# Radiographic referral in mandibular fracture assessment: A survey on oral maxillofacial surgeons

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**ABSTRACT**

**Introduction:** Epidemiological studies show a significant increase in mandibular fractures in the past few decades. Various radiographic projections are indicated for the diagnosis of mandibular fractures. This study was aimed to gather information on the type of radiographic examination commonly prescribed in the diagnosis of mandibular fracture among the oral maxillofacial surgeons and factors influencing the choice of radiographic prescription. **Methods:** A descriptive study with survey method was conducted on 30 respondents in the Oral Surgery Departments of three hospitals in Bandung, by purposive sampling technique. The data collected using the self-structured questionnaire method and assessed according to frequency distribution. **Results:** Highest choice of radiographic prescription in the survey for each location of fractures in the mandible was panoramic (83.3 to 100%), and the least is CBCT (10 to 16.7%). The most factors influencing the choice of prescription were availability (53.3 to 56.7%), image accuracy (50 to 60%) and cost (46.7 to 56.7%) of the radiographic examination. **Conclusion:** Most of the dentists in this study prescribe panoramic radiographs in mandibular fracture assessment based on availability, image accuracy, and cost of the radiographic examination.

**Keywords:** Mandibular fracture, radiographic referral, survey, oral maxillofacial surgeons.

## INTRODUCTION

In the past few decades, there is a significant increase of maxillofacial injuries in developing countries.[1] Mandible fractures constitute a substantial proportion, up to 59% of all maxillofacial fracture due to its anatomical peculiarity of form and location in the facial skeleton.[2] Young male adults the most affected for mandibular fractures in the setting of road traffic accidents. Several studies have reported that parasymphysis region in mandible is the most common fracture site.[1,3]

The key for a successful treatment of a fractured mandible is a proper diagnose that requires a detailed history or anamnesis, clinical examination and followed by radiographic evaluation as an important diagnostic tool to enhance the clinical examinations done formerly.[4] Dr. B.H. Cho in White[5] states that the accuracy of clinical examination is only 68% of mandibular fractures, therefore radiographic evaluation is vital to detect the fracture site, direction and degree of displacement of each fracture line. However, radiographic exposures are necessary only when it is reasonably likely that the patient will benefit by the discovery of clinically useful information on the radiograph.[5]

The goal of dental care is to preserve and improve patient's oral health while minimizing

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other health related risks. Dental practitioners should be aware that every radiographic examination does carry the potential for harm from exposure to ionizing radiation, although the diagnostic information provided by radiographs may be of definite benefit to the patient.[5]

Effort should be made to avoid repeated exposure that will not contribute information pertinent to patient care. Thus, the right selection of an appropriate imaging modality has a considerable support in its contribution to the proper diagnosis and care of the patient.[6]

In the last few years, there has been a considerable interest and controversy exists over the issue of which radiologic views are preferable in the diagnosis of mandibular fracture.[7] For the first part of the 20th century, plain film radiographs were the basis for diagnosing fractures to the maxillofacial skeleton. In 1940's and 1950's, many institutions use the combinations of conventional plain films which include lateral oblique, transcranial, occlusal and posteroanterior (PA) projections as the baseline radiographic for mandibular fracture assessment.[8]

In the 1960s, based on the principles of scanography and tomography, panoramic radiography was then commercialized.[9] Panoramic radiography is capable to provide a good view of the entire jaws, therefore it is commonly used by many clinicians as an ideal screening view for mandibular fractures.[10] According to a study by Chayra and colleagues in 1986, 92% of the 88 fractures in 50 patients were recognized in the panoramic radiography and only 66% were detected in the plain radiographs. This view has brought a considerable support by most surgeons, considering a panoramic view to be superior to plain views and become a modality of choice in the mandibular fracture assessment.[7,11]

The value of any diagnostic modality depends on the amount of information is solely gained by its utilization. Although panoramic view reported to be superior to plain radiographs, it still suffers from a number of weaknesses such as loss of diagnostic accuracy and decreased sensitivity.[12] This view is also agreed by Chacon, *et al*. where panoramic radiograph showed a high incidence of false-negative and false-positive results especially for mandibular condyle fractures. Besides that, a report by Al-Musaed (1999) indicates that mandibular angle region fractures were most often undiagnosed on the panoramic radiography.

