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Diagnosis of jaw and dentoalveolar fractures in a traumatized patient with cone beam computed tomography

CASE REPORT

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Abstract – The purpose of this case report is to discuss and illustrate the clinical usage of Cone Beam Computed Tomography (CBCT) for the diagnosis of maxillofacial fractures in a traumatized patient. In this presentation, a 30-year-old male patient who was referred to Oral Diagnosis and Radiology Department with a limitation of mouth opening was reported. The history of the patient revealed a traumatic injury on his face because of a fall. The patient was initially examined by a medical practitioner in the emergency department of a public hospital. According to 2D cephalometric analysis, no fracture existed. Panoramic radiograph and postero-anterior reverse-town showed bilateral condyle fractures. In addition, a fracture in the left mandibular incisor region could clearly be detected on the panoramic radiograph. For further diagnosis, digital images were taken with CBCT. Cross-sectional views showed two vertical fracture lines on the alveolar bone between teeth numbers 17, 18 and 14, 15. A palatal root fracture was observed associated with tooth number 18. A fracture line in the left mandibular incisor region as well as bilateral condyle fractures could be seen clearly on CBCT views. CBCT is becoming a popular tool in modern dental practise. In the diagnosis of dentoalveolar fractures, CBCT has made it possible for the practitioner to get more detailed information.

In traumatized patients accurate diagnosis is very important. In the diagnosis of dentoalveolar fractures, Cone Beam Computed Tomography (CBCT) has made it possible for the practitioner to get more detailed information and it is becoming a popular tool in dentistry.

Previous studies show the usage of CBCT imaging in implant planning (1–3), surgical assessment of pathology, temporomandibular joint (TMJ) imaging (4–6) and pre- and postoperative assessment of craniofacial fractures (7–9).

The purpose of this case report is to discuss and illustrate the clinical usage of CBCT for the diagnosis of maxillofacial fractures in a traumatized patient.

Case report

A 30-year-old male patient was referred to Oral Diagnosis and Radiology Department with a limitation of mouth opening. His medical anamnesis was unremarkable. The history of the patient revealed a traumatic injury on his face because of a fall while walking in another city 17 days ago. The patient was initially examined by a medical practitioner in the emergency department of a public hospital. According to 2D cephalometric analysis, no fracture existed. As the CT scans of brain did not show the details clearly especially on the left side, the magnetic resonance imaging (MRI) of brain was taken for further examination in the same hospital. Patient was informed that no injury had been detected.

After 17 days, the patient was referred for dental examination because of limitation of mouth opening. Panoramic radiograph (OPTG; Planmeca Promax, Helsinki, Finland) and postero-anterior reverse-town (Clementisch) showed bilateral condyle fractures (Figs 1 and 2). In addition, a fracture in the left mandibular incisor region could clearly be detected on the panoramic radiograph (Fig. 1).

For further diagnosis, digital images were taken using an ILUMA ultra CBCT scanner (Imtec Imaging, Ardmore, OK, USA) with an amorphous silicon flat-panel image detector and a cylindrical volume of reconstruction up to 19 × 24 cm. Images were obtained at 120 kVp, 3.8 mA, and a voxel size of 0.2 mm, with an exposure time of 40 s. Frontal and cross-sectional reconstructions were created by reformatting the axial CBCT scans on a local workstation using the ILUMA dental imaging software in accordance with the manufacturer's instructions. The frontal reconstruction of CBCT view showed the alveolar fracture in the left mandibular incisor region (Fig. 3).

Sagittal views showed two vertical fracture lines on the alveolar bone between teeth no. 17, 18 and 14, 15

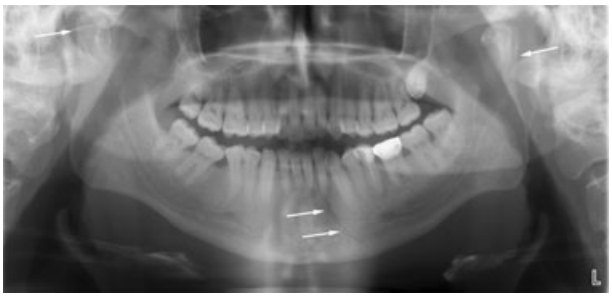

Fig. 1. Panoramic radiograph showed the fracture in the left mandibular incisor region and bilateral condyle fractures.

Fig. 2. Postero-anterior reverse-town (Clementisch) showed bilateral condyle fractures.

