Principles of Dentoalveolar Extractions

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Contents

Foreword

The attachment of teeth to bone, facilitated by the periodontal ligament, is a unique connective tissue articulation. It enables tooth eruption, appropriate physiological responses to compressive force, and planned orthodontic tooth movement. However, as odontogenic infections may be potentially fatal, specialised skills for efficient tooth extraction have evolved from the days of the 'barber-surgeons' of the Middle Ages to contemporary exodontia. Today, every conceivable type of useful instrumentation and imaging is available to the clinician.

Tooth removal in the middle of the last century occupied a large part of the dental practitioner's work and skill set, but this has markedly reduced due to better dental care and tooth maintenance. The time devoted to the discipline of exodontia in the dental curriculum has thus diminished proportionally, and many graduates emerge with minimal experience in removing teeth. A fresh, comprehensive guide to the principles of dentoalveolar extractions for all interested practitioners who wish to underpin their clinical experience with clear guidelines is therefore most welcome.

In a logical sequence, the authors have addressed all aspects of managing a patient for simple and surgical extractions. By introducing the 'principles of surgery' from the outset, the reader is reminded that tooth removal is within the surgical spectrum and carries the same responsibilities in terms of providing careful patient assessment, consent, a controlled clinical environment, and necessary documentation. A detailed knowledge of the associated anatomy and competence in the administration of local anaesthesia are fundamental for successful dentoalveolar surgery in the outpatient setting and are well covered in this book, as are the available surgical instruments.

A methodical approach in performing simple and surgical extractions, including the management of intraoperative events and third molar surgery, is also provided, with headings for assessment, equipment, and patient position. These chapters are supported by good-quality anatomical diagrams to assist in the understanding of the suggested techniques.

With our ageing population, there are many medications and diseases that must be thoroughly understood by the dental practitioner. A chapter on medical compromise is an important addition to this text as it covers issues such as the newer anticoagulant agents and medications for bone loss that influence healing. The taking of these drugs may significantly modify a treatment plan, and decisions regarding joint management with the patient's prescribing physician are often indicated. Finally, postoperative care and complications are discussed, as these represent vital knowledge in surgical care.

Many books covering this field have included chapters devoted to exodontia, as part of a broader spectrum of oral and maxillofacial surgery. However, this neat, clear, and inclusive volume fulfills

the objective of providing a modern reference text devoted to dentoalveolar surgery alone. It will instruct all those who set out to master the skills of exodontia in their practising lives, from undergraduate students to surgical trainees and newly qualified dental practitioners. I have no doubt that this excellent resource will be consumed and enjoyed by many in the years to come.

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About the Companion Website

Don't forget to visit the companion website for this book:

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There you will find valuable material designed to enhance your learning, including:

- MCQs

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1

Principles of Surgery

> ***surgery*** *n. manual treatment of injuries or disorders of the body, operative therapeutics.*
> ***surgeon*** *n. a person skilled in surgery.*

Exodontia, the removal of teeth, involves the manipulation of hard and soft tissues and the amputation of the dentition or parts thereof in order to treat or prevent disease, or as part of an overall treatment plan. The surgeon who carries out this treatment must possess qualities, skills, and decision-making abilities to the standard of any other trained surgeon who diagnoses and treats disease. It is the responsibility of this surgeon to provide the highest standard of care of which they are capable, and when they cannot provide it to a suitable level, to refer to the appropriate specialist service.

It is somewhat self-evident, though easily forgotten, that the surgeon's responsibility is not limited to the operation only, but also involves preoperative consultation and postoperative monitoring, as well as other aspects of care such as liaising with other practitioners and communicating treatment plans. Surgeons are trained to possess several qualities and characteristics not limited to procedural skills:

- **Knowledge.** Knowledge can be considered the facts, information, skills, and experience gained through education, training, and professional practice. It is a fundamental and essential aspect of the carrying out of dentoalveolar extractions. It includes technical and medical expertise, which facilitate safe patient management. As scientific knowledge evolves over time, there is a need for ongoing maintenance through continuing professional development and keeping up to date with evidence-based practice.
- **Quality and Safety.** Quality is the commitment to excellence, providing a service that is guided primarily by the best interests of the patient. This is achieved through recognition of one's own strengths and limitations, stringent self-audit, and the fortitude to request assistance when needed. Safety is the avoidance of risk or injury to oneself, one's staff, and one's patients. Maintenance of a safe workplace is the responsibility of all individuals employed in a health environment, and requires appropriate training and awareness of risk-mitigation strategies such as aseptic and sterilisation techniques. Quality and safety are dynamic components of surgery and necessitate constant refinement and improvement to ensure the wellbeing of patients and a high standard of care.
- **Communication and Collaboration.** Good communication is essential in the interaction both with patients and with other health professionals. Clear, concise, and relevant documentation of patient management will improve interactions with specialists and foster a culture of collaboration and professional development. This is particularly important when patients are

