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Precision of 3D MSCT Scan Diagnostcs on Maxillofacial Trauma Compared to Stabilization and Instrumentation Operation Results

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Abstract

Handling standardized radiological readings of patients with maxillofacial trauma, particularly in radiology are currently absent. Appropriate and accurate of radiological reading results could be as the guideline for surgeons in determining surgical procedures. This study aimed to evaluate the diagnostic accuracy of maxillofacial fracture patients with head 3D CT scan compared to stabilization and instrumentation results as gold standard. Secondary data that derived from medical records were used as 29 patients with clinical maxillofacial trauma enrolled in this study at Radiology Section of Dr.Soetomo General Hospital from November 2012 to March 2013. The Mc Nemar test showed that there was no significant difference between the 3D CT scan results and the stabilization also instrumentation results with $p = 1.000$ ($p > 0.05$). While, the result was by calculating Kappa coefficient that a high suitability between head 3D CT scans and stabilization also instrumentation result with $\kappa = 1.000$, $p = 0.000$ ($p < 0.05$). There were several complications in the form of Cranii Bone Fraktur (25%), intracranial complication (15.24%), Haematosinus (52.38%) and Soft tissue haematoma (32.38%) with most intracranial complications ICH (31.25%), then, most soft tissue complications were in the Orbita region (26.47%) and the most common Haematosinus complications regarding Sinus Ethmoid and Maksilaris (29.09%). It concluded that the 3D CT scan results were in accordance with the results of stabilization and instrumentation operations.

Keywords: *Maxillofacial Trauma, Head Ct Scan, Head 3D Scan, Stabilization Operation*

Introduction

Handling standardized radiological readings of patients with maxillofacial trauma, particularly in radiology are currently absent. This standardization is of crucial importance because it affects the diagnostic accuracy, especially in trauma cases. Appropriate and accurate of radiological reading results could be as the guideline for surgeons in determining surgical procedures. Radiology examination was originally a head photograph, which is expected to evaluate the presence of fractures and some of the complications, but in cases of maxillofacial fracture, the modalities complexity has much deficiency because of it unevaluated the bones in an overlapping state[1].

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CT Scan is used as an evaluation of trauma cases with an excess of axial reformated sagittal and coronal slices, MPR and 3D reconstruction that could evaluate anatomical structures more broadly and in detail. It could evaluate the state of the fracture to the size of <2cm, soft tissue, compartments that are regulated in craniomaxillofacial and evaluated the complications from intracranial hemorrhage to the presence of cranial also cervical fractures. Images of CT scan could be rotated, split, also anatomical structures could be separated and individual images of different tissue types could be generated. 3D images provide an overall spatial concept that allows a better understanding of the complexity of some 2D axial. 3D CT scan we are able to focus on specific areas of clinical and surgical concern. We could easily appreciate the postoperative improvement of possible complications. 3D reconstruction is useful in visualizing bone fragments from all points of view, not only the fracture fragments but suggestions of the

mechanism of injury could easily assess. In addition, 3D CT scan reform has helped many patients with maxillofacial fractures[2].

This is in accordance with research conducted by Johnson and Feuerbach (2011) that stated by using conventional photos of bone trauma are technically difficult and only small information could be obtained. However, by using MSCT 3D with the volume rendering technique on fracture patients, it could be seen complex anatomical images such as facial bones from various orientations. A 3D MSCT image could make a better interpretation of difficult fracture than in CT cross-sectional image(Gillespie). 3D CT scans were performed on 100 patients with maxillofacial trauma, which 80% were male and 20% were female. Based on the etiology, road traffic accidents (75%) is the most common, followed by the attack (16%), decrease (7%) and sports-related accidents (2%), also 28 cases (28%). Head 3D CT scans have a significant degree of accuracy in determining the final diagnosis and treatment plan for the maxillofacial fracture. The conclusions were head 3D CT scans particularly valuable in assessing cases of maxillofacial fractures with the severe injury, allowing a clear perception of the primary rate of fracture line and resulting in fragment displacement. Modality allows precise surgical analysis and surgical planning compared to conventional radiography in cases of maxillofacial fractures[3-7].

Based on the description above, the authors were interested to evaluate the diagnostic accuracy of maxillofacial fracture patients with the examination of head 3D CT scan that compared to the results of stabilization and instrumentation operations as the gold standard.

Method

Twenty-nine patients with clinical maxillofacial trauma at Radiology Section of Dr.Soetomo General Hospital Emergency Unit from November 2012 to March 2013. Total sampling with inclusion criteria conducted in this study was: Head 3D CT scans of maxillofacial clinical trauma patients and undergo stabilization operation and instrumentation.

A retrospective observational study by using secondary data derived from medical records was used, while the collected nominal data was arranged in tabular form and analyzed descriptively by calculating the sensitivity, specificity, positive and negative predictive value also accuracy, followed by inferential analysis with Mc Nemar test and calculating Kappa coefficient.

