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Foreword

Surgery for mandibular third molars has long awaited a thorough update. This textbook titled *Transalveolar Extraction of the Mandibular Third Molars* published by the Taylor & Francis Group and CRC Press, with renowned contributors is intended for international readership. This manual is useful for education in the field of maxillofacial surgery and will find its academic place as an authoritative teaching resource. The book is edited and mentored by Professor Darpan Bhargava, Consultant in Oral and Maxillofacial Surgery, who is a renowned academician in the field. This book has received its prologue from M. Anthony Pogrel, Professor, Department of Oral and Maxillofacial Surgery, University of California, San Francisco.

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Preface

Let us start this journey to the *Transalveolar Extraction of the Mandibular Third Molars* by thanking the Almighty, the supreme power, that keeps us driving to the limits we ourselves don't realize.

त्वं ज्ञानमयो विज्ञानमयोऽसि

You are wisdom and knowledge personified

It was the need of the hour to compile the updated basics on the topic. As I was a student of Oral and Maxillofacial Surgery, it was necessary to refer to extensive literature from various sources to master the art and science of the *Transalveolar Extraction of the Mandibular Third Molars*. Pioneers such as Charles Edmund Kells, George Winter, Kurt Thoma, William Kelsey Fry, Wilfred Fish, Warwick James, Ward, Gustav Kruger, William Harry Archer, Geoffrey L. Howe, A. J. MacGregor and many others have laid a very strong foundation for the exodontia practice. The responsibility lies on our shoulders to take this science forward.

In a race to learn fascinating advanced surgical skills that involve craniofacial surgery, head and neck surgery, temporomandibular joint-related surgeries and microvascular surgery, the importance of the basics in oral surgery is usually underestimated. "Good" exodontia is the "backbone" of dentistry and it is the life and soul of oral and maxillofacial surgical practice. To knock off someone's tooth and still receiving a compliment of doing a "great job" is the best and satisfying experience. Understanding the importance of learning and executing a refined minor oral surgery practice is a matter of prolonged experience and is usually understood very late by the current generation of oral and maxillofacial surgeons. The art and science of *Transalveolar Extraction of the Mandibular Third Molars* not only involves executing the surgical procedure in the limitations of the oral cavity in a less accessible area of the posterior mandible but also, the understanding of right indications and managing the complications, when they arise.

I hope this compilation is a reader's delight to understand and master the art and science of the *Transalveolar Extraction of the Mandibular Third Molars* and also, provides a single point reference.

My piece of advice to a learner or student of maxillofacial surgery is that:

> In the practice of maxillofacial surgery, only reading a book hardly helps. Reading a book, applying it to your surgical practice under the guidance and supervision of an experienced wise teacher is the key to refine the skills, until you are skilled enough to pass on the science to your future generation. Fundamentals and basics to any science including surgical exodontia are static, only the advances remain dynamic. If one develops a strong static base, which no one can shake, the pace of the fast-growing advanced dynamics can be easily matched.

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Acknowledgements

I would take this opportunity to express my heartfelt gratitude to my parents, Ragini Bhargava and Dr. Madan Mohan Bhargava, for all their efforts and dedication towards my making. I would not have completed this endeavour without the tireless support of my wife Dr. Preeti G. Bhargava and patience of my son Dear Darsh.

I am thankful to Ms. Shivangi Pramanik, Senior Editor for Medicine, CRC Press and Ms. Himani Dwivedi, Editorial Assistant for Medical, CRC Press and Taylor & Francis Group for their constant support for this project. In spite of their existing commitments and busy schedule, they pursued the project to make it a reality today. I am also grateful to Ms. Miranda Bromage, Publisher, Surgery and Medicine, Taylor & Francis, Oxfordshire, United Kingdom, for having confidence and belief in this work.

I would not miss the opportunity to acknowledge the efforts from Mr. Vijay Shanker P, Sr. Project Manager from codeMantra, for swiftly coordinating and organising the contents of this book.

About the Book

TRANSALVEOLAR EXTRACTION OF THE MANDIBULAR THIRD MOLARS

Impacted tooth is completely or partially unerupted and is positioned against another tooth, bone or soft tissue so that its further eruption is unlikely, described according to its anatomic position. There are several different radiological evaluation protocols that can be used prior to transalveolar extraction of the mandibular third molars. Conventional intraoral radiography provides surgeons with an overview of the basic information at the surgical site without detailed three-dimensional spatial relationship of the anatomic structures. The incorporation of the cone-beam computer tomography remains new to the field considering acquisition is simple with clinically acceptable exposure to radiation for complicated cases. The manual describes practically oriented details regarding the clinical and radiographic evaluation, classification, principles of suturing and flaps, intricacies of the transalveolar surgery, newer advances for mandibular third molar surgery and complications that may be encountered while mandibular third molar surgical exodontia. The manual presents the vital surgical techniques for the mandibular third molar exodontia in a concise and to-the-point manner. This compilation will be a delight to the students of dentistry and maxillofacial surgery considering that it will have an amalgamation of information from various resources of repute at a single terminus. The text will serve as a ready reckoner and clinical notes for undergraduate and postgraduate maxillofacial surgery education.

