A Novel Proforma for Clinical and Radiographic Evaluation of Impacted Third Molars Prior to Surgical Removal

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ABSTRACT

Background: *Dental surgeons and resident doctors of oral surgery who encounter the complex situation during the third molar removal, such as those in unexpected areas, often have limited resources to provide a structured care. Therefore, there is always a need for simple, easy to memorize, situate into practice, comprehensive and cost-effective "Proforma of third molar evaluation" required.* **Objective:** *The purpose of this paper was to facilitate the residents of oral and maxillofacial surgery and the dentists throughout their preliminary phase, by organizing the comprehensive proforma for evaluating upper and lower wisdom tooth impactions, access and anticipate the difficulty, judge intraoperative tribulations they might encounter and hence, prepare an appropriate treatment plan.* **Materials and methods:** *The available literature relevant to oral and maxillofacial surgery in online database of the United States National Library of Medicine: PubMed (http://www.ncbi.nlm.nih.gov/pubmed/) was investigated. The inclusion criterion was to review the published clinical papers, abstracts, and evidence based reviews on "Preoperative Evaluation of Impacted Third Molar".* **Results:** *Thirty-six articles found with the search term "Preoperative Evaluation of Impacted Third Molar" in the literature were searched. Thirteen articles met the inclusion criteria for the study. The relevant data extracted and discussed.* **Conclusion:** *The advantages of the proforma uses were reported for inpatient care with correct diagnosis, treatment, follow up and prevention of the any superfluous complications further and improved the quality of patient care.*

Keywords: Third molar, impaction, dental surgeons, third molar evaluation

INTRODUCTION

Surgical removal of mandibular and maxillary third molar impactions is a most frequent procedure in the routine dentistry. Surgery for its removal by oral and maxillofacial surgeons is the most common performed surgical procedure might be due to pathological changes or prophylactic purposes [1,2]. A comprehensive preoperative evaluation is mandatory to avoid unpleasant complications related to their existence or during their surgical removal. Consequently, a proper clinical and radiographic evaluation is obligatory which gives the important information associated to the third molar and its neighboring vital structures [3].

To take the case history in detail has an important task in arriving at an appropriate diagnosis and inventing the best treatment plan for the patient. Significance of maintaining precise and absolute medical records should never be underestimated because they provide chronological data of the evaluation and treatment of patients and are essential for the legal protection of both the patient and dental surgeon, and provide the means to assess the quality of care [4].

The aim of this paper is to help the residents of oral and maxillofacial surgery and the dentists during their preliminary phase, by organizing the comprehensive proforma for evaluating upper and lower wisdom tooth impactions. To access, anticipate the difficulty, and to judge intraoperative tribulations they might encounter turn into trouble-free.

MATERIALS AND METHODS

A systematic search of the literature was carried out to identify the appropriate articles at our institute in a period from January to July 2016. The existing literature through the term "Preoperative Evaluation of Impacted Third Molar" relevant to oral and maxillofacial surgery in online data-base of the United States National Library of Medicine:

Pubmed was searched. The inclusion criteria were to review the published reports, abstracts, and studies with clinical and evidence based reviews on "clinical and radiographic evaluation prior to surgical removal". The exclusion criteria were postsurgical comparison and postsurgical evaluation of the third molar.

RESULTS

Thirty-six articles were found with the search terms "Preoperative Evaluation of Impacted Third Molar" in the online Pubmed database. Thirteen out of thirty-six articles met the inclusion criteria for this study. The relevant data extracted; conclusions were drawn and discussed in proforma based on inclusion criteria of the study in Figure 1.

Proforma for the Evaluation of Impacted Third Molar

OPD No: .... Date: ....

Patient's Name:... Age/Sex:.........Marital status:.............

Address:..Race:.................Occupation:.........................

Telephone/Mobile Contact No:............................... Email Id:.....................................

Date of Birth: ....

Chief Complaint:..

History of Present Illness:...

Past/Present Medical History: ....

Past/Present Dental History: ....