In regards to that, little research has actually explored the details of these issue and later on the helical computed tomography (CT) scan became more widespread that was able to represent the defects in the facial skeleton more accurately.[13] According to E.J Escott, CT scans were more sensitive than panoramic tomography, particularly for fractures of the mandibular angle, ramus and condyle. Research by B.Schuknecht revealed that symphyseal fractures are also better visualized by CT, as overlap with the spine on conventional radiographs that may preclude recognition of these fractures. Helical CT scan has been reported to be more accurate, sensitive and specific for the diagnosis of mandibular fractures and to have a better fracture characterization than panoramic tomography.[14]

Although CT scans has been described with promising results, however the routine use of conventional helical CT scan for mandibular fractures is not justified due to its high cost and increased radiation dose exposure.[10] Thus, CT scans are rarely indicated as the modality of choice in mandibular fracture assessment.[4] Anyhow, radiologic advancements were not finished. More recently, the three dimensional cone beam computed tomography (3D CBCT), an emerging CT technology has entered the field of dentistry that eliminates the shortcomings of conventional helical CT scans. CBCT produces a 15 times lower radiation dose with a short scanning time as low 10 to 40 seconds and capable of higher spatial resolution than that produced by CT.[8,15,16] In addition, CBCT data are also amenable to reformation in a volume, rather than a slice, providing 3D information that enables the imaging of the mandible to be accurate than CT scan. This is appropriate with the findings that mandibular fractures that are not evident in CT scans can be identified using CBCT.[8,17]

Considering the reports from W H Shintaku, both conventional and advanced imaging modalities may be indicated for mandibular fractures, depending on several factors. But little is known about the radiograph prescribing pattern among dental practitioners in mandibular fracture. One study has been done in Bulgaria where patients prescribed a routine mandibulo-

facial series consists of posteroanterior, lateral oblique and occipitomental view whenever the possibility of mandibular fractures is suspected. According to the study, using this series of radiograph considered as more cost effective, time effective and reduction in radiation exposure. However, question still remains since there is a considerable variation of opinions among the dental practitioners in deciding the radiograph to be prescribed in mandibular fracture.[18]

To date, there is no available data about the radiograph prescribing pattern of dental practitioners of Bandung in mandibular fracture assessment. Therefore, the author is very interested to gather information on the type of radiographic examination that is commonly prescribed by the Oral Maxillofacial Surgeons in Bandung, Indonesia in the assessment of mandibular fracture and their factors influencing the choice of radiograph by means of self structured questionnaire.

The research aim is to gather information on the type of radiographic examination that is commonly prescribed in the diagnosis of mandibular fracture by Oral Maxillofacial Surgeons in Bandung, Indonesia. The research is also aimed to find out the factors influencing the choice of prescription of radiograph by means of self-structured questionnaire.

## METHODS

This research is a descriptive study with a survey method, which is conducted with the primary objective to create a description of a phenomenon in a objectively state (Notoatmodjo, 2005). The research is approved by the Department of Dentomaxillofacial Radiology, University of Padjadjaran and meets all the requirements involving human subjects, including the ethical conduct in every research location.

Target population is the population of ultimate clinical interest. But, because of practicalities, entire target population often cannot be studied. Study population is the subset of target population that can be studied. Samples are subsets of study populations used in clinical research because often not every member of study population can be measured.[19] Thus, the target population of the research is limited to the Oral Maxillofacial Surgeons in Bandung Hospitals. To limit the scope of the research, the study population is taken in top three regional referral hospitals in Bandung which includes Dr. Hasan Sadikin General Hospital, Santosa International Bandung Hospital and Santo Borromeus Hospital. The samples of the research are Specialist and Residents of Oral Maxillofacial Surgery Department in previously mentioned hospitals.

The tools that needed are the basic stationery items, questionnaire sheet, informed consent form and data recording sheet. The questionnaire sheet that will be used is divided into three sections, namely: Section A: Questions on sociodemographic data such as practice specific characteristics, Section B: Questions on technical aspects in oral radiology, and Section C: Questions on choice of radiograph prescribed and factors influencing the choice.

## RESULTS

Of the 35 questionnaires distributed to the research locations, 30 respondents responded to the questionnaire, a response rate of 85.7%. The following results are divided into sections of questions as outlined by practice specific characteristics, technical aspect in oral radiology and finally the diagnostic imaging and projections in mandibular fracture.

The first section comprises of two questions which is on sociodemographic data. Table 1. below describes the table on the frequency of the years in practice of the respondents took part in the survey. The majority of the respondents have less than 10 years in practice, which comprises to 63.3 %. There were 20 % of the respondents that has been practicing more than 25 years and 16.7% of them have around 10 to 25 years in practice.

The next question from this section is where the respondents were asked about their professional qualification which is depicted below in table 2.

From here, we can see most of the participants of our survey were the Specialist of Oral Surgery (Sp.BM) which makes up to 63.3%. The second highest professional took part in the survey are the Residents of Oral Surgery Department which accumulate to 36.7%.

