ORIGINAL ARTICLE

THE POSSIBILITIES OF CONE-BEAM COMPUTER TOMOGRAPHY IN THE DIAGNOSTIC OF FRACTURES OF THE MANDIBLE WITHIN THE DENTAL ROW

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ABSTRACT

The aim: To establish the possibilities and advantages of cone-beam tomography in the primary diagnostic of mandibular fractures within the dental row compared with traditional methods of radiation diagnosis.

Materials and methods: The research was performed involving of 28 patients who had traumatic injuries of the maxillofacial area. The age of the victims was 18-56 years. The injured people were selected who were examinated by traditional radiological methods of diagnosis in the first hours after injury, and for final diagnostic in hospital were used cone-beam tomography of the mandible. The comparison of the results obtained with the help of traditional X-ray examinations with the data of cone-beam tomography allowed to conduct a comparative analysis of the diagnostic capabilities of these methods and to determine the advantage of the last one.

Results: A comparative analysis of the results of the examination of injured people, which were obtained by using of traditional methods and cone-beam tomography of the mandible, shows the diagnostic advantages of the last one, which allows to determine the extent of traumatic injuries of the mandible and identify hidden fractures that were not determined by traditional X-ray methods.

Conclusions: For the primary diagnostics of traumatic mandibular injuries, traditional X-ray examinations may be informative, but for complex, combined injuries, as well as fractures that raise doubts,it is advisable to use cone-beam computed tomography. The use of cone-beam computed tomography in mandibular fractures makes it possible to better assess the degree of damage and determine the displacement of fragments.

KEY WORDS: cone-beam computed tomography, mandibular fractures, radiation diagnostics

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INTRODUCTION

Today, the frequency of lower jaw injuries, their severity, the proportion in the structure of maxillofacial pathology is steadily increasing. According to domestic and foreign authors, 6.1-23% of patients who are treated in specialized clinics are patients with facial bone injuries [1]. At the same time, traumatic fractures of the mandible in our time are 74-95% of the total number of injuries of the facial skeleton. Socially important is the fact that injured people usually belong to the most active, able-bodied group of people aged 18-45. Significant terms of disability, severe functional and cosmetic consequences give great social significance to the search and improve of new methods for the diagnostic and treatment of fractures of the jaws [2, 3].

Currently, radiological fractures are indispensable for the diagnostic of mandibular fractures. And today radiation diagnostics plays a decisive role in the medical field; with its help up to 90% of diagnoses are established; More than 50 million radiological examinations are performed annually in Ukraine. However, the correct diagnostic in time mostly depends upon the validity of the radiological examination and the adequate choice of the method of radiological diagnostic [4].

Cone-beam computed tomography is a modern method of X-ray examination that allows not only to identify the location, shape and size of objects, but also to obtain their three-dimensional image. It allows you to visualize various bone structures with the accuracy required for further treatment of the patient and control over the course of reparative processes. Due to the technical features of cone-beam computed tomography devices, this study is easy to perform, non-invasive, with a low level of radiation exposure. The scanning area is determined by the size of the sensors, the scanning time is 14 seconds, and the slice thickness is 0.15–0.3 mm. Cone-beam computed tomography allows to obtain high-quality images of the type of orthopantomographic section with alignment of the dental arch of the upper and lower jaw, cephalometric sections in direct and lateral projections with alignment of the dental arch, to perform linear and angular measurements. perform dynamic densitometry of different anatomical structures, obtain tomographic sections of individual areas and teeth or the entire scan area in three projections, rotate the image at any angle, view 3D images of the entire study area and individual areas of the dental system, magnify images of different areas several times [5-9].

Fig. 1. The orthopantomogram of double fracture of the mandible without dislocation.

