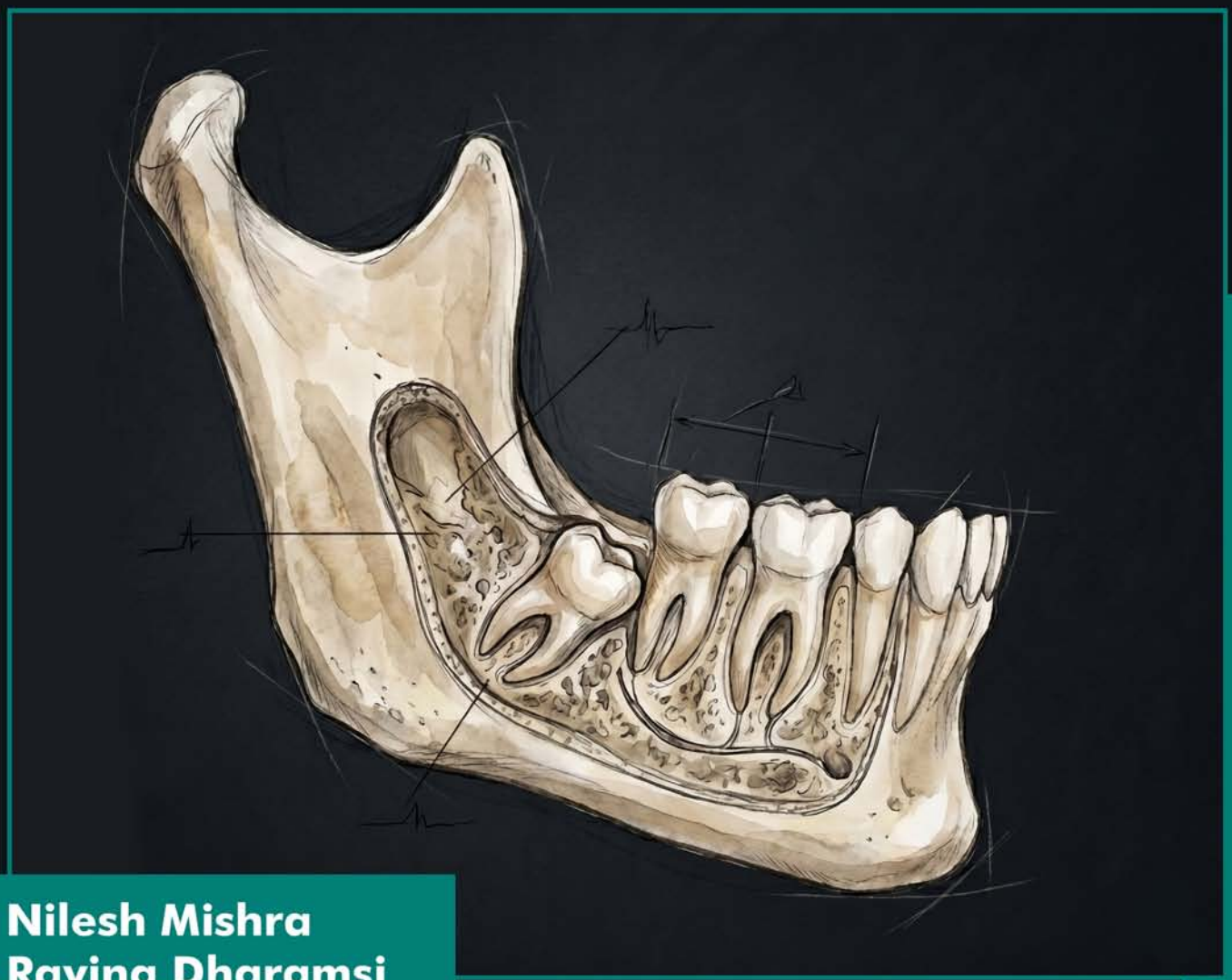
COMPREHENSIVE MANDIBULAR THIRD MOLAR SURGERY



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Comprehensive Mandibular Third Molar Surgery

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Comprehensive Mandibular Third Molar Surgery

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FOREWORD

It is with pleasure that I write the foreword of this book titled “Comprehensive Mandibular Third Molar Surgery”, authored by Professor Nilesh Mishra, whom I have known as an astute clinician and a sound teacher, always eager to teach as well as learn. The manual will be a comprehensive compilation of academic knowledge and a clinically oriented guide on the topic of mandibular third molar surgery. The book published by Bentham Science Publishers will be useful for dental and oral surgeons in their day-to-day practice of third molar surgery. It will serve as a reference textbook on the topic of third molar surgery for students. A book focusing on this topic was very much awaited. The exhaustive compilation of literature on the surgical removal of impacted mandibular third molars, which is one of the most commonly performed surgical procedures in a dental clinic, will be beneficial to trainees and consultants alike. I hereby wish all the very best to the author and publisher of the book. Happy reading to all.

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PREFACE

The idea for writing this book originated from numerous encounters with undergraduate dental students and oral surgery residents, who highlighted the lack of a comprehensive compilation of literature on various aspects of mandibular third molar surgery. There was a need to address this gap. Hence, a decision was made to compile this concise yet comprehensive book, which will be useful as a reference textbook as well as a practical guide to the minor surgery involving the removal of the impacted lower third molar.

The book is a sincere attempt to address each facet of mandibular third molar surgery management in a point-by-point manner. The initial part of the book deals with various terminologies related to the topic. The causes leading to the impaction of the lower third molar tooth and the reasons for its removal are elaborated. The foundation of a surgery's success is laid by thorough preoperative planning. Clinical findings relevant to impacted teeth and subsequent radiological assessment are detailed with numerous images for easy understanding. Over the past decade, the use of 3D imaging and cone beam tomography has been a boon to the detailed assessment of deeply impacted teeth. The section on the CBCT provides useful inputs regarding various aspects that need to be evaluated in the tomographic images for improved clinical outcomes and reduced postoperative complications. The armamentarium used for the procedure has been elucidated with relevant photographs for a better understanding of its applications. The surgical management has been thoroughly presented in the book, with numerous case studies and illustrations. The choice of anesthesia and the pharmacological agents used for third molar surgery have been described in separate sections as well.

The practice of third molar surgery has advanced over the years. A procedure done under basic anesthesia and with the use of a chisel and mallet for bone and tooth removal has now advanced with the use of new and sophisticated armamentarium. The use of piezosurgery, endoscopes, growth factor concentrates, and grafting of the bone defects, along with others, is elaborated in the book. In this age of increased patient awareness, medical litigation has been on the rise. The third molar surgery is no exception. Today, it is even more important that a dental surgeon be aware of informed consent and methods of safe practice. The medicolegal aspects of the procedure have been aptly described in this textbook.

I hope that both dental surgeons and oral surgeons, as well as students, will find this book beneficial and helpful in furthering their understanding and practice of mandibular third molar surgery.

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DEDICATION

I dedicate this book to my father, mother, and uncle for their unconditional love and the values they have imparted to me. To my wife, Aaditee, and my little boy, Aneesh, who are my pillars of strength and reason, each day feels so blissful with you.

Nilesh Mishra

This book is dedicated to my mother, Deepa Manoj Dharamsi. Her unwavering support and love have been my foundation. She has stood by me through every challenge, and her strength and encouragement have been pivotal in helping me reach this point.

Ravina Dharamsi

CHAPTER 1

Introduction

Abstract: This chapter presents the common definitions for an impacted tooth. The chronology of tooth eruption and frequency of impaction of various teeth is subsequently discussed.

Keywords: Impacted molar, Definition, Malposed tooth.

INTRODUCTION

Third molars are present in 90% of the population, out of which about 33% fail to erupt in the oral cavity and remain impacted [1]. Almost one-fourth of these impacted molars require surgical removal during the lifetime of an individual for various reasons, including caries, pericoronitis, pain, abscess, or the formation of a cyst [2].

Surgical removal of the impacted third molars is the most common minor surgery procedure in a dental clinic. A 2007 report estimates that the United States of America surgically removes approximately 10 million teeth annually, resulting in an annual cost exceeding 3 billion dollars [3]. Proper knowledge, training, skill, and experience are necessary to perform the surgical procedure with minimal trauma and postoperative complications. This textbook is compiled to comprehensively present various aspects of mandibular third molar surgery.

DEFINITION

The term *"impaction"* originated from the Latin word *"impactus"*, which means wedged. Broadly, the term impaction means failure of an organ or structure to attain its normal anatomical position because of an abnormal mechanical condition or obstruction. In 1943, Durbeck W. E. was among the first to define impaction of a tooth as the cessation of tooth eruption due to a physical barrier (detectable by clinical or radiological examination) in the eruption path or an ectopic position of a tooth. A physical barrier for tooth eruption can be due to a neighboring tooth, dense bone, fibrous tissue, pathology, an abnormal eruption path, or a lack of space. Since then, several authors have provided definitions of impaction, as summarized in Table **1**.

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Table 1. Definition of impaction proposed by various authors.

Mead (1954) [4]	An impacted tooth is a tooth that is prevented from erupting into position because of malposition, lack of space, or other impediments.
Archer (1975) [5]	An impacted or an embedded tooth is the tooth that has failed to erupt completely to its correct normal position in the dental arch, and its eruption potential has been lost.
Andreasen (1997) [6]	Impaction is cessation of the eruption of a tooth caused by a clinically or radiographically detectable physical barrier in the eruption path or by an ectopic position of the tooth.
Peterson (1998) [7]	Impacted teeth are those that fail to erupt into the dental arch within their expected developmental time period and can no longer reasonably be expected to do so.
Farman (2004) [8]	Impacted teeth are those teeth that are prevented from erupting due to a physical barrier within the path of eruption.

COMPLETE *VS* PARTIAL IMPACTION

When a tooth is entirely submerged within the bone, it is referred to as completely impacted **(**Figs. **1.1a** and **1.1b**). On the other hand, a partially impacted tooth is partially erupted into the oral cavity **(**Figs.**1.2a** and **1.2b**).

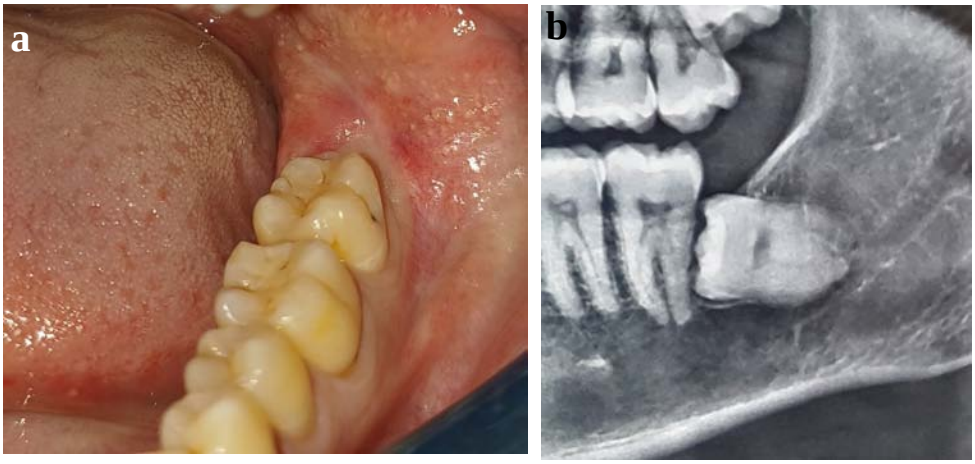

Fig. (1.1). Clinical photograph (a) and radiograph (b) showing completely impacted tooth.

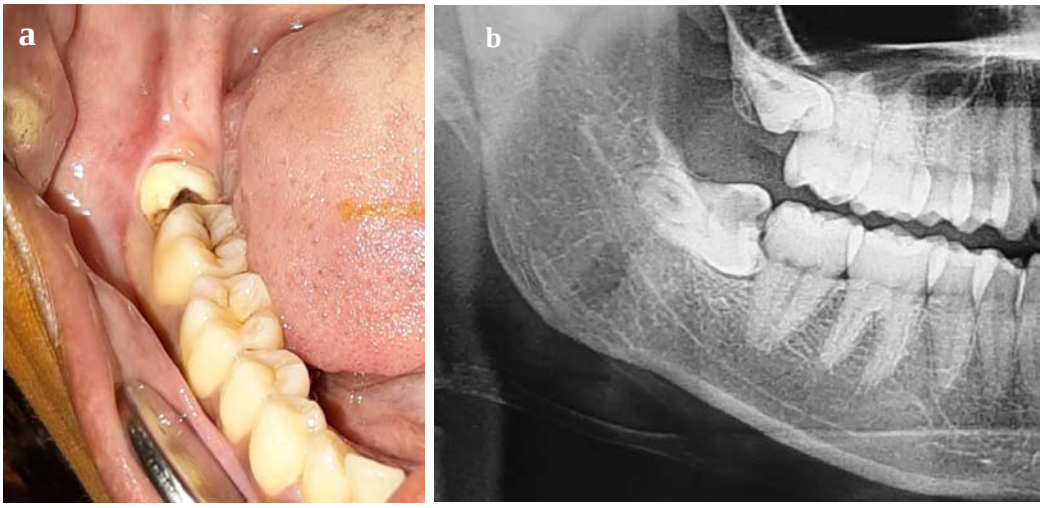

Fig. (1.2). The clinical image (a) and the radiograph (b) show a partially impacted lower third molar. It is important to note that the tooth is partially visible in the oral cavity, with the remaining portion embedded in the bone.

IMPACTED *VS* UNERUPTED TEETH

When a tooth does not fully emerge into the oral cavity within the anticipated eruption age, it is considered impacted. Such a tooth loses its eruption potential and remains embedded in bone **(**Fig. **1.3a**). On the other hand, the term "unerupted tooth" refers to both teeth that are in the process of erupting **(**Fig. **1.3b)** and teeth that are impacted.

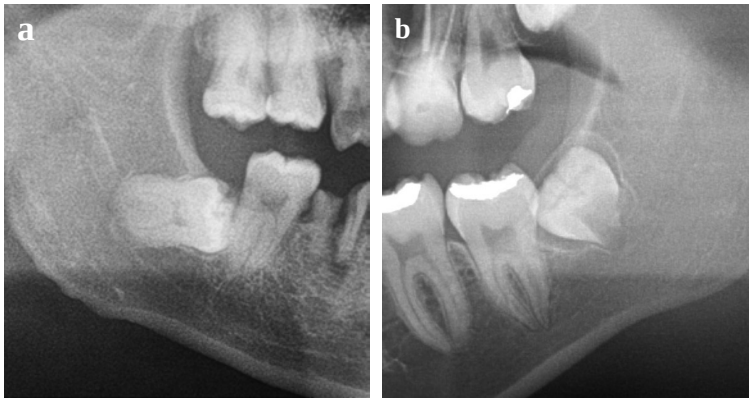

Fig. (1.3). Image of a section of an orthopantomogram shows an impacted lower right 3rd molar. Note that the root formation is complete, and the tooth has no potential for eruption. Furthermore, the abnormal orientation of the tooth will not allow it to emerge into the oral cavity (a). An image from an orthopantomogram reveals a tooth germ located in the lower third molar. The tooth is still in its process of development and has potential to erupt in the future (b).

CHAPTER 2

Applied Surgical Anatomy of Impacted Lower Third Molar

Abstract: This chapter elaborates upon the applied surgical anatomy. Vital structures, including nerve, vessel, bone, and muscle in the vicinity of the impacted tooth, and their influence during third molar surgery, are discussed.

Keywords: External oblique ridge, Inferior alveolar canal, Lingual nerve, Mandible.

INTRODUCTION

To perform any surgical procedure, it is mandatory to have in-depth knowledge of the region's anatomy. A lack of understanding of the regional anatomy can give rise to complications, which can be severe and even life-threatening. This chapter discusses various vital anatomical structures that the surgeon should be aware of during the removal of an impacted mandibular third molar.

MANDIBLE AND IMPACTED THIRD MOLAR

The mandible is the strongest and largest bone of the face. It is tubular in shape, having a thick buccal or labial cortex and a thin lingual cortex, which encloses the cancellous bone in between. It has superior and inferior borders. The parts of the mandible include the symphysis menti, parasymphysis, body, angle, ramus, coronoid, and condyloid processes. Symphysis is the prominent anterior part of the mandible where the right and left halves meet. Parasymphysis is the region anterior to the mental foramen and posterior to the incisors. The body region is located behind the mental foramen. The angle lies between the body and the ramus. Posterior to the angle, the mandible takes a sharp curve to form the ramus, coronoid, and condyle. The mandibular third molar is present at the angle between the posterior part of the body and the anterior part of the ramus (Fig. **2.1**). Rarely, ectopic eruption can place the mandibular third molar in unusual locations, such as the lower border of the mandible, condyle, ascending ramus, and coronoid (Fig. **2.2**).

