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The Use of Ultrasonography in Zygomatic Arch Fractures-A Preliminary Study.

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ABSTRACT

The zygomaticomaxillary complex (ZMC) plays a key role in the function and appearance of the facial skeleton; prominent convex shape of the zygoma gives the contour of the cheek and makes it vulnerable to traumatic injury. The frequency of zygomatic arch fractures either isolated or associated with ZMC is about 45% and is second only to nasal bone fractures.Imaging techniques such as Computed tomography (CT) and Radiographs are used in the diagnosis of ZMC fractures. Ultrasound (US) has been used to image disease of soft tissues. The advent of high resolution US resulted in the diagnosis of bony pathology including assessment of zygomatic arch fracture isolated or associated with ZMC fractures in oral and maxillofacial surgery. It is safe, inexpensive, non-invasive, less dependent on patient cooperation, portable enough to take the image during pre, intra and postoperative period, easily reproducible and gives information in real-time.The purpose of this study was to compare the ultrasonography with CT scan and conventional radiograph in the identification of zygomatic arch fractures. A Preliminary study was conducted in Department Of Oral And Maxillofacial Surgery, M.S Ramaiah Dental College and Hospital, Bangalore from January 2014 to March 2015. The study was conducted on six patients with zygomatic arch fracture isolated or associated with zygomatico maxillary complex fracture. We used Ultrasound (US) for diagnosing zygomatic arch fracture. Efficacy of this procedure was assessed according to the ease of application of US in determining its sensitivity, positive and negative predictive values. The Ultrasonography was utilized in six cases of zygomatic arch fracture isolated or associated with zygomatico maxillary complex fracture. It revealed the nature of the fracture clearly in all the six cases with sensitivity of 100% (no false negatives).US is safe, inexpensive, non-invasive, less dependent on patient cooperation, portable enough to take the image during pre, intra and postoperative period, easily reproducible and gives information in real-time.

Key words: Ultrasonography, Zygomatic arch fracture, Computed tomography, Radiograph

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INTRODUCTION

Zygomatic arch fracture is the second most common facial fracture, with a peak incidence occurring in the second and third decades of life. The zygomatic arch is important for facial contour and plays a key role in determining facial width, also serving as origin and insertion for muscles of mastication and expression [3]. Depressed zygomatic arch fracture can hinder movement of the coronoid process of mandible leading to pain and trismus. The main purpose of zygomatic arch fracture reduction is anatomic restoration and freedom of mandibular movement [3].

The management of the zygomatic arch fracture depends on the extent of the injury, the displacement of the bone, and coronoid impingement. Zygomatic arch fractures can be treated by both closed and open reduction [3]. Zygomatic arch fractures which do not require fixation can be treated either by an intraoral approach, known as Keen approach in which the fragments are repositioned using bone elevators passed through small incisions in the mucosa of the gingival sulcus or a temporal hairline approach, known as Gilles approach [4]. The advantage with both the approaches is the protection of the facial nerve and its branches [3].

Fracture of the zygomatic arch is usually treated using blind methods and the fracture lines cannot be directly visualised during reduction. Digital exploration and crepitus noise or radiographic images are used clinically as a guide to repositioning the fragments. Digital exploration and crepitus are not reliable and radiographic image during surgery often leads to difficulties in positioning the patient and the risks of exposure to radiation [4].

Conventional plain radiography and computed tomography (CT) scans are the basic diagnostic tools for maxillofacial injuries and CT being the gold standard. Both of them have their own disadvantages and limitations [5]. In normal radiography, the superimposition of images of the overlying structures sometimes makes definite radiological interpretation difficult and the real-time image visualization is impracticable without digital technology [5]. The CT has overcome the limitations of the normal radiography but the disadvantages associates with the CT are limited facilities, high cost, and high radiation exposure [5].

