Oculoplastic Surgery

Brian Leatherbarrow

Third Edition

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Oculoplastic Surgery

Third Edition

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This book is dedicated to my wife Angela, my son Michael, and my daughter Erin.

Contents

Foreword ix
Preface x
Acknowledgments xi
Video Contents xii

I Basic Principles 1
1. Surgical Principles 2
2. Applied Anatomy 33

II Eyelid Surgery 107
3. Lower Eyelid Entropion 108
4. Upper Eyelid Entropion 127
5. Abnormal Eyelashes 140
6. Lower Eyelid Ectropion 145
7. Blepharoptosis 173
8. The Management of Thyroid-Related Eyelid Retraction 231
9. Facial Palsy 246
10. Eyelid and Periocular Tumors 262
11. Management of Malignant Eyelid and Periocular Tumors 292
12. Eyelid and Periocular Reconstruction 299
13. The Use of Autologous Grafts in Ophthalmic Plastic Surgery 354

III Cosmetic Surgery 379
14. The Evaluation and Management of the Cosmetic Patient 380
15. Blepharoplasty 402
16. Complications of Blepharoplasty 441
17. The Management of Brow Ptosis 455

IV Orbital Surgery 473
18. Orbital Disorders 474
19. Surgical Approaches to the Orbit 511
20. Thyroid Eye Disease 537

V Lacrimal Surgery 563
21. The Diagnosis and Management of Epiphora 564

VI Socket Surgery 595
22. Enucleation and Evisceration 596
23. Secondary Anophthalmic Socket Reconstruction 617
24. Orbital Exenteration 638

VII Trauma 649
25. The Management of Eyelid, Orbital, and Lacrimal Trauma 650
26. Orbital Wall Blowout Fractures 669
27. Zygomatic Complex Fractures 683
28. Other Orbital Fractures 689
29. Traumatic Optic Neuropathy 692

Index 695

Foreword

It is again an honor to write the foreword to the third edition of Brian Leatherbarrow's *Oculoplastic Surgery.* There are many books in print addressing surgery in the periocular region, but this third edition of *Oculoplastic Surgery* is a must for all readers who want a refreshing and comprehensive approach to these surgical procedures. Brian Leatherbarrow brings a different perspective due to his combined training in England with Mr. Richard Collin and in the United States with Dr. Jeffrey Nerad and myself. During my time with Brian, I noted that he always approached patients in an organized manner based on facial and periorbital anatomical relationships. I have adopted some of his approaches, which have improved the surgical care of patients in my practice. Brian combines the best of his training and shares his 25-plus years of surgical practice in this book.

This third edition continues the practical approach to the diagnosis and management of a variety of oculoplastic, orbital, and lacrimal challenges. Brian shares his experience through the complete and anatomically based descriptions of surgical procedures that have brought satisfactory results to his patients over the years. The chapters are comprehensive with regards to clinical presentations, patient selection, surgical indications, technical aspects of procedures, salient features for successful procedures, and potential complications. His narrative is exquisitely accented with both illustrations, numerous color photos of patients, and videos of these procedures. Each chapter ends with suggested reading for further investigation. This approach provides an engaging presentation for the interested reader and a concise method of teaching that guides you to successful surgical procedures. This book adds to our understanding of the treatment of patients with oculoplastic conditions.

I congratulate Brian for undertaking the enormous task of a third edition to an already excellent textbook. There are ample improvements in this edition that will satisfy readers from any field with an interest in the area of oculoplastic and reconstructive surgery.

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Professor of Ophthalmology and Otolaryngology
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Preface

This textbook has been written with the intention of providing the reader with a pragmatic approach to the diagnosis and management of patients presenting with a broad range of oculoplastic, orbital, and lacrimal problems and disorders. This third edition has been updated, improved, and expanded. Although aimed primarily at the ophthalmologist with a major interest in the subspecialty, it should prove very useful to clinicians of all grades and experience in several other specialties that share an interest in the fields of ophthalmic plastic and reconstructive surgery, orbital and lacrimal surgery:

- Plastic surgeons
- Maxillofacial surgeons
- ENT surgeons
- Neurosurgeons
- Dermatologists and dermatological surgeons
- Neuroradiologists
- Cosmetic physicians

The reader should already have acquired a basic knowledge of eyelid, orbital, and facial anatomy and should seek to expand this knowledge as much as possible. As the eye, periocular area, and orbit represent a major crossroads of surgical anatomical dissection, the surgeon/clinician who wishes to contribute to this field should acquire a very detailed knowledge of the anatomy of this area and its adjacent structures. Applied anatomy relevant to each problem/disorder and to each surgical procedure is presented in detail in an updated dedicated anatomy chapter and the surgical and nonsurgical procedures described are based on anatomical principles as much as possible.

Important principles are highlighted in the text as key points in boxes. Pertinent clinical signs, investigations, surgical indications, important technical considerations, and complications receive appropriate emphasis in each chapter. The surgical techniques and procedures described are not exhaustive but represent those most commonly used in the author's own practice. The text is accompanied by a considerable number of high-quality color photographs, complementary original illustrations, and some high definition videos. References have not been cited throughout the text; instead, further reading lists have been provided at the end of each chapter to serve as a starting point for those who may wish to pursue additional information.

Brian Leatherbarrow

Acknowledgments

I wish to convey my sincere gratitude to a number of people without whose assistance, time, influence, support, and encouragement I would not have been able to complete this work. My wife, Angela, has shown enormous patience and forbearance in allowing me to write the third edition of this book in my "spare time" and during our holidays over a period of four years, 2014–2018.

My medical illustrator, Philip Jones, has devoted an enormous amount of time to this third edition. I am grateful not only for his skill and his patience but also for his enthusiasm, commitment, and great desire to achieve accuracy and effect in the many detailed illustrations he has produced. He has painstakingly observed my surgical procedures in order to achieve the best results. His illustrations are outstanding.

My consultant anesthetic colleague and very close friend, Dr. Roger Slater, has taken many of the intraoperative photographs for me. I am most grateful not only for the skill he has demonstrated in this task but for the dedication, patience, and forbearance he has displayed to me and my team over the course of over 18 years during our very lengthy operating sessions together. I am indebted to him. I, and my patients, have benefited enormously from his skills and experience in both general and local sedation anesthetic techniques that he has perfected for the safe delivery of anesthesia to patients undergoing the wide range of surgical procedures described in this book. Over the course of last few years my consultant anesthetic colleague and friend, Dr. Paul Lancaster, has taken over his roles in my practice, and has also very patiently contributed to the intraoperative video recording for this third edition. I am most grateful to him.

I am hugely indebted to my original preceptors, Mr. JRO Collin, Dr. JA Nerad, and Dr. KD Carter, from whose outstanding teaching and exemplary clinical and surgical skills I have benefited so much. They have greatly influenced the treatment philosophies and surgical approaches outlined in this text. I am also indebted to the late Mr. John Lendrum, consultant plastic surgeon, who very generously allowed me to assist at many operations and observe his head and neck plastic surgery practice for over a year before I embarked on my training fellowships in oculoplastic surgery at Moorfields Eye Hospital, London, UK, and in oculoplastic and orbital surgery at the University of Iowa, Iowa City, Iowa, USA.

I have been extremely privileged to have worked for many years in close cooperation with very skilled and excellent colleagues in other specialties who have been very generous in sharing their skills, knowledge and experience with me. I am particularly indebted to Mr. Peter Richardson, consultant neurosurgeon, Mr. Scott Rutherford, consultant neurosurgeon, Dr. Roger Laitt, consultant neuroradiologist, Dr. Nick Telfer, consultant dermatological and Mohs' micrographic surgeon, Mr. David Whitby, consultant plastic surgeon, Dr. Richard Bonshek, consultant ophthalmic histopathologist, and Mr. Elgan Davies, consultant ENT surgeon.

I am also particularly grateful to my ocularist friends and colleagues Mr. Robin Brammar, Mrs. Louise Edwards, Mrs. Andrea Morris, and Mrs. Mojgan Abbariki for their skilled assistance, and to my dedicated oculoplastic nursing and assistant team, who have lent me such enormous support with my work over the course of the last 25 years: Rachel Kay, Sarah Day, John Cooper, Marian Platts, Jane Wray, Jenni Carruthers, Linda Kelly, Ruby Ruby, and Tracey Locke.

I wish to acknowledge the multitude of patients who have so kindly and generously agreed to the use of their photographs and videos for this textbook. I am extremely grateful to them. I am also particularly grateful to so many colleagues throughout the United Kingdom and in many countries throughout the world, who have referred so many challenging patients, and without whom this book would not have been possible.

Video Contents

2 Applied Anatomy
2.1 Lower Lid Retractors

3 Lower Eyelid Entropion
3.1 Lower Lid Everting Sutures
3.2 Lower Lid Retractor Advancement and Lateral Tarsal Strip

6 Lower Eyelid Ectopion
6.1 Lower Lid Full Thickness Skin Graft + Medial Spindle + Lateral Tarsal Strip
6.2 Lower Lid Full Thickness Skin Graft + Medial Spindle + Lateral Tarsal Strip 2
6.3 Medial Spindle and Lateral Tarsal Strip

7 Blepharoptosis
7.1 Herring's Law
7.2 Müller's Muscle Dissection
7.3 Müller's Muscle Dissection and Suture Placement
7.4 Müller's Muscle Resection
7.5 Müller's Muscle Resection 2
7.6 Subconjunctival Local Anaesthetic Injection
7.7 Levator Aponeurosis Advancement

10 Eyelid/Periocular Tumors
10.1 Trichloroacetic Acid Application

13 The Use of Autologous Grafts in Ophthalmic Plastic Surgery
13.1 Full Thickness Skin Graft
13.2 Dermis Fat Graft
13.3 Fat Harvesting For Facial and Periorbital Injection
13.4 Facial Fat Injections
13.5 Nanofat Injections
13.6 Fat Pearl Grafting

14 The Evaluation and Management of the Cosmetic Patient
14.1 Botulinum Toxin Injections
14.2 Tear Trough Restylane Injections

15 Blepharoplasty
15.1 Repositioning of Prolapsed Lacrimal Gland
15.2 Upper Lid Anaesthetic Injection
15.3 Upper Lid Blepharoplasty with Debulking Of Medial Fat Pad
15.4 Upper Lid Medial Fat Pad Debulking
15.5 Lower Lid Transconjunctival Blepharoplasty with Fat Repositioning
15.6 Inverse Shoe Shine Sign
15.7 Lower Lid Transconjunctival Blepharoplasty with Fat Debulking 2
15.8 Lower Lid Transcutaneous Blepharoplasty with SOOF Lift

16 Blepharoplasty Complications
16.1 Upper Lid Microfat Injections with Before and After Videos

17 The Management of Brow Ptosis
17.1 Dissection for Endobrow Lift and Upper Lid Blepharoplasty
17.2 Temporal Direct Brow Lift

19 Surgical Approaches to the Orbit
19.1 Swinging Lower Eyelid Flap Approach to Orbit

20 Thyroid Eye Disease
20.1 Swinging Lower Eyelid Flap and Lateral Orbital Wall Burring

21 The Diagnosis and Management of Epiphora
21.1 Dacryolith
21.2 Endoscopic Dacryocystorhinostomy
21.3 Insertion of Lester Jones Tube
21.4 Endonasal Septoplasty and CDCR with Lester Jones Tube

22 Enucleation and Evisceration
22.1 Enucleation
22.2 Dermis Fat Graft Implant

26 Orbital Wall Blowout Fractures
26.1 Forced Duction Test in Child with Orbital Floor Fracture

Part I

Basic Principles

I

1 Surgical Principles *2*

2 Applied Anatomy *33*

1 Surgical Principles

Abstract
"Surgical Principles" provides a step-by-step overview of the treatment of the ophthalmic plastic surgery patient, from preoperative patient evaluation through postoperative care. The fundamental principles and techniques essential to success in ophthalmic plastic surgery are similar to those that underlie other branches of surgery. Careful attention to detail, meticulous surgical technique, and an utmost respect for the functional requirement of the eye are of paramount importance. A surgeon who is well versed in fundamental surgical principles and techniques will avoid unnecessary complications and the requirement for secondary procedures.

Keywords: ophthalmic plastic surgery, preoperative evaluation, anesthesia, surgical instruments, hemostasis, reconstruction, postoperative care

1.1 Introduction

The fundamental principles and techniques essential to success in ophthalmic plastic surgery are similar to those that underlie other branches of surgery. Careful attention to detail, meticulous surgical technique, and an utmost respect for the functional requirement of the eye are of paramount importance. A surgeon who is well versed in fundamental surgical principles and techniques will avoid unnecessary complications and the requirement for secondary procedures.

1.2 Preoperative Patient Evaluation

The surgeon should develop a routine for questioning and examining patients to avoid omitting important questions or crucial aspects of the examination. Obtaining a careful detailed history about the presenting problem from the patient is essential. Details should also be obtained about the past ophthalmic history, past medical and surgical history, current medications, allergies, family, and social history. Time spent in obtaining the history has additional benefits:

- It provides the surgeon with information about the patient's potential expectations.
- It provides an opportunity for the surgeon to establish a rapport with the patient.
- It allows the surgeon to simply observe the patient and detect subtle physical signs, which may otherwise be overlooked, such as signs of aberrant reinnervation of the facial nerve, blepharospasm, hemifacial spasm, an abnormal head posture, frontalis overaction, and facial asymmetries.

The patient examination should be methodical. A record of the patient's corrected visual acuity and a basic ophthalmic examination should form part of the assessment of every patient presenting with an eyelid, orbital, or lacrimal disorder. The detailed examination methods for various conditions are discussed in their respective chapters. Any ancillary laboratory or imaging investigations should be selected on the basis of the clinical evaluation of the patient and not simply performed as a blind "workup."

