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Comparison of the diagnostic accuracy of mandibular fractures with Cone beam computed tomography and multislice CT using dry human skull

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Abstract

Background: the aim of this study was to compare the accuracy of Cone beam computed tomography and multislice CT in diagnosing factitious fractures in mandible. Method and material simulated fractures were created in both sides of 4 human dried mandibles using a micro-saw 20mm blade without displacement. The skulls were scanned with a spiral 16-slice MSCT scanner and a CBCT device. Three observers assessed and interpreted the images judging whether fracture was present or absent. The sensitivity, specificity , positive predictive value (PPV) , negative predictive value (NPV) were calculated. Result: The sensitivity, specificity, PPV, NPV for diagnosing fractures in CT were all 1 and in CBCT were 0.97 , 1 , 1 , 0.97 which are presented in table 1. Conclusions: The validity of CBCT for the identification of the number of mandibular fractures were similar to that of MSCT.

Keywords: CBCT, CT, Mandibular fractures.

Introduction

The facial area is one of the most frequently injured areas of the body,1-4 and the mandible is one of the most common maxillofacial bones fractured,1,5,6 due to its prominent position on the face.

Studies around the world have shown that assaults are the predominant cause of maxillofacial fractures in developed countries, while motor vehicle accidents (MVA) are the most common cause in developing countries.2,7-13

The analysis of diseases in the maxillofacial region has greatly evolved since the introduction of computed tomography (CT), improving the accuracy of the diagnosis and facilitating the planning of surgical procedures to treat oral and maxillofacial lesions [1]

The introduction of multislice computed tomography (MSCT) represented a fundamental evolutionary step in the development and ongoing refinement of CT imaging techniques. A single MSCT scan can yield multiple, thin, overlapping slices that can be rapidly reconstructed, resulting in higher quality reconstructed images and precluding the need for further patient radiation exposure. This technology allows volume data acquisition and three-dimensional (3D) reconstruction of craniofacial structures, which have become essential to the assessment of maxillofacial morphology [1,4]. Cone-beam computed tomography (CBCT) using recently-designed equipment for dental and maxillofacial imaging stands out as a relevant tool in oral and maxillofacial radiology because it provides images of high quality and allows a diagnosis to be established with greater

specificity and sensitivity. In addition, CBCT allows images to be acquired using a low dose of radiation, is more readily available and costs less than the other CT methods, which makes the routine use of CBCT feasible in the scope of oral and maxillofacial procedures [5-7].

The purpose of this study was to compare, the validity of MSCT and CBCT in the diagnosis of mandibular fractures.

Materials and Methods

An in vitro study was performed on four dry human mandibles free of fracture. All skulls were numbered and sites of fractures were marked by a permanent marker pen. Using a micro-saw reciprocating hand piecewith a micro-blade simulated fracturewas made exactly along the marked sites in left and right sides of skulls without displacement. To have control group the mandibles were scanned before creating fractures. Then mandibles were coded individually for each modality to blind the observers. The mandibles were submitted to a spiral 16-slice MSCT scanner and by a CBCT device. Observers were allowed to adjust the brightness and contrast setting for best display. A questioner was prepared and coded with respect to scan codes for each observer, in order to record the diagnostic judgment regarding presence or absence of fractures and if was present to mention the site of the fracture.

Results

The sensitivity, specificity, PPV, NPV for diagnosing fractures in CT were all 1 and in CBCT were 0.97 , 1 , 1 , 0.97 which are presented in table 1.

		State.1	Gold.St		Total	SEN	SPC	PPV	NPV	ACC
			Fracture	No Fracture						
CT	Y1	Fracture	32	0	32	1	1	1	1	1
		No fracture	0	32	32					
		Total	32	32	64					
CBCT	Y1	Fracture	155	0	155	0.97	1	1	0.97	0.98
		No fracture	5	160	165					
		Total	160	160	320					

Discussion

The present study evaluated the validity of CBCT and MSCT for the identification of mandibular fractures. Both methods of image acquisition have advantages and disadvantages regarding radiation dose, acquisition time, cost, scattered radiation and artifacts [14,15,16,17]. The drawbacks should be taken into consideration, since they can influence the quality of the images and the accuracy of the interpretation. The quality of CT images is affected by several scanning settings. The combination of slice thickness, slice interval, and tube current can influence image quality, especially during reconstruction. Kim et al. [18]

The applicability of MSCT has been widely discussed and includes cranial measurements, the analysis of craniofacial deformities, the diagnosis of and the surgical planning for maxillofacial fractures and lesions, and the surgical planning for implants [14,15,18-22]. Perrella et al. [10] have shown that MSCT has high sensitivity and specificity for the diagnosis of mandibular lesions even in the presence of dental metallic artifacts. Cara et al. [19] compared different single- and multislice methods (including axial slices and axial slices with MPR) for analyzing simulated lesions in the head of the mandible. The results showed that MSCT images were highly accurate for the detection of bone lesions. The results of a study conducted by Utumi et al. [22] which demonstrated the validity of MSCT using MPR and parasagittal images in order to detect lesions in the mandibular condyle, corroborated the aforementioned study. Currently, CBCT is a valuable imaging method in oral and maxillofacial radiology. According to Mozzo et al. [23], CBCT is central to diagnostic imaging in dentistry due to the following: no superimposition of structures; no image distortion; low radiation doses; and lower costs for patients. There are various studies in the literature describing the accuracy of CBCT for the evaluation and detection of bone destruction due to endodontic, periodontal and orthodontic causes [24-26]. However, further studies are necessary in order to determine the sensitivity and specificity of CBCT for detecting mandibular fractures.

Our results showed no significant differences between 3D-MSCT and 3D-CBCT for the detection of simulated mandibular lesions. Despite the good values of specificity and sensitivity, 3D reconstructions should be used in association with axial, coronal and sagittal images (MPR) and cross sectional slices in order to improve the accuracy of the diagnosis of mandibular lesions [27].

In spite of the results found in this study, CBCT and MSCT were similarly accurate (high sensitivity and specificity) for the identification of the number of mandibular fractures. Both reconstruction techniques were equivalent in terms of clinical diagnosis.

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