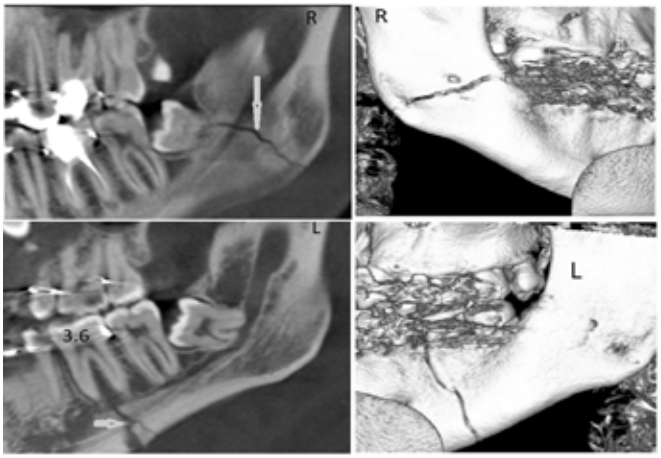

Fig. 3. The cone-beam computed tomography of double fracture of the mandible without dislocation.

Fig. 5. The cone-beam computed tomography of double fracture of the mandible with dislocation.

Fig. 2. The orthopantomogram of double fracture of the mandible with dislocation.

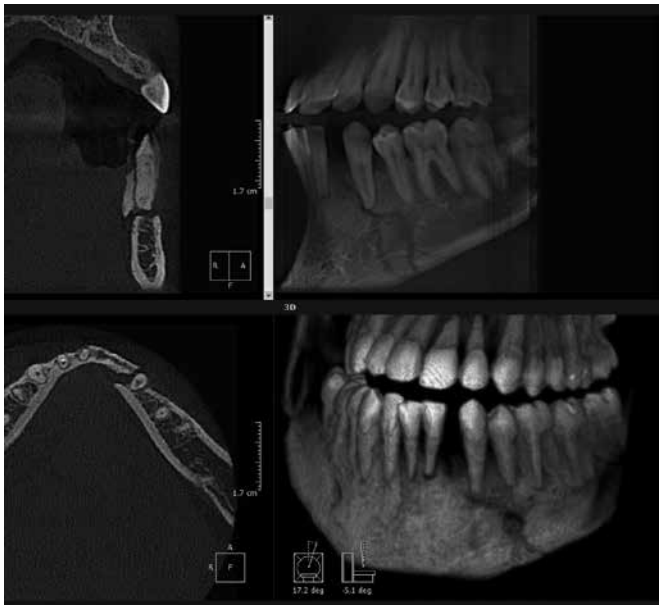

Fig. 4. The cone-beam computed tomography of double fracture of the mandible with dislocation.

THE AIM

To establish the possibilities and advantages of cone-beam tomography in the primary diagnostic of mandibular fractures within the dental raw compared to traditional methods of X-ray diagnostic.

MATERIALS AND METHODS

The study was conducted in compliance with the requirements for maintaining the health of the patient, ensuring his rights, human dignity and moral and ethical standards. The work was carried out in accordance with the principles of the Helsinki Declaration for the Protection of Human Rights, the Council of Europe Convention on Human Rights and Biomedicine and the provisions of the relevant laws of Ukraine.

The study was performed involving of 28 patients (27 men and 1 woman) who had traumatic injuries of the maxillofacial area, in accordance with the requirements of

international standards of bioethics. The age of the injured person was 18-56 years.

The injured people were selected who were examinated by traditional radiological methods of diagnosis (digital radiography, namely review radiography of the skull in direct and lateral projections - 18 people, or digital orthopantomography - 10 patients) in the first hours after injury, and for final diagnostic in hospital were used cone-beam tomography of the mandible. The comparison of the results obtained with the help of traditional X-ray examinations with the data of cone-beam tomography allowed to conduct a comparative analysis of the diagnostic capabilities of these methods and to determine the advantage of the last one. The examinations were performed by using a PaxZenith 3D cone-beam computed tomograph manufactured by Vatech.

RESULTS

All patients who participated in the research were recommended traditional radiological diagnostic methods: digital radiography or orthopantomography in the first hours after maxillofacial injuries, for a preliminary diagnosis, in accordance with the recommendations of the «National Guidelines for Physicians Referring Patients for Radiological Examination». Among the advantages of X-ray examination, which make it decisive in the role of facial bone injury, are the availability and high reliability, which are essential for the provision of emergency medical care. X-ray examination was performed taking into account the specific features of jaw injuries, in particular the location of injuries.

