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Literature Review

What You Might Have Forgotten About Suture Materials and Suture Techniques in Dentistry: A Literature Review

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Abstract

The main goal of suturing is to maintain haemostasis, allow healing by primary intention, provide support to the tissue until healing have occurred, reduce postoperative pain and prevent bone exposure to prevent delayed healing and unnecessary resorption. The ideal suture material should have good tensile strength, dimensional stability, lack of memory, knot security and sufficient flexibility to avoid damage to the oral mucosa. The selection of an appropriate suture material and suture technique is integral to obtaining an optimal outcome of healing. Each wound must be assessed individually and basic knowledge of the suture material and healing characteristics of the tissue is essential in making the right decision as to which material and technique is most appropriate.

Keywords: *Sutures; Materials; Techniques; Principles; Classification*

Introduction

A suture can be described as any strand of material used to ligate blood vessels or approximate tissues [14]. Good healing relies on precise approximation of the wound edges and their fixation to the surrounding tissues [18]. Inadequate suturing may result in flap skipping, exposed bone or necrosis, pain and delayed wound healing [14]. The choice of suture material may also contribute to the healing of the incised soft tissues [13].

Sutures can be classified according to the origin of the material (natural or synthetic), structure (monofilament or multifilament), degradation (absorbable or non-absorbable), tissue reaction (reactive or non-reactive), colour (dyed or undyed), handling characteristics (easy or difficult) and the presence of a coating (coated or uncoated) [16]. The ideal suture material should have high tensile strength, good knot security and easy handling characteristics [10].

Suture thread

Size

Suture sizes are measured by diameter and demonstrated using the United States Pharmacopeia (USP) system. Suture diameter increases from USP size 0 to size 1 and decrease from size 0 to 2-0 as illustrated in figure 1 [4].

USP size	Reference	Metric gauge	Diameter (mm)
3	Three (3)	6	0.600-0.699
2	Two (2)	5	0.500-0.599
1	One (1)	4	0.400-0.499
0	Zero (0)	3.5	0.350-0.399
2-0	Two zero (00)	3	0.300-0.339
3-0	Three zero (000)	2	0.200-0.249
4-0	Four zero (0000)	1.5	0.150-0.199
5-0	Five zero (00000)	1	0.100-0.149
6-0	Six zero (000000)	0.7	0.070-0.099
7-0	Seven zero (0000000)	0.5	0.050-0.069
8-0	Eight zero (00000000)	0.4	0.040-0.049
9-0	Nine zero (000000000)	0.3	0.030-0.039

Figure 1: *Table indicating the various sizes of sutures according to their US Pharmacopeia denotation, metric gauge and diameter (in millimetres) [4].*

Classification of suture materials

Source (natural or synthetic)

Sutures of natural origin are further classified as those from animal origin such as catgut and silk, vegetal origin such as linen and cotton, minerals and metals [19].

Sutures of synthetic origin are further classified as those derived from glycolic acid, galactic acid, polyamides such as nylon,

polyester and polymers derived from vinyl such as ethylene and propylene [19].

Degradation (absorbable or non-absorbable)

In reality, most or all natural materials will be absorbed by the body in due course of time. However, for clinical practice, a suture is considered non-absorbable if it retains its tensile strength in the tissues for more than 60 days and absorbable if it loses its tensile strength before 60 days [25].

Absorbable materials are degraded by enzymatic digestion or hydrolysis. Non-absorbable materials cannot be digested by tissue enzymes and are encapsulated or walled [20].

Absorbable materials avoid patient discomfort that comes with removal of the sutures and is more convenient as the patient does not have to return for an additional visit post-operatively [22]. The disadvantage of absorbable materials is that it may cause a greater degree of inflammation in comparison to non-absorbable materials due to their degradation by hydrolysis, enzymatic digestion or phagocytosis [27].