UNIQUE ABOUT THIS MANUAL

1. Based on available historic oral and maxillofacial surgical literature
2. Short and concise
3. Compilation for undergraduate and postgraduate education as a manual with practical notes
4. Amalgamation of information from various resources of repute in a single compilation
5. Based on exam-oriented approach co-centred on clinical principles and practice

Association of Oral and Maxillofacial Surgeons of India (AOMSI)

PRESIDENTIAL MESSAGE

It is a pleasure to recommend the manual titled *Transalveolar Extraction of the Mandibular Third Molars* dedicated to the international community of oral and maxillofacial surgeons published by the Taylor & Francis Group and CRC Press. This compilation edited by Professor Darpan Bhargava would provide a comprehensive academic teaching and learning material. The text has received contributions in the form of 18 sections from 26 renowned international clinical and surgical specialists in the field adding to the excellence in the academic content. I wish and hope this compilation serves as an important and vital surgical learning tool in the field of maxillofacial surgery.

Jai Hind
Yours Faithfully,

Professor Manjunath Rai BDS, MDS, MOSRCS(Edinburgh), LLB, PGDMLE
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Professor Bhargava completed his bachelor's in dental surgery and master's in oral and maxillofacial surgery from Meenakshi Ammal Dental College and Hospital, Chennai, India. He is a distinction holder and gold medallist from The Tamil Nadu Dr. MGR Medical University (Undergraduation) and Meenakshi Academy of Higher Education, Chennai (Postgraduation). He has also successfully completed Diploma of Membership in Oral and Maxillofacial Surgery from Royal College of Physicians and Surgeons, Glasgow. He holds postgraduate diploma in Hospital Management and Clinical Research. He is credited with introduction of twin-mix nerve block for mandibular anaesthesia. Currently, he is serving as a professor and clinical consultant in the Department of Oral and Maxillofacial Surgery at People's University, Bhopal, Madhya Pradesh, India. He is the founding director of TMJ Consultancy Services, Bhopal, Madhya Pradesh, India. He has more than 100 national and international scientific publications to his credit. He holds first-ever Indian patent for temporomandibular joint prosthesis. He is awarded PhD from Meenakshi University, Chennai for his acclaimed research on "Predictability and Feasibility of Total Alloplastic Temporomandibular Joint Reconstruction Using DARSN TM Joint Prosthesis for Patients in Indian subcontinent". He is the author of the authoritative book *Temporomandibular Joint Disorders: Principles and Current Practice*, published by Springer Nature, Singapore.

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1

Prologue to "Transalveolar extraction of the mandibular third molars"

M. ANTHONY POGREL

It gives me the greatest pleasure to write this prologue for this volume entitled *Transalveolar Extraction of the Mandibular Third Molars*.

Problems associated with third molars are one of the most common issues that confront oral and maxillofacial surgeons. In much of the world, it appears that issues related to third molars account for approximately 60% of the business of many oral and maxillofacial surgeons and sometimes over 65% of income. It is therefore a subject of great importance. It does appear that the occurrences of wisdom tooth problems, particularly impactions, have increased considerably over the last 50 years, and there would appear to be a number of reasons for this.

1. There is some evidence that the human jaws have become smaller over the last 200–300 years while the teeth have stayed the same size. Since the third molars are the last teeth to erupt, they are the ones that are pushed out of the arch and become impacted. The reason for the decrease in size of the jaws is not genetic but is more to do with the equivalent of disuse atrophy as we move to a softer diet that requires less chewing, and therefore there is less muscle development and less bone development.
2. As we move to a more processed diet, requiring less chewing, and causing less abrasion, interproximal wear on the teeth is decreased, and there is less mesial drift, allowing less space for the third molars to erupt.
3. Until relatively recently, it was not uncommon for first molars to be extracted between the ages of 8 and 10 due to gross caries, and therefore, the second and third molars would drift forward. Similarly, second molars were sometimes extracted around the age of 13 or 14 and the third molars would again often drift forward and not become impacted.
4. Orthodontic treatment has moved from being carried out in combination with dental extractions to becoming non-extraction cases where the arches are expanded, widened, and proclined. This reluctance to remove any teeth again means that the last teeth to erupt, which are the third molars, are the ones that are most likely to become impacted.