Ultrasound (US) has been used to image disease of soft tissues. The advent of high resolution US resulted in the diagnosis of bony pathology including assessment of ZMC fractures in oral and maxillofacial surgery [1]. It is safe, inexpensive, non-invasive, less dependent on patient cooperation, portable enough to take the image during pre, intra and postoperative period, easily reproducible and gives information in real-time.The purpose of this study was to compare the ultrasonography with CT scan and conventional radiograph in the identification of zygomatic arch fractures.

PATIENTS AND METHODS

An ethical Clearance was obtained from the Research Ethics Committee of M.S Ramaiah Dental College and Hospital. A preliminary study was conducted on patients who had reported with zygomatic arch fracture either isolated or associated with zygomatico maxillary complex fractures to Accident and Emergency Department of M.S. Ramaiah Hospital, Bangalore (Fig - 1).

Figure 1: Flattening of the left zygoatic prominence.

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All the patients had US examination of the affected region carried out by a radiologist using an Ultra sound machine (GE, VOLUSON 730 PRO) with a10-12 MHz linear probe. The US investigation was conducted with the patient's head turned to the opposite side in the supine position. After application of gel, the probe was placed over the fractured arch transversely and its whole length was evaluated. The zygomatic arch was scanned to detect any depression, discontinuity or displacement. The procedure was repeated on corresponding bone on the other side of the face. The US examination was conducted by the same radiologist to avoid inter-observer variation. This radiologist was unaware of the plain radiographs and CT scan diagnosis.

RESULTS

All the patients were men and the cause of the injury was motor vehicle accident in five patients and in one case it was because of assault. Ultrasonography was applied in all the case of zygomatic arch fracture to confirm the diagnosis.US and CT scan were accurate in assessing the fractured arches with a sensitivity of 100% (Fig- 2 & 3). They clearly revealed the nature of the fracture and provided the real time image. In the healthy arches the US images were always concordant with the radiological and CT scan findings. (No false positives and 100% specificity).In one case the conventional radiograph did not show the fracture of the left zygomatic arch as shown in the table.

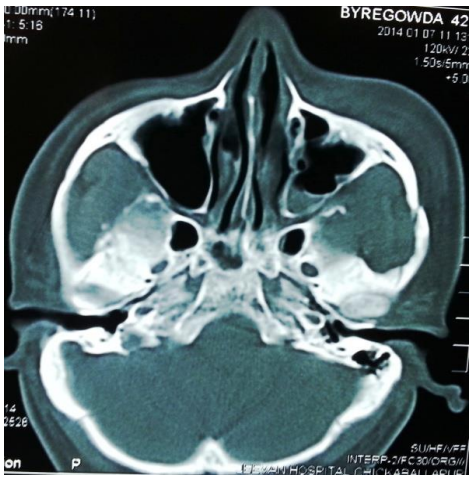

Figure 2: Preoperative CT scan of the same patien.

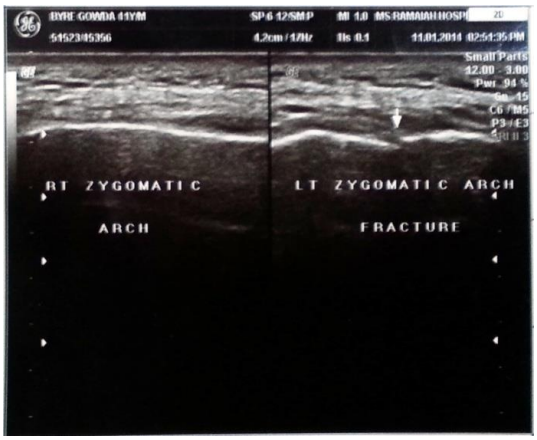

Figure 3: Preoperative US scan(Right and left side) of the patient.

The usual ultrasound scan for one isolated Zygomatic arch examination took less than 10 minutes, and none of the patients found the procedure painful or uncomfortable. In five cases, zygomatic arch fracture was associated with zygomaticomaxillary complex fracture and were undisplaced and they did not require any surgical intervention. In one case it was an isolated displaced fracture and it was treated intra orally by keen's approach.