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undergoing tooth extraction as part of a wider treatment plan where multiple other medical comorbidities require interdisciplinary management. In such situations, good communication minimises delays to receiving time-critical treatment, such as in the case of dental extractions prior to head and neck radiotherapy or bisphosphonate treatment.

- **An Individualistic Approach.** Patients will have a wide variety of backgrounds, demands, and prior medical knowledge. A tailored and individualised approach is required in order to ensure they understand the proposed procedure, its risks, and its expected outcomes, and are able to compare options in order to make an informed decision.
- **Leadership and Management.** A surgeon will often find themselves the leader of a multifaceted treatment team, including nursing staff, dental assistants, anaesthetic staff, and sterilisation technicians. This leadership comes with great responsibility: the expert surgeon must guide others in the team, provide feedback and education, and thus help maintain a standard of excellence. The surgeon must ensure that all staff are orientated towards the goal of achieving the best outcome for the patient. When the highest standard of care is compromised, the responsibility is on the surgeon to make sure the team gets back on track.
- **Decision Making.** The word 'decision' shares a common root with another word often associated with surgery: incision. Both are derivatives from the Latin word *caedis*, meaning 'to cut'. Incision means to cut into something, such as the operative site; decision literally means 'to cut away'. A decision thus precludes other options, and sets one upon a particular course of action. A skilled surgeon will be able to make treatment planning decisions that are in the best interests of their patients.

1.1 Wound Healing

Good outcomes following surgery depend on satisfactory wound healing. This involves a range of inflammatory, biochemical, and physiologic changes at the operative site, which will ultimately lead to resolution, healing, and bone remodelling. Wound healing does not always follow a predictable course, and therefore an understanding of its key aspects will serve as a foundation for interpreting clinical signs and determining when it is compromised.

There are four key stages in wound healing (Figure 1.1):

1) Haemostasis.
2) Inflammatory phase.
3) Proliferative phase.
4) Remodelling and resolution.

An interruption at any one of these stages will lead to a protracted recovery period.

1.1.1 Haemostasis

Any tissue trauma will result in bleeding from the local vasculature supplying the tissues. The immediate physiologic reaction is haemostasis, which involves reactive vasospasm, formation of a platelet plug, and activation of the coagulation cascade.

Reactive vasospasm occurs in the seconds to minutes following damage to the blood vessels. This is mediated through neurologic mechanisms, as well as the local release of endothelin. It rapidly reduces blood loss from trauma. In surgery, exogenous vasoactive medications such as adrenaline utilise this response to improve visual access to the surgical field by reducing blood flow.

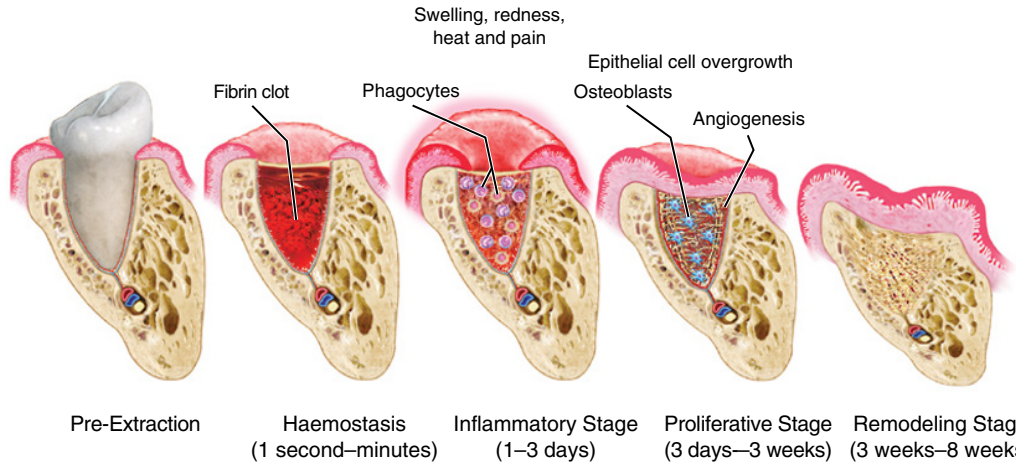

Figure 1.1 Phases of wound healing.

