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Review Article

Suture materials in maxillofacial surgery – A comprehensive review

Seema Shantilal Pendharkar[1]*

[1] *Dept. of Oral and Maxillofacial Surgery, CSMSS Dental College and Hospital, Chh. Sambhajinagar, Maharashtra, India*

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ABSTRACT

By holding tissues together to speed up the healing process, surgical sutures are used to secure and restore active or trauma-induced wounds. In dentistry, a variety of sutures are employed. Both absorbable and nonabsorbable suture materials are part of the primary category. A well-fitting suture prevents the displacement forces caused by external agents, functional movements, and muscle insertions. The potential of novel suture materials to resemble wounds and cure wounds is driving up their manufacture in recent times. In order to help the clinician obscure the best possible soft tissue care, this review provides an update on the features and guiding principles of suture selection.

1. Introduction

In both oral and general surgery, suturing is an essential and significant procedure. The materials used for sutures have a big impact on tissue repair. After oral surgical operations, primary wound closure is achieved using a range of suture materials. Sutures can be classified as monofilament and multifilament variations, as well as absorbable and nonabsorbable. A variety of materials can be used intraorally, such as nylon, silk, cotton, polyglecapron, polyacticacid, and polyglycolic acid.[1] Anatomical location, tissue type, wound incision, and patient characteristics must all be taken into consideration when choosing an appropriate suture material.[2] Some materials can promote severe scarring and impede the best possible wound healing. A suture with high tensile strength, knot security, and ease of handling should be considered ideal.[3]

2. Suture's Physical Characteristics

1. The physical configuration.
   (a) Monofilamentous or multifilamentous.
   (b) Twisted or braided.
2. The Tensile Strength.
   (a) The weight required to break a suture, divided by its cross sectional area.
   (b) Identified by a different number of zeros.
3. The Knot Strength.
   (a) The amount of force needed to cause a knot to slip.
   (b) It is proportional to the coefficient of friction of the material.

The Elasticity: The ability of a suture to regain its original form and length after being stretched.

The Plasticity: The ability of a suture to expand when stretched, but not to return to its initial length.

The Memory: The ability of a suture to return to its former shape after being manipulated. It's a reflection of its stiffness.

3. Suture Thread Characteristics

Suture threads should have the following desirable attributes: minimal knot slippage, tissue biocompatibility,

* *Corresponding author.*
E-mail address: dr.seemapendharkar@gmail.com (S. S. Pendharkar).

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easy tying, and tensile strength adequate for the intended purpose. The thickness of the tissues to be sutured and the existence or absence of tension-free mobile tissues should be taken into consideration by the clinician when choosing the appropriate suture thread and diameter.[4]

Many kinds of sutures have been used in intraoral operations. Sutures are classed as either monofilament or multifilament forms, and they can be further separated into absorbable and non-absorbable categories.[5–7] Absorbable sutures are those that break down and absorb into tissues within tissues. Nonabsorbable sutures are those that resist absorption and typically retain their tensile strength.

3.1. *Absorbable materials*

1. Catgut plain: used to stitch the tongue and lip mucous membranes. In a week, they are easily absorbed.
2. Catgut chromic: used to ligature blood vessels, muscles, and fascia. Usually, it absorbs in 30 to 45 days.
3. Vicryl: used to ligature blood vessels, muscles, and fascia. need a minimum of 70 days to be absorbed. When closing in layers, it is the suture material most frequently utilized during surgery.

3.2. *Non-absorbable materials*

1. Ethilon: most frequently used for skin closure and suturing following surgery or skin injuries. Typically, cutting needles are utilized.
2. Prolene: utilized for blood vessel, tendon, and nerve sutures. It is preferable to use round body needles.
3. The qualities of linen and silk are comparable. Although they are quite powerful, they can induce an infection or response because they stick to the tissues.

