of nasal bone fracture was found to be superior to plain lateral X-ray view in accuracy rate, sensitivity, specificity, positive predictive and negative predictive values.

KEY WORDS: nasal bone fracture, ultrasonography.

INTRODUCTION:

The treatment of nasal bone fractures was first recorded ٥٠٠٠ years ago during the early Pharonic period in ancient Egypt. Edwin Smith Papyrus ١٨٦٢ described repositioning of deviated nasal bones with the fingers or elevators, the insertion of splints and the application of external dressings[١].

Nasal bone fractures are the third most common types of fractures, behind fractures of clavicle and wrist[٢]. Nasal bone fractures comprise up to ٤٠-٥٠٪ of all facial fractures[٣]. Relatively little force is required to fractures the nasal bone, as little as ٢٥-٧٥ Ib/in^{٢}[١].

Although a physical examination is regarded as the gold standard for the diagnosis of nasal fracture, the surrounding hematoma and edema may be considerable and can make the diagnosis of nasal fracture more difficult to establish[٤]. Adequate imaging of a nasal fracture is often required because of the legal consequences that can result from the injury's cause[٥].

The need for nasal X-ray is controversial and in many places it is actively discouraged[١]. There is no diagnostic efficacy of nasal X-ray films because of the high incidence of "bony abnormalities" found on normal x-rayfilms. Normal suture lines are often misinterpreted as fracture lines, as are vascular channels[٤,٦].

High-resolution sonography using linear probe with frequency ٧-١٥ MHz can be a primary diagnostic technique for evaluating nasal bone fractures especially in children. It inflicts no radiation and evaluates the cartilaginous septum.

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Potential pitfalls are the nasofrontal suture, the junction between the nasal bone and pyriform aperture of the maxilla, the vascular groove, and the presence of an old fracture[٧].

The goal of the present study is compare the validity of ultrasonography versus plain lateral X-ray view in diagnosing different classes of nasal bone fracture.

PATIENTS AND METHODS:

This randomized clinical trial included ١١٧ patients with trauma to nose who had consulted Otolaryngology Department at Aljamhory Teaching Hospital, Mosul, IRAQ for the period from August ٢٠٠٨ to May ٢٠٠٩.

These ١١٧ patient were randomly assigned into ٤ groups:

Group I (٣٠ patients): patients no. ١،٥،٩١٣،١٧،٢١.....

Group II (٣٠ patients): patients no. ٢،٦،١٠،١٤،١٨،٢٢.....

Group III (٣٠ patients): patients no. ٣،٧،١١،١٥،١٩،٢٣.....

Group IV (٢٧ patients): patients no. ٤،٨،١٢،١٦،٢٠،٢٤.....

X- ray of the nasal bone "lateral view" was taken for Group I, whereas high frequency ultrasonography using VIVID machine with linear superficial probe "frequency ٧-١٠ MHZ" for Group II. These imaging tests were done in the Radiological Institute of the same hospital. Both plain lateral X-ray view of nasal bone and high frequency ultrasonography were done for Group III and in Group IV the evaluation depended on clinical examination alone. So plain lateral X-ray view of nasal bone was done for ٦٠ patients and ultrasonography for another ٦٠ patients.

Another clinical examination was carried out ٥-٧ days later on after oedema has subsided for further assessment which is the gold standard test for diagnosis of nasal bone fracture "change in shape of nose, step deformity, cracking and instability of nose ".

If there was a fracture, a decision was made for reducing it either under local or general anaesthesia at the first waiting list. The method of reduction was closed method.

The results of imaging tests were compared using validity tests.

RESULTS:

The distribution of patients with trauma to nose according to age is shown in figure. A high percentage of our patients (٧٣,٥٪) were below the age of ٣٠ years. The mean age of the patients was ٢١ years with a range of ١-٦٧ years. The peak age incidence was in the second decade of life (Fig.١). The study included ٨٤ males (٧١,٨٪) and ٣٣ females (٢٨,٢٪) with male: female ratio of ٢,٥:١(Fig. ٢).