Damaged endothelial cells result in a conformational change in von Willebrand factor expressed on the cell surface. Von Willebrand factor interacts with glycoprotein Ib on circulating platelets, resulting in activation and aggregation of the platelets, forming links to fibrinogen via the GpIIb/IIIa receptor. This leads to the formation of the platelet plug. Antiplatelet medications inhibit aspects of platelet plug formation and increase the risk of bleeding during surgical procedures.

The coagulation cascade is a series of successive reactions that occur in order to activate thrombin and form a stable fibrin clot (Figure 1.2). There are two pathways in this cascade: intrinsic and extrinsic. The intrinsic pathway is activated within the vascular system through exposure

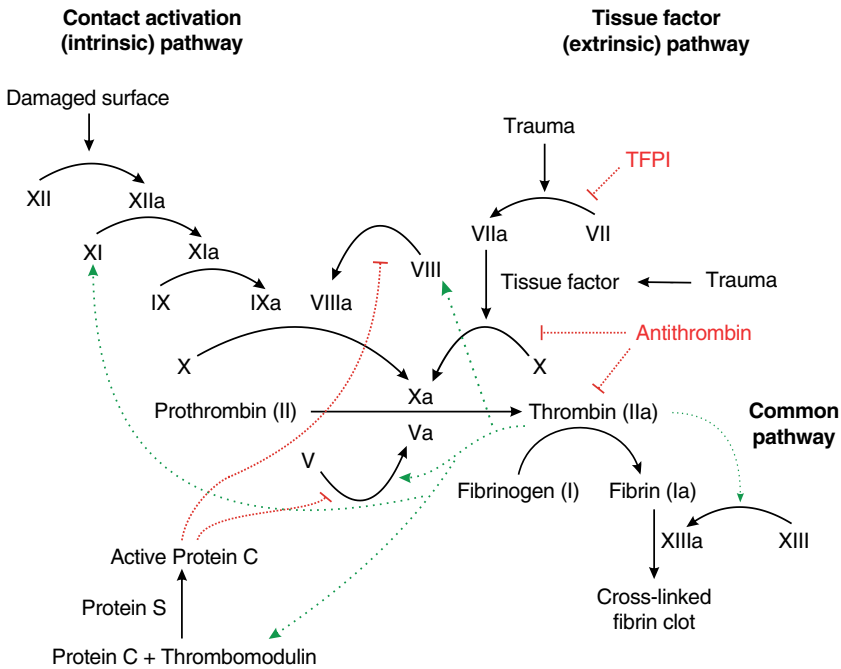

Figure 1.2 The coagulation cascade.

to endothelial collagen, whilst the extrinsic pathway is activated by tissue trauma and release of intracellular tissue factor. Anticoagulant medications and coagulopathies increase the tendency to bleed by inhibiting aspects of the coagulation cascade, and awareness of these effects may be clinically relevant in surgical planning.

Coagulation studies used clinically can assess the function of either the intrinsic, the extrinsic, or the shared common pathway. Prothrombin time screens for factors II, V, VII, and X and fibrinogen; these are all part of the extrinsic pathway, which is used to guide treatment for patients treated with warfarin. Warfarin inhibits vitamin K-dependent factors common to both pathways, but because factor VII has the shortest half-life, the extrinsic pathway is used to determine coagulability. The partial thromboplastin time will screen for factors in the intrinsic pathway affected by medications such as heparin and low-molecular-weight heparin.

1.1.2 Inflammatory Phase

This will commence on day one after the procedure and will continue for approximately three days. Important aspects of the inflammatory response include the release of pro-inflammatory mediators and vasoactive factors such as the prostaglandins, leukotrienes, interleukins, and histamine, and recruitment of phagocytes to remove dead tissue and foreign debris. The inflammatory mediators lead to the swelling, redness, heat, pain, and loss of function associated with inflammation. Anti-inflammatory medications are commonly prescribed after dentoalveolar procedures in order to mitigate the postoperative pain and swelling.

