Sutures and Suturing Techniques in Dental Surgery

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Abstract. The goal of suturing in dental surgery is to maintain haemostasis and permit healing by primary intention. Suturing in dental surgery permits proper flap position and helps to prevent underlying bone exposure that may result in delayed healing and unnecessary resorption. Inappropriate suturing, however, adversely hamper the healing process. The aim of this review article was to report sutures and suturing techniques in dental surgery. Sutures and suturing techniques in dental surgery was categorized into suture materials, suture armamentarium, principles of suturing, suturing techniques, removal of sutures and possible suturing complications. Clearer understanding of sutures and suturing techniques in dental surgery will greatly improve the clinical outcome of dental surgical procedures rendered to patients.

Key words: suture materials, suturing armamentarium, suturing techniques, dental surgery.

Introduction

Sutures, also known as stitches, are used to secure the edges of a surgical or traumatic wound together until healing processes are complete (Rose & Tuma, 2020). Sutures are used also in ligation of blood vessels (Ball & Feliciano, 2009: 1-3). Historically, several surgeons have described suturing as far back as 500 BC ago. For centuries, they were made from plant materials like hemp or cotton or from animal material such as tendons and silk. Synthetic materials were developed in the twentieth century (Rose & Tuma, 2020). Suturing is the act of securing the edges of a surgical or traumatic wound and holding them in apposition until healing has taken place. When performed properly, healing by primary intention occurs (Daley, 2021).

The ideal suture should allow the healing tissues to recover sufficiently so that they no longer require support, once the sutures are removed or absorbed. It should have adequate strength to prevent suture breakdown, good handling and knot tying characteristics to prevent untying or knot slippage and should be non-allergic, non-toxic, non-electrolytic and non-carcinogenic (Ratner et al., 2020a).

Classification of suture materials

Suture materials can be classified in several different ways. According to their source/origin, they can be classified into natural or synthetic. Natural suture materials are made of natural fibres. They tend to induce a greater degree of tissue reaction than synthetic. Catgut and silk are examples of natural suture materials. Synthetic suture materials are composed of fabricated materials. They are more frequently used because they provoke lesser degree of tissue reaction than the natural suture materials. Vicryl (polyglactin 910), nylon, polypropylene (prolene) and stainless steel wires and staples are examples of synthetic suture materials (Ratner et al., 2020a; Suture materials, 2021). According to their structure/fibre construction, they can be classified into monofilament or multifilament. Monofilament sutures are single stranded fibre sutures e.g. nylon. They have no capillary action, lower infection risk, higher tensile strength, smoother tissue

passage. They however, have poor knot security, thus requiring more throws and their ease of handling is poor. Multifilament suture materials are made of several fibres that are braided e.g. silk and vicryl. Multifilament sutures have capillary action, higher risk of infection, less smooth tissue passage and lesser tensile strength. They however, have better knot security and better ease of handling (Ratner et al., 2020a; Suture materials, 2021). According to their fate/absorption, they can be classified into absorbable and non-absorbable suture materials. Absorbable suture materials are broken down by the body via enzymatic reactions or hydrolysis and they lose significant tensile strength within 60 days, of being placed in tissues. Examples of absorbable are catgut and vicryl. Non-absorbable suture materials maintain their tensile strength in tissues for at least 60 days. Examples of non-absorbable are nylon, polypropylene (prolene) and silk (Ratner et al., 2020a; Suture materials, 2021; Nindhia et al., 2019: 157-159). According to their coating, sutures materials can be classified into coated or uncoated. Coated suture are sutures that have been tanned with a solution containing high concentration of specific proteins, growth factors, antibacterial factors or metallic salts. The aims of coating sutures are to promote biological healing at site of repair, reduce surgical site infections, and/or increase the tensile strength of the material and its resistance to absorption by the body. The uncoated sutures lack these additions (Suture materials, 2021; Wang et al., 2013: 465-473; Rothenburger et al., 2002: 79-87).

Common suture materials in dental surgery

Catgut

It is a natural, absorbable, monofilament Suture (Fig. 1). It is derived from sheep intestinal sub mucosa or bovine intestinal serosa. It is absorbed by the body's own proteolytic enzymes degradation and phagocytosis. It is completely absorbed in 90 days. The action of enzymes on catgut increases the risk of tissue reaction compared to inorganic suture materials. When placed intra-orally through mucosal surfaces, the sutures are digested in 3-5 days. It should not be boiled or autoclaved as heat destroys its tensile strength. It loses tensile strength in 7-10 days. Chromic catgut is plain gut that has been tanned with a solution of chromium salts. Chromium salts increase the tensile strength of the material, increases its resistance to absorption by the body and has less stimulation for tissue reaction (Chu, 2013: 275-334). Catgut and its chromic variant are used in ligation of vessels, subcutaneous tissue suturing, closing muscle layer in cleft lip repair and in plastic surgery (Encyclopedia Britannica, 2021).