Personal History:..

Family history:...

Figure 1 Proforma for the evaluation of impacted third molar

Extraoral examination

- **Face:** symmetrical/ asymmetrical; color and texture of skin; any lacerations or abrasion or hemorrhage.

- **Eyes:** pallor/icterus/exophthalmos/enophthalmos/diplopia/subconjunctival hemorrhage/ecchymosis etc.

- **Nose:** symmetrical/asymmetrical; any depression or obliteration or discharge.

- **Extraoral any swelling/sinus/fistula:** present/absent.

  (If present→describe the number, size, shape, extent, soft/hard, fluctuant/non-fluctuant, warm, tenderness, etc).

- **Lymph nodes:** palpable/non-palpable; tender/nontender; mobile/fixed.

- **TMJ examination:** Tenderness/ Clicking/Crepitus/Deviation/Range of opening/left and right lateral excursions any other abnormalities (specify).

- **Rima oris:** Macrostomia/Normal/Microstomia.

- **Elasticity of the cheek:** needs to assess cheek elasticity.

Intraoral examination

- **Tongue:** Macroglossia/Normal/Microglossia (any other abnormality then specified).

- **Interincisal Mouth Opening (IIO):** ………….mm.

- **Trismus:** Present/Absent.

- **Total number of teeth present in the oral cavity:**

  87654321 | 12345678
  87654321 | 12345678

- **Total number of impacted teeth:** Needs to assess complete evaluation of teeth.

- **3rd molar eruption:** Erupted/Partially erupted/Non-erupted.

- **Type of Impaction:** Soft tissue/Bony/Both soft and Hard tissue.

- **Previous pericoronitis:** Yes/No.

- **Present periodontal status/presence of restoration/pulpal status of adjacent tooth:** Needs to be assessed.

- **Position of External oblique ridge:** Behind the tooth/alongside or in front of third molar.

Reason for extraction/surgical removal

Pericoronitis/non-treatable pulpal and periapical pathology/Periodontal disease/Unrestorable caries/Internal or external resorption of tooth/fractured tooth/Associated cyst or tumor/Prosthetic reasons/Orthodontic reasons/Prior to orthognathic surgery/Tooth involved in fracture line impeding trauma management/root resorption of adjacent tooth/ Systemic health considerations/Satisfactory tooth for use as donor for transplantation/Economic considerations.

Investigations

Complete Blood Count (CBC), Platelet count, Routine urine: Must be assessed.

Radiographs: Periapical radiographs/Bitewing radiographs/Occlusal radiographs/Orthopantomography (O.P.G.)/ Lateral oblique/CT scan/CBCT.

Radiographic interpretation

1) Relationship with neighboring vital structures: Maxillary sinus/Inferior alveolar canal/Adjacent teeth roots.

2) Position and depth:

a) Winter's Lines: by George Winter (1926) (**W**hite, **A**mber, and **R**ed line) WAR Lines.

b) Length of Red line: ……………. mm.

Winter's Classification

1) Angulations: The position of the long axis of the impacted 3rd molar in relation to the long axis of the 2nd molar: Vertical/Horizontal/Inverted/Mesioangular/Distoangular/Buccoangular/Linguoangular. Any of these may also occur in: Buccal version/ Lingual version/ Torsi version.

2) Depth: The correlation to the occlusal surface of the adjoining 2nd molar with the impacted 3rd molar.

a) Position A: Highest position of the wisdom tooth is at/above the occlusal plane of 2nd molar.

b) Position B: Highest position of the wisdom tooth is below the occlusal plane, but above the cervical level of the 2nd molar.

c) Position C: Highest position of the wisdom tooth is below the cervical level of the second molar.

N.T. The deeper the impacted/wisdom tooth, the more overlying bone is present, the more difficult it is to remove.

Pell and Gregory's classification

Relationship of the impacted lower third molar to the ramus of the mandible and the second molar (Based on the space available distal to the second molar).