1.1.3 Proliferative Phase

This typically starts around day three and lasts for up to three weeks. The proliferative phase relies on the formation of granulation tissue and type III collagen, mediated by fibroblasts; wound contraction starts due to the action of myofibroblasts. Angiogenesis takes place as new capillaries are formed to provide blood and nutrients in order to help the wound heal. A number of growth factors, including vascular endothelial growth factor (VEGF), are also involved. At the wound edges, epithelial cells proliferate and begin to grow over the granulation tissue scaffold that has formed. Bone healing starts to take place as osteoprogenitor cells arrive, differentiating into osteoblasts, which begin depositing an osteoid matrix. Note that any systemic conditions or medications which prevent or suppress components of angiogenesis or inflammation may delay or prolong healing.

1.1.4 Remodelling and Resolution

At the completion of three weeks of healing, granulation tissue and immature bone will fill the extraction site, and the socket should be completely covered by a layer of epithelium. Bone remodelling will continue to take place with active resorption and deposition mediated by osteoblasts and osteoclasts. This important step can be impeded by medications that inhibit osteoclast function, such as bisphosphonates or denosumab. Radiographic evidence of bone remodelling will not become evident until after six to eight weeks.

1.2 Patient Assessment

Any medical or dental intervention requires a comprehensive patient history. This includes: a detailed medical history, including current and past medical treatments; documentation of known drug allergies and reactions; a social history comprising occupation and use of alcohol, cigarettes,

Surgical Handrubbing Technique

- Handwash with soap and water on arrival to OR, after having donned theatre clothing (cap/hat/bonnet and mask).
- Use an alcohol-based handrub (ABHR) product for surgical hand preparation, by carefully following the technique illustrated in Images 1 to 17, before every surgical procedure.
- If any residual talc or biological fluids are present when gloves are removed following the operation, handwash with soap and water.

Put approximately 5ml (3 doses) of ABHR in the palm of your left hand, using the elbow of your other arm to operate the dispenser.

Dip the fingertips of your right hand in the handrub to decontaminate under the nails (5 seconds).

Images 3-7: Smear the handrub on the right forearm up to the elbow. Ensure that the whole skin area is covered by using circular movements around the forearm until the handrub has fully evaporated (10-15 seconds).

Images 8-10: Now repeat steps 1-7 for the left hand and forearm.

Put approximately 5ml (3 doses) of ABHR in the palm of your left hand as illustrated, to rub both hands at the same time up to the wrists, following all steps in images 12-17 (20-30 seconds).

Cover the whole surface of the hands up to the wrist with ABHR, rubbing palm against palm with a rotating movement.

Rub the back of the left hand, including the wrist, moving the right palm back and forth, and vice-versa.

Rub palm against palm back and forth with fingers interlinked.

Rub the back of the fingers by holding them in the palm of the other hand with a sideways back and forth movement.

Rub the thumb of the left hand by rotating it in the clasped palm of the right hand and vice versa.

When the hands are dry, sterile surgical clothing and gloves can be donned.

Repeat this sequence (average 60 sec) the number of times that adds up to the total duration recommended by the ABHR manufacturer's instructions. This could be two or even three times.

World Health Organization

Figure 1.7 WHO surgical handrubbing technique. *Source:* From Surgical Handrubbing Technique, https://www.who.int/gpsc/5may/hh-surgicalA3.pdf, WHO. © WHO.

Figure 2.5 Conventional 'open-mouth' technique.

nerve course. If local anaesthetic solution is inadvertently injected into the parotid gland, the patient will develop a transient facial nerve palsy for the duration of effect of the local anaesthetic. Local anaesthetic solution should not be deposited until bony contact is noted against the needle point during insertion, confirming the correct location of the needle.

2.5.2.2 Akinosi 'Closed-Mouth' Technique

The 'closed-mouth' or Akinosi block can be utilised to anaesthetise the inferior alveolar nerve and the lingual nerve. It is useful in cases where there is severe trismus or macroglossia, or if the patient has a prominent gag reflex.

1) Position the patient in the dental chair, lying flat with head slightly extended.
2) Retract the buccal tissues to place tension on the pterygomandibular soft tissues and obtain sufficient vision and access (Figure 2.6).
3) Slowly advance the needle buccal to the maxillary molars, parallel to the occlusal plane at the level of the gingival margin of the maxillary teeth.
4) Advancing the needle in this manner, pierce the mucosa overlying the medial aspect of the mandible. Continue to advance approximately 2 cm. Because of the orientation of the needle, there is no bony anatomic landmark that will indicate the correct location of the needle tip relative to the lingula; as such, it is not recommended to insert the needle further, as the parotid space will be entered.
5) Aspirate the syringe to ensure the needle point has not traversed the intravascular space of a blood vessel.
6) Deposit the anaesthetic solution slowly; a slow rate of injection significantly reduces discomfort for the patient.
7) Allow the local anaesthetic sufficient time to anaesthetise the tissues, based upon the pharmacokinetic properties of the solution, and monitor the patient for any adverse reaction.