When third molars need to be removed, I have watched a transition of techniques. In times when drills were expensive and unreliable, reliance was placed on the mallet and chisel and the lingual split technique was often employed, taking away a portion of the lingual plate and delivering the third molar on the lingual side.[1] This technique required less bone removal than the buccal technique and healing was generally straightforward. However, removal of bone with a mallet and chisel is less predictable than with a drill, and there is higher lingual nerve involvement, although this is often attributed to the use of a narrow lingual retractor, such as a Howarth's nasal raspatory, rather than a broader lingual retractor, such as Walter's

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retractor,[2] specifically designed for third molar removal. From the 1980s, as surgical drills became more reliable, it was suggested that third molar removal should be carried out from the buccal approach, carrying out all incisions and surgery on the buccal side of the mandible and avoiding the lingual side altogether in order to attempt to decrease the incidence of lingual nerve involvement. This is the technique largely taught today, though proponents of the lingual technique would state that providing a wide enough retractor is utilized, the incidence of permanent lingual nerve involvement is the same as with the buccal approach, though temporary involvement may be greater.

More recently, alternative techniques to conventional removal of the third molar have been suggested. These include coronectomy or intentional root retention,[3] orthodontic extrusion of the third molar,[4] and sequential removal of the impacted portion of the crown of the tooth to allow it to partially erupt.[5] All three of these techniques are proposed to decrease the problem of inferior alveolar nerve involvement when there is evidence of a close relationship between the roots of the third molar and the inferior alveolar nerve. The advent of the cone-beam computed tomography (CBCT) technique allows accurate three-dimensional imaging of the third molar and all associated structures at a relatively low price with low radiation dosage and is now widely employed.

The technique of lateral trepanation also has its advocates where third molar follicles are "scooped out" of the crypt from a lateral approach at the age of 13 or 14. One must accurately assess radiographically the exact state of teeth development in this case, and the correct choice of anaesthesia can be an issue at that age.

I hope this gives the reader some flavour of the subjects to be covered in this volume and the scope of issues related to third molars and their removal.

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2

Antiquity and introduction to the third molar or the "wisdom" tooth

BEENA SIVAKUMAR AND DARPAN BHARGAVA

Treatment of a decayed tooth dates back to prehistoric evidence in the Neolithic era (10,000–4,500 BC). The first documented tooth extraction was performed by Hippocrates with an instrument named "Plumbeum odontogagon". Aristotle was the first person to use a forceps for teeth extraction and described the forceps in detail in his book titled "Mechanics". Aulus Cornelius Celsus was the first physician who proposed the technique of gingival detachment from the bone to extract a tooth. He also explained that incomplete tooth/root removal from the socket can lead to a possible swelling in the maxilla or mandible [1].

The procedure of third molar extraction gained popularity towards the end of the 18th century. The initial techniques to remove the third molar can be traced to being developed in Germany in the 1800s. In early 1903, National Dental Association published the first official manuscript on third molar extraction. But it is Charles Edmund Kells (1856–1928) who fostered a comprehensive technique for a wisdom tooth removal. Kells in 1918 opined that clinicians should think of them as an engineer to design their extraction technique in such a way that it should be tailor-made for every individual requiring the extraction. Although there are numerous contributors to this science, a few vital ones towards various techniques and procedures to remove the third molar and various soft tissue access incisions to facilitate the tooth removal have been summarized in Table 2.1 [1,2,3,4].

ROLE OF GENETICS IN RELEVANCE TO THIRD MOLAR TOOTH

The natural history of the eruption of third molars is such that it is not possible to foresee the fate predictably among individuals. Various factors, such as adequate space between the anterior mandibular border and the distal of the mandibular second molar, are necessary to allow successful eruption of the wisdom tooth to reach the occlusal plane [1,3,4].

Third molar teeth are unique as they erupt last in the oral cavity with their eruption time ranging from 17 to 24 years, depending on the ethnographic region and race. Understanding various regulatory mechanisms of its variable development patterns is of great clinical importance in terms of decision-making regarding the timing of third molar surgical removal, autologous transplantation, orthodontic treatment planning, and chronological age estimation for medico-legal purposes. Several studies have demonstrated the role of genetics in the agenesis of lateral incisors, central incisors, or second bicuspids, but this aspect is not clearly understood in regard to the hereditary influence on third molars, which could possibly be highly different from the other teeth because of their course of unique development. This area still needs further research to obtain conclusive evidence [5].

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Table 2.1 Contributions to the art and science of exodontia