The second section of the questionnaire are related to technical aspect in oral radiology,

**Table 1. Years in practice; Table 2. Professional qualification; Table 3. ALARA concept; Table 4. Panoramic effective Dosage; Table 5. Use of CBCT in dentomaxillofacial imaging**

| No | Prescribing determinants | f | % |
|---|---|---|---|
| **Years in practice** | | | |
| 1 | Less than 10 years | 19 | 63.3 |
| 2 | 10 to 25 years | 5 | 16.7 |
| 3 | More than 25 years | 6 | 20.0 |
| | Total | 30 | 100.0 |
| **Professional qualification** | | | |
| 1 | Residents, DDS | 11 | 36.7 |
| 2 | Specialist, OMS | 17 | 63.3 |
| | **Total** | **30** | **100.0** |
| **Consider ALARA** | | | |
| 1 | Yes | 10 | 33.3 |
| 2 | No | 3 | 10.0 |
| 3 | Unsure | 17 | 56.7 |
| | **Total** | **30** | **100.0** |
| **Panoramic effective dosage** | | | |
| 1 | 13 µSV | 4 | 13.3 |
| 2 | 40 µSV | 1 | 3.3 |
| 3 | 2000 µSV | 1 | 3.3 |
| 4 | Unsure | 24 | 80.0 |
| | **Total** | **30** | **100.0** |
| **CBCT use** | | | |
| 1 | Yes | 22 | 73.3 |
| 2 | No | 8 | 26.7 |
| | **Total** | **30** | **100.0** |

**Table 6. CBCT effective dosage; Table 7. Principles of CBCT**

| Prescribing determinants | f | % |
|---|---|---|
| **CBCT effective dosage** | | |
| 15 times lesser than panoramic effective dosage | - | - |
| 15 times higher than panoramic effective dosage | 2 | 6.7 |
| 15 times lesser than CT scan effective dosage | 5 | 16.7 |
| 15 times higher than CT scan effective dosage | - | - |
| Unsure | 23 | 76.7 |
| **Total** | **30** | **100.0** |
| **Principles of CBCT** | | |
| Volume surface rendering | 11 | 36.7 |
| Consecutive slices | 3 | 10.0 |
| Unsure | 16 | 53.3 |
| **Total** | **30** | **100.0** |

consisting five questions of the ALARA concept, effective dosage of panoramic radiography and specific knowledge on CBCT imaging.

**Table 8. Radiographic prescription in mandibular fracture; Table 9. Radiographic prescriptions for symphyseal fracture; Table 10. Influencing factor in prescribing radiograph for symphyseal fracture**

| No | Prescribing determinants | f | % |
|---|---|---|---|
| **Prescription** | | | |
| 1 | Yes | 30 | 100 |
| 2 | No | - | - |
| | **Total** | **30** | **100** |
| **Radiographic examination** | | | |
| **1** | Panoramic | 30 | 100 |
| **2** | Lateral Cephalometric | - | - |
| **3** | Posteroanterior | 7 | 23.3 |
| **4** | Lateral oblique | 3 | 10 |
| **5** | CT scan | 10 | 33.3 |
| **6** | CBCT | 3 | 10 |
| **7** | Others | 1 | 3.3 |
| **Influencing factor** | | | |
| 1 | Radiation Dosage | 4 | 13.3 |
| 2 | Cost consumption | 17 | 56.7 |
| 3 | Time consumption | 12 | 40 |
| 4 | Data storage | 7 | 23.3 |
| 5 | Availability | 17 | 56.7 |

These results seem to illustrate that approximately half of the respondents (56.7%) were unsure of the ALARA concept whereas 10.0% answered 'no' in considering the concept while prescribing a radiographic examination. An interesting point were noted in this question that 33.3% of the respondents considered the ALARA concept, by saying 'yes' to the question and most of them were less than 10 years of practice.

Along with that, table 4.4 is about the effective dosage in the panoramic radiography examination.

The survey defined nearly more than half (80%) of the respondents were unsure about the effective dosage of the panoramic radiograph. There were 13.3% of them were right about the dosage value. However, 3.3% chose the different value of the dosage, which happened to be the effective dosage value of CBCT and CT scan. The next question was about the specific use CBCT technology in the dentomaxillofacial imaging and the results is displayed below in table 5.

73.3% of the respondents are reported know about the emerging technology of Cone Beam Computed Tomography (CBCT) used specifically in

**Table 11. Radiographic prescriptions for parasymphyseal fracture; Table 12. Influencing factor in prescribing radiograph for parasymphyseal**

| No | Prescribing determinants | f | % |
|---|---|---|---|
| **Radiographic examination** | | | |
| 1 | Panoramic | 30 | 100 |
| 2 | Lateral cephalometric | 2 | 6.7 |
| 3 | Posteroanterior | 7 | 23.3 |
| 4 | Lateral oblique | 3 | 10 |
| 5 | CT scan | 8 | 26.7 |
| **6** | CBCT | - | - |
| **7** | Others | 1 | 3.33 |
| **No** | **Influencing factor** | **f** | **%** |
| 1 | Radiation dosage | 6 | 20 |
| 2 | Cost consumption | 17 | 56.7 |
| 3 | Time consumption | 13 | 43.3 |
| 4 | Data storage | 6 | 20 |
| 5 | Availability | 19 | 63.3 |
| **6** | Distortion of image | 8 | 26.7 |
| **7** | Broad coverage | 14 | 46.7 |
| **8** | Image accuracy | 16 | 53.3 |

dentomaxillofacial imaging. Regardless, 26.7% of the respondents were not aware about this new technology.