Structure (monofilament or multifilament)

Monofilament sutures consist of a smooth single strand of fibre that have minimal tissue reaction and is less prone to causing infection [24]. Other advantages include easy passage through the tissue, easy removal, less knot tie-down resistance, lower tissue drag and lower bending stiffness that makes knot tying easier [16,17].

Disadvantages of monofilament sutures include poor handling characteristics, decrease knot security due to less friction that keep the knot in place and less flexibility causing sharp ends that can irritate the oral tissues [17,24,25].

Multifilament sutures are made up of multiple fibre strands, which are either coated or braided together to make one fine thread [25]. Multifilament sutures are more prone to causing infection and tissue reaction [17]. This can be attributed to bacterial colonies that form in the spaces between the filaments as well as the large surface area that is in contact with the tissues where inflammatory cells penetrate into the interstitial space within the suture [16].

Despite the disadvantages, clinicians prefer multifilament suture materials due to its better handling characteristics, low memory, increased knot security, higher tensile strength and smooth cut edges that cause less irritation to the oral tissues [17,25].

Coating (coated or uncoated)

Multifilament sutures are coated or uncoated. The coating aids to decrease the coefficient of friction so that the suture slides easily as it passes through the tissue and knot tie down is improved [26]. Without a coating, multifilament sutures have a rough surface that can have a saw effect on the tissues [3]. Thus, the coating makes the suture less traumatic when passing through the tissues and decreases capillarity which decrease the risk of infection [26]. It must however be noted that the surface coating is thin and can rub off due to friction during manipulation [3].

Some sutures are available with an antimicrobial coating to decrease the risk of surgical site infection. Triclosan, an antimicrobial agent frequently used in cleansers and sanitizers is used as a coating to prevent colonization of bacteria on the suture. Triclosan is non-toxic, biocompatible, effective against a broad spectrum of bacteria without causing resistance and it does not interfere with wound healing [3].

Colour (dyed or undyed)

Dyed sutures act as an indicator to distinguish between different anatomical structures. The colour enhances suture visibility, even if steeped in blood, to make suture removal easier [9]. The addition of dye to a suture enables the suture to retain its strength slightly longer when compared to undyed suture materials [26].

Undyed suture materials are less visible and more discreet. It is indicated in eye surgery or skin suturing. Dyed sutures are rarely used on the outer surface of the body to avoid a tattoo effect [3].

Tissue reaction (reactive or non-reactive)

Tissue reaction is represented by an inflammatory response which usually develops between the second and seventh day post-operatively. Synthetic materials cause less tissue reaction than natural materials. This can be confirmed by the histology of silk that shows a large number of neutrophilic polymorphonuclear leucocytes in the oral tissues as well as delayed formation of fibroblasts and new capillaries which leads to delayed healing [13]. Furthermore, natural materials are degraded by proteolysis whereas synthetic materials are degraded by hydrolysis that results in minimal tissue reaction [10].

Multifilament or braided sutures initiates a greater tissue response as bacteria adhere to the suture five to eight times more compared to monofilament sutures [13].

Systemic conditions such as poorly controlled diabetes mellitus and cardiovascular disease are directly associated with oral inflammatory conditions. Therefore, these conditions may often mask the tissue reactions provoked by the suture material [13].

Handling (easy or difficult)

As previously mentioned, multifilament suture materials are preferred by clinicians due to its ease of handling as it exhibits better pliability and flexibility than monofilament sutures.

Most common suture materials used in dentistry

Absorbable

Natural

Chromic catgut

Chromic catgut is impregnated with chromic salts to overcome the disadvantages of plain catgut [25]. The tensile strength is retained for 14 days, complete absorption time is increased to 90 days, knot security is improved and tissue reaction is reduced during the early stages of wound healing [7].

The material is soaked in an isopropyl alcohol solution to retain flexibility and to increase the shelf life. The suture should be rinsed with sterile saline before use. Some manufacturers use a glycerine coating as an alternative solution which makes the material smoother and thicker with better handling characteristics [25].