It may be helpful to obtain copies of patient records from other institutions where the patient has previously been treated. The details of previous surgical procedures, the results of previous investigations and imaging, and original histology slides should be sought wherever this is relevant. A review of previous imaging and histology slides rather than a reliance on previous reports can prove to be invaluable.

1.3 Documentation

The surgeon must ensure careful and accurate documentation of the history and examination findings as well as the diagnosis, management plan, and preoperative discussion with the patient.

High-quality preoperative photographs should always be taken. These are essential for patients who will be having ophthalmic plastic and reconstructive surgery. They serve a number of useful and important purposes:

- A learning and teaching aid for the surgeon.
- A verification of the patient's disorder for health care insurance companies.
- An aid to defense in the event of a medicolegal claim.
- An aid to the patient in legal proceedings after accidents and assaults.
- To jolt the postoperative memory of a forgetful patient.

Key Point

Written patient consent should be obtained before the photographs are taken. It should be made clear to the patient how the photographs may be used.

The treatment options should be discussed with the patient. This should include the option of not being treated. The advantages, disadvantages, risks, and potential complications should be discussed with the patient and relatives if possible. The risks and the incidence of complications need to be outlined in an open and honest manner. Serious or frequently occurring risks must be discussed and documented. This should be undertaken in a manner that neither frightens nor offends. The consequences of complications and their management should also be outlined. If the patient expresses a wish not to be given this information, this must be clearly documented. The consultation should be followed by a detailed letter summarizing this information, which should be sent to the patient's family practitioner with the patient's permission, and a copy should be sent to the patient or, in the case of children, to the parents.

Any periocular surgical procedure can be associated with serious ophthalmic complications. The surgeon should therefore avoid describing any periocular procedure as "basic," "straightforward," "simple," "minor," or "routine."

Key Point

For purely elective procedures, the patient should be encouraged to consider the information carefully before making a decision to proceed. This may necessitate a further consultation or attendance at a preassessment clinic to obtain fully informed consent and to answer any residual queries. This is particularly important for a patient seeking aesthetic surgery. The patient should not be asked to sign a consent form for an elective procedure on the day of surgery. The risks and potential complications that have been discussed should be documented in the patient's records.

A surgeon who is fully conversant with the nature of the surgery and who is qualified to take informed consent from a patient should complete the surgical consent form. The consent form must be legible and must document the correct side and the precise details of the surgical procedure to be undertaken without the use of abbreviations. All known risks, particularly serious or common risks, must be documented on the consent form and in the patient's records, and it is wise to include these in the postconsultation correspondence.

1.4 Selection of the Appropriate Surgical Procedure

The surgical procedure that is best suited to the individual requirements of the patient should be selected; for example, a patient whose other eye has poor visual function should not be subjected to a Hughes tarsoconjunctival flap procedure for the reconstruction of a lower eyelid defect. An alternative surgical procedure should be selected.

An operation that is not indicated will not benefit a patient no matter how skillfully it is performed. For example, a patient whose blepharoptosis is related to giant papillary conjunctivitis that has been overlooked by the failure to evert the upper eyelid will not benefit from any surgical procedure.

The patient's age and general health must be taken into consideration. Under certain circumstances the patient's best interests may be served by advising against surgical intervention.

1.5 Surgical Planning and Communication

Each procedure should be planned carefully. The timing of surgical intervention may be crucial to the outcome (e.g., an orbital floor blowout fracture with signs of orbital tissue entrapment in a child should be managed without delay, whereas for the same clinical scenario in an adult a delay of 10 to 14 days or more is usually advisable). Any significant delay in the management of a child could result in an ischemic contracture of the inferior rectus muscle with a poor prognosis for the restoration of a satisfactory field of binocular single vision.

Preoperative planning ensures that the surgical team is aware of the required instrumentation and materials. For elective operations, it is ideal to run a preassessment clinic in conjunction with a specialist oculoplastic nurse who can coordinate preoperative investigations, ensure that investigation results are communicated to the anesthetist, communicate potential problems such as undiagnosed hypertension to the general practitioner, and liaise with the operating theater nursing team regarding factors such as ensuring that the required range of orbital implant sizes and socket conformers is available. The operating list should be detailed and should not contain abbreviations referring to surgical procedures.

The scrub nurse needs to be aware of the required preparation and draping of the patient, including the proposed site for the harvesting of a skin graft or dermis fat graft. This ensures that the procedure can be performed efficiently, minimizing tissue exposure and operating and anesthetic time, and thereby minimizing risks to the patient. Preoperative planning is essential when operating as a team with other surgical disciplines.

The lead surgeon who will be responsible for coordinating the preparations for surgery should be determined in advance.

The details of the planned surgical approach should be communicated to the anesthetist. The anesthetist is an essential member of the team and should know details about the following:

- The anticipated duration of the operation.
- Special positioning of the patient, such as to harvest a dermis fat graft from the buttock.
- The potential sites for harvesting autologous tissue (e.g., upper inner arm sites may affect the siting of intravenous lines and a blood pressure cuff).
- The requirement for hypotensive anesthesia.
- The potential blood loss.
- The potential risk of an oculocardiac reflex (e.g., during an enucleation or secondary orbital implant procedure).
- Vasoactive agents to be used intraoperatively, including their concentration and volume (e.g., subcutaneous local anesthetic agent injections with adrenaline, topical intranasal cocaine solution).
- The potential for postoperative pain (e.g., severe pain may be experienced after an enucleation with placement of an orbital implant, requiring opiate analgesia, whereas severe pain after a lateral orbitotomy may indicate a retrobulbar hemorrhage, which should be investigated and not merely suppressed with opiates).
- The necessity to avoid anti-inflammatory agents for a patient after intraorbital surgery.
- The requirement for a throat pack.
- The requirement to position the endotracheal tube in a specific location (e.g., to one side of the mouth or intranasally when harvesting a mucous membrane graft or hard palate graft).

These details should also be discussed at the time of the World Health Organization (WHO) surgical safety checklist in the operating department before the commencement of the operating list and again at the "time out" discussion before the initiation of anesthesia and for each individual patient.

1.6 Selection of the Most Appropriate Type of Anesthesia

Several types of anesthesia are available:

- Topical anesthesia.
- Local anesthesia.

- Local anesthesia with intravenous sedation.
- Regional anesthesia.
- General anesthesia.

The selection of the type of anesthesia for an individual patient depends on multiple factors:

- The age of the patient.
- The general health and emotional status of the patient.
- The extent and anticipated duration of the surgery.
- The requirement for intraoperative patient cooperation.

The chosen anesthesia should allow the surgeon to complete the surgery in a safe and controlled manner while providing the best possible degree of comfort for the patient. This should be discussed with the patient in advance.

1.6.1 Topical Anesthesia

Local anesthesia may be applied topically (e.g., Minims proxymetacaine by pledget in the inferior fornix to perform a forced duction test). Proxymetacaine causes a minimal degree of discomfort and acts very rapidly. For this reason it is preferred over other topical anesthetic agents for surface anesthesia of the cornea and the conjunctiva. Topical anesthetic agents last for only a short time and should be instilled at regular intervals during surgery on a conscious patient. Care should also be taken to ensure that the anesthetized cornea is protected during the course of surgery (e.g., Lacri-Lube ointment should be instilled into both eyes after the application of the topical anesthetic agent if a traction suture has not been used to close the eye).

Topical agents applied to the skin are very useful to reduce the pain of injections, such as EMLA cream, which contains lidocaine and prilocaine, and is applied to the eyelids before the injection of a local anesthetic agent. A minimum delay of 10 to 15 minutes should be allowed before injection, and great care should be taken to ensure that the cream does not enter the eye. The same topical agent can be very effective for other procedures, such as the injection of a soft tissue filler for the cosmetic improvement of nasolabial folds associated with a midface ptosis. However, a minimum period of 30 to 45 minutes is required for the topical agent to take effect in an area of the face where the skin is significantly thicker.

Topical cocaine 5% is a very effective topical anesthetic agent for use in intranasal surgery, such as a dacryocystorhinostomy (DCR). Co-Phenylcaine (a phenylephrine–lidocaine mixture) nasal spray is a very effective topical anesthetic agent for use in intranasal examinations and minor intranasal procedures in the clinic.

1.6.2 Local Anesthesia

Local anesthesia is most commonly achieved by local infiltration with either lidocaine 2% containing 1:80,000 units of epinephrine for relatively short procedures or bupivacaine (0.5% for adults and 0.25% for children) containing 1:200,000 units of epinephrine for longer procedures. For some procedures, it is preferable to use a 50:50 mixture of lidocaine and bupivacaine. A period of 5 to 10 minutes should be allowed for the local anesthetic agent and the adrenaline to take effect. The duration of action of lidocaine is approximately 45 to 60 minutes, whereas that of bupivacaine is approximately 2 to 3 hours. The amount of local anesthetic agent used in relation to the age and body weight of the patient should be noted and care taken not to exceed safe levels, particularly in children. The anesthetic agent should be warmed before use to reduce the pain associated with its injection.

Subcutaneous injections in the eyelid should be placed just beneath the skin, avoiding injection into the orbicularis muscle. This reduces the risk of causing a hematoma, which can distort the tissue planes and cause a mechanical ptosis in the upper eyelid, making ptosis surgery more difficult to perform. The volume used in the eyelids should rarely exceed 1 mL per eyelid for most procedures. A 25-gauge, 24-mm needle is used to avoid the need for multiple injections, which further predispose to bleeding and hematoma. If only a small central area of the eyelid needs to be injected, it is preferable to use a 30-gauge needle. Injections into the eyelid should be performed from the temporal side of the patient, with the needle parallel to and not toward the eyelid. This reduces the risk of perforation of the globe in the event of sudden inadvertent movement of the patient. Immediate pressure and massage should be applied over the injection site for 5 minutes.

Additional local anesthetic agent should be kept available in a sterile syringe on the scrub nurse's cart in case it is required during the surgical procedure.

The use of subconjunctival injections is preferable for some procedures, such as a posterior approach Müller's muscle resection, because this minimizes the risk of an upper lid hematoma, but great care must be taken to protect the eye during the course of such injections.

1.6.3 Local Anesthesia with Sedation

Many oculoplastic procedures can be safely and satisfactorily performed with the use of a combination of local anesthesia and neuroleptic sedation. An anesthetist can provide safe conscious sedation and monitoring and management, if required, of a variety of medical conditions (e.g., hypertension, arrhythmias) while providing safe intravenous sedation, which can be titrated to the individual patient's requirements and rapidly reversed. The agent most commonly used for this purpose is propofol. This drug is ideal for an anxious adult patient who requires a levator aponeurosis advancement or a Müller's muscle resection. The patient is sedated during the administration of the injections but is fully cooperative during the intraoperative assessment and adjustment of the eyelid height and contour. For a more invasive, potentially painful procedure in an elderly patient, such as an enucleation, midazolam and an opiate can be used in addition (e.g., remifentanil, a potent ultrashort-acting synthetic opioid analgesic drug). The agents selected by the anesthetist should take into consideration whether the patient is undergoing the procedure on an outpatient or an inpatient basis.

Great care must be taken when administering periocular local anesthetic injections to a sedated patient. Such a patient may lose all inhibitions and become aggressive during a painful injection. This should be anticipated and assistance sought to prevent the patient from moving or raising his or her hands toward the face. This is particularly important in younger, strong

patients. For such patients only light sedation should be used. In addition, the operating team and the anesthetist should be fully aware of the risk posed by the sternutatory (sneeze) reflex. This reflex affects a large proportion of patients sedated with midazolam and propofol. The reflex is suppressed by deep sedation and by the additional administration of an opiate such as remifentanil. The reflex may occur without warning and poses a risk during the administration of local anesthesia around the eye.

Key Point

Safe conscious sedation for oculoplastic procedures requires skill and experience on the part of the anesthetist and a good understanding of the procedure to be performed and the surgeon's requirements. Intravenous sedation should be used with great caution during lacrimal drainage surgery, because the airway may not be adequately protected from the effects of bleeding or the use of irrigation fluid.

1.6.4 Regional Anesthesia

Regional nerve blocks are useful to supplement the effects of subcutaneous injections for a limited number of surgical procedures under local anesthesia. An infratrochlear block can be combined with local tissue infiltration and intranasal cocaine for an external DCR. A peribulbar injection of 0.5% bupivacaine with 1:200,000 units of adrenaline mixed with hyaluronidase is ideal for an enucleation or evisceration procedure. Regional nerve blocks targeting the supraorbital, supratrochlear, infratrochlear, infraorbital, zygomaticofacial, zygomaticotemporal, and lacrimal nerves in addition to such a peribulbar injection, in combination with safe intravenous sedation, can permit an orbital exenteration to be performed on a conscious patient who is unfit for general anesthesia.

1.6.5 General Anesthesia

General anesthesia is required for children and uncooperative patients and is indicated for longer and more extensive surgical procedures, such as a lateral orbitotomy. It is also required to protect the airway of patients undergoing procedures that are likely to result in bleeding from the nose or mouth. The patient's general health will determine the suitability of the patient for general anesthesia. A patient with a history of general medical disorders who is to undergo elective surgery should be identified to the anesthetist at the preassessment clinic.

Bupivacaine injections containing adrenaline (1:200,000 units) are used in combination with general anesthesia to assist hemostasis and to provide immediate postoperative pain relief. The use of such injections in combination with hyaluronidase before enucleation or evisceration surgery can be very effective in blocking the effects of the oculocardiac reflex. The anesthetist should be made aware of the potential for such a reflex, which can cause severe bradycardia and, rarely, asystole.