The analysis of the obtained images showed that on the review radiographs in the direct anterior projection of the body of the mandible has the form of an irregular quadrangle, the lower contour of which is convex downwards in the medial part, and in lateral directions, above the corners of the mandible. The base of the lower jaw is defined as a clearly visible, clear strip, wide is 2-4 mm. The upper contour of the mandible is formed by the alveolar process, in which the alveols with teeth are defined. Examination radiograph in lateral projection allows you to assess the condition of the corresponding half of the body of the mandible, its angle and the branch with processes. In the naso-chin projection on the radiographs well defined joint cavity and the head of the temporomandibular joint with the joint space, as well as the neck of the mandible. The lower jaw in the axial projection of the radiograph is projected on the middle cranial fossa, where its body and projectionally shortened branches form a horseshoe-shaped shadow; condylar processes pass into the transverse oval shadows of the heads of the mandible, and the coronal processes are defined more medially than the previous ones in the form of triangular formations.

Among all mandibular fractures, in 25 patients (89.3%) the fracture line passed through the tooth cavity. Unilateral mandibular fractures occurred in 19 cases (67.9%), double fractures in 7 cases (25%), and rolling fractures in 2 patients (7.1%) (Fig. 1, 2).

Using classical radiography methods, it was difficult to assess the displacement of fragments in the area of the mandibular angle, which was observed in 2 cases.

In digital cases of orthopantomography in 3 cases (10.7%) it was impossible to diagnose the presence of a fracture line at the level of the neck of the mandibular articular process due to anatomical features of the temporomandibular joint and limited diagnostic capabilities of traditional methods.

Cone-beam computed tomography allowed to obtain additional diagnostic information, which was not detected according to traditional methods of radiological diagnostics (radiography, orthopantomography). During the follow-up of patients were additionally diagnosed with: incomplete fracture of the mandible in the chin area (2 cases), double fracture of the mandible within the dentition (2 cases), fracture of the tooth (1 case), and the diagnosis of double fracture of the mandible, so as a second fracture line on the CBCT study was not confirmed (1 case) (Fig. 3-5). Thus, the discrepancy between the previous diagnostics, established on the basis of traditional methods of X-ray examination, and the final ones, formulated after cone-beam computed tomography, was observed in 6 patients (21.4% of cases).

DISCUSSION

A comparison of the results of X-ray examinations performed by using traditional methods and cone-beam computed tomography shows the significant advantages of the last one . The use of cone-beam computed tomography makes it possible to determine in more detail the extent of traumatic injuries of the mandible and to detect latent fractures that have not been diagnosed due to the limited capabilities of traditional methods.

In our opinion, traditional X-ray examination methods should be used for the initial diagnosis of traumatic mandibular injuries, but cone-beam computed tomography should be used for complex, combined injuries, as well as for fractures that are questionable. The use of cone-beam computed tomography in mandibular fractures makes it possible to detect the displaced fragments and assess the degree of damage. This will reduce the risk of complications after injury, speed up the provision of adequate medical care, reduce the time of examination of patients, reduce radiation exposure to the patient.

These advantages of cone-beam computed tomography also make it the optimal method for controlling the consolidation of mandibular fractures.

CONCLUSIONS

1. For the initial diagnosis of traumatic injuries of the mandible, traditional X-ray examination methods can be quite informative, but for complex, combined injuries, as well as fractures that cause doubt, it is advisable to use cone-beam computed tomography.
2. The use of cone-beam computed tomography in cases of mandibular fractures makes it possible to better assess

the degree of damage and determine the displacement of fragments.

3. The use of cone-beam computed tomography will reduce the risk of complications after mandibular injury, speed up the provision of adequate medical care, reduce the time of examination of patients, and reduce radiation exposure.

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Conflict of interest:
The Authors declare no conflict of interest.

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