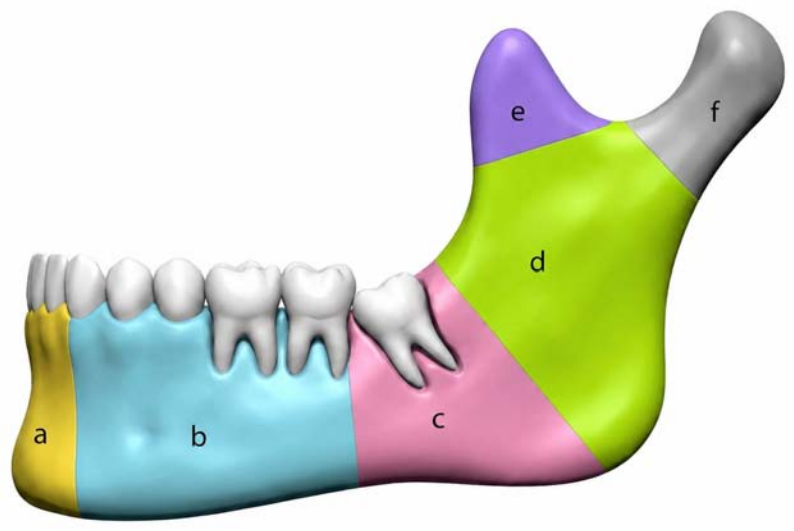

Fig. (2.1). Symphysis (a), body (b), angle (c), ramus (d), coronoid (e), and condyle (f) are the anatomical divisions of the mandible. The impacted mandibular third molar tooth is located in the angle region of the mandible.

Fig. (2.2). The 3D-formatted image displays the ectopic position of the impacted mandibular third molar in the ramus. Such an unusual location may result from either an abnormal eruption path or the displacement of the tooth due to associated pathology.

The angle of the mandible with the associated impacted third molar is the second weakest region of the mandible after the neck of the condyle [1]. Therefore, applying undue force during the removal of an impacted mandibular third molar may result in an inadvertent bone fracture (Fig. **2.3**). Despite the extremely low incidence of iatrogenic mandibular angle fracture associated with the removal of

an impacted third molar, which ranges from 0.0034% to 0.0075%, it is crucial to exercise utmost care to prevent it [2]. The following factors increase the risk of mandibular angle fracture during impacted mandibular third molar surgery:

1. **Age:** In young individuals, the bone exhibits greater elasticity, allowing it to expand during extraction. This consequently reduces the likelihood of mandibular angle fracture during third molar extraction. In elderly individuals, the bone is relatively fragile, resulting in an elevated risk of mandibular angle fracture (Fig. **2.3**).

Fig. (2.3). An orthopantomogram reveals an inadvertent non-displaced fracture in the right-angle area (arrow) of an elderly male patient during the extraction of an impacted mandibular third molar.

2. **Height and width of the mandible:** Patients with narrow and short mandibles have a higher risk of angle fracture during third molar surgery compared to those with a broad and longer mandible. Less width of the mandible results in a relatively reduced cross-sectional area in the already weaker portion of the angle region, which further increases the risk of angle fracture.

BUCCAL AND LINGUAL CORTICAL PLATES

The impacted mandibular third molar is present at the angle region of the mandible, embedded between the buccal and lingual cortical plates. In most instances, the buccal cortex is thicker than the lingual cortex. The lingual cortical plate is usually less than 1 mm in width (Fig. **2.4**). In patients with buccally placed third molars, the buccal cortex is relatively thin, while it is relatively thicker when the impacted molar tooth is placed lingually (Fig. **2.5**).

CHAPTER 3

Theories and Causes of Impaction

Abstract: The commonly proposed theories that explain the reason behind the failure of the lower third molar to erupt into a functional occlusion are described in the present chapter. The causes of impaction are grouped and elaborated under local and systemic factors.

Keywords: Mendelian, Phylogenetic theory, Tooth eruption.

INTRODUCTION

The literature has suggested numerous factors for the impaction of the mandibular third molar, but the most widely acknowledged are the five theories proposed by Durbeck in 1943. The five theories include the following:

1. **Mendelian theory:** Mendelian theory relates to the biological laws of inheritance. If an individual receives a smaller jaw from one parent and larger teeth from another, then there is a lack of space in the dental arch. As the mandibular third molar is one of the last teeth to erupt, the small jaw size and tooth excess result in impaction of the third molars (Figs. **3.1** and **3.2**).
2. **Phylogenetic theory:** Phylogenetics relates to the evolutionary development of a species. Over the period of evolution, the eating habits of humans have shifted from coarse, raw food to refined, processed, soft food. As nature attempts to eliminate disused organs, decreasing masticatory demands caused by civilizations' shifting food preferences have virtually eliminated huge, robust jaws [1, 2]. Therefore, the jaw size has become smaller over the course of time (Fig. **3.3**, Table **1**). Because the third molar tooth is the last to erupt in the dental arch, there may not be enough space for it to emerge, resulting in impaction.

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Fig. (3.1). Caricature shows the inheritance of large teeth from one parent and a smaller jaw from the other parent, increasing the likelihood of third molar impaction in the child.

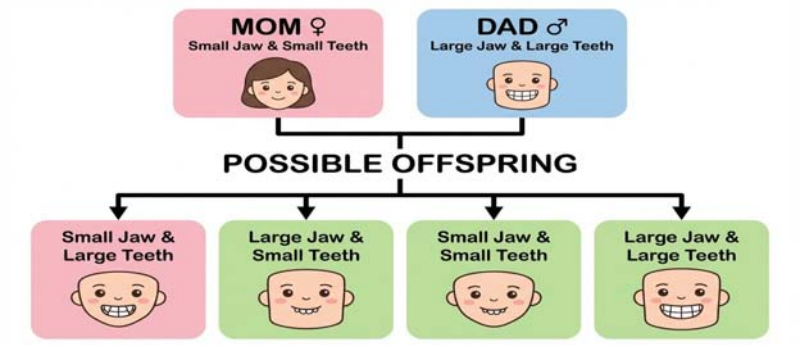

Fig. (3.2). The flow chart illustrates the potential patterns of inheritance in terms of jaw and tooth size among siblings, with one parent having a small jaw and teeth and the other having a large jaw and teeth.

Table 1. Phylogenetic theory.

▪ The theory was popularized by Nodine in 1943. ▪ It is based on Lamarck's use and disuse theory, which states that if a particular organ is not used, it tends to disappear over a period of time (and vice versa; when an organ becomes more developed due to certain environmental needs, then that state of development is hereditary and is passed on to progeny). ▪ Due to changes in the nutritional habits of our civilization, the use of large, powerful jaws has been practically eliminated. Hence, over the years, the maxilla and the mandible have decreased in size, leaving insufficient room for the third molar to erupt.

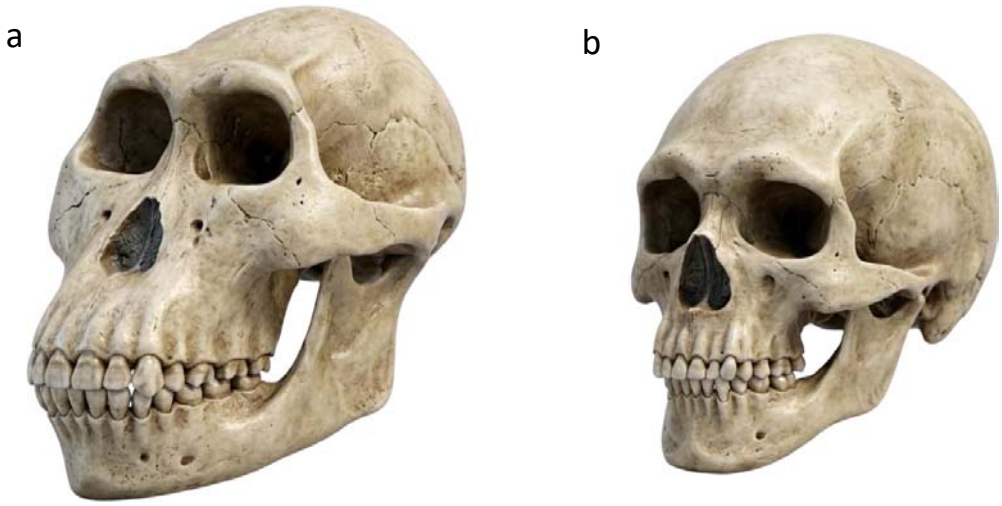

Fig. (3.3). A comparison of the skull and jaw sizes of primitive (a) and present-day humans (b) shows a reduced mandible bone volume to accommodate all the teeth.

3. **Orthodontic theory:** The jaws normally grow and develop in a forward direction, as does the movement of teeth. So, anything that interferes with such development can result in impaction [3]. A dense bone decreases the movement of teeth in a forward direction. Constant mouth breathing usually contributes to contracted arches, thus leaving insufficient room for the last erupting teeth. Occasionally, an early loss of deciduous teeth may cause the malposition of permanent teeth, which results in impactions. Similarly, conditions, like acute infection and trauma, which affect normal jaw growth, can result in impaction (Fig. **3.4**).
4. **Endocrine theory:** The theory suggests that the tooth impaction is the consequence of endocrine disturbances, including hypopituitarism and hypothyroidism, which result in abnormal osteoclastic activity, reduced jaw development, and delayed dental emergence.
5. **Anthropological theory:** This theory states that in the early civilizations, people consumed tough, gritty, attritive diets. The chewing forces resulted in significant interdental tooth loss due to attrition and mesial migration. This led to the creation of space in the dental arch for the eruption of the third molar. However, with the emergence of a civilized world and the consumption of processed diets, lower chewing forces have become the requirement, in turn reducing the inter-tooth movement and thereby leading to third molar impaction.

CHAPTER 4

Indications and Contraindications for the Removal of Impacted Lower Third Molars

Abstract: This chapter discusses indications and contraindications for the surgical removal of an impacted mandibular third molar. The most common causes of lower third molar removal include pericoronitis and caries, while the other causes comprise orthodontic reasons, associated pathology, damage to adjacent teeth, and prosthetic reasons. Both absolute and relative contraindications for the removal of the mandibular third molar are subsequently presented.

Keywords: Cyst, Pericoronitis, Space abscess.

INTRODUCTION

An impacted mandibular third molar can remain asymptomatic throughout a person's life. However, it often gets associated with various conditions, ranging from simple dental caries to more serious pathologies, like cysts and tumors. These conditions provide straightforward indications for surgical removal. On the contrary, the removal of an asymptomatic, impacted third molar is a matter of debate and careful consideration. Table **1** enlists the indications for the removal of an impacted mandibular third molar.

Table 1. Indications for surgical removal of an impacted third molar.

Recurrent pericoronitis	Cyst formation
Periodontitis	Prior to radiotherapy
Dental caries	Pre-prosthetic reasons
Prior to orthodontic treatment	Involvement of an angle fracture
Preparation for orthognathic surgery	Atypical odontalgia
Pathologic resorption of the adjacent tooth	Fascial space infection

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INDICATIONS FOR REMOVAL

1. Recurrent pericoronitis: Pericoronitis is the inflammation or infection of the gingiva overlying the crown of a partially erupted tooth (Fig. **4.1**). It is the most common cause, requiring the removal of an impacted mandibular third molar. The reported incidence of pericoronitis ranges from 5% to 95% [1]. The infection occurs in the remnants of the dental follicle between the crown of the impacted tooth and the surrounding bone and gingiva. When the infection is limited to the overlying gingival flap (operculum), it is termed 'operculitis'.

Clinically, pericoronitis presents as a painful, edematous swelling of the gingiva overlying the impacted tooth. The gingiva is often inflamed, red, and readily bleeds on probing. Food impaction, extraoral swelling, halitosis, and restricted mouth opening are other features associated with pericoronitis. Third molars with pericoronitis are removed, either to prevent recurrent episodes or as treatment. Table **2** summarizes the cause, presentation, and management of pericoronitis Fig. (**4.2**).

Fig. (4.1). Clinical photograph shows pericoronitis associated with a partially impacted lower left third molar. The swollen, red, edematous gingival tissue overlying the impacted tooth (arrow) should be noted.

Table 2. Cause, presentation, and management of pericoronitis.

Cause
1. A bacterial infection exists beneath the pericoronal flap that covers the partially impacted mandibular third molar. 2. The cusp of the supraerupted opposing maxillary third molar causes trauma to the pericoronal tissue.
Clinical presentation

(Table 2) cont.....

1. Pain occurs in the region of the impacted mandibular third molar. The pain can radiate along the lower border of the mandible and preauricular region. 2. Signs of inflammation present over the inflamed pericoronal soft tissue (*i.e.,* redness, swelling, and warmth). 3. The overlying soft tissue readily bleeds during probing or manipulation. 4. Halitosis 5. Trismus due to the spread of infection to the masseter, temporalis, medial pterygoid muscles, and pterygomandibular raphe. 6. Cervical lymphadenopathy 7. Systemic signs of inflammation (fever, chills, and malaise)
Management
1. Conservative management It includes the use of oral antibiotic therapy and local wound irrigation with normal saline and/or antiseptic solution (povidone iodine). Oral mouth rinses are prescribed to patients to relieve the inflammation. Extraction of the opposing maxillary third molar should be advised in case of supraeruption or trauma from occlusion. 2. Surgical management The surgical management includes the following: a. Surgical removal of an impacted tooth b. Surgical removal of the gingival tissue (operculectomy) (Fig. **4.2**).

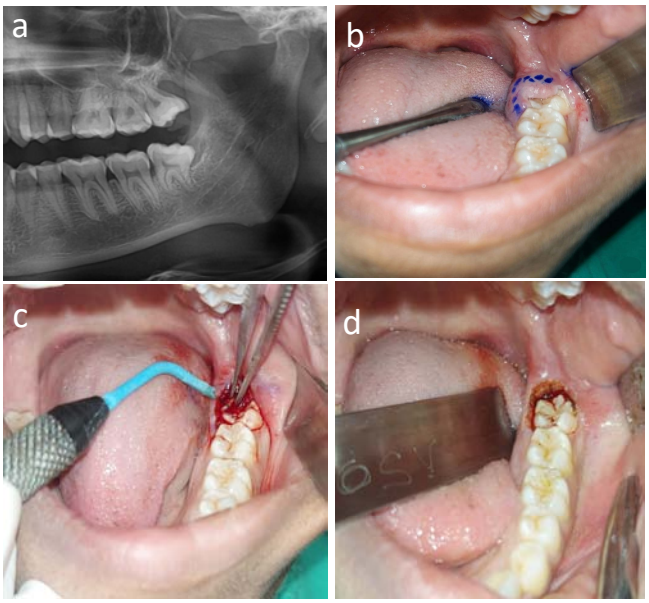

Fig. (4.2). The panoramic view reveals a partially impacted left mandibular third molar (a). The clinical image reveals a gingival flap partially covering the third molar. The tissue has been delineated with a surgical marker for operculectomy (b). Before the surgical procedure, the patient received local irrigation therapy, oral antibiotics, and mouth rinse to reduce soft tissue inflammation. The intraoperative image illustrates the removal of the operculum using electrosurgery (c). The procedure can also utilize a surgical blade. The advantages of using electrocautery include accurate cutting and coagulation of small capillaries, thereby providing better hemostasis. After the removal of the flap, the tissue distal to the third molar is excised to remove the distal crypt, completely exposing the tooth into the oral cavity (d).

CHAPTER 5

Classification of Impacted Mandibular Third Molar

Abstract: Impacted mandibular third molars are classified in various ways. The classification commonly accepted in literature is elaborated in the present chapter. Clinical examples are presented for each classification for ease of understanding and application in clinical practice.

Keywords: Distoangular impaction, Mesiongular, Pell and Gregory's classification, Vertical, Winter's classification .

INTRODUCTION

The aim of classifying any disorder is to have a universally accepted system for grading the severity of the condition, which is simple to communicate and document. The classification of an impacted mandibular third molar must convey its position within the bone. Ideally, the classification must include all the parameters defining the surgical difficulty, so as to aid in the preparation and execution of the operative procedure with minimal complications (Table **1**).

Table 1. Ideal requisites for impacted mandibular third molar classification.

1. Universally accepted
2. Easy to understand and document
3. Convey the impacted tooth's position within the bone.
4. Describe the relationship of the tooth with adjacent anatomical structures (*e.g.*, ramus, second molar, inferior alveolar canal)
5. Grade impaction based on surgical difficulty
6. Reproducible, with minimum subjective variation

George B. Winter (1926) and Pell and Gregory (1933) provided the most widely accepted classifications for impacted mandibular third molars. Other classifications described in the literature include the Killey and Kay classification and the ADA and AAOMS classification. A recent classification of lower third molar impaction utilizes clinical and imaging parameters (including cone-beam CT scans) to predict the difficulty of surgery (Table **2**).