Fig. 1. Catgut Sample

Silk

It is a natural, non-absorbable, braided suture made from filament spun from silkworm larva (Fig. 2). Although classified as a non-absorbable suture, silk is an organic substance that undergoes slow proteolysis when implanted. It disappears after two years of implantation. Silk is inexpensive. It has excellent handling characteristics, good knot

security and moderate tissue response. It does not irritate adjacent mucous membrane. Silk, however, has increased tendency to cause Stitch granuloma and Infection at site of placement. Intra-orally, it can be used for suturing of lacerations, wound edges or surgical flaps (Thilagavathi & Viju, 2015: 219-232). Uses of silk, outside dental surgery, include ligation of blood vessels and pedicles, suturing of skin, tendons and nerve grafts in vascular surgeries (DoplhinSutures, 2021a).

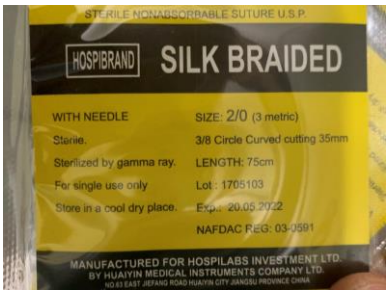


Fig. 2. Silk Braided Sample

Nylon

Nylon sutures are also known as polyamide sutures (Fig. 3). They are synthetic and non-absorbable. They are inexpensive and have minimal tissue response. Nylon sutures are remarkably smooth and soft and possess good tensile strength and good knot security. Nylon sutures however, possess the property of "memory". Therefore, multiple square knots are necessary to maintain the tie. Nylon sutures has tendency to tear through non-keratinized tissues. It is not frequently used intra-orally. It is indicated for use on the skin and plastic surgery (DoplhinSutures, 2021b; Byrne & Aly, 2019, 67-72).

Fig. 3. Nylon Sample

Polypropylene

It is a Synthetic, non-absorbable monofilament. It has great tensile strength with no appreciable loss of tensile strength over time. The suture is blue pigmented to enhance visibility (Fig. 4). It has minimal tissue reactivity and is therefore often used in vascular surgery. Polypropylene has high degree of smoothness so it requires much less force to draw through the tissue. Prolene has good knot security (DoplhinSutures, 2021c). The drawback of prolene is its fragility and high plasticity. It therefore has more difficulty of use compared to standard nylon sutures (FPNotebook, 2021). It use include general surgery, plastic surgery, cardiovascular surgery, ophthalmic surgery and skin closure (Jnjmedicaldevices, 2021a).

Fig. 4. Polypropylene Sample

Polyglactin 910 (Vicryl)

Vicryl is an absorbable synthetic multifilament suture (Fig. 5). It is composed of a braided copolymer of 90% glycolide and 10% L-lactide and is coated with calcium stearate and polyglactic acid to improve its handling characteristics (Jnjmedicaldevices, 2021b). Polyglactin 910 undergoes enzymatic degradation by hydrolysis. Vicryl retains approximately 70% of its tensile strength till 2 weeks and is completely absorbed within 56-70 days (Universalsutures, 2021).

Vicryl and other polyglycolic acid sutures can be impregnated with triclosan to provide antimicrobial protection of the suture line. Thus it can be used in infected tissues (Rothenburger et al., 2002: 79-87). Triclosan use may have negative effects on fetal development, rate of asthma. Caution is therefore advised for asthmatic and pregnant patients (Spanier et al., 2014: 475; Wang et al., 2018: 279-286). It is commonly used in Intra-oral suturing, gut anastomoses, vascular ligature, ophthalmic surgery and soft tissue approximation of the skin and mucosa. Vicryl has minimal tissue reactivity (DoplhinSutures, 2021c).

Irradiated polyglactin 910 (vicryl rapide) is vicryl suture that has received gamma radiation. Vicryl rapid has good tensile strength, forms secure knots, minimal tissue reaction, faster absorption rate (within 35 to 42 days) and is ideal for intra-oral use (Talbot et al., 2002: 1-8).

