Review Article

Sutures in Ophthalmology

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Abstract

Sutures are vital in ophthalmic surgery for wound closure, tissue approximation, and securing implants. They vary in material (absorbable/non-absorbable), gauge, and needle design, tailored to specific tissues like cornea, conjunctiva, or eyelid. Proper selection—considering tensile strength, biocompatibility, and absorption—ensures optimal healing and minimizes complications, enhancing surgical outcomes in procedures ranging from corneal repairs to strabismus surgery.

Keywords: Sutures, Ophthalmology, Cornea, Conjunctiva.

Introduction

Sutures are an important component of surgery, playing an important role in wound closure, wound healing and the final surgical outcome. There are numerous applications for sutures in eye surgery. Closure of soft tissue defects, tying blood vessels, traction to be applied to the globe or eyelids, using devices to secure devices or implants, or to secure tissue grafts or extraocular muscles during strabismus surgery, to change tissue contours for therapeutic or cosmetic reasons. Sutures are utilized in ophthalmology for external DCR surgery, closure of major limb wounds, and corneal, conjunctival, and lid restoration are some of the surgeries done using sutures.

Suture Anatomy

In its most basic form, a suture is essentially a needle fastened to a thread composed of various materials.[1]

Needles

These suture-attached needles function similarly to the standard sewing needles used today for clothing. The perfect surgical needle should have:

- Enough rigidity to prevent bending.
- Long enough to allow it to be retrieved without damaging its point after being grabbed by the needle holder for passage.
- Enough diameter to provide a sharp cutting edge and slim-point geometry, creating a tract big enough to bury the knot.
- Non-traumatic.

The needle is composed of three components. A point or tip is the area that is sharpest. The needle's largest component, the body, comes in second. Swage comes in third (Figure 1).

The suture needle can be pointed, spatulated, reverse-cut, taper-cut, straight-cut, conventional-cut, and other shapes. Its length ranges from around 5.5 to 13 mm (Figure 1). It can have single or double-armed sutures and can be either straight or curved.

Suture material

The ideal suture material should have the following properties-

Sharpness

Sharp needles reduce tissue trauma and improve penetration.[2]

Strength

The needle must withstand forces during suturing without breaking or bending.

Biocompatibility

Materials should not elicit an adverse tissue response.

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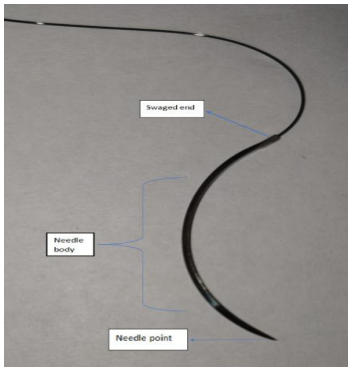

Figure 1:

Size and Shape

Different surgical contexts require specific sizes and shapes for optimal access and efficacy.

Suture Attachment

Secure attachment to the suture prevents detachment during use.

Ease of Handling

The design should promote efficient handling, especially in complex procedures.

Minimal Trauma:

A well-designed needle minimizes damage to surrounding tissues.

Visibility

In certain procedures, visibility can be critical for effective use.

Silk, polypropylene, nylon, polyglactin, chromic/ gut, Gore-Tex, polyester, and other materials can be used to make the suture thread, which can be braided or monofilament, permanent or dissolvable, and vary in length

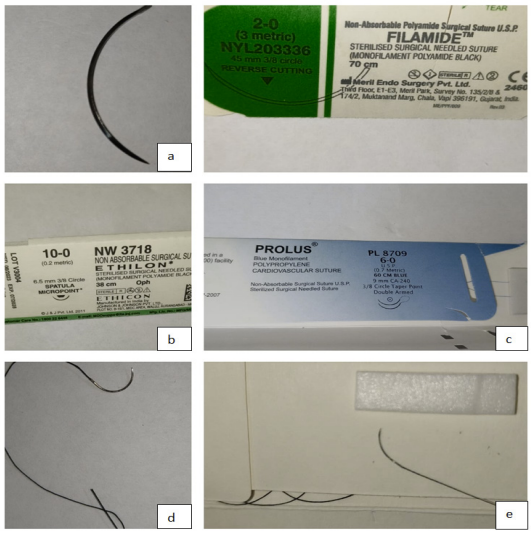

Figure 2: (a).Reverse Cutting Non absorbable (b).Spatulated micropoint non absorbable suture. (c). Double armed Taper point Prolene suture. (d).Rounded Bodied Non absorbable silk 4-0 suture. (e). Reverse cutting micropoint non absorbable 6-0 silk suture.

from approximately 15 to 45 inches. As the given number rises, the thread shaft's thickness decreases; the thickest is 0-0, and the thinnest is 11-0. Conventionally, the second "-0" has little practical significance.