1.7 Surgical Instrumentation

The variety of delicate surgical instruments used in ophthalmic plastic surgery attests to the special demands of surgery in this region.

A basic ophthalmic plastic surgery instrument set should be available for oculoplastic cases (▶ Fig. 1.1a). Separate instrument sets should be available for enucleation and evisceration (▶ Fig. 1.1b), external DCR (▶ Fig. 1.1c), endoscopic DCR and endoscopic browlift surgery (▶ Fig. 1.1d), and orbital surgery (▶ Fig. 1.1e). A variety of accessory instruments should be readily available (▶ Fig. 1.1f). These instruments must be kept in good repair and should be respected and used appropriately. Alternatively, consideration can be given to the use of disposable instruments that are now of very good quality. Inappropriate use of instruments can result in damage to delicate instruments and damage to tissues. The nurse assistant should ensure that dried blood, tissue, and char are carefully removed from the instruments as they are handed back during the course of surgery. The surgeon should ensure that the instruments are carefully handed to the nurse assistant to prevent injury from sharp blades and needles.

Key Point

The surgeon should ensure that instruments are never passed across the patient's face.

A number of basic principles apply to the use of ophthalmic instruments. Toothed forceps or skin hooks should be used to avoid crushing and damaging tissue. A variety of forceps of varying size are available and should be selected according to the type of tissue to be handled. The most commonly used toothed forceps to assist with dissection of the eyelids are Paufique forceps. The 0.12 Castroviejo forceps are ideal for the handling of delicate eyelid skin when suturing. Skin hooks must be handled with great care to prevent inadvertent injury to the globe. The eyelid skin is very delicate, and it is preferable to hold and lift the underlying orbicularis muscle, and not the skin, to dissect underlying tissue planes. Adson forceps are more robust and are used for handling the cheek, lower face, and scalp tissues.

A variety of scissors may be used during surgery. These may be curved, straight, sharp, or blunt-tipped. Curved, blunt-tipped Westcott scissors are used for the dissection of tissue planes in eyelid surgery and conjunctival surgery. They should not be used to blunt-dissect tissue planes. Stevens tenotomy scissors are more appropriate for this purpose and for the dissection of thicker tissue, such as a glabellar flap. Straight iris scissors are used for eyelid wedge resections. Straight Stallard scissors should be used for the removal of skin in a lower lid blepharoplasty.

Gross separation of tissue planes should be accomplished with blunt-tipped Stevens tenotomy scissors, which minimize the risk of bleeding; for example, they are used to blunt dissect Tenon's fascia from the globe in an enucleation and the orbicularis muscle in an external DCR. Sharp-tipped iris scissors are used for performing eyelid wedge resections. Small suture scissors should be used for cutting sutures.

A Colorado or short Megadyne needle is an efficient instrument for the precise, delicate, and bloodless dissection of tissue planes in the eyelids. An earthing plate must first be attached to the patient, and care must be taken to ensure that the patient has removed all metallic objects from their clothing. The needle has

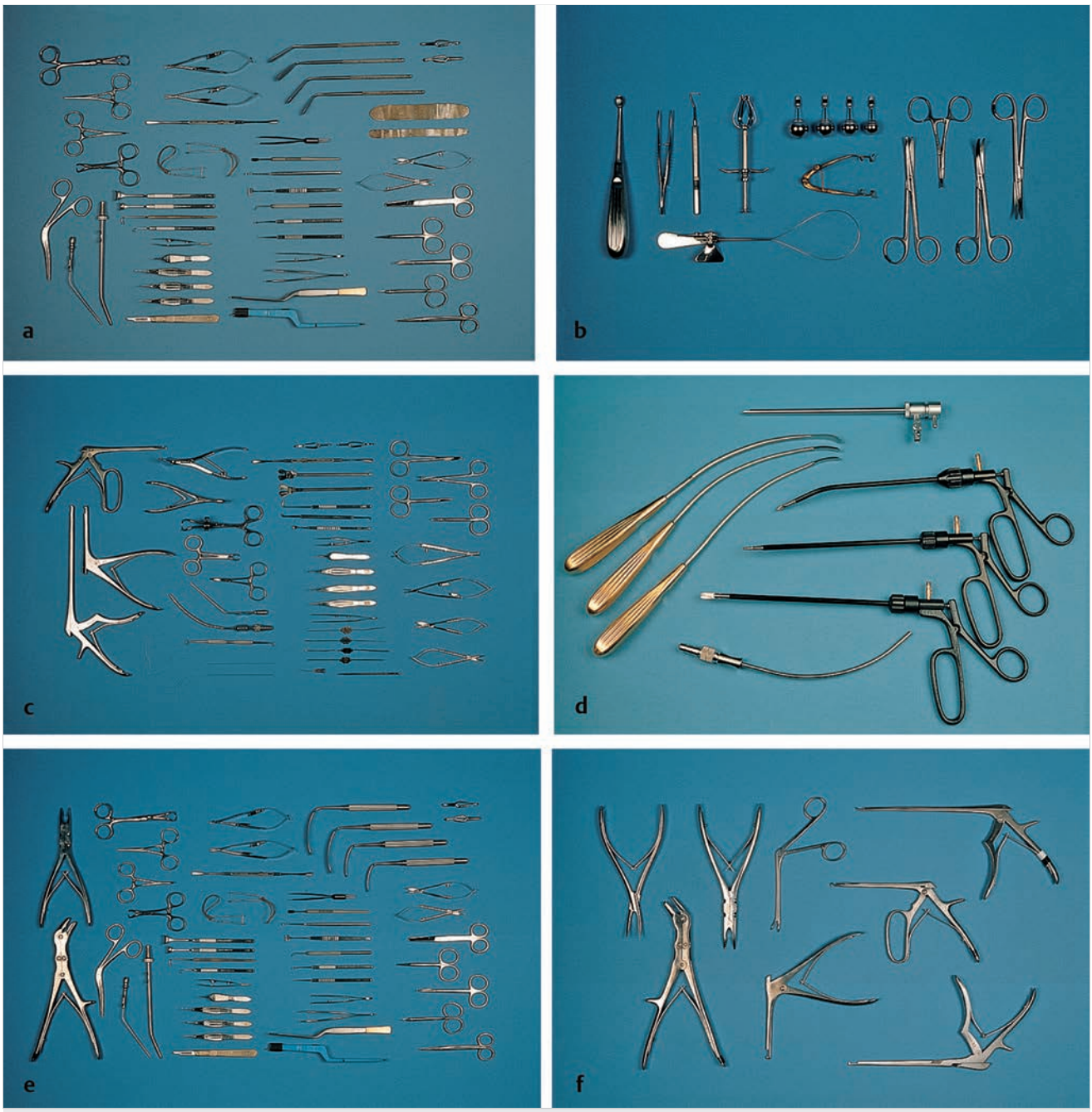

Fig. 1.1 Basic instrument sets. **(a)** A basic oculoplastic instrument set (nondisposable). **(b)** An enucleation and evisceration instrument set. **(c)** An external dacryocystorhinostomy instrument set. **(d)** Endoscopic browlift instruments. Many of these instruments are now redundant, because the use of the endoscope for this procedure has greatly diminished. **(e)** A basic orbitotomy instrument set. **(f)** A variety of accessory bone rongeurs and forceps for orbital surgery.

both cutting and monopolar coagulation modes. It is used in conjunction with a Valleylab diathermy machine (▶ Fig. 1.2). I use this instrument ubiquitously in my practice for making skin crease incisions, subciliary incisions, and transconjunctival incisions in addition to general eyelid dissections (e.g., to perform blepharoplasties or to expose the levator aponeurosis and the inferior orbital margin). Alternatively, it can be used for soft tissue dissection in the eyelids after making the initial skin incision with a No. 15 Bard Parker blade. Its use requires a dry surgical field. The tissues to be dissected should be held under some tension. The tip of the needle should be moved constantly across the tissue to be dissected when the instrument is activated to avoid burning the tissues and should be used with a delicate stroking motion without applying pressure to the tissues.

Artery clips are used routinely to fix traction sutures and Jaffe retractor bands to the surgical drapes. Curved clips that lie flat against the surface of the drapes are preferable to straight clips. To fix the suture or bands, one limb of the clips should lie beneath a fold of the drapes before the clips are closed.

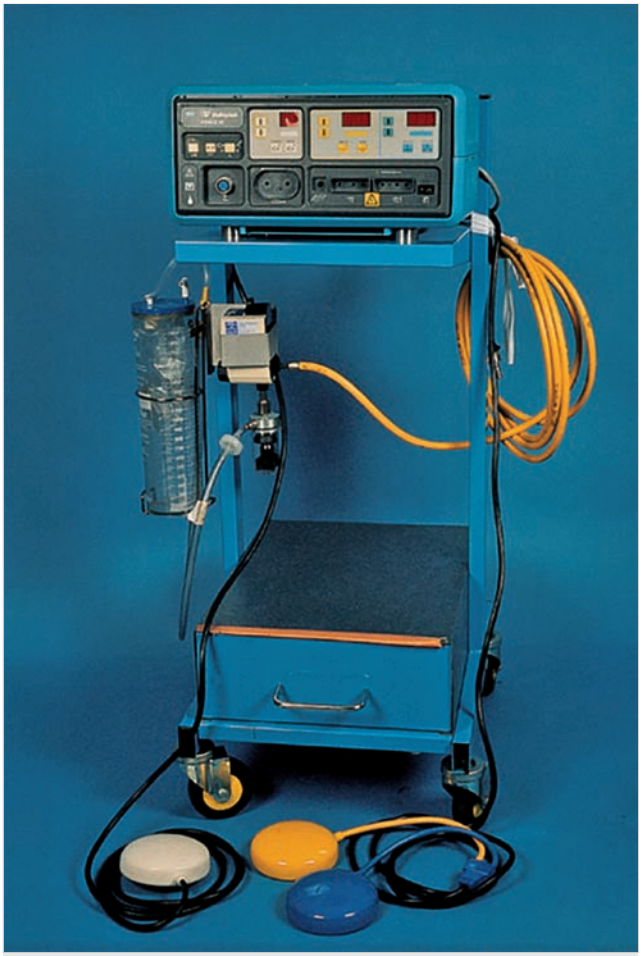

Fig. 1.2 A Valleylab diathermy machine.

Enucleation scissors in a variety of curvatures and sizes should be available and used whenever the use of a snare is inappropriate, such as where a long piece of optic nerve is required, in the presence of a soft globe, a previous corneal section, or a penetrating keratoplasty. A snare may transect the posterior aspect of a soft globe and can cause a globe weakened by previous surgery to rupture, causing intraocular fluid to spray out under pressure. A snare is otherwise very useful for enucleation surgery, and its use is associated with minimal bleeding (▶ Fig. 1.3).

Spring-handle needle holders are available in a variety of sizes and may be curved or straight. These are excellent for use in oculoplastic surgery. These are selected according to the size of needle to be used. Needle holders designed to hold small needles, such as a 7–0 Vicryl suture needle, will be damaged if used inappropriately to hold larger needles. The Castroviejo needle holders are preferred, because they have a simple locking mechanism that permits the needle to be loaded securely and held between suture passes. Ring-handle needle holders (e.g., the Webster needle holder) are used to hold suture needles larger than 4–0.

A variety of bone punches are available for bone removal, such as for an external DCR (▶ Fig. 1.1f). It is important that these are used appropriately. The delicate bone of the lacrimal fossa floor can be removed using a fine punch, such as a Hardy sella punch.

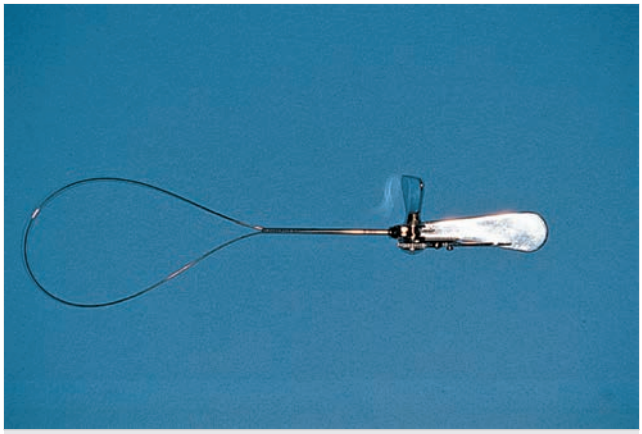

Fig. 1.3 An enucleation snare.

This should then be replaced by progressively larger Kerrison rongeurs for the removal of the anterior lacrimal crest and nasal bone. The continued use of the delicate Hardy sella punch for the thicker bone will result in damage to this instrument.

1.8 Correct Surgical Site Marking and Allergy Check

It is the responsibility of the surgeon to ensure that he or she has seen the patient before surgery and has clearly marked the correct surgical site after carefully checking the patient's consent form and the patient's identification bracelet. As mentioned previously, when the patient arrives in the anesthetic room, the surgeon should pause. This pause before anesthesia and surgery, or time out, forces everyone to slow down for a few moments and double check what they are about to do.

The surgeon should follow the hospital's agreed protocol to ensure that the correct patient has arrived; that every member of the surgical team agrees that the correct operation is to be performed on the correct side; that the appropriate scans are available; and that all required surgical equipment, implants, and disposables are available. In addition, where appropriate, the availability of cross-matched blood should be checked and the availability of a pathologist confirmed whenever a frozen section is required. A checklist should be completed and signed.

The surgeon should check the patient's allergy history before giving any injections and before prepping the patient. The surgeon should also inform the anesthetist before the administration of any injections. The surgeon should always prep and drape the patient himself or herself and should not allow himself or herself to be distracted during this very important process.