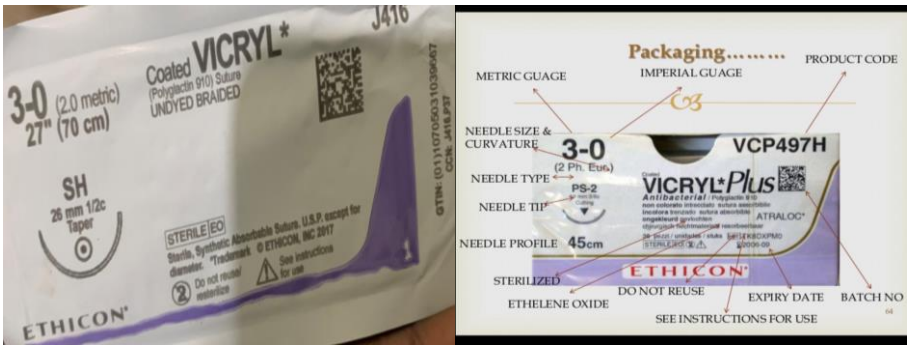


Fig. 5. Vicryl Sample

Metals

Metal sutures can be monofilament or multifilament sutures. Stainless steel suture and tantalum suture are examples of metal suture. They are the strongest of sutures, have the greatest tensile strength and they have the most secured knot (DoplhinSutures, 2021d; Brumme et al., 1989: 308-313). They are indicated for scar revision in keloid forming patients and for abdominal wound closure, hernia repair, sternal closure and orthopaedic procedures (DoplhinSutures, 2021e; Goutos, 2019: 1-9). They are used as

stainless steel wires for intermaxillary fixation either alone or in combination with Arch bar (Jeong et al., 2016: 475). The use of stainless steel sutures is contra-indicated in patients with known sensitivities or allergies to steel and/or its principal metallic components, chromium and nickel. Additionally, the presence of steel may interfere with certain radio diagnostic procedures ((DoplhinSutures, 2021e).

Suture armamentarium

Suture armamentarium refers to the instruments required for suturing. These along with the suture material include the suture needle, needle holder, suture scissors and Adson forceps.

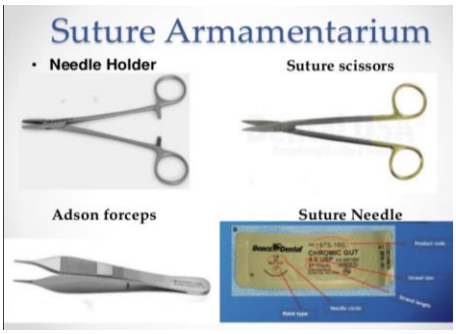


Fig. 6. Suture Armamentarium Sample

Suture needle

A surgical needle is the vehicle with which the suture material passes through the tissue to be approximated. The size and shape of the needle differs in dental practice depending on the location and type of surgery to be performed (Merillife, 2021).

The size of suturing needle is determined by the needle length which is the distance measured along the needle from the needle point to the swage or eye (where the thread connects the needle). This is the measurement supplied on suture packages (Ratner et al., 2020b). The chord length, also known as the bite width is the linear distance from the swage (or eye) to the needle point. The radius, or bite depth, is the distance from the body of the needle to the centre of the circle along which the needle curves. The diameter of the needle is considered the gauge or thickness of the needle [30]. In practice, the needle with the smallest possible length is advised (JuniorDentist, 2021).

The shape of a suturing needle could be straight or curved. The curved shape is available as J shape or different proportions of a circle. The most commonly used needle shape in dental surgery are the 3/8 and 1/2 circle needles (Ratner et al., 2020c). The straight suturing needle is traditionally used to suture easily tissue such as the skin (Ratner et al., 2020d) but is rarely used now.

The suture needle has 3 basic parts: The needle eye (or swage), the needle body and the point (Ratner et al., 2020d).

NEEDLE EYE (OR SWAGE)

Suture needles can be classified into eyed needle or swaged or eyeless needles depending on whether the eye is open or closed

Eyed needles.

This class of suture needles has the eye of the needle open and is bigger than the diameter of the suture needle. The suture material is tied in the eye of the needle. Eyed needles can be reused. It can however, cause tissue damage.

Eyeless or Swaged needles.

The suture material is inserted into the eye of the needle during manufacturing and the eye is sealed or closed. This makes the needle unusable for the second time. It

causes minimal damage to the tissue during suturing making it ideal for surgery. It is available in different shapes and sizes for different surgeries. It is however more expensive than the eyed needle.

NEEDLE BODY

The needle body is also called the needle shaft. It is the part of the needle that is held by the needle holder. The needle body can be of different shapes as earlier discussed.

NEEDLE POINT

The needle point is the working end of the suture needle (Ratner et al., 2020d; Byrne & Aly, 2019: 67; Ratner et al., 2020e). It acts to pierce the tissue, beginning at the maximum cross section of the body and running to the end or tip of the needle. It can be either sharp or blunt. Sharp needles pierce tissue with minimal cutting and are used in areas where leakages must be prevented whereas the blunt needles are used in friable tissues such as the gingiva. Needle points can also be either of the following (Figs 7-9):

1. The conventional cutting: The Sharp tip is placed upward. Caution should be exercised when in use, as the sharp tip is more likely to tear the tissue. It is used in thick regions such as the skin.