3.3. *Other suture materials that are also used are:*

1. Staples: used to seal wounds with high tension, such as those on the scalp, trunk, and extremities.
2. Strips and tapes: these are applied to facial lacerations that are superficial.

During the healing process, tissues digest absorbable materials, which are derived from synthetic polymers or collagen, an animal protein. Non-absorbable materials are often composed of inorganic substances and resist the action of enzymes during digestion.

An absorbable suture is made from a polymer of lactide and glycolide called polyglycolic acid. To make a thin fiber easier to handle, it is produced into a braided shape after being removed as a melted polymer. After insertion, polyglycolic acid is absorbed 60–90 days later. Compared to absorbable organic sutures, it is hydrolyzed without phagocytosis, which results in a less immunological reaction.[8]

Made of polyamide polymer, nylon is one of the most well-known non-absorbable monofilaments. It has been noted to have low acute inflammatory response, high tension, and strong resistance to infection.[5]

Suture size is given as a string of zeros. The diameter of the strand decreases with the amount of zeros in it. 3-0 and 4-0 threads are utilized for mucosal closure in maxillofacial surgery, while 5-0 and 6-0 threads are used for skin closure.[9]

A resorbable suture that will lose its tensile strength at a rate similar to the tissue's strength gain should be chosen by the physician if a suture is to be placed in a tissue that heals quickly, such as intraoral tissue. Once the tissue has healed, the suture will be absorbed by the tissue, ensuring that no foreign material, such as surgical gut or the new, quickly resorbable PGA suture material (PGAFA), remains in the wound.[10]

4. Nonresorbable Sutures

4.1. *Silk*

The most commonly used suture material in nonresorbable suture threads is silk, a naturally occurring multifilament that is twisted or interlaced and covered in silicone or wax to minimize capillarity. Silk is derived from the cocoon of the silk worm and is composed of 30% foreign material and 70% natural proteins. In order to decrease capillarity and promote impermeability and fluency, numerous manufacturers saturate and coat the thread with waxes and silicones. It has drawbacks as a tissue reaction that are associated with bacterial nidation in the filament interstices; as a result, it should not be used in the presence of infected wounds. It is also not very elastic or flowable.

Consequently, its usage in infected tissues is disagreeable due to its inflammatory response. Among the benefits, we list strong flexibility, low cost, and good knot and maneuverability estate.

4.2. *Polyamides*

The nonresorbable synthetic polymers known as polyamides are the source of nylon fiber. With the formation of monofilament or interlaced and skewed multifilament, they are introduced into commerce. The monofilament possesses fluency, minimal tissue damage, and lacks capillarity. The skewed multifilament is covered with a nylon girdle, while the interlaced multifilament is covered with silicone. When this fiber comes into touch with tissues, macrophages partially break it down, which also releases the potent antibacterial substances adipic acid and esamethylendyamine. Its inflexibility and memory preservation make it less capable of holding knots and more difficult to handle.

4.3. Polyesters

The polyesters are synthetic materials that do not biodegrade. They can be prepared as single or interlaced multifilaments, coated or not, and with a girdle. The monofilament is minimally damaging to the tissues and exhibits a rare buildup of harmful bacteria. The rough surface of the uncoated multifilament causes tissue damage and encourages the growth of bacteria. Because of this, multifilaments coated with silicone, teflon, polyethylene, and vinyl acetate are the favored option.

4.4. Polypropylene

The polymerization of propylene yields the nonresorbable synthetic monofilament known as polypropylene. It is less resistant to germs and more elastic than nylon. However, owing of its stiffness, particularly when it comes to medium-calibre sutures like the 3/0, it is less frequently employed in oral surgery. It also exhibits good knot fluency and holding.