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Table 2. Various classifications of impacted mandibular third molars.

George B. Winter's classification	1926	Based on the angulation
Pell and Gregory's classification	1933	Based on the relation with ramus and the occlusal level
Killey and Kay's classification	1979	Based on angulation, state of eruption, and root anatomy
Combined ADA and AAOMS classification		
Tanaka *et al.*'s classification	2000	Based on the position of the tooth in the bone
Quek et al.'s classification	2003	Based on the apico-coronal relationship with the canal
Abu-el Naaj *et al.*'s operative classification	2010	Based on the measurement of the angulation
Juodzbalys and Daugela's classification	2013	Based on the apico-coronal relationship with the canal
Maglione M. *et al.*'s classification	2015	Based on the localization of the third molar in all dimensions
		Based on the 3D relationship of the third molar with the canal

WINTER'S CLASSIFICATION

George B. Winter, in the year 1926, classified impacted mandibular third molars according to the angulation of the tooth with the long axis of the adjacent second molar [1]. The classification system has endured over time and remains one of the most widely used methods of classification. Winter's classification assigns the impacted mandibular third molars to the following categories:

- Mesioangular
- Vertical
- Horizontal
- Distoangular

Mesioangular Impaction

In mesioangular impaction, the long axis of the third molar is inclined mesially towards the adjacent second molar (Fig. **5.1**). It is common and accounts for almost 45% of lower third molar impactions. Because of the mesial orientation, these impactions are usually easy to remove. However, the degree of difficulty increases with the depth of impaction. The surgical complexity also increases when a substantial portion of the third molar is locked under the distal aspect of the second molar.

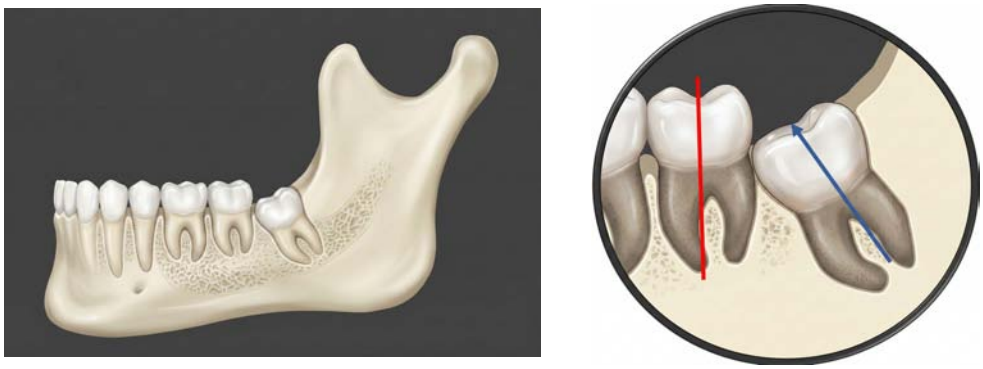

Fig. (5.1). Mesioangular impaction of the lower third molar. The impacted tooth is inclined in a mesial direction towards the adjacent second molar.

Vertical Impaction

In vertical impaction, the long axis of the impacted third molar is parallel to the long axis of the adjacent second molar (Fig. **5.2**). It is the second most common type of impaction, accounting for about 40% of the cases. The vertically impacted third molar is usually not locked under the crown of the second molar, and the difficulty of its removal depends on the amount of overlying bone (depth of the impaction). The surgical removal becomes difficult when the tooth is covered at its posterior aspect by the anterior ramus of the mandible. Vertical impaction is believed to be the second most difficult, after distoangular impaction.

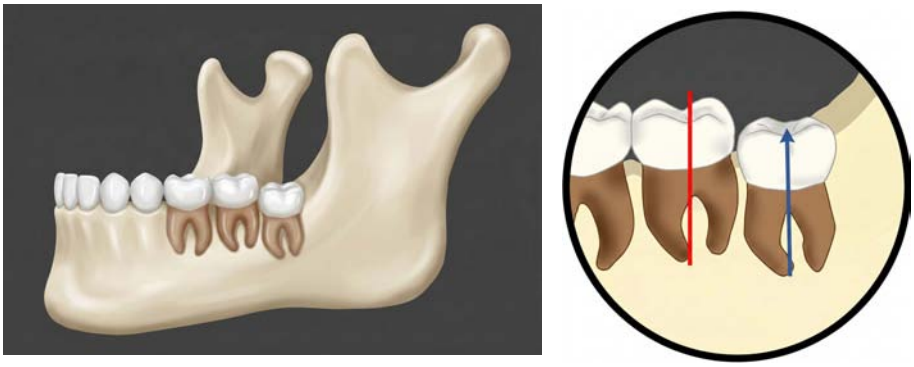

Fig. (5.2). A vertically impacted lower third molar has its long axis parallel to the long axis of the adjacent second molar.

Horizontal Impaction

In horizontal impaction, the long axes of the third and second molars are perpendicular to each other (Fig. **5.3**). It is uncommon (10% of cases) and more difficult to remove than mesioangular impaction. The occlusal surface of the horizontally impacted lower third molar is usually in close relationship with the

CHAPTER 6

Preoperative Planning: Clinical Assessment

Abstract: Clinical assessment is an essential step in preparation for the surgical removal of an impacted lower third molar. This chapter sequentially elaborates on the various systemic and local factors that must be evaluated before undertaking surgical intervention.

Keywords: Pain, Second molar, Swelling, Trismus.

INTRODUCTION

Every patient must undergo a thorough clinical assessment before the surgical removal of an impacted mandibular third molar. Following that, radiography is recommended to determine the critical anatomical structures surrounding the impacted tooth, and the difficulty of the surgical removal is evaluated. A comprehensive clinical and radiological examination helps to reduce the possibility of intraoperative and postoperative complications. This chapter offers a detailed description of the preoperative examination in preparation for impacted lower third molar surgery.

CLINICAL ASSESSMENT OF PATIENT UNDERGOING THIRD MOLAR SURGERY

An astute clinician should always perform a thorough clinical examination before the surgical removal of the impacted third molar. The clinical assessment includes evaluation and documentation of:

- Chief complaint
- Medical history
- Clinical examination

Chief Complaint

Asymptomatic impacted mandibular third molar: Asymptomatic patients may be diagnosed with an impacted mandibular third molar during a routine dental check-up. Based on informed consent, the choice of whether to remove the

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asymptomatic third molar ahead of time or to wait until the first sign of infection or disease is made (for further reading, the readers are referred to chapter **18**).

Symptomatic impacted mandibular third molar presenting with pain: Pain is a common symptom associated with an impacted third molar. The discomfort, which may be accompanied by swelling, is usually due to pericoronitis or pulpitis. The pain is localised to the area around the third molar (intraoral), or it can radiate to the angle of the jaw and the preauricular region (extraoral).

Symptomatic impacted mandibular third molar presenting with swelling: Swelling of the gingiva overlying the impacted third molar is a common presentation and is attributed to pericoronitis (Fig. **6.1a**). Pus may express beneath the pericoronal tissue, and the patient usually complains of foul taste and halitosis. These patients require surgical removal of the involved tooth along with oral antibiotic therapy. Lack of early intervention can result in the spread of infection, resulting in cellulitis, dentoalveolar, or fascial space abscesses. Extensive soft tissue involvement results in extraoral swelling. The involvement of the masticatory space presents as swelling over the angle of the mandible and is associated with significant trismus. The abscess can spread to the upper neck area, leading to the involvement of the submandibular and sublingual spaces (Fig. **6.1b**). Such delayed presentations can compromise the airway, resulting in a medical emergency that requires hospitalisation for airway management, abscess drainage, surgical removal of the impacted tooth (foci of infection), nutritional support, and parenteral antibiotic therapy.

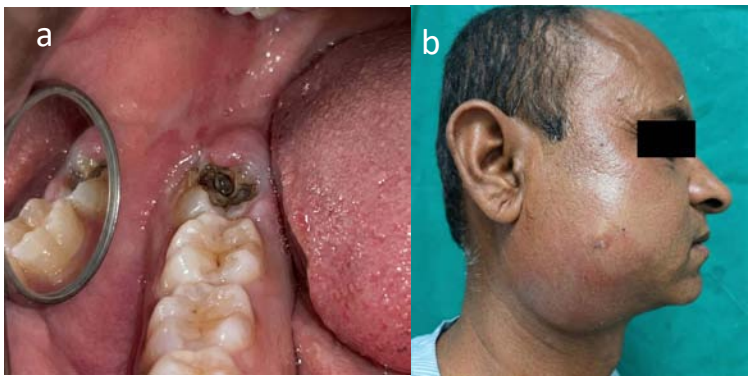

Fig. (6.1). Patient with lower third molar infection presenting with edematous and inflamed gingiva localized over the impacted tooth (pericoronitis) (a). Spread of infection can result in the involvement of fascial spaces around the mandible, like the submandibular space, as can be seen in the clinical photograph (b).

Medical History

It is important to assess the medical history of a patient undergoing third molar surgery to avoid any untoward events. Current advances in medicine and

improvements in healthcare infrastructure have increased the life expectancy of patients. This means that a greater number of elderly patients with potentially serious medical conditions are likely to present for the removal of their impacted third molar than ever before. There is an increased likelihood of intraoperative and postoperative complications in this age group. Besides the systemic condition, with increasing age comes an increase in bone sclerosis, which reduces the elasticity of bone, making it brittle. There is an increased chance of iatrogenic bone or tooth fracture in elderly patients, making the removal of an impacted mandibular third molar difficult.

How to Record Medical History?

Neither is it an established practice, nor is it expected to conduct a comprehensive medical assessment of patients in a dental office. This makes the role of medical history all the more important before the third molar surgery. Properly recorded medical history allows the operator to recognise any medical disorder that can complicate the surgery or compromise patient safety and make necessary modifications accordingly. The medical history of the patient may be verbally inquired about by the dental surgeon. However, it is advised to record the medical history through a written questionnaire. The questionnaire should adequately list all the medical conditions that can possibly complicate the third molar surgery and be in simple language to enable better understanding of the patient. Most of the clinics with minor oral surgery practice have their own format of case history record with some variations. The basic aim of any medical history should be to identify the following aspects:

- **Allergies to medications**: Allergy to any medication, particularly to local anaesthetic drugs (important to inquire past dental history), general anaesthetic agents (important to ask regarding previous history of hospitalization, blood transfusion, and surgery), antibiotics, and analgesics, must be inquired and documented.
- **Underlying medical conditions:** Medical conditions that can increase the risk of complications from minor oral surgery (*e.g*., diabetes mellitus, hypertension, epilepsy, asthma, thyroid disorder, bleeding disorders, history of stroke or myocardial infarction, anemia, cardiac, renal, and liver disease) must be evaluated.
- **Systemic skeletal diseases:** Various systemic skeletal disorders, like osteogenesis imperfecta, Paget's disease, osteopetrosis, and osteosclerosis, affect bone metabolism. Patients with the above conditions seeking impacted third molar surgery should be approached with caution. The dense and sclerotic nature of the bone associated with these diseases leads to difficulty in bone removal. There is an increased risk of iatrogenic fracture. The bone remodeling

CHAPTER 7

Preoperative Planning: Radiological Evaluation

Abstract: Preoperative imaging plays an important role in the assessment of the impacted lower third molar. Intraoral periapical radiographs as well as orthopantomograms are commonly used radiographs. This chapter elaborates on various factors assessed on the radiograph, including the depth and position of the impacted tooth, the relationship with the adjacent second molar, the anatomy of the surrounding bone, and the proximity to the inferior alveolar canal. Various parameters suggestive of a close relationship between the impacted tooth and the canal are discussed in detail.

Keywords: Darkening, Deflection, Imaging, Impacted, Molar, Narrowing, Root.

INTRODUCTION

Radiological assessment is a crucial component of the preoperative evaluation for third molar surgery. An intraoral periapical radiograph or an extraoral orthopantomogram radiograph may be utilized for this purpose.

Indications of Intraoral Radiographs

Intraoral Periapical radiographs (IOPAs) can be used to image an impacted mandibular third molar in the following situations:

- In the presence of adequate mouth opening
- If a severe gag reflex is not present
- There is no severe pain or trismus present
- The tooth lies in the alveolar ridge, not extending too far into the body or ramus of the mandible

Intraoral periapical radiographs are more accurate than the orthopantomogram (OPG) in terms of image resolution and show minute details (Fig. **7.1a**) [1].

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Fig. (7.1). IOPA shows a mesioangularly impacted lower third molar. The image distinctly illustrates the osseous and dental structures (a). The IOPA image partially depicts the posteriorly located and horizontally positioned impacted lower third molar, necessitating an OPG (b).

Indications of Extraoral Radiographs

An orthopantomogram (OPG) is the standard extraoral radiograph employed for evaluating an impacted mandibular third molar. Severe impactions position the tooth distally within the ramus, which is not visible in an intraoral view (Fig. **7.1b** and Fig. **7.2**). In such instances, OPG is essential for preoperative imaging. OPG is also advised to study deep impaction in aberrant sites, such as the ramus or the inferior border of the jaw, and to rule out concomitant pathology (Fig. **7.3**). Patients with decreased mouth opening and a strong gag reflex also benefit from OPG. Various indications of OPG for third molar surgery are summarized in Table **1.**

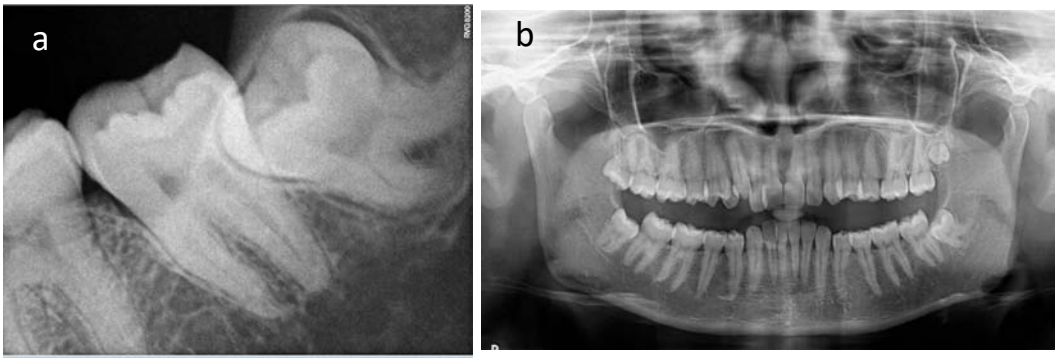

Fig. (7.2). The IOPA image displays an impacted third molar with a curved distal root. It should be noted that the image does not cover the entire tooth root (a). An OPG of the same patient shows the complete tooth and its relation with the ramus of the mandible and inferior alveolar canal (b).

Fig. (7.3). An OPG image reveals an impacted lower left mandibular third molar associated with pathology.

Table 1. Indications for an orthopantomogram used to assess an impacted mandibular third molar.

▪ Deep impactions (*e.g*., horizontal/distoangular impaction, position B/C, class II/III)
▪ Patients with trismus and reduced mouth opening
▪ Patients with excessive gagging
▪ Patients with oral submucous fibrosis
▪ To study the relation of the impacted tooth with the inferior alveolar canal
▪ Impacted teeth in an aberrant position
▪ To rule out associated pathology

OPG allows the evaluation of a larger area of the jawbone. In addition to examining the affected third molar, it permits assessment of the surrounding osseous and dental structures, including the inferior alveolar canal, the ascending ramus, the external oblique ridge, the retromolar canal, and the adjacent second molar tooth (Fig. **7.4**). Table **2** enumerates the parameters that must be assessed on the radiograph before the extraction of an impacted lower third molar.

Fig. (7.4). The orthopantomogram is used for assessment of the impacted lower right third molar. It allows evaluation of angulation of impaction, size of the third molar crown and its relationship with the adjacent second molar, number and pattern of roots, proximity of tooth roots to the inferior alveolar canal, relationship to the anterior ramus, density of the surrounding bone, follicle size, and the presence of associated pathology.

CHAPTER 8

Preoperative Planning: Role of Cone Beam Computed Tomography

Abstract: The role of three-dimensional imaging has gained significant importance over the past decade. Cone beam computed tomography allows the assessment of deeply impacted lower third molars in all three planes. It allows the precise study of the morphology of the impacted lower third molar. The proximity to the inferior alveolar canal can be evaluated, thereby helping in making an informed consent and reducing the risk of intraoperative complications. It also allows the evaluation of the surrounding bone, adjacent tooth, and associated pathology.

Keywords: Inferior alveolar canal, Jawbone pathology, Three-dimensional imaging.