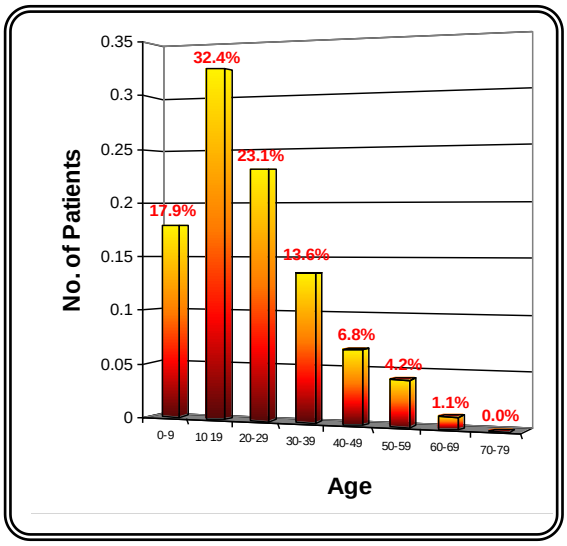

Figure ١: The age distribution of patients consulted ENT Department with trauma to nose.

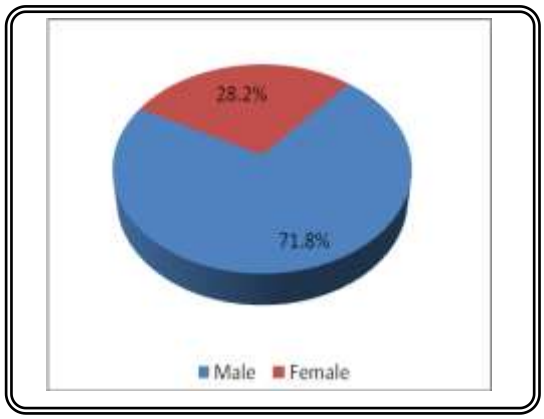

Figure ٢: Sex distribution of patients.

Table (١) shows the classification of nasal bone fracture. Class I fracture was ٢٤,٧٪, whereas class II & III were ٥٨,١٪ and ٢,٢٪ respectively. No fracture was found in ١٣,٦٪ of patients.

Table ١: The classes of nasal bone fracture.

Class	NO.	%
Class I	٢٩	٢٤,٨٪
Class II	٦٨	٥٨,١٪
Class III	٤	٣,٤٪
No fracture	١٦	١٣,٧٪
total	١١٧	١٠٠٪

Plain lateral X-ray view

Plain lateral X-ray view was done for ٦٠ patients, ٣٠ patients alone and another ٣٠ patients with ultrasounography. Table (٢) shows the accuracy rate, sensitivity, specificity, positive and negative predictive values of plain lateral X-ray view according to the equation:

Accuracy rate = (a+d)/(a+b+c+d)=٤٦/٦٠=٧٦,٦٪

Sensitivity= a/(a+c)=٣٦/٤٤=٨١,٨٪

Specificity=d/(b+d)=١٠/١٦=٦٢,٥٪

Positive predictive value =a/(a+b)x١٠٠ =٣٦/٤٢ x١٠٠=٨٥,٧٪

Negative predictive value = d/(c+d)x١٠٠ = ١٠/١٨x١٠٠=٥٥,٥٪

So the accuracy rate, sensitivity , specificity , positive and negative predictive values of plain lateral X-ray view in diagnosing different classes of nasal bone fracture were ٧٦,٦٪, ٨١,٨٪, ,٦٢,٥٪ ,٨٥,٧٪ and ٥٥,٥٪ respectively.

Table ٢: The accuracy rate, sensitivity and specificity of plain lateral X-ray view.

	Clinical findings		
Plain lateral X-ray findings	True +ve A=٣٦	False +ve B=٦	A+B=٤٢
	False–ve C=٨	True -ve D=١٠	C+D=١٨
	A+C=٤٤	B+D=١٦	All=٦٠

❖ Ultrasound

Ultrasounography was done for ٦٠ patients, ٣٠ patients alone and another ٣٠ patients with plain lateral X-ray view. Table (٣) shows the accuracy rate, sensitivity, specificity, positive and negative predictive values of ultrasounography according to the equation:

Accuracy rate=(a+d)/(a+b+c+d)=٥٨/٦٠=٩٦,٦٪

Sensitivity= a/(a+c)=٤٨/٤٩=٩٧,٩٪

Specificity=d/(b+d)=١٠/١١=٩٠,٩٪

Positive predictive value =a/(a+b)x١٠٠ =٤٨/٤٩ x١٠٠=٩٧,٩٪

Negative predictive value = d/(c+d)x١٠٠ = ١٠/١١x١٠٠=٩٠,٩٪

So the accuracy rate, sensitivity, specificity ,positive and negative predictive values of

ultrasonography in diagnosing different classes of nasal bone fracture were ٩٦,٦٪, ٩٧,٩٪, ٩٠,٩٪ ,٩٧,٩٪ and ٩٠,٩٪ respectively.