Chromic catgut is absorbed faster in acidic environments. Hence, these materials should not be used in patients with a low intraoral pH as in the case of epigastric reflux, a hiatal hernia, reflux bulimia, esophagitis, Sjogern's syndrome, patients undergoing radiation and chemotherapy and patients using medications that result in the formation of a dry mouth [23].

Synthetic

Polyglycolic acid (Dexon)

Polyglycolic acid (PGA) is an interlaced multifilament suture that can be coated, uncoated, dyed or undyed. The coating produces a pseudo-monofilament structure that reduces capillarity, improves sliding through the tissues and facilitates knot dissolution [20].

When compared to catgut, the tensile strength and knot security is excellent [25]. The suture material undergoes a slow resorption that begins after 10 to 15 days and is completed within 90 to 180 days [20]. It is useful for wounds that have an increased risk of infection [10]. When exposed to physiological conditions, PGA is degraded by hydrolysis and some enzyme classes [20].

Polyglactin (Vicryl)

Polyglactin is a dyed or undyed absorbable synthetic multifilament suture material with a lubricant coating consisting of polyglactin and calcium stearate that ensures a smooth passage through the tissues. In oral surgery where faster resorption is desired, the coating is treated with γ-radiation to lose its strength by the second week and is fully absorbed by the sixth week [25].

The main advantages of polyglactin over polyglycolic acid are a higher tensile strength and faster absorption that takes place between 40 and 70 days [25]. Other advantages are that it does not allow plaques to adhere, it has good handling properties and show no intensive local reaction [5].

Due to the materials' gaining popularity, manufacturers began to produce modified products such as a monofilament version which does not require a coating, an antimicrobial suture embedded in triclosan and a rapidly absorbing polyglactin (vicryl rapide) [25].

Gazivoda., *et al.* (2015) conducted a study where three suture materials were compared - Vicryl, catgut and Dexon. Results showed that Vicryl rapide initiated the mildest local reaction, while Dexon initiated the most severe local reaction. Vicryl rapide also contributes to faster healing of wounds in humans with a lower incidence of dehiscence. Breaking of the suture material occurred after 12 to 16 days and absorption occurred by hydrolysis [5].

Non-absorbable

Natural

Silk

Silk is classified as a non-absorbable natural multifilament braided suture material dyed black in colour. Silk is composed of proteins namely fibroin and sericin [2]. Sericin in virgin silk has

been identified as an antigenic agent causing type I allergic reactions and is removed with a degumming process to make it more suitable for medical use [25].

Silk is inexpensive, easy to handle, flexible and when coated with wax, it ensures a smooth passage through the tissues and has no tissue reactions [5]. Disadvantages include low tensile strength, high levels of tissue friction, capillary action and tissue inflammatory response. The wax coating often helps to counteract these disadvantages [25].

In a study conducted by Sala-Pérez., *et al.* (2016) on the effects of suture materials on third molar surgery, it was shown that when silk material is used, there was presence of bacterial growth when compared to vicryl in which bacterial growth was absent. Newer studies and advancements have developed a braided silk coated with triclosan which reduces the bacterial load even more significantly [2].

Silk is not considered as an appropriate material for cutaneous suturing, except on specific sites such as eyelids and lips. It is very often used for ligating blood vessels and for hitching drains. Its soft and pliable nature makes it suitable for use in the oral mucosa which is mobile and wet [25].

Synthetic

Polyester (Ethibond, Surgidac, Dacron)

Polyester is a non-absorbable synthetic monofilament or multifilament suture that is dyed green in colour. The monofilament suture has less tissue reaction in comparison to the multifilament suture. For this reason, the multifilament polyester is coated with silicone, teflon, polyethylene and vinyl acetate [19].

Polyester has a high tensile strength and low tissue reactivity. The braided nature enhances the handling properties, knot-tying and retentivity. Thus, it combines the positive features of monofilament and multifilament sutures. It is the suture of choice in cardiovascular surgery, prosthetic implants and facelifts [25].