2. The Reverse cutting: The sharp tip is placed downward. It is safer when working in delicate tissue where there is need to reduce the risk for tissue cut-out.

3. The taper point (round) which is less traumatic than the other two and requires more force. It is used in, for example, in abdominal fascia surgery where there is need to prevent inadvertent visceral injury and bleeding such as the liver or kidney.

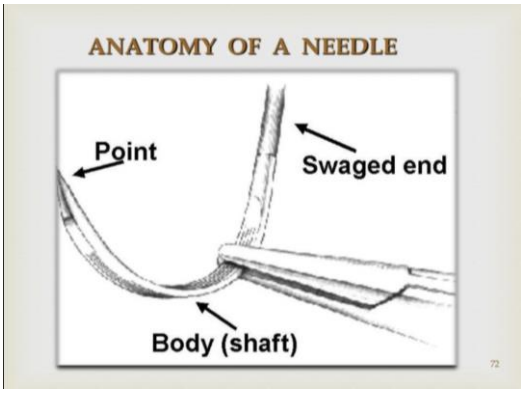


Fig. 7. Anatomy of a Needle

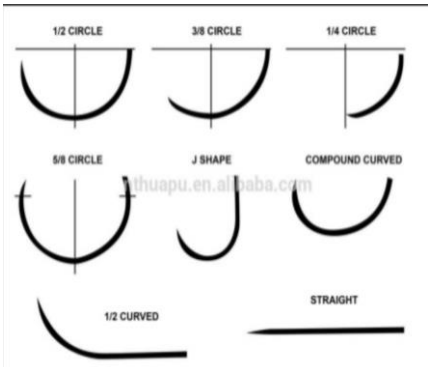


Fig. 8. Different Suture Needle Shapes

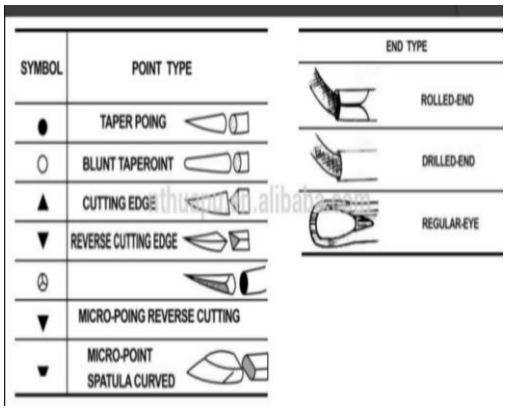


Fig. 9. Points & Ends Types

IDEAL PROPERTIES OF A SUTURING NEEDLE (GerVetUSA, 2021)

1. It should be of high quality stainless steel
2. It should be of the smallest diameter possible
3. It should be capable of implanting sutures with minimal trauma to tissues
4. It should be stable in the needle holder
5. It should be sharp enough to penetrate tissue with minimal resistance
6. It should be sterile and corrosion resistant

Needle holder

A needle holder is used to grasp the suture needle while suturing. They are robust instruments, so they can cope with repeated metal on metal use when gripping needles. Some needle holders have tungsten-carbide inserts to provide an improved grip and durability, which can be replaced when worn. Needle holders with tungsten-carbide inserts are normally identified with gold plated rings (Cordero, 2013: 17; Ratner et al., 2020f). Needle holders are designed to securely hold and manipulate suture needles and thread. If used properly, it enables the surgeon perform procedures correctly and with great precision

PARTS OF A NEEDLE HOLDER (Fig. 10)

1. Working tips/Jaws
2. Hinge device/Box Lock
3. Shank/Body
4. Catch mechanism/Ratchet
5. Grip area/Ring Handle (Chu et al., 1996).

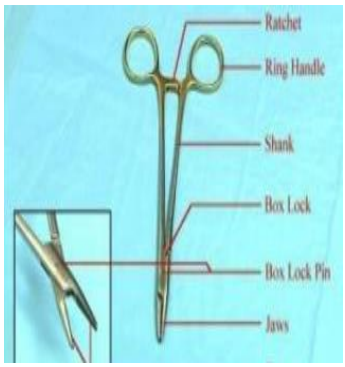


Fig. 10. Parts of a Needle Holder

When the needle holder is in use, it should grasp the distal portion of the body of the needle, about 3/4 to 1/2 of the distance from the tip of the needle, depending on the surgeon's preference. The needle holder should be closed until the first ratchet catches. Do not over close because damage to the needle and the needle holder may result. The tip of the jaws should meet. The needle should be held vertically and longitudinally perpendicular to the needle holder (Boothe, 2022). Appropriate size of the needle holder for the suture needle is advised (Chu et al., 1996).