Table ٣: The accuracy rate, sensitivity and specificity of ultrasound.

	Clinical findings		
Ultrasonic Findings	True +ve A=٤٨	False +ve B=١	A+B=٤٩
	False–ve C=١	True -ve D=١٠	C+D=١١
	A+C=٤٩	B+D=١١	All=٦٠

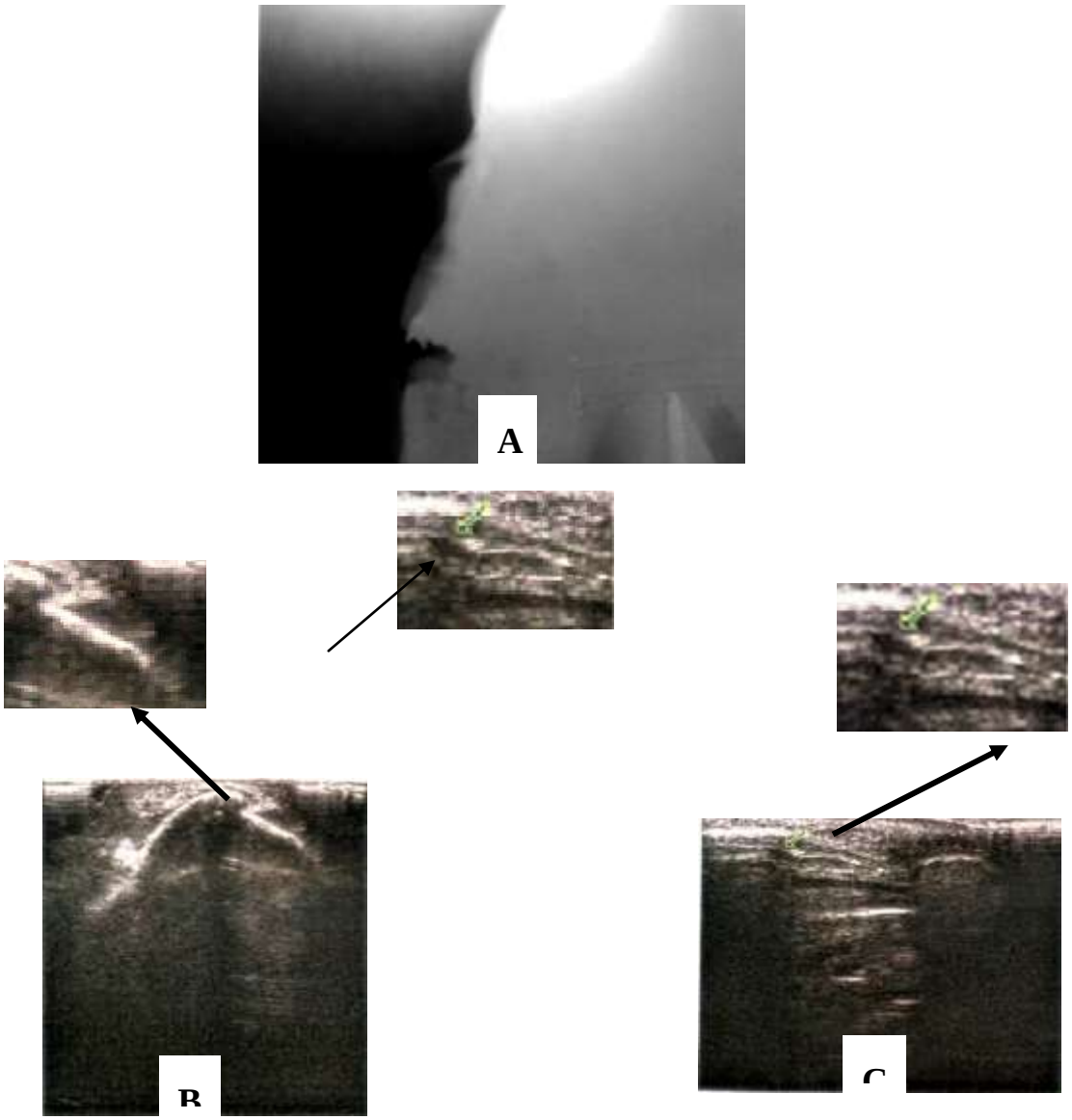

Figure ٣: ٣٢-years old female with painful swelling of nose after blunt trauma. A- X-Ray of nasal bone shows no fracture. B-Axial sonogram shows depressed fracture lines. C- Longitudinal sonograms shows fracture line

DISCUSSION:

This study revealed that nasal bones fractures is a common problem in younger age groups and seldom occurs above ٥٠ years. Moreover, it is more common in males than females as the male/female ratio was ٢,٥:١.

Similarly, Dickson and Sharpe (١٩٨٦) reported that ٤٠٪ of their patients were aged below ٣٠ years [٨]. Moreover Zargar M, et al (٢٠٠٤) reported that the male to female ratio was ٤,٥:١, among them, ٥٣,٣٪ were aged ١١-٣٠ years [٩].

In our study the sensitivity and specificity of plain lateral X-ray view in diagnosing different classes of nasal bone fractures were ٨١,٨٪ and ٦٢,٥٪ respectively. In comparison, Takenorio O Naohiros S and Takuji O (٢٠٠٢) reported that the sensitivity of plain lateral X-ray view examination in identifying nasal fractures was ٧٥,٦٪[١٠] .

These differences can be explained by the fact that radiographic diagnosis of nasal fracture may be controversial. Additionally, old fractures frequently heal by fibrous union, therefore permanently visible on x-ray examination. In pediatric patients, X-rays are even of less value because the nasal bones are not fused and the nasal skeleton is primarily cartilage[١١].

Moreover, Oluwasanmi and Pinto (١٩٩٩) concluded that doctors need to be better informed that nasal radiography has no useful value. A clear clinical guideline should be set up nationwide to protect patients from unnecessary exposure to radiation. This will also save the time of the doctors, radiographers and patients. It will prevent inappropriate referrals. Money and other resources will therefore be better utilized[١٢].

