“Intraoperative Ultrasonography to corroborate reduction of zygomatic arch fracture”

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Keywords ultrasound; ultrasonography; intraoperative imaging; zygomatic fractures; zygomatic arch; report case.

Summary

Intraoperative assessment of the zygomatic arch is very important in achieving adequate repositioning. The correct alignment of the zygomatic arch indicates the proper position of the zygoma and ensures adequate prominence of the lateral midfacial aspect. Intraoperative ultrasound assessment of the zygomatic arch allows the visualization of the zygomatic arch in real time with the advantage of no radiation exposure to the patient, easy and ready to use in the operating theatre that helps surgeons, especially not very experienced ones, to check and correct if it is necessary the position of the zygomatic arch after reduction. Like in this case report, the use of ultrasound in a patient that had suffered a maxillofacial trauma in a car accident leading to a left orbito-zygomatic complex fracture along with a zygomatic arch fracture ipsilaterally, where ultrasonography was a rapid and easy to perform intraoperative visualizing tool that helped in the correct reduction of the displaced zygomatic arch in this left orbito-zygomatic complex fracture and proved its usefulness in such cases.

Introduction

The zygomaticomaxillary complex (ZMC) plays a key role in the function and appearance of the facial skeleton. The prominent convex shape of the zygoma gives the contour of the cheek and makes it vulnerable to traumatic injury. The frequency of ZMC fractures is about 45% [9]. Intraoperative evaluation of the zygomatic arch is important as an accurate anatomical reduction is a mainstay in the alignment of the zygomatic complex and the midface. An inadequate reduction of the zygomatic arch itself might lead to a visible depression of the overlying soft tissues and the zygomatic arch might interfere with the

mandibular coronoid process resulting in limitation of mouth opening. Finally, an incomplete reposition might be unstable and bears the risk of loss of reduction which might require reoperation. In an intent to overcome the latter, intraoperative imaging allows the visualization of fracture morphology by providing in real time, a guide for surgical decision making. Although various intraoperative imaging modalities such as Cone Beam Computer Tomography (CBCT), C-arm Fluoroscopy and O-arm have been reported in maxillofacial surgeries, most of them are expensive, cumbersome, carry a radiation risk and require a steep learning curve, thus making them less feasible for use in simpler fracture scenarios. Reduction of the zygomatic arch fracture is conventionally done by blind method, and the position of the fragments is usually confirmed by radiography or palpation during the operation. Radiography is not always possible because of difficulties in managing the patient or the risk of X-ray exposure, and palpation by the surgeon is less objective due to swelling. Conversely, ultrasonography is a non-invasive, safe, easily reproducible, and portable method that gives information in real-time overcoming the disadvantages of intraoperative radiography and palpation, thus making it a reliable tool to use in the operating theatre when a zygomatic arch reduction has to be made.

Case Presentation

A 35 years old male was referred to the University Hospital Marburg from a smaller hospital in a near town. The patient had suffered a car accident that led to a left orbito-zygomaticomaxillary complex fracture compromising the ipsilateral zygomatic arch. The patient reported paresthesia of the first and second branch of the trigeminal nerve, and presented a depression of the affected side and a superior palpebral hematoma. His eye movements were preserved and he did not report double vision. He received a complete ophthalmologic examination by the ophthalmology specialist and the patient did not present any particularity by the time it was done. In the CT scan he presented displacement of the left orbital floor, zygomaticomaxillary buttress, frontal zygomatic suture and a displaced zygomatic arch fracture (figures 1-10).