HANDLING NEEDLE HOLDER (Khan, 2022)

There are different ways a needle holder can be held, depending on the area of surgery and surgeon's preference and skill. They include:

THE TRIPOD GRIP

Here, the needle holder is grasped in a similar manner to scissors (Fig. 11). The thumb and ring finger are placed in the ring. The ratchet lock is used to secure the needle in position, at the tip of the jaws. The instrument is stabilized with the index finger placed along the handle towards the fulcrum. Wrist rotation is used to drive the needle through the tissues. The grip provides excellent precision with minimal movement of needle and instrument when jaws open (VSAC, 2022). Tripod grip is the standard grip and is recommended for novice surgeons (Surgical Instruments, 2022).

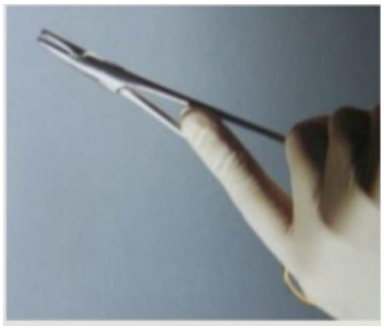


Fig. 11. A Tripod Grip

THE PALM GRIP

It is used when driving needle through tough tissues such as periosteum, cartilage scar tissue etc. (Fig. 12). In this form of grasp, the fingers are not placed through rings. The handles are held in the palm. The arm and wrist are used to drive needle through the tissues. The palm grip is less efficient and precise with movement of needle when the instrument grasp is released (VSAC, 2022). It is mostly used only when necessary.

Fig. 12. A Palm Grip

MODIFIED THENAR EMINENCE GRIP

In the modified thenar eminence grip, the ring finger is placed through one ring (Fig. 13). The other ring rests on fleshy pad at base of thumb (thenar eminence). The Wrist is used to drive needle through tissues. Grip facilitates rapid needle grasping. It is associated with some needle motion as needle is released. It is used for rapid continuous patterns when precise needle release is less critical (Surgical Instruments, 2022).

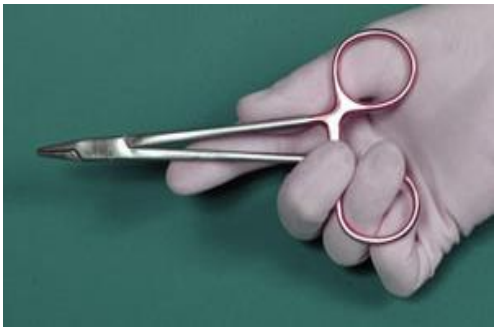


Fig. 13. A Modified Thenar Eminence Grip

PENCIL GRIP

The pencil grip is used for specialized needle holders (for example, Castroviejo) (Fig. 14). It requires spring locking mechanism and provides most precise control of needle movement. The operator finger generates force to drive needle (not wrist or arm). Its use is restricted to fine suturing (for example, microvascular surgeries) (Surgical Instruments, 2022; VSAC, 2022).

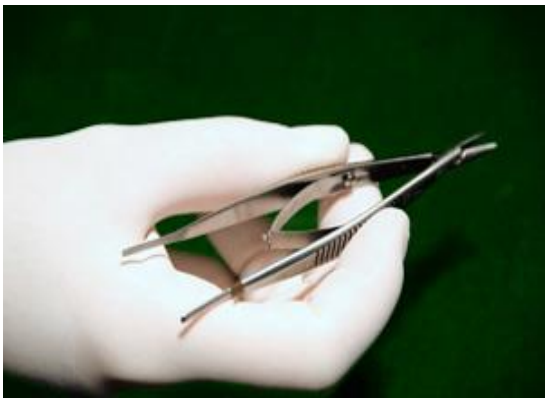


Fig. 14. A Pencil Grip

TYPES OF NEEDLE HOLDER

There are different types of needle holders. Examples include, but not limited to, the following (Fig. 15):

The Olsen-Hegar needle holder incorporates a cutting edge just caudal to the jaws, which can be used to cut suture materials (Surgical Instruments, 2022).

The Mayo- Hegar needle holder is similar but without a cutting edge (Surgical Instruments, 2022).

The Gilles needle holder has a large thumb grip set at an angle to the other finger grip. A cutting edge is incorporated in to the jaws but no ratchet. They require more finger pressure during use and can result in more surgeon fatigue (Hygitech, 2022).

The Castroviejo needle holder is a specialised needle holder that is used for fine suturing, for example ophthalmic and microvascular surgeries (Ellis, 2007: 347).

The Ryder Stille needle holder has very narrow, non-tapered serrated tunstein carbide jaws. They are very popular in vascular surgery (Hygitech, 2022).

The Kilner needle holder is a delicate needle holder with bayonet shaped shanks. It is intended for 4/0 sutures and finer. It features hatched jaws to maintain grip on needles. This ingenious instrument combines the dual functions of a stitch-cutting scissors with a needle holder. It is designed to hold fine suturing needles when closing wounds and is popoular in long platic surgical procedures (Integra LifeSciences, 2022).