Results

Characteristics The Study Sample

Twenty-nine subjects with maxillofacial trauma that consisting of 25 male (86.21%) and 4 female (13.79%) were obtained. There was a group of under 20 years old was 8 (27.59%) patients, age group 20 - 30 years old was 8 (27.59%) patients, age group 30-40 years old was 7 (24.14%) patients, age group 40-50 years old was 3 (10.34%) patients, and age group above 50 years old was 3 (10.34%) patients. The oldest was 52 years old while the youngest was 13 years old. From 29 patients, the injury was caused by traffic accident by 26 (89.66%), fell by 2 (6.90%), fights (3.45%) and sports (0%).

Characteristics of Maxillofacial fractures

Twenty-nine patients in this study were; who experienced a maxillofacial fracture was 27 (93.10%) and non-fractured was 2 (6.90%) (Table 1). Maxillofacial fractures were obtained on maxillofacial bone and zygoma bone (21.25%) and incarceration of rice and tooth septum (1.25%) (Table 1).

Table 1. Distribution of maxillofacial fractures according to affected bone

Bones	Frequency	Percentase (%)
Frontal Bone	7	8.75
Temporal Bone	4	5.00
Parietal Bone	3	3.75
Zygoma Bone	17	21.25
Orbital Bone	8	10.00
Nasal Bone	6	7.50
Maxilla Bone	17	21.25
Mandibular Bone	14	17.50
Ethmoidal Sinuses	2	2.50
Nasal Septum	1	1.25
Teeth	1	1.25
Total	80	100.00

Characteristics of Orbital Bone Fracture

The highest number of orbital segment fractures was on Supraorbital (27.27%) and infrequently on Lasser wing and Greater wing (0.00%) (Table 2).

Table 2. Characteristics of Fracture Segment Orbital

Segments	Frequency	Percentase (%)
Frontal Process	1	9.09
Supraorbital	3	27.27
Temporoorbita	0	0.00
Zygoma frontal process	2	18.18
Maksiloorbita	2	18.18
Lacrimal bone	3	27.27
Lasser Wing	0	0.00
Greater Wing	0	0.00
Total	18	100.00

The most fractures obtained from the Zygoma Segments was on Orbital Process and Orbital Surface 12 (44.44%) also infrequently was Zygomaticofacial foramen 1 (3.70%). Meanwhile, fracture of Segment Zygoma mostly on left Frontal Process and Orbital Process was 8 cases.

Characteristics of a Zygoma Segment Fracture by Type of Fracture

The obtained fractures of the Zygoma Segment by Most Segmental Fracture Type was 53.33%.

Frontal Fracture

Most Characteristics of Frontal segments Fracture was Frontal bone (100%) and imprinted on the Peduncular plate (0.00%). Most Frontal Fractures on Frontal bone on the left side was 5 cases. The most characteristics of Frontal Segment Fractures based on fracture type was Segmental Type (80%).

Nasal Bone Fracture

Most nasal segment fractures were Nasal Bone characteristic (75%) and inhibited Peduncular plate (0.00%). Most Nasal Segment Fractures regarding Nasal Bone on both right and left side was 2 cases, while, most Nasal Segment Fracture Based on Types of Fracture was Segmental Types (66.67%).

Maxilla Bone Fracture

Most maxilla segment fracture distribution of Orbital surface 11 frequency (27.50%) and infrequently on Temporal Process also Frontal Process 5 frequency (12.50%). Most of the maxillary segmental fracture characteristics on left side orbital surface were 10 cases. While, most Fracture of the Maximum Segment by Type of fracture was segmental and communitive Type (43.75%).

Mandibular Bone Fracture

The most characteristics of Mandibular segment fracture was Symphysis Mandibula (34.48%), infrequently wasCondylar Process and Coronoid Process (0.00%) (Table 3). Then, the most Mandibular Segment Fractures was Symphysis Mandibula on the right side were 7 cases. While, the most Fracture of Mandibular Segment by Type of Fracture was Segmental and Communitive Type (42.86%).

Table 3. Characteristics of Mandibular Segment Fracture

Segments	Frequency	Percentase (%)
Condylar Process	0	0
Coroid Process	0	0
RamusMandibula	3	10.34
AngleMandibula	4	13.79
BodyMandibula	8	27.59
Alveola Process	4	13.79
Symphysis Mandibula	10	34.48
Total	20	100

Special Classification of Maxillofacial Fracture

Twenty-nine Orbita Fracture patients who experienced NOE type (Naso-Orbita-Ethmoidal) was 1 (3.45%) and Blow Out Orbita was none The classification distribution of maxilla fracture type Le-Fort 1 was 4 people (13.79%), Fracture Max type Le-Fort 2 and Le-

Fort 3 was none. Two-types head fractures that excluded in the Maxillofacial Fracture group was Cranii Bone Fracture (25%) and Occipital Fracture (75%).