1) Class I: Adequate space is present between the anterior border of the mandibular ramus and the distal surface of the second molar for the eruption of the 3rd molar.

2) Class II: Space availability between the anterior border of the mandibular ramus and the distal surface of the second molar is less than the mesiodistal width of the crown of the 3rd molar. It means some portion of tooth is covered by bone.

3) Class III: Third molar is completely embedded in the bone (ramus) because of absolute lack of space.

Proximity with inferior alveolar (mandibular) canal: Not close/close (In case of mandibular third molar).

If Relationship to the Inferior Alveolar Canal [5,6].

Related but not involving the canal: Separated/Adjacent/Superimposed.

Related to changes in the canal: Darkening of the root/Dark and bifid root/Narrowing of root/Deflected roots.

Related with changes in the canal: interruption of lines/converging canal/diverted canal.

- **Root pattern**
- **Number of roots:** Single/multiple.
- **Root formation:** Complete/Incomplete.
- **Root pattern:** long and slender/short and stout.
- **Dilacerations of roots:** Present/absent.
- **Divergence of roots:** Present/absent.
- **Bulbous roots:** Present/absent.
- **Root apex is deflected buccally/lingually:** Present/absent.
- **Ankyloses:** Present/absent.
- **Hypercementosis:** Present/absent.
- **Root caries:** Present/absent.
- **Root resorption:** Present/absent.
- **Shape of crown:** Large square crown with prominent cusps/small conical crown with flat cusps.
- **Texture of investing bone**
- **Size of cancellous bone:** More/less.
- **Bone sclerosis:** Present/absent.
- **Follicular space:** Present/absent.
- **Bone loss distal to third molar:** Present/absent.
- **Space or contact in relation to mandibular second molar: T**he impacted tooth is locked against the crown/root of the second molar present/absent
- **Width of PDL (Periodontal ligament) space:** less/normal/increased.
- **Mandibular retromolar canal:** Present/absent.

Maxillary Third Molars' classification

1) Angulation and Depth classification is same as mandibular third molars.

2) Classification of the maxillary third molar in relation to the floor of maxillary sinus.

a) Sinus approximation (SA): no bone or a thin bony partition presents between impacted maxillary third molar and the floor of the maxillary sinus.

b) No sinus approximation (NSA): 2 mm or more bone is present between the sinus floor and the impacted maxillary third molar.

Procedure

- **Extra-oral antisepsis:** 2.0% chlorhexidine solution.
- **Intraoral antisepsis:** 0.12% chlorhexidine rinse.

- **Type of anesthesia:** Local anesthesia (LA) alone/ LA + Sedatives/ General Anesthesia.

- **LA Dose**: Needs to be assessed.

- **Incision and Full Thickness Flap:** Envelope/Ward's I' incision / Modified Ward's Incision/ any other.

- **Bone removal performed using:** Hand piece and Burs (irrigation with sterilized 0.9% physiological solution) / Chisel and Mallet.

- **Odontectomy:** Yes/No.

- **Delivery of tooth:** forceps/elevator.

- **Bleeding control:** AbGel/ Bone wax/ any other.

- **Sutures used:** Absorbable/non-absorbable.

Perioperative assessment

- **Patient's cooperation:** good/average/poor.

- **Mouth opening:** satisfactory/non-satisfactory.

- **Gagging reflex:** present/absent.

- **VAS pain control:** 0-10.

- **Campbell's method for the difficulty of the tooth removal procedure are as follows:**

1) Simple tooth extraction;

2) Either bone removal or tooth sectioning;

3) Both bone removal and tooth sectioning;

4) Same as III, but more complicated.