Yasargil micro needle holders are specialist instruments that hold surgical needles and grant optimal visualization in suturing procedures. They have spring joints for fast manipulations. They are available as straight and curved jaws needle holders. They are used in general, micro- and neurosurgery (Bolognia et al., 2012).

Fig. 15. Types of Needle Holder

Suture scissors

Suture scissors are a type of utility scissors for cutting suture materials when placing or removing suture materials. They are distinct from other types of scissors like the operating scissors which are used to cut soft tissues (Suretex instruments, 2022). Suture scissors, like any other type of surgical scissors are usually made of stainless steel with two finger loops or rings. Some suture scissors like the Surtex® micro suture scissors (spring scissors) handles end in flat springs connected with a pivot joint. These scissors are designed for ambidextrous use in ophthalmic surgery and cardiovascular surgery. The cutting action of spring scissors is achieved by pressing the handles together. As the pressure is released, the spring opens the jaws. Spring scissors are also used for dissecting tissues during microsurgeries (GerVetUSA, 2022). Some scissors have tungsten carbide reinforcements along their cutting edges (Suretex instruments, 2022).

Suture sutures are quite versatile and are available in a variety of sizes and colour and can be either straight or curved. Spencer® stitch scissors, Mayo® scissors, Northbent® suture scissors, Surtex® micro suture scissors and Stille® suture scissors are some of suture scissors available in the market (Suretex instruments, 2022; GerVetUSA, 2022; AnthonyProducts, 2022).

Adson forceps

Adson forceps are forceps toothed at the tip to provide a gentle grasp of tissues. They are non-locking. These forceps have a wide flat thumb grasp area that is commonly serrated. They are available in a variety of forms: with a cross serrated platform, 1x2 or 2x3 teeth and straight or angled tips. They are used for holding and manipulating soft tissues during suturing and also for handling dressings during surgical procedures (GPSurgical, 2022). The Adson non toothed forceps is a single used disposable forceps used to hold tissue in place when suturing (Veterinary surgery online, 2022). The Adson forceps should be held between the thumb and index finger with a pencil grip when in use rather than a palm grip (Guide ERT, 2015).

Principles of suturing (Chu et al., 1996)

When penetrating the tissues, always hold the needle tip at an angle of 90^0 to the tissue surface. This will ensure the optimal hold of the tissues being sutured. If the needle pierces the tissue obliquely, a tear may develop. Do not use digital pressure on tissues so the tissue retain its form and does not tear or become necrotic. Suturing should always be from a movable to a fixed tissue. Use only sharp needles with minimal force. Replace dull needles. Never force the needle through the tissue. Avoid retrieving the needle from the tissue by the tip. This will damage or dull the needle. The suture should be placed at an equal distance from the incision on both the sides and at an equal depth. If one tissue side is thinner than the other, the needle should pass from the thinner tissue to the thicker one. If one tissue plane is deeper than the other, then the needle should pass from the deeper to the superficial side. The tissues should not be closed under tension since they will tear or undergo necrosis around the suture. The knot should not be placed over the incision line. Sutures should be placed approximately 3-4mm apart. The suture should be tied so that the tissue edges are well approximated.

Suturing techniques

In dental surgery, like in many surgical practices, many different techniques exist to achieve the primary goal of suturing. They are broadly classified into two groups including interrupted sutures and continuous sutures (Silverstein et al., 2009: 82-90).

INTERRUPTED SUTURES

This suture technique uses several strands of suture material to close the edges of a surgical or traumatic wound. After each individual strand of suture material is placed, it is cut and tied off. This technique leads to a securely closed wound. If one of the stitches breaks, the remainder of the stitches will still hold the wound together.

There are different types of interrupted sutures:

A. Simple loop suture
B. Crisscross suture
C. Vertical mattress suture
D. Horizontal mattress suture

CONTINUOUS SUTURES

This technique involves a series of stitches that use a single strand of suture material. This type of suture can be placed rapidly and is also strong since tension is distributed evenly throughout the continuous suture strand. Continuous sutures, however, run the risk of failure if the suture is cut in just one place.

There are different types of continuous sutures:

A Continuous sling suture
B Continuous interlocking suture
C Continuous horizontal mattress suture
D Continuous vertical mattress suture

Each of the technique, as used in dental surgery, will now be discussed.

SIMPLE LOOP SUTURE

This is the most commonly used suturing technique used to stabilize elevated flaps and to stabilize tissue along the incision line (Fig. 16).