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Figure 4: Preoperative X-ray of the patient

IMAGING TECHNIQE	ANATOMIC SITE (ZYGOMATIC ARCH) FRACTURE –PRESENT/ABSENT					
	CASE(1)	CASE(2)	CASE(3)	CASE(4)	CASE(5)	CASE(6)
COMPUTED TOMOGRAPHY	P	P	P	P	P	P
PLAIN RADIOGRAPH	P	P	A	P	P	P
ULTRASOUND	P	P	P	P	P	P

DISCUSSION

The frequency of ZMC fractures is about 45% and is the second most common facial bone fracture after nasal bone fracture [1]. Isolated zygomatic injuries occur as a result of acute and direct trauma to the side of the face and it accounts for 10% of zygomatic injuries [2]. The zygomatic arch plays a crucial role in facial contour and its dislocation hinders the normal excursion of the coronoid process of the mandible resulting in restricted mouth opening [1]. Therfore it is very important to diagnose the zygomatic arch injuries properly for both cosmetic and functional reasons [2].

Conventional plain radiography (Fig.4) and computed tomography (CT) scans are the basic diagnostic tools for maxillofacial injuries and CT being the gold standard. Both of them have their own disadvantages and limitations [5]. In normal radiography, the superimposition of images of the overlying structures sometimes makes definite radiological interpretation difficult and the real-time image visualization is impracticable without digital technology [5]. The CT has overcome the limitations of the normal radiography but the disadvantages associates with the CT are limited facilities, expensive and high radiation exposure [5, 7].

Sonography was introduced in early 1950's as a diagnostic modality in the field of medicine and later in the field of Dentistry [10]. Ultrasound is traditionally used to image irregularities of soft tissues. It is extensively used for examination of the abdomen, pelvis and the soft tissues of the neck [1]. US has gained wide acceptance as a valuable diagnostic aid in the evaluation of head and neck lesions [4]. The use of US in dentistry has been increasingly developed and widely studied in recent years and its role in maxillofacial surgery is less recognized [6,7]. Sonographic evidence may be treated as an alternative diagnostic imaging modality to radiology by which the use of conventional radiographs may not be required [8]. US has shown high accuracy in the detection of nasal bone fracture with a sensitivity ranging from 90% to 100%′.specificity of 98-100% and high predictive value [5]. It is safe, inexpensive, non-invasive, portable, and readily available diagnostic imaging modality which has created hopes in its possible use in the diagnosis of facial trauma [1,4].

Reduction of the zygomatic arch fracture is conventionally done by blind method, because the anatomical pathways of the facial nerve rules out any large incision. The position of the fragments is usually

confirmed by radiography or palpation during the operation. Radiography is not always feasible because of difficulties in managing the patient or the risk of X-ray exposure, and palpation by the surgeon is often unreliable [4]. In maxillofacial injuries US has been used to aid in the closed reduction of zygomatic arch fractures [7]. Ultrasonography is non-invasive, safe, easily reproducible and gives information in real-time, it overcomes the disadvantages of radiography and palpation [4, 9].

In our study, ultrasonography was used in six cases of zygomatic arch fractures isolated or associated with zygomaticomaxillary complex fractures which were undisplaced in five cases and in one case it was displaced. We confirmed the fracture of the zygomatic arch in all the cases by US and CT. In one case plain radiograph missed the fracture. It is intended to use US intraoperatively during the reduction of the zygomatic arch fracture to confirm the position of the fragments. In five cases wherein we applied US were undisplaced fractures requiring no surgical intervention and in one case it was depressed fracture and it was reduced by intra oral approach.

CONCLUSION

Ultrasonography was done in six cases of zygomatic arch fracture preoperatively to confirm the fracture and it showed a sensitivity and specificity of 100%. It clearly revealed the nature of the fracture and provided the real-time image. The technique may be useful as an accurate adjunct to conventional radiography of facial bones by reducing the overall amount of radiation. Considering the results of the present study, we strongly recommended to use US in the identification of zygomatic arch fractures.

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