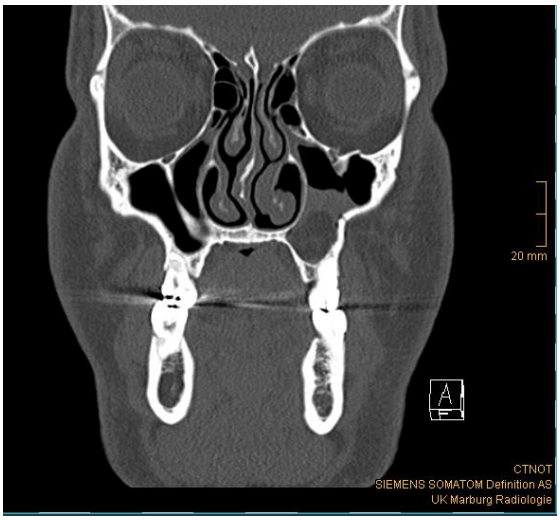

Figure 1

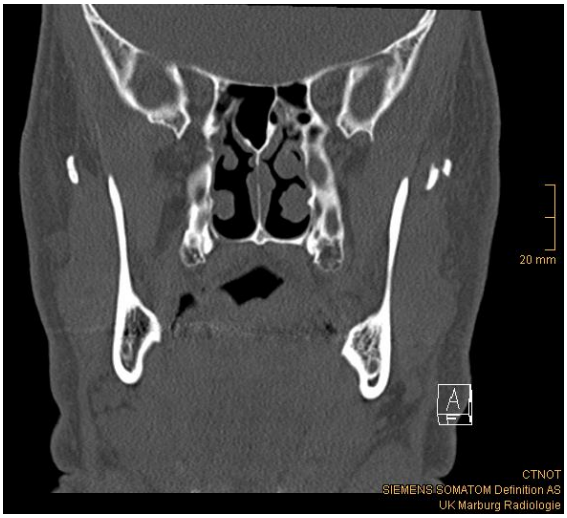

Figure 2

Figure 3

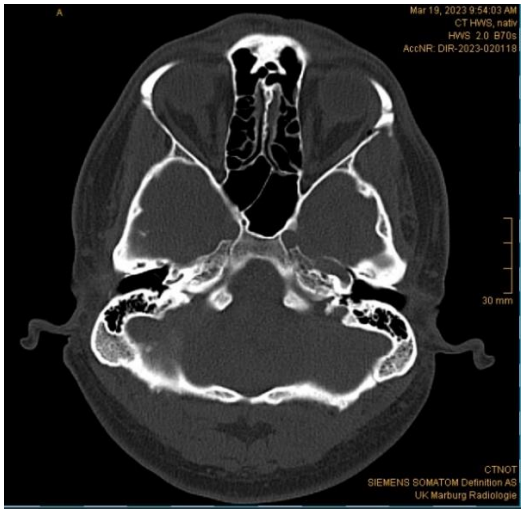

Figure 4

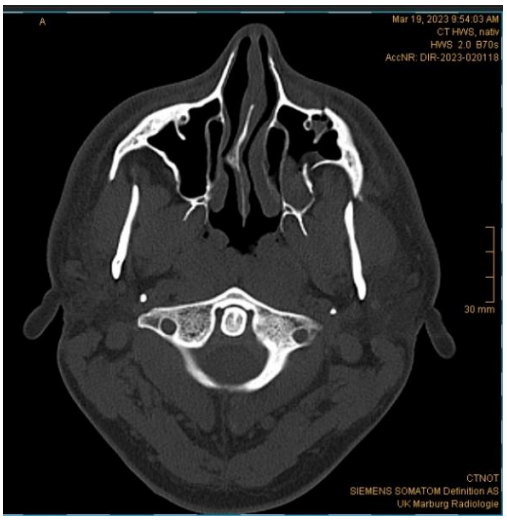

Figure 5

Figure 6

Figure 7

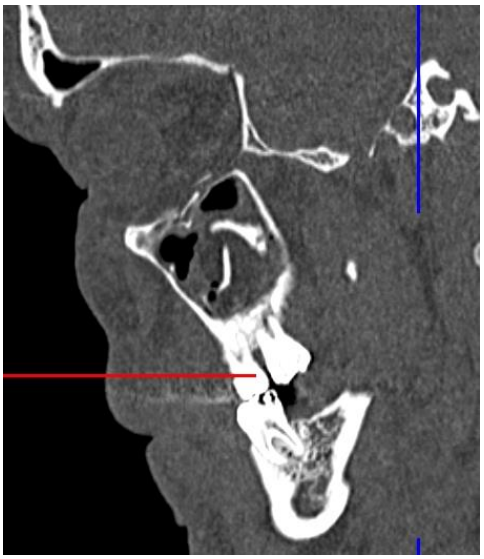

Figure 8

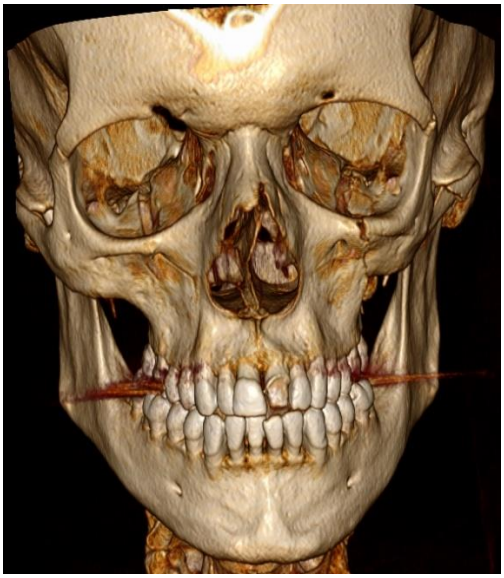

Figure 9

Figure 10

The surgery with reduction and osteosynthesis of the fractures had been scheduled for the next day following the patient´s admission to the hospital. Under general anesthesia and nasal intubation, the surgery was performed starting with an ultrasound examination of the zygomatic arch that showed the gap between the two fractured segments. Then a blind reduction with a Stromeyer repositioning hook placed under the zygomaticomaxillary buttress was done. After palpation to check the reduction of the entire zygomatic complex, another ultrasonography was made to evaluate the correct position of the zygomatic arch. As the position of the arch was correct, the operation went on with exposure of the