Polyamide/Nylon (Ethilon, Dermalon)

Nylon is a non-absorbable synthetic monofilament or multifilament suture that is dyed black in colour [19]. Monofilament nylon sutures are very popular for cutaneous suturing [25].

Advantages include a high tensile strength, exceptional elasticity and low tissue reaction. The elasticity helps the material to accommodate tissue swelling and maintain wound edge apposition [25].

The biggest disadvantage of this material is its shape memory, which negatively affects its knot-tying and knot-holding properties. Three to four knots are often required to hold a stitch in place. Addition of alcohol in the package reduces the shape memory and improves pliability The monofilament nylon may be stiff. Multifilament nylon sutures are available with increased pliability and handling features [25].

Principles of wound suturing

General guidelines for suturing include the following:

1. Sutures are usually placed distal to the last tooth in the interproximal space and continued in a mesial direction.
2. Sutures should always be inserted through the more mobile tissue flap first.
3. A ½ circle needle should be used in areas with restricted space.
4. The suture needle should only be grasped by a needle holder and inserted and pulled through the tissue in line with the curvature of the needle.
5. The needle should always be grabbed at the centre and never at the tip or where the thread is swaged.
6. The needle should be placed a few millimetres from the tip of the needle holder when grasped.
7. When multiple tissue layers are sutured, the goal is to suture periosteum to periosteum and gingival tissue to gingival tissue.
8. The needle should be placed through the tissue at a right angle.
9. Sutures are placed two to three millimetres from the wound edge to prevent tearing through the flap during post-operative swelling.

10. The suture should be pulled tight enough to secure the flap in place without blanching. If tension is present the tissues should be undermined to relieve it [6].

11. The smallest suture size should be selected that will hold the wound edges securely.

12. When one side of the wound is thicker than the other, the thinner wound edge should be engaged first.

13. When one side of the wound is deeper and the other more superficial, the deeper side should be engaged first.

14. To ensure eversion of the wound edges, the depth of needle penetration should be more than the distance from the wound edge to needle penetration point.

15. The knot should lie on one side of the wound and not over the wound edges.

16. Sutures are generally placed three to four millimetres apart, but in areas of underlying muscle activity and when a smaller suture size is used, the sutures are placed closer together [25].

17. It is not advisable to pass the suture through the facial and lingual papillae in one pass.

18. If the needlepoint is dull, rather get a new one and do not try to force it through the tissues.

19. The suture should be placed at an equal distance from the incision on both the sides and at an equal depth.

20. Avoid excessive tissue bites with small needles, as it will be difficult to retrieve them [14].

21. Intraoral sutures are generally removed after seven days but if there is stress or tension while suturing, sutures are removed after ten days [20].

Most common suture techniques in dentistry

Simple interrupted suture technique (Figure 2)

The simple interrupted suture technique is the most commonly used suture technique in dentistry [11]. The needle is inserted three millimetres from the wound edge through the buccal aspect of the buccal flap to the inner aspect of the lingual flap where the needle is then taken back to the buccal side. The two suture tags are tied together and the knot is situated on the buccal side [25].

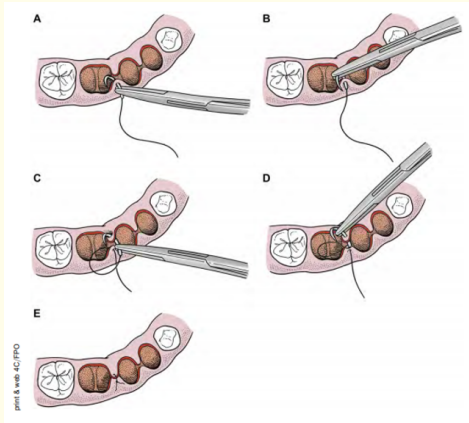

Figure 2: *Simple interrupted suture technique [11].*

Indications

This technique is ideal to suture divided papillae, to re-approximate flap edges and for soft tissue closure after a biopsy [11]. Interrupted sutures may also be used if a wound is infected, because microorganisms may be less likely to travel along a series of interrupted sutures [7].