INTRODUCTION

The accessibility and prevalent application of 3D imaging have significantly contributed to the surgeon's capacity to determine precise anatomical details. The constraints of 2D imaging have been eradicated, and the ambiguity associated with the interpretation of 2D radiography has been alleviated. Cone beam computed tomography (CBCT) scans are now commonly employed in clinical dentistry and have demonstrated significant utility. The CBCT scan's buccolingual slices clearly show the number and shape of third molar roots, as well as the stage of root apex development. The scans unequivocally ascertain the closeness or direct contact with the mandibular canal [1, 2]. The orientation of the mandibular canal with relation to the root apices is easily discernible in various planes. The 3D-reconstructed volumetric pictures and multi-planar reformatted images are essential in comprehending anatomical complexities. The characteristics frequently assessed on CBCT scans for the evaluation of impacted lower third molars are listed in Table **1** and elaborated upon in this chapter.

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Table 1. Assessment of an impacted mandibular third molar on a cone-beam CT scan.

▪ **Number and morphology of the root**
▪ **Relationship of the inferior alveolar canal to the impacted tooth**
▪ **Cortical anatomy**
▪ **Anatomic variants**
▪ **Pathology associated with the impacted tooth**

NUMBER AND MORPHOLOGY OF THE ROOT

A CBCT scan enables the precise visualization of the number and morphology of roots. This is particularly necessary when the roots are curved, dilacerated, hypercementosed, or when the root trunks bifurcate into several apices (Figs. **8.1-8.3**). The status of apical closure, or incompletely formed apices, can be viewed.

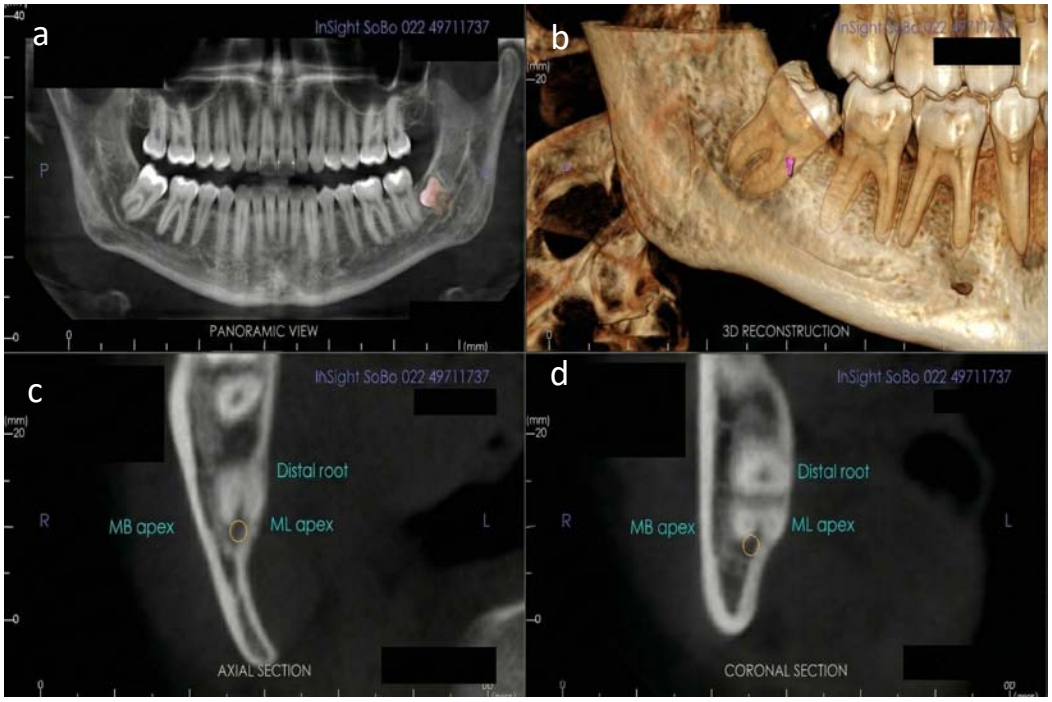

Fig. (8.1). A cone-beam CT scan shows the right mandibular third molar presenting with a mesioangular axial inclination. The panoramic views reveal two roots, mesial and distal (a, b). However, the buccolingual slices demonstrate the splitting of the mesial root trunk into two (mesiobuccal and mesiolingual) root apices (c, d) (image courtesy: Dr. Ajay Nayak, INsight CBCT centre, Mumbai).

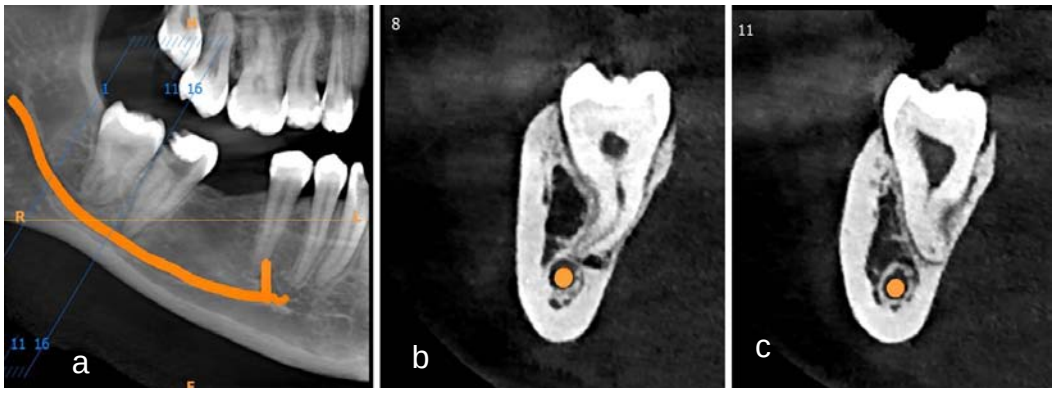

Fig. (8.2). CBCT images show a vertically impacted lower right third molar. In the panoramic image, the roots have a favorable curvature and appear conical (a). However, the cross-sectional images clearly display a severe bucco-lingual curvature. The distal root is buccally curved (b), whereas the mesial root possesses a lingual curvature and is in close proximity to the lingual cortical plate (c).

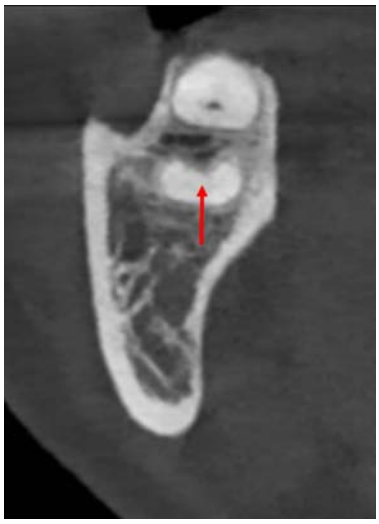

Fig. (8.3). A cross-sectional image of the CBCT scan of a horizontally impacted third molar shows notching of the inner surface of the mesial tooth root, increasing the risk of its fracture intraoperatively.

RELATIONSHIP OF THE INFERIOR ALVEOLAR CANAL TO THE IMPACTED TOOTH

The ability to visualize the whole mandibular canal in cross-sectional slices enables the radiologist to delineate the complete trajectory of the canal. Consequently, the radiologist can mark the sequential scan images in a designated color to highlight the mandibular canal. This facilitates the observation of the canal and its relationship to the root ends of the third molars, indicating proximity, adjacency, or distance (Figs. **8.4**–**8.10**). Additionally, it can be ascertained whether the canal is buccal, lingual, or aligned in the same vertical plane as the

CHAPTER 9

Difficulty Index for the Surgical Removal of Impacted Molar

Abstract: The present chapter elaborates on various factors that determine the surgical difficulty in the removal of an impacted mandibular third molar. The conventionally used difficulty index, including WHARFE's index, the Pederson scale, and the Kharma scale, is discussed with clinical examples. New scales described in the literature are also elaborated.

Keywords: Kharma scale, Pederson scale, WHARFE's index.

INTRODUCTION

Preoperative assessment of the surgical difficulty of removing an impacted mandibular third molar is crucial for optimizing the procedure and minimizing postoperative complications. There are a number of factors that contribute to the ease or difficulty of the surgical procedure. Patients with TMJ disturbances have difficulty keeping their mouths open for long periods of time. These patients often complain of aching pain, which necessitates the use of a mouth prop during the procedure to keep the mouth open. Microstomia, macroglossia, and inelastic, chubby cheeks can restrict surgical access to the impacted third molar, thereby complicating the procedure. Teeth with incomplete root formation are easier to extract than those with completely formed roots. Bulbous, divergent, and multiple roots also make the surgical removal difficult. Long and slender roots fracture more easily than short and stout roots. Removing deeply positioned teeth with unfavourable angulations is more challenging and associated with a higher risk of postoperative complications.

The removal of impacted third molars requires the preoperative evaluation of surgical complexity. A surgeon must have evidence-based scientific information regarding the estimated level of difficulty for every case of an impacted mandibular third molar undergoing surgical removal. The literature has described a number of classification systems and difficulty indices for this purpose (Table **1**). Commonly discussed among them are WHARFE's index, Pederson's scale,

modifications of Pederson's scale by Kharma MY *et al*. and Roy *et al*., the Prarant scale, the Pernambuco index, and the Gbotolorun index.

Table 1. Difficulty indices commonly used for the assessment of impacted lower third molar.

Name of Index	Year	Name of Index	Year
Parant scale	1974	Juodzbalys G (MRACBS) scale	2013
WHARFE index	1979	Kharma scale	2014
Pederson scale	1988	Mario Vicente-Barrero (SPESD)	2014
Modified Pederson scale	1994	Roy *et al*.'s index	2015
Koerner index	1994	Conti scale	2015
Modified Parant scale (Garcia *et al*.)	2000	Pernambuco index	2017
Penarrocha *et al*.'s index	2000	Ribes Lainez N *et al*.'s index	2017
Yuasa index	2002	Sammartino G *et al*.'s index	2017
Gbotolorun index	2007	Zang *et al*.'s index	2019
Carvalho *et al*.'s scale	2011	Kim JY *et al*.'s index	2019

Three basic factors characterize the surgical difficulty: the angulation of the affected third molar (as described by Winter), depth, and position (as suggested by Pell and Gregory) (Table **2**). Common difficulty indices proposed by several authors in the literature are covered in this chapter.

Table 2. Key factors influencing the difficulty of removing the mandibular third molar.

▪ **Angulation** of the third molar in relation to the long axis of the second molar (mesioangular, distoangular, horizontal, *etc*.) according to Winter's classification.
▪ **Depth** of the third molar in relation to the occlusal plane (level A, B, C) according to Winter's classification.
▪ **Position** of the mandibular third molar in relation to the vertical ascending ramus and the distal surface of the second molar (class I, II, III) according to Pell and Gregory's classification.

WHARFE'S INDEX

WHARFE's index is among the earliest instruments for evaluating the complexity of lower third molar extraction. The scale was introduced by MacGregor in 1979 [1]. This index relies on the preoperative radiological assessment of the orthopantomogram to determine the difficulty score (Table **3**) (Fig. **9.1**). The acronym WHARFE is derived from the six elements utilized for scoring, which include:

Table 3. WHARFE's index scores.

Variables	Score	Variables	Score
Winter's classification		**Root shape and morphology**	
▪ Horizontal	2	▪ Complex	1
▪ Distoangular	2	▪ Favourable curvature	2
▪ Mesioangular	1	▪ Unfavourable curvature	3
▪ Vertical	0		
Height of mandible		**Follicle development**	
▪ 01-30mm	0	▪ Normal	0
▪ 31-34mm	1	▪ Possibly enlarged	1
▪ 35-39mm	2	▪ Enlarged	2
Angulation of the third molar		**Path of exit**	
▪ 1-59 degrees	0	▪ Space available	0
▪ 60-69 degrees	1	▪ Distal cusps covered	1
▪ 70-79 degrees	2	▪ The mesial cusp covered	2
▪ 80-89 degrees	3	▪ Both covered	3
▪ 90 + degrees	4		

Fig. (9.1). An orthopantomogram reveals bilateral impaction of the lower third molars. The evaluation of surgical complexity based on WHARFE's index is detailed below. The right lower third molar, with a total score of 8, is anticipated to be more challenging to extract than the left one, having a total score of 4.

Assessment of Right Lower Third Molar Impaction	Score	Assessment of Left Lower Third Molar Impaction	Score
Winter's classification (horizontal impaction)	2	Winter's classification (vertical impaction)	0
Height of mandible (31-34mm)	1	Height of mandible (31-34mm)	1
Angulation of third molar (80-89 degrees)	3	Angulation of third molar (1-59 degrees)	0
Root shape and morphology (favourable)	2	Root shape and morphology (favourable)	2
Follicle development (normal)	0	Follicle development (possibly enlarged)	1
Path of exit (space available)	0	Path of exit (space available)	0
Total score	8		4

CHAPTER 10

Surgical Removal of Impacted Mandibular Third Molar: Introduction

Abstract: This chapter summarizes various steps in preoperative assessment before the surgical removal of an impacted mandibular third molar. The options for treatment and steps involved in the surgical removal of the impacted tooth are enumerated.

Keywords: Preoperative assessment, Steps, Surgical removal.

INTRODUCTION

The decision-making for the management of an impacted mandibular third molar depends on the evaluation of both local and systemic factors, some of which are highlighted below:

- A carious, partially erupted mandibular third molar often presents with pain and swelling and may require surgical removal of the tooth.
- Pericoronitis with a partially impacted third molar can be treated with the removal of the pericoronal flap (operculectomy). However, recurrent pericoronitis warrants surgical extraction of the impacted tooth.
- Pulpal inflammation, periapical infection, and fascial space abscess associated with an impacted molar often require urgent intervention with antibiotic therapy, abscess drainage, and removal of the culprit tooth.
- The impacted mandibular third molar may also require removal for orthodontic or prosthodontic reasons.
- Surgical removal is contraindicated in medically compromised patients, like those with a recent history of myocardial infarction or radiation therapy. These patients should be treated conservatively before the surgical procedure can be undertaken with a reasonable risk.
- In the case of elderly patients and third molars in close proximity to the inferior alveolar canal, the potential complications of surgical intervention should be weighed against the potential benefits.

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- Recent studies have advised incomplete removal of the impacted third molar (coronectomy, *i.e.*, removal of the crown and retention of the tooth root) in close proximity to the inferior alveolar canal to reduce the risk of nerve injury [1].
- Asymptomatic third molars can be kept on observation and surgically removed at the earliest sign of any pathology.
- An asymptomatic third molar may be surgically removed and transplanted to the extraction socket of an unsalvageable lower first molar (autotransplantation).

Various options for the management of impacted mandibular third molars are summarized in Table **1**.

Table 1. Options for the management of an impacted mandibular third molar.

▪ Observation of an asymptomatic impacted lower third molar ▪ Operculectomy ▪ Surgical removal/transalveolar extraction ▪ Autotransplantation ▪ Coronectomy ▪ Surgical exposure and orthodontic traction

The surgical removal is also referred to as odontectomy, open extraction, or transalveolar extraction (Table **2**) [2]. The assessment of systemic (medical history and general well-being of the patient) and local factors (clinical and radiographic examination) is essential before scheduling the patient for third molar surgery. A summary of the preoperative intraoral assessment is presented below. For a detailed description of the same, refer to chapters 6, 7, and 8.

Table 2. Terminology.

Odontectomy, or surgical extraction, is the removal of a partially erupted, impacted, or retained root that cannot be extracted normally with forceps. These teeth must, therefore, be removed surgically, requiring placement of an incision, reflection of a flap, removal of bone, sectioning of the tooth (when required), delivery of the tooth, and suturing. It is also termed "transalveolar extraction".

- **Assessment of pericoronal tissue (Fig. 10.1):** Pericoronal tissue overlying the third molar should be examined for the presence of inflammation or infection. Surgical removal should be planned under antibiotic cover and after the acute symptoms of pericoronitis subside.
- **Assessment of the state of eruption of the impacted tooth (Fig. 10.1):** The state of eruption of the impacted tooth must be evaluated. Clinical and radiological examination can determine whether the tooth is partly erupted or unerupted. If the crown is unerupted, it may be covered exclusively by soft tissue (soft tissue impaction) or partially or fully by bone (bony impaction).
- **Assessment of the impacted lower third molar (Fig. 10.2):** Assessing the

angulation of the impacted tooth, which can be mesioangular, vertical, horizontal, distoangular, buccoversion, or linguoversion, is crucial.