zygomaticofrontal suture via a superior palpebral approach and exposure of the inferior border of the left orbit and orbital floor via a transconjunctival approach. The fixation of the fractures with midface osteosynthesis plates was done at the zygomaticofrontal suture and at the inferior border of the orbit, with one 4-hole plate (1.5 system) each respectively, and a polydioxanone foil was placed to reconstruct the orbital floor. After that, the approaches to the zygomatic complex were closed by multilayered suturing. Postoperatively, the correct reduction of the left zygomatic complex was checked with an X-ray, occipitomental view for the zygomatic complex and a submental vertical projection for the zygomatic arch (Figure 11 and 12), that showed the adequate position of the zygomatic bone, zygomatic arch and appropriate situation and contouring of the osteosynthesis plates. The evolution of the patient was satisfactory, eye movements were preserved, he showed no complaints, his postoperative ophthalmologic exam was considered normal by the specialist and the patient was discharged one day after surgery with scheduled follow up appointments.

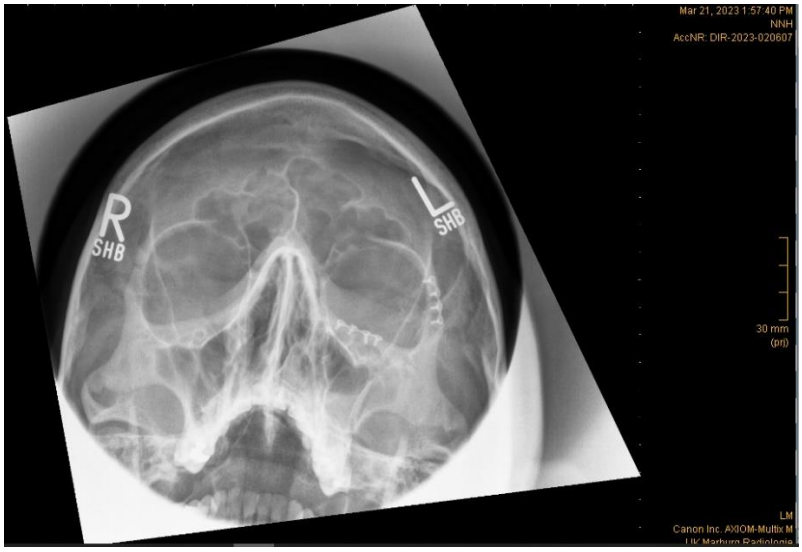

Figure 11

Figure 12

Discussion of the case

Ultrasonography was first used in medical practice during World War II when it was introduced to obstetric practice by Ian Donald [12]. It is a non-invasive diagnostic procedure and does not produce ionization. It is rapid and painless and has no known deleterious biological side effects. When it was introduced to the head and neck region, it was restricted to the imaging of superficial structures of the head and neck and was considered to have a limited role in bony lesions. Rapid developments in computing hardware and microelectronic technology have facilitated technological advancement in ultrasonography in the last three decades, making it applicable not only to soft tissues but also to bony lesions of the head and neck [9]. Computed Tomography (CT) provides a three-dimensional assessment of fractures but radiation exposure, high cost, and difficulty in transporting limit its intraoperative use to assess the reduction, also it cannot be used in pregnant women and in those with cervical spine injuries. Fluoroscan assisted closed reduction using C-arm has the same problem of exposure to radiation for its intraoperative use.

The use of diagnostic ultrasonography in zygomatic arch fractures has been well investigated and has been found very accurate in all cases of displaced arch fractures [10]. Ultrasound control provides additional visual information for the surgeon's assessment of the reduction quality, enables the surgeon's option of immediate correction of the fracture position and is also a relatively feasible and efficient alternative to the blind reduction technique of zygomatic arch reduction as it is available in the operating theatre and reduces costs, expenses, time and does not expose the patient to radiation like fluoroscopy with C arm or CBCT.

Although gross swelling and emphysema make the ultrasonographic visualization of bony surfaces difficult, this problem was overcome by choosing an ultrasound frequency of 7.5 MHz or less. In their study Buller et. al show a significant improvement of ultrasound-controlled reduction in the subgroup presenting with variable fractures [3]. Particularly, the displaced segments can be located and the position of the hook tip could be made visible to the surgeon.

I believe that the supplementary use of intraoperative ultrasonography should be a way to improve the surgical outcome in the reduction of zygomatic arch fractures as it allows verification of the accurate reduction. Furthermore, it permits the correction of malalignments during the same surgical procedure. The use of intraoperative imaging in fracture repairs involves a slightly longer operating time but it reduces the number of post-operative CT

examinations and the rate of reoperations as suggested in the literature reviewed and shown by this case report. As well it could help young surgeons without long time experience in treating this kind of facial fracture to profit from intraoperative US imaging but it cannot resolve the surgeon's ability to feel and control traction movement which finally leads to a satisfactory reduction.

Acknowledgement

The oral and maxillofacial department of the Universitätklinikum of Marburg looks for the best and more appropriate treatment for their patients such as in this case, using different useful tools as the ultrasound imaging guidance for checking the appropriate reduction of the zygomatic arch. I am grateful to the all the staff of this department for letting me join them in their surgical and hospital routines during the period of time that I stayed there.

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