Advantages

- It is strong and can be used in areas of stress.
- Successive sutures can be placed according to individual requirement.
- Each suture is independent and therefore if one suture loosens, it does not affect the other sutures.
- A degree of eversion can be produced.
- If the wound becomes infected or forms a haematoma, removal of a few sutures can be done easily.
- The sutures are free of interferences and easy to clean [14,20].

Disadvantages

- The technique is more time consuming [14,20].

In contrast, Veeraraghavan (2021) reported a disadvantage of wound inversion due to tissue contraction during healing. This can be prevented by making the suture configuration 'flask-shaped' inside the tissues. Therefore, the needle must be taken farther away laterally from the wound within the tissues [25].

Simple continuous running suture technique (Figure 3)

The simple continuous running suture technique is very similar to the simple interrupted suture technique and started in the same manner. The suture needle is passed through the buccal flap three millimetres from the wound edge and taken to the opposite flap [28]. The loop is completed and an appropriate knot is made.

The needle is then inserted three to five millimetres from the anchor point beginning with the same flap. This process is continued until the entire wound has been traversed [28]. Once the end has been reached, the thread is only partially pulled through, leaving some loose thread on the opposite side where it will form a small loop. The suture is then tied to this small loop for the final knot [25].

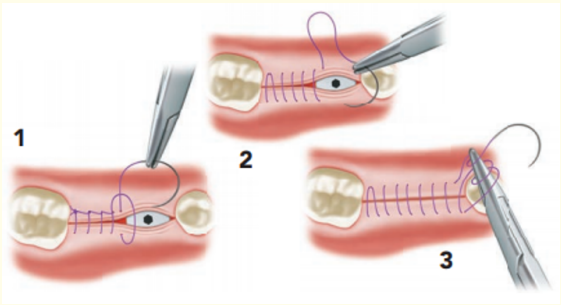

Figure 3: *Continuous running suture technique [28].*

Indications

This technique is indicated in full arch extractions with alveoloplasty and redundant tissue [28].

Advantages

- The technique is less time consuming.
- Tension is distributed uniformly.
- Better water tight closure is obtained.
- Only two knots with associated tags [14].

Disadvantages

- If cut at one point, the suture slackens along the whole length of the wound, which will then gape open [14].

Continuous locking/blanket suture technique (Figure 4)

This technique begins and end in a similar fashion to the continuous running suture but each loop of the continuous suture is 'locked' on itself before making the next loop [25]. This is accomplished by engaging the previous loop of suture after the second bite is completed, prior to placing tension to close the wound at that anchor point [28].

Figure 4: *Continuous locking/blanket suture technique [14].*

Indications

This method is indicated for closing wounds over a long span [25].

Advantages

- Multiple knots are avoided.
- The tissues are aligned in a proper anatomic orientation perpendicular to the wound.
- Added haemostatic effect due to the tension of the sutures.
- Uniform tension is maintained across all the loops [14,25].

Disadvantages

- The technique is dependent on only two knots and there is the risk of complete loss of suture integrity in case of breakage at any point.

- Adjustment of tension over suture line is prevented as tissue swelling occurs.
- The locks may cause vascular compression of the underlying tissues if they are too tight [14,25].

Vertical mattress suture technique (Figure 5)

The vertical mattress technique is a modification of the simple interrupted technique. After the initial passage of the needle through the buccal and lingual papillae at five millimetres from the wound edge, the needle is turned back and picks a small bite at the tip of the lingual papilla before passing back to the buccal side where the appropriate knot is tied [25].