- **Assessment of the second molar:** If the second molar is carious, resorbed, or has a large restoration, applying the elevator for the third molar removal could inadvertently fracture it. When the second molar has conical or fused roots, it might get luxated accidentally when the force and direction of elevation for the removal of the third molar are incorrect.
- **Distance between the second molar and ascending ramus:** If the space between the ascending ramus and the distal aspect of the second molar is less than the mesio-distal width of the crown of an impacted third molar, then there will be reduced accessibility, and the surgical removal of the third molar will be more difficult. The presence of a distally angulated second molar further complicates the surgery.
- **Root morphology** (Fig. **10.3**): The number of roots, their curvature (straight or curved), the orientation of a curved root (mesial/distal/buccal/lingual), their girth (long and slender or short and thick), and their proximity to the inferior alveolar canal should be examined on a radiograph.
- **Periodontal ligament space:** The presence of periodontal ligament space around the roots of an impacted tooth should be confirmed. Periodontal ligament tissue in an impacted tooth or a tooth out of functional occlusion may sometimes undergo resorptive changes, followed by repair, resulting in ankylosis of the tooth. Ankylosis of the tooth thus significantly increases the surgical difficulty and postoperative morbidity. In patients past the middle age, the periodontal ligament space is much smaller than in young patients, which makes the removal of impacted teeth difficult in this age group.
- **Follicular space:** The size of the follicular sac must be studied. A narrower follicular space increases the surgical difficulty. A significant increase in the space between the follicular sac and the crown of the impacted tooth indicates cyst formation, which must be recognised and treated accordingly.
- **Relation of the third and second molar teeth:** The intraoral radiograph should be taken in such a way that the second molar and third molar teeth do not overlap. This helps to accurately ascertain if the crown of the third molar is locked below the crown of the second molar. When the crown of the third molar is locked, tooth sectioning is required.
- **Assessment of bone:** Dense and sclerotic bone makes surgical removal of the tooth difficult. Systemic bone disorders, like osteogenesis imperfecta or osteopetrosis (marble bone disease), make the bones brittle and increase the risk of fracture.

CHAPTER 11

Choice of Anesthesia for the Lower Third Molar Surgery

Abstract: Surgical removal of the mandibular lower third molar can be carried out under local anesthesia, sedation, or general anesthesia. The choice of anesthesia for the given case is determined by assessment of various factors, which are discussed in the present chapter. Additionally, the technique and drugs used for the chosen method are also elaborated.

Keywords: Deep impaction, Local anesthesia, Nerve block.

INTRODUCTION

The surgical removal of an impacted mandibular third molar is a routinely performed procedure under suitable anesthesia. Local anesthesia is commonly preferred. The advantages of performing the procedure under local anesthesia include the following:

1. It allows proper positioning of the patient in the dental chair (which improves the ease of performing the procedure).
2. It eliminates the need for hospitalization.
3. It prevents exposure to the risks of general anesthetic agents.
4. The cost of the procedure is significantly lower under local anesthesia.

However, general anesthesia is preferred over local if the tooth is in an ectopic position or has a higher difficulty index. Anxious or fearful patients and mentally challenged patients are at risk of this procedure and also pose difficulty to the operator if performed under local anesthesia. In such patients, sedation or general anesthesia is preferred over local anesthesia. Since general anesthesia involves risks, it should be limited to certain categories of patients only and the deeply impacted mandibular molars having a difficulty index of 8 or higher. General anesthesia may also be considered in cases where all maxillary and mandibular third molars are indicated for surgical extraction (and especially if one or more of them have a high difficulty level of removal) (Fig. **11.1**).

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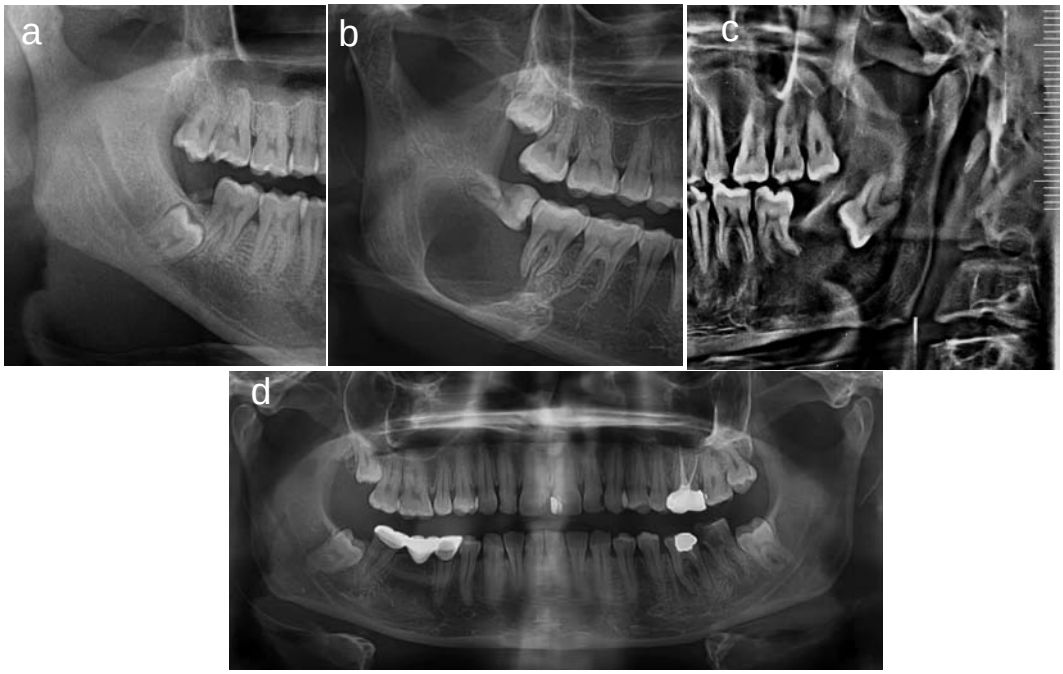

Fig. (11.1). Various indications of general anesthesia for third molar surgery include deep impaction with close proximity to vital structures, like the inferior alveolar canal (a), a third molar associated with pathology (b), an impacted tooth in an aberrant position (c), and the removal of multiple impacted teeth (d).

LOCAL ANESTHESIA

Almost all routine dental procedures are carried out under local anesthesia, including third molar surgeries. The contraindications include psychiatric and physically challenged patients, syndromic patients, patients having anxiety issues or fear of injection, and uncooperative pediatric patients [1].

Pharmacological Agents Used

1. **Lignocaine (lidocaine):** 2% lignocaine is the most commonly and widely used agent. It is intermediate-acting, and when used with the vasoconstrictor adrenaline (1:80000, 1:100000, or 1:200000), it helps minimize bleeding and provides a clear surgical field (Fig. **11.2a**). It exhibits good efficacy in both surface anesthesia and injectable forms. Lignocaine blocks the conduction within 3 minutes, and its duration of action is 40 to 60 minutes for pulpal anesthesia, while 90 to 120 minutes for soft tissue anesthesia [2]. A healthy adult patient can use a maximum dose of 7 mg/kg body weight (not exceeding 500 mg) of local anesthetic with epinephrine. In the case of using lidocaine without adrenaline (Fig. **11.2b**), the maximum recommended dose is 4 mg/kg body weight (not exceeding 300 mg). In patients with cardiovascular disease,

local anesthesia with adrenaline can be used, provided the concentration of adrenaline does not exceed 0.04 mg. A skin test should be done prior to injecting the local anesthetic solution so as to rule out any allergic reaction. In most cases, the cause of an allergic reaction to a local anesthetic solution is methyl paraben (a preservative).

2. **Bupivacaine** (0.5% with adrenaline 1:200000): It is a long-acting local anesthetic agent and is used when the duration of the surgery is expected to be longer. It comes only in injectable form (Fig. **11.2c**). It is highly lipid-soluble and rapidly gets distributed in tissues. Thus, it is more prone to causing toxicity and ventricular tachycardia when used in higher dosages (the maximum dose is 100 mg). The onset of action is slower (5 to 7 minutes), but the duration of nerve block is from 180 to 360 minutes [2].
3. **Articaine:** It is a relatively new agent that has been shown to have greater diffusibility, a quicker onset of action, and a more profound anesthetic effect. However, extensive studies have not explored its use in third molar surgeries.

Ropivacaine, dibucaine, mepivacaine, and tetracaine are some of the other anesthetic agents used, though they are not widely reported (Fig. **11.3**).

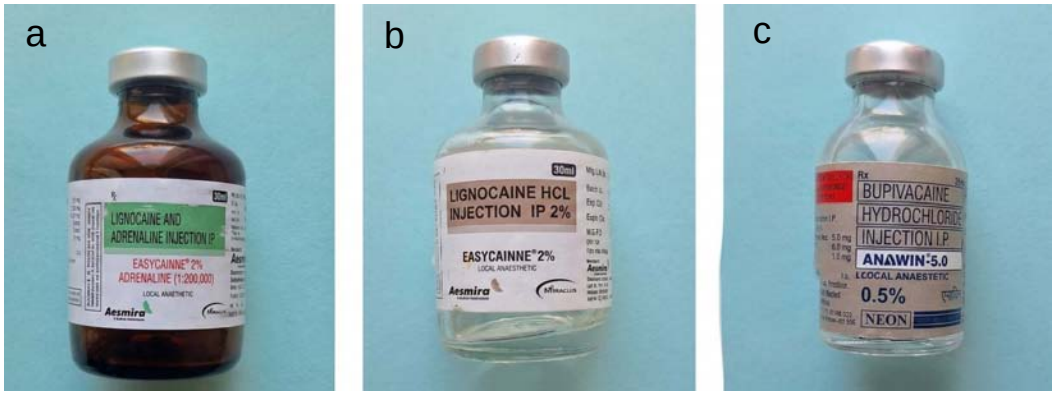

Fig. (11.2). Images show vials of lignocaine with (a) and without adrenaline (b), and bupivacaine (c).

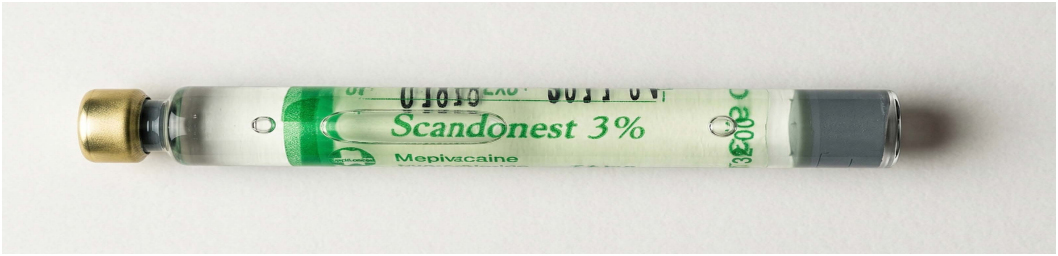

Fig. (11.3). Image of a mepivacaine cartridge.

CHAPTER 12

Surgical Removal of Impacted Mandibular Third Molar: Armamentarium

Abstract: Various instruments are used for third molar surgery. The choice of appropriate armamentarium not only improves efficiency, but also reduces the risk of intra- and postoperative complications. This chapter classifies the instruments used for third molar surgery for ease of discussion. All the categories of instruments based on their use are discussed in detail. The principle of use of the device and its clinical application is elaborated with illustrations.

Keywords: Dental elevator, Extraction forceps, Instruments, Third molar surgery.

INTRODUCTION

The surgical removal of an impacted mandibular third molar requires a variety of instruments. The availability of an appropriate surgical arsenal is essential for a predictable and safe treatment outcome. A carefully chosen and maintained set of instruments not only improves the efficiency of the removal of the impacted tooth, but also improves operator's comfort and reduces intraoperative time. It also minimizes the risk of damage to vital structures during the surgery and reduces the risk of postoperative sequelae and complications. This chapter discusses various instruments used for the removal of an impacted third molar. The principles and techniques of use, along with their maintenance and sterilization, are described. Table **1** and Fig. **12.1** show a basic selection of instruments for lower third molar surgery. To accommodate individual variations in technique, any instrument can be added or substituted for these.

DIAGNOSTIC INSTRUMENTS

The commonly used diagnostic instruments include the following:

- Mouth mirror
- Straight and graduated periodontal probe
- Explorer
- Tweezers

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Table 1. Classification of the instruments.

Based on the reusability of the instrument ▪ Disposable: These instruments are meant for single-time use. Examples are a BP blade and a plastic suction tip. ▪ Reusable: These instruments can be used multiple times. Most of the metallic instruments are reusable after cleaning and adequate sterilization (autoclaving). The examples include retractors, periosteal elevators, and forceps.
Based on the material of the instrument ▪ Plastic: These instruments are made of medical-grade plastics and are meant for single-time use. The examples are a disposable plastic BP handle and a plastic suction tip. ▪ Metallic: The majority of the surgical instruments are metallic and can be made of either stainless steel or tungsten carbide. While instruments made of stainless steel are relatively inexpensive, instruments made of tungsten-carbide working tips are sturdier and have better corrosion resistance, thereby providing better durability and work efficiency.
Based on the primary function of the instrument ▪ Diagnostic instruments (mouth mirror, probe, explorer, tweezers) ▪ Instruments for isolation and preparation of the surgical site (swab holder, towel clip) ▪ Instrument for mouth opening and access to the site of surgery (mouth prop/bite block, jaw opener/stretcher, tongue depressor, cheek retractor, suction tip/cannula) ▪ Instruments for administration of local anesthesia (syringe, local anesthetic solution cartridge/vial) ▪ Instruments for incision (BP handle, BP blade, tissue dissecting scissors) ▪ Instrument for reflection of flap (Molt and Howarth periosteal elevator, Mitchell's trimmer) ▪ Instruments for flap retraction (Austin's retractor, Langenbeck retractor, Minnesota retractor, Bowdler-Henry retractor) ▪ Instruments for bone removal and tooth-sectioning (motorized rotary machine with handpiece, bur, chisel, mallet, bone rongeurs) ▪ Instruments for luxation and removal of teeth (elevators, luxators, periotomes, tooth forceps) ▪ Instruments for socket debridement (curette, bone file) ▪ Instruments for wound closure/suturing (suture material, needle holder, tissue-holding forceps, suture-cutting scissors)

The mouth mirror (Fig. **12.2**) is used for intraoral evaluation of the surgical site at the third molar region, including the gingiva overlying the impacted tooth. It is used to examine the part of the impacted tooth visible in the oral cavity and its relationship and angulation with the adjacent mandibular second molar and the antagonist maxillary third molar. It can also be used to inspect the extraction socket once the tooth has been removed. A mirror's reflected illumination helps to detect any fractured root pieces, loose bone, or follicular tissue in the extraction socket.

Fig. (12.1). The image displays a surgical trolley equipped with instruments designed to extract impacted lower third molar teeth. Top row, from left: bowl, bite block, bur, syringe with local anesthetic solution, irrigation syringes and needle, BP handle with 15-number blade, tweezer, long and short-toothed forceps, long and short periosteal elevators, mandibular third molar forceps, bone file, curette, bone rongeur, mosquito forceps, needle holder, suture-cutting and tissue-cutting scissors. The items in the bottom row, from left to right, include a mouth mirror, a suction tip, retractors, such as Langenbeck, Minnesota, and Austin's, elevators, such as Coupland, Apex, and Cryer, a crossbar, a mallet, a chisel (5 mm and 10 mm), and suture material.

Fig. (12.2). Mouth mirror.

A probe primarily checks for the presence of periodontal pockets at the distal aspect of the erupted second mandibular molar tooth. A graduated periodontal probe has markings on its working tip. This allows accurate measurement and documentation (Fig. **12.3**). An explorer is used to diagnose dental caries involving the second molar or partially erupted crown of the lower third molar tooth (Fig. **12.4**). A probe or explorer can also be used to check the thickness of the gingival tissue overlying the impacted tooth after attaining local anaesthesia and to evaluate the depth of tooth sectioning during odontotomy.

CHAPTER 13

Surgical Removal of Impacted Mandibular Third Molar: Incision and Flap Design

Abstract: This chapter provides a detailed description of the principle of flap design and classification of various incisions used in mandibular third molar surgery. Each incision is discussed in detail, highlighting its design, indication, and limitations. The clinical photographs and diagrams are provided for a better understanding of the readers.

Keywords: Mucoperiosteal flap, Ward incision.

INTRODUCTION

An incision is defined as "a planned cut or a wound deliberately made by the operator into the skin or mucous membrane with a sharp instrument (surgical blade or cautery) so that the underlying structures are exposed adequately for surgical access." Placement of an incision is the first and essential step of any surgical procedure. The incision must be designed to provide sufficient access to the impacted tooth without jeopardising the adjacent vital structures.

ASEPSIS AND ISOLATION

Before starting with the incision, the surgical site should be aseptically prepared and isolated. This includes scrubbing, cleaning, and painting of the skin and rinsing of the oral cavity (Table **1**).

INCISION AND FLAP DESIGN

The incision must provide adequate accessibility and visualization. It must also allow easy retraction of the adjacent tissue and primary closure after removal of the impacted tooth. The requirements of an ideal incision design are listed in Table **2**. An adequately designed incision and surgical exposure reduce the possibility of postoperative complications (Table **3**).