2.5.2.3 Gow–Gates Technique

This is a well described but technically challenging method of obtaining mandibular anaesthesia that uses extraoral landmarks to guide the needle path of insertion. It results in deposition of anaesthetic

2.6.2 Intrapulpal Injection

Intrapulpal injection is useful in cases where an attempt to section a tooth has already been made and the patient has experienced pain during instrumenting or sectioning. As the name suggests, the anaesthetic agent is injected into the pulp chamber to directly anaesthetise the pulpal tissues.

1) Position the patient in the dental chair, allowing for adequate light and access to the dental pulp.
2) Visualise the pulp chamber – this will be the site of needle entry.
3) Advance a short needle into the pulp chamber (Figure 2.15).
4) Deposit local anaesthetic into the pulp. As the volume of the pulp chamber is small, only a minute volume of anaesthetic is required to achieve pulpal anaesthesia. It may be necessary to apply firm pressure on the syringe in order to deliver the solution into the chamber.
5) Allow the local anaesthetic sufficient time to anaesthetise the tissues, based upon the pharmacokinetic properties of the solution, and monitor the patient for any adverse reaction.

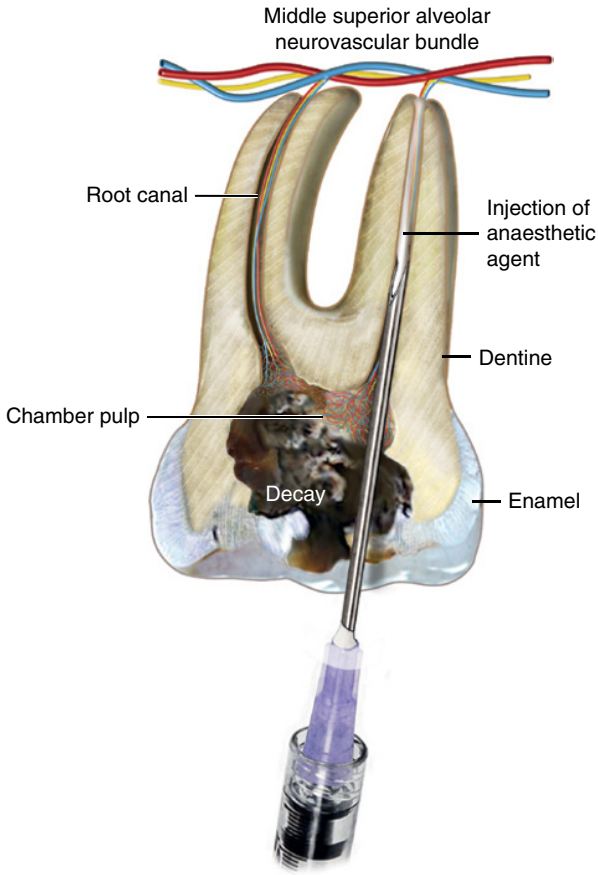

Figure 2.15 Intrapulpal injection.

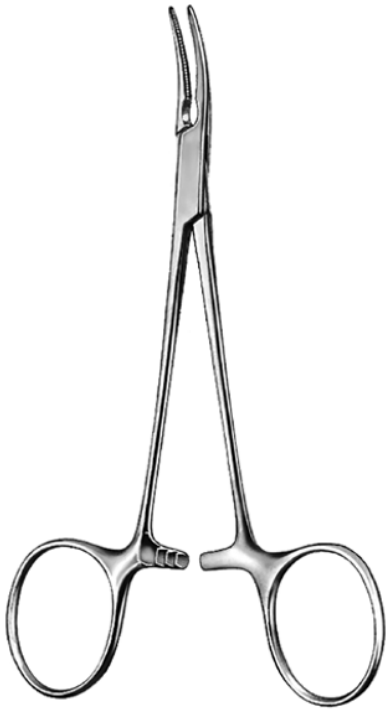

Figure 3.12 Curved artery forceps. *Source:* KLS Martin.