In our study the sensitivity and specificity of ultrasound in detecting different classes of nasal bone fracture were ٩٧,٩٪ and ٩٠,٩٪ respectively. Similarly, Hong HS, Cha JG, and Paik SH (٢٠٠٧) reported that sonographic scans were able to show all the fracture lines. One case was diagnosed as an old nasal fracture on the basis of physical examination**.** Sonography can be a primary diagnostic technique for evaluating nasal fracture in children. It inflicts no radiation, provides various imaging planes without positional change, and can be used to evaluate the cartilaginous septum. Potential pitfalls are the nasofrontal suture, the junction between the nasal bone and the pyriform aperture of the maxilla, the vascular groove, and the presence of an old fracture. CT can be used in addition to sonography in cases of suspected complex facial bone trauma[٧].

Similarly, Thiagarajan and Ulaganathan (٢٠١٣) showed that X-ray of nasal bone has very minimal role in the diagnosis of fractures involving the nasal bones. CT scan of nose and sinuses helps in identifying fractures involving other facial bones and in Lefort II and Lefort III fractures. Ultrasound using ١٠ MHz probe gives a clear view of the nasal bone area thereby facilitating easy identification of fractures. It also has the advantage of nil radiation hazard to the patient. Many images can be taken without any problem. It is also cost effective. According to Lee the accuracy of ultrasound in identifying fracture nasal bone was close to ١٠٠٪ while for conventional radiographs it was close to ٧٠٪[١٣].

CONCLUSION:

Ultrasound was found to be superior to plain lateral X-ray viewin diagnosing different classes of nasal bone fracture in accuracy rate, sensitivity, specificity, positive predictive and negative predictive values. Ultrasound can detect fractured nose even in the presence of soft tissue edema sparing the need for re-examining the patient after subsiding of edema.

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