The suture materials are grossly divided into two types- Absorbable and non-absorbable. Their characteristics are described in Table 1.

Principle of selecting suture

The suture used depends on the tissue that is sutured and the duration for which it is needed. However, to a certain extent, it depends on the individual surgeon's choice.

Nevertheless, there are some basic principles that should be kept in mind. They include-

Table 1: Characteristics of common suture materials

Characteristics	Absorbable suture	Non-absorbable suture
Composition	Made from materials like polyglactin, polydioxanone, and chromic gut	Made from materials like silk, nylon, polypropylene, and polyester
Duration	Absorbed by the body within days to months	Remain intact indefinitely
Uses	Commonly used for internal structures (e.g., conjunctival sutures, corneal repairs)	Used for skin closure (e.g., eyelid sutures), and certain corneal procedures
Advantage	- Reduced risk of irritation - No need for removal - Good for internal tissues where healing is rapid	Maintained strength - Excellent for areas needing long-term support - Less tissue reactivity in some materials
Disadvantage	May not provide sufficient strength for longer healing processes - Potential for variable absorption rates	- Requires follow-up for removal - Risk of irritation and inflammation if left in too long
Tensile strength	Sufficient for short-term support but decreases over time	Provides consistent strength if sutures remain in place
Example of use	Conjunctival closure - Corneal suturing in early healing phases	- Eyelid suturing - Permanent corneal sutures

Table 2: Suture Gauge used in different ophthalmic tissues

Tissue name	Thread gauge used
Sclera	8-0
Limbus	9-0
Cornea	10-0/11-0
Conjuctiva	7-0 to 9-0
Eyelid skin	5-0 to 7-0
Tarsus	5-0/6-0
Levator aponeurosis	5-0/6-0
Extraocular muscle	5-0/6-0
Superior oblique tendon	5-0/6-0
Device fixation	6-0/7-0
Scleral buckle	5-0/6-0
Deep orbital fascia	4-0/5-0

- Sutures should be utilized for the minimum amount of time necessary, whether they are removed manually or through absorption.
- Sutures that possess the required tensile strength for the closure should be selected, including anticipated changes in wound tension that will occur postoperatively from swelling, active muscle contraction, or increases in intraocular pressure.
- Superficial suture that will be removed must be properly visualised. Those sutures that must be removed should generally be monofilament.
- Different suture gauges are used for different ocular tissues (Table 2).

Applications in Ophthalmic Surgeries

LID REPAIR

Eyelid skin closure is similar to skin closure of any other body part, but the difference lies in the structures involved in the closure. It is easy to suture the eyelid margin because eyelid skin is very loose. Reapproximate skin edges with simple interrupted sutures using 6-0 silk or 6-0 plain gut suture. Be sure to evert the skin edges. Take small bites (approximately 1 mm from the skin edge) and space sutures 2 to 3 mm apart. Avoid tightly tying the skin sutures to prevent strangulation of delicate tissues. The silk suture will need to be removed, while plain gut sutures are absorbable.

This is most commonly required in trauma cases. Essentially, lid skin closure is performed by placing a central suture, dividing the wound in half, and then dividing each half in half again. Deciding how many sutures to use depends on the size of the wound and the length and tension of the suture placed. During suturing of a full thickness eyelid defect, if tarsal plate is used than additional skin suture have to be placed so that it can be removed early (1 week), but if Gray line and skin suture are used without a cardinal tarsal suture than they must be left for 2 to 3 weeks for proper healing, especially if the wound is under tension in such condition when a proportion of the lid length has been removed in tumour removal or entropion surgery. Vicryl is usually used for securing the deeper lid layers because it is an absorbable suture.

Conjunctival repair

A rapidly absorbing suture, such as Vicryl 8-0 or collagen to hold the conjunctiva in place. When suturing the conjunctiva, one must recognise the inherent tendency of the tissue to curl. When the conjunctival tissue curls, there is some retraction of the conjunctival epithelium. The retraction can be offset by countertraction on the subepithelial tissue. For limbal-based trabeculectomy conjunctival flap, 9-0 Vicryl suture is used. On a pterygium autoconjunctival graft, we can use a 10-0 nylon suture for the placement of the graft.