S. No.	Technique	Year	Described by
1	First documented extraction	Between 500 and 300 BC	Hippocrates – Using an instrument named plumbeum odontogagon
2	Forceps extraction	(384–322 BC)	Aristotle
3	Detaching the gingiva from bone	–	Aulus Cornelius Celsus
4	Incisions for difficult extractions	late 1700s	Walter Harris
5	Published first official manual for extraction of third molars	1903	National Dental Association
6	First to foster a comprehensive approach to third molar removal	1856–1928	Charles Edmund Kells
7	Described a more "humane" approach to removal of third molars	1918	Kells
8	Published *Principles of Exodontia as Applied to the Impacted Mandibular Third Molar* Described three flap designs for the extraction of lower third molars depending on the axial orientation of the teeth	1926	George B. Winter
9	Proposed the term odontectomy to describe the surgical removal of teeth	1932	Kurt H. Thoma
10	Split bone technique	1933	William Kelsey Fry
11	Officially published split bone technique	1956	Terrence George Ward
12	Concept of sectioning the tooth with a chisel and mallet	1957	Wilfred Fish
13	Wide flaps were to be sutured only once and with little tension	1937	Warwick James
14	Described three incisions that are widely used today for both upper and lower third molar surgery	1956	Ward
15	First to compare the use of chisel and mallet, low-speed burr, and high-speed burr	-	Harold C. Kilpatrick
16	Described an envelope flap where a distal-buccal incision is made and continued into a crevicular incision Described an approach for distally angled maxillary third molars	1959	Gustav Otto Kruger
17	Provided an in-depth description of all of the surgical approaches to the impacted lower third molar	1960	Guillermo Ries-Centeno
18	Described a flap that provided a good blood supply, vision for instrumentation and minimum trauma	1966	Alistair Berwick
19	Described numerous techniques to section impacted lower molars to facilitate extractions	1971	Lucian Szmyd
20	Published an approach for third molar that was a novelty at the time	1972	Walt W. Magnus
21	Published a minimally invasive incision	1999	Donlon and Triuta
22	Proposed comma-shaped incision	2002	Iyer Nageshwar
23	Introduction of twin-mix anaesthesia for transalveolar mandibular extractions	2013	Darpan Bhargava

CURRENT TRENDS

Some additional therapies being investigated which can be beneficial to the patient for uneventful post-operative outcomes are ozone gel, cryotherapy, platelet-rich plasma (PRP), platelet-rich fibrin (PRF), piezoelectric surgery, and lasers. Ozone gel has shown beneficial outcomes after third molar surgery, but it is not a popular choice owing to the cost factor involved and lack of evidence-based literature currently. There has been renaissance on studies related to cryotherapy or ice application causing vasoconstriction, thereby decreasing post-operative swelling. It diminishes the nerve conduction velocity producing an analgesic effect. However, its use is controversial in relation to third molar surgery. Benefits of cold fomentation or cold compress following a third molar surgical extraction are well documented and clinically demonstrated. PRP and PRF are proven to be effective in third molar surgery in terms of enhanced post-operative outcomes. Low-level laser therapy (LLLT) is a therapeutic laser evoking cellular bio-stimulation, thereby accelerating wound healing and tissue regeneration. LLLT is being studied for its effects to reduce discomfort post-operatively and promote healing following wisdom tooth extraction. Piezoelectric surgical interventions are being studied and incorporated for the transalveolar mandibular extraction surgeries with the benefit of minimal damage to the soft tissues including abating the chances of nerve damage [6,7] Recently, "Twin-Mix Anaesthesia" has been studied for surgical removal of impacted mandibular third molars [8–10].

The newer interventions and surgical modifications in terms of technique, equipment, and utilizing pharmacological or physical agents would require a more robust investigation utilizing well-designed multicentric randomized controlled trials for their endorsement for incorporation for these surgical procedures.

The future of third molar surgery is still undergoing transformation to this present day. Advancements with transoral robotic surgery (TORS) may produce a significant paradigm shift and impact on third molar surgery in the future, similar to its use in procedures such as tonsillectomies, retromolar trigone tumours, and base of tongue neoplasms.

The intention towards any surgery remains directed to reduce complications using a single or multimodal approach which includes the administration of antibiotics, analgesics, steroid-based pharmacological agents along with the execution of an appropriately planned surgical procedure. This holds true for transalveolar extractions too. Conventionally, operator considerations in pre-operative planning include flap design, judicious handling of soft and hard tissues followed by appropriate suture placement and drainage are vital aspects for a successful mandibular third molar surgery.

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3

Applied surgical anatomy for transalveolar extraction of the mandibular third molar

V. VIDYA DEVI AND DARPAN BHARGAVA

The "*mandibular third molar region*" associated with the impacted third molar is a clinico-surgically defined area incorporating the impacted tooth itself and its immediate surrounding structures that are of significance while performing a transalveolar extraction of the concerned impacted molar. In-depth understanding of the anatomy of this region is essential to implement an expedient approach for the removal of the third molar while keeping the patient morbidity low and avoiding potential complications.

The impacted third molar may be completely or partially embedded as the tooth may have coverage with only the mucosa or with the bone of the posterior mandible. Depending on its spatial position and depth of impaction, it can extend into the body of the mandible or cross the anterior border of the ramus. Also, the angulation of the third molar determines the course of its eruption which may be completely or partially covered with the overlying mucosa [1–3].