The surgeon should also ensure that all members of the surgical team are wearing eye protection prior to the commencement of surgery and that suction is available for the evacuation of surgical smoke.

Key Point

The surgeon should ensure that "time out" is called before the commencement of anesthesia and surgery.

1.9 Preparation and Draping of the Patient

If local anesthesia with or without sedation is used, the whole of the patient's face should be cleaned with povidone-iodine solution diluted 50:50 with sterile water or saline, starting with the eyelids and moving outward. If the patient is allergic to povidone or iodine, aqueous chlorhexidine can be used instead. The face should then be dried. If general anesthesia is used, the area to be operated on should be cleaned, but both eyes should be left exposed if there is a need to check the symmetry of the globe positions. Additional areas may need to be cleaned, such as the postauricular area or the upper inner arm if a skin graft is required. The eyes should be instilled with a preservative-free lubricant ointment. The drapes should be applied by the surgeon in a manner that ensures no restriction on the movement of a local tissue flap or pressure on the eyebrow when undertaking a ptosis procedure.

1.10 Surgical Incision and Exposure

Incisions should be planned preoperatively to provide adequate surgical access and yet result in a minimally conspicuous scar. Wherever possible, skin incisions should be planned to follow the relaxed skin tension lines (RSTL). These lines lie within normal skin creases or folds, enabling incisions to be hidden or disguised (▶ Fig. 1.4). The lines correspond to the directional pull existing in relaxed skin; this is determined by the underlying structures and the depth of subcutaneous tissue and fat. Incisions that run parallel to the RSTL tend to remain narrow after wound closure, unlike those running perpendicular to them, which are more likely to gape.

Incisions that interrupt lymphatic drainage (e.g., incisions directly over the infraorbital margin) should be avoided, because they can lead to persistent postoperative lymphedema.

Skin incisions should be marked before the injection of the local anesthetic agent, which may obscure anatomical landmarks such as the upper eyelid skin crease. Marking is best achieved with a cocktail stick inserted into a gentian violet marker block (▶ Fig. 1.5a). This results in a fine line (▶ Fig. 1.5b). Grease on the skin surface should first be removed with a small alcohol wipe so that the marks are not inadvertently lost when the face is prepped with povidone-iodine solution.

For very young patients or patients who are prone to hypertrophic or keloid scar formation (▶ Fig. 1.6), skin incisions may be avoided for certain procedures. For example, a DCR may be performed endoscopically and an orbital floor blowout fracture may be approached via a conjunctival incision.

Skin incisions which are commonly used in ophthalmic plastic surgery are shown in ▶ Fig. 1.7. The Stallard Wright lateral orbitotomy incision is used for older patients, but for younger patients an upper lid skin crease incision is used instead, and the incision carried into a "laughter" line at the lateral canthus.

Skin incisions should be made perpendicular to the skin surface, except in the eyebrow region or scalp, where the incision should be beveled. For eyelid skin incisions, the Colorado needle is a very effective alternative to the use of a No. 15 Bard Parker blade. It results in less bleeding and permits a layer-by-layer dissection of the tissues, allowing identification of blood vessels that can be cauterized before they are cut.

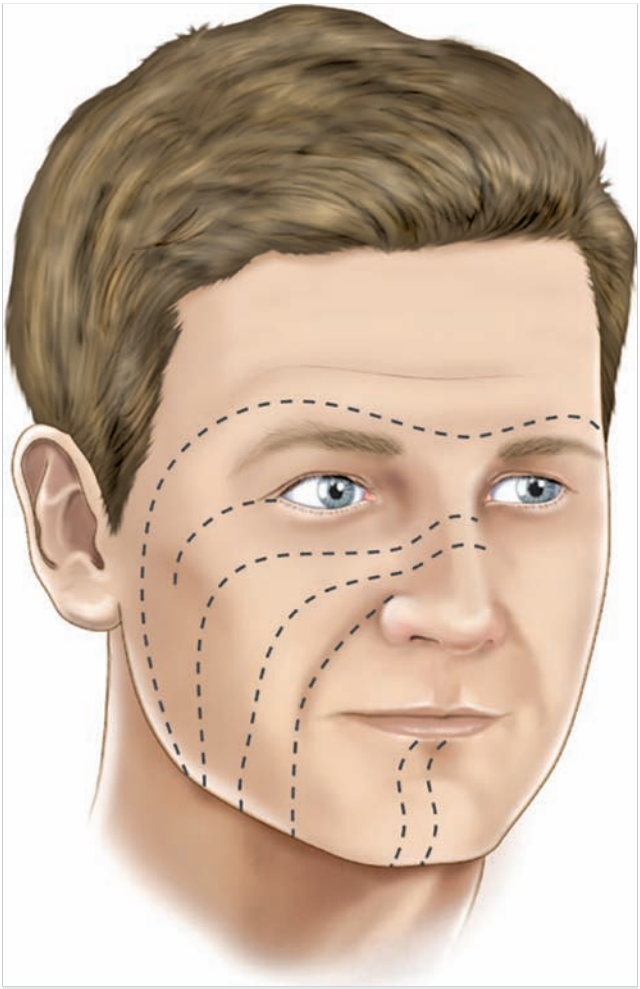

Fig. 1.4 Relaxed skin tension lines.

When making a skin incision with either a blade or the Colorado needle, the incision should be made with a continuous motion to avoid jagged wound edges. The skin should be held taut. Skin incisions in the eyelids are aided by the use of 4–0 silk traction sutures placed through the gray line. A 4–0 black silk suture on a reverse-cutting needle is passed into the gray line of the eyelid and the curvature of the needle followed until the needle emerges from the gray line again. The delicate eyelid skin should be held with fine-toothed forceps, such as Bishop Harmon forceps. Skin hooks should be used with great care in the periocular region because of the risk of inadvertent injury to the globe.

Incisions along the gray line of the eyelids, such as a gray line split into the upper eyelid as part of an upper eyelid entropion procedure, or in both eyelids as part of a tarsorrhaphy procedure, should be made with a Beaver microsharp blade (7530) on a Beaver blade handle (▶ Fig. 1.8).

Surgical exposure is aided by the use of a variety of retractors or by the use of traction sutures. In upper eyelid levator surgery or an orbital floor fracture repair, self-retaining Jaffe retractors enable the surgeon to operate without needing a surgical assistant, unlike with Desmarres retractors (▶ Fig. 1.9). Desmarres

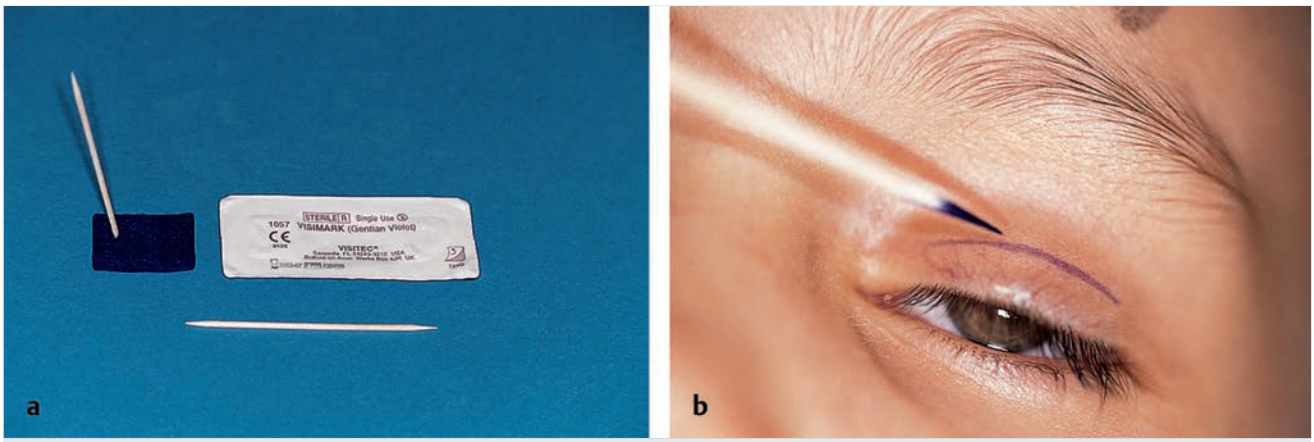

Fig. 1.5 **(a)** A gentian violet pad used with a cocktail stick. **(b)** An upper eyelid skin crease incision being marked with a cocktail stick that has been inserted into a gentian violet marker pad.

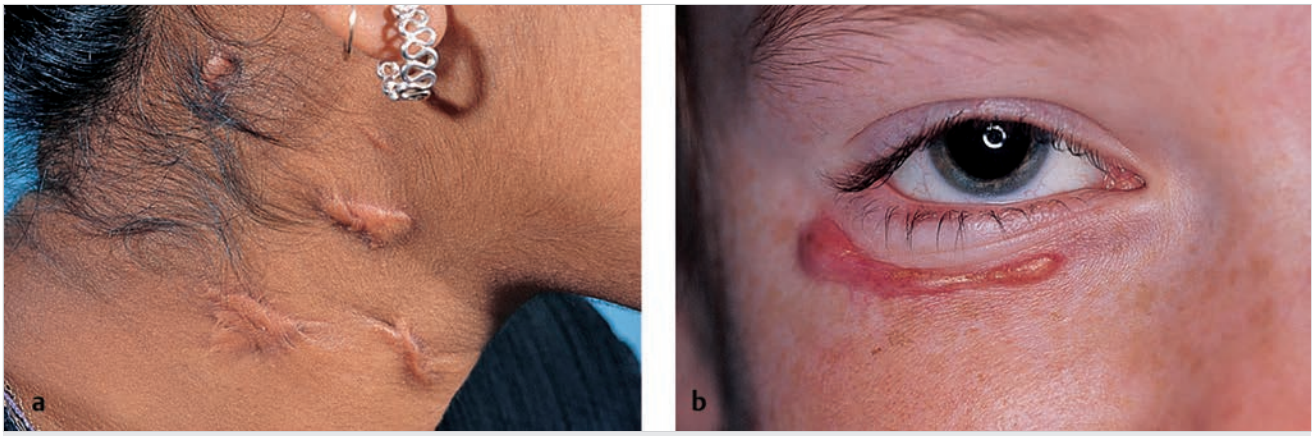

Fig. 1.6 **(a)** Keloid scarring in an Asian patient. **(b)** A lower eyelid hypertrophic scar.

retractors are very useful and are available in different sizes. They are also used to evert the upper and lower eyelids in conjunction with a gray line traction suture for posterior-approach surgery, such as a posterior approach Müller's muscle resection. It is important to use the appropriate size of Desmarres retractor to evert the eyelid and avoid undue pressure being applied to the supraorbital margin by the retractor when everting the upper eyelid.

Sewall retractors (▶ Fig. 1.10) are used to retract the orbital contents during an orbital fracture repair, an orbital decompression, or an orbital exenteration. The blades are available in different sizes and should be selected appropriately. They can be used in conjunction with a piece of Supramid to improve the retraction of orbital fat during these procedures. Typically, these retractors are placed into the subperiosteal space. Great care, however, must be taken by the assistant when using these retractors, because extreme force can be applied to the globe. In addition, it is easy to "toe-in" the tip of the retractor and tear the periorbita. This can also lead to direct trauma to the optic nerve.

Wright retractors (▶ Fig. 1.11) are more delicate retractors that are used to retract tissues in the orbit during the course of the exploration of an orbital mass or during the course of an optic nerve sheath fenestration. Malleable retractors are mainly used to protect the orbital contents from the use of drills and saws. The use of retractors in orbital surgery is discussed in more detail in Chapters 19 to 20.

Traction sutures not only improve surgical exposure but also assist in hemostasis, such as in an external DCR (▶ Fig. 1.12).

Safe surgical dissection is greatly facilitated by adequate magnification and illumination of the surgical field. The surgeon should wear surgical loupes, which do not unduly restrict the visual field. The loupes should be comfortable and should not require adjustment; typically, they provide 2.5 to 3.5 times magnification; they should be fitted with protective side shields (▶ Fig. 1.13a).

The use of a headlight offers a number of advantages over an overhead operating lamp. The light is always focused on the surgical field, which is not placed in shadow by the surgeon or assistant's hands. The use of a headlight is essential in surgery within cavities, such as an external DCR or an orbital decompression. Modern lights can be fitted to the surgical loupes and turned on and off by the surgeon by a switch that is operated by the inside of the elbow and worn beneath the surgical gown (▶ Fig. 1.13b).