Complications

Characteristics of maxillofacial fractures according to the appear complications from 29 patients were intracranial complications 16 (15.24%), Haematosinus 55 (52.38%) and Soft tissue hematoma 34 (32.38%). The most intracranial complications were ICH (31.25%) and infrequently were EDH (0.00%) (Table 4). Complications in the softest tissue was Orbita region (26.47%) and infrequently was Parietal Region (2.94%) (Table 5) The most common Haematosinus complications was Sinus Ethmoid and Maksilaris (29.09%) also Nasopharynx (1.82%). (Table 6)

Table 4. Distribution of intracranial complications

Intracranial	Frequency	Percentase (%)
ICH	5	31.25
IVH	0	0.00
SAH	3	18.75
EDH	0	0.00
SDH	2	12.50
Pneumatochele	3	18.75
Difusaxional brain injury	3	18.75
Total	16	100

Table 5. Distribution of complications in soft tissue

Region	Frequency	Percentase (%)
Ocipital	1	2.94
Frontal	6	17.65
Temporal	7	20.59
Parietal	1	2.94
Orbital	9	26.47
Nasal	4	11.76
Fasialist	6	17,65
Total	34	100.00

Table 6. Distribution of complications in haematosinus

Sinus	Frequency	Percentase (%)
Maxillary	16	29.09
Ethmoid Sinus	16	29.09
Frontalis	6	10.91
Sphenoid	7	12.73
Nasal Cavum	9	16.36
Nasopharynx	1	1.82
Total	55	100.00

Stabilization and instrumentation operations

From 29 patients, stabilization action and instrumentation were performed in the form of closed reposition was 3 (6.25%), open repositioning wiring was 15 (30.61%), Open Repositioning plating was 23 (46.94%) and Butterfly Gypsum was 7 (16.33%).

Comparison of MSCT Scan examination results and Stabilization also Instrumentation operations.

All of the total subjects, only 14 subjects the researchers could get from the patient's medical records, from the 14 existing data with maxillofacial trauma, 3D CT Scan and result of stabilization and instrumentation operation were obtained. True Positive (TP) = 100%, True Negative (TN) = 100%, False Positive (FP) = 100%, and False Negative (FN)) = 100%. (Table 7).

Table 7. Results of Stabilization & Instrumentation Operations

		Operation stabilization & instrumentation results		
		Positive	Negative	
3D MSCT Scan	Positive	14	0	14
	Negative	0	2	2
		27	2	29

Mc. Nemar p=0.000 Kappa=1.000 p=0.000

The result of Mc Nemar test showed no significant difference between head 3D CT scans result and stabilization also instrumentation operation with p = 1,000 (p> 0.05). While the of the analysis by calculating Kappa coefficient shows that there was a high suitability between head 3D CT scans with stabilization and instrumentation result with κ = 1.000, p = 0.000 (p <0.05).

Discussion

A Head 3D CT Scan with Volume Rendering (VR) to display bone images in 3D reconstruction was used, while 3D reconstruction was considered as the best modality in looking at the anatomical structure of bone because it produces spatial resolution and builds a combination of ultra-thin submillimeter combinations of slices[8,9].

In the study, the epidemiologic incidence of maxillofacial trauma was more common in male (86.21%) than female (13.79%) with the most in <20 years old group and 20-30 years old group (27.59%). The mechanism of etiology injury was a traffic accident (89.66%). This was in accordance with previous

research which states that the incidence rate was higher in men (20-29 y/o) with the etiology of traffic accidents, especially motorcycles.

The physical examination of the maxillofacial trauma patient was insufficient to maintain the maxillofacial fracture diagnostic, it still needs radiological examination. From a radiological examination that using a head 3D CT scan, it was found that patients with maxillofacial fractures (93.1%) and had no fracture (6.9%) with the most fractures occurring was in zygoma and maxillary bone (21.25%). This was in accordance with the previous study that most fractures occur in the maxillary bone due to bustrecess in the maxillary region[10,11,12].

Maxillofacial trauma results were; a severe variation injury, bruise, excoriation, various vulnus of soft tissues to fractures. Maxillofacial fractures only occur in one place or complex, due to impact with low strength or high strength (> 50% gravitational forces). Maxillofacial fractures will unreleased from the head injury due to the location and adjacent structures. Maxillofacial structures were considered reducer due to trauma, thus to protect the intracranial structure[13,14,15].

There were several complications in the form of Cranii Bone Fracture (25%), intracranial complication (15.24%), Haematosinus (52.38%) and Soft tissue haematoma (32.38%), the most intracranial complications was ICH (31.25%), most soft tissue complications was in the Orbital region (26.47%) and the most common Haematosinus complications was Sinus Ethmoid and Maxilla (29.09%). This was in accordance with previous studies that stated, 253 maxillofacial fractures patients with the head injury was 20.2%, maxillofacial fractures accompanied by intracranial hemorrhage was 28.3% in the upper third of the face while Maxillofacial fractures accompanied by a cranial fracture was 57.1%.

Conclusion

The 3D CT scan results were compatible with the results of stabilization and instrumentation operations.

Ethical Clearance: The present study was carried out in accordance with the research principles. This study implemented the basic principle ethics of respect, beneficence, nonmaleficence, and justice.

Conflict of Interest: There is no report of conflict of interest involved with this study so far.

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