4.5. Polyethylene

These sutures come in a variety of forms, such as polytetrafluoroethylene (PTFE), sometimes referred to as GORE-TEX, though its use has significantly decreased in recent years, and polyvinylidene fluoride (PVDF). This final monofilament is preferable than polypropylene in that it has a high traction resistance, remarkable flexibility, little memory, and minimum tissue reactivity because of its chemical and biological inertia. These qualities make the suture easier to handle, more flexible, and better at knotting. However, medium-calibre filaments, like the 3/0, can cause traumatic lesions to the tissues when used in large quantities; this stress lessens when 5/0 and 6/0 sutures are used.

5. Absorbable Sutures

5.1. Catgut

The multifilament used to construct the catgut is derived from the small intestine serosa of cattle or the submucosa of ovines, making it a naturally occurring absorbable suture. The substance remains unaltered within the tissues for roughly eight days. Subsequently, it is broken down enzymatically in less than 30 days, with the help of macrophages and lymphocytes. The oral cavity experiences a 40% rise in volume and a 20%–30% decrease in force as a result of fluid absorption, which frequently determines the knot's solution. In order to prevent this, it becomes evident that the knot's longer than usual heads must be cut.

The catgut is especially useful for suturing non-collaborating individuals and deep tissues such the periosteum, subcutaneous tissue, and vascular ligatures. When wounds are not healing quickly, it is not advised. Additionally, keep in mind its considerable capillarity. It is feasible to postpone resorption until the eighteenth day since chromium salts were added to the original product. Many manufacturers now repurpose the catgut by using raw materials from animals bred in carefully monitored and protected conditions.

6. Polygalactic Acid

Made up of 10% lactic acid and 90% glycolic acid, polygalactic acid is an absorbable synthetic multifilament. Its resistance dramatically decreases throughout the first 20 days until canceling out entirely on the sixty-first day. It has a covering made of calcium stearate.

6.1. Polydiossanone

The absorbable synthetic monofilament polydiossanone, or PDS for short, is derived from glycolic acid and replaces the oxygen atom bound to the second carbon with two hydrogen atoms. Its best maneuverability, decreased capillarity and bacterial adherence, and improved traction resistance over polygalactic acid sutures are its distinguishing features. Resorption starts in 0–15 days and ends in 90–180 days.

6.2. Polyglycolic acid

The most basic member of the family of linear alyphatic polyesters is polyglycolic acid, often known as polyglycolide (PGA), a thermoplastic polymer that is biodegradable. It can be sinthetized via polymerization with the opening of the glycolic acid ring or by condensation. The PGA is made up of entwined multifilament suture threads and comes in both coated and uncoated forms. In order to achieve a pseudo-monofilament structure that decreases capillarity, enhances sliding, but promotes knot dissolving, the coating agrees. It shows a gradual resorption that starts after 10–15 days and takes 90–180 days to finish. The polymer is reverted to glycolic acid during the erosive breakdown process, which appears to proceed in two stages.

7. Recent Advances

In an effort to improve the suture's functional outcomes, sutures with similar extra features—such as modified antimicrobials and bioactive substances like DNA, medications, antibodies, proteins, growth factors, and silver—have proliferated recently. Antimicrobial, drug-eluting, stem cell-seeded, and smart sutures are among the types of sutures used today. Shape memory sutures, elastic sutures, and electronic sutures are examples of smart sutures.[11] They are intended to treat scars, pain, inflammation, infection, and scarring associated with surgical incisions. The fields of tissue engineering, regenerative medicine, and minimally invasive surgery can greatly benefit from these advancements in sutures.

8. Conclusion

Surgical sutures are an essential therapeutic technique in the management of wounds. The suture's span must be maintained, and the suture's interaction with the surrounding tissue must be taken into account while choosing a suture material.[12] Improvements in sutures created for certain surgical procedures have been demonstrated to dentists by the creation of suture materials. Recent advancements in suture material eliminate some issues encountered during surgical closure and lower the chance of infection after surgery. Dentists need to choose the right suture material for various wounds by being aware of the material's physical properties.[13]

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10. Conflict of Interest

None.

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Author biography

Seema Shantilal Pendharkar, Associate Professor

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