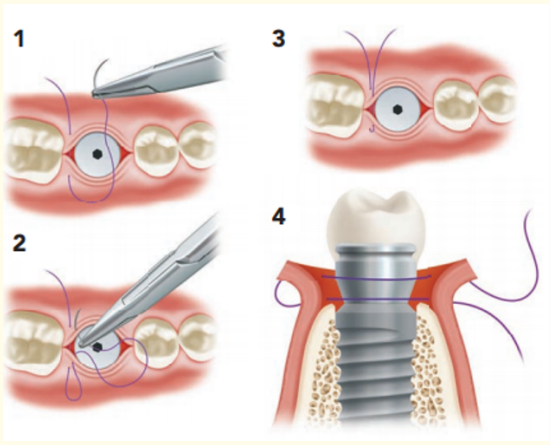

Figure 5: *Vertical mattress suture technique [14].*

Indications

This technique is indicated where additional strength is needed for instance in the case of advancing flaps under tension around implant healing abutments, closure of the crestal incision over guided bone regeneration (GBR) at an edentulous space and closure of the crestal incision over vertical grafting [28].

Advantages

- Better adaptation and maximum tissue approximation.
- Slight eversion of wound margins.
- Provides added wound support where delayed wound healing is expected.
- Used to control soft tissue haemorrhage.
- Runs parallel to the blood supply of the edge of the flap and therefore not interfering with healing [14].

Horizontal mattress suture technique (Figure 6)

The needle is placed through the first flap three millimetres from the wound margin through to the opposing flap. The needle direction is then reversed and the same flap is re-entered at a five-to-eight-millimetre distance [28]. The reinserted needle now passes through both flaps and the thread tags, now on the same side, are tied together [25].

Figure 6: *Horizontal mattress suture technique [14].*

Indications

This technique aids in haemostasis and is indicated where a watertight closure is required like in the case of closing a crestal incision at the site of vertical grafting [28]. In addition, this technique is also indicated for closing bony deficiencies such as an oro-antral fistula or cystic cavity [14].

Advantages

- Enables mucosal margins to evert by bringing greater areas of raw tissue into contact.
- Prevents the flap from being inverted into the cavity.
- Controls post-operative haemorrhage from the gingiva around the tooth socket by producing tension of the muco-periosteum over the underlying bone.
- It does not cut through the tissue and can be used in cases where there is tissue tension [14].

Disadvantages

- More trouble to insert.
- Constricts the blood supply to the incision if improperly used resulting in wound necrosis and dehiscence [14].

Figure of 8 suture (Figure 7)

The needle is passed through the base of the mesial papilla of the buccal flap and advanced diagonally across the wound to the opposite corner entering the distal lingual papilla. The suture needle is then brought over the wound margin to repeat the process on the buccal flap again, now at the distal papilla. The figure of 8 suture can be tightened and tied down with the appropriate knot for the suture material [28].

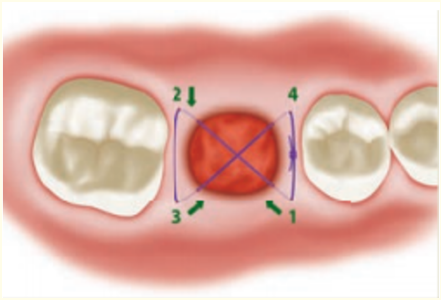

Figure 7: *Figure of 8 suture technique [28].*

Indications

This technique is particularly useful when suturing over an open socket, as both mesial and distal papillae can be secured with one stitch. The crossing of the suture material over the socket can also help to contain graft material or haemostatic agents [28].

Sling suture around a single tooth (Figure 8)

The independent sling suture uses a tooth or dental implant to secure a single flap without having to engage the opposing flap [28].

The needle is first passed under the distal contact point of tooth or implant through the interdental papilla. The suture needle then pierces through the inner side of the elevated surgical flap three millimetres from the tip of the papilla. Thereafter, the suture needle is placed back under the contact point and passed under the next contact point mesial to the tooth. The pattern distal to the tooth is repeated on the mesial side and the knot is tied on the non-elevated tissues [14].