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Table 1. Steps involved in asepsis and isolation of the surgical site.

1. SCRUBBING Scrubbing of the skin of the face is done from below the ala of the nose to the upper part of the neck. Commonly used scrubbing solutions include the following Fig. **(13.1**): ▪ Aqueous-based solution, *e.g.*, povidone iodine (7.5%) ▪ Alcohol-based solution, *e.g.*, ethyl and isopropyl alcohol Aqueous-based solutions, such as povidone-iodine, contain an iodine complex that acts as an antiseptic. It causes the destruction of microbial proteins and DNA. They are more commonly used because of their broad-spectrum antimicrobial properties, efficacy, and safety on skin as well as mucosal surfaces. Alcohol-based solutions are fast and short-acting. They have broad-spectrum antimicrobial activity. However, flammability is their major drawback, and they are not recommended for use on sensitive mucosal surfaces [1].
2. CLEANING After scrubbing the skin, a cleaning solution is applied to the face to eliminate any remaining soap solution. Commonly used cleaning solutions include the following (Fig. **13.2**): ▪ Normal saline ▪ Alcohol/spirit ▪ Cetrimide (0.5% w/w) and chlorhexidine digluconate (0.1% w/w)
3. PAINTING Finally, a painting solution is used topically to inhibit the growth of microbes. Painting is done on skin surfaces. For preparation of the oral cavity, the patient is given an antiseptic mouthwash. Solutions used for painting and oral rinse include the following: (Fig. **13.3**): ▪ Povidone-iodine (Betadine 10% for skin and 1% for oral mucosa) ▪ Chlorhexidine gluconate (7.5% for skin and 0.2% for oral mucosa)
4. DRAPING After scrubbing, cleaning, and painting, the surgical site is draped with sterile linen (Fig. **13.4**). The area below the cheek prominence and up to the upper neck is typically left exposed during the surgical procedure. Keeping the eyes covered can protect them against the strong overhead light of the operating room. However, blocking the vision may cause anxiety in some patients. The eye can be left uncovered for these patients.

Fig. (13.1). Scrubbing solution: povidone-iodine scrub (7.5%).

Fig. (13.2). Cleansing solutions: normal saline (a) and cetrimide and chlorhexidine solution (b).

CHAPTER 14

Management of Impacted Mandibular Third Molar: Bone Removal

Abstract: Removal of the bone overlying an impacted mandibular third molar is an important step in third molar surgery. Various techniques and armamentarium used for bone removal are explained in this chapter. Methods of bone removal for deeply impacted third molars are also presented.

Keywords: Bone guttering, Chisel-mallet, Postage-stamp method.

INTRODUCTION

After reflecting the flap to expose the underlying bone, an appropriate amount of bone overlying the impacted tooth is removed.

What is the Appropriate Amount of Bone to be Removed?

An adequate quantity of bone obstructing the removal of teeth must be removed. The depth and angulation of the impacted tooth primarily determine the quantity of the bone removed.

- **Partially impacted lower third molar**

In partial impaction of the lower third molar, bone is removed exclusively from the buccal and, in some cases, distal aspects of the teeth. This is termed buccal and distal bone guttering, respectively. The bone removal is recommended until the bulge of the crown is completely visible. A purchase point is then created to engage the working tip of the elevator and luxate the tooth.

- **Completely impacted lower third molar**

Significant bone removal is required when the tooth is completely impacted within the bone. The bone present over the occlusal surface of the impacted tooth is removed first. Subsequently, the bone is removed from the buccal aspect until the greatest protuberance of the crown is exposed. The amount of bone removed

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can be reduced through tooth sectioning (odontosection). As the phrase goes, "Tooth belongs to the surgeon, but bone belongs to the patient." As a result, appropriate tooth sectioning should help reduce the amount of bone removal.

What are the methods for bone removal?

Based on instrumentation, there are two ways to perform bone removal, which are presented as follows:

1. Handpiece-bur technique
   Moore and Gillbe's collar technique
   Postage-stamp method
2. Chisel-mallet technique

MOORE AND GILLBE'S COLLAR TECHNIQUE FOR BONE REMOVAL

Technique

The steps involved in the use of the technique are listed as follows:

- The bur is used in a sweeping motion around the occlusal, buccal, and distobuccal parts of the impacted tooth to expose the crown.
- When the tooth is completely impacted, the alveolar bone overlying its occlusal surface is removed with a round-shaped carbide bur. Commonly used round burs are nos. 6 and 8. No. 8 bur is of a larger size. The diameter of these burrs ranges between 1.5 and 2.5 mm. If the tooth is erupted, then the occlusal bone removal is not required.
- When the tooth is locked under the anterior aspect of the ramus of the mandible (usually for vertical and distoangular impaction), bone from the distobuccal aspect of the tooth has to be removed (distobuccal guttering). It creates a space for the removal of the impacted tooth when it is luxated by application of the elevator.
- The buccal surface of the tooth is exposed until the CEJ, which ensures exposure beyond the bulk of the crown. This is called "buccal guttering" (Figs. **14.1, 14.2,** and **14.3**). The distal and buccal bone removal is done using a straight fissure bur, mounted on a micro-motor-driven straight handpiece, and rotated at a speed in the range of 30,000 to 50,000 revolutions per minute. Copious irrigation with an isotonic saline solution is advised to prevent heat generation and tissue necrosis.
- The commonly used carbide straight-fissure burs for bone removal are nos. 701, 702, and 703 (Fig. **14.4**). The working tip diameters of the 701, 702, and 703

burs are 0.8 mm, 1.2 mm, and 1.6 mm, respectively. The 701-number bur is the thinnest. It cuts thin sections of bone and prevents excess bone removal. It is used when a smaller amount of bone removal is indicated. However, it can readily break when used under pressure (increased torque) due to its thin diameter. The 703 bur is the thickest and is used in cases where more bone removal is desired. No. 702 can be ideal with adequate bone removal and less risk of breakage.

- Guttering should not be done on the distolingual aspect of the tooth so as to preserve the lingual plate and prevent damage to the lingual nerve.

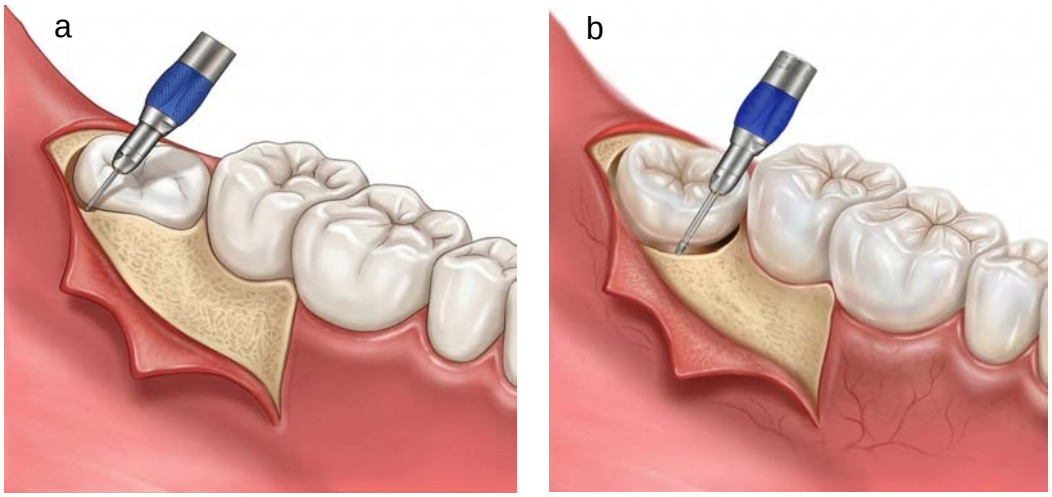

Fig. (14.1). Line diagrams showing distobuccal (a) and buccal (b) bone guttering.

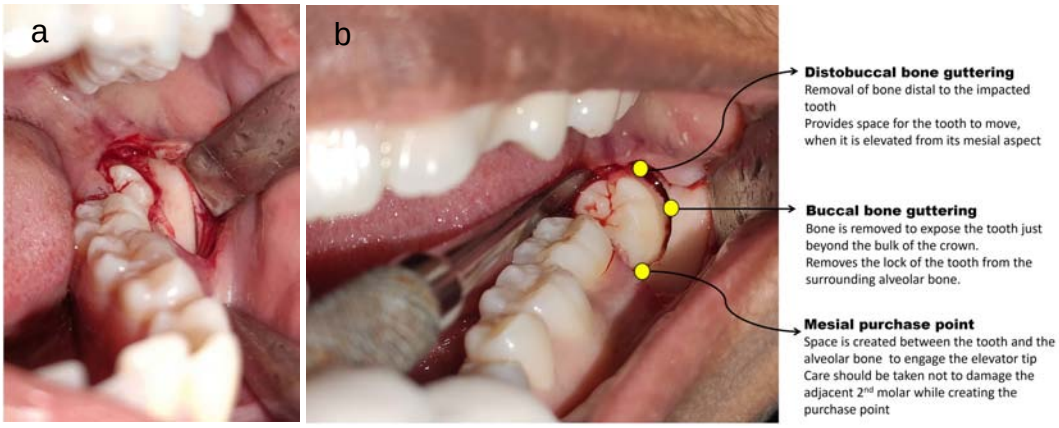

Fig. (14.2). Removal of bone by the Moore and Gillbe's collar technique. Intraoperative images showing flap reflection (a) and bone guttering (b).

CHAPTER 15

Management of Impacted Mandibular Third Molar: Tooth Sectioning and Removal

Abstract: Tooth sectioning is an important step during the surgical removal of an impacted mandibular third molar. Sectioning of the tooth is indicated for a deeply impacted tooth to limit the amount of bone removal. It is also done to reduce the force of luxation and potential damage to adjacent vital structures. This chapter elucidates various methods of tooth sectioning for different types of impacted teeth.

Keywords: Burr, Crown sectioning, Extraction, Impacted tooth.

INTRODUCTION

Sectioning of the impacted tooth is indicated in cases where the extraction of the tooth is not possible, only by bone removal in an acceptable quantity. Tooth sectioning reduces the need for excessive removal of bone [1]. Various advantages of tooth sectioning are enumerated in Table **1.** The following principles should be kept in mind while performing tooth sectioning:

1. The procedure should be performed under direct vision.
2. The cuts should be made so that the sectioned tooth can be extracted with the least amount of force.
3. The sectioning should not risk injury to vital structures, like the inferior alveolar neurovascular bundle or lingual nerve.
4. The second molar and its adjacent periodontal structures should not be injured.
5. The method of sectioning of teeth is variable and mainly depends on the angulation of the impacted tooth.

Radiographic Criteria for Determining the Need for Tooth Sectioning

Proper preoperative planning leads to a well-executed surgery with fewer intraoperative and postoperative problems. Complications can occur when an impacted tooth that requires sectioning for removal is attempted with only bone cutting. Radiographic evaluation of the "arc of rotation" aids in identifying whether the impacted third molar is locked against the second molar and requires

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sectioning for removal. The following steps are involved in assessing the arch of rotation:

Table 1. Advantages of tooth sectioning.

a. The bone cutting is considerably reduced, if not completely eliminated. This reduces the postoperative pain, swelling, and discomfort.
b. It reduces the risk of injury to the adjacent tooth since no attempt is made to aggressively elevate the impacted tooth against the convexity of the second molar, which would ordinarily tend to elevate the second molar out of its socket.
c. The risk of fracture of the jaw is minimised, as most fractures occur due to the application of excessive force during elevation.
d. When the impacted tooth is in close relationship with the inferior alveolar nerve, heavy force transmitted to the root apex of the tooth during its elevation can cause damage to the nerve. Tooth sectioning minimises the risk of nerve injury.

- On an IOPA or OPG, a line is drawn from the mesial cusp tip to the apex of the distal root of the impacted mandibular third molar. This distance is measured.
- Using this distance as the radius, an arc is drawn with the tip of the distal root of the third molar as its centre.
- If this arc touches any portion of the adjacent second molar, then it signifies that the third molar is locked against the second molar, and *vice versa* (Fig. **15.1**).
- When the impacted tooth is locked against the adjacent second molar, tooth sectioning is recommended.

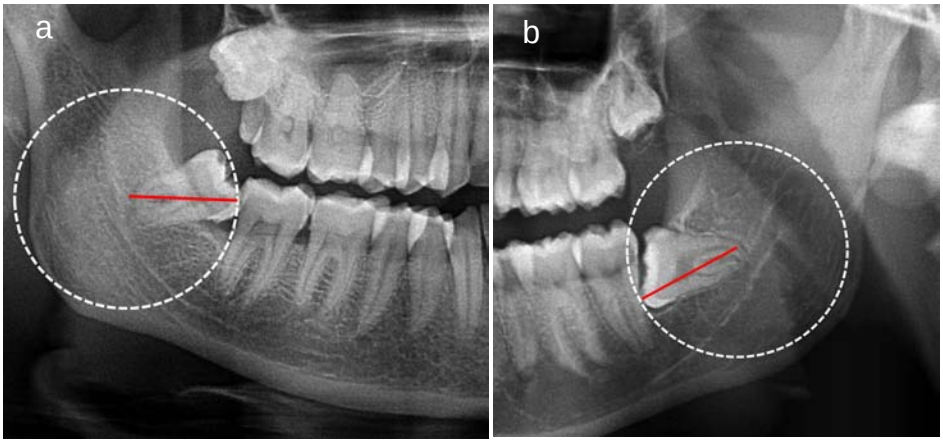
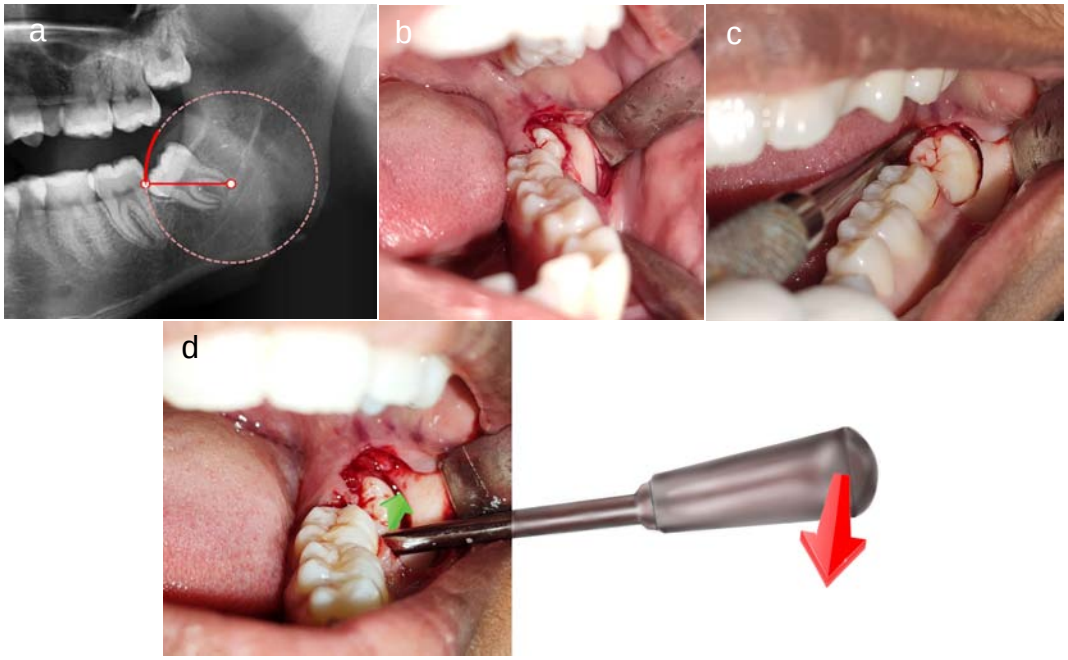


Fig. (15.1). An orthopantomogram shows a mesioangular impaction of the lower right third molar. The distal root apex and mesial cusp tip of the impacted tooth are joined together to form the radius, shown by the red line. The exclusion of the adjacent second molar from the rotation's arc makes tooth sectioning unnecessary (a). The left lower third molar demonstrates interaction of the second molar with the arc of rotation. This indicates that the impacted tooth requires sectioning (b).

TOOTH SECTIONING FOR MESIOANGULAR IMPACTIONS

In mesioangularly impacted mandibular third molars, the tooth may be either locked or unlocked against the distal surface of the adjacent second molar's crown. A pre-operative radiograph (OPG or IOPA with appropriate angulation) can indicate whether the impacted tooth may be removed through elevation without excessive force and potential harm to the second molar. Sectioning of the impacted tooth is advised if the assessment of the arc of rotation indicates a lock, and conversely (Fig. **15.2**). Sectioning of the impacted tooth is also recommended when the neighbouring second molar is compromised by:

- Root canal treatment with a crown/dental prosthesis (Fig. **15.3**)
- Short and/or fused roots
- Single root
- Weak periodontal support



(Fig. 15.2) contd.....