Figure 3.13 Basic suturing equipment. Needle holders, forceps, and scissors come in a variety of sizes. As dentoalveolar surgery is carried out in the confines of the patient's mouth, larger instruments make it more difficult to access the posterior aspects. Small needle holders with a fine tip offer good manoeuvrability and control of the soft tissues. *Source:* KLS Martin.

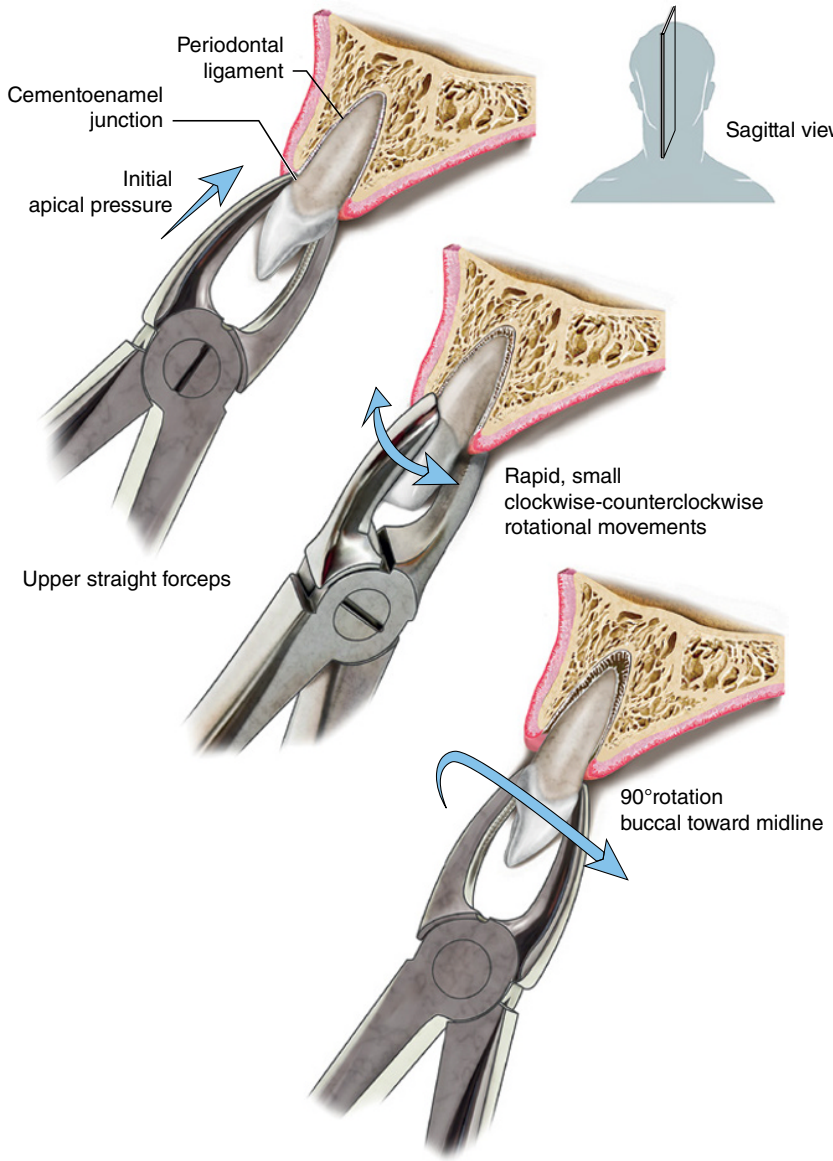

Figure 4.1 Extraction of a maxillary incisor tooth.

8) **Delivery.** Apply the beaks of the straight forceps on to the cementoenamel junction of the tooth. Initially, use apical pressure to slide the beaks as deep on to the root as possible. Employ rapid, small clockwise–counterclockwise rotational movements to continue tearing the periodontal ligament. Finally, rotate the buccal part of the crown towards the midline. This final movement reduces the risk of fracture of the curved root tip, as anterior maxillary alveolar bone is more pliable than thick palatal bone.
9) **Assessment.** Assess the tooth root to ensure it has been removed complete. Flush the socket with saline to remove any surgical debris. Examine the socket for bleeding, alveolar bone fracture, or soft tissue trauma, and manage as appropriate.