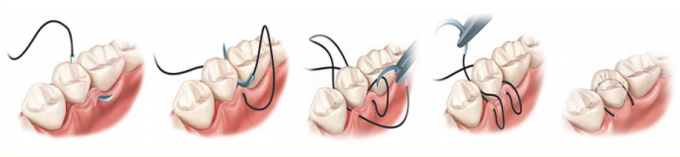

Figure 8: *Sling suture about a single tooth [14].*

Indications

This technique is indicated in situations where the opposing tissue may not be of sufficient quality to hold the sutures or if it is in an inaccessible or significantly different position from the flap [28].

Periosteal suturing technique (Figure 9)

The periosteal suture technique involves penetrating the periodontal or peri-implant tissues and periosteum all the way to the bone. The needle is then rotated back toward the starting point, where the periosteum is penetrated again and taken back to the keratinized tissue. The needle makes a 180° rotation [14].

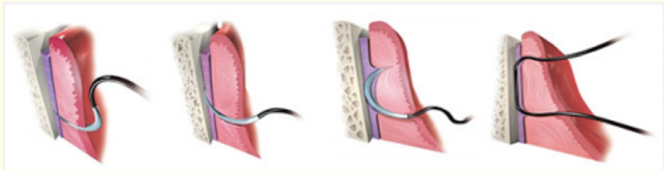

Figure 9: *Periosteal suturing technique [14].*

Indications

Periosteal suturing is indicated to immobilize a partial thickness flap or free gingival graft to a new position by using the adjacent periosteum to anchor the flap [15].

Factors to consider when choosing a suture material

The selection of a suture material is based on knowledge of the following:

1. Healing characteristics of the tissues to be approximated.

2. Physical and biological properties of the suture material.
3. Condition of the wound to be closed.
4. Probable post-operative outcome of the patient (e.g., oedema) [14].
5. Number of tissue layers involved in the wound closure.
6. Tension across the wound.
7. Depth of suture placement.
8. Expected time of suture removal [12].

The specific suture thread and diameter selected is based on the thickness of the tissues to be sutured and the presence or absence of tension-free mobile tissue. The finest suture size should be used that will correspond with the natural strength of the tissue [1].

Multifilament sutures should be avoided in contaminated wounds as bacteria are prone to attach to the suture material and may cause infection [14]. When an aesthetic result is required, close and prolonged apposition of the wound and avoidance of irritants produces the best results. The smallest inert monofilament suture material such as polyamide or prolene should be used [14].

If the post-operative course of the patient produces a sudden strain on the suture line, it should be reinforced with retention sutures and removed as soon as the condition is stabilized [1].

The tissue is approximated until the tensile strength of the wound is sufficient to withstand stress [6].

Conclusion

The main goal of suturing is to maintain haemostasis, allow healing by primary intention, provide support to the tissue until healing have occurred, reduce postoperative pain and prevent bone exposure to prevent delayed healing and unnecessary resorption. The ideal suture material should have good tensile strength, dimensional stability, lack of memory, knot security and sufficient flexibility to avoid damage to the oral mucosa. The selection of an appropriate suture material and suture technique is integral to obtaining an optimal outcome of healing. Each wound must be assessed individually and basic knowledge of the suture material and healing characteristics of the tissue is essential in making the right decision as to which material and technique is most appropriate.