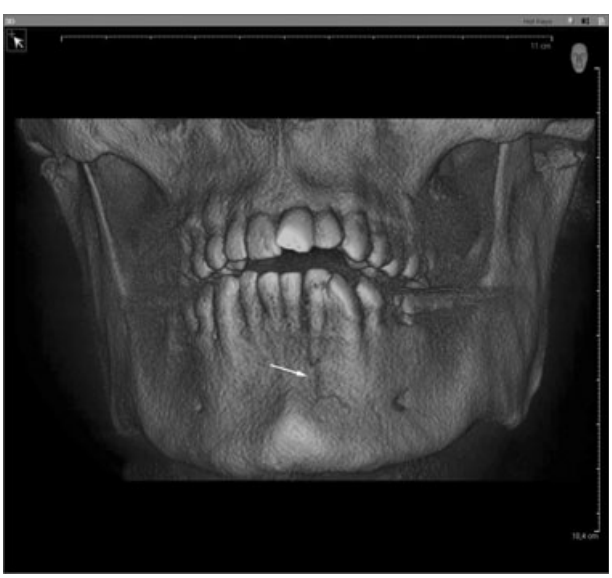

Fig. 3. A frontal cone beam CT view showed the fracture in the left mandibular incisor region.

Fig. 4. Sagittal view showed a vertical fracture line on the alveolar bone between teeth no. 17, 18.

Fig. 5. Sagittal view showed a vertical fracture line on the alveolar bone between teeth no. 14, 15.

(Figs 4 and 5). A palatal root fracture was observed associated with tooth number 18 (Fig. 6). A fracture line on the left mandibular incisor region as well as bilateral condyle fractures could be seen clearly on both coronal and axial CBCT views (Figs 7 and 8).

The patient was referred for operation to a state hospital because of his financial limitations.

Discussion

Radiology is important in the diagnostic assessment of the dental patient and guidelines for the selection of appropriate radiographic procedures for patients sus-

Fig. 6. A palatal root fracture was observed associated with tooth number 18 on coronal view.

Fig. 7. A fracture line on the left mandibular incisor region could be seen clearly on coronal cone beam CT view.

pected of having dental and maxillofacial disease are available (10). Our previous case report showed that the medical radiologist was incompetent in detecting the fractures in the maxillofacial region (11).

In this case report, the clinical approach of the medical practitioner was inadequate and the selection of the radiographic examination was inaccurate. Only brain was assessed by CT scans and MRI. In addition, no remarkable finding was found according to conventional radiographic evaluation of the skull.

The conventional radiograph is a 2D shadow of a 3D object. Detection of root fractures on radiographs is most influenced by the direction of the radiation beam, which must pass through the fracture line (12). Three-

Fig. 8. Bilateral linear oblique multiplanar reformation through lateral and medial poles of the mandibular condyle fractures on the axial image.

dimensional imaging overcomes this major limitation by allowing us to visualize the third dimension while at the same time eliminating superimpositions (13). The periapical radiographs taken from the patient were unsatisfactory in reflecting root fracture clearly.

Generally, CBCT requires less radiation exposure than conventional CT (12, 13). Ludlow et al. (13) reported that imaging of a maxillomandibular volume with the NewTom 3G results in an effective dose (E), which is used to estimate risks in humans (14), of 57 μSv and according to Ngan et al. (15), traditional medical CTs result in an E of 1400 μSv for a maxillary CT scan and 2100 μSv for a maxillomandibular examination.

Published reports showed that the effective dose of radiation is significantly reduced by up to 98% compared with 'conventional' fan-beam CT systems (12, 13, 15–18). This reduces the effective patient dose to approximately that of a film-based periapical survey of the dentition 18–20 or 4–15 times that of a single panoramic radiograph (13, 15, 19–21). Previous studies of TMJ assessment (4–6) and pre- and postoperative assessment of craniofacial fractures with CBCT have been reported (7–9).

As the CBCT technology has been in use for almost 2 decades, new systems become commercially available.

According to guidelines of the European Academy of Dental and Maxillofacial Radiology, the final 'basic principles' maintain the view that, with adequate training, it is reasonable to expect dentists to perform clinical evaluation of images in the familiar area of teeth and their supporting structures, while advocating a specialist evaluation for other anatomical areas (22).

ILUMA uses proprietary Flash CT technology, the latest generation of advancement in ultra cone beam volumetric tomography to produce state-of-the-art sinus, skull base, head and neck and temporal bone images in a simple 20-s scan (23).

Cone Beam Computed Tomography is appropriate for use in clinical dental practise where cost and dose considerations are important. All these advantages should be known by not only dental practitioners but also medical practitioners. The development and becoming widespread of CBCT technology will certainly increase the practitioner's access to 3D radiographic imaging.

In conclusion, CBCT should take part as an appropriate radiography technique in varied cases especially maxillofacial traumatized patients when the other radiographic methods are inadequate.

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