Post-operative medication

- **Antibiotics used:** Yes/No if Yes: Type, dose, duration, and route: _____

- **Analgesics used:** Yes/No if Yes: Type, dose, duration, and route: _____

- **Corticosteroids used:** Yes/No if Yes: Type, dose, duration, and route: _____

- **Enzymes used:** Yes/ No if Yes: Type, dose, duration, and route: _____

Postoperative follow up

On 1st, 3rd and 7th day: Hemorrhage, Swelling, trismus, Pain, Dry socket, hematoma, Paresthesia (INB/lingual/Both), oroantral fistula, injury to adjacent tooth and /hard or soft tissue, complications associated with LA/sedatives/GA any other complications and their management

Name and Signature of the Operating Surgeon with his Dental Council Registration number:

_____

DISCUSSION

Wisdom tooth removal is one of the most common surgical procedures performed in routine oral surgical practice. Dental surgeons and resident doctors of oral surgery do encounter the complex situation during the third molar removal, and often have limited resources to provide a structured care. Therefore, there is always a need for simple, easy to memorize, situate into practice, comprehensive and cost-effective "Proforma of third molar evaluation". Ideally, pre-operative clinical and radiographic assessment must provide the difficulty level of surgery and to select the proper surgical technique (for example, which medical and maxillofacial emergency can arrive, method of incision, how much amount of bone removal required, how to section the tooth, how the tooth roots can be lifted) by arranging the comprehensive proforma. The significant facts of the current article "Preoperative Evaluation of Impacted Third

Molar" are discussed in the order as they come into sight in the questionnaire sheet [7].

Extraoral examination

The submandibular, submental, and cervical lymph nodes palpated for any enlargement, tenderness, mobility, and consistency. If tender, mobile, enlarged lymph node then it suggests acute infection; if nontender, mobile, enlarged lymph nodes then it suggest chronic infection; while fixed enlarged lymph nodes suggest malignancy. The temporomandibular joint (TMJs) usually palpated by placing the index fingers of both the hands just anteroinferior to the tragus of the ear. They can also be palpated intrameatally in a similar fashion. Joints can be examined for any tenderness, clicking, crepitus, deviation on mouth opening, or closing, left and right lateral excursions. Masticatory muscles palpated for any tenderness. Patients with temporomandibular joint disorders will have obscurity in the mouth opening and complain of pain and may require the usage of mouth prop to keep the mouth open during surgical intervention [8].

Intraoral examination

Patient should be examined for oral hygiene, number of teeth present/absent, or any caries/restorations/periodontal problem/mobility of teeth. Fetid odor indicates a poor oral hygiene or any infection present in the oral cavity. Oral mucosa should be examined for color, pigmentation, texture, and presence of ulceration, growth, or draining sinuses/fistula. Interincisal (IIO) opening should be measured pre-and post-surgery so as not to confound with any postoperative trismus, if at all, it occurs. Tongue size, its mobility, and surface should be checked. Limited mouth opening, microstomia, macroglossia and inelastic, chubby cheeks, limit the surgical access and create the surgical procedure more complicated.

Laboratory and radiographic examination

Blood investigations reports like complete blood count and blood sugar are mandatory to rule out any infection, nutritional status, bleeding disorders, or to facilitate postoperative recovery. Imaging techniques for impacted lower third molars are: intraoral periapical radiograph (IOPA), bisecting, paralleling, distal oblique method, Clark's and right angle technique, extraoral techniques like lateral oblique, OPG, skull radiograph, stereo radiography, xeroradiography, CT scan, magnetic resonance imaging (MRI) [9].

Conventional radiographic examination with plain radiography like OPG (Orthopantomogram) is sufficient in most the cases [7]. According to Ferrus-Torres E., et al., digital panoramic radiographs offer significantly greater diagnostic precision than conventional panoramic radiographs in terms of detailed dentialveolar exploration [10]. Mahesh MS also found that digital PSP (photostimulable phosphor) panoramic radiographs were more efficient when compared with conventional film in terms of their accuracy in the preoperative assessment of impacted mandibular third molar with regard to impaction status, tooth position, number of roots, and proximity to the mandibular canal [11].