The Procedure for simple loop suture involves stabilizing the needle with a needle holder and the outer surface of the buccal flap is pierced, keeping the needle perpendicular to the surface. The needle is pushed along its curvature, moving it towards the lingual flap and piercing the inner aspect of the lingual flap. The needle is then passed below the contact area to bring the suture thread on the buccal aspect. The free ends of the suture are tied at the original entry point and the suture thread is cut off, leaving 2-3mm of suture material (Koshak, 2017: 1-11).

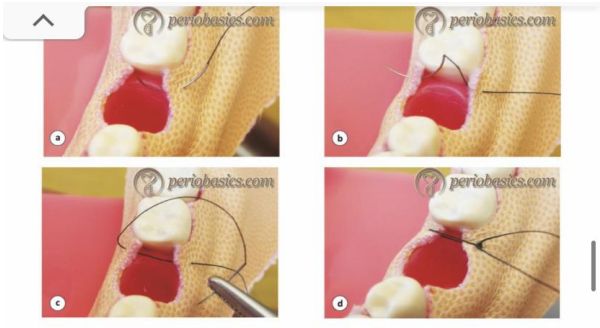


Fig. 16. Simple Loop Suture

CRISSCROSS SUTURE

This is also a commonly used suturing technique in dental surgical procedures. Their indications are similar to that of simple loop technique. It can provide a barrier to clot displacement and help to retain procoagulant or other materials placed into a socket (Silverstein et al., 2009: 82-90).

The procedure for figure of eight suture involves stabilizing the needle with the needle holder and the outer surface of the buccal flap, on the mesial side for example, is pierced. The needle exits the distal side of the buccal flap. It then crosses over the extraction socket and enters the lingual flap on the mesial side and exits the lingual flap on the distal side. The free ends of the suture thread are tied at the original entry point on the mesial side on the buccal flap and cut off leaving 2-3mm of suture material (Koshak, 2017: 1-11).

VERTICAL MATTRESS SUTURE

This suturing technique facilitates precise adaptation of interdental papillae. It is also very useful for appropriate tissue approximation in regenerative procedures.

The procedure for vertical mattress suture involves stabilizing the needle with the needle holder and the needle is passed from one edge of the flap to the other and again from the latter edge to the first and knot tied. When needle is brought back from second flap to the first, depth of penetration is much superficial (Allen, 2010: 479).

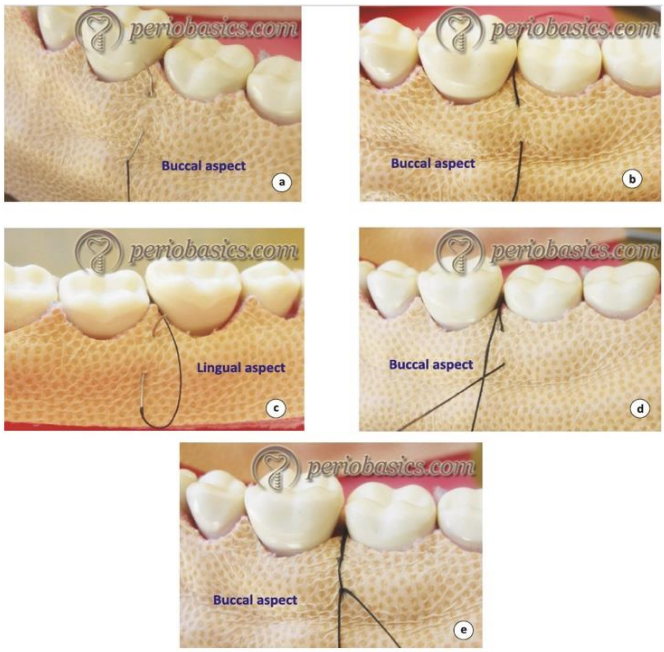


Fig. 17. The Vertical Mattresses Suturing Technique

HORIZONTAL MATTRESS SUTURE

The horizontal mattress suture is placed primarily to resist flap tension caused by muscle pull and soft tissue contraction providing stability to the healing wound. The procedure involves piercing the outer surface of the buccal flap with the needle stabilized with the needle holder. The needle is brought on the lingual flap and exits the lingual flap on the same side. The needle then pierces the lingual flap on the other side, crosses the wound and penetrates the buccal flap. The suture is then tied off at the original entry point and excess suture is removed (Koshak, 2017: 1-11).

CONTINUOUS SLING SUTURE

Continuous sling sutures (Fig. 18) are usually required when flap has to be coronally repositioned (Katsan medical services, 2022; Periobasics, 2022). The outer aspect of the flap is pierced at the distal end of the tooth and the needle is passed below the contact area. The suture is wrapped mesially around the tooth and the inner aspect. This procedure is repeated on each of the teeth in the area of surgery until it reaches the mesial aspect of the last tooth where knots are placed and the suture is cut off leaving 2-3mm of the suture material. Continuous sling suture may be dependent or independent. When both buccal and lingual/palatal flaps are raised, this suturing method is referred to as dependent sling suture whereas when only one flap is elevated it is referred to as independent sling suture (Katsan medical services, 2022).