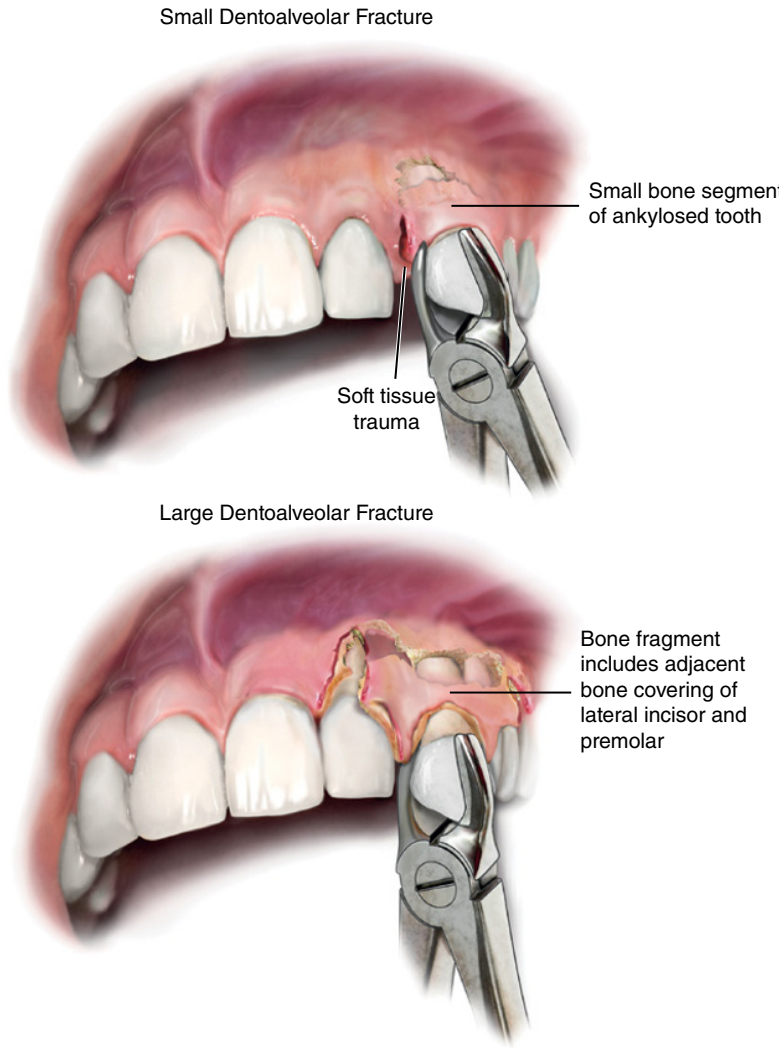

Figure 6.2 Small and large dentoalveolar fractures.

the soft tissues is essential in order to reposition this fractured segment, which is now essentially biologically identical to a free bone graft, and is susceptible to future necrosis and sequestration.

When the fractured segment is large and other teeth are attached to the fractured complex, repositioning and rigid splinting of the segment is the priority, to allow for bony healing and salvage of as many teeth as possible. Whilst fractures of this nature can appear disastrous, appropriate repositioning and splinting using traumatology principles carries an excellent prognosis. The tooth extraction procedure should be delayed as long as is safely possible until bone healing is complete, at approximately four weeks post-repositioning. A surgical approach is then necessary, in order to reduce the amount of force required for future attempts at tooth extraction.