MUCOSA AND MUCOPERIOSTEUM

The mucosa over the impacted third molar region forms the superior surface overlying the tooth. The medial, lateral, and posterior surfaces can be further divided into three areas for better understanding:

a. ***Posterosuperior mucosal surface*:** A roughly quadrilateral shaped region forming a concave inclined plane from the occlusal level of the maxillary molars to the lower alveolar region and may be further divided into two triangular areas by the elevated pterygomandibular ligament as superolateral and inferomedial triangles (Figure 3.1).
   i. *Superolateral or anaesthetic triangle*, which is covered by a thin mucosal lining, characteristically bright red in colour and is the continuation of the buccal mucosa. The shape of this triangle can be altered with the action of the underlying buccinator muscle. This region is remarkable as it is the puncture site for the inferior alveolar nerve block utilized to anaesthetize the inferior alveolar and lingual nerves (Figure 3.1).
   ii. *Inferomedial or retromolar triangle*, which is covered by a relatively thicker pale mucosa, and towards its anterior end forms the retromolar pad (piriformis papilla). The retromolar pad is a triangular soft elevation of mucosa that lies distal to the third molar (or the last erupted tooth) [4]. It comprises non-keratinized loose alveolar mucosa covering the glandular tissues, fibres of buccinator muscle, fibres

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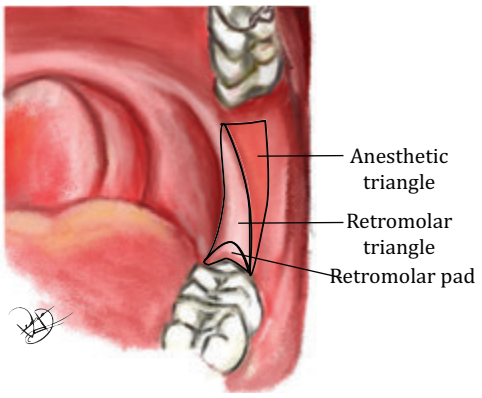


Mucosa of the posteriosuperior surface of third molar region

Figure 3.1 Note the surface anatomy of the retromolar area and mucosa of the posterio-superior surface of the mandibular third molar region.

of superior constrictor muscle, fibres of pterygomandibular raphe, and the terminal part of the tendon of temporalis muscle [5] (Figure 3.1).

In relevance to third molar surgery, the incision starts at the vertex of the retromolar triangle and moves in contact with the bone till the second molar.

b. ***Lateral surface*:** In the buccal aspect that forms the lateral surface, the mucosa is strongly adherent to the underlying bone forming the mucoperiosteum before it continues further laterally along the posterior floor of the buccal vestibule.

Elevation of the mucoperiosteum at the subperiosteal plane without disturbing the supra-periosteal areas can ensure minimal bleeding while exposing the underlying bone for the exposure and access to the surgical site for the transalveolar extraction of the impacted third molar.

c. ***Medial surface*:** The mucosa in this area is at its thinnest and adheres firmly to the underlying bone before continuing as the floor of the mouth medially and towards the faucial pillars posteriorly.

The mucosa may be further thinned in cases of lingually rotated impacted tooth that may result in tear of the mucosa during mucoperiosteal elevation.

SKELETAL ANATOMY

Mandibular third molar region is anatomically located at the distal end of the body of the mandible more in a transition zone between the body and the ramus. Relevant anatomical landmarks should be given consideration in understanding the skeletal anatomy of this region with an emphasis on the thickness of the cortical plates and the soft tissue arrangement for better surgical execution and outcome. The skeletal formations include the cortical plates, internal and external oblique ridge, retromolar fossa, retromolar triangle, latero-alveolar canal, and the mylohyoid ridge (Figure 3.2a–d).

Cortical plates, internal and external oblique ridges: The third molar is embedded between a thick cortical plate which is buttressed by the thicker external oblique ridge and the thinner lingual internal oblique ridge. On palpation, the thick buccal cortex may be felt in the buccal vestibular region, reinforced by the external oblique ridge lateral to the third molar region. The mylohyoid ridge runs obliquely at the medial surface and extends superiorly over the medial margin of the retromolar triangle. The mylohyoid ridge provides enforcement to the thin lingual cortical plate (Figure 3.2b and d).

The thickness of the lingual plate is also dependent on the position and angulation of the impacted third molar and is more vulnerable to fracture during the elevation of the tooth while applying force in an inappropriate manner and direction. Note the view from the inferior aspect, the third molar remains in proximity to the lingual shelf of the bone (Figure 3.2e). Lingual plate deficiency is a developmental anomaly which may be seen as a dehiscence or fenestration below the lingual crest causing the apices of the third molar to penetrate into the lingual cortex and lie in and adherent to the overlying mucosa.

The external oblique ridge on the buccal side is a bulky prominence that may impede the buccal traction of the mandibular third molar.

Bone trajectories or "grain" of the cortical bone, related to the mechanical stress, run longitudinally in the mandible. This has significance in the removal of the impacted tooth using a chisel where stop cuts are required to prevent transmission of cutting forces beyond what is desired.