Corneal wound repair

Ideal characteristics for suture material in ophthalmic micro-suturing vary depending on the tissue being sutured and the purpose for the suture. The avascular nature of the cornea and sclera presents a unique circumstance for suturing in that the lack of blood flow, and therefore the lack of cellular components required for wound healing, leads to prolonged wound healing times and diminished tissue strength at the incision site.[3] Therefore, a strong and long-lasting suture that does not incite chronic inflammation is required for suturing the cornea or sclera. Nylon (10-0) has become the most commonly used ophthalmic suture for closing limbal and corneal wounds. Nylon biodegrades and loses its tensile strength beginning at 12 to 18 months.

The principles of corneal suturing are depicted in the image. Non-absorbable suture, i.e., monofilament nylon (Ethilon), is most commonly used in corneal tear repair and in cataract surgery. The needle track must cut through the lamellae of the tissue. Surgical incisions can be placed appropriately to facilitate closure, whereas traumatic wounds must be examined first for location and depth and then sutured accordingly suture it. Corneal sutures should be 90% deep in the stroma and of equal depth on both sides of the wound. Full-thickness sutures may allow the suture material to act as a conduit for microbial invasion, so they should be avoided. Suture passes should be approximately 1.5 to 2.0 mm in total length, and the needle pass through the opposite side should mirror the initial needle pass in depth and length. This can be difficult in lacerated and oedematous tissue, and one must incorporate healthy tissue in each suture pass, or else the sutures will pull through the tissue when tied. The goal of cornea suturing is to achieve watertight closure of the wound with minimal scarring and astigmatism. In the cornea, interrupted sutures are placed and preferred for easier manipulation of postoperative astigmatism.

In corneal ulcer perforation, sutures may be applied to secure the multilayered amniotic membrane Transplant in place. This involves filling the defect with multiple pieces

of amniotic membrane before covering the entire cornea with a final layer of transplanted tissue.[4,5] The transplanted membrane can then be secured using Monofilament Nylon sutures.[6]

When the suturing is done for corneoscleral lacerations, the limbus is first approximated, followed by closure of the cornea and the sclera.

Suturing the zig-zag corneal incision

Each linear aspect of the incision should be closed individually so that the wound will be allowed to seal on its own, so that additional trauma will not occur. In repairing these lacerations, the use of slipknots is helpful. The straight aspects of the zig-zag incision are closed first with interrupted sutures. The apical portion of the incision may then self-seal. If the apical portions require suture closure, a mattress suture technique may be useful.[7]

No-touch suturing technique of the cornea

In penetrating keratoplasty (full-thickness corneal transplant) and Descemet's membrane endothelial keratoplasty (DMEK), the no-touch technique helps reduce the risk of graft rejection and infection. The use of sterile instruments and techniques to handle the corneal graft or donor tissue ensures that it remains free from contamination and physical damage. This should be the preferred method for suturing all the corneal tears/incisions.

Iris repair

The iris is vascular; however, it typically does not show any healing response, is extremely delicate, and can generate little force or tension on a suture. The optimal suture for the iris is therefore a material that is inert so as to last indefinitely and cause no intraocular inflammation, but also easily manipulated in the challenging intraocular space.

A permanent suture is needed, as with suturing of the iris or transscleral fixation of an intraocular lens (IOL), 10-0 Prolene is frequently used. Prolene is difficult to work with, somewhat difficult to tie because of its memory, and has been shown to erode through both sclera flaps and conjunctiva.

Strabismus Surgery

In this type of surgery majority of braided, synthetic absorbable suture material is used (Polyglactin, Vicryl) for suturing the muscle to the sclera. Surgeons prefer a 6-0 or 5-0 gauge size for this surgery.

Scleral Buckling

The surgical instruments required for suturing during scleral buckle surgery include callipers, forceps, scissors, muscle hooks, needle holders, sutures, and retractors. In this surgery, we mainly use 5-0 nylon, 5-0 polyester Mersielene, or 5-0 silk suture. The advantage of nylon is that its stiff memory holds the knot between throws and does not loosen as easily as Mersilene. In addition, studies have shown less inflammatory reaction to nylon than to synthetic braided sutures, following chronic implantations in infected experimental wounds.

A knowledge of the various types of suture materials used for ocular and orbital surgery is necessary for an ophthalmic surgeon. A meticulous attention to these details can help a surgeon achieve the best surgical outcome.

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