However, conventional radiographs like OPG have its shortcoming like poor detail, formation of ghost images, and especially distortions in the size and position of the objects imaged because they project a tridimensional surface into a two-dimensional image. Therefore, the need for more advanced techniques like CT scan and CBCT is essential to confirm the anatomical relationships and prevent the superfluous postoperative complication [7,12]. Cone-beam computerized tomography (CBCT) shows three-dimensional (3D) images of the dental structures like mandibular incisive canal, accessory mental foramen, accessory mandibular canal, etc. with high accuracy, authenticity, and more reliable images [13]. Jhamb A., also found the advantages of spiral CT images over visualization of the relation of the tooth to the Inferior alveolar neurovascular bundles (IANB) [14]. When Suomalainen A., compared the reliability of cone-beam computerized tomography (CBCT) with the multiprojection narrow-beam radiography (MNBR) and cross-sectional tomography for the preoperative evaluation of third molars, they found the CBCT examination was highly reliable [15]. The higher radiation dose, increased financial cost and less accessibility, however, are the negative aspects of CT compared with conventional imaging [16].

Yıldıray Sisman found that the mandibular retromolar canal (MRC) is not a rare anatomical structure found in retromolar triangle. Furthermore, the presence of mandibular retromolar canal (MRC) had shown a statistical difference with CBCT compared to plain radiographs was used. The detection of the presence of the MRC using CBCT is crucial for extraction of mandibular third molars because this anatomical variation may prevent complications in the anesthesia and surgical procedures in this area [17].

Neurosensory deficit

Trauma to a peripheral nerve may result from a mild decrease in feeling (mild hypoesthesia) to a total loss of sensation (anesthesia). These sensory deficits may be either temporary 3.3% to 13% or permanent 0.2% to 1% [16,18-20]. Incidence of paresthesia after surgical removal of third molars for lingual nerve 0.2% to 22% and for inferior alveolar nerve 0.4% to 7%. Incidences of inferior alveolar nerve injury in fully erupted, partially erupted, and unerupted lower wisdom teeth were 0.3%, 0.7% and 3.0%, respectively while in horizontally impaction (1.7%), followed by distal impaction (1.4%), mesioangular impaction (1.3%) and vertical impaction (1.1%) [16]. Leung and Cheung demonstrated that the risk ratio of inferior alveolar nerve injury from intraoperative nerve exposure is 14.9 times more likely than if the nerve is not exposed [16,21]. Lingual nerve injury was at high risk for unerupted mandibular third molars (5.8%) followed by partially erupted (2.0%) and fully erupted (0.3%) teeth while in distoangular (4.0%), followed by horizontal (2.8%), mesioangular (2.4%), and vertical (1.9%). Risk ratio of lingual nerve injury was 1.94 times more common if the lingual flap was elevated in contrast to if it was not while 4.1 times more if the lingual split technique was used in contrast with the buccal approach [16,22,23]. Guerrero ME found in their randomized controlled trial for preoperative assessment that CBCT was not superior to panoramic radiography (PAN) in predicting postoperative sensory disturbances but was superior in predicting inferior alveolar nerve (IAN) exposure during third molar removal in cases having "moderate" risk [24].

Third molar and its surrounding area

George winter's three imaginary lines well known as Winter's lines can be assessed by tracing over intraoral X-ray and/ or OPG [25]. White line is drawn touching the occlusal surfaces of first and second molar and is extended posteriorly over the third molar region which corresponds to the occlusal plane and indicates the differences in occlusal level of second and third molars. Amber line represents the bone level, which is drawn from the crest of the interdental septum between the molars and extended posteriorly distal to third molar or to the ascending ramus. This line denotes the alveolar bone covering the impacted tooth and the portion of tooth not covered by the bone. Red line is drawn perpendicular from the amber line to an imaginary point of application of the elevator. It indicates the amount of bone that will have to be removed before tooth elevation, i.e. the depth of the tooth in bone and the difficulty encountered in removing the tooth. The longer the Red line, the more difficult is the impaction. Winter's classification is based on angulations and depth while Pell and Gregory's classification is based on relationship of the impacted lower third molar to the ramus of the mandible and the second molar [26].