Retromolar triangle: Mostly but not always triangular-shaped area is present between the two bony ridges and the distal surface of the posterior

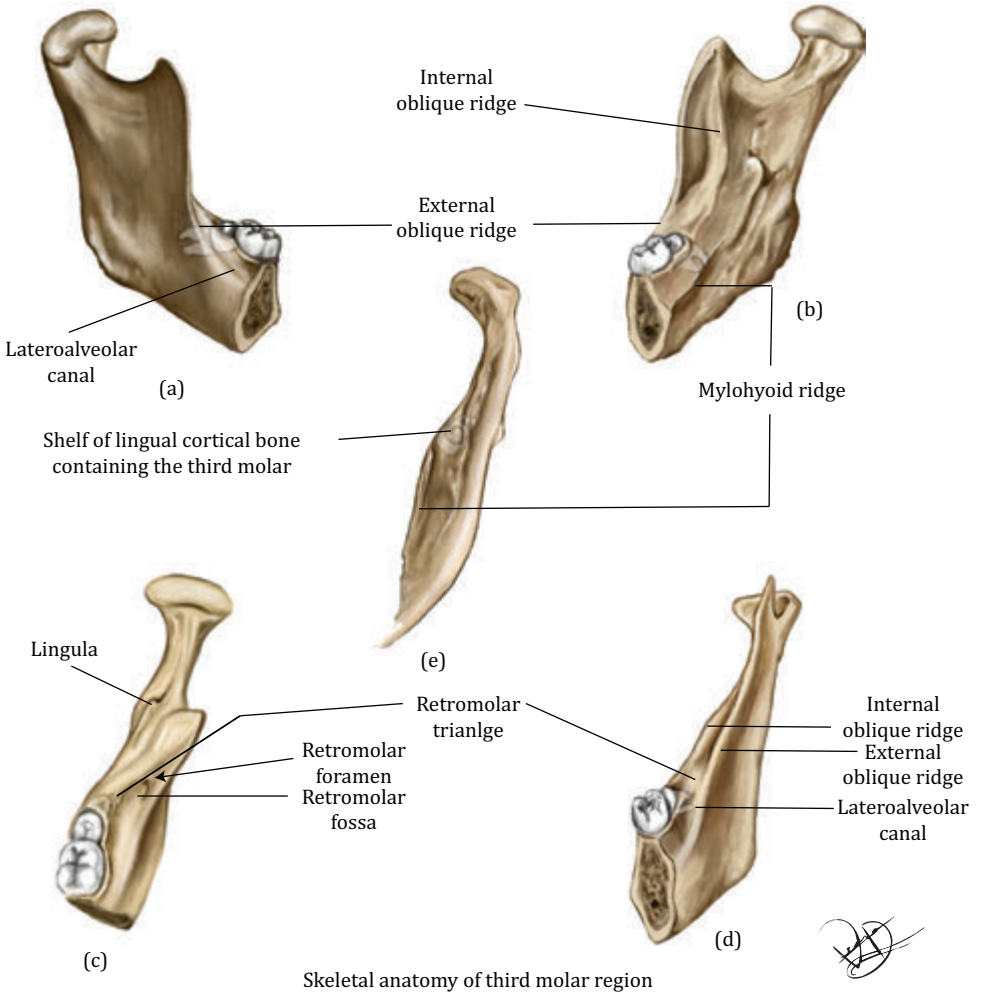


Figure 3.2 Osteology relevant to the mandibular third molar region: (a) Lateral. (b) Medial. (c) Superior. (d) Supero-lateral. (e) Inferior.

most molar. This area is perforated by a number of openings to canals conducting branches of the buccinator artery that anastomose with the inferior alveolar artery (Figure 3.2c and d).

Retromolar fossa: It is a depression bounded medially by the lateral lip of the retromolar triangle and laterally the anterior portion of the mandibular ramus. It owns the insertion of the buccinator muscle. The retromolar foramen is sometimes present in this region conducting blood vessels in the region and facilitating their anastomosis with the inferior alveolar blood vessels. Injury of these anastomosing vessels may lead to abundant bleeding and at times post extraction haematoma (Figure 3.2c).

Lateroalveolar canal: A misnomer describing an elongated depression on the buccal side of the alveolar process extending up to the mental foramen that lacks any muscle attachment (Figure 3.2a and d). Buccal guttering during removal of the third molar stays medial to the lateroalveolar canal. The retromolar fossa and the lateral alveolar canal also form a passage for the spread of infections from the third molar region. This is sometimes referred to as Chompret-L'Hirondel migratory abscess.

Mylohyoid ridge: Rough bony elevation running in an oblique line on the medial surface of the mandible, with its posterior end extending into the third molar region providing insertion to

Figure 3.3 The inferior alveolar canal deroofed as part of a marginal mandibular resection showing neurovascular vessels in third molar region. The vein (V) lies superiorly, and the artery (A) lies lingually and superiorly. The inferior alveolar nerve (N) lies below. (Adapted with permission from Pogrel, Dorfman, and Fallah. Inferior alveolar neurovascular bundle. *J Oral Maxillofac Surg*. 2009.)

the mylohyoid muscle and anchorage to mylopharyngeal portion of the upper constrictor muscle (Figure 3.2b).