CHAPTER 16

Surgical Removal of Impacted Mandibular Third Molar: Wound Debridement and Closure

Abstract: The management of the surgical site after removal of the impacted mandibular third molar involves debridement of the socket, achieving adequate hemostasis, and closure of the soft tissue flap. This chapter discusses these three steps in detail, with emphasis on armamentarium, techniques, and clinical tips.

Keywords: Bleeding socket, Curettage, Suturing.

INTRODUCTION

Once the impacted third molar is surgically removed, the surgical site, including the extraction socket, should be carefully examined. The subsequent sequential steps involved include the following:

1. Wound debridement
2. Haemostasis
3. Closure (suturing)

WOUND DEBRIDEMENT

The following guidelines need to be followed for wound debridement:

1. Any loose bone, tooth fragment, or root when present must be identified and removed by holding it with a fine instrument, like a tweezer/plier, Adson's forceps, or artery forceps (Fig. **16.1**).
2. Special care should be given when a carious, partially impacted tooth is removed. The carious crown structure readily chips off during its removal (Fig. **16.2**). The surgical site should be thoroughly inspected, and tooth fragments, when present, must be removed.
3. The area immediately distal to the erupted second molar is difficult to directly visualize and should be carefully inspected for any retained tooth fragment.

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4. Irregular bone margins or sharp bone spicules are removed with a bone nibbler/rongeur and bone file (Figs. **16.3** and **16.4**).
5. It is advisable to remove any traumatized, jagged edges of the buccal cortical bone at the external oblique ridge that has been used as a fulcrum. The bone is smoothed off with a bone file or a round surgical bur mounted on a moderate-speed (10,000–20,000 rpm) electric motor under copious irrigation (Fig. **16.5**).
6. Remnants of the tooth follicle, when present at the extraction socket, should be identified and removed (Fig. **16.6**).
7. If there is any doubt regarding tooth particles, bone spicules, or foreign bodies (*e.g.*, bur tips) remaining in the socket, an intraoral radiograph should be taken to rule out their presence. If the bur breaks during bone cutting or tooth sectioning, the bur tip should be identified and retrieved (Fig. **16.7**).
8. Any inadvertent trauma to the distal surface of the crown or root of the second molar should be checked before the site is sutured.
9. Thorough irrigation with a concentrated betadine solution, followed by isotonic saline, is done to remove fine particles of bone and tooth created during bone cutting and tooth sectioning. These usually tend to accumulate at the buccal pouch of the mucoperiosteal flap (Fig. **16.8**).
10. In the case of partial impactions where the portion of the crown is visible in the oral cavity, the edges of the gingiva that approximate the crown of the tooth should be de-epithelialized to facilitate healing by primary intention (Fig. **16.9**).
11. Management of dead space:
    Dead space is an area that remains devoid of tissue after the closure of the wound. A dead space is created as a result of the removal of an impacted tooth. As this space gets filled with blood intraoperatively and inflammatory exudate in the postoperative period, it increases the likelihood of hematoma and infection. To prevent the formation of dead space, various authors have advised packing the socket with different materials, including platelet concentrate, collagen plug, bone graft, and hemostatic absorbable surgical gelatin sponge. A rubber drain is also used to reduce the risk of accumulation of inflammatory exudate, thereby reducing the postoperative sequelae of pain, swelling, and trismus (Fig. **16.10**).

Fig. (16.1). A tweezer (a) or long-handled tissue-holding forceps (b) can be used to grasp and remove any loose bone, root tip, or tooth fragment after extraction of the impacted tooth. The curved working tip of the tweezer allows better access to the depth of the socket, while long-handled tissue-holding forceps are well-suited to access the posterior part of the oral cavity. Curved artery forceps (c) can be used to hold and remove a larger bone/root/tooth piece.

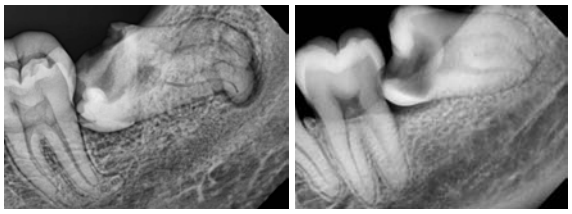

Fig. (16.2). The intraoral radiographs show a carious impacted tooth. During its sectioning and luxation, it is likely to be fragmented. Before suturing, the surgical site should be carefully inspected to identify and remove any tooth fragments.

CHAPTER 17

Post-Operative Care and Pharmacological Agents

Abstract: Following the surgical extraction of an impacted lower third molar, healing must proceed uneventfully when proper postoperative instructions are followed. This chapter provides detailed information about commonly prescribed drugs, including dose, mechanism of action, and alternatives. The chapter's final section addresses suture removal following healing.

Keywords: Antibiotics, Analgesics, Suture removal.

INTRODUCTION

The patient's care does not stop with the completion of the surgery. Good after care and compliance with postoperative instructions are essential to prevent severe postoperative sequelae and complications. It is necessary to ensure that the patient makes a satisfactory recovery with minimum discomfort, and the objective behind post-operative care is to expedite healing and relieve pain and swelling. The factors highlighted below need to be considered in the patient's postoperative care.

Intraoral Pressure-Pack

The patient is instructed to apply firm pressure on a gauze pack positioned at the extraction site for 30 to 45 minutes. This aids in controlling bleeding at the surgical site and permits time for the clot to stabilize. Should oral bleeding occur following the removal of the pack, a new pack must be used until the bleeding ceases. If bleeding persists, the patient should promptly contact the dentist's office. The patient is instructed to refrain from spitting during the recovery period to avoid dislodging the clot.

Rest

Adequate rest following surgery is important. When the procedure is performed under local anaesthesia, an ambulatory patient accompanied by a bystander should be directed to go home and rest. The patient is advised to avoid talking frequently

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and should lie down with their head elevated on a pillow. Intermittent ice-pack application externally over the site of surgery is advised for the next 24-48 hours.

Diet

Liquid and soft diets should be taken on the first day following surgery. Hot food and beverages must be avoided. The use of a straw should be discouraged, as the sucking action can create negative pressure, leading to clot dislodgement. Certain operators also advise avoiding carbonated beverages. In cases of unilateral extraction, the patient should be asked to chew from the opposite side to prevent discomfort and food lodgement. The patient should start eating only after the effect of the local anaesthesia wears off. In bilateral cases, only a liquid diet should be advised for the next 24 hours. Fluids should be taken in greater amounts to prevent dehydration from limited food intake. A normal and healthy diet facilitates healing and should be resumed as soon as possible.

Smoking

Cigarette smoking should be avoided after extraction as it increases the incidence of alveolar osteitis. Although the precise time for ceasing smoking after extraction has not been established, it is recommended that smoking should be discontinued for at least 3-5 days post-operatively.

Oral Hygiene

Maintenance of oral hygiene should not be neglected. Brushing should be done as usual, except for the surgical site at the posterior part of the oral cavity. Warm saline rinses (half a teaspoon of salt in a glass of lukewarm water) should be advised from the next day of surgery. Alternatively, the patient can use an antiseptic mouthwash. This approach helps maintain cleanliness at the surgical site and prevents the sutures from wicking food particles into the wound. Hydrogen peroxide rinses should be avoided as they dislodge the blood clot and can cause tissue irritation.

Heat and Cold Therapy

The application of external cold therapy over the operated site reduces post-operative swelling. When ice is applied, vasoconstriction occurs, which stops blood and fluid from leaking into the tissue spaces. However, prolonged use of cold therapy leads to compensatory vasodilation and thus makes its original purpose meaningless.

Once the swelling has reached its maximum size, *i.e*., after 24 to 48 hours, cold therapy application is no longer effective. Local application of heat in the form of

moist compresses or hot isotonic saline gargles is effective. This causes vasodilation, which boosts circulation and speeds up the removal of waste products from tissue breakdown. It also makes it easier for protective cells and antibodies to get to the area of surgery, thus promoting healing.

Extra-Oral Pressure Dressing

Extra-oral pressure dressings are useful in limiting post-operative swelling. It is preferable to apply pressure dressing with Dynaplast or Elastoplast in the angle region for 24 to 48 hours postoperatively in cases of removal of a deeply impacted lower third molar. Besides the various modalities of postoperative management of swelling, an operator must always remember that intraoperative adherence to sound surgical principles goes a long way in minimizing the postoperative sequelae and improving postoperative quality of life.

Intraoperative Measures for the Control of Postoperative Swelling

- As the common saying goes, "Respect the tissue, and the tissue will respect you." Gentle handling of the tissues is the single most significant factor for non-eventful and efficient wound healing.
- Excessive pulling or crushing of the soft tissue should be avoided as it can lead to delayed healing, pain, wound dehiscence, and tissue necrosis.
- Careful retraction with judicious force is essential to avoid tearing of the flap and inflicting trauma to the surrounding vital structures.
- Extreme temperatures or excessive heat generation must be avoided during bone cutting by copious irrigation with 0.9% (isotonic) normal saline; however, in the case of failure, the surrounding healthy bone might get necrosed.
- Excessive bone cutting beyond what is required must be avoided. Tooth-sectioning must be done when indicated to reduce the need for excess bone removal.
- The use of electrocautery and any chemical agents should be kept to a minimum.
- The selection of proper instrumentation is also a key factor in causing minimal trauma and satisfactory wound healing.

Prevention or reduction of swelling to a minimum after the surgery adds to the comfort of the patient. The degree of swelling that arises post-surgery is directly proportional to the degree of surgical trauma.

MEDICATION (PHARMACOLOGICAL AGENTS USED)

Various pharmacological agents are prescribed perioperatively during third molar surgery. These drugs are mainly used to minimize the postoperative sequelae and promote uneventful wound healing. These agents are summarized in Table **1**.

CHAPTER 18

Prophylactic Removal of Impacted Mandibular Third Molar

Abstract: Prophylactic removal of an impacted lower third molar involves early removal of the impacted tooth to circumvent possible complications associated with it, like caries, pericoronitis, cysts, etc. Although it is commonly practiced, the necessity of the procedure has been challenged recently. This chapter discusses the ideal timing, method, benefits, and limitations of prophylactic removal of an impacted lower third molar.

Keywords: Early removal of impacted lower third molar, Germectomy, Inferior alveolar canal.

INTRODUCTION

Prophylactic removal of an asymptomatic, impacted mandibular third molar is defined as the surgical removal of the tooth in the absence of any local disease or symptom. Although it is a commonly practiced procedure by many dental surgeons across the globe, the necessity of the procedure is debated.

FACTORS IN FAVOUR OF PROPHYLACTIC REMOVAL

Pericoronitis, dental caries involving the third and/or second molars, periodontal defects distal to the second molar, tooth-root resorption, periapical infection, space infection/abscess, crowding of the lower incisors, and odontogenic cysts/tumors are all potential consequences of an impacted tooth [1]. In the event of a traumatic injury, the risk of an angle fracture is also elevated by the presence of an impacted tooth [2]. Prophylactic removal of impacted third molars is recommended for athletes who participate in contact sports, such as rugby and football, to mitigate the risk of mandibular angle fractures [3].

The number of intraoperative and postoperative complications associated with third molar surgery decreases when the tooth is asymptomatic. The surgical morbidity is further exacerbated by age. Many authors recommend extraction as soon as it is evident that the impacted lower third molar is in an unfavourable position or that there is a lack of space for a proper eruption.

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Ideal Timing for the Prophylactic Removal of an Impacted Lower Third Molar

The best time to prophylactically remove an impacted mandibular third molar is between the late teens and early twenties (Table **1**). It is advised to remove the impacted tooth when the root is half to two-thirds formed (Fig. **18.1**). This is due to the following reasons:

1. If the extraction of an impacted molar is attempted when the roots are not formed, the crown tends to rotate inside its bone crypt during its elevation, making its removal difficult. Surgical removal of the impacted tooth at an early age is also challenging, as the patient tends to be uncooperative under local anaesthesia.
2. Similarly, when the roots are completely formed, the chances of developmental deformities, like dilaceration and the subsequent risk of root fracture, increase. Additionally, the risk for inferior alveolar nerve injury is low if the tooth is removed when the root apex is not completely formed. As the root formation completes, the impacted tooth tends to get closer to the inferior alveolar canal (Fig. **18.2**).

Table 1. Reasons in favour of early removal of impacted third molars.

▪ At a young age, patients are less likely to be systemically compromised.
▪ In young patients, the bone is more elastic and the tooth is less brittle, making the surgical removal easy. This also reduces the risk of postoperative complications.
▪ The proximity of the root tip to the mandibular canal increases (increased risk of inferior alveolar nerve paraesthesia) when the root formation becomes complete.
▪ There is an increased chance of abnormal root morphology (*e.g.*, curved apex, dilaceration) on completion of root formation.

Fig. (18.1). An orthopantomogram shows an impacted mandibular third molar, with two-thirds of the tooth roots having formed. It is important to note that continued development of tooth roots is likely to lead to divergent roots and a closer proximity to the mandibular canal.

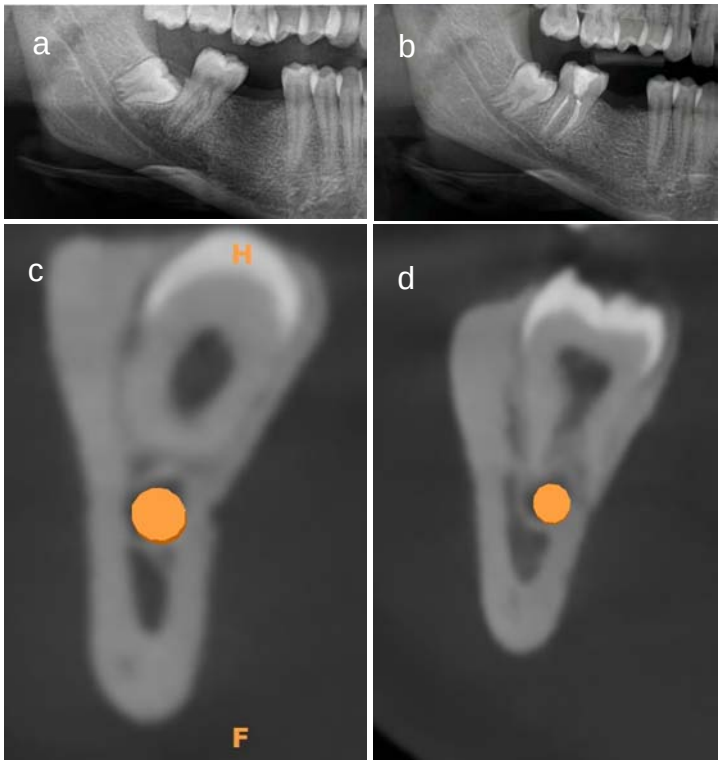

Fig. (18.2). Orthopantomogram images depict an impacted mandibular lower third molar with incomplete (a) and complete root formation (b). Coronal sections of the CBCT images reveal a lack of contact between the canal and the tooth root during the initial phase of tooth development (c), but the roots are in close proximity to the canal following root formation (d).

The formation of the crown of the lower third molar is complete by 14–15 years of age, while the root formation is complete by 19–20 years of age. Chiapasco *et al*. suggested waiting till 17–24 years of age for prophylactic removal of the lower third molar, whereas Haddad *et al*. proposed a narrow age range of 18–20 years [4, 5].

Procedure of Prophylactic Removal of a Completely Impacted Mandibular Third Molar

Prophylactic odontectomy is indicated when there is a lack of space for the eruption of the third molar and when there is a risk of damage to the adjacent second molar due to its eruptive forces. The best time for performing prophylactic odontectomy is when the roots are half to two-thirds formed. If odontectomy is done early, when only the crown is developed (germectomy), the tooth rolls

CHAPTER 19

Complications of Mandibular Third Molar Surgery

Abstract: This chapter classifies and discusses various complications that can occur during and following mandibular third molar surgery. The presenting features and methods of prevention and management are presented in detail.

Keywords: Bleeding, Dry socket, Paresthesia, Syncope, Trismus.

INTRODUCTION

The patient views a surgeon's ability to alleviate their pain, agony, and suffering as a success. For an OT assistant, a successful surgeon is one who completes the surgery faster. However, according to another surgeon, a surgeon is effective when he or she is able to successfully manage all of the complications that can arise due to the surgery.

In any surgery, be it minor or major, complications are inevitable. However, it is in the best hands that the complications can be minimized, if not totally avoided. In order to manage all the associated complications that arise with the risk of mandibular third molar surgery, the operator should first have better knowledge regarding the issue.