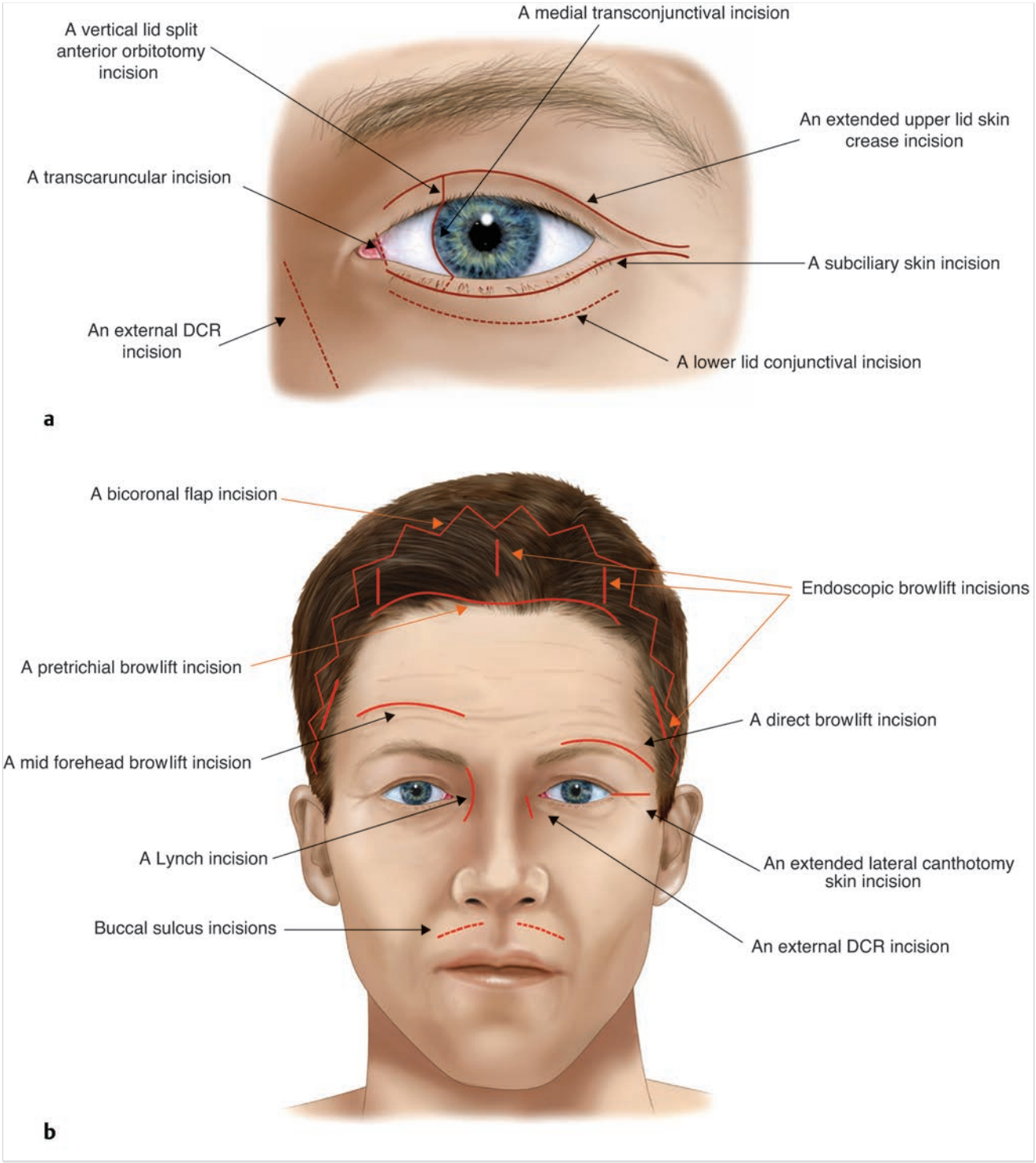

Fig. 1.7 **(a)** Periocular incisions commonly used in ophthalmic plastic surgery. **(b)** Periocular and facial incisions commonly used in ophthalmic plastic surgery DCR, dacryocystorhinostomy.

(*Continued*)

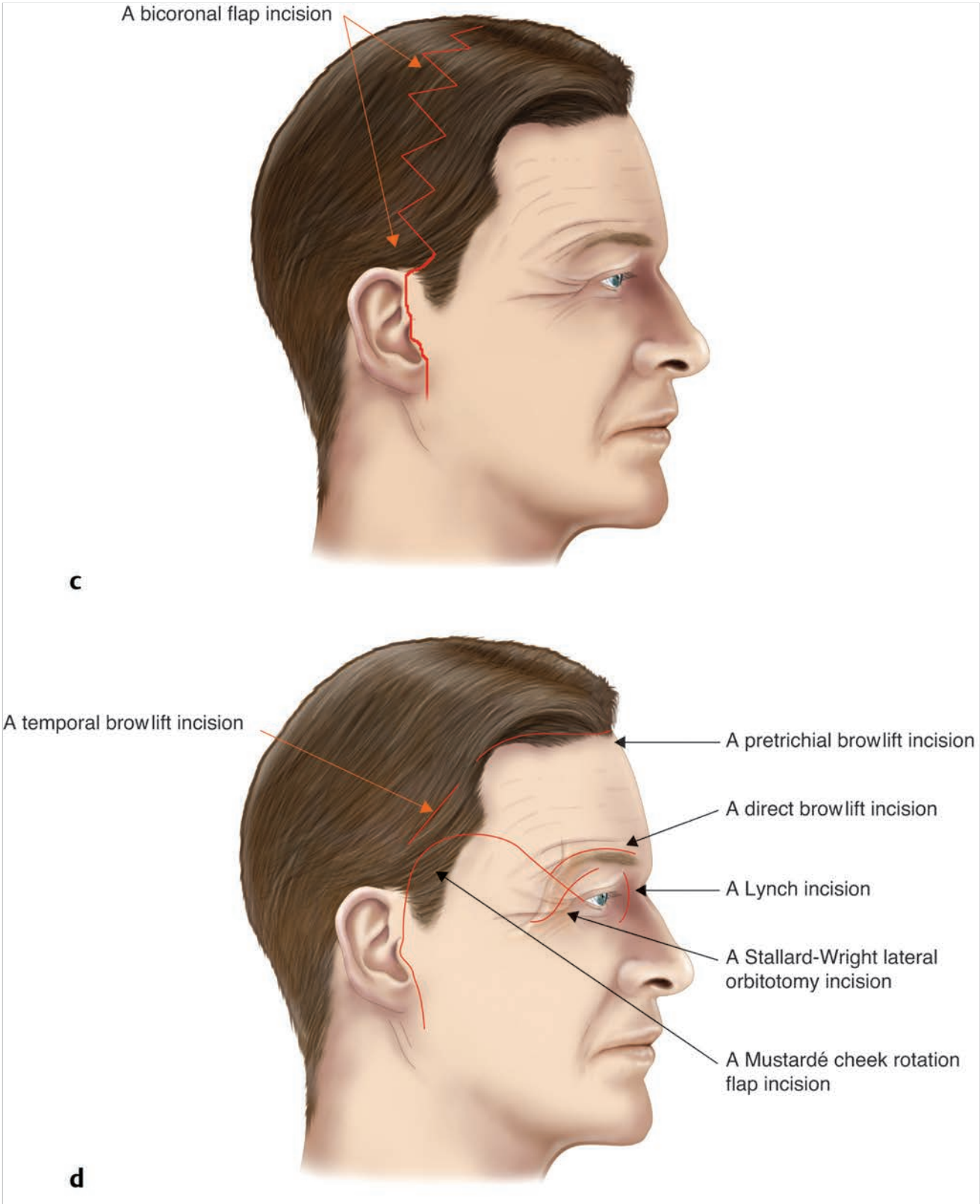

Fig. 1.7 **(c)** A bicoronal flap incision extended as a facelift incision. **(d)** Some examples of periocular and facial incisions commonly used in ophthalmic plastic surgery.

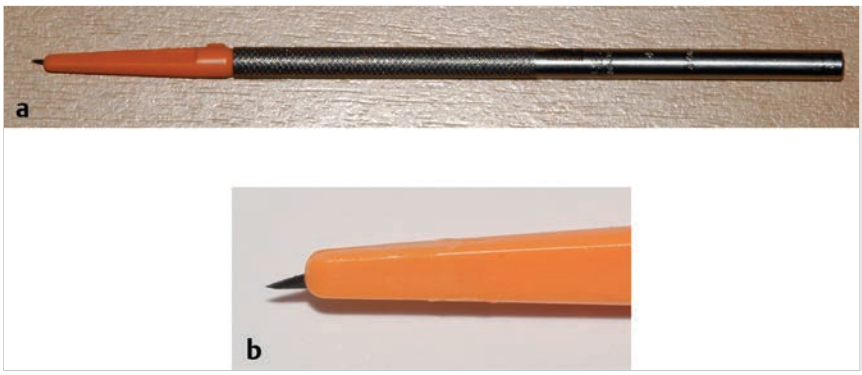

Fig. 1.8 **(a)** A microsharp blade on a Beaver blade handle. **(b)** A close-up of the disposable blade.

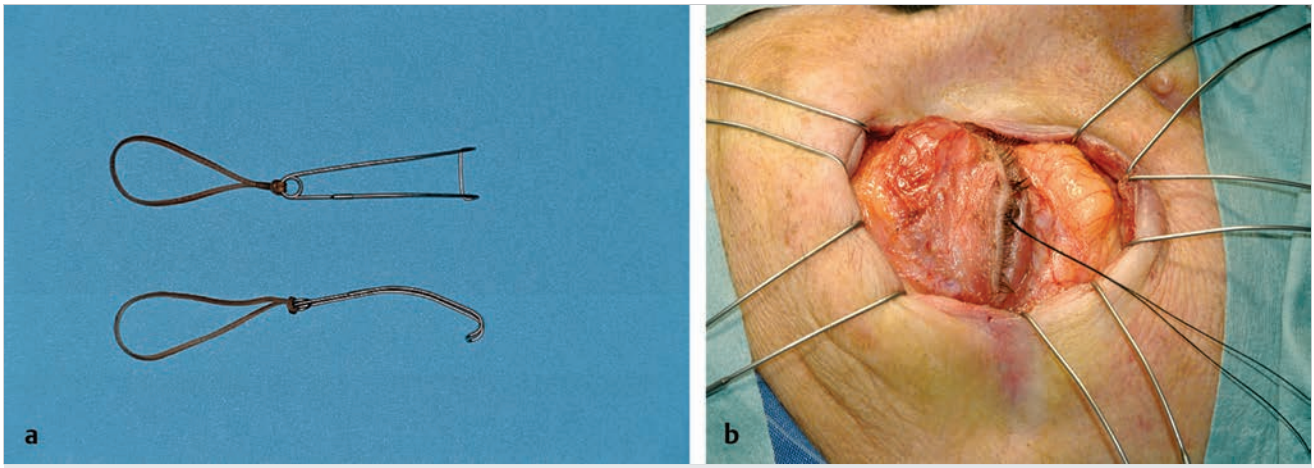

Fig. 1.9 **(a)** Jaffe retractors. **(b)** Use of the Jaffe retractors for an orbital exenteration.

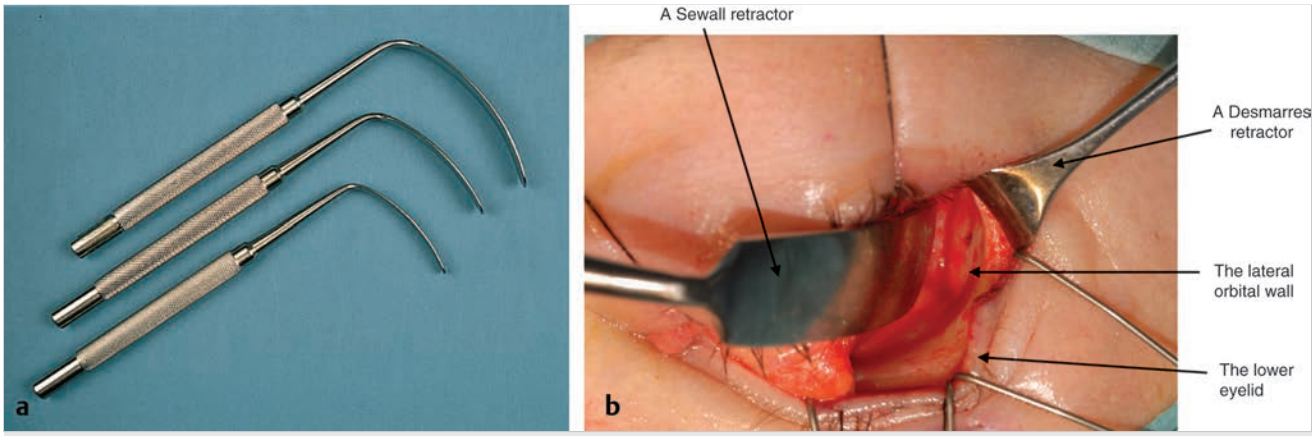

Fig. 1.10 **(a,b)** Sewall retractors.

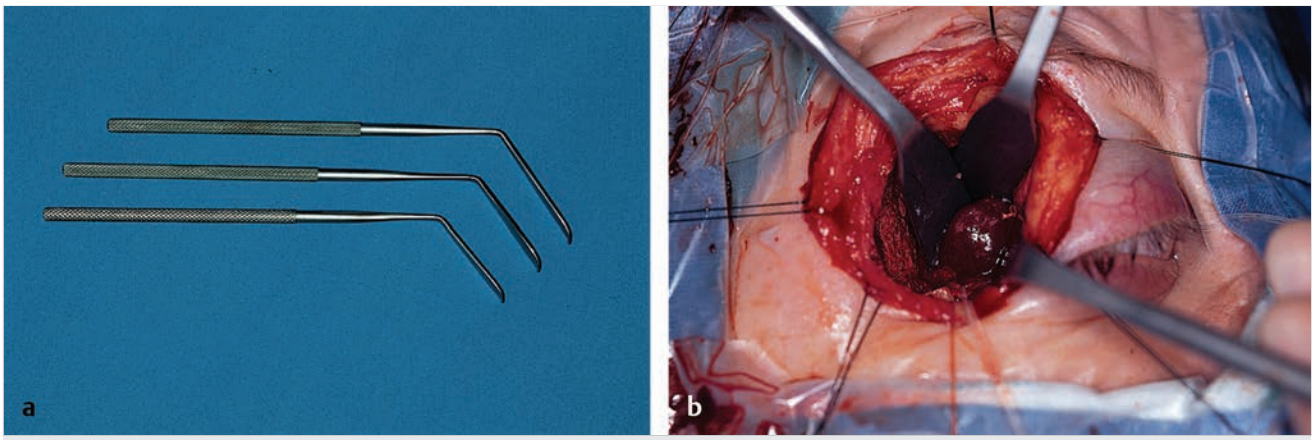

Fig. 1.11 **(a)** Wright retractors. **(b)** The use of Wright retractors for a surgical dissection within the orbit.

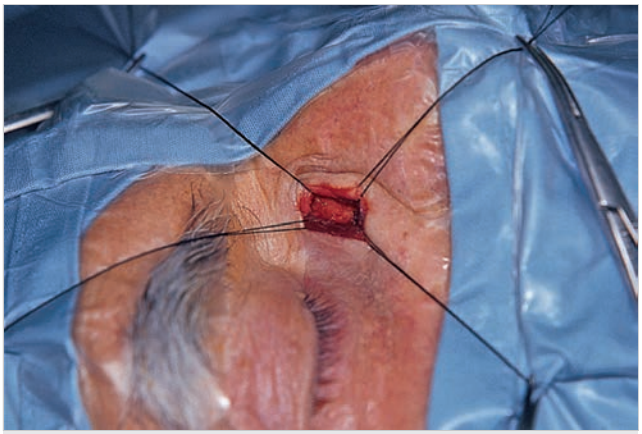

Fig. 1.12 Traction sutures are used to aid exposure and hemostasis for an external dacryocystorhinostomy.

1.11 Hemostasis

Meticulous attention to hemostasis is essential in ophthalmic plastic surgery. The process of hemostasis begins preoperatively and continues postoperatively. Intraoperative bleeding can obscure and distort tissue planes, making surgical dissection difficult and prolonging the operative procedure. Eyelid hematoma formation can prevent accurate intraoperative assessment of eyelid height and contour in levator surgery. Hematomas retard healing, promote scarring, and act as a nidus for the growth of microorganisms. Postoperative bleeding in the orbit can result in compressive optic neuropathy and blindness.

1.11.1 Preoperative Evaluation

A careful medical history should be taken to identify medical conditions that will predispose the patient to intraoperative and postoperative bleeding, such as systemic hypertension. Steps should be taken to ensure that these issues are adequately controlled before surgery is undertaken, particularly for elective procedures. The patient should be questioned about any history of a bleeding disorder, a tendency to bruise easily, or a prior history of intraoperative bleeding.

It is important to determine whether the patient has a cardiac pacemaker, because the use of a radiofrequency device is contraindicated in such patients. The use of sympathomimetic agents (e.g., adrenaline and cocaine) may be contraindicated in patients with a history of cardiac arrhythmias, myocardial infarction, cerebrovascular accident, or hypertension.

A careful drug history should be taken. The use of aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs), and other antiplatelet agents should be discontinued for at least 10 days before surgery unless discontinuation is contraindicated, as in a patient with cardiac stents or a previous history of transient ischemic attacks who thus should not discontinue the use of prescribed aspirin. It is important to liaise with the patient's general practitioner or physician about the use of such medications. The risks of discontinuing the medication versus the risks of intraoperative and postoperative bleeding and its implications have to be considered carefully. Patients should be specifically asked about the use of aspirin, because this information is rarely volunteered. It is preferable to consult with a hematologist for the management of patients who are taking anticoagulants. Patients taking warfarin or similar anticoagulants who have undergone heart valve surgery should be admitted to the hospital and converted to heparin preoperatively in conjunction with hematology specialists. Oculoplastic surgeons need to be familiar with newer anticoagulant drugs such as direct thrombin inhibitors and direct factor Xa inhibitors commonly used for patients with atrial fibrillation. Dabigatran is a direct thrombin inhibitor. Factor Xa inhibitors include rivaroxaban, apixaban, and edoxaban.

Patients should also be advised about herbal medicines and dietary supplements that have an antiplatelet or anticoagulant effect, including garlic, ginger, ginkgo biloba, ginseng, glucosamine, and omega-3 fatty acids.

1.11.2 Preoperative Injection

Subcutaneous or submucosal injection of local anesthetic agents containing adrenaline (1:80,000 or 1:200,000 units) is very helpful in minimizing intraoperative bleeding. The surgeon should then spend 5 minutes scrubbing and a further 5 minutes prepping and draping the patient. This allows 10 minutes for

Fig. 1.13 **(a)** Surgical loupes with side shields, offering ocular protection from sudden unexpected bleeding. **(b)** A lightweight surgical headlight with rechargeable battery.

the adrenaline to work. The anesthetist must be informed before the use of any adrenaline.

1.11.3 Nasal Packing

For operations involving the nose, such as external or endoscopic DCR, the nose should be packed before surgery with small patties or a nasal epistaxis tampon, which are moistened with 5% cocaine solution. This is very effective in decongesting the nasal mucosa. Its use may be contraindicated, such as in children or in patients with cardiovascular disease. For these patients, oxymetazoline should be substituted. Small patties moistened in 1:1,000 units of adrenaline may be placed directly over bleeding nasal mucosa in patients without a contraindication to the use of topical adrenalin.

1.11.4 Positioning of the Patient

Correct positioning of the patient can aid in achieving hemostasis. A gentle head-down position allows identification of the external angular vessels before marking the proposed skin incision in an external DCR procedure. The patient should then be placed into a reverse Trendelenburg position as soon as this is permitted by the anesthetist. This reduces venous pressure within the head and face and can significantly reduce bleeding.

1.11.5 Surgical Technique

A meticulous gentle surgical technique is essential to prevent bleeding. The surgeon must be familiar with vascular anatomy of the periocular and orbital region (▶ Fig. 1.14).

The following vessels are commonly encountered in ophthalmic plastic surgery:

- The marginal and peripheral eyelid arcades in eyelid surgery.
- The angular vessels in an external DCR.
- Branches of the infraorbital vessels in orbital floor blowout fracture surgery or orbital decompression.
- The anterior and posterior ethmoidal vessels in an orbital exenteration or a medial orbital wall decompression or fracture repair.
- The zygomaticofacial and zygomaticotemporal vessels in a lateral orbitotomy or lateral orbital wall decompression.
- The supraorbital and supratrochlear vessels in browlift surgery.

The use of the Colorado needle aids meticulous surgical dissection and ready identification of tissue planes. The tissue must be handled with great care to prevent tearing and maceration. It is essential to avoid traction on orbital fat, which can risk rupture of deeper orbital vessels. The surgical dissection should be restricted to that required to expose the area of interest.

Blunt dissection can prevent unnecessary intraoperative bleeding. For example, in secondary orbital implant surgery, blunt dissection of deep orbital fibrous bands with blunt-tipped Stevens tenotomy scissors, also aided by digital dissection, is preferred.

1.11.6 The Application of External Pressure

Intraoperative pressure tamponade is useful to encourage hemostasis before the application of cautery. It is particularly

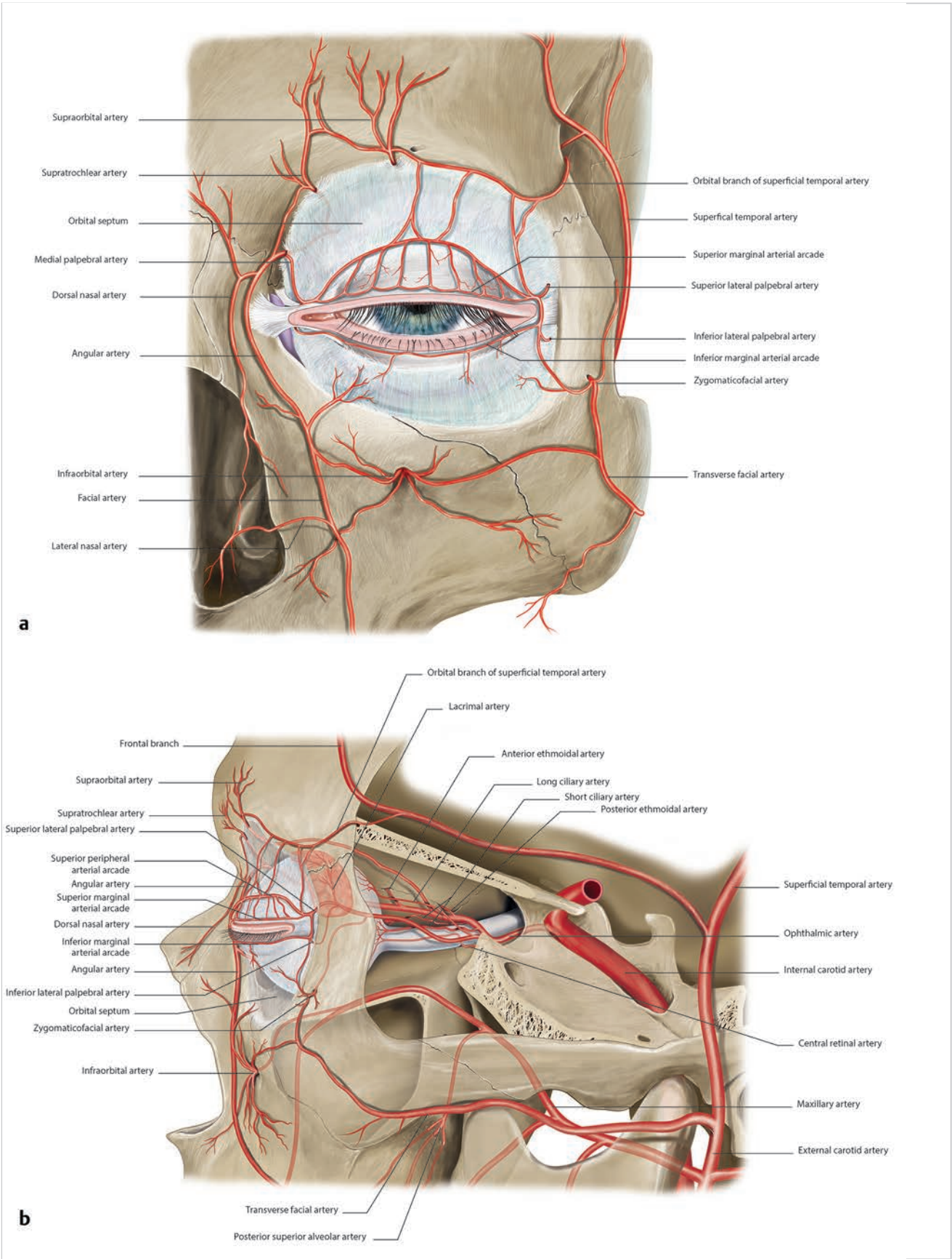

Fig. 1.14 (a,b) Vascular anatomy of the periocular and orbital region.

useful after enucleation. Postoperatively, capillary oozing may be limited by the application of a pressure dressing. This is particularly useful after anophthalmic socket surgery. It must be used with great caution, however, when postoperative bleeding may lead to compressive optic neuropathy, such as after an anterior orbitotomy for an incisional orbital biopsy.

1.11.7 Suction

Suction is an important aid to hemostasis and must be used appropriately. There are a number of different suction tips available, and the one used is determined by the specific surgical procedure. A small Frazier suction tube is appropriate to use in the nondominant hand when performing dissection with a Freer periosteal elevator held in the dominant hand during an external DCR procedure. A Baron suction tube is smaller and very useful to use in more delicate situations, such as in the course of delicate orbital surgery. Applying a moistened swab or neurosurgical cottonoid over orbital fat will prevent it from being drawn into the sucker. Suction can then be applied to the swab or cottonoid. The suction can be increased, if necessary, by occluding a port on the suction tube with the surgeon's forefinger.

The Yankauer tonsil suction catheter is used for suctioning the oropharynx after lacrimal surgery and intraoral surgery such as the removal of a hard palate graft.

1.11.8 Instrumentation

Hemostasis can be greatly influenced by the choice of instrumentation. For example, hemostasis is aided in enucleation surgery by the use of a snare. Contraindications to the use of a snare must, however, be respected, including a soft globe, a previous corneal section, or penetrating keratoplasty.

1.11.9 Cautery

A Colorado needle has both a cutting mode and a monopolar cautery facility. This is very useful for cauterizing fine vessels in the eyelids. For larger vessels, bipolar cautery is used. Fine-tipped jeweler's forceps limit tissue destruction to the zone between the tips of the instrument. A bayonet style of forceps is used for cautery of vessels at deeper levels within the orbit or socket. The forceps should be gently approximated until cauterization of tissue occurs. A common error is to grasp tissue too firmly with the opposing tips of the forceps forced against each other. The surgeon should ensure that he or she is familiar with the required settings on the machine before using bipolar or monopolar cautery. Charred tissue should not be allowed to accumulate on the tips of the forceps.

Cautery should be used with great care. Overuse of cautery may compromise the blood supply to periorbital flaps. However, underuse of cautery may place a skin graft at jeopardy. If bleeding occurs beneath a skin or mucosal graft, the graft may fail.

A larger cutting diathermy blade (▶ Fig. 1.15) can be used for fast bloodless incisions in the periorbital area, such as in exenteration surgery. The blade can also be used in a fulgurate mode to prevent or stop bleeding from bone.

Disposable thermal hot-wire cautery should be used with caution close to the eye or within the orbit. The eye must be adequately protected. This tool is useful in the treatment of simple periocular skin lesions, particularly in a clinic setting. It is essential that nonflammable moistened swabs be used in conjunction with such cautery devices and that any supplemental oxygen be used with great caution.