Mandibular canal (inferior alveolar canal/inferior dental canal): It runs from the mandibular foramen to the mental foramen carrying the inferior alveolar neurovascular bundle. The canal runs from lingual to buccal further anteriorly before ending at the mental foramen. In the third molar region, it has an ovoid shape and lies relatively closer to the lingual cortical plate or rarely between the lingual and buccal plates [1–6]. The variations to the normal anatomy of the mandibular canal are documented with sporadic cases having bifid or trifid canals or accessory canals. Pogrel et al. studied the anatomic structure of the inferior alveolar neurovascular bundle in the third molar region and demonstrated that the inferior alveolar vein lies superior to the nerve and that there are often multiple veins. The artery appears to be solitary and lies on the lingual side of the nerve, slightly above the horizontal position [7] (Figures 3.3 and 3.4).

Bone is relatively elastic in young individuals and becomes brittle as age advances. This may influence the factors like the choice of method for removal of the impacted tooth and the amount of bone removal that may be required.

ADJACENT MUSCLES AND LIGAMENTS

Three principal muscles are present in the mandibular third molar region (Figure 3.5).

a. ***Buccinator*:** This muscle contributes to the formation of the muscular wall of the anaesthetic triangle. Part of the muscle originates from the periosteum under the retromolar pad in the retromolar fossa.
b. ***Superior pharyngeal constrictor*:** The origin of the muscle lay on the lingual side of the mandible below the lingual crest, above the mylohyoid ridge and medial to the third molar forming a part of the third molar region with its buccopharyngeal and mylopharyngeal components. The pterygomandibular ligament (raphe) lies between the superior constrictor and buccinator muscle, which is an important landmark for the anaesthesia in this region.
c. ***Temporalis*:** The distal fascicle of the temporalis muscle advances downward as the temporalis tendon around the medial and anterior surfaces of the coronoid, extending downwards onto the anterior mandibular ramus and further to the buccinator line. A buccal approach for the surgical removal of the third molar transects the lowest part of the temporalis tendon to facilitate the removal of the buccal and the distal bone covering the impacted molar. Excessive injury to the large portion of this tendon and the ramal attachment of the muscle may result in trismus.

In addition, the mylohyoid muscle demarcates the floor of the mouth and is important in relation to the lingual nerve. At the posterior attachment of the muscle, which lies in the third molar region the

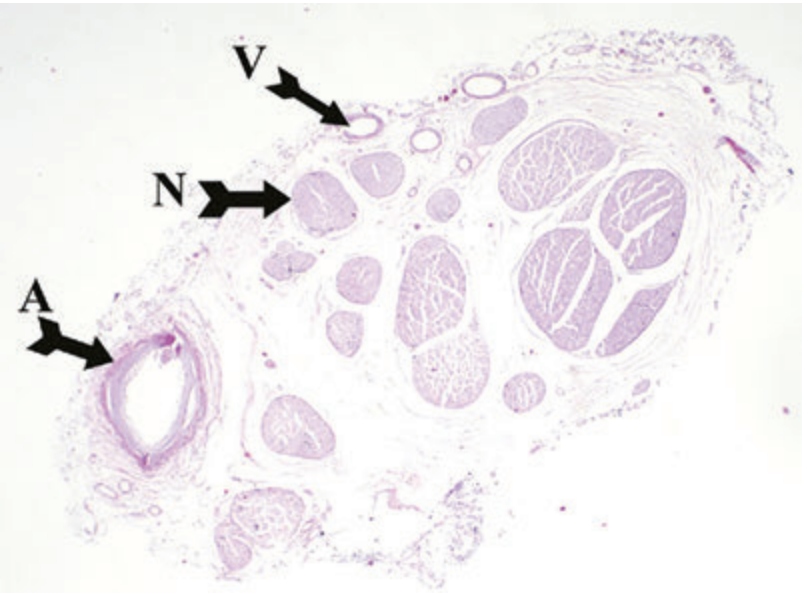


Figure 3.4 Histologic examination of specimen from the right third molar region as seen from behind showing inferior alveolar canal contents. The vein (V), lying superiorly, consists of a number of venules, whereas the artery (A), lying lingually, contains only a single vessel. The nerve (N) itself consists of around 16 fascicles at this point. (Hematoxylin and eosin; original magnification ×40.) (Adapted with permission from Pogrel MA, Dorfman D, Fallah H. Inferior alveolar neurovascular bundle. *J Oral Maxillofac Surg*. 2009 Nov;67(11):2452–4. doi: 10.1016/j.joms.2009.06.013.)