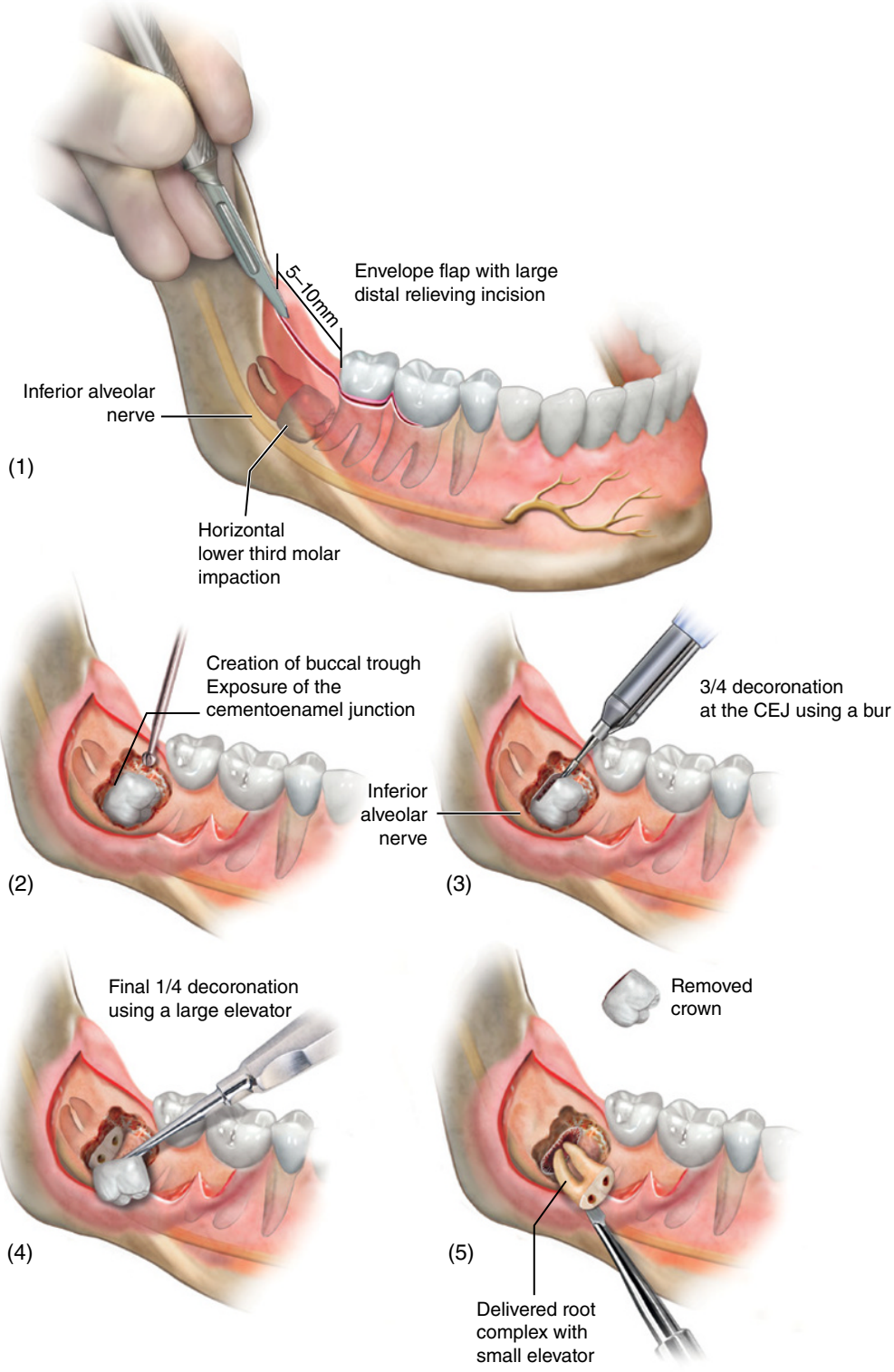

Figure 7.5 Steps in the removal of a horizontal mandibular third molar.

rule out other causes of temporomandibular symptoms. If the patient's presentation can be explained by intraoperative trauma or a prolonged and forceful procedure, the prognosis is generally good, and there will likely be a return to baseline after three months postoperatively. Advice on conservative management (including jaw rest, physiotherapy, and anti-inflammatory medications) should be provided, with regular follow-up to assess for clinical improvement. Rarely, patients may require advanced management by an oral medicine specialist or oral and maxillofacial surgeon, and a timely referral may be required.

9.5.5 Epulis Granulomatosa

The normal healing of an extraction socket involves the formation of granulation tissue inside it, which is gradually replaced by bone and gingival soft tissue. This normal healing may be complicated by the development of hyperplastic granulation tissue that exudes out of the socket and into the oral cavity, giving the appearance of an epulis (Figure 9.1). This is usually a foreign-body reaction to debris or bony sequestra in the socket, as a result of inadequate debridement following extraction. Occasionally, haemostatic dressings or treatments used for alveolar osteitis may be implicated in this reaction.

Epulis granulomatosa is clinically indistinguishable from intra-alveolar squamous cell carcinoma or other giant cell lesions of the jaws. As such, the presence of this hyperplastic tissue warrants urgent biopsy for formal histopathologic diagnosis. Simultaneous curettage and debridement of the socket is often adequate to treat epulis granulomatosa and encourage normal healing.

Figure 9.1 Epulis granulomatosa following third molar removal.