The complications associated with the removal of the impacted mandibular third molar can be broadly categorized into preoperative, intraoperative, and postoperative complications. They can also be classified as local or systemic complications depending upon the site or region of occurrence.

PRE-OPERATIVE COMPLICATIONS

These are the complications that arise prior to the surgical procedure. The most common preoperative complication before any minor oral surgery, in general, and impacted mandibular third molar surgery, in particular, is syncope.

VASODEPRESSOR SYNCOPE

Common fainting, also known as vasovagal syncope, is a self-limiting but potentially fatal condition that should be properly recognized and treated. Fear,

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worry, emotional stress, and the sight of a needle or syringe for local anesthesia are the predisposing factors for syncope in a patient before surgery. These conditions cause the fight-or-flight response to develop, which causes peripheral blood to pool and the central blood flow to fall below levels necessary for sustaining consciousness. As a result, hypoxia occurs, which results in cerebral ischemia and convulsions. The incidence of syncope in patients undergoing mandibular third molar surgery is about 2% [1].

How to Manage?

Prior to syncope, the patient gets pre-syncopal signs and symptoms. When detected early by the operator, it prevents the patient from entering a syncope stage, where voluntary muscle function is lost. The early presyncopal signs and symptoms are as follows:

- Feeling of warmth
- Loss of colour or paleness of skin
- Dizziness
- Heavy perspiration (diaphoresis)
- Nausea
- Blood pressure at or slightly below baseline
- Tachycardia

If any of these signs or symptoms are noticed, then the following actions should be immediately taken:

- Shift the patient to a supine position so as to gain adequate blood flow to the brain, which overcomes the cerebral hypoxia.
- Ask the patient to voluntarily move his/her legs, which prevents the peripheral pooling of blood.
- The operator should talk to the patient to make him feel comfortable so as to lower their anxiety level.

If the patient goes into syncope and loses consciousness, then the following steps should be taken:

1. **Position:** The patient should be shifted into a supine position with the head level at the level of the chest and feet slightly at a higher level (Fig. **19.1**).
2. **C-A-B:** Circulation, airway, and breathing should be assessed immediately, and basic life support should be initiated if required.
3. **Definitive care:** Oxygen should be administered through the use of a face mask or nasal prong. Vitals and oxygen saturation levels should be monitored.

Airway patency should be increased by head-tilt and chin-lift manoeuvres. The medical emergency system should also be activated. Once the patient is stable, he/she should be monitored for the next few hours. In the case of repeated or deep syncope, and once the patient recovers, the surgery should be postponed to the next sitting.

Fig. (19.1). Position of a patient on a dental chair during syncope.

INTRA-OPERATIVE COMPLICATIONS

These are the complications that arise during the operative procedure. These may be either due to the local anaesthesia or the surgical procedure. Various intraoperative complications are listed in Table **1**.

Table 1. Intra-operative complications during lower third molar surgery.

Due to the Anaesthetic Solution	Due to the Insertion of the Needle	Due to the Surgical Procedure
1. Toxicity 2. Allergy 3. Anaphylactoid reactions 4. Idiosyncrasy 5. Infections caused by contaminated solution or tissue reactions caused by the anaesthetic solution	1. Syncope (common faint) 2. Pain or hyperalgesia 3. Trismus 4. Oedema 5. Infection 6. Broken needles 7. Prolonged anesthesia 8. Hematoma 9. Sloughing 10. Bizarre neurological symptoms	1. Fracture of the root/tooth 2. Nerve injury (lingual/inferior alveolar nerve) 3. Haemorrhage 4. Injury to the lip commissures 5. Extraction of the wrong tooth 6. Herniation of the buccal fat pad 7. Gingival and mucosal lacerations 8. TM joint trauma 9. Breakage of instruments 10. Displacement of the third molar 11. Fracture of the alveolar bone 12. Fracture of the mandible 13. Subcutaneous emphysema 14. Injury to the second molar

CHAPTER 20

Advances in Mandibular Third Molar Surgery

Abstract: Numerous advancements have occurred in the fields of surgery and medicine over time. Recent advancements in impacted mandibular third molar surgery should be incorporated into standard clinical practice to enhance patient care and lower intraoperative difficulties and problems. For the benefit of readers, these advancements are explained in the current chapter with the use of clinical examples and illustrations.

Keywords: Coronectomy, Endoscopy, Laser, Piezosurgery, Platelet concentrate, Tooth transplantation.

INTRODUCTION

Over the years, there have been many advances in imaging and various treatment modalities for the surgical removal of impacted mandibular third molars. This chapter describes the recent advances in third molar surgery.

INWARD FRAGMENTATION TECHNIQUE (ENDOSCOPE-ASSISTED THIRD MOLAR SURGERY)

Endoscopy-guided, minimally invasive surgery is gradually replacing the conventional open surgery approach in all fields of surgical practice, and oral surgery is not an exception. The conventional third molar surgery involves the reflection of a full-thickness buccal mucoperiosteal flap, followed by bone removal from the distobuccal aspect of the impacted tooth. The flap reflection and bone removal are done to create the space for mobilization and delivery of the impacted tooth in an outward and buccal direction. Soft tissue reflection, along with bone removal, is associated with increased postoperative sequelae of pain, swelling, and trismus. It also increases the risk of postoperative complications, including alveolar bone loss, periodontal defects distal to the second molar, and nerve damage. Inward Fragmentation Technique (IFT) is a bone-sparing technique for impacted tooth removal, as reported by Engelke W. *et al*. in 2014 [1]. The technique involves endoscopically assisted visualization of the impacted tooth through an occlusal mini-flap raised in the region of the impacted tooth. The specialized endoscopic technique used is termed Support Immersion Endoscopy (SIE), which allows visualization of the surgical field contaminated with blood,

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for *e.g*., extraction socket, periodontal defect, and impacted third molar removal (Fig. **20.1**). Table **1** provides a description of SIE.

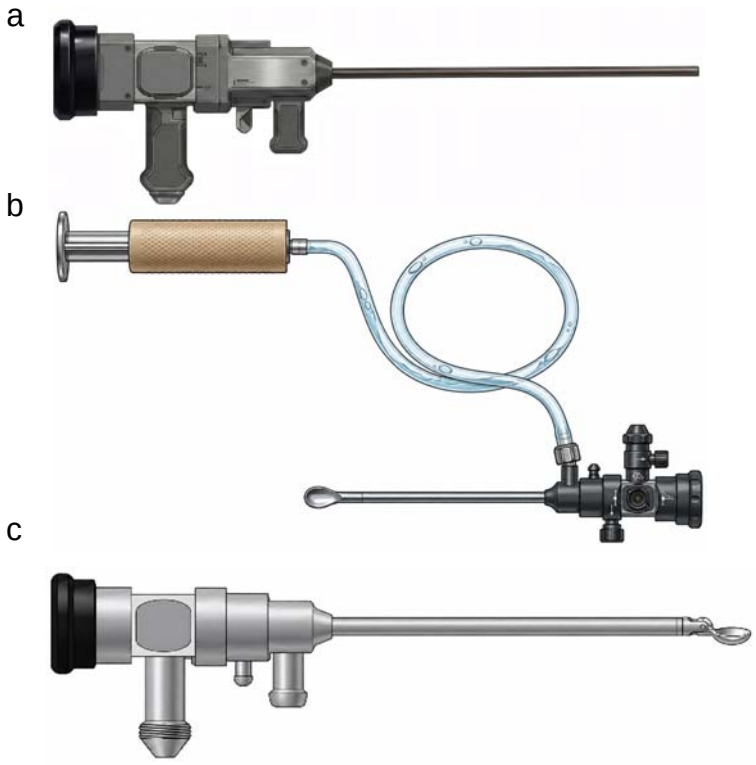

Fig. (20.1). Line diagrams showing the structure of a simple endoscope (a). An immersion endoscope has an irrigation system to remove saliva, blood, and debris, thus providing clear vision at the surgical site (b). A spoon-shaped support at the working end of the endoscope helps to rest the instrument and keep it steady (c).

Table 1. Endoscopy in oral surgery.

Endoscope-assisted surgery is presently being used in various areas of maxillofacial surgery, including traumatology and orthognathic surgery. The application of this technique in intraoral dentoalveolar surgery is very novel and necessitates specialized instruments. Endoscopes utilized for dental procedures must possess a small size (1.9 to 2.7 mm) and incorporate an internal irrigation system. This enables the physician to enhance visibility by eliminating loose debris and persistent bleeding from the oral tissues. A direct or simple endoscope is composed of a rigid rod that is mounted with a lens (Fig. **20.1a**). A visualization screen is attached to the endoscope. A continuous irrigation system is necessary to remove the blood and debris from the surgical site in the dentoalveolar region, thereby facilitating visualization. There is an additional irrigation system in an immersion endoscope. This enables the continuous or intermittent cleansing of the distal end of the endoscope lens, thereby enabling the visualization of the surgical site in a clean manner (Fig. **20.1b**). A small spoon-shaped metal flange is also present at the functional end of the endoscope's rod. The flange rests on the underlying bone at the surgical site. This serves to stabilize and support the endoscope during operation (Fig. **20.1c**). This endoscope system, having an irrigation system and support rest, is popularly called the Support Immersion Endoscope (SIE).

The inward fragmentation technique is based on the engineering concept of 'controlled collapse'. The principle is utilized to demolish large buildings or structures by creating sufficient space within their centers. The building is brought down by calculated forces so that all the debris falls within the center space. As the building does not collapse in an outward direction, there is no damage to the adjacent structures. Similarly, in IFT, the crown structure of the impacted tooth is hollowed in the center (reaching to the pulp chamber and furcation area) by using bone cutting burs, followed by collapsing the remaining crown towards the center. All these processes are performed under endoscopic visualization. Once the crown fragments are removed, the roots are visualized and removed using fine elevators. The steps in IFT for the surgical removal of impacted mandibular third molar teeth are enumerated below.

Steps Involved in the Inward Fragmentation Technique

1. **Anaesthesia:** The procedure is usually carried out under local anesthesia. The line diagrams in Figs. (**20.2a** and **20.2b**) demonstrate the use of the technique for the removal of a vertically impacted lower third molar.
2. **Incision:** In the retromolar region, a small incision is made occlusally over the impacted molar. The incision is initiated at the distobuccal line angle of the second molar and extends posteriorly for a few millimeters to the crest of the ridge (for a completely impacted molar) or around a partially erupted third molar, ultimately reaching the retromolar region (Fig. **20.2c**). An occlusal mini-flap is subsequently raised. The tip of the endoscope is placed at the distal ledge of bone to visualize the exposed occlusal aspect after flap reflection (Fig. **20.2d**).
3. **Bone removal:** The flap is gently retracted, and the bone overlying the occlusal table of the impacted molar is removed (Fig. **20.2e**). This method, unlike conventional third molar surgery, does not require buccal and distal bone guttering.
4. **Odontosection:** At this stage, the support immersion endoscope is used. The spatula-shaped support tip is rested on the bone ledge at the distal aspect of the surgical field. The spatula also helps to keep the mini flap retracted on the buccal aspect. Under endoscopic vision, the tooth structure is removed using a combination of straight and round Lindemann burs (Fig. **20.2f**). Tooth removal should be done carefully under direct endoscopic vision in critical zones, for *e.g*., close to the lingual plate and alveolar canal, using a diamond burr or piezo surgery tip. A rose-head burr can be used in less critical areas, for *e.g*., the buccal region. The removal of tooth structure is continued toward the furcation for a vertically impacted tooth and between the crown and roots for a horizontally impacted tooth.

CHAPTER 21

Medico-Legal Considerations in Third Molar Surgery

Abstract: With an increase in patient awareness, medicolegal challenges associated with lower third molars have seen a significant rise. An operator must not only adhere to the protocol of the surgical procedure, but also document the event in case of any possible complication. The major cause of the medicolegal issue, the role of informed consent, and the importance of case documentation are highlighted in this chapter.

Keywords: Case documentation, Complications, Informed consent.

INTRODUCTION

The anatomical and surgical challenges involved in working in the most posterior part of the oral cavity and the location of the impacted tooth in close proximity to various vital structures, mainly the inferior alveolar neurovascular bundle and lingual nerve, increase the associated risk of intra- and postoperative complications. It is not surprising that undesirable results sometimes can occur, even under ideal conditions and surgical execution. As the risk of complications increases, so does the possibility of a lawsuit arising from it. The chances of a legal complaint increase when:

- An asymptomatic third molar that is prophylactically removed results in complications postoperatively.
- There is a lack of proper patient counselling before the surgery, and the patient is not appropriately made aware of the potential benefits and the risks of the procedure.
- There is a failure to obtain an informed written consent about the same.
- An untoward incidence develops subsequent to surgery, which is regarded as a significant deviation from the normal.
- The patient is persuaded by someone that an injury occurred due to medical malpractice resulting from the doctor’s negligence.

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COMMON CAUSES OF MEDICO-LEGAL ISSUES

Nerve damage is the most common cause of litigation after third molar surgery. According to a malpractice insurer that provides coverage for the maximum number of oral and maxillofacial surgeons in the United States, almost 30% of the lawsuits arise with grievances of either nerve damage or the extraction of the wrong tooth [1]. The other causes include infection, injury to adjacent sites, TMJ pain, and retained foreign bodies.

The location of both the inferior alveolar and lingual nerve is significantly close to an impacted third molar. It is especially true for a deeply impacted tooth. Most of the time, the inferior alveolar nerve is less than 2 millimetres from the impacted tooth. However, despite the close proximity, the reported risk of nerve injury is much lower. The estimated risk of paraesthesia of the inferior alveolar nerve is 0.4% to 8.4%, while that of the lingual nerve is 0.04% to 0.6% [2, 3]. An operator must take all measures to avoid this complication. The respective chapters of this book have described various preoperative measures and intraoperative safe practices for preventing nerve damage.

The second most common cause of legal complaint in third molar surgery is the removal of the wrong tooth. Occasionally, when one or more molars are missing or in an unusual position, the operator may extract the wrong tooth. It may also occur due to the incorrect documentation of the patient's chief complaint. Injury to an adjacent tooth, especially the adjacent second molar, is more likely than removal of the wrong tooth.

In addition to the surgical complications previously discussed and covered in other pertinent sections of this book, two crucial nonsurgical aspects of patient care significantly impact the medico-legal issue that arises after a third molar surgery.

1. Informed consent
2. Case documentation

Informed Consent

The Oxford dictionary’s definition of informed consent is “permission from a patient for a medical professional to carry out treatment, with a complete understanding of the possible risks and consequences.” Practically, it entails much more than the explanation of just the risks involved in a given procedure.

Historically, in the year 1767, Slater versus Baker and Stapleton was the first medico-legal case where the surgeon was held liable for managing an orthopedic

injury to the leg of a patient with a new external fixation device without informing the patient. However, until the early part of the 20th century, surgical procedures were carried out, with the surgeons making the necessary decisions related to the treatment on behalf of the patient. The concept of informed consent emerged from the pivotal judicial decision of Schloendorff v. Society of New York Hospital in 1914. The court's ruling asserted that "every human being of adult years and sound mind has a right to determine what shall be done with his own body." With time, the process of informed consent has evolved to become a standard of care in all medical and surgical practices.

While informed consent is typically documented in writing, it is not confined to it. Additional verbal communication, implication, diagrams, brochures, and videos can be used to provide necessary information. Studies have indicated that informed consent and risk disclosure in third molar surgery heighten patient anxiety and increase indecisiveness for the surgery [4]. The presentation of information through a video recording of the surgery most commonly increases patients' apprehension [5]. However, given the rise in third molar surgery-related lawsuits, standard patient care must include informed consent. All patients in the adult age group and with legal mental capacity should themselves sign the informed consent. In the case of a child and a mentally challenged individual, a parent or guardian must sign on their behalf. The document must be in the language understood by the patient. An illiterate patient must have the informed consent read to them by an independent witness who signs it. Even if the surgery is uneventful, a surgeon may find themselves in litigation if they fail to obtain appropriate informed consent from a patient prior to third molar surgery. Table **1** elaborates various components of informed consent. Table **2** enumerates various benefits and potential risks associated with the removal of the lower third molar. Fig. (**21.1**) presents a prototype of the informed consent form.

Table 1. Various components of an informed consent.

▪ It should provide information about the planned surgery, including its purpose, summary, and associated risks and benefits.
▪ It should provide other alternative options for management and their advantages and limitations.
▪ The option of no intervention or no surgery and the drawbacks and limitations must be mentioned.
▪ The choice of anaesthesia and associated risks must be mentioned.
▪ The name of the operating surgeon(s) must be provided.
▪ The need for perioperative medication and possible adverse reactions must be mentioned.
▪ The postoperative sequelae, common and rare complications, must be mentioned.
▪ The need for follow-up and its importance must be discussed.

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Nilesh Mishra

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