Bibliography

1. Akifuddin Syed. Review On Sutures in Oral Surgery - An Update. Journal of Advanced Medical and Dental Sciences Research. 2014;2(3):201-204.
2. Balakrishnan, et al. Efficacy Of Non-Absorbable Suture Materials With Respect To Healing In Intra Oral Lesions: A Review Article. European Journal of Molecular & Clinical Medicine,7, 5, 2020, 1618-1620.
3. Braun. Suture Glossary. Braun, 2006.
4. Byrne, Miriam, Al, Aly. The Surgical Suture. Aesthetic Surgical Journal. 2019;39(2):67-72.
5. Chandrasekhar, Harshinee, et al. Comparison of Influence of Vicryl and Silk Suture Materials on Wound Healing After Third Molar Surgery- A Review. Journal of Pharmaceutical Sciences and Research. 2017;9(12):2426-2428.
6. Dimova Cena, et al. Various Suturing Material and Wound Healing Process After Oral Surgery Procedure - A Review Paper. Journal of Hygienic Engineering and Design. 2020:95-100.
7. Dunn, David. Wound Closure Manual. ETHICON INC, 2005.
8. Gazivoda, Dragan et al. Influence of Suturing Material on Wound Healing - An Experimental Study on Dogs. Vojnosanitetski Pregled. 2015;72(5):397-404.
9. Goel, Amit. Surgical Sutures - A Review. Delhi Journal of Ophthalmology. 2015.
10. Gowtham K, et al. Suture Materials in Dental Surgeries: A Review. Annals of SBV. 2020;9(1):30-32.
11. Hupp, James. Guide to Suturing with Sections on Diagnosing Oral Lesions and Post-Operative Medications. Journal of Oral and Maxillofacial Surgery. 2015;73(1):1-62.
12. Indhumathi M, Kumar S. Antibacterial Suture vs Silk for the Surgical Removal of Impacted Lower Third Molars. A Randomized Clinical Study. Drug Intervention Today. 2019;12(1):108-113.

13. Javed Fawad, et al. Tissue reactions to various suture materials used in oral surgical interventions. ISRN dentistry. 2012:762095.

14. Koshak, Hassan. Dental Suturing Materials and Techniques. Global Journal of Otolaryngology. 2017;12(2):27-37.

15. Kramer G, et al. The Utilization of Periosteal Suturing in Periodontal Surgical Procedures. Journal of Periodontology. 1970;41(8):457-462.

16. Krishna Vamsee, et al. Suture Materials in Dentistry. International Journal of Innovative Science and Research Technology. 2020;5(4):981-984.

17. Kushwah Atul, et al. Effect of Different Suture Materials on Wound Healing: A Clinical Study. International Journal of Research in Health and Allied Sciences. 2016;2(3):1-4.

18. Meyle Jörg. Suture Materials and Suture Techniques. Periodontology. 2006;3(4):253-268.

19. Minozzi F, et al. The Sutures in Dentistry. European Review for Medical and Pharmacological Sciences. 2009;13:217-226.

20. Modi, Manu. Critical Evaluation of Suture Materials and Suturing Techniques in Implant Dentistry. International Journal of Clinical Implant Dentistry. 2009;1(2):31-40.

21. Sala-Pérez Sergi, et al. Antibacterial suture vs silk for the surgical removal of impacted lower third molars. A randomized clinical study. Medicina oral, patologia oral y cirugia bucal. 2016;21(1):e95-102.

22. Selvi Firat, et al. Effects of different suture materials on tissue healing. Journal of Istanbul University Faculty of Dentistry. 2016;50(1):35-42.

23. Silverstein Lee, et al. Suturing for Optimal Soft-Tissue Management. Journal of Oral Implantology. 2009;35(2):82-90.

24. Syaflida Rahmi, et al. Comparison of Wound Healing Time Post Odontectomy Surgery Using Silk and Catgut Sutures in Pirngadi Hospital. Journal of Dentomaxillofacial Science. 2019;4(2):96-99.

25. Veeraraghavan Ravi. Oral and Maxillofacial Surgery for the Clinician. Singapore, SpringerLink, 2021.

26. Yag-Howard, Cyndi. Sutures, needles, and tissue adhesives: a review for dermatologic surgery. Dermatologic surgery: official publication for American Society for Dermatologic Surgery. 2014;40(9):S3-S15.

27. Yaltirik M, et al. Comparison of four different suture materials in soft tissues of rats. Oral diseases. 2003;9(6):284-286.

28. Yip Kyle, Bach Le. A Guide to Sutures. Dental Learning, 2019.

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