The next subject in this section is regarding the comparison between effective dosage of the CBCT to the panoramic and CT scan. The results of the survey are displayed in the table 6.

From the table above, we can conclude that approximately 83.3% of the respondents were unsure or incorrect about the CBCT effective dosage. However, 16.7% answered correctly for this question, by choosing effective dosage 15 times lesser than the conventional CT scan.

The final question in this second section was on working principles of the CBCT in the image construction. This question was concerned on the importance and ability of the CBCT in producing a higher diagnostic value. The results are depicted below in table 7.

The same pattern is seen in the survey, defining almost half of the respondents (53.3%) were unsure on the working principles of the CBCT. Volume surface rendering is the principles of the CBCT where 36.7% of the respondents chose it. However, 10% answered the consecutive slices, which was the working principle of the CT scan.

**Table 13. Radiographic prescriptions; Table 14. Influencing factor in prescribing radiograph for body fracture**

| No | Prescribing determinants | f | % |
|---|---|---|---|
| **Radiographic examination** | | | |
| **1** | Panoramic | 30 | 100 |
| **2** | Lateral cephalometric | 4 | 13.3 |
| **3** | Posteroanterior | 2 | 6.7 |
| **4** | Lateral oblique | 1 | 3.33 |
| **5** | CT scan | 8 | 26.7 |
| **6** | CBCT | - | - |
| **7** | Others | 2 | 6.7 |
| **Influencing Factor** | | | |
| **1** | Radiation dosage | 6 | 20 |
| **2** | Cost consumption | 16 | 53.3 |
| **3** | Time consumption | 13 | 43.3 |
| **4** | Data storage | 7 | 23.3 |
| **5** | Availability | 19 | 63.3 |
| **6** | Distortion of image | 9 | 30 |
| **7** | Broad coverage | 14 | 46.7 |
| **8** | Image accuracy | 15 | 50 |

The final section of the questionnaires consists of 15 questions, mainly on the diagnostic imaging prescribed in the mandibular fracture and their reasons for prescribing it. Table 8. below describes the number of respondents prescribes a radiographic examination in the diagnosis of mandibular fracture.

The result shows that almost all the 30 respondents (100%) of the survey answers yes, which means the every respondents of the survey often prescribes a radiographic examination in the diagnosis of mandibular fracture.

Table 9. below illustrates the type of radiographic examinations often prescribed in the diagnosis of mandibular symphyseal fracture by the oral maxillofacial surgeons.

It is evident that panoramic tomography view is the most common where almost all the respondents (100%) prescribe such view for mandibular symphyseal fracture. This was followed with 33.3% of the respondents prescribe a computed tomography (CT) scan and 23.3% for a posteroanterior (PA) view. There are 10% of the respondents that answered lateral oblique and Cone Beam Computed Tomography (CBCT) respectively. Approximately 3.3% of the respondents chooses other view such as the mandibular occlusal view.

**Table 15. Radiographic prescription for mandibular angle fracture; Table 16. Influencing factor in prescribing radiograph for angle fracture**

| No | Prescribing determinants | f | % |
|---|---|---|---|
| **Radiographic examination** | | | |
| **1** | Panoramic | 30 | 100 |
| **2** | Lateral cephalometric | 5 | 16.7 |
| **3** | Posteroanterior | - | - |
| **4** | Lateral oblique | 4 | 13.3 |
| **5** | CT scan | 10 | 33.3 |
| **6** | CBCT | - | - |
| **7** | Others | - | - |
| **Influencing factor** | | | |
| **1** | Radiation dosage | 6 | 20 |
| **2** | Cost consumption | 16 | 53.3 |
| **3** | Time consumption | 16 | 53.3 |
| **4** | Data storage | 7 | 23.3 |
| **5** | Availability | 20 | 66.7 |
| **6** | Distortion of image | 10 | 33.3 |
| **7** | Broad coverage | 14 | 46.7 |
| **8** | Image accuracy | 14 | 46,7 |

**Table 17. Radiographic prescriptions for mandibular ramus fracture; Table 18. Influencing factor in prescribing radiograph for ramus fracture**

| No | Prescribing determinants | f | % |
|---|---|---|---|
| **Radiographic examination** | | | |
| **1** | Panoramic | 30 | 100 |
| **2** | Lateral Cephalometric | 4 | 13.3 |
| **3** | Posteroanterior | 1 | 3.3 |
| **4** | Lateral oblique | 2 | 6.7 |
| **5** | CT scan | 9 | 30 |
| **6** | CBCT | - | - |
| **7** | Others | - | - |
| **Influencing factor** | | | |
| **1** | Radiation Dosage | 6 | 20 |
| **2** | Cost consumption | 16 | 53.3 |
| **3** | Time consumption | 15 | 50 |
| **4** | Data storage | 8 | 26.7 |
| **5** | Availability | 18 | 60 |
| **6** | Distortion of image | 9 | 30 |
| **7** | Broad coverage | 14 | 46.7 |
| **8** | Image accuracy | 15 | 50 |

Table 10 depicts the influencing factor in prescribing the choice of radiographic examination for mandibular symphyseal fractures. From the table can be seen that the radiographic examination prescribed were mostly based on the cost and availability of the examination in the hospital setting (56.7%). Other than that, broad coverage (50%) and image accuracy (53.3%) of the radiographic examination are also taken in consideration by the respondents in the diagnosis of the mandibular symphyseal fracture.

Table 11 is about the type of radiographic examinations often prescribed in the diagnosis of mandibular parasymphyseal fracture. The panoramic tomography view is the most preferable radiographic modalities used in the mandibular parasymphyseal fracture, which accounts to 100% of the respondents. The next preferable modality used was the CT scan (26.7%), and posteroanterior (23.3%), followed by lateral oblique (10%) and lateral cephalometric (6.67%). Approximately 3.3% of the respondent chooses mandibular occlusal radiograph for the view of the mandibular parasymphyseal fracture.

Table 12 illustrates the influencing factor in prescribing the choice of radiographic examination for mandibular parasymphyseal fractures.

Most of the respondents choose the factor ease of availability (63.3%) of the radiographic examination, mainly the conventional radiographs in the hospital setting. Factors like affordable cost (56.7%) by the patient, image accuracy (53.3%), broad coverage (46.7%) and time consumption in taking the radiographs (43.3%) was also taken into consideration by the respondents in prescribing radiographic examination for mandibular parasymphyseal fractures.

Table 13 is about the type of radiographic examinations often prescribed in the diagnosis of mandibular body fracture by the respondents. All respondents prescribing panoramic view, 26.7% prescribe a CT scan examination. There were 6.67% of the respondents that choose for prescribing PA and submentovertex view for the mandibular body fracture examination.

Table 14 depict the influencing factor in prescribing the choice of radiographic examination for mandibular body fractures. The results showed that ease of availability factor (63.3%), followed by gradually cost factor (53.3%), image accuracy (50.0%), broad coverage (46.7%) and time consumption (43.3%) were the influencing factor in prescribing radiographic examination for mandibular body fractures.

**Table 19. Radiograph prescriptions for mandibular condylar fracture; Table 20. Influencing factor in prescribing radiograph for condylar fracture**

| No | Prescribing determinants | f | % |
|---|---|---|---|
| **Radiographic examination** | | | |
| **1** | Panoramic | 25 | 83.3 |
| **2** | Lateral cephalometric | 4 | 13.3 |
| **3** | Posteroanterior | 3 | 10 |
| **4** | Lateral oblique | 1 | 3.33 |
| **5** | CT scan | 15 | 50 |
| **6** | CBCT | 5 | 16.7 |
| **7** | Others | 4 | 13.3 |
| **Influencing factor** | | | |
| **1** | Radiation dosage | 4 | 13.3 |
| **2** | Cost consumption | 14 | 46.7 |
| **3** | Time consumption | 12 | 40 |
| **4** | Data storage | 5 | 16.7 |
| **5** | Availability | 16 | 53.3 |
| **6** | Low distortion of image | 8 | 26.7 |
| **7** | Broad coverage | 14 | 46.7 |
| **8** | Image accuracy | 18 | 60 |

Table 15 explains the type of radiographic examinations often prescribed in the diagnosis of mandibular angle fracture by the respondents. It is reported that 100% of the respondents prescribe panoramic view whereas 33.3% of them prescribes CT scan, 16.7% prescribes lateral cephalometric and 13.3% for lateral oblique for mandibular angle fractures.

Table 16 illustrates the influencing factor in prescribing the choice of radiographic examination for mandibular angle fractures. The results show almost more than half of the respondents choose the factor of ease of availability (66.7%), cost and time consumption (53.3%) as the reason for prescribing such radiographic examination for mandibular angle. Other reasons were broad coverage and image coverage (46.7%) respectively.

Table 17 describes about the type of radiographic examinations often prescribed in the diagnosis of mandibular ramus fracture by the respondents.

Survey that was done clearly shows that panoramic view (100%) again is the most frequent radiographic examination prescribed for mandibular ramus fracture, followed by CT scan (30%), lateral cephalometric (13.3%), lateral oblique (6.67) and finally PA view (3.33%).

**Table 21. Radiograph prescription for mandibular coronoid process fracture**

| No | Radiographic examination | f | % |
|---|---|---|---|
| 1 | Panoramic | 27 | 90 |
| 2 | Lateral cephalometric | 4 | 13.3 |
| 3 | Posteroanterior | 0 | 0 |
| 4 | Lateral oblique | 4 | 13.3 |
| 5 | CT scan | 12 | 40 |
| **6** | CBCT | 4 | 13.3 |
| **7** | Others | 0 | 0 |

**Table 22. Influencing factor in prescribing radiograph for coronoid fracture**

| | Reasons for prescribing | | % |
|---|---|---|---|
| 1 | Radiation dosage | 5 | 16.7 |
| 2 | Cost consumption | 14 | 46.7 |
| 3 | Time consumption | 13 | 43.3 |
| 4 | Data storage | 6 | 20 |
| 5 | Availability | 16 | 53.3 |
| **6** | Distortion of image | 9 | 30 |
| **7** | Broad coverage | 15 | 50 |
| **8** | Image accuracy | 17 | 56,7 |

Table 18 depict the influencing factor in prescribing the choice of radiographic examination for mandibular ramus fractures.

Not much changes from the previous results, ease of availability (60%) is still the leading factor, followed gradually with cost consumption (53.3%), image accuracy (50%), time consumption (50%) and broad image coverage (46.7%) factors.

Table 19 describes about the type of radiographic examinations often prescribed in the diagnosis of mandibular condylar fracture by the respondents.

For the mandibular condylar fracture assessment, respondents have a different opinion in prescribing radiographic examination compared to other locations of the fracture in mandibular. Although, panoramic view is still preferable by the majority of the oral surgeons, but the number of respondents prescribe it have dropped to 83.3%. CT scan examination here has reached 50% of the respondents prescribing for the condylar fracture. A newer trend can be seen in some oral surgeons (16.7%) prescribing the Cone Beam Computed Tomography (CBCT) examination and 13.3% of them prescribes other radiographic examination

such as the open-closed lateral radiographic view and schedel or skull radiographs.

Table 20 depicts the influencing factor in prescribing the choice of radiographic examination for mandibular condylar fractures. A different trend is also seen in the factors prescribing such radiographic examination in mandibular condylar fracture, where image accuracy is the leading factor, accounting to 60% of respondents. Next, the factor availability (53.3%) followed by broad coverage (46.6%), cost (46.6%) and time consumption (40%) are taken into consideration by the respondents during prescribing the radiograph. Like the other fracture location results, image distortion (26.7%) , ease of data storage (16.7%) and radiation dosage (13.3%) is still in lower consideration compared to the rest of the factors.

Table 21 describes about the type of radiographic examinations often prescribed in the diagnosis of mandibular coronoid process fracture by the oral maxillofacial surgeons. Here, 90% of the respondents choose panoramic view as the most commonly prescribed radiographic examination, followed by CT scan examination (40%), lateral cephalometric, lateral oblique and CBCT examination (13.3%) respectively.

Table 22 depicts the influencing factor in prescribing the choice of radiographic examination for mandibular coronoid process fractures. It was reported image accuracy (56.6%) is the leading factor, being similar to the factors for condylar radiographic examination. Ease of availability (53.3%) followed gradually broad image coverage (50%), cost (46.7%) and time consumption (43.3%) factors are taken into account.

## DISCUSSION

The goal of this study is to gather the information on the radiographs that are commonly prescribed in the assessment of mandibular fracture and to find out the factors influencing the choice of radiograph prescribed.

One of the main objectives of radiology is to produce images of sufficient diagnostic quality while keeping the dose as low as reasonably achievable.[20] This is accordance as set forth in the ALARA (as low as reasonably achievable) principle. However, based on the results of previous surveys by FR. Khan (2010), A.S. Eksioglu (2011) and S.Shahab (2012), it is not surprising that 66.7% of the respondents in this study do not aware the importance of using ALARA principle while prescribing the radiographic examination to the patients. However here in this study, the ALARA principles were better appreciated by respondents with less than 10 years in practice (33.3%).

The results expressed above point to the fact that young doctors are better educated on ALARA principle than doctors with more clinical experience.[21] Although this appears to be a contradiction, it makes sense because the new generation has grown up in an environment in which medical radiation issues are discussed in the radiology curriculum. It is encouraging that the new generation has a better understanding of radiation principle; however our sample sizes are too small to draw any statistically significant conclusion.

The number of panoramic radiograph prescribed has risen in recent years at a greater rate and has been as one of the most prescribed extraoral radiographic examination in the field of dentistry[22,23] However, regarding the panoramic radiography effective dosage questions, the results appear to illustrate that almost 86.6% of the respondents were either unsure or incorrect for that question. This is because the question may have turned out to be confusion for the participants as a non-radiologist. This effective dosage value should be defined more precisely if this question is used in future studies.

The next series of questions were regarding the CBCT technology, specifically used in dentomaxillofacial imaging. A very notable finding here is almost 73.3% of the respondents unanimously agree and knew the fact that CBCT is used specifically in the dentomaxillofacial imaging. This is in accordance with K. Kamburoglu, *et al* reporting that majority of their study participants (63.3%) also knew the use of CBCT specifically in the dentomaxillofacial imaging.[24]

However, the result of previous question was not consistent with the expectations for the issue of the estimated effective dosage comparison of CBCT, as it has less likely contributed to some degree of uncertainty to the study participants, where 83.3% were unsure or incorrect. In contrary with the study from S Dolekoglu in Turkey, where 82% of their study respondents knew that CBCT requires lower radiation dosage than CT scan.

The same pattern was illustrated in the question regarding the working principles of the CBCT, where almost 63.3% answered incorrectly or unsure of it. The findings above could be because of CBCT technology that is in general relatively new to Bandung city. Considering the fact that there are only one CBCT unit available throughout the entire city (by comparison 20 CBCT units in Turkey, 800 in Germany and 3000 in USA), it is not surprising that awareness and understanding in CBCT remains limited.[24] The lack of a CBCT unit in the city seems to have played a significant role in respondents' unfamiliarity with this technology.

Every prescription of radiographs made by clinicians should be based on an evaluation of the individual patient benefit. The fact that panoramic radiograph is superior to other plain film could be a concern in the findings of our study where panoramic radiography become a modality of choice in mandibular fracture.[25] From the outcome of our result, we can notice a similar pattern in every location of fracture where almost 83 to 100% of the respondents prescribed for a panoramic radiograph whenever a mandibular fracture is clinically indicated.

Panoramic radiography is indicated for every location of fracture in the mandible, although the condylar and coronoid region are believed may be overlooked in panoramic and reduce the overall diagnostic accuracy in that region.[4] This study is similar to our findings where the number of respondents prescribes the panoramic radiograph for condylar and coronoid process region has reduced to approximately 17% compared to other regions.

A specific challenge to all the Oral Maxillofacial Surgeons is dealing with a symphseal or parasymphyseal mandibular fracture. Our research indicates 100% of the respondents prescribe a panoramic radiograph for anterior mandible, however, Al-Musaed affirmed that panoramic radiograph may not be an excellent view for these regions due to both fractures can be obscured by superimposition and interferences of underlying cervical spine which may reduce the overall diagnostic accuracy. Reasons of this situation could be because the respondents in this study may have opted to digital panoramic radiograph, which is reported to have a satisfactory diagnostic value than the conventional panoramic radiograph.[26] Next, although the lateral cephalometric has a lower value in detecting lower jaw fractures accurately[5] it is indicated in viewing the posterior part of the mandible especially the ramus and angle fractures[27] which is accordance with our findings that 13.3% and 16.7% of the respondents precribed for this view for ramus and angle fractures.

As the literature reveals, the posteroanterior (PA) radiographs has a medium usefulness in detecting the fractures in mandible, especially the body, ramus, angle and low condylar neck[5] This was in accordance with the literature as only several respondents choosed this view for body and condyle. There were 23.3% respondents use this radiograph to locate the symphyseal and parasymphyseal fractures which is in agreement to another study.[28] However, there were only one prescribed this view for ramus. A closely related factor was the assumption that our respondents might have feel that there is a better options of radiographs to view the ramus fracture.[5] For lateral obliques radiographs, it is indicated as medium to high usefulness for depecting mandibular body, ramus, condylar and coronoid process. In our observation, most of them favours this particular view for every locations ranging from 3.3% to 13.3%. The interesting point noted here was the 10% of the respondent used lateral oblique used for anterior mandible fractures, which is not recommended in literatures.[5] This differing response could be from the possibilities for the respondents to use a different angulation of lateral oblique while taking the radiograph of anterior mandible.

Aside from the uniformity of the respondents's answer, other extra findings that were found in our study are occlusal radiographs used in the fractures of symphysis and parasymphysis. This is accordance with W. Schubert, 2002 that has stated in a study that occlusal radiography offers a unique view of symphyseal and parasymphyseal area compared to any other views. Another finding was submentovertex view used in the mandibular body fractures (6.67%) even it is stated as having relatively low usefulness (S C White, 2009). For condyle fractures, a portion of respondents (13.3%) prescribes the open closed transcranial projection which is also an indication. These concerns all relate to the study participants that

may have been comfortable with the conventional plain radiographs.

Several interesting points were noted from the data presented in previous section that computed tomography (CT) scans was used for almost for every location of the fractures, particularly the condyle and coronoid region which accounts 40 to 50% of the respondents. Research by MK Nair, *et al*, reveals that the advanced imaging is indicated in cases of fracture displacement such as in condylar fractures.[29] This findings are not surprising as the respondents may find the CT scan to be more sensitive and can be interpreted more predictably than the plain film radiographs.[30]

Among all the indicated imaging modalities, CBCT is rarely used by our study participants in mandibular fracture except for condyle (16.7%), coronoid (13.3%) and symphyseal (10%) fractures, even though CBCT is capable of providing more accurate treatment plan decisions. The lack of a CBCT unit in the city seems to have played a significant role in respondents' unfamiliarity with this technology. Other than that, our study respondents were all from hospital setting that are accustomed in the use of CT scan rather than this new technology, being responsible for the less number of CBCT prescription compared to CT scan. Also other than that, maybe the use of CBCT is higher in other treatment procedures such as in the implant planning.[15] The issue of how CBCT is used in the clinical application would be a good topic to include in future studies of the use of CBCT technology.

From the section of the results regarding the factors influencing the radiographic prescription pattern, a couple of interesting points are evident. Firstly, there was unanimous agreement among our study participant that 53.3 to 66.7% answered the availability of the radiographic examinations as their reason to prescribe such radiographic examination. There are no existing data that indicate the numbers or percentages of panoramic x-ray unit available throughout the city, however, in every hospital that was surveyed in this study apparently has the facility; being a necessary component for the use of panoramic radiograph widely.

Research by MK Nair, *et al*, (2000) revealed that locations of fractures did affect the accuracy significantly although fractures in ramus, angle and body of the mandible were easier to detect than those in the condylar and coronoid process. Our finding in the present study is similar to this observation where the highest factor influencing their choice of radiograph for condylar and coronoid fracture was image accuracy, accounting to 56.7% to 60%. Even though the sample sizes are small, these noteworthy differences between radiation doses should be taken in account. Important differences emerge that there were only 13.3% to 20% of them that considered radiation dose during the prescription. By right, all radiographic examinations should be justified and has an obvious benefit for the patient before exposures made, as outlined in the National Council on Radiation Protection and Measurements.[31]

Respondents' choice of radiograph in the mandibular fracture assessment is also highly influenced by the cost of the radiograph examination. Our findings reveal that 46.7 to 56.7% of them consider cost during their prescription of radiograph to the patients. This is primarily because the expensive radiographs are not affordable by every patient who has to pay solely for the radiograph as part of the treatment. We should take in account the National Socioeconomic Survey report of Indonesia Income Distribution in 2008 stated that poor people in Indonesia is 15.4%.[32] The rising income inequality here leads to a change in spending patterns among the citizens, which include the medical treatments.

Another aspect to be considered is the radiation dose. Only 13.3% to 20% indicated that radiation dose influenced the choice of imaging examination. CBCT should be the preferred 3D imaging procedures rather than the CT scans, especially in diagnosing the fractures at the condyle and coronoid processes. Although CBCT has higher radiation dose compared to the conventional two dimensional radiographs, increased radiation dose appears to be reasonable and the improvements in the diagnostic accuracy outweigh this disadvantage.[33] However, dental practitioners should be clear on the implications of the technologies they decide to use on their patients and how and why they choose to implement them.

These results should be considered in the light of some study limitations. The sample of

respondents surveyed was small and represented only 39.2% of the registered Oral Maxillofacial Surgeons of the West Java province; Indonesian Association of Oral and Maxillofacial Surgeons (PABMI). The sample size may have contributed to less significant findings when compared to a larger sample. However, this sample can be representative of the community surveyed as it involved a group of professionals working in top referral hospitals of Bandung.

Besides that, some questions may have been too specific to the respondents such as the panoramic effective dosage. This might have confused the respondents and lead to lack of interest in continuing the survey. Improvisation could be done in future by not asking specifically, but rather in terms of comparison to dosage of daily basis radiographs taken in clinical practice.

Despite these limitations, this study has several strengths including it is the first to report on this topic of importance and clinical relevance. Very little is known about radiographic prescribing practices of dentists in relevant to mandibular fracture and almost nothing is known about prescribing practices among Oral Maxillofacial Surgeons in Bandung. The study provides preliminary data for dental professionals in Bandung adhering to ALARA guidelines while prescribing radiographs for patients. The data also include factors associated with prescribing practices. Understanding these factors will help shape educational strategies and the development of future professional guidelines.

## CONCLUSION

The radiographic examination that is commonly prescribed by Oral Maxillofacial Surgeons in Bandung, Indonesia is conventional two dimensional radiographs merely the dental panoramic radiograph. The factors that influence their choice of radiographic examinations are the availability, image accuracy and the cost of the radiographic examination.

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