Angulations of the third molar according to Ma'aita and Alwrikat that refers to the angle formed between dental long axis and occlusal plane: Horizontal <20°; Mesioangular=20-80°; Vertical=80-100°; Distoangular ≥ 100° [27]. Fanourakis J., et al. found in his radiographic study that most of the impacted third molars were 42.34% mesioangular, 21.13% vertical, 20.60% horizontal and 2.73% lingo-angular [28]. Ohman A. found the course of mandibular canal as buccal, lingual, inferior, or inter-radicular [7].

Tooth with single conical roots compared with multiple roots are easier to extract. If the root development is (less than one-third) insufficient, then the tooth is more difficult to remove because it moves like a ball in the socket and difficult to elevate. Bulbous, ankylosed and hypercementosed roots increase the difficulty. Long and slender roots fracture more easily as compared to short and stout roots. Dilacerated, curved, divergent roots are difficult to remove compared to fused conical roots. Presence of root caries requires some extra care during impaction. If the impacted tooth locked against the crown/root of the second molar and there is no space for elevation, then sectioning should be planned. Younger patients have spongy; elastic pliable bones are in favor of easier removal of impacted molar while older group of patients may exhibit sclerosed bone. The thick sclerotic bone requires greater amount of bone removal. Nonexistent or narrow follicular sac around the crown require more bone removal compared with presence of a large follicular sac [3,7,8,11,16]. If the crown of either the third molar or second molar is carious and or any restoration given, then some extra care is required during surgery. Nature of the covering tissue is soft tissue, bony or both soft and bony also recorded during the examination. Presence of external oblique ridge in close proximity with 3rd molar makes the surgical removal more difficult [8].

Difficulty index

The first model for assessing surgical difficulty was given by MacGregor [29]. Winter's, Pell and Gregory's, Pederson's and the WHARFE scoring systems are also important in assessment of difficulty of impacted third molar.

Furthermore**,** Carvalho and Vasconcelos accomplished that root number, root morphology, tooth position, periodontal space and second molar relation were significant predictors for surgical difficulty [30]. Akadiri and Obiechina also demonstrated that wisdom tooth depth, angulations, and root morphology as the most consistent determinants of extraction difficulty [1,31]. However, Amit Bali found that the important variables like bone density, mouth opening, abnormal root curvature, width of root, age, basal metabolic rate (BMI) of patient, depth from point of elevation, relationship of root with inferior alveolar canal, and root periodontal space interface were not considered by Pederson [32].

Surgical procedure and post-operative follow up

Various treatment options like observation, surgical exposure, operculectomy, surgical removal, and surgical re-implantation/transplantation are available for the management of impacted wisdom molars [33]. Surgical management may be carried out with local anesthesia alone (2% local anesthetic solution with 1:2,00,000 adrenaline), sedation or general anesthesia based on difficulty level and patient's willingness. Following appropriate anesthesia surgeon can proceed with anterior and posterior releasing incision for better visualization with adequate amount of bone removal to facilitate for elevation either with the help of straight and/or contra-angle hand piece and bur or with the chisel and mallet. Nowadays chisel and mallet technique has historical importance because chances of bone necrosis and inadvertent fracture than bur technique. However, with the sectioning of teeth extensive bone removal is minimized. Wound debridement is accomplished to remove any remaining dental follicle, epithelium, granulation, or any pieces of tooth/bone. Hemostasis achieved and sutures given. The type of suture material, number of sutures should be recorded in proper documentation. Perioperative patient's cooperation, mouth opening, gagging reflex, and difficulty of the tooth removal procedure should be recorded by operating surgeon while pain threshold score given by patients [29]. Pain intensity was assessed from no pain-0 to severe/unbearable pain -10 using a 10-level visual analog scale (VAS) [29]. Hemorrhage, swelling, trismus, pain, wound dehiscence or dry socket, hematoma, paresthesia (INB/lingual/Both), oroantral fistula, injury to adjacent tooth and /hard or soft tissue should be evaluated at follow up visits [33].

CONCLUSION

Utilization of Proforma for evaluation of impacted third molars prior to the surgical removal in routine dental practice helps the residents of oral surgery and the dental surgeons who are new in practice by facilitating in documentation, correct diagnosis, treatment planning, follow up and prevention of the any superfluous complications further and improved the quality of patient care.

REFERENCES

[1] Akadiri, Oladimeji A., and Ambrose E. Obiechina. "Assessment of difficulty in third molar surgery—A systematic review." *Journal of Oral and Maxillofacial Surgery* 67.4 (2009): 771-774.

[2] Polat, Hidayet Burak, et al. "Prevalence of commonly found pathoses associated with mandibular impacted third molars based on panoramic radiographs in Turkish population."*Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* 105.6 (2008): e41-e47.

[3] Mehdizadeh, Mohammad, et al. "Radiographic evaluation of impacted third molars and their complications in a group of Iranian population." *Journal of Research and Practice in Dentistry* 2014 (2014): m1-11.

[4] Manuel, Suvy, LK Surej Kumar, and Mathew P. Varghese. "A comprehensive proforma for evaluation of mandibular third molar impactions." *Journal of Maxillofacial and Oral Surgery* 13.4 (2014): 378-385.

[5] Howe, G. L., and H. G. Poyton. "Prevention of damage to the inferior dental nerve during the extraction of mandibular third molars." *Br Dent J* 109.5 (1960): 353-63.

[6] Rood, J. P., and BAA Nooraldeen Shehab. "The radiological prediction of inferior alveolar nerve injury during third molar surgery." *British Journal of Oral and Maxillofacial Surgery* 28.1 (1990): 20-25.

[7] Öhman, A., et al. "Pre-operative radiographic evaluation of lower third molars with computed tomography." *Dentomaxillofacial Radiology* (2014).

[8] Malik, Neelima Anil. *Textbook of Oral and Maxillofacial Surgery*. Jaypee Brothers Publishers, 2008.

[9] Saraswati, F. K., B. Balajirao, and G. P. Mamatha. "Clinical and orthopantomographic evaluation of mandibular third molar." *Contemporary Clinical Dentistry* 1.1 (2010): 27.

[10] Ferrús-Torres, E., et al. "Diagnostic predictability of digital versus conventional panoramic radiographs in the presurgical evaluation of impacted mandibular third molars." *International Journal of Oral and Maxillofacial Surgery* 38.11 (2009): 1184-1187.

[11] Mahesh, M. S., V. G. Mahima, and Karthikeya Patil. "A comparative evaluation of film and digital panoramic

radiographs in the assessment of position and morphology of impacted mandibular third molars." *Indian Journal of Dental Research* 22.2 (2011): 219.

[12] Sant'Ana, L. F. M., et al. "Clinical evaluation of the effects of radiographic distortion on the position and classification of mandibular third molars." *Dentomaxillofacial Radiology* (2014).

[13] Chen, Quan, et al. "Pilot clinical study of the dental cone beam CT examination before the impacted mandibular third molar extraction." *Zhonghua kou qiang yi xue za zhi= Zhonghua kouqiang yixue zazhi= Chinese Journal of Stomatology* 46.7 (2011): 398-402.

[14] Jhamb, Aakarsh, et al. "Comparative efficacy of spiral computed tomography and orthopantomography in preoperative detection of relation of inferior alveolar neurovascular bundle to the impacted mandibular third molar." *Journal of Oral and Maxillofacial Surgery* 67.1 (2009): 58-66.

[15] Suomalainen, Anni, et al. "Reliability of CBCT and other radiographic methods in preoperative evaluation of lower third molars." *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* 109.2 (2010): 276-284.

[16] Juodzbalys, Gintaras, and Povilas Daugela. "Mandibular third molar impaction: review of literature and a proposal of a classification." *Journal of Oral & Maxillofacial Research* 4.2 (2013): e1.

[17] Sisman, Yıldıray, et al. "Diagnostic accuracy of cone-beam CT compared with panoramic images in predicting retromolar canal during extraction of impacted mandibular third molars." *Medicina oral, patologia oral y cirugia bucal* 20.1 (2015): e74.