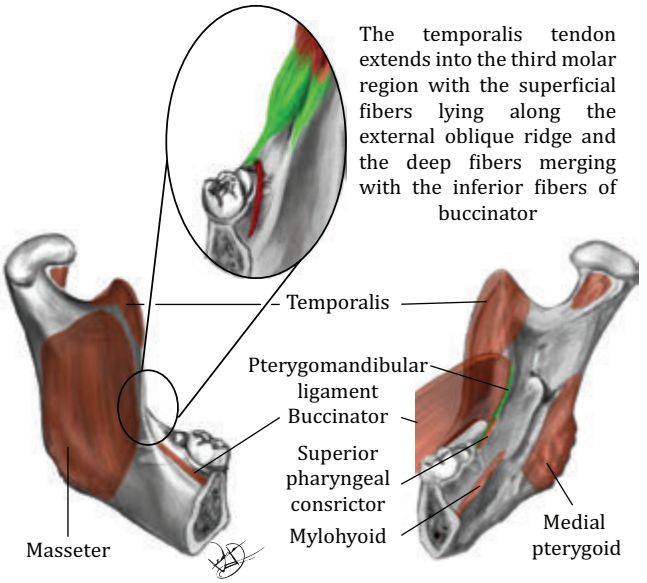


Figure 3.5 Musculature and ligamentous structures relevant to the mandibular third molar region. Note the formation of the "pterygomandibular ligament" with its buccal and lingual relation to various anatomical structures.

lingual nerve remains superior to it before it makes an anteromedial turn.

REGIONAL BLOOD VESSELS

The third molar region is mainly supplied by the inferior alveolar and the buccal arteries and drained by their corresponding veins. Other important arteries of the region are the ascending palatine artery, lower masseteric, and facial artery.

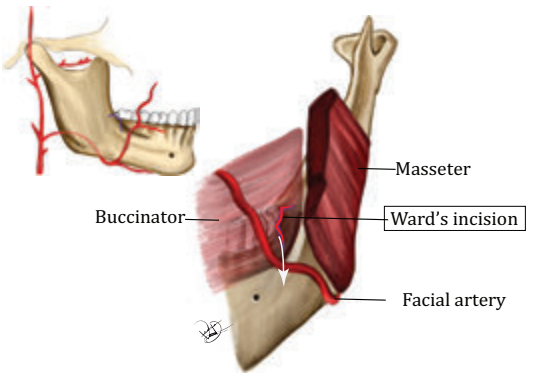
a. ***Inferior alveolar artery and vein*:** Inferior alveolar artery originates from the first segment of the maxillary artery, gives off the mylohyoid branch, and enters the inferior alveolar canal through the mandibular foramen, supplying the mandibular body, posterior teeth, the alveolar and the gingival region. The artery continues anteriorly as two divisions: the incisive artery and the mental artery.

   The vessels are normally located superior to the inferior alveolar nerve in the canal and are therefore the first to be injured, which may occur when the impacted tooth is impinging on the canal or when injudicious removal of the buccal cortical bone injures the artery in a canal placed lateral to the tooth. Injury to the artery during surgical procedures may lead to excessive bleeding.

b. ***Buccal artery*:** Originating from the second part of the maxillary artery, it supplies the buccinator muscle and the buccal mucosa in the third molar region. It is also responsible for the collateral supply anastomosing with the inferior alveolar artery through the retromolar foramen.

c. ***Ascending palatine artery*:** It originates from the facial artery and supplies the pharyngeal wall and tonsillar region passing along the anterior faucial pillars. Injury to this artery can occur in the region of the faucial pillar when excessive force is applied while retraction resulting in tearing of the flap or injury with injudicious use of an instrument like an elevator which may cause heavy bleeding.

d. ***Facial artery and vein*:** After its origin from the external carotid artery, the facial artery passes upward and forward medial to the ramus of the mandible, deep to the submandibular salivary gland, and crosses the inferior border of the mandible just anterior to the masseter muscle, close to the second molar.



Facial artery passing superiorly along the anterior border of the masseter is at risk of injury if vertical release of Ward's incision slips, extending anterior and buccally

Figure 3.6 Facial artery with its relation to the mandibular angle and the anterior masseteric region.

Accidental injury to the facial vessels may occur due to slipping of the scalpel during placement of the buccal releasing incision or the intentional extension of the incision in the buccal vestibule (Figure 3.6).

Lymphatics of the third molar region drains in the submandibular and retropharyngeal lymph nodes.

ADJACENT NERVES AND INNERVATION

The inferior alveolar region has innervation form the inferior alveolar nerve, lingual nerve, long buccal nerve. Additionally, the anatomy and the role of the mental and mylohyoid nerves should be considered (Figures 3.7 and 3.8).

A. ***Inferior alveolar nerve*:** A mixed nerve branching from the posterior division of the mandibular nerve, which descends medial to the lateral pterygoid muscle, lateral and posterior to the lingual nerve, to the region between the sphenomandibular ligament and the medial surface of the mandibular ramus, enters the mandibular canal at the level of the mandibular foramen. It travels along the canal mostly lying inferior and lingual to the roots of the third molar (Figures 3.7 and 3.8). Kim et al. classified the buccolingual location of the mandibular canal into three types [8]: