Oculoplastic Surgery

A Practical Guide to Common Disorders

Essam A. El Toukhy
Editor

Springer

EXTRAS ONLINE

Oculoplastic Surgery

Essam A. El Toukhy
Editor

Oculoplastic Surgery

A Practical Guide to Common Disorders

Springer

Editor
Essam A. El Toukhy
Cairo University
Dokki, Cario, Egypt

ISBN 978-3-030-36933-0 ISBN 978-3-030-36934-7 (eBook)
https://doi.org/10.1007/978-3-030-36934-7

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Contents

Part I
Introduction

Basics of Oculoplastic Procedures

Ahmed G. El Sharkawy, Rania A. Ahmed and Ali Odadi

Introduction

Oculoplastic surgery is the subspecialty that combines the art and principles of plastic and reconstructive surgery with the delicacy and precision of ophthalmic surgery. An oculoplastic surgeon should be aware of the principles of both worlds as well as surgical skills to get optimum cosmetic and functional results while protecting the globe and the patient's vision. This chapter will focus on these basic surgical principles.

Wound Healing

Wound healing is a natural response to tissue injury. A complex cascade of cellular and vascular events is involved to restore the tissue structure, ensure resurfacing and restoration of tensile strength of the injured skin. This process comprises mainly 3 phases that usually overlap.

A. G. El Sharkawy
Department of Plastic Surgery, Cairo University, Cairo, Egypt

R. A. Ahmed (✉)
Department of Ophthalmology, Cairo University, Cairo, Egypt
e-mail: ransalam@gmail.com

A. Odadi
Odadi Cosmetic Eye Center, Abha, Saudi Arabia

The inflammatory phase is the first response to injury where hemostasis occurs through blood vessels constriction and formation of platelets clot. Once homeostasis is achieved, the blood vessels dilate allowing inflammatory cells, antibodies and enzymes to debride the injured site, promote wound healing and fight infection. At this stage, the patient experiences the signs of inflammation such as pain, swelling, redness and hotness.

The proliferation phase is the stage where a new healthy granulation tissue appears to restore the tissue defect. This requires a good blood supply in order to provide oxygen and nutrients. Mesenchymal cells in the injured area change into fibroblasts that secrete collagen and growth factors that induce angiogenesis. Both form the granulation tissue which is the base for the scar tissue development. The granulation tissue is soft, fragile and bleeds easily. It is pinkish-red if the wound is healthy and dark or yellow in cases of poor vascular supply or infection. At this stage, epithelial cells at the wound edge proliferate, differentiate and migrate to cover the surface area.

The remodeling stage starts after 3 weeks and continues for 6–12 months. This is the stage where the final scar tissue is formed, and the wound gets mature. During this phase, the dermal tissues are overgrown to enhance their tensile strength and non-functional fibroblasts are replaced by functional ones. Cellular activity

E. A. El Toukhy (ed.), *Oculoplastic Surgery*, https://doi.org/10.1007/978-3-030-36934-7_1

declines with time and the number of blood vessels in the affected area decreases.

During healing, the tensile strength of the wound gradually increases. Sutures support the wound and take some of the strain over it till the time of their removal. The presence of marked wound tension causes bad wound stretch and unsightly scar.

Scar behavior varies with age, site, skin type and the wound direction. Scars in children tend to be red for a longer period of time and they can become hypertrophic. With aging, the scar settles rapidly, and they tend to be hidden within the existing wrinkles. Suture marks are more prominent in coarse oily skin.

These factors are unavoidable and may jeopardize the outcome. However, proper surgical technique, combating infection and hematoma as well as improving the patient's general condition with special stress on avoiding smoking could provide the best possible results.

Skin incision placement

In order to gain a cosmetically accepted scar, incisions should be placed in natural lines, natural junctional lines or in areas where the scar will not be visible.

The natural creases or wrinkle lines provide a good camouflage for the placed scar. These creases occur perpendicular to the direction of muscles creating them. The upper lid crease incision and the lateral canthal crow's feet are good examples for such placements in the periocular region.

Skin incisions placed near anatomic structures such as eye lashes (in subciliary incision) and eye brow are usually less visible. However, it should be noted that in cases of the latter, the skin incision should be made parallel to the hair follicles to avoid their destruction with the result of an unsightly scar.

Wound closure

A surgical wound closure is usually preplanned to achieve the best cosmetic outcome. In presence of tension on wound edges, subdermal tissue undermining can be done to create small advancing flaps to relieve the tension. The wound edges should be everted to avoid a depressed scar after healing. Hence, sutures should be taken perpendicular to the wound line, equally distanced from the edges with equal bite depth.

However, in cases of trauma with irregular wounds, time should be invested to identify the wound main landmarks and fit the fresh parts of the tissue jigsaw. Although Z-plasty can improve the appearance of scars, its use should be deferred for subsequent scar revisions after proper evaluation.

In cases of suspected tissue defects, the viable tissues should be replaced in their correct places so that the actual defect can be properly assessed. According to the level of expertise of the surgeon, it can be primarily managed or deferred.

Suture material

Sutures' main role is to support the tissues throughout the critical period of wound healing. In oculoplastic procedures, there are used for deep closure or fixation as well as skin closure. Other skin closure techniques such as staples and tissue adhesives have no or limited role in closing wounds in the periocular region due to its thin mobile skin. The choice of the suture material depends on the surgeon's preference and experience as well as the wound condition.

Suture materials are now routinely swaged into the surgical needles and they are mainly classified into;

Absorbable or non-absorbable
Monofilament or multifilament
Natural, synthetic or metal wires.

Absorbable Sutures

They degrade naturally overtime from 5 days to 40 days. They can be left in situ yet the surgeon should consider the extent of tissue reaction induced by them. Gut (collagen), chromic gut, polyglycolic acid (Vicryl) and polycaprolate (Dexon) are common absorbable sutures used in oculoplastic surgery.

Natural absorbable sutures like collagen and chromic gut are absorbed through enzymatic degradation which is unpredictable and can affect the process of wound healing. Synthetic sutures like Polyglactin are degraded by hydrolysis which is more predictable and takes a longer period.

Non-absorbable Sutures

They are permanent sutures that need to be removed if used to close the skin. Examples include Prolene, nylon and polyester.

Monofilament Versus Polyfilament

Monofilament sutures are formed of a single strand making it easier to pass through tissues and are less organism inviting. However, they have a memory making it a bit of a challenge to handle and they can be crushed rendering them weaker. Polyprolene (Prolene) is an example of monofilament suture.

Polyfilament sutures, as the name implies, are formed of multiple filaments that are either braided or twisted. They show higher tensile strength and are easier to handle due to their pliability. They could also be coated to enhance suture knotting and reduce reactions in the tissues. These sutures may invite infection due to their increased capillarity, however, antimicrobial coated sutures are available. Silk and polyglactin are examples of polyfilament sutures.

Natural Versus Synthetic

Natural suture materials include silk, gut and chromic gut while synthetic include prolene, polyester, polyglycolic acid and polytetrafluoroethylene (Gore-Tex). Metal sutures are usually used for repair of telecanthus and certain types of fractures.

The common suture materials used in oculoplastic surgeries and their characteristics are summarized in Table 1.

Needles

Needle penetration and the subsequent suture passage induce an additional injury to the existing wound, hence affecting its healing course. Subsequently, proper needle selection is critical. The surgical needle is formed of a point, a body and a swaged end where the suture is attached. Needles vary in shape, tip and size.

Table 1 Common suture materials and their characteristics

Suture	Nature	Characteristics	Degradation	Color	Uses
Silk	Natural	Multifilament	2 years	Black	Skin closure Lid margin repair
Plain gut	Natural	Monofilament	7–10 days	Straw colored	Skin and conjunctiva closure
Chromic gut	Natural	Monofilament	2–3 weeks	Brown	Deep wound closure, tarsus closure
Nylon	Synthetic	Monofilament	Non absorbable	Black	Skin closure
Prolene	Synthetic	Monofilament	Non absorbable	Blue	Skin closure Permanent deep suturing Used in cases of potential infection
Polyglactin	Synthetic	Multifilament	3–4 weeks	Violet	Deep wounds closure, anchoring sutures, tarsus sutures
Polydioxanone (PDS)	Synthetic	Monofilament	4–6 weeks	White or violet	Deep suspension sutures
Gore-Tex	Synthetic	Monofilament	Non absorbable	White	Frontalis suspension, brow pexy
Polyester	Synthetic	Multifilament	Non absorbable	White or green	Deep permanent sutures

The body forms most of the needle length. It is the part interacting with the needle holder and is responsible for transmitting the penetrating force to the needle point. It can be either straight, curved, half curved or compound curved.

Needles used for oculoplastic surgeries are curved as they have a predictable path through the tissues and require less space for maneuvering. The curve is described as a proportion of a full circle (Fig. 1) and is available in different sizes. The 3/8 circle needles are used for general suturing purposes while the 1/2 circle needles are used for suturing in deep confined spaces such as attaching the lateral tarsal strip to the periosteum and closure of posterior flaps in external dacryocystorhinostomy.

The point is the part that extends from the tip of the needle till the maximum cross section of the body and it determines how easily sutures pass through the tissue. Cutting and taper point (round) needles (Fig. 2) can be used by the ophthalmic and oculoplastic surgeons.

Taper point or rounded needles cut only at the tip and pass through tissues by stretching without cutting thus minimizing potential tissue tearing. They are used for easily penetrated tissues and their use is limited in oculoplastic surgery but can be used to close mucosa and for temporary tarsorrhaphy.

The majority of needles used in practice are cutting needles (Fig. 2). They have at least 2 opposing cutting edges and pass through tissues by cutting. Three types are available;

(a) Conventional cutting: They have triangular cross-section that changes to a flattened body. The third cutting edge is on the inner, concave curvature (surface-seeking) and it cuts at the tip and edges. The suture pass is superficial to the needle path. However, this type of needles may pull out tissues during its passage enlarging the needle pass.

(b) Reverse cutting: They are the most commonly used. They also have a triangular cross section yet the third cutting edge is on the outer convex curvature of the needle (depth-seeking) and it also cuts at the edges and tip. The suture pass is beneath the needle path. It has less cutting out of the tissues and is usually used in oculoplastic surgery. Nevertheless, accidental perforation may occur with partial thickness suture such as rectus scleral fixation.

(c) Side cutting/spatulated: Their cross section is flattened and designed to pass in a lamellar

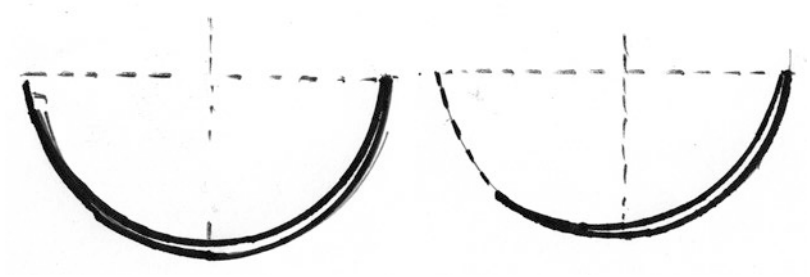

Fig. 1 ½ circle needle (Rt), 3/8 circle needle (Lt)

Fig. 2 Cut section of the needle tips. From left to right; taper (round), cutting, reverse cutting, spatulated

fashion as they cut at the tip and the sides parallel to the tissue plane. They provide easy penetration and better control while avoiding accidental perforation. They are designed for ophthalmic procedures but can be used for attaching the levator aponeurosis to the tarsal plate.

The size of the needle corresponds to the suture size and the choice depends on the type of the tissues to be sutured. For example, thick tissues with greater tension require larger sutures and needles.

Stitch craft

Skin sutures can be interrupted or continuous. Interrupted sutures allow precise wound alignment, eversion of the edges and selective suture removal when required. They are preferred in areas outside the skin lines and in irregular wounds. They can be either simple sutures, horizontal or vertical mattress.

The simple interrupted sutures (Fig. 3) are the commonly used. The wound is better divided into halves and each half is further divided into halves and so on so that the sutures are distributed over the wound. The needle should take an equal bite on each side and should include at least the entire thickness of the dermis. To achieve edge eversion, the base of the sutures should be slightly wider than the surface.

Vertical mattress sutures (Fig. 4) are used when more eversion is needed, e.g. in lid marginal wound repair. The vertical mattress suture is like a U-shaped loop with the outer limits placed deep and inner limits placed more superficial.

Horizontal mattress sutures (Fig. 5) are used for levator muscle attachment to the tarsus during ptosis surgery or if sutures are taken near the lid margin so that the knot is away from the cornea.

Fig. 3 Interrupted sutures

Fig. 4 Vertical mattress suture

Fig. 5 Horizontal mattress suture

Fig. 6 Continuous locked suture (Left), continuous non locked sutures (Right)

If there is no tension on the wound, interrupted sutures are usually enough. However, if there is tension, the use of buried absorbable sutures or continuous intradermal (subcuticular) sutures is suggested thus allowing early removal of skin sutures without fear of wound disruption.

Deep or buried sutures are also used to close any dead space to prevent hematoma, stabilize the wound and anchor muscle flaps or skin.

Subcuticular sutures can be done using a monofilament suture material to reduce wound tension and minimize leaving suture marks. Although they can be used on their own, it was found that additional interrupted sutures make the wound edge opposition more accurate.

Continuous or running sutures (Fig. 6) whether locked or not are faster to place and easier to remove. They are used to close linear wounds especially those placed in crease lines.

Management of Dog ears

They are usually created by redundant tissue at the end of the incision. They can be due to unequal incision length or incisions that are joined at an acute angle. If not removed, they tend to remain prominent and affect the overall appearance of the scar.

A proper wound design minimizes their occurrence. However, to remove a dog ear, the wound should be sutured till the elevation becomes prominent. The extent of the dog ear is then identified by raising it above the wound level. An incision is then placed at the base of

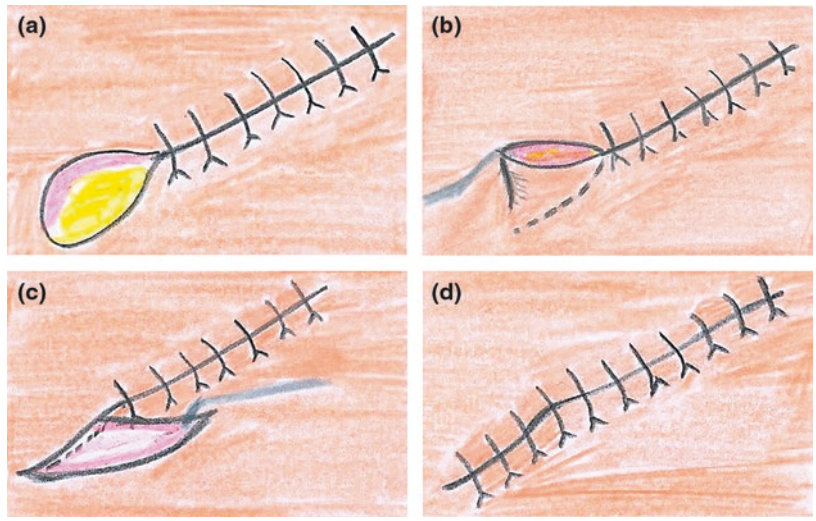

Fig. 7 Removal of dog ear. **a** The wound is closed until the dog ear is apparent. **b** A hook is used to define the dog ear and an incision is made at the base at one side. **c** The excess triangle of skin is removed. **d** The wound is closed at the dog ear area

one side finishing at the wound line to create a flap. The flap is then brought across the wound and the excess skin is removed (Fig. 7).

Basics of flaps and grafts

Skin grafts and flaps are very useful tools in many situations dealing with skin defects such as trauma with tissue loss, after tumor excision, congenital defects and managing scars.

Grafts are usually avoided in conditions with deep spaces as well as exposed bones or cartilage where flaps are preferred.

Basics of grafts

Free skin grafts are either:

- Full thickness graft; that consists of the epidermis and the whole thickness of the dermis and shows less contracture upon healing. It requires a good vascular bed and a longer time to be taken. It is usually harvested using a scalpel and the donor side should be closed. This type is commonly used in the face and neck area and its use is restricted to relatively small defects.
- Split thickness graft; that consists of the epidermis and variable proportion of the dermis. It is usually harvested by a special instrument. It is less vascular with easier take yet more likelihood of contracture. It is not used in the periocular area.

When the graft is applied to its recipient bed, it initially adheres by fibrin that breaks down within 48 hours. This usually coincides with revascularization that encompasses outgrowth of capillary buds from the recipient to unite with those on the deep surface of the graft. This becomes well established by the 3rd day where the graft appears pink in color. Fibroblasts of the bed proliferate and lay collagen to replace the fibrin and the graft is usually anchored to its bed by the 4th day. Lymphatics and nerve supply will be reestablished afterwards.

From the above mentioned, the success of the graft take depends primarily on the extent and speed of vascularization. This is determined by the characteristics of the bed, the character of the graft itself and the conditions under which the graft was applied to its bed.

A well perfused bed is necessary for graft take. The face areas are good recipients and even its fat is highly vascular. Bare bone or cartilage as well as areas exposed to previous irradiation

are poor graft beds. The patient's general condition as well as smoking may also affect the bed microcirculation.

A graft harvested from a highly vascular donor area will likely be easier to take which is better for thin grafts compared to thick grafts. The head and neck areas are highly vascular allowing good take of full thickness grafts.

Provided the bed is vascular and free from pathogens, it is of utmost importance that the graft should be in the closest possible contact with its bed (no hematoma or seroma) and immobile.

Harvesting the Graft

Common donor sites for full-thickness skin grafts of the periocular region include the post auricular region, the eyelids, the supraclavicular region and the upper arm. The first two sites provide a good skin matching characters like texture and color, besides, the scar at the donor site is cosmetically accepted.

The free graft should be accurately fitting in its recipient area with normal skin tension. The size and pattern can be determined by a template using cardboard, paper or aluminum foil. The defect should be displayed to the full before making the pattern to avoid post-operative shortage or ectropion. The template is then applied on the donner area and the skin is marked.

On harvesting the graft, it should be cleared from any fat on its deep surface, either primarily during harvesting or after the graft is cut out using scissors. The donor site is then closed primarily.

The recipient bed should be dry before applying the graft so that no hematoma could collect beneath the graft. Excessive cauterization in the bed should be avoided and simple pressure for enough time is preferred. The graft is sutured to its bed margins. Small grafts could be left exposed.

If the applied graft is large, the surgeon should avoid presence of dead space and collection of hematoma beneath the graft. Few stabs in the graft can provide a possible exit for any blood to be collected. A nonadherent dressing is usually applied with gentle pressure (<30 mmHg) before the final dressing. A "Tie-over dressing" is useful, because it minimizes the risk of hematoma or seroma formation without exerting high pressure on the graft and it also prevents shearing forces from outside.

Basics of flaps

A flap is a unit of tissue that is transferred from a donor to recipient area while keeping its own blood supply. Flaps can be classified according to their composition, location or blood supply and there is usually an overlap between these classifications. Flaps range from simple advancements of skin and subcutaneous tissue to composite flaps that may contain any combination of skin, muscle, bone, fat or fascia. Flaps can either be local or distant that use donor tissue from sites not adjacent to the recipient bed. Flaps that have no specific blood supply are known as random flaps while those having a specific vascular supply in the long axis are known as axial flaps.

Local skin flaps

They are the commonest type used in reconstructing the periocular region. The skin is borrowed from areas of relative excess and transposed to close an adjacent defect. The choice of the flap depends on the site and size of the defect, and the availability of the surrounding tissue. The donor site is closed, and the scar is better planned to be in a natural skin line.

Based on their method of movement, local flaps are classified into sliding flaps, advancing flaps and pivotal flaps.

Sliding flaps

This is one of the most helpful techniques to facilitate wound closure. They are simply achieved by generous undermining of the wound margins. The dissection is carried out until the surgeon is able to draw the wound edges together without tension (Fig. 8). Closure under tension may cause wound dehiscence, wide scars with atrophic or hypertrophic appearance.

Fig. 8 Closure of an elliptical wound (Lt) using undermining at the edges and sliding the skin to achieve closure without tension

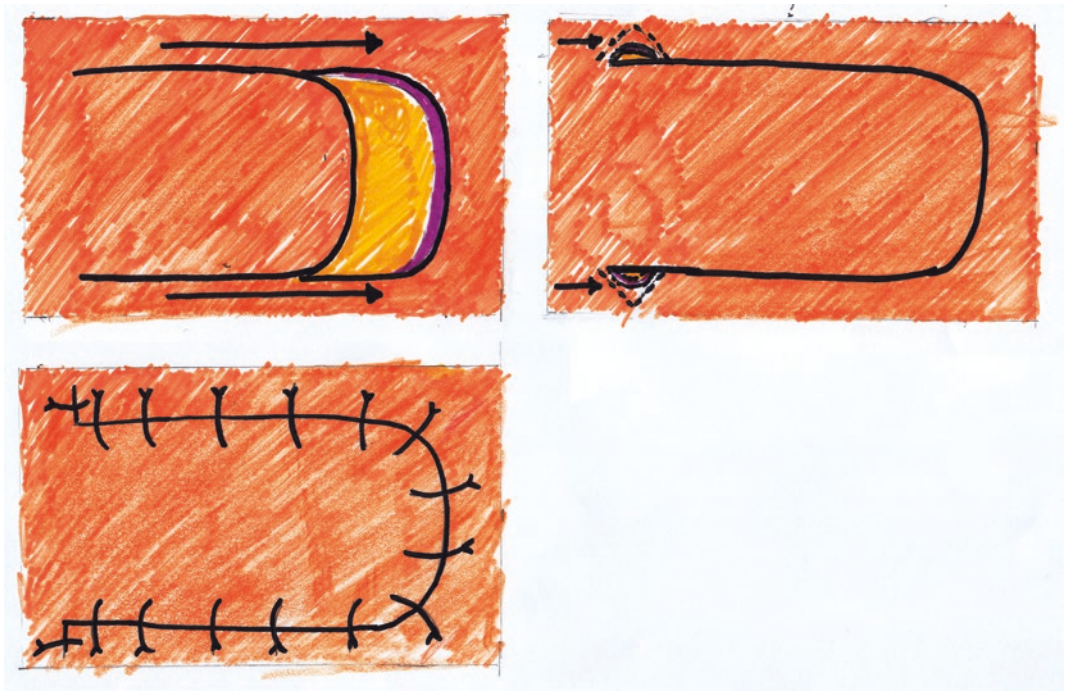

Fig. 9 Unipedicle advancing flap moving towards the defect's direction, small Burrow's triangle (small arrows) are removed at the flap base to achieve good closure without tension

Advancement flaps

They are designed to slide towards an adjacent defect in a single vector without rotation or lateral movement. They are useful in square or rectangular defects.

The flap is usually designed in a way that the length to be 2.5–3 times the width to avoid sloughing. This complication is rare in the lids due to high vascularity.

The flap should be completely dissected until it can be mobilized into the defect with no or minimal tension. An area of stress may appear along the edges of the advancing flap that may hinder its advancement. Excision of

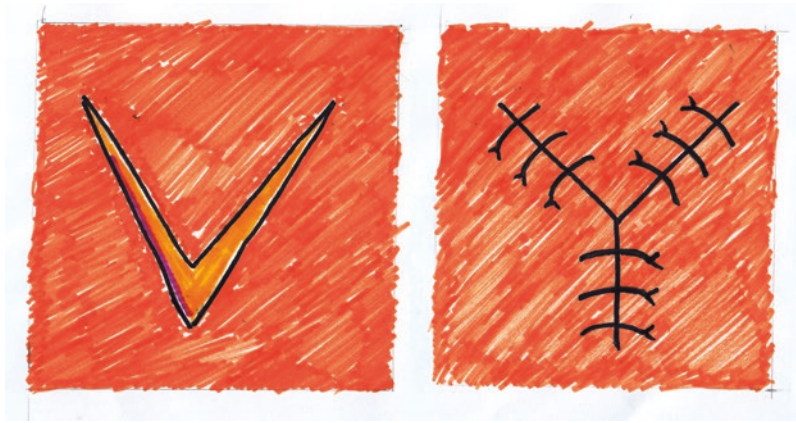

Fig. 10 V–Y plasty

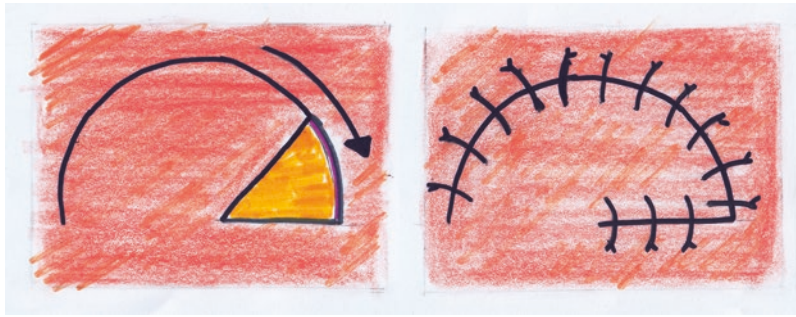

Fig. 11 Closure of a triangular defect using a rotational flap. The greatest tension is at the recipient site

small triangles called Burow's triangles at these areas will facilitate the flap movement (Fig. 9).

Bilateral/ bipedicle flap provide more coverage compared to single/unipedicle flap. V–Y and Y–V repairs are also considered advancement flaps.

V–Y plasty (Fig. 10) is widely used in the face and is very helpful in canthus reconstruction. It can be used to close a defect and to release tension. A V shaped incision is placed along its tension meridian while bisecting the V. The flap is then advanced, and the donor site is closed in a Y fashion. Although in this flap, the skin is not dissected from the underlying tissue, the area lateral to the V is undermined to release the flap. Closure of the lower limb of the Y first will further help advancing the flap into the defect. It is possible to turn Y to V in a reverse manner.

Pivotal flaps

These flaps pivot on a point or a shared base to cover the defect. The greater the pivot, the shorter the effective length of the flap. They include rotational, transposition and interpolation flaps

a. Rotational flaps:

They have a curvilinear or semicircular configuration and they are best used to close a triangular defect. They are designed immediately adjacent to the defect with one border of the flap is the border of the defect (Fig. 11). Ideally, the ratio between the flap length and the width of the defect base should be 4:1 and the ideal defect for repair has a height twice the width in size. Excision of a Burrow's triangle at the base usually facilitate the flap rotation. The greatest

tension is present at the recipient site. The donor site is either closed directly or using a skin graft. Tenzel's semicircular flap and cheek rotation flap are examples of such flaps.

The rhomboid (Limberg) flap:

This is a rotational flap variation that provides minimal tension at wound closure and preserves the natural distances at the site of its use. The tissue to be removed should have a rhomboid shape and the orientation of the excision site is an important key for successfully creating this flap.

The surgeon should identify the direction in which the skin is most extensible. This line becomes the lateral aspect of the flap. In cases of the eyelid reconstruction, perpendicular lines to lid margin should be avoided as they induce excess tension and lid margin malposition. This technique is commonly used in reconstructing the areas lying between the eyebrow and the anterior hairline.

A rhomboid is designed with its short diagonal equals the length of each side and the angles are 120° and 60° as shown in (Fig. 12). The short diagonal is then extended for a distance equal to its length, bisecting the 120° angle. A lateral incision is placed at the end of the extended diagonal at 60° angle, parallel to the top or bottom sides according to the direction in which the flap will be rotated and of the same length as the rhomboid side. The flap is dissected from its site and rotated into the defect, then sutures are taken to secure it in place (Figs. 12 and 13a–c).

b. Transposition flaps:
They have a linear configuration that is laterally rotated about a pivot point into an immediately adjacent defect. The flap shares the base with defect site with the greatest tension is at the donor's site (Fig. 14). The flap must be designed to be longer than the defect as the effective length of the flap becomes shorter the farther the flap is rotated. A cut back incision may be of

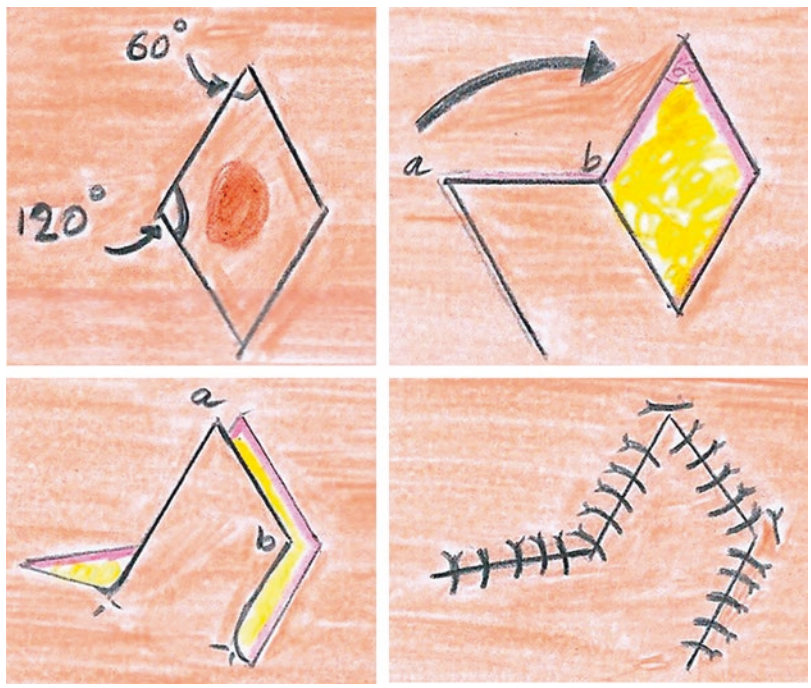

Fig. 12 Creation of the rhomboid flap: tissue excision, design, rotation and closure of rhomboid flap

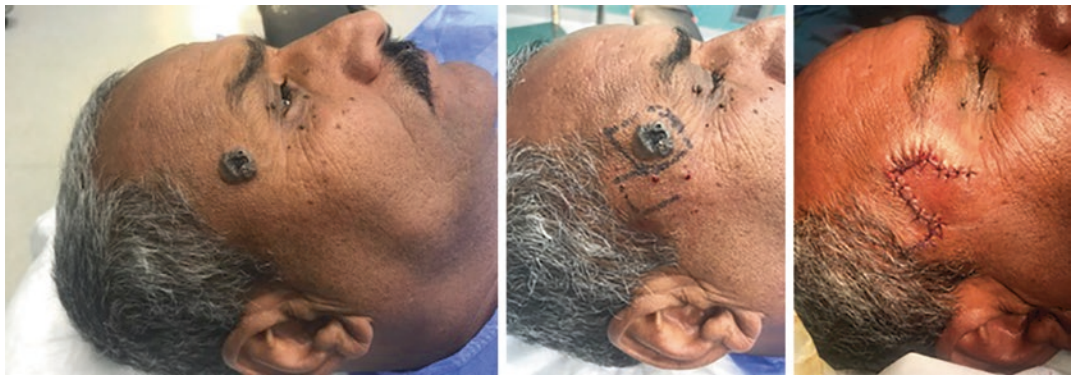

Fig. 13 **a** Basal cell carcinoma affecting the temporal region lateral to orbit. **b** Design of excision with safety margin and a rhomboid flap. **c** Excision of the lesion and closure of the defect

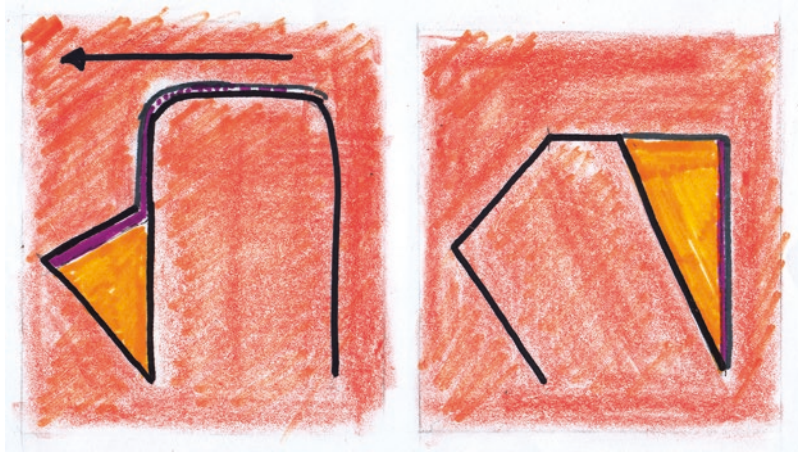

Fig. 14 A transpositional flap that is laterally rotated (Lt), the donor site is either closed directly or with graft (Rt). The greatest tension is at the donor's site

help. Transposition skin flap from the upper to the lower lid is an example.

c. Interpolated flaps:
They are like transposition flaps but the base is not contiguous with the defect. The pedicle either crosses over or under an intervening tissue and it needs a second stage to release its connection. Forehead and Cutler Beard flaps are examples of this type.

Z-plasty:
Z-plasty is an important surgical technique in revising a scar or releasing a scar contraction as it elongates the tissues and changes the scar axis with a more cosmetic appearance.

It is a transpositional flap in which two triangular flaps are reversed and rotated 90°. The central limb is placed along the scar to be excised and the three limbs of the Z must be of equal length to facilitate closure. The lateral limb to central limb angles should be equivalent and the gained length is related to this angle. The 60° Z-plasty is most effective because it lengthens the central limb without placing too much tension laterally (Fig. 15).

In designing the Z-plasty, the surgeon should consider that the final position of the scar will be

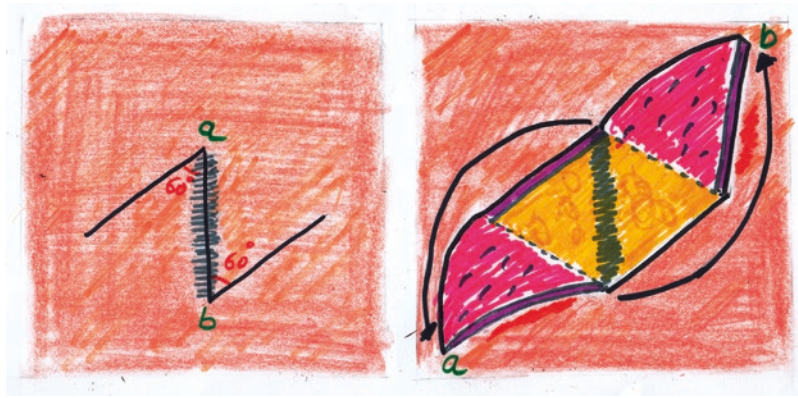

Fig. 15 Creating the flaps by placing the central limb along the scar line, the two other limbs are of equal length at 60°. The arrows show the direction of **a** and **b** upon flap creation

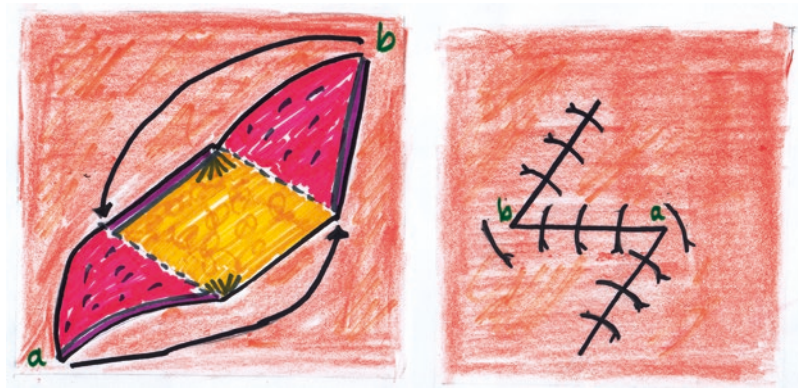

Fig. 16 The subcutaneous scar is removed. The arrows show the direction of flap movement. The flaps are then closed

perpendicular to the original central limb, hence it should be planned to be parallel to the skin lines. Consecutive Z-plasties can obliterate skin straight line scars yet result in transverse shortening and lateral tension on the wound.

After the flaps are created, it is essential to release and excise the subcutaneous bands to make the flaps freely mobile. They are then transposed, and their bases anchored first (Fig. 16). The tension along the flap is evenly distributed using interrupted sutures. Inequality of flaps may cause stress on the wound with poor outcome. If making flaps with equal angles is not feasible, the difference between them should not exceed 20°.

Forehead Flap

Tissues from the forehead could be elevated to replace lower or upper eye lid defects. To minimize unsightly scar at the donor area the flap is raised either above the eye brow or just in front of scalp hair line. The incision at the site of hair line is slanted away to avoid injuring hair follicles with possible resulting alopecia. If a long flap is needed it could be delayed as a bipedicle flap for two week before harvesting.

After insetting the flap the inner surface is covered by mucous membrane graft and in the lower eye lid a cartilage support may be needed at a later stage (Fig. 17a, b).

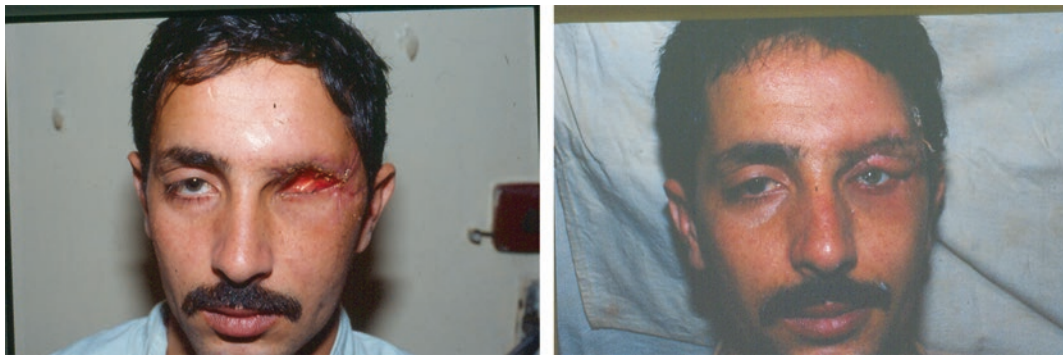

Fig. 17 **a** Upper eye lid defect in a case of subtotal excentation. **b** Reconstruction of the upper eye lid with a forehead flap

Fig. 18 **a** Basal cell carcinoma affecting most of the lower lid. **b** Excision of the lesion with safety margin and reconstructing the lower lid with Mustarde flap

Mustarde Flap

This flap is very useful for a major defect of the lower eye lid. It is a major facial flap in which the whole cheek is mobilized. The incision starts at the lateral end of the defect and goes at a higher level than the outer canthus until it reaches the front of the auricle then is directed downwards in front of auricle like a face lift incision. The whole flap is mobilized at the subcutaneous level and moved medially at its upper end to reconstruct the lower eye lid. The donor site is usually closed primarily and very easily especially in the older age group (Fig. 18a, b).

Inner Canthal Defects

Inner canthal defects present a challenge especially when deep as it is usually associated with disturbance of the canalicular anatomy. In addition repair of the medial canthal tendon or applying a tendon graft that is sutured to the posterior lacrimal crest should be done.

The skin defect itself is usually covered by a skin graft (Fig. 19a–c). An alternative is a transposition flap from nose, glabella or forehead, but the main disadvantage of these flaps is its bulkiness which may need thinning in a second stage (Fig. 20a, b).

Some authors suggest leaving medial canthal defects to granulate and heal by secondary intention. This takes long healing time and can lead to ectropion of the medial aspect of the lower lid. This method may be useful only for small defects.

Eye Brow Injuries and Defects

Wounds of the eye brow should be meticulously sutured with proper alignment of the upper and lower border of the brows. If the wound is deep it

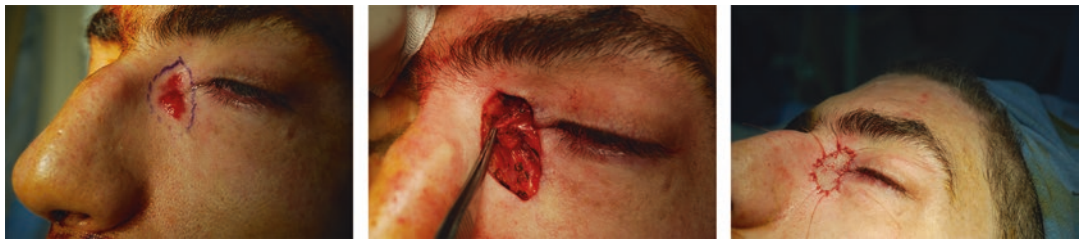

Fig. 19 **a** Basal cell carcinoma at inner canthus. **b** Excision with safety margin. **c** Closure of the defect with split thickness skin graft

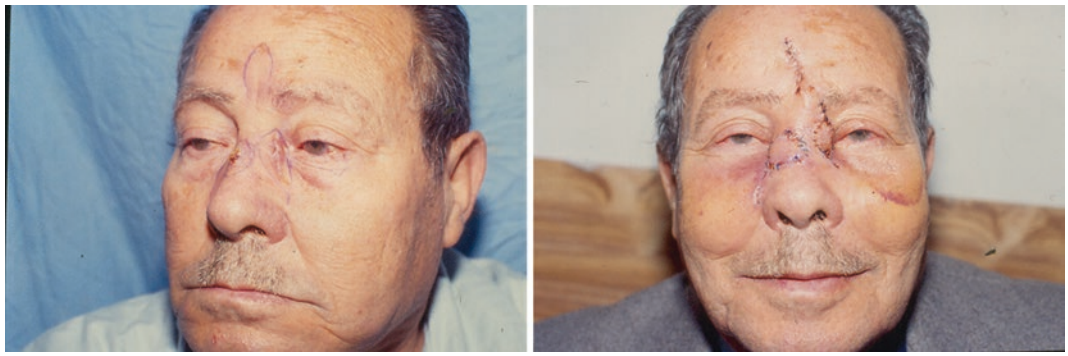

Fig. 20 **a** Basal cell carcinoma affecting inner canthus. **b** Excision and closure of the defect with a glabellar flap with noticeable bulkiness

should be closed in layers to minimize scar stretching. However in spite of the best efforts many wounds of the eye brow will show few weeks after healing as a hairless scar. This could be managed by scar revision and follicular hair transplantation from the opposite or the same brow.

In many occasions brow injury is associated with injury to upper eye lid and forehead. It is advisable to correct the brow first and guarantee its proper alignment then consider forehead and lid injury and if there is a forehead skin defect it should be managed without compromising. The brow alignment is by using properly designed flaps or skin grafts. Deformities of the brow resulting from closing forehead defects without respect to brow alignment are more difficult to correct at a second stage.

If the brow is obviously shorter than the opposite brow follicular hair transplant from opposite brow can correct the shortening. In females tattooing can camouflage this starting.

In large or total brow loss a superficial temporal island flap from scalp could be harvested to reconstruct the brow but the hair is usually denser than the normal brow and needs to be regularly cut or shortened. Tattooing especially in females is an alternative.

Complications of Flap Reconstruction

Variable complications following flaps reconstruction may occur, yet most of them are preventable and can be treated.

Early complications include infection, hematoma, seroma, and wound dehiscence. Flap necrosis is a serious complication and can be due to improper design or execution. It can be avoided by precise flap design and avoiding violation of the flap blood supply as well as closure under tension. If distal necrosis occurs, treatment is conservative and the area could be left to

heal by secondary intention or subsequent surgical revision based on the situation.

Late complications such as unfavorable scars that can be avoided by proper planning. When they are mature, they can be revised or corrected using Z-plasty.

Suggested Readings

1. Lelli GJ Jr, Zoumalan CI, Nesi FA. Basic principles of ophthalmic. In: Black EH et al, editors, Smith and Nesi's ophthalmic plastic and reconstructive surgery; 2012. p. 61–79.
2. Gosman AA. Principles of flaps. In: kenkel JM, editor. Selected readings in plastic surgery, vol. 10, no. 1. Dallas, Texas: The University of Texas Southwestern Medical Center, Baylor University Medical Center; 2005. p. 24–53.
3. McGregor AD, McGregor IA, editors. Fundamental techniques of plastic surgery. 10th ed. UK: Churchill Livingstone London; 2000.
4. Nerad JA. The art of the surgical technique in oculoplastic surgery. In: krachmer JH, editor. The requisites in ophthalmology, 1st ed. Mosby, St. Louis, Missouri; 2005; Chapter 1. p. 1–24.
5. Shimizu R, Kazuo Kishi K. Skin graft. Plast Surg Int, 2012 Article ID 563493.
6. Thornton JF. Skin grafts and skin substitutes. In: Kenkel JM, editor. Selected readings in plastic surgery, vol. 10, no. 1. Dallas, Texas: The University of Texas Southwestern Medical Center, Baylor University Medical Center; 2005. p. 1–23.
7. Tschoi M, Hoy EA, Granick MS. Skin flaps. Clin Plastic Surg. 2005;32:261–73.
8. Black E, Nessi-Eloff F, Nessi FA. Eye lid lacerations and lid defects. In: Levine M and Allen R, editors. Manual of oculoplastic surgery. Springer; 2018.
9. Berges AF. The rhombic flap. Plast Reconstr Surg. 1981;67(4):459–66.
10. Callahan MA, Callahan A. Mustarde for lower lid reconstruction after malignancy. Ophthalmology. 1980;87(4):279–68.
11. Tenzel RR. Eye lid reconstruction by a semicircular flap technique. Ophthalmology. 1978;85:1164–9.
12. Hughes WL. Total lower lid reconstruction technical details. Trans Am Ophthamol Soc. 1976;74:321–9.
13. Cutler NL, Beard C. A method for partial and total upper lid reconstruction. Am J Ophthal. 1955;39(1):1–7.

Anaesthesia in Oculoplasty

Oya Yalcin Cok and Ezzat Sami Aziz

Introduction

Anaesthesia is an indispensable component of every surgery. However, every surgical specialty and subspecialty has its own needs and requirements regarding anaesthesia management. The oculoplastic procedures also need tailored approaches of local, regional and general anaesthesia techniques. This chapter will cover the main anaesthetica techniques used during oculoplastic surgeries, related anaesthetic drugs and some practical advices for anaesthesia management.

Local Anaesthesia

Local anaesthesia techniques sufficiently cover the requirements of most of the oculoplastic surgeries. These techniques include topical anaesthesia with local anaesthetics (LAs) and intradermal or subcutaneous LA administration as infiltrations. They can be used both alone and in combination with each other.

O. Yalcin Cok (✉)
Department of Anaesthesiology and Reanimation, School of Medicine, Adana Research and Education Center, Baskent University, 01250 Adana, Turkey
e-mail: oyacok@yahoo.com

E. S. Aziz
Department of Anaesthesiology, Cairo University, Giza, Egypt

Topical Anaesthesia

Topical anaesthesia, mostly reserved for ocular surgeries, still can be used for brief and superficial procedures of the globe, conjunctiva, and the lids or prior to infiltration anaesthesia to ease the injection pain. It has an advantage of less distortion of the surgical site. Especially, cornea and conjunctiva are very susceptible to topical local anaesthetic effect in where nerve endings are very superficial under a tear film and a thin epithelium. The local anaesthetics for topical anaesthesia are used in the form of eye drops, gels, creams, ointments, sprays and patches. Furthermore, local anaesthetic soaked cotton tip applicators may be used for topical anaesthesia of the conjunctiva. These drugs have higher concentrations of local anaesthetics and may be readily absorbed to the systemic circulation in high amounts.

Local Infiltration Anaesthesia

Local anaesthetic infiltration is an easy technique to provide a pain-free surgical area for many of the oculoplastic procedures. It is also suitable in some selected paediatric cases. In this technique, local anaesthetics (LAs) are injected into the soft tissue of the operative site. It may be accompanied with or without sedation.

E. A. El Toukhy (ed.), *Oculoplastic Surgery*, https://doi.org/10.1007/978-3-030-36934-7_2

Some technical issues should always be considered during local anaesthesia as follows. Local infiltration should always be utilized after cleaning the skin with appropriate material. The needle used should be sufficiently long to avoid multiple insertions, by long passes beneath the skin. This may help decrease the severity of pain and bruising. The syringe should be tightly secured to the needle with the bevel up; a Luer-Lok syringe should be used if possible to prevent needle expulsion which may cause inadvertent penetration of the globe or surrounding tissue. Eyelids are thin structures and they are not resistant to inadvertent full-thickness penetration. Penetration to the globe or corneal puncture should be suspected if the ballooning following LA infiltration ceases immediately.

Concerns During the Local Infiltration Anaesthesia for Oculoplastic Surgery

The local anaesthetic injection causes mild to moderate pain, burning, stinging sensation due to the needle insertion and acidity of LAs. Local anaesthetic injection rate affects injection pain in oculoplastic procedures as slower injection enables less painful infiltration. A smaller gauge needle may also alleviate the pain of injection. Because overall pain sensation and satisfaction during the surgery highly correlates with the initial pain during local anaesthetic infiltration, this is an important matter, especially at the office setting where a higher patient satisfaction and perception of good care are desired. Needle-free jet injections are not recommended for oculoplastic procedures. However, there are still ongoing and promising studies for new needleless alternatives such as nano enabled (nanoparticle) local anaesthetic delivery systems for oculoplastic surgery.

Periocular anaesthetic injections may trigger a forceful reflex sneezing (sternutatory reflex), even under sedation. This possibility should be anticipated and the needle should be drawn quickly to prevent deeper penetration.

A technical concern about local anaesthetic infiltration is its potential to distort the original anatomy of the patient that may be especially important in correction surgeries. This may be due to mass effect or haematoma formation. Therefore meticulous planning of the surgery should be made and drawn on the skin prior to local anaesthetic administration. Especially during ptosis surgery, the use of epinephrine may also result in upper eyelid retraction due to sympathetic activation of Müller muscle. On the other hand, LA diffusion to levator muscle may cause paralysis and make height adjustments difficult. This can be avoided by limiting the LA volume to less than 1 mL in the upper lid.

There are some complications that can be encountered due to periocular injections. First of all it is wise to check if the patient is on anticoagulant drugs and to cease them under the control of prescribing physician to avoid bleeding-related complications such as retrobulbar haematoma. Allergic reactions to LAs are rare, but, they may be observed against the preservatives or the antioxidants in the formula of the local anaesthetics. Systemic local anaesthetic toxicity is less expected since the use of large volumes and high concentrations of local anaesthetics during oculoplastic surgery isn't expected. But it may be of concern during tumescent anaesthesia or with large infiltration areas during full facial reconstruction. The initial symptoms of local anaesthetic systemic toxicity include central nervous system symptoms and signs such as anxiety, dizziness, tinnitus, restlessness, and tremor, and, sometimes, convulsions. Respiratory and cardiac alterations may co-exist or follow central nervous system disturbances. The management includes supportive therapy such as prevention of hypoxia, cardiopulmonary resuscitation and lipid emulsion therapy.

Blocks

The blocks used for oculoplastic surgery includes ocular blocks such as retrobulbar, peribulbar and sub-Tenon blocks and periorbital blocks of separate nerves. They can be used alone or in combination with each other to cover the surgery site. They cause minimal discomfort, lower cost, and lower perioperative morbidity in comparison to general anaesthesia. They also provide the advantages of less local anaesthetic

use and minimal tissue distortion when compared with infiltration anaesthesia. These blocks may be utilized with a blind technique or with the use of ultrasound guidance.

Ocular Blocks

Ocular blocks include retrobulbar, peribulbar and sub-Tenon blocks. They provide the anaesthesia of the globe. The local anaesthetic is injected into intraconal space, extraconal space by a needle and into sub-Tenon's space by a cannula during retrobulbar, peribulbar and sub-Tenon blocks respectively. However, they have very limited use for oculoplastic surgery. They have been reported to have beneficial effects such as longer optic nerve transection, less pain, less postoperative nausea and vomiting following eye amputation procedures.

Periorbital Nerve Blocks

Periorbital sensorial nerve blocks include supraorbital, supratrochlear, infratrochlear, zygomaticotemporal, zygomaticofacial, infraorbital, maxillary nerve blocks. The facial nerve must be blocked for motor blockade of the relevant muscles in the area. Here, the blocks will be described starting from the peripheral and the superficial to the main branches and the deeper ones.

Supraorbital Nerve and Supratrochlear Nerve Blocks

The supraorbital nerve and the supratrochlear nerve are two of the terminal branches of the frontal nerve which is the largest branch of ophthalmic division (V1) of the trigeminal nerve. Both nerves exit the orbit anteriorly and

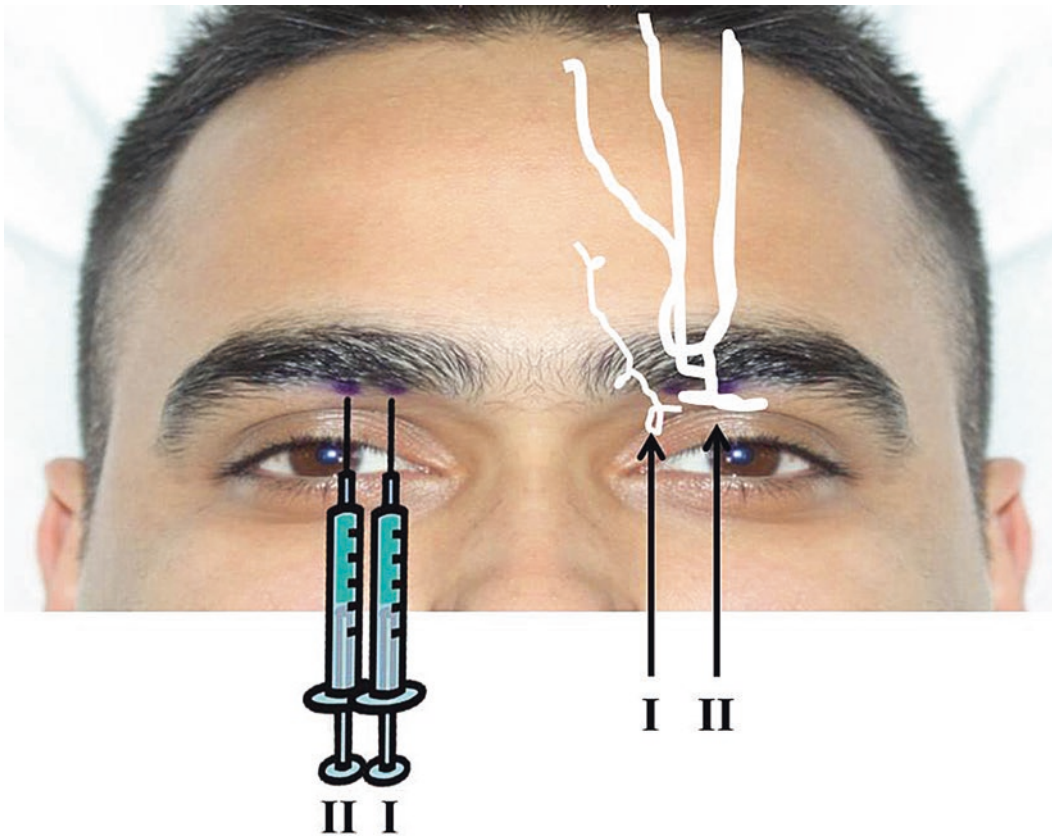

Fig. 1 The supratrochlear and the supraorbital nerves and the respective block sites. I: The supratrochlear nerve, II: The supraorbital nerve

superiorly. The supratrochlear nerve and the supraorbital nerve are located approximately 1 cm and 2 cm lateral from the midline of the forehead on the supraorbital ridge, respectively (Fig. 1). The supraorbital nerve exits from the supraorbital notch or foramen at 0.5–0.7 cm above the supraorbital margin which are usually palpable and visible under ultrasound guidance.

The blockade of supratrochlear and supraorbital nerves provides anaesthesia for procedures such as repair of lacerations, debridement, removal of foreign bodies, oncologic interventions of the forehead and upper eyelid without compromising levator function and specific neuralgias of the related nerves.

The supraorbital nerve can be blocked by a 23–30 G needle inserted perpendicular to the skin by palpating the foramen or the notch by a blind technique and 1–2 mL of LA should be injected. Direct injection the foramen should be avoided to prevent the nerve injury. The supratrochlear nerve can be blocked at 1 cm medial to supraorbital notch/foramen on the upper orbital margin. A practical technique to block both nerves at once is to infiltrate the medial two-thirds of the eyebrow with one long pass of a sufficiently lengthy needle beneath the eyebrow and inject 4–5 mL LA along while withdrawing the injector.

A high-frequency ultrasound transducer transversely placed on the eyebrow should be moved slowly from lateral to medial while dynamically searching for a break in the hyperechoic edge of the bone indicating the supraorbital notch or foramen (Fig. 2). The foramen or the notch should be checked by colour or Doppler mode to visualise vascular structures. The supraorbital nerve can't be visualised in long axis by this approach, however in-plane needle advancement, sectional view of supraorbital nerve, LA spread around the foramina can be observed during the block (Fig. 3). The supratrochlear nerve may also be visualized medial to the supraorbital nerve on the supraorbital ridge with the use of a high-frequency ultrasound transducer (Fig. 4).

Infratrochlear Nerve Block

The infratrochlear nerve is one of the terminal branches of the nasociliary nerve, which is a branch of the ophthalmic division (V1) of the trigeminal nerve. It travels along the medial wall of the orbit before leaving over the medial canthus. The branches of the infratrochlear nerve are distributed throughout the medial area of the upper eyelid and 1/5 of the medial part

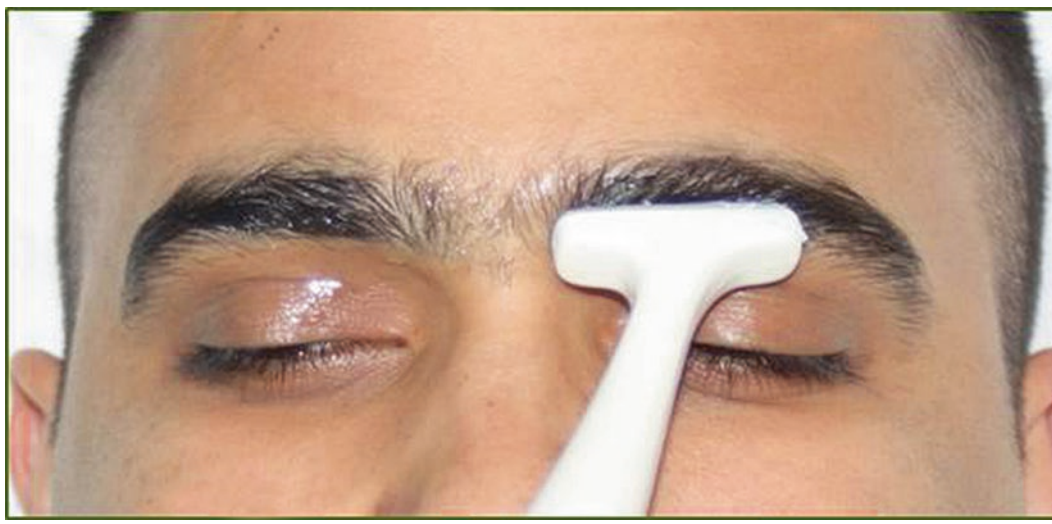

Fig. 2 A high-frequency ultrasound transducer transversely placed on the eyebrow for supraorbital nerve block

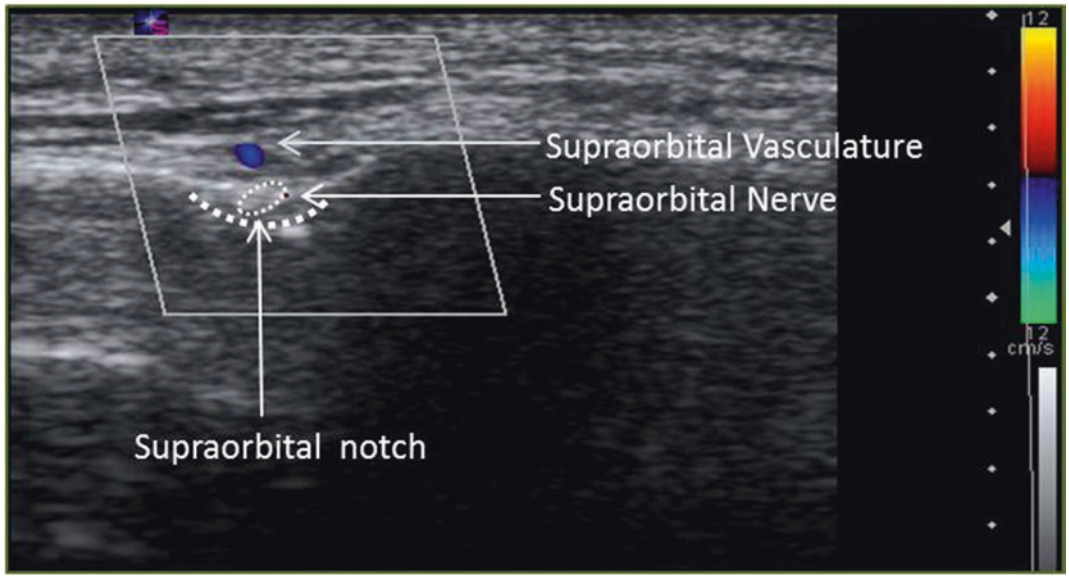

Fig. 3 Ultrasound image for supraorbital nerve block

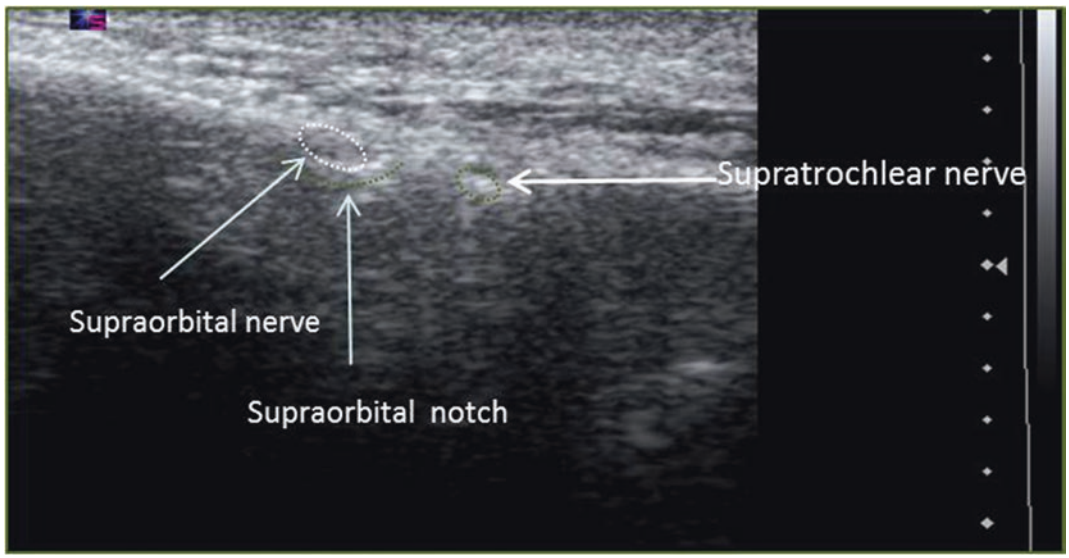

Fig. 4 Ultrasound image for supratrochlear nerve block

of eyebrow height. This nerve innervates the internal angle of the orbit and the medial upper eyelid, the upper bridge of the nose and/or the lacrimal caruncle.

The infratrochlear block is performed by administering 0.5–1 mL of LA with the needle inserted 0.5–1 cm above the medial canthus at the intersection of the nasal base and the orbit (Fig. 5). The blockade of the supraorbital, the supratrochlear and the infratrochlear nerves all at once is possible by 2–3 mL LA injection starting from the midline of the eyebrow to the glabella, however, this technique is more painful than separate blocks of these nerves.

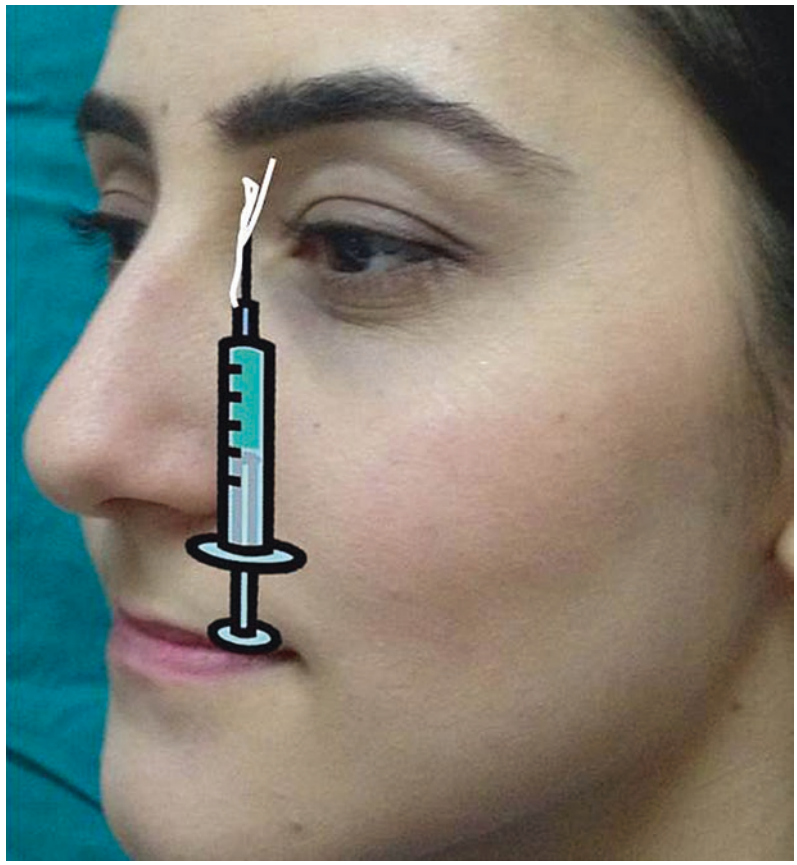

Fig. 5 Infratrochlear nerve and the block site

Zygomaticotemporal Nerve and Zygomaticofacial Nerve Blocks

The zygomaticotemporal nerve and the zygomaticofacial nerve are the peripheral branches of the maxillary division of the trigeminal nerve. The zygomaticotemporal nerve ran along the lateral wall of the orbit and reaches to the temporal fossa between the deep layer and the superficial layer of the deep temporal fascia after passing through the zygomaticotemporal foramen. It has communicating anastomoses with the temporal branch of the facial nerve, which is assumed to be myelinated fibers of proprioceptive or motor function. The zygomaticotemporal nerve innervates an area which is 3 cm lateral to lateral canthus and of 3 cm diameter in adult patients. The zygomaticofacial nerve passes through the lateral wall of the orbit anterolaterally and traverses the zygomaticofacial foramen and it innervates the skin over the zygomatic bone, the inferior region of the temple and the lateral aspect of the lower eyelid.

The blockade of these nerves is indicated when the surgery involves the lateral part of the orbit, separation of temporal muscle from the cranium, lateral part of the lower eyelid, lateral region on the zygoma.

To block the zygomaticotemporal nerve blindly, one should palpate the lateral edge of the orbit at the level of lateral canthus and follow the edge until the superior of the lateral orbital wall at the level of the frontozygomatic suture. The nerve can be blocked at this area (Fig. 6). However, the frontozygomatic suture cannot be palpated in every patient. In this case,

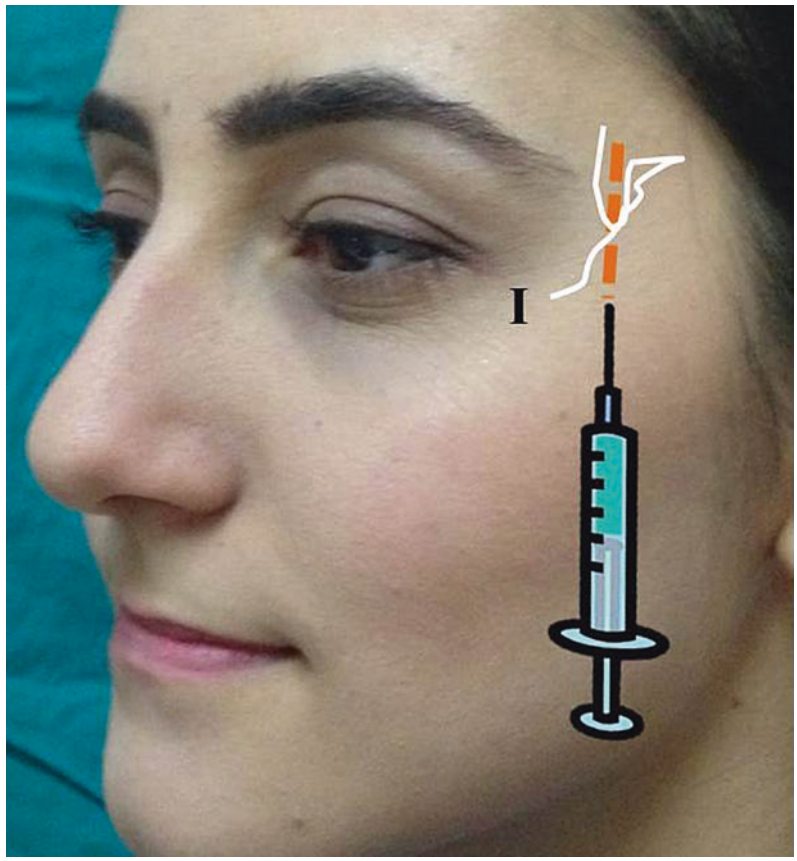

Fig. 6 The zygomaticotemporal nerve and the block site. I: The zygomaticotemporal nerve

the lateral orbital edge must be palpated 1 cm superiorly and then the palpating finger should be moved to into a groove 0.5–1 cm posteriorly. The zygomaticofacial nerve can be blocked at this area which is 1–1.5 cm posterior to frontozygomatic suture and 2 cm superior to zygomatic arch. Due to numerous variations of the zygomaticotemporal nerve location, the block must be performed by superficial and deep injections of 5 mL LA to block both the temporalis and temporoparietalis muscles.

The zygomaticofacial nerve can be blocked blindly by subcutaneous injection of 1–2 mL LA to the area 2 cm lateral and 2 cm inferior to the lateral canthus in the proximity of the zygomaticofacial foramen. It may be also blocked by injecting LA at the lateral edge of the orbit at the level of the frontozygomatic suture in the direction of zygoma. It is frequently blocked together with the zygomaticotemporal nerve. The finer the needle used, the less haematoma or bruising at this delicate area. The use of ultrasound guidance for identifying bony and vascular landmarks eases the block of these nerves, especially in obese patients (Fig. 7).

Infraorbital Nerve Block

Infraorbital nerve is a terminal branch of the maxillary division (V2) of the trigeminal nerve. An infraorbital nerve block is indicated for lower eyelid, lateral side of the nose and upper lip anaesthesia.

This nerve is blocked at the site where it emerges from infraorbital nerve. Infraorbital foramen is located at 2 cm below the midline of orbit. Practically, it is on the same virtual

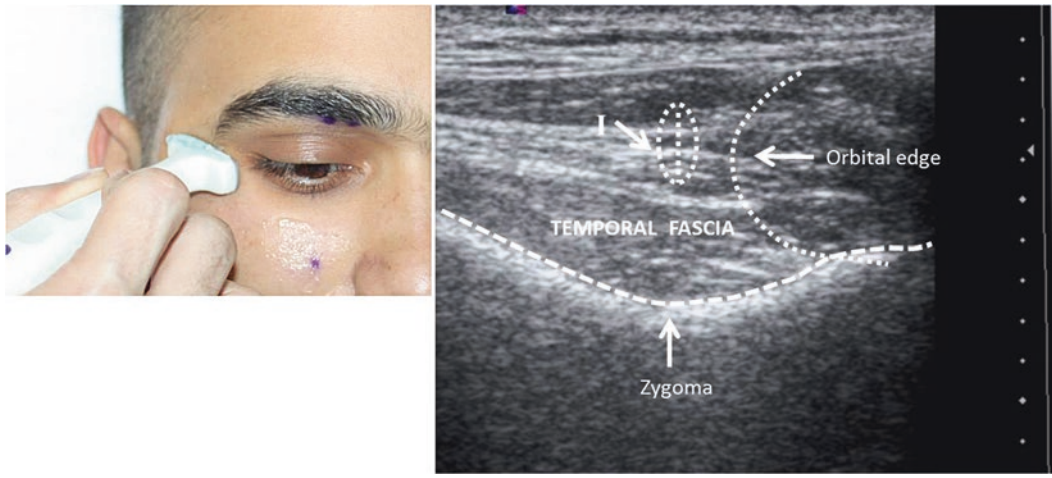

Fig. 7 Ultrasound image for zygomaticotemporal nerve block. I: The zygomaticotemporal nerve block LA injection site

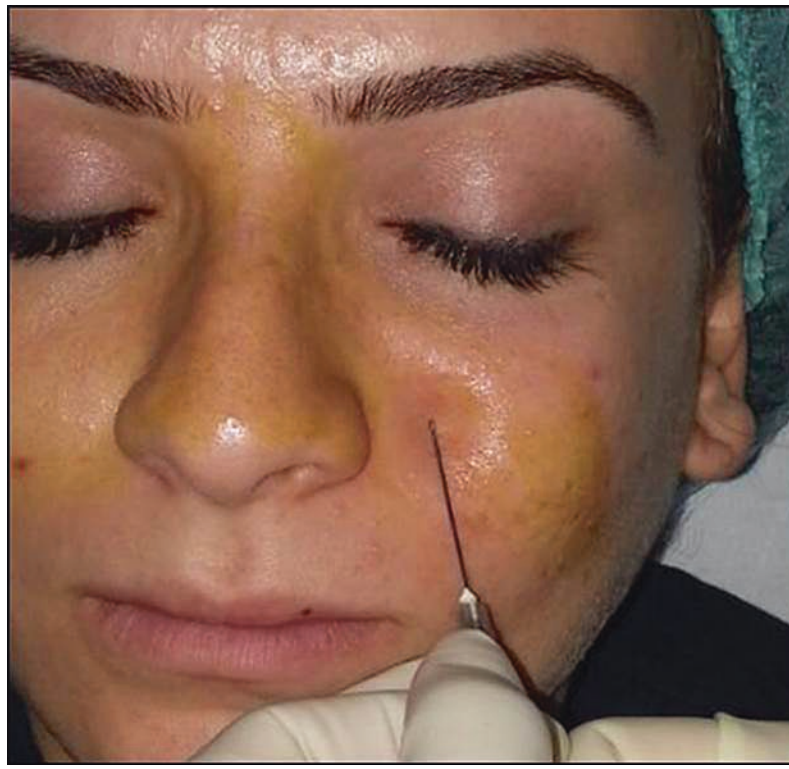

Fig. 8 Infraorbital nerve block site with percutaneous extraoral approach

line drawn from supraorbital notch and pupil at neutral gaze. This block can be performed percutaneous extra-oral or intraoral approaches and blindly or by ultrasound guidance. During the ***percutaneous extraoral approach***, the infraorbital foramen is palpated according to anatomical landmarks such as the infraorbital ridge and the 1–2 mL LA is deposited subcutaneously by a needle perpendicular the skin (Fig. 8). A deeper injection beneath the muscle

is recommended in patients with prominent quadratus labii superioris muscle. The needle should not be introduced into the infraorbital foramen since this may cause globe injury and nerve damage due to direct needle contact, toxicity or local pressure of LA.

During the ***intraoral approach***, the needle is aligned between the roots of the first and the second maxillary premolar teeth and introduced towards the ipsilateral pupil. Palpating the foramen simultaneously provides control of the LA injection and spread. LA spread can be facilitated by 10–15 second massage after LA injection. Theoretically, blind intraoral approach increases the risk of orbital penetration and globe perforation since the needle trajectory, infraorbital foramen and the canal lies on the same plane. If the needle enters the orbit, a swelling in the lower lid is observed during LA injection.

Infraorbital foramen's location rapidly moves to the more inferotemporal site during the first 3 years and between 10 and 12 years of life and this is finalized around the age of twenty. It is more inferotemporal in male patients in comparison to female patients. In paediatric patients, its distance from the midline can be calculated according to the formula as follows: Distance = 21 mm + 0.5 × age (years).

A high-frequency ultrasound transducer should be placed at the inferior orbital rim and transverse sono-scan is performed until a hypoechoic break in the bone indicating the infraorbital foramen is observed (Fig. 9). The foramen should be checked by colour or Doppler mode to visualise vascular structures. The needle is introduced with the in-plane approach and the block is performed while observing the spread of local anaesthetic at the opening of the foramen. However, sagittal scanning parallel to the nose may also be performed and the same imaging principles apply since the foramen can be found in the same way. In-plane needle advancement and LA spread around the foramina can be observed during the block.

Maxillary Nerve Block

Maxillary nerve (V2) is one of the three divisions of the trigeminal nerve. The maxillary nerve exits the cranium through the foramen rotundum and enters the pterygopalatine fossa. Then it starts to give its peripheral branches such as zygomatic nerve (the main branch giving off zygomaticotemporal and zygomaticofacial nerves) and infraorbital nerves which innervate the inferior and lateral periocular region. The blockade of this nerve in the pterygopalatine fossa enables to anaesthetise the area innervated by all terminal branches of this nerve at once.

After defining the midline of the zygomatic process, the sulcus beneath the bone should be

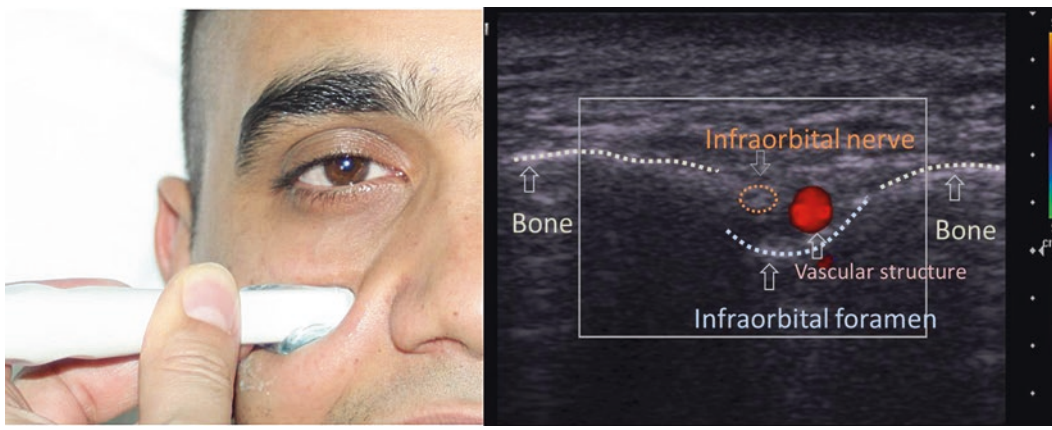

Fig. 9 Ultrasound image for infraorbital nerve block

marked to block the maxillary nerve blindly. A 22G needle should be inserted perpendicularly at this point until it touches the lateral pterygoid plate at around 4 cm depth. Then the needle is retracted and directed upwards for 4.5 cm (not more than 4.5 cm) and 3–4 mL LA is sufficient for the nerve blockade.

During the ultrasound-guided maxillary nerve block, the transducer is placed distal and parallel to the zygomatic arch to bridge the coronoid and condylar processes. The aim of the imaging is to visualize the lateral pterygoid plate and the sphenoid palatine artery, which is a branch of the maxillary artery, flowing to the pterygoid palatine fossa. The needle is introduced to the area anterior to the lateral pterygoid plate which is the pterygopalatine fossa and LA is injected. This block may also be performed with several different approaches.

Facial Nerve Block

The facial nerve block provides motor blockade of the muscles of the face. It doesn't offer sensorial anaesthesia around the eye although it has some communicating branches with the peripheral branches of the trigeminal nerve. Akinesia of the muscles around the eye may benefit some particular surgeries. However, current improvements in oculoplastic techniques minimized the need for this block. The proximal and distal approaches of the facial nerve are Nadbath-Rehman, O'Brien, Atkinson, van Lint techniques and their modifications. In the proximal site, the facial nerve can be blocked by delivering 3 mL LA 1.5 cm deep into the area where facial nerve emerges from stylomastoid foramen, between anterosuperior part of the mastoid and the ramus of the mandible. In the original O'Brien technique, LA is injected directly beneath the condyloid process at the level of the neck of the mandible just anterior to the tragus of the ear. In the modified O'Brien technique, the injection site is at more posterior and inferior of the original approach and approximately 5 mL of LA is injected at the dorsal rim of the mandible near the tragus of the ear at a maximal depth of 1 7 cm. The Atkinson block is performed by subcutaneous injection of 2–5 mL LA at the midpoint of a line between the lower edge of the zygoma and the jaw joint. The modified van Lint block is the most distal of the facial nerve blocks particularly reserved for eye surgeries and practically, 2–5 mL LA is injected below the orbicularis oculi muscle. The more distal the block site gets, the less akinesia is provided. Nadbath-Rehman technique has a higher risk of complications due to its proximity to vagus and glossopharyngeal nerves and these complications include dysphagia, respiratory distress and pulmonary oedema. Van Lint approach causes swelling and distortion of the lids and ocular adnexa and O'Brien technique produces postoperative pain at the site of anaesthesia.

Contraindications of the Periocular Blocks

Infection at the block site, congenital or acquired coagulopathies and the refusal of the patient are a contraindication to block performance. Bone defect or tumours may change the normal anatomy of the block site and may cause an increased risk of complications as well as block failure.

Complications of the Periocular Blocks

Pain during the block performance, bruising and local infection are the common complications during the periocular blocks. Vascular structures accompanying the nerves and the dense vasculature on the face increase the risk of the subcutaneous bleeding. Haematoma formation may be observed in patients who are on anticoagulant and some herbal drugs. However, adding epinephrine to LA is not a recommended practice in these blocks. Pressure due to LAs or direct needle contact may cause nerve injury since most of the nerves of the region are located in a narrow foramen or notch or very superficially. Inadvertent injury to the surrounding structures

via the foramina has also been reported, especially during the infraorbital nerve block.

Essential Knowledge for Ultrasound Guidance During Periorbital Nerve Blocks

Ultrasound guidance helps visualizing the supraorbital foramen or notch and vasculature near the block site and efficient spread of LA to minimize the LA volume used. Since periorbital nerves are very superficial and thin structures to visualize, high frequency linear or hockey stick transducer use (>13 MHz) is advocated for these nerve blocks. Higher frequency ultrasound transducers allow better differentiation of the structures at the depth of 0–3 cm. Use of colour or Doppler mode may help distinguish vasculature, especially arteries which are rarely compressible. It is practical to search for the anatomical landmarks such as foramina, notches, and vascular structures during the ultrasonographic scan. Bony structures present as hyperechoic (bright) lines with an anechoic (dark) shadow beneath. A gap in the hyperechoic line may indicate a notch or foramen. Block performance during real-time visualization should be done very cautiously since the distance to be advanced by the needle is very short or superficial for periorbital nerve blocks. Furthermore, needle tip location and the spread of the LA should be observed during the block to prevent direct nerve injury by the needle or the LA volume itself. The sterile technique should be preserved throughout the ultrasound-guided block performance.

Local Anaesthetic Agents and Adjuvants

Local anaesthetics (LAs) are essential components for topical, local and block anaesthesia. LAs had been first introduced to clinical practice for ophthalmic anaesthesia. Topical administration of cocaine as the first LA agent by Karl Koller opened a new era in surgical anaesthesia.

LAs act on the cell membrane to prevent the generation and the conduction of nerve impulses. Their main action site is voltage-gated Na^+ channels. The open and inactivated states of voltage-gated Na^+ channels have higher affinity to LA drugs than the resting state. In ophthalmic practice, reversibly blocking Na^+ channels inhibits painful nerve impulses from the cornea, conjunctiva, sclera, and orbital tissues.

Local anaesthetics are poorly water-soluble and weak base molecules. However, commercially available LAs are generally water-soluble salts to increase the stability of the LA, but LAs become more charged in these mildly acidic solutions. Higher concentrations ensure rapid onset, whereas lipid solubility allows a greater potency. However, the onset of action of LA also depends on the route of administration and dose of the drug, while the longer duration of effect depends on the higher protein binding. All LAs contain an aromatic ring (hydrophobic part), an intermediate ester or amide bond and an amino group (hydrophilic part). LAs may be classified into two groups according to their chemical formulation as ester type and amide type LAs. Ester type LAs are metabolised by plasma esterase, such as plasma cholinesterase, whereas amide type LAs are degraded by the hepatic cytochrome P450.

In clinical practice, LAs can be grouped into three groups according to their duration of action: short (approximately 20–45 minutes) such as procaine, intermediate (approximately 60–120 minutes) such as lidocaine, mepivacaine and long (more than 2 hours) including bupivacaine, ropivacaine, and tetracaine. The chemical and clinical features of commonly used LAs in oculoplastic procedures are as follows:

Ester Type LAs

Cocaine has a historical significance and is known to the first non-synthetic local anaesthetic used in ophthalmic practice. It has an intense vasoconstrictor feature different than other LAs. Its use as an LA is nearly abandoned

due to its many undesirable effects during anaesthesia as well as substance abuse potential.

Tetracaine (amethocaine) is a highly potent, intermediate-acting local anaesthetic which is mostly used topically at 1% concentration in an aqueous form. It has a higher toxicity potential and repeated administration may also cause corneal epithelial impairment. It causes a burning sensation and pain during administration, which can be alleviated by cooling the solution.

Proparacaine hydrochloride is a short-acting LA, commonly used for topical administration. It is formulated in 0.5% aqueous solution. Its effect onsets within seconds and continues for approximately 15 minutes. Its burning sensation is reported to be less than tetracaine. Due to a rare, but severe and hypersensitivity reaction, it may cause large areas of necrotic epithelium, ground-glass appearance, and erosion of the cornea.

Oxybuprocaine is an ester-type local anaesthetic which is used extensively for topical anaesthesia in 0.4% concentration.

Amide Type LAs

Lidocaine is the most commonly used LA for oculoplastic procedures with its predictable and rapid onset (approximately 60 seconds), duration of action up to an hour and unexpected risk of toxicity. Its maximum dose is 4 mg/kg when administered alone and 7 mg/kg with epinephrine. It provides 30–60 minutes of action without epinephrine. This duration may be prolonged up to 2–4 hours with the addition of epinephrine. Its concentration is 4% during topical administration and total dose may be as high as 5 mg/kg during tumescent anaesthesia. Therefore, the patient should be monitored attentively for the possible risk of systemic toxicity since systemic absorption of the topically and tumescent applied drugs is relatively very high. Lidocaine in gel form is also efficient in providing anaesthesia in a dose-dependent manner. Lidocaine is also effectively used for subconjunctival, transconjunctival and intracameral application.

Prilocaine is an intermediate-acting LA very similar to lidocaine. It is administered at 2–4% concentrations for infiltration and topical anaesthesia, respectively. It is also available in a eutectic mixture of local anaesthetics with lidocaine, which is commonly used to alleviate the pain before LA injections to eyelids and periocular botulinum toxin injection. High doses of prilocaine exceeding 7 mg/kg or a total dose of 500 mg lead to methemoglobinemia as a sign of systemic toxicity which should be treated with methylene blue in a dose of 1–2 mg/kg (except in patients with known G6PD deficiency) and ascorbic acid (vitamin C).

Bupivacaine is a highly lipid-soluble and potent agent with slow onset (10–25 minutes) and prolonged duration of action (up to 6–8 hours) with a narrow therapeutic index. It has a severe cardiotoxicity potential above its maximum dose of 2–3 mg/kg.

Levobupivacaine is the pure S (-) isomer of bupivacaine. Its clinical features are very similar to bupivacaine, however, with less potential cardio- and neurotoxicity.

Ropivacaine is an LA similar to bupivacaine with slow onset and long duration of action; however, its cardiac toxicity and potency are less than bupivacaine. It is used in 0.75–1% concentrations for topical, local and block anaesthesia.

Etidocaine is used in 0.5–1.5% concentration enabling rapid-onset, prolonged duration, and intense motor blockage during ophthalmic regional anaesthesia.

Mepivacaine used at 2–3% concentrations in ophthalmic practice, is similar to lidocaine with longer duration of action.

Adjuvants have been added to LAs to provide an early onset, longer duration, less pain during injection, less bleeding and less systemic effects.

LAs are frequently accompanied with ***epinephrine*** (1:100.000–400.000) to slow down the systemic absorption and decrease bleeding during oculoplastic procedures. Duration of action may be prolonged by 50% when epinephrine is added to intermediate-acting and natural

vasodilator LAs. However, adding epinephrine to long-acting LAs usually do not provide the advantage of longer duration but only less bleeding and less systemic absorption. Addition of epinephrine to the local anaesthetics before infiltration enables less bleeding during the surgery and this practice reaches maximal haemostatic effect in 7 minutes and waiting longer doesn't offer a further decrease in bleeding. Periocular injections with epinephrine are a relatively contraindicated in patients with untreated narrow angles because of pupillary dilation. It should also be kept in mind that the use of vasoconstrictors with LA during ophthalmic surgery may also reduce retinal artery blood flow and lead to vision loss and this should be avoided during retrobulbar, peribulbar, sub-Tenon blocks and during regional administrations close to vascular structures. Lower concentrations of epinephrine may help avoid such complications.

Sodium bicarbonate is another adjuvant used with LAs to increase the pH of them to accelerate the onset of action slightly and alleviate injection pain. It is reported to be used in a ratio of 1: 10–31 (sodium bicarbonate: LA). However, it may cause precipitation of the solution.

General Anaesthesia

Sedation and general anaesthesia management are not very detailed for oculoplastic surgeries. Sedoanalgesia with short-acting benzodiazepines such as midazolam and opioids such as alfentanil and remifentanil for oculoplastic surgery under local anaesthesia enables low pain scores and high patient satisfaction as well as maintaining the requirements of outpatient setting. Ketamine is an NMDA receptor antagonist and provides a dissociative state when administered. The main advantages of ketamine are its good analgesic potency and minimal effect of respiration; however, it may cause agitation and hallucinations when it is not accompanied by a benzodiazepine. Propofol may also be used at sedative doses while periocular LA injections. Monitored anaesthesia care has been reported to provide effective anaesthetic conditions even for enucleations and eviscerations.

General anaesthesia techniques must meet a few particular needs of oculoplastic surgery. In terms of hypnotics, any intravenous and inhalation anaesthetics can be used to provide induction and maintenance of the general anaesthesia. Total intravenous anaesthesia may provide the advantage of rapid recovery and discharge from the hospital. Laryngeal mask airway insertion or intubation may secure the airway effectively and can be used according to the operation site if there is no emergency case with a full stomach. The use of neuromuscular blocking agents is frequently limited to non-depolarizing ones. Patients undergoing oculoplastic surgery under general anaesthesia experience postoperative pain and discomfort by 32.1% and 28.3% respectively. Anxiety, prior surgery in the eye and smoking are the predictors of postoperative pain and discomfort following general anaesthesia in this patient population. Management of preoperative anxiety, postoperative pain, and prevention of postoperative nausea and vomiting should be an essential part of the anaesthetic plan. The main recommendation for sedation and general anaesthesia is the existence of a physician, preferably an anaesthesiologist, monitoring and managing the patient.

Challenges of Anaesthetic Management During Oculoplastic Surgery

Specific anaesthetic challenges during lacrimal, orbital and oculoplastic surgery must also be highlighted. These issues include challenging patients and challenging procedures.

Challenging Patients

The patients' anaesthetic needs have been expected to be low for many oculoplastic surgeries which are performed at an office setting. However, the patients undergoing surgery due to oculoplastic disorders may be too young, too old, or may have serious co-morbidities. These

patients may have increased malignant hyperthermia risk due to neuromuscular disorders, considerable hormonal alterations, or metabolic disorders, systemic manifestations of malignancies which may affect anaesthetic management.

The patients with ptosis and strabismus who may have oculoplastic surgery are specifically at risk of ***malignant hyperthermia*** (MH). MH is an autosomal dominant disorder of skeletal muscle, mostly caused by a defect in the ryanodine receptor. It is a hypermetabolic response triggered by inhalational anaesthetics and succinylcholine, a depolarizing muscle relaxant. The incidence has been reported to range from 4 to 100 in one million cases. The clinical signs of MH include hyperthermia, tachycardia, tachypnea, increased end-tidal carbon dioxide, acidosis, hyperkalemia and muscle rigidity. Increased oxygen consumption and rhabdomyolysis also co-exist. The risk of malignant hyperthermia may jeopardize or alter general anaesthesia plans. Detailed family history regarding general anaesthesia and related mortality is essential during the preoperative assessment of these patients. Early suspicion and recognition of the MH is the key for immediate treatment. General anaesthesia may be acceptable when precautions are in place with close follow-up. However, regional anaesthesia techniques should be preferred if possible especially in patients with concomitant neuromuscular or metabolic diseases such as Kearn-Sayre Syndrome. When MH is initiated, the management plan includes cessation and removal of the inhalational anaesthetics, external cooling, and supportive therapy and, mainly, the administration of dantrolene sodium. Increased understanding of the pathophysiology and better intraoperative monitoring systems enabled a considerable decrease in mortality the last few decades.

The patients with ***thyroid eye disease*** may also represent a challenge for anaesthetic management. These patients usually undergo orbital decompression surgery. They may present to the operating room with considerable hormonal alterations since both hypo- and hyperthyroidism has ophthalmic manifestations. Both disorders may affect the eye and surrounding tissues via auto-immunity by antibodies to eye muscles and fat tissue. These patients should have thyroid function tests preoperatively to check euthyroidism which is the preferred state. Elective surgery should be deferred until the patient has been rendered euthyroid and appropriate medication has started to control cardiovascular response due to disease. During anaesthetic management of hyperthyroid patients, the agents that can stimulate the sympathetic nervous system, such as pancuronium, ketamine, direct and indirect adrenergic agonists, should be avoided. Exaggerated hypotensive response during induction may be observed, however exaggerated hypertensive response is also possible due to inadequate anaesthetic depth before laryngoscopy or any surgical stimulation. Epinephrine should not be added to local anaesthetics. In patients with hypothyroidism, increased sensitivity to anaesthetic agents, delayed recovery, hypothermia, poor tolerance to blood loss are expected. Inhalational anaesthetics may exaggerate cardiac depression in very symptomatic hypothyroid patients. Neuromuscular monitoring is also recommended for titrating neuromuscular blocking agents and timing of tracheal extubation in these patients. Opioids should be used attentively. Another concern in thyroid eye disease patient is difficult airway management due to tracheal compression or deviation by overgrown thyroid gland or tumour. Patients should be evaluated for difficult ventilation and/or intubation preoperatively and difficult airway management measures should be readily available in the setting.

Patients with orbital tumours with systemic malignancies or systemic tumours with orbital metastasis may also need ophthalmic surgery. Especially, melanoma has cardiac involvement which is usually in the right chambers of the heart. On the other hand, renal cell carcinoma, breast cancer, angiosarcoma, lymphoepithelioma, and hepatocellular carcinoma have been reported to have orbital metastasis. Here, the primary disease and its systemic effects are the major concerns during anaesthesia. These patients should be evaluated individually and the anaesthetic management should be tailored accordingly.

Challenging Procedures

One of the brief but challenging procedures is ***probing and nasolacrimal intubation***. It is the most frequent lacrimal operation in children. Tracheal intubation, laryngeal mask airway, and mask ventilation are possible ways to secure ventilation. Although this a very brief intervention in experienced hands, the main concern during this procedure are sharing the airway with the surgeon and the possible risk of aspiration of blood or saliva when the airway protective devices aren't used during a sedation technique. General anaesthesia with inhalational or intravenous anaesthetics is both feasible. However, only sedation is mostly the frequent anaesthetic technique at an office-based setting, which is practical as well as highly satisfying according to the parents. Probing and nasolacrimal intubation is also one of the rare ophthalmic surgeries possibly indicating infection prophylaxis for endocarditis in patients at high risk, however the results of the studies about the issue are still controversial.

Another procedure that needs more attentive anaesthetic management is ***orbital fracture surgery***. Orbital surgeries often present as an emergency due to trauma which occurs frequently with the problem of full stomach and underevaluation of the patient. A difficulty in airway management such as insufficient mask ventilation or unsuccessful intubation as well as a need for fast induction and smooth intubation may co-exist. The patients with orbital fractures may also have concomitant intracranial pathologies or dural tears. The anaesthesia measures during these surgeries must also meet the needs of neuroprotection.

Enucleation, ***evisceration, exenteration and socket reconstruction*** may also represent a challenge for anaesthesia and ophthalmology teams since patients may experience severe postoperative nausea and vomiting and pain. These adverse events prevent early discharge from the hospital. Postoperative acute pain is usually localized to the remaining orbit and responds well to paracetamol, NSAIDs, and opioids. Perioperative regional techniques may also provide efficient pain relief. In the late postoperative period, phantom eye syndrome may be present as any sensation as originating in the eye despite it was amputated. These sensations include painful sensation such as cutting, penetrating, shooting or superficial burning pain, itching, feeling of non-existent eyelids and visual hallucinations. The medical therapy frequently consists of tricyclic antidepressants, anticonvulsants, ß-blockers, IV calcitonin, NMDA antagonists and rarely opioids.

Summary

Anaesthetic management for oculoplastic surgeries mainly requires a thorough knowledge of anatomy, local anaesthetic pharmacology, and particular adjustments according to the specific needs of the surgery. Periocular blocks usually provide intraoperative anaesthesia and postoperative analgesia effectively; however, general anaesthesia is still a custom practice for a specific patient population such as children and specific surgeries such as dacryocystorhinostomy.

Suggested Readings

1. Moody BR, Holds JB. Anesthesia for office-based oculoplastic surgery. Dermatol Surg. 2005;31:766–9.
2. Ing EB, Philteos J, Sholohov G, Ta Kim D, Nijhawan N, Mark PW, Gilbert J. Local anesthesia and anxiolytic techniques for oculoplastic surgery. Clin Ophthalmol. 2019;13:153–60.
3. Bartamian M, Meyer DR. Site of service, anesthesia, and postoperative practice patterns for oculoplastic and orbital surgeries. Ophthalmology. 1996;103:1628–33.
4. Vagefi MR, Lin CC, McCann JD, Anderson RL. Local anesthesia in oculoplastic surgery. Arch Facial Plast Surg. 2008. https://doi.org/10.1001/archfaci.10.4.246.
5. Lalatsa A, Emeriewen K, Protopsalti V, Skelton G, Saleh GM. Developing transcutaneous nanoenabled anaesthetics for eyelid surgery. Br J Ophthalmol. 2016;100:871–6.
6. Ahn ES, Mills DM, Meyer DR, Stasior GO. Sneezing reflex associated with intravenous sedation and periocular anesthetic injection. Am J Ophthalmol. 2008;146:31–5.
7. Ascaso FJ, Peligero J, Longás J, Grzybowski A. Regional anesthesia of the eye, orbit, and periocular skin. Clin Dermatol. 2015;33:227–33.

8. Ismail AR, Anthony T, Mordant DJ, MacLean H Regional nerve block of the upper eyelid in oculoplastic surgery. Eur J Ophthalmol 16:509–13.
9. Barnett P. Alternatives to sedation for painful procedures. Pediatr Emerg Care. 2009;25:415–9.
10. Herlich A. Focused local anesthesia and analgesia for head and neck surgery. Int Anesthesiol Clin. 2012;50:13–25.
11. Burroughs JR, Soparkar CNS, Patrinely JR, Kersten RC, Kulwin DR, Lowe CL. Monitored anesthesia care for enucleations and eviscerations. Ophthalmology. 2003;110:311–3.
12. Yen KG, Elner VM, Musch DC, Nelson CC. Periocular versus general anesthesia for ocular enucleation. Ophthal Plast Reconstr Surg. 2008;24:24–8.

Part II
EyeLid Disorders

Benign Lid Lesions

Rania A. Ahmed

Background

Various lesions can be detected in the eyelid due its diverse composition. The skin epidermis is keratinized stratified squamous epithelium while its dermis contains cilia in addition to modified sweat and sebaceous glands. The tarsus also contains Meibomian glands which are modified sebaceous glands while the lining conjunctiva contains accessory lacrimal glands and goblet cells. The majority of the lid lesions are benign, but their identification is important for proper treatment and ruling out malignancy.

Benign lesions are usually uniform with regular borders and show slow growth. They usually don't show induration, ulceration or lid margin destruction and can be classified according to:

- Structure of origin to epidermal, dermal or adnexal
- Clinical appearance either solid or cystic
- Location whither related to the lid margin, pretarsal area or supra/infra tarsal region.

Generally, the clinical appearance is highly suggestive of the lesion nature yet, when in doubt, a biopsy is required to confirm the diagnosis. Biopsies are either incisional which entails removal of a part of the lesion or excisional in which the lesion is totally removed thus, additionally provides a cure.

Treatment options in general include total excision of the lesion, with special attention to removal of the walls in case of cysts, marsupialization i.e. removal of the top of the cyst if excision is not feasible and surface ablation in superficial lesions.

Some of the common benign lid lesions are described below.

Seborrheic Keratosis (Basal Cell Papilloma)

This is extremely common asymptomatic benign proliferation of the epithelium basal cells that shows slow increase in size and number with age.

The lesions are superficial, usually present on the face, trunk and extremities of the elderly patients. They are either single or multiple; typically with a well defined edge, rough surface and classically described to have a greasy, ***stuck on*** appearance. According to the degree of skin pigmentation, the lesion's color varies from flesh color to dark brown (Fig. 1). Large and flat lesions may show pits filled with keratin. In the eyelid area, the lesions appear wrinkled. Seborrhoeic keratosis should be differentiated from pigmented basal cell carcinoma, neavus and malignant melanoma

R. A. Ahmed (✉)
Department of Ophthalmology, Kasr Al Aini School of Medicine, Cairo University, Cairo, Egypt
e-mail: ransalam@gmail.com

E. A. El Toukhy (ed.), *Oculoplastic Surgery*, https://doi.org/10.1007/978-3-030-36934-7_3

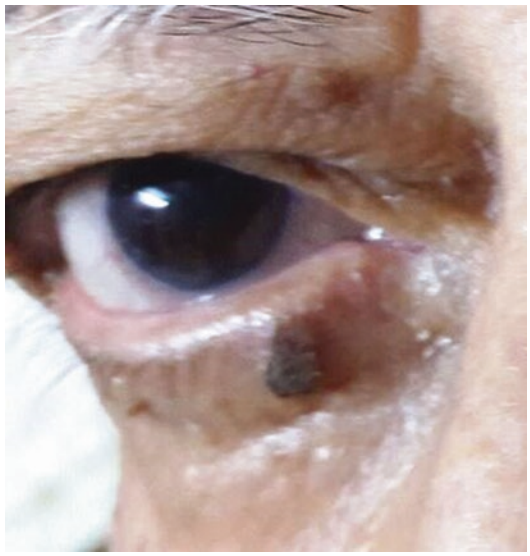

Fig. 1 Upper and lower seborrheic keratosis. The one in the lower lid is more pigmented

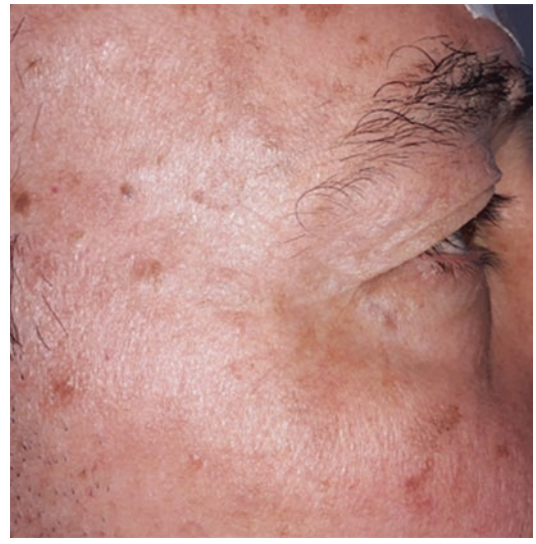

Fig. 2 Multiple actinic keratosis lesions

Sudden onset of multiple seborrheic keratoses is associated with systemic malignancy, classically gastrointestinal adenocarcinoma. This is known as Leser-Trélat sign.

Pathologically, there is proliferation of basal cells of the epidermis, acanthosis and hyperkeratosis with variable pigmentations. It may contain pseudohorn cysts that are formed by infoldings of the epidermis and appear as cysts in cross section filled with keratin.

Treatment

Total surgical excision, however, shave excision at the epidermal-dermal junction could also be done. Laser ablation, cryotherapy and chemical peeling are available options.

Actinic (Solar/Senile) Keratosis = Sun Damaged Skin Lesions

The ultraviolet rays are largely responsible for face aging and this damage is common and more profound in fair skinned individuals. The sun damaged skin is thin with deep wrinkles, variable pigmentations and visible blood vessels. The presence of such signs suggest that the patient is at risk of developing skin cancers.

Actinic keratois is a common slowly growing skin lesion that is rarely seen in the eyelid. The lesions appear as part of solar skin damage and they may turn to squamous cell carcinoma.

They appear as flesh colored, yellow or brown plaques with distinct borders and a rough dry scaly surface (Fig. 2). Pathologically, there is epithelial dysplasia with hyperkeratosis and parakeratosis.

Treatment

Surgical excision, cryotherapy or topical 5FU in selected cases. Patients should be closely monitored by a dermatologist for the development of squamous cell carcinoma.

Cutaneous Horn (Fig. 3)

These are non specific hyperkeratotic lesions that may be associated with variable lesions whether benign or malignant. They need surgical excision

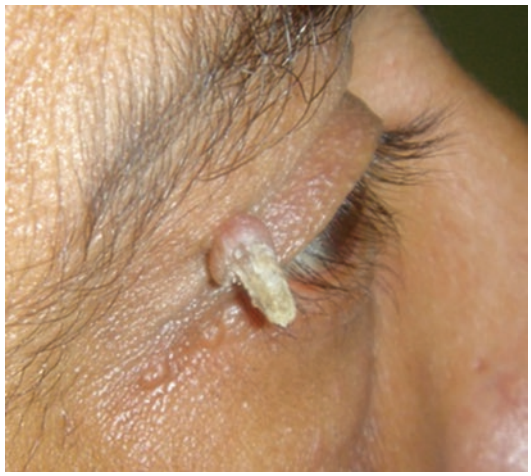

Fig. 3 Cutaneous horn

Epidermal Inclusion Cyst/Epidermoid Cyst

An epidermal inclusion cyst (EIC) is a dermal implantation cyst of epidermis. It can be congenital occurring along the closure lines (**epidermoid cyst**) or acquired following trauma or surgery.

It is a small, slow-growing, round, smooth, white lesion that could be either superficial or subcutaneous (Fig. 4). It is usually firm and opaque on transillumination due to its ***keratin*** content. It may get infected or ruptured with an associated inflammatory reaction.

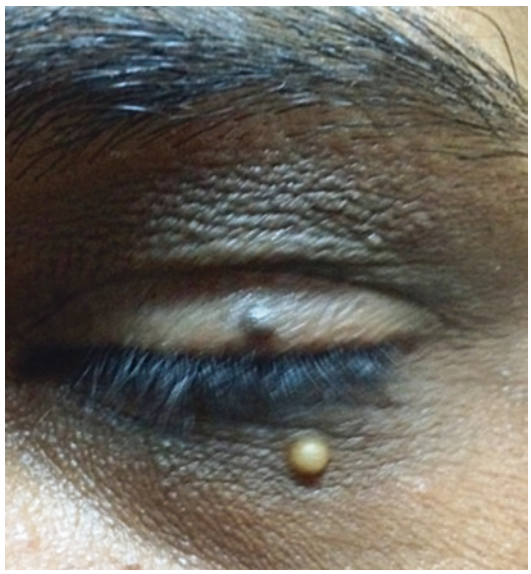

Fig. 4 Upper and lower lid epithelial inclusion cysts

Treatment

Excision or marsupialization.

Adnexal Lesions

Skin adnexa including sebaceous and sweat glands as well as hair follicles are placed in the dermis and can give an origin to a wide variety of, usually, benign lesions.

The sebaceous glands of the eye lid include; the Meibomian gland of the tarsus, glands of Zeis that are related to the eye lashes and the sebaceous glands related to hair of the eyelid skin as well as the hair of the eye brow.

The sweat glands of the eye lid are either eccrine glands (that have a true secretory duct) that are present everywhere in the body skin including the eyelid or apocrine glands (that have no duct and secrete by cellular decapitation) that are present in relation to eyelashes and known as glands of Moll. They are discussed in chapter "**Periorbital Dermatology and Oculoplasty**".

Chalazion/Hordeolum

A chalazion is a chronic lipogranulomatous inflammatory process that occurs in the eyelid. It results from obstruction of the meibomian glands (deep chalazion) or sometimes Zeis glands (superficial chalazion) orifices with retention of sebaceous secretions that may leak to the surrounding tissues inducing a granulomatous inflammatory reaction.

Pathologically, there is lipogranulomatous inflammation surrounding a clear space (previously occupied by lipids that dissolve on processing). It contains neutrophils, plasma cells, lymphocytes, epithelioid cells and multinucleated giant cells (touton giant cells) that have a

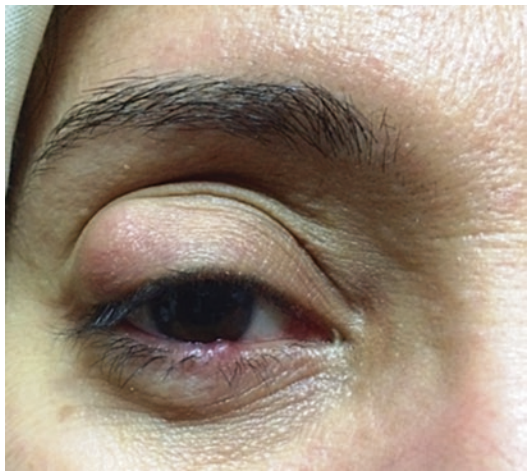

Fig. 5 Upper lid large chalazion inducing mechanical ptosis while the lower lid shows marginal chalazion

central foamy cytoplasm corresponding to the ingested lipids.

The lesion is a slowly growing painless hard nodule that may start de novo or follow an attack of acute inflammation (hordeolum). It is commonly associated with blepharitis and rosacea both of which usually present with recurrent multiple chalazia.

The deep chalazion bulges towards the conjunctival side and is usually associated with mild inflammatory reaction or a conjunctival granuloma. It is better felt than seen and the orifice of the affected gland may show inspissated sebum (Fig. 5).

A marginal chalazion (Fig. 7) is located at the lid margin either is connected to a deep chalazion or due to blocked Zeis gland. Vision is usually preserved yet may be temporary affected with large chalazia either due to mechanical ptosis or induced corneal astigmatism. Carcinoma should be ruled out in cases of recurrent lesion within the same place especially in the elderly.

If any of these glands become infected with pyogenic bacteria, a ***hordeolum*** is formed which is usually painful, red, tender and can be associated with preseptal cellulitis. It is called ***hordeolum internum*** (Fig. 6) if the Meibomian gland is affected and ***hordeolum externum or stye*** if Zeis gland is affected.

Treatment

- Conservative treatment:
  This includes warm compresses 15 minutes 2–4 times per day, lid massage and expression of inspissated sebum at the Meibomian gland orifices especially in recent chalazia. These measures are effective in at least a third of cases.
- Treatment of risk factors:
  - Blepharitis: via lid hygiene
  - Systemic tetracycline such as oral doxycycline 100 twice per day or minocycline 50 mg once per day, can be used in cases associated with rosacea and in recurrent cases.
- Antibiotic (topical and oral):
  They are reserved to cases with significant bacterial infection as chalazia are inflammatory, not infective lesions.
- Intralesional steroids:
  Injection of 0.1–0.2 ml of triamcinolone 40 mg/ml into or around the non infected lesion is reported to have a similar outcome to surgical removal. It is usually used in cases of multiple or marginal chalazia or those related to the upper lacrimal system. Injection can be repeated after 1–2 weeks especially with large lesions.
  However, it may result in localized skin atrophy and depigmentation, though uncommon, it can be avoided by injecting through the conjunctival side. Few reports of retinal vascular occlusion are present due to inadvertent intravascular injection with distant embolization.
- Surgical excision:
  It is reserved for persistent lesions. It is usually an outpatient procedure unless general anesthesia is required, or an operating microscope is needed for juxta punctal chalazia.

Technique

After local anesthesia is infiltrated and topical anesthetic instilled, a chalazion clamp is applied and the lid is everted.

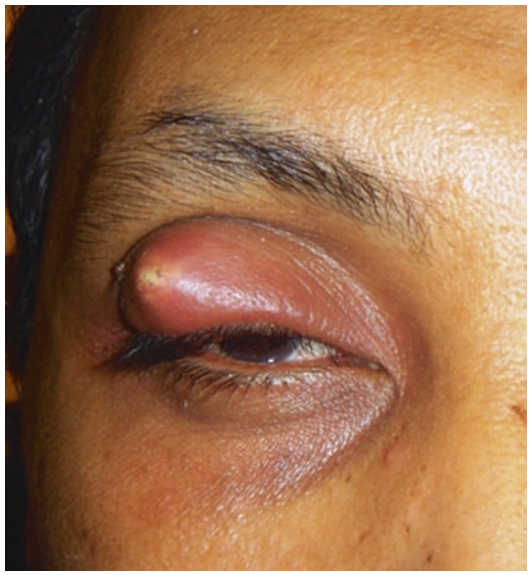

Fig. 6 Hordeolum internum of the upper lid

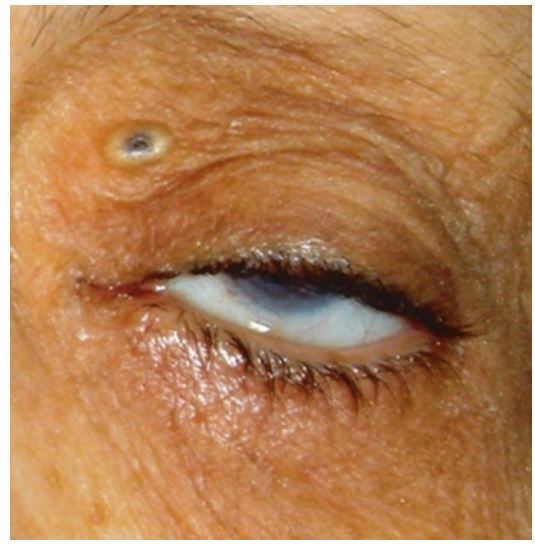

Fig. 7 Sebaceous cyst of the upper lid with comedo head

A vertical incision is done through the tarsus using a no 11 blade and the cyst contents are curetted. If the content was solid or in cases of recurrence, an incisional biopsy is taken for histopathological correlation.

The wall of the cyst is removed as much as possible. Temporary gentle compression is then applied to the lid to ensure hemostasis. Topical antibiotic ointment is instilled by the end of the surgery and the eye is patched for a couple of hours.

Surgical removal of marginal chalazion can be done in a similar way by placing a the incision across it, better from the conjunctival side without cutting down to the lid margin. The contents are also scraped.

Sebaceous/Pilar Cyst

It occurs due to blockage of a sebaceous gland related to pilosebaceous unit. It is not common in the eyelid yet may occur near the medial canthus and eye brow (Fig. 7).

Sebaceous Hyperplasia

A common lesion that occurs due to proliferation of the sebaceous gland elements. It is usually found on the cheek, nose and forehead. It appears as a yellow papule with raised irregular margins and central umbilication that shows slow growth.

Benign Pigment Cell Lesions

Any type of skin lesion could contain melanin and be pigmented. It is important to differentiate between pigment cell lesions (that originate from melanocytes) and pigmented lesions.

Freckles (Ephelides)

Multiple, small, well circumscribed red brown macules (Fig. 8) that occur in the sun exposed areas and get darker upon sun exposure. They

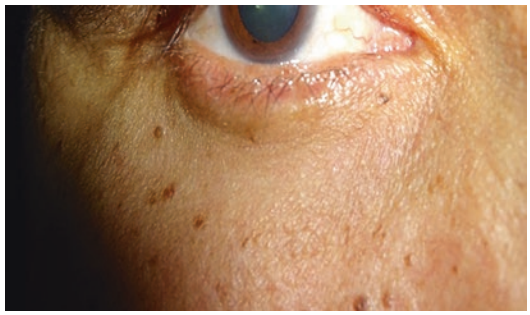

Fig. 8 Multiple freckles on the cheek and lower lid

result from hyperpigmentation at the basal cell layer of the epidermis due to increased melanin content without change of the melanocytes number.

Treatment

Using sun screens as well as covering with cosmetics can improve the appearance.

Melanocytic Nevus (Mole) = Acquired Melanocytic Nevus

It is a collection of melanocytes in the skin either congenital or acquired. Acquired nevi are not present at birth yet they start to appear in childhood as junctional nevus where they appear flat and get deeper in color towards puberty. The nevus becomes raised and acquire dome shaped appearance by the middle age as it turns into a compound nevus. As the nevus gets older, it becomes intradermal, remains elevated while its color fades. The clinical appearance and the potential for malignant changes is determined by the location of the nevus

a Junctional: (Fig. 9): it lies at the junction between the dermis and epidermis. It is usually dark brown flat lesion with uniform color. Malignant transformation is low.

Fig. 9 Upper lid junctional naevus lid

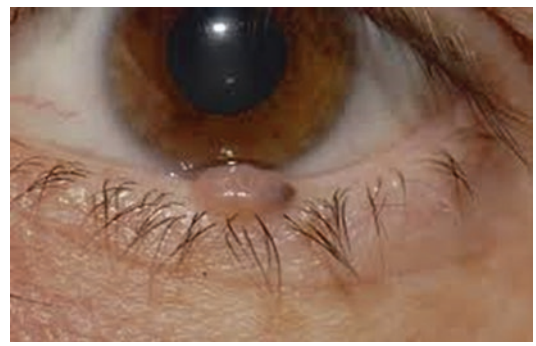

Fig. 10 Compound nevus of the lower

b Compound: (Fig. 10): it extends from the epidermis to dermis. The potential to turn malignant is low and related to its junctional component.
c Intradermal: it lies entirely in the dermis. There is no potential of malignant transformation.

Nevi are frequently found on the periocular skin, eyelids and eyelid margin. Atypical or dysplastic moles can occur. In atypical mole syndrome (AMS) multiple dysplastic moles are present and are associated with increased risk of developing conjunctival and iris nevi as well as skin and, conjunctival and uveal melanomas.

Treatment

Treatment is indicated for cosmetic reasons or if malignant changes are suspected. Surgical excision should be complete in most cases. If the lesion is on the lid margin, wedge resection is required. In some elderly intradermal nevi, shave excision may be useful.

Congenital Melanocytic Nevus

This is a nevus that appears at birth. It varies in size from a small lesion to a large one that covers an entire area. It is usually dark, uniform in color and may be hairy. Kissing nevi are form of congenital nevus that develop on the eyelid while still fused in utero so the nevi will be located opposite each other in the upper and lower eyelids. It has a high potential for malignant transformation and if indicated, total surgical excision is the treatment of choice.

Vascular Lesions

These include vascular benign tumors such as **Capillary hemangioma and port wine stain.** **(see chapter "Periorbital Dermatology and Oculoplasty")**

Suggested Readings

1. Bowling B, Kanski J. editors. Kanski's clinical ophthalmology; a systematic approach, Chapter 1, 8th ed. Sydney, Australia: Elsevier; 2016. pp. 2–62.
2. Jin KW, Shin YJ, Hyon JY. Effects of chalazia on corneal astigmatism: Large-sized chalazia in middle upper eyelids compress the cornea and induce the corneal astigmatism. BMC Ophthalmol. 2017;17(1):36.
3. Lenci LT, Kirkpatrick CA, Clark TJ, Maltry AC, Syed NA, Allen RC, Shriver EM. Benign lesions of the external periocular tissues: a tutorial. EyeRounds.org. posted 10 May 2017; http://EyeRounds.org/tutorials/benign-lid-lesions/index.htm.
4. Nerad JA. Oculoplastic surgery. In Krachmer JH editor. The Requisites in ophthalmology, Chapter 10, 1st ed., St. Louis, Missouri: Mosby; 2005. pp. 255–281.
5. Pe'er J. Pathology of eyelid tumors. Indian J Ophthalmol. 2016;64(3):177–90.
6. Wu AY, Gervasio KA, Gergoudis KN, Wei C, Oestreicher JH, Harvey JT. Conservative therapy for chalazia: is it really effective? Acta Ophthalmol. 2018;96(4):e503–9.

Malignant Lid Lesions

Kareem B. Elessawy and Aliaa A. Farag

Introduction

Lid and periocular skin lesions are common finding that encounter most of the ophthalmologists. The main goal of the general ophthalmologist is to exclude malignancy. Certain points in history taking and clinical examination help to rule out malignant lesions.

Features suspicious of malignancy:

- Recent onset
- Increasing in size
- Change in color or multiple colors
- Ulceration
- Telangiectasia
- Pearly borders
- Ill-defined margins
- Distorted anatomy e.g. loss of lashes, distorted lid margin
- Recurrent lesion e.g. recurrent chalazion
- Pain disproportional to the lesion i.e. peineural spread
- History of irradiation e.g. for acne, retinoblastoma
- History of other malignancies
- Immunosuppression

K. B. Elessawy (✉) · A. A. Farag
Faculty of Medicine, Cairo University, Giza, Egypt
e-mail: kemos1984@yahoo.com

Biopsy, either incisional or excisional is required in suspicious cases for definite tissue diagnosis. Histological examination is essential for both definite diagnosis and differentiation between different malignant lid tumors.

Basal Cell Carcinoma (BCC)

BCC is a common, slowly growing, locally malignant epidermal skin tumor that has a higher prevalence in Caucasians.

BCC is the commonest human malignancy (about 80% of non-melanoma skin cancers). BCCs usually occur between 5th and 8th decades of life.

It is more common in the lower eyelid or medial canthus. It may be associated with other BCC located elsewhere on the face in 60% of these patients. The eyelids and nose are the commonest sites of BCC in young adults.

The most important risk factor for BCC is exposure to ultraviolet radiation. However, the exact relation between risk of basal cell carcinoma and the amount, duration and pattern of exposure to ultraviolet radiation is not fully understood.

People with skin type 1 (skin always burns, never tans on exposure to sun light), fair hair, and light colored eyes have been shown to be risk factors for the development of basal cell carcinoma.

E. A. El Toukhy (ed.), *Oculoplastic Surgery*, https://doi.org/10.1007/978-3-030-36934-7_4

A positive family history of skin cancer is also a risk factor for development of basal cell carcinoma.

Other environmental factors that have been associated with increased risk of basal cell carcinoma include; ionizing radiation, high fat diet, low vitamins intake, many chemicals as arsenic and dust.

Previous irradiation to head and neck and immunosuppression also increase the risk of basal cell carcinoma.

Smoking and fluorescent lighting does not seem to increase risk of basal cell carcinoma.

Several precancerous conditions are associated with the risk of developing basal cell carcinoma as albinism, xeroderma pigmentosa, Bazex's syndrome, and the naevoid basal cell carcinoma syndrome (Gorlin's syndrome).

These syndromes either decrease pigments level in the epidermis with increased risk of UV light-induced oncogenic transformation or develop epidermal genotypic instability.

Desmoplastic trichilemmoma is a condition associated with different atypical basaloid changes as acantholytic processes of diverse type, warts, porokeratosis, neurofibromata, nevi sebaceus and epidermal nevi, condylomata accuminata, hemangiomas, cysts of hair follicle derivation, pilomatricomas and a variety of common skin neoplasms such as seborrheic keratoses and melanocytic nevi. BCC can occur also in up to 19% of the cases. Basal cell carcinoma have also been reported in association with a common dermal fibrosis reaction to trauma (i.e. dermatofibroma)

Typically, basal cell carcinoma is indolent and slowly growing. It usually spreads by infiltrating the surrounding tissues in finger-like outgrowths. It is mostly not associated with metastasis to regional lymph nodes or distant organs. The morbidity associated with BCC is related to local tissue invasion and destruction, especially on the head and neck. However, metastasis may occur in large, locally aggressive, neglected and recurrent lesions.

Clinical Picture

BCC vary widely clinically, presenting as; nodular, cystic, ulcerated ('rodent ulcer'), superficial, morphoeic or sclerosing, keratotic and pigmented variants as shown in Fig. 1.

Early the lesion is small nodule, may be translucent, with pearly margins, with surface telangiectasia as shown in Fig. 2.

The classic picture is the rodent ulcer, with indurated base, rolled in edge and ulcerated center as shown in Fig. 3.

Although this tumor is slowly growing but, if left untreated, it may spread deeply to the surrounding tissues, especially around the eye, nose, or ear even into the periorbital tissues and bone.

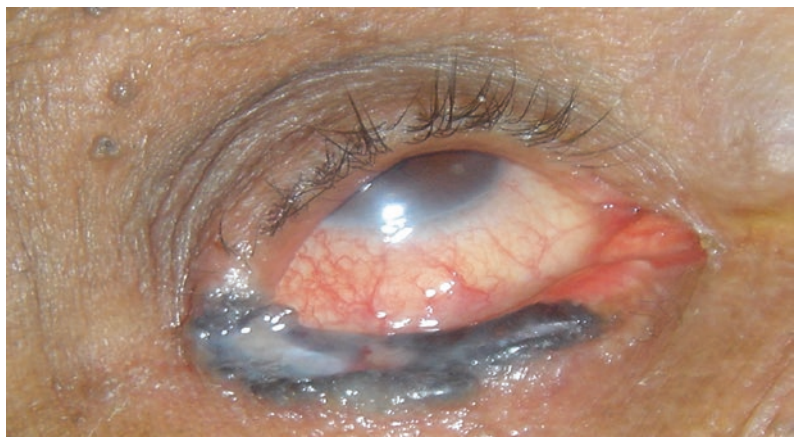

Fig. 1 Pigmented basal cell carcinoma of the lower lid (Courtesy Rania A Ahmed, M.D.)

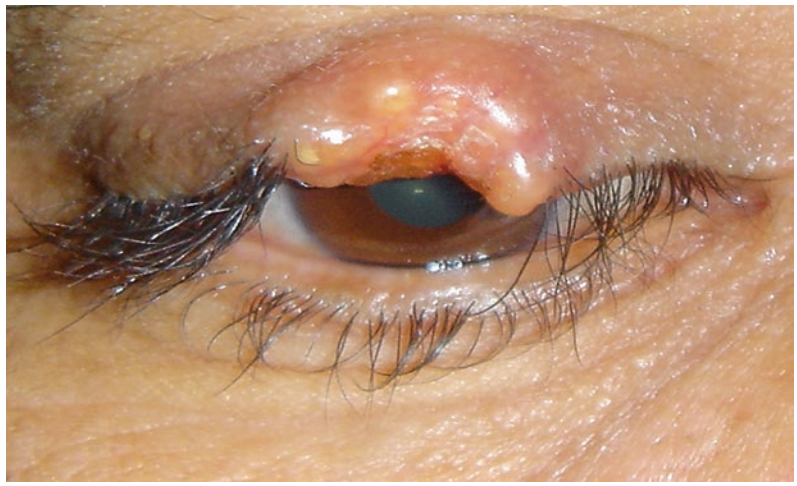

Fig. 2 Nodular basal cell carcinoma of the lower lid (Courtesy Rania A Ahmed, M.D.)

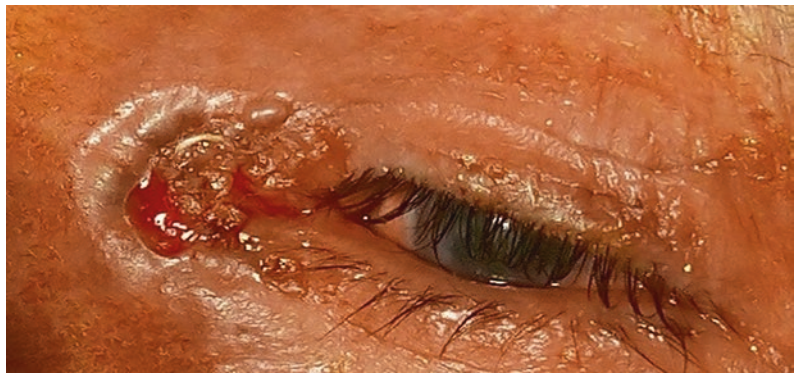

Fig. 3 Basal cell carcinoma (rodent ulcer)

Superficial basal cell carcinoma is flat well demarcated erythematous plaque, that usually occurs on the trunk. Psoriasis, discoid eczema, and Bowen's disease may produce a similar picture and should be included in the differential diagnosis. Superficial variant is particularly slow growing when compared to other types.

Nodulocystic basal cell carcinoma appears as a solitary red nodule with surface telangiectasia, it usually develops on the face.

The most important clinical subtype is the morphoeic basal cell carcinoma. It is the most aggressive type with ill-defined borders, making complete excision difficult. This type of basal cell carcinoma is difficult to be diagnosed clinically and is usually detected in late stage. Some of these tumors reach a very large size that require lengthy surgical reconstructions and is usually associated with significant cosmetic disfigurement. It represents 5% of all BCC variants.

Differential Diagnosis

Differential diagnosis includes squamous cell carcinoma, malignant melanoma (pigmented), melanocytic naevi (pigmented), Bowen's disease (especially superficial), psoriasis and eczema (superficial), molluscum contagiosum.

Prognosis

Prognosis depends on several factors as tumor size, tumor site, clinical type and margins definition, growth pattern and histological subtype. Poor prognostic factors include recurrent tumors and immunocompromised patients.

A BCC greater than 5 cm in diameter is called a "giant BCC" and is associated with a higher risk of morbidity and mortality. Also, BCC arising in a young person than 35 years of age may show more aggressive course.

Recurrent BCC

Recurrence can occur in about 10% of BCCs treated by conventional management, either surgical excision or curettage followed by fulguration of the lesion base. The recurrence rate is related to the margin positivity after attempted surgical excision, at least 4 mm free safety margins are required after surgical excision. Incidence of recurrence varies according to the histological type, being highest for the aggressive variants (for example 26.5% for morhoeic infiltrative BCCs) and lowest in the indolent variants (e.g. 6.4 and 3.6% for nodular and superficial BCC, respectively).

After the introduction of Mohs micrographic surgery, the recurrence rate is lessened to be about 1%. The recurrence rates may also vary according to the anatomic site.

Most of recurrences occur within the first 3 years following the original surgery; however, 20% of recurrences may occur later between 6 and 10 years after the original operative procedure. The risk of further recurrence after management of a recurrent lesion is said to be higher, in the range of 40%.

Recurrent BCC presents clinically by areas of induration, erythema, ulceration or bleeding at the surgical site for known BCC. The histopathology of recurrent BCC is usually more aggressive growth than indolent growth variant. The presence of scar tissue of the previous surgery usually disrupts the pre-existing original anatomy. It also shows no connection to the overlying epidermis or to pre-existing follicular structures. A strong positive correlation is found between the surgical margins clearance and the recurrence rate.

Nevoid BCC (Basal Cell Nevus) Syndrome

The nevoid BCC syndrome (Gorlin–Goltz syndrome) is an autosomal dominant trait with some sporadic mutations in about 30–50% of case. Although the syndrome is typically expressed in young adulthood, it may appear in children as young as 2 years of age.

The clinical manifestations of nevoid BCC syndrome include the presence of multiple BCCs, mainly nodular, superficial, and nodular cystic variants. Patients may also develop pitting of the palms and the soles of the feet, jaw cysts, bone anomalies in spine and rib, and calcification of the falx cerebri.

Differential diagnosis includes tumor syndromes that can form basaloid adnexal neoplasms as Muir–Torre syndrome and Cowden's syndrome but these form neoplasms with sebaceous and trichilemmal differentiation.

Squamous Cell Carcinoma (SCC)

Squamous cell carcinoma is an invasive malignant tumor that arises from the squamous cell layer of the skin epithelium.

It is the second most common malignant eyelid tumor after BCC.

It may occur in different locations, such as: esophagus, anus, lungs, head, neck, prostate, urinary bladder, vagina, and cervix.

In the eyes, it affects specially the lid, the conjunctiva and the cornea.

It may develop de novo but often it may arise on top of preexisting lesions such as actinic keratosis, xeroderma pigmentosum, carcinoma in situ (Bowen's disease), or after radiotherapy.

About 5–10% of all skin cancers occur in the eyelid, SCC represents about 5–10% of all types of skin cancer in the eyelids. It also may occur

in the palpebral conjunctiva representing around 5% of its malignancies.

SCC is more common in males. It usually occurs in elderly (the 7th and 8th decade of life, however may occur in younger age). It shows a higher prevalence in the lower lid more than the upper lid, in the inner canthus more than the outer canthus.

Important risk factors include: chronic exposure to Ultra Violet (UV), arsenic and exposure to oil derivate, active or even passive smoking, viral infections as Human Papilloma Virus (HPV) and Human Immunodeficiency Virus (HIV), precancerous lesions as xeroderma pigmentosa, skin lesions as albinism, on top of old burns, chronic ulcers and scars, previous irradiation and immunosuppression.

UVB exposure can induce mutations that disturb multiple cellular pathways which lead to the formation of SCC.

SCC exhibits defective genomic maintenance with the evolution of new mutations. The mechanism of genomic instability in keratinocytes is likely due to inactivation of p53 induced by UVB exposure.

Clinical Picture

The clinical types of carcinoma are variable and there are no pathognomonic features.

Sometimes, the tumor may be difficult to be differentiated from a basal cell carcinoma (BCC), but usually it does not have telangiectasia or superficial vascularization, it grows faster with more frequent hyperkeratosis.

The nodular SCC is shows a hyperkeratotic nodule with crusts and fissures as shown in Fig. 4.

The ulcerating SCC has a hyperemic base with well defined, hard and raised everted edges, but not pearly margins. Superficial vascularization and telangiectasia are not present as in BCC as shown in Fig. 5.

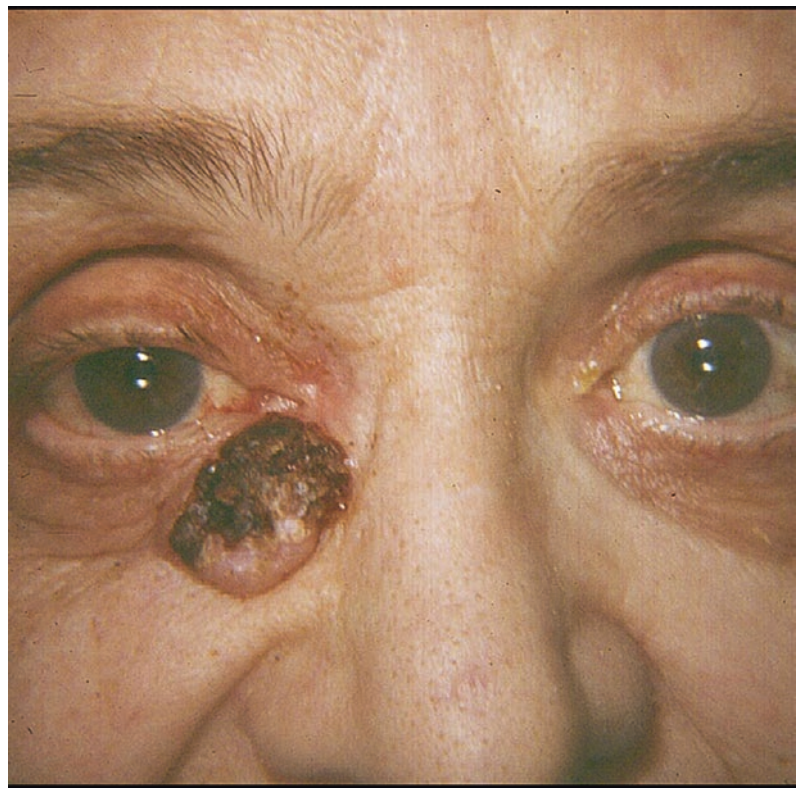

Fig. 4 Nodular squamous cell carcinoma of the lower lid (Courtesy: Essam Eltoukhy, M.D.)

Fig. 5 Ulcerative squamous cell carcinoma of the lower lid (Courtesy Rania A Ahmed, M.D.)

The histopathologic feature of SCC differs according to the degree of differentiation of the tumor. In well-differentiated tumors, the cells are polygonal with hyperchromatic nuclei and acidophilic abundant cytoplasm with, dyskeratosis and intercellular bridges. Poorly differentiated SCC shows evidence of anaplasia with pleomorphism, multiple abnormal mitotic figures, no or little keratinization and loss of intercellular bridges. Variants of SCC include spindle SCC and adenoid SCC.

The tumor may show metastasis to the regional lymph nodes or to distant organs. Perineural spread can occur in about 14%.

Perineural spread is characteristic for squamous cell carcinoma; it has the tendency to extend in the nerve sheaths, surrounding the nerve just beneath the perineurium. The perineural space acts as conduit with low resistance for malignant cell invasion. Malignant cells invade the perineural space with no significant invasion of the nerve itself. Imaging may be required for detection of the tumor invasion. Perineural invasion makes complete surgical excision more difficult and should be taken into consideration during histopathological examination. Unfortunately, perineural spread is associated with poorer outcome.

In Situ Carcinoma

It shows cytological abnormalities characteristics of malignancy as hyperchromatism, pleomorphism, frequent mitoses and loss of the architecture only in the epithelium, but with no evidence of invasion either locally or to distant metastases.

The squamous cell carcinoma in skin is known as Bowen's disease.

It appears as a brown spot, resistant to treatment that may be mistaken for psoriasis or eczema.

There is a strong association of Bowen's disease with HPV (human papilloma virus) infection, type 16.

Cutaneous Horn

A cutaneous horn is a formed of a base and a cap, the base is usually papule or nodule while the cap is a keratotic cap of different lengths and shapes, and it resembles an animal horn.

Clinically, it varies in size, color and shape; size varies from few millimeters to several centimeters, its color may be white, black or yellowish, it may be straight, curved, or spiral.

Histologically, it is also variable; it usually shows hypertrophic actinic keratosis, however it may show SCC in situ, or invasive SCC at its base. Because of the possibility of invasive SCC, any cutaneous horn should always be excised.

Actinic Keratosis

Actinic keratosis is the commonest precancerous skin lesions, it affects people in 4–7th decade of life, it occur in about 60% of fair-skinned population over the 4th decade of life.

Actinic keratosis appears as round or oval hyperkeratotic lesions with or without erythematous base, commonly seen in sunlight exposed areas.

Actinic keratosis is a direct precursor of invasive SCC and also it is considered a risk factor for other skin cancers. Although the incidence of progression to invasive SCC is rare, actinic keratosis is considered as a SCC in situ.

The main histological feature of actinic keratosis is keratinocytes dysplasia or maturation disorder.

Keratoacanthoma

Recently, it is considered as a variant of SCC, the lesion is typically a cup-shaped nodule with a central crater of keratin with elevated and rolled edges.

It usually develops within a short period (weeks to a few months) and may show spontaneous regression.

Histologically, these cup shaped nodules is formed of thickened epidermis containing areas of well-differentiated squamous epithelium surrounding a central mass of keratin. These epithelial islands may be infiltrated by neutrophils. The base of the lesion can be easily differentiated from the adjacent dermis by inflammatory reaction.

Cancer Stage Grouping

The stage of an eyelid SCC is given by combining the T, N, M, and G classifications: as shown below in Table 1.

Table 1 Squamous cell carcinoma cancer stage grouping

Stage	TNM	Local tumor	Lymph node	Distant metastasis
Stage 0	Tis N0 M0	Carcinoma in situ	No	No
Stage IA	T1, N0, M0	The tumor is 5 mm or smaller in diameter or has not invaded the tarsal plate	No	No
Stage IB	T2a, N0, M0	The tumor is larger than 5 mm but not more than 10 mm in greatest diameter, or it has invaded the tarsal plate	No	No
Stage IC	T2b, N0, M0	The tumor is between 10 and 20 mm in greatest diameter or has spread into the full thickness of the eyelid	No	No
Stage II	T3a, N0, M0	The tumor is larger than 20 mm in greatest diameter or has spread to nearby parts of the eye	No	No
Stage IIIA	T3b, N0, M0	The tumor is large enough or has spread enough so that the surgeon will need to remove the eye and nearby structures to get rid of the tumor	No	No
Stage IIIB	any T, N1, M0	The tumor is of any size	Yes	No
Stage IIIC	T4, any N, M0	The tumor has spread outside of the eye,, and cannot be surgically removed due to extensive invasion in structures near the eye	Yes or No	No
Stage IV	Any T, any N, M1	A tumor of any size	Yes or No	Yes

Recurrent: Recurrent lesions after treatment. Recurrence may occur in the eye or another part of the body especially sun exposed parts.

Follow Up and Prognosis

SCC is more aggressive than BCC and may spread to the orbit, regional lymph nodes or other distant organs.

The prognosis is good in lid if it is detected early and completely removed.

If malignant orbital invasion occurs, multidisciplinary team should share in the management including ophthalmology, oncology, maxillofacial, plastic surgery and radiology according to the extent and direction of tumor invasion.

In general, sun exposure should be reduced as much as possible with use of sunscreen. Alcohol and tobacco smoking should be discouraged.

Any recurrence should be treated aggressively.

Malignant Melanoma (MM)

Malignant melanoma of the skin of the eyelid is a rare, highly malignant tumor; it represents 1% of all eyelid tumors and less than 3% of all skin melanomas.

This tumor can arise from the eye lid skin or the conjunctiva with possibility of growth into the both directions. If eyelid melanoma is associated with conjunctival involvement, it becomes more aggressively than if it is confined to the eyelid skin only.

Malignant melanoma has a relatively poor prognosis: two thirds of all mortality from skin cancer results from malignant melanoma. Survival rates in patients with malignant melanomas depend on the depth of skin invasion. Histopathologically, 5-year survival rate is 100% if the tumor measures 0.76 mm or less, whereas 5-year survival rate is only 50–60% in patients with tumors that had invaded more than 1.5 mm.

Risk factors for developing malignant melanoma of the skin involves: ultraviolet light exposure, fair skin, light hair, personal history of melanoma or other skin cancers, family history of melanoma or other skin cancers, previous irradiation, immunosuppression, old age, precancerous lesions as xeroderma pigmentosa and eyelid nevi.

A nevus is considered hamartoma (benign neoplasm in the tissue of origin) tumor of incompletely differentiated melanocytes (nevus cells). The incidence of malignant transformation from the eyelid nevi into melanomas is rare.

The clinical presentation of a nevus is variable. Nevus usually presents at birth and typically manifests throughout a person's life. A benign nevus is usually a brown or black spot on the skin. It may be flat or raised. It may be round or oval. Nevus is generally less than 6 mm. Some nevi present at birth, but mostly nevi appear during childhood or young adulthood. Any new nevi that appear later in life may be suspicious and should by investigated.

Nevi usually keep the same size, shape, and color for long duration. Eventually, some nevi may show spontaneous resolution.

Junctional nevus: it presents as a flat pigmented macule. Histopathologically, the nevus cells are located in the basal epithelial layer at the epidermal-dermal junction. It usually occurs during childhood. During puberty pigmentation often increases and then extends beyond the second decade; it may turn into an elevated, pigmented papule.

Compound nevus: As the patient grows older, the nevus may transform into a compound nevus when the nevus cells extend from the junctional zone down into the dermis.

Intradermal nevus: in older age, the nevus loses its epidermal pigmentation and remains as an elevated, minimally pigmented or even amelanotic lesion. Histopathologically, there is involution of the epidermal component and all of the nevus cells are within the dermis.

Nevi are common finding on the periocular skin, eyelids and eyelid margins. Nevi that present on the lid margin may extend to the underlying ocular surface if they contact the globe. In nevi, lashes are still present and seen protruding from them.