[18] Neves, Frederico Sampaio, et al. "Risk assessment of inferior alveolar neurovascular bundle by multidetector computed tomography in extractions of third molars." *Surgical and Radiologic Anatomy* 34.7 (2012): 619-624.

[19] Dalili, Zahra, Porousha Mahjoub, and Ali Khalighi Sigaroudi. "Comparison between cone beam computed tomography and panoramic radiography in the assessment of the relationship between the mandibular canal and impacted class C mandibular third molars." *Dental research journal* 8.4 (2011).

[20] Caissie, René, et al. "Iatrogenic paresthesia in the third division of the trigeminal nerve: 12 years of clinical experience." *J Can Dent Assoc* 71.3 (2005): 185-90.

[21] Leung, Y. Y., and L. K. Cheung. "Risk factors of neurosensory deficits in lower third molar surgery: A literature review of prospective studies." *International Journal of Oral and Maxillofacial Surgery* 40.1 (2011): 1-10.

[22] Cheung, Lim K., et al. "Incidence of neurosensory deficits and recovery after lower third molar surgery: A prospective clinical study of 4338 cases." *International Journal of Oral and Maxillofacial Surgery* 39.4 (2010): 320-326.

[23] Janakiraman, Eswari Natt, Mohan Alexander, and Pasupathy Sanjay. "Prospective analysis of frequency and contributing factors of nerve injuries following third-molar surgery." *Journal of Craniofacial Surgery* 21.3 (2010): 784-786.

[24] Guerrero, Maria Eugenia, et al. "Inferior alveolar nerve sensory disturbance after impacted mandibular third molar evaluation using cone beam computed tomography and panoramic radiography: a pilot study." *Journal of Oral and Maxillofacial Surgery* 70.10 (2012): 2264-2270.

[25] Winter, G. B. "Principles of exodontias as applied to the impacted third molar: A complete treatise on the operative technique with clinical diagnosis and radiographic interpretations." *St Louis: American Medical Books* (1926).

[26] Pell, Glenn J., and B. T. Gregory. "Impacted mandibular third molars: classification and modified techniques for removal." *Dent Digest* 39 (1933): 330-338.

[27] Costa, Fábio Wildson Gurgel, et al. "Correlation between radiographic signs of third molar proximity with inferior alveolar nerve and postoperative occurrence of neurosensory disorders: A prospective, double-blind study." *Acta Cirurgica Brasileira* 28.3 (2013): 221-227.

[28] Fanourakis, J., et al. "Topographic evaluation of the impacted mandibular third molar. Radiographic study." *To Helleniko periodiko gia stomatike & gnathoprosopike cheirourgike/episemo organo tes Hetaireias Stomatognathoprosopikes Cheirourgikes= The Greek Journal of Oral & Maxillofacial Surgery* 5.3 (1990): 115-119.

[29] De Santana-Santos, Thiago, et al. "Prediction of postoperative facial swelling, pain and trismus following third molar surgery based on preoperative variables." (2013).

[30] Carvalho, Ricardo Wathson F., and Belmiro Cavalcanti do Egito Vasconcelos. "Assessment of factors associated with surgical difficulty during removal of impacted lower third molars." *Journal of Oral and Maxillofacial Surgery* 69.11 (2011): 2714-2721.

[31] Akadiri, O. A., A. O. Fasola, and J. T. Arotiba. "Evaluation of Pederson index as an instrument for predicting difficulty of third molar surgical extraction." *The Nigerian Postgraduate Medical Journal* 16.2 (2009): 105-108.

[32] Bali, Amit, et al. "Is pederson index a true predictive difficulty index for impacted mandibular third molar surgery? A meta-analysis." *Journal of Maxillofacial and Oral Surgery* 12.3 (2013): 359-364.

[33] Pilot clinical guidelines. British Association of Oral & Maxillofacial Surgeons. London January 1995.