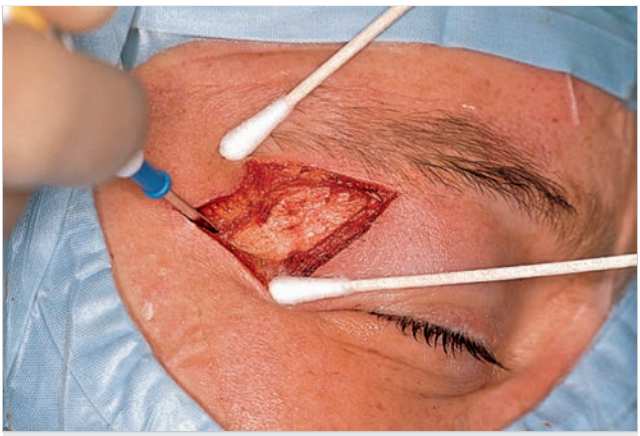

Fig. 1.15 A cutting diathermy blade.

Bleeding should first be stopped by the application of pressure. Small bleeding vessels are rolled with a cotton-tipped applicator until the vessel can be identified and cauterized. The applicators should not be wiped across the tissue, which removes clot and provokes more bleeding. For more profuse bleeding, a gauze swab should be applied and gently removed until the bleeding vessels can be identified.

There is little justification for the use of a carbon dioxide laser to aid in hemostasis in ophthalmic plastic surgery. Most of the advantages of the carbon dioxide laser can be obtained with a Colorado needle without the numerous disadvantages of the carbon dioxide laser: significant expense, the requirement for nonflammable drapes, the risks of inadvertent injury to adjacent structures, the requirement for nonreflective instrumentation, the need to avoid supplemental oxygen, and the need for the operating room personnel to use protective eyewear.

1.11.10 Topical Hemostatic Agents

Several topical hemostatic agents are commonly used during ophthalmic plastic surgery:

- Adrenaline.
- Thrombin.
- Surgicel.
- Bone wax.
- Tisseel/Artiss fibrin sealant.
- Floseal hemostatic matrix.

The application of 1:1,000 units of adrenaline to the donor site of a mucous membrane or hard palate graft on a cottonoid is particularly useful before cautery. This prevents mucosal capillary oozing and allows a more conservative use of bipolar cautery with less tissue destruction.

Thrombin is a protease that facilitates the clotting cascade by converting fibrinogen to fibrin. It is applied to tissue with Gelfoam, an absorbable sponge, as a carrier. This is particularly useful to stop oozing from a tumor bed in the orbit after an incisional biopsy. The Gelfoam should be removed from the orbit once hemostasis has been achieved.

Surgicel is oxidized cellulose that is applied dry to produce a local reaction with blood, promoting the formation of an artificial clot. It is nontoxic and creates very little local tissue reaction. Although it can be left in situ, it is preferable to remove Surgicel at the completion of surgery, because it can promote local swelling and a compartment syndrome in the orbit.

Bone wax is used to arrest bleeding from small perforating vessels in bone. The wax is applied on a cotton-tipped applicator or on the blunt end of a Freer periosteal elevator to plug the bleeding sites. It is important to dry the surrounding bone first to enable the wax to adhere.

Tisseel is a topically applied fibrin sealant that contains human fibrinogen, bovine aprotinin, calcium chloride, human thrombin, fibronectin, and factor XIII. It is both a tissue adhesive and a topical hemostatic agent. It is available in a ready-to-use prefilled double-chamber syringe. It is very effective and has many potential applications in oculoplastic surgery; for instance, its use has been advocated to assist the placement of full-thickness skin grafts, saving surgical time devoted to suturing, and to assist hemostasis and fixation of the forehead in browlift surgery. Its potential advantages must be weighed against the cost and the very small potential risks of transmissible disease and anaphylactic reactions. Artiss is another topically applied fibrin sealant that can be used to aid hemostasis and to close the conjunctival wound, such as in a transconjunctival lower lid blepharoplasty. Artiss sets more slowly, allowing more time to make adjustments. Fibrin sealants can also be used as a spray to aid the placement of a partial-thickness skin graft in patients undergoing an orbital exenteration.

Floseal hemostatic matrix can provide rapid hemostasis for patients undergoing an orbital exenteration. It can also be used to manage a severe postoperative epistaxis.

The oculoplastic surgeon should be aware of the advantages of the various agents available and should be familiar with the small risks associated with their use. Informed consent should be obtained from patients for their use.

1.11.11 Postoperative Hemostasis

The maintenance of a head-up position overnight after surgery can help to prevent postoperative bleeding. Restriction of activity postoperatively can also be important. The patient should be instructed to avoid blowing the nose after a DCR or orbital decompression procedure. The use of a surgical drain may be indicated after certain procedures; for example, it can help to prevent a hematoma after a Mustardé cheek rotation procedure. It should be noted, however, that a drain is not a substitute for good intraoperative hemostasis.

1.12 Wound Closure

Although some periocular wounds can be left to heal by secondary intention with good functional and cosmetic results, avoiding the additional scars associated with skin flap reconstructions; most periocular, scalp and facial wounds; and tissue graft donor sites require a formal closure.

1.12.1 Suture Closure of Wounds

Meticulous wound closure is essential to obtain good cosmetic and functional results. Although the skill and technique of the surgeon are important, the selection of wound closure materials is also important. The purpose of these materials is to maintain wound closure until the wound is secure enough to withstand daily tensile forces and to enhance wound healing when the wound is most vulnerable.

A number of factors are important to successful wound closure:

- The proper anatomical realignment of tissues.
- The avoidance of unnecessary or excessive wound tension.
- Atraumatic tissue handling.
- The elimination of dead space.
- The appropriate selection of needles.
- The appropriate selection of suture materials.

Dead space within a wound must be eliminated because it may act as a reservoir for hematoma and microorganisms; it may prevent anatomical realignment of the tissues and may delay or impair wound healing. The appropriate deep closure of wounds reduces tension on the cutaneous wound, reducing the risk of wound breakdown or widening of the scar.

Deep wounds should be closed with 5–0 or 4–0 Vicryl (polyglactin 910) sutures—for example, in the lateral thigh, after the harvesting of autogenous fascia lata, the subcutaneous tissues are realigned with interrupted 4–0 Vicryl sutures. The suture should be placed while everting the wound edge. The needle is inserted into the subcutaneous tissue so that the needle reaches 2 to 3 mm back from the wound edge. The sutures' knots are buried to prevent interference with skin closure or postoperative erosion of the sutures through the skin wound. To bury the knot, the needle is first passed from deep to superficial in the wound and then from superficial to deep. Both ends of the suture should lie on the same side of the loop, and the suture should be tied by pulling its ends along the line of the wound (▶ Fig. 1.16).

Wound strength gradually increases during the process of healing. After 2 weeks, a wound has less than 10% of its final healed strength. By this time, most skin sutures are removed, and the resulting wound has little to rely on for strength unless additional support is provided. Wound strength increases to approximately 20% by 3 weeks and 50% by 4 weeks. At 3 to 6 months, a skin wound achieves its maximum strength, which is 70 to 80% that of normal skin.

1.12.2 Selection of Suture Needles

Suture needles are selected according to their size, curvature, and cutting characteristics and the characteristics and location of the tissues to be sutured. Several needles are commonly used in ophthalmic plastic surgery:

- Cutting (▶ Fig. 1.17a).
- Reverse cutting (▶ Fig. 1.17b).
- Spatula (or side-cutting) (▶ Fig. 1.17c).
- Taper (▶ Fig. 1.17d).

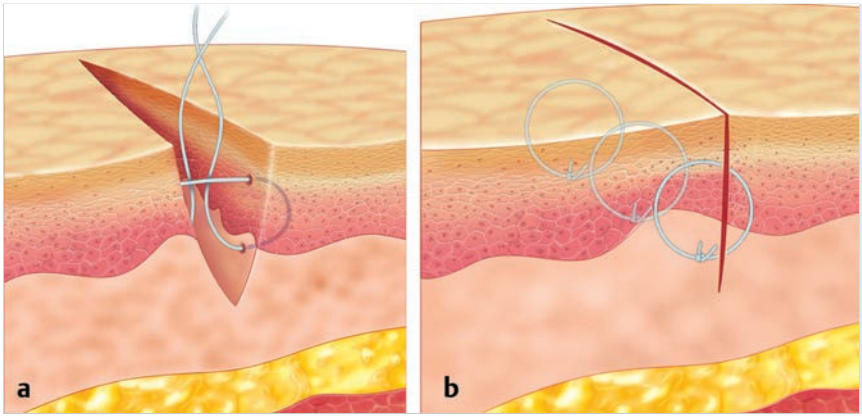

Fig. 1.16 **(a)** Buried subcutaneous suture. **(b)** This technique of suture placement ensures that the knots are buried deep in the wound.

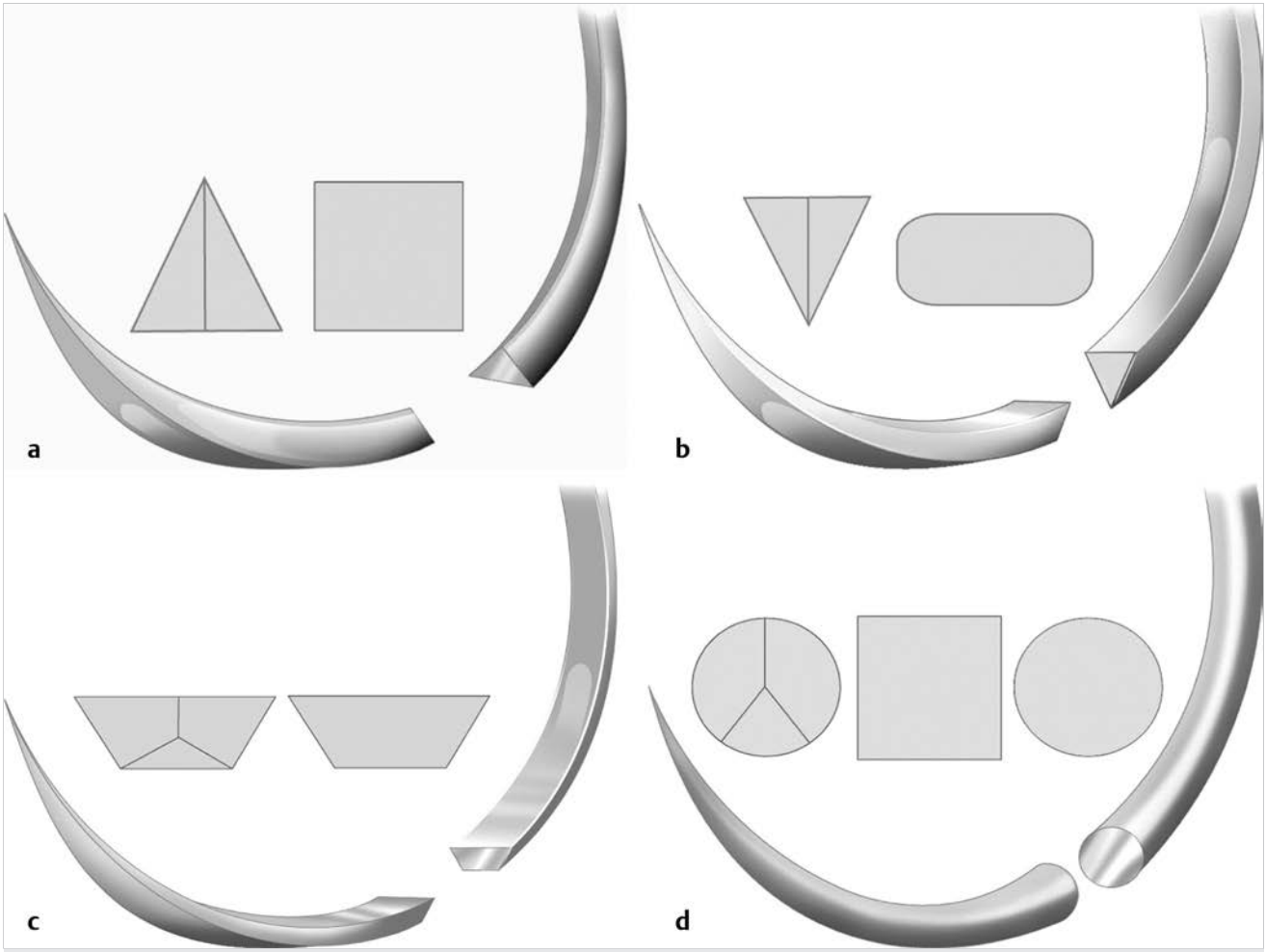

Fig. 1.17 **(a)** Conventional cutting needle. **(b)** Reverse cutting needle. **(c)** Spatulated needle. **(d)** Taper needle.

The needles are most commonly 3/8-, 1/4-, or 1/2-circle: 3/8-circle needles (e.g., 5–0 Vicryl) are more commonly used for the reattachment of the levator aponeurosis to the tarsus; a 1/2-circle needle (e.g., 5–0 Vicryl) is used in a more confined space, such as for the closure of mucosal flaps in external DCR surgery or for the fixation of a lateral tarsal strip to the periosteum of the lateral orbital margin. Cutting and reverse cutting needles pass through tissue very easily and are particularly suited to skin closure and general purpose use.

Reverse cutting needles are the most commonly used needles in ophthalmic plastic surgery. The reverse cutting needle has a third cutting edge located on the outer convex curvature of the needle. This offers several advantages:

- Reverse cutting needles have more strength than similar-sized conventional cutting needles.
- The danger of tissue cut out is greatly reduced.
- The hole left by the needle leaves a wide wall of tissue against which the suture is to be tied.
- The side-cutting edges of spatulated needles are designed for ophthalmic surgery. They permit the needle to separate or split through the thin layers of tissue (e.g., sclera). They are suited to partial-thickness passage through tarsus.
- Taper needles are designed to limit the cutting surface to the tip, making them more suitable for passage through more vascular tissues (e.g., extraocular muscles). They cause the smallest possible hole in the tissue and require minimal cutting of tissue.

The actual placement of the needle in the patient's tissue can cause unnecessary trauma if performed incorrectly. The following principles should be considered:

- Force should be applied in the same direction as the curve of the needle.
- Excessively large bites of tissue should not be taken with a small needle.
- A blunt needle should not be forced through tissue. It should be replaced.
- The needle should not be forced or twisted to bring the point through the tissue.
- The needle should not be used to bridge or approximate tissues for suturing.
- If the tissue is tougher than anticipated, a heavier gauge needle should be used.
- If a deep confined area prevents ideal placement of the needle, it should be exchanged for a heavier gauge needle or a different curvature.

1.12.3 Selection of Suture Materials

Suture materials are selected according to the type of tissue to be sutured, its physical location, the degree of wound tension, and the suitability of the patient for suture removal. The size denotes the diameter of the suture material. In general, the smallest diameter suture that will adequately support the wound is chosen to minimize trauma caused by passage of the suture through the tissue. The suture size is denoted numerically: as the number of 0s in the suture size increases, the diameter of the suture decreases—thus size 7–0 is smaller than size 6–0.

Understanding the various characteristics of available suture materials is important to enable a surgeon to make an educated selection of a suture. No single suture possesses all the desirable characteristics. The optimal suture should be easy to handle and have high tensile strength and knot security. Any tissue reaction should be minimal, and the material should resist infection and have good elasticity and plasticity to accommodate wound swelling. A low cost is obviously preferred. Although some of the newer materials available have many of these properties, no one material is ideal, and compromises have to be made.

The physical characteristics of a suture material determine its utility; these characteristics include configuration, diameter, capillarity and fluid absorption, tensile strength, knot strength, elasticity, plasticity, and memory.

The configuration of a suture is based on the number of strands of material used to fabricate it. Monofilament sutures are made of a single strand of material. They encounter less resistance than multifilament sutures as they pass through tissue. They also resist harboring microorganisms, which may cause suture line infection, and cause little tissue reaction. The sutures tie easily, but crushing or crimping of this suture type can create a weak spot, predisposing to breakage. Multifilament sutures consist of several filaments braided together. This provides greater tensile strength, pliability, and flexibility. They may be coated to assist in passage through tissues.

Plasticity refers to the ability of the suture to retain its new form and length after stretching. Plasticity allows a suture to accommodate wound swelling, thereby decreasing the risk of strangulating tissues. However, as swelling subsides, the suture retains its new size and may not continue to support the wound edges adequately.

Elasticity refers to the ability of a suture to regain its original form and length after stretching. After the swelling of a wound subsides, the suture returns to its original length and keeps the wound well supported. Most sutures provide elasticity. Few are "plastic."

Memory refers to the ability of a suture to return to its original shape after being tied. Memory is also related to plasticity and elasticity. Sutures with a high degree of memory, particularly monofilament sutures, are stiff and difficult to handle. As a consequence, the knots are less secure and may require extra throws to prevent loosening (e.g., polypropylene).

Pliability refers to the ease with which a suture can be bent. The more pliable a suture, the easier it is to tie.

Sutures may be absorbable or nonabsorbable. Absorbable sutures are defined by the loss of most of their tensile strength within 60 days after placement. Synthetic absorbable sutures are hydrolyzed. They are used primarily as buried sutures to close the dermis and subcutaneous tissues and to reduce tension on the wound. The only natural absorbable suture available is surgical gut or catgut; these are no longer used in the United Kingdom. Synthetic multifilamentous materials include polyglycolic acid (Dexon; Syneture) and polyglactin 910 (Vicryl; Ethicon). Monofilamentous forms include polydioxanone (PDS; Ethicon), polytrimethylene carbonate (Maxon; Syneture), poliglecaprone (Monocryl; Ethicon), Glycomer 631 (Biosyn; Syneture), and Polyglytone 6211 (Caprosyn; Syneture).

Nonabsorbable sutures are defined by their resistance to enzymatic digestion or hydrolysis by the body. They are most useful in

percutaneous closures. Surgical silk is a natural material. Synthetic nonabsorbable monofilament sutures are most commonly used in cutaneous procedures and include nylon and polypropylene. Synthetic nonabsorbable multifilament sutures composed of nylon and polyester are used occasionally in oculoplastic surgery. The most recently developed monofilament nonabsorbable synthetic suture is polybutester (Novafil; Syneture).

The suture materials commonly used in ophthalmic plastic surgery include the following:

- Polyglactin (Vicryl).
- Silk.
- Polyester (Ethibond).
- Nylon.
- Polybutester (Novafil).
- Polydioxanone (PDS).
- Polypropylene.

Polyglactin 910 (Vicryl)

Polyglactin 910 has good tensile strength and is absorbed relatively quickly after subcutaneous placement. It retains approximately 60% of its tensile strength 14 days postoperatively and only 8% of its original strength at day 28. It is completely hydrolyzed by 60 to 90 days. Tissue reactivity with polyglactin is low. It has easy tissue passage, precise knot placement, and a smooth tie down. It is usually dyed violet. Although used primarily as a buried suture, it can also be used for skin closure without adverse outcomes.

Vicryl Rapide is polyglactin 910 that has been ionized with gamma rays to speed its absorption. This suture is useful as a buried suture in a wound requiring limited dermal support. It is completely absorbed in 35 days. It is very useful for skin wound closure in the periocular area in children.

Coated Vicryl Plus Antibacterial is coated with triclosan. This suture inhibits bacterial colonization with both methicillin-sensitive and methicillin-resistant *Staphylococcus aureus* and *Staphylococcus epidermidis.* This suture may be useful in wounds at increased risk of infection.

The 4–0 Vicryl is used for subcutaneous wound closure in the thigh, such as after fascia lata removal; in the abdominal wall, for example after dermis fat graft removal; or in the brow, such as after a direct browlift.

The 5–0 Vicryl is used for subcutaneous wound closure in the periocular region and for the attachment of the levator aponeurosis to the tarsus, for the advancement of the lower lid retractors to the tarsus, for a lateral tarsal strip and medial spindle procedures, and for lower lid everting sutures. It is also used to reapproximate the mucosal flaps in external DCR surgery and for the attachment of the extraocular muscles to an orbital implant.

The 7–0 Vicryl is typically used for eyelid skin wound closure. It may be removed in adults, but in uncooperative patients or children it can be left to disintegrate spontaneously, aided by the application of warm saline compresses and the application of antibiotic ointment. They do not tend to cause any significant inflammatory reaction or leave visible suture track marks. Although more expensive, Vicryl Rapide is preferable for use in children.

The 8–0 Vicryl is typically used for conjunctival wound closure.

Silk

Silk is a braided material formed from the protein fibers produced by silkworm larvae. Although silk is considered a nonabsorbable material, it is gradually degraded by the body over a period of 2 years. Silk has excellent handling and knot-tying properties and is the standard to which all other suture materials are compared. Its knot security is high, tensile strength low, and tissue reactivity high. Silk sutures are usually dyed black for easy visibility in tissue.

The 6–0 silk is typically used to close an eyelid margin defect.

The 4–0 silk sutures are used for eyelid traction sutures or to assist in wound exposure, such as during an external DCR or a lateral orbitotomy.

The 2–0 silk sutures are passed through the eyelid margins and used for traction in an exenteration procedure.

Polyester (Ethibond)

Ethibond sutures comprise untreated fibers of polyester closely braided into a multifilament strand. The suture does not weaken when wetted before use, retains its strength for extended periods, and gradually becomes encapsulated in fibrous connective tissue. The coating of the suture allows easy passage through tissue and provides pliability, good handling qualities, and a smooth tie down. The suture is available in white or dyed green. Ethibond is no longer common in ophthalmic plastic surgery, however, because it is associated with an increased risk of granuloma formation.

The 5–0 Ethibond is typically used to reattach the tarsus to the posterior lacrimal crest.

The 2–0 Ethibond is typically used for the fixation of the scalp tissues to a bone tunnel in endoscopic browlift procedures.

Nylon

Nylon is available in both monofilamentous and multifilamentous forms. It has a high tensile strength, and, although it is classified as nonabsorbable, it loses tensile strength when implanted in the body. Multifilamentous forms retain no tensile strength after being in tissue for 6 months, whereas monofilamentous forms retain as much as two-thirds of their original strength after more than 10 years. Monofilament nylon is stiff; therefore handling and tying are difficult and knot security is low. The suture also may cut easily through thin tissue. Multifilamentous forms have better handling properties but greater tissue reactivity and cost. They are not commonly used for oculoplastic surgery. Monofilament nylon (Ethilon) is relatively inexpensive.

Ethilon sutures are particularly suited to skin closure because of their elasticity. Monofilament nylon sutures also have good memory. More throws are therefore required to securely hold monofilament nylon sutures.

The 4–0 Ethilon is used as a Frost suture and for temporary suture tarsorrhaphies. It is used for wound closure under tension, such as for a thigh skin wound after the removal of a fascia lata graft or for upper inner arm skin graft donor site wound closure.

The 6–0 Ethilon is used for facial skin wound closure.

Polybutester (Novafil)

Polybutester combines many of the desirable characteristics of polypropylene and polyester. Polybutester has a high tensile strength with good handling qualities. Its memory is lower than that of polypropylene, and therefore its knots are more secure. Polybutester is not a plastic suture, but it has unique elastic properties that allow it to optimally respond to wound edema. Like polypropylene, polybutester has a low coefficient of friction and is an excellent choice for a running subcuticular closure. Polybutester is available as a clear or a blue suture. Its cost is comparable to that of polypropylene.

The 6–0 Novafil is typically used for the subcuticular closure of skin wounds that are not under tension, such as a lateral orbitotomy wound. It is also used for the percutaneous closure of a variety of facial skin wounds.

Polypropylene (Prolene)

Polypropylene is a monofilament synthetic suture that, unlike nylon, does not degrade over a number of years and can be considered permanent. It has extremely low tissue reactivity. Its handling, tying, and knot security are poor as a result of its stiff nature and high memory. An additional throw is needed for adequate knot security. Polypropylene is more expensive than nylon and is available as a clear or a blue suture.

The 4–0 Prolene is the ideal material for brow suspension surgery for patients at risk of exposure keratopathy, because it can be cut easily and the eyelid position instantly reversed. It can also be used as a running subcuticular suture. I prefer 4–0 Prolene for fat repositioning in a lower lid transconjunctival blepharoplasty.

Polydioxanone (PDS)

The 4–0 PDS can also be used for the subcutaneous closure of a thigh wound after harvesting of fascia lata or for suborbicularis oculi muscle fat (SOOF) lifting.

Closure of Wounds Using Supplementary Materials

Staples

Staples are formed from high-quality stainless steel. They are relatively easy to place and can save surgical time. The staplers are disposable. Most regular staples are 4 to 6 mm wide and 3.5 to 4 mm high. Their use results in a less precise wound approximation. The cost is usually higher than that of suture material.

To place the staples, the stapler is held on the surface of the skin, perpendicular to the wound, and the handle is squeezed, injecting the staple into the skin to form an incomplete rectangle. The depth of penetration depends on the pressure exerted on the stapler against the skin. To disengage the staple, the handle is released. If the stapler has an ejector-spring release, it is lifted vertically off the skin.

The correct placement of staples is important to prevent tissue strangulation. Staples should be inserted at 45- or 60-degree angles. As the wound swells, a staple placed at an acute angle rotates into a vertical position, leaving a space between the cross-member and the skin surface to accommodate swelling. If placed at a 90-degree angle, however, the staple is unable to move, having no plasticity or elasticity, and is likely to strangulate the tissues as they swell. Staples are removed painlessly by using a specialized set of extractors.

The primary utility of staples is in the closure of wounds under high tension on the trunk, extremities, and scalp. In oculoplastic surgery, the main use is the closure of a temple wound after the removal of a temporalis fascial graft and for the closure of central and paramedian scalp wounds after an endoscopic browlift.

Tissue Adhesives

Cyanoacrylate adhesive (Dermabond Ethicon) is useful for the closure of simple facial laceration in children, but it has a small role to play in the closure of most periocular wounds. It can be applied to external DCR wounds to save surgical time.

Surgical Tapes (Steri-Strip Skin Closures, 3M)

Surgical tapes are strips of microporous nonocclusive material backed by a thin film of acrylic polymer adhesive. They are useful as an adjunct to other wound closure materials and in oculoplastic surgery are most often used to reinforce a wound after placement of sutures (e.g., to support the wound after a direct browlift).

It is essential to maximize adhesion of the tapes to the skin using a tincture of benzoin.

1.12.4 Skin Suturing Techniques

Most skin wounds should be closed with a slight eversion of the skin edges to prevent an inverted wound. The exception to this is where skin wounds are to be hidden within a natural skin crease, in which case a slight inversion of the wound is desirable, such as in a direct browlift.

The skin wound edges should not be under unnecessary tension. If this cannot be achieved, undermining of the tissues may be required. Overly tight sutures should be avoided, because they will cheese wire through the tissues or impair the vascular supply, resulting in wound breakdown.

The surgeon should use a needle holder that is appropriate to the size of the needle. The self-locking Castroviejo needle holders are the most appropriate for use. The needle holder should be loaded properly. The needle should be grasped at the junction of the proximal two-thirds with the distal one-third, with approximately 1 mm of the needle holders overlapping the needle (▶ Fig. 1.18). This will prevent rotation of the needle or the

Fig. 1.18 Correct arming of the needle holder.