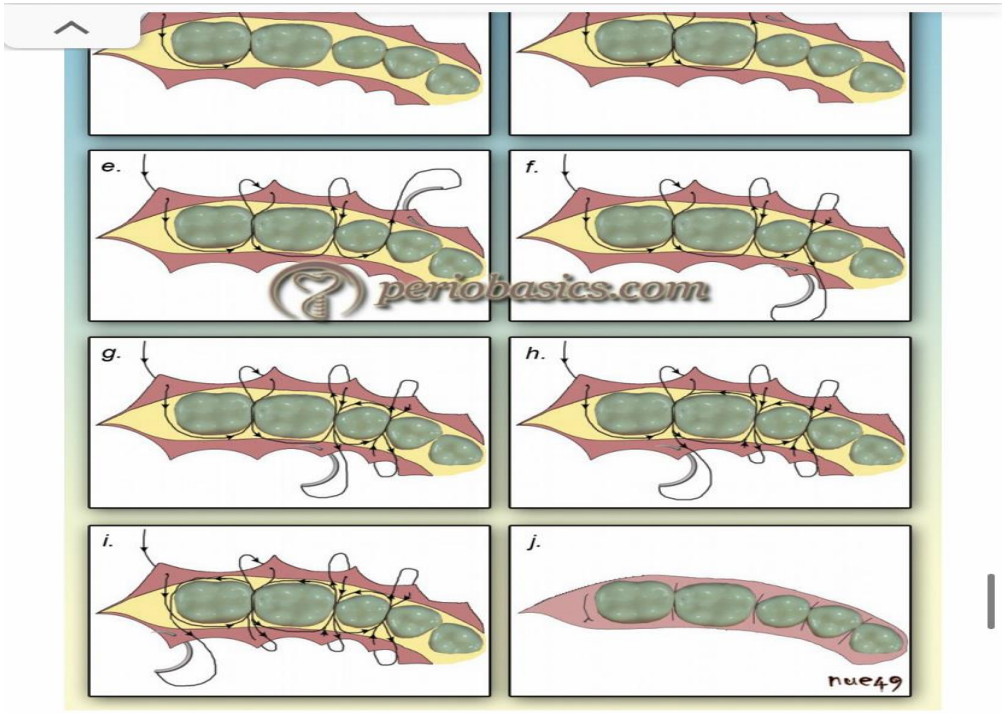


Fig. 18. Coutinuous Sling Suture

CONTINUOUS INTERLOCKING SUTURE

This technique is used to suture long edentulous spans. It is usually utilized after the implant placement in edentulous span or during ridge augmentation or reduction surgeries. This is a quick technique for closing long horizontal or vertical incisions.

The procedure involves placing a simple loop suture at one end of the incision and only the free end of the suture thread is cut. Both flap margins are pierced 5mm laterally from the simple loop. An interlock is made by threading the needle under the last horizontal span. The locking pattern is followed in increments of 5mm from the last locking segment and the entire span is closed. A small loop is left on the final segment after piercing both flap margins. This loop is used to place a knot and the excess of the suture material is cut. The continuous locking suture is in some way a more secure version of the continuous sling suture (Katsan medical services, 2022).

CONTINUOUS HORIZONTAL MATTRESS

It is primarily applied to suture edentulous areas. The procedure involves placing a simple loop is at the distal end of the span and free end of the suture is cut off. Both the flaps are pierced a few millimetres from the initial simple loop. Continue the piercings in increments alternating between buccal and lingual flaps. At the mesial end of the span, after piercing both the flaps, a small loop is left for placing the knot. The knot is placed and excess suture material is cut off leaving 2-3mm of suture material (Katsan medical services, 2022; Davis & Smith, 2021). In total, there are two knots in the surgical site, one at the beginning and the other at the end. The continuous horizontal mattress helps to transmit the tension of the wound along the entire suture line (Davis & Smith, 2021).

CONTINUOUS VERTICAL MATTRESS SUTURE

This suturing technique is indicated during resective procedures where flap has to be positioned apically to prevent re-formation of periodontal pockets. It is frequently used during the crown lengthening procedure.

The procedure involves placing an interrupted vertical mattress suture at the mesial or distal end of the span and free suture end is cut off. Suture is then passed through the

same interdental area and is wrapped around the lingual tooth surface to reach next buccal interdental area. A vertical mattress suture is placed on the buccal aspect in the next interdental area and the needle is passed on the lingual aspect to place a vertical mattress suture. The needle is then passed on the buccal aspect and is wrapped around the tooth to reach the lingual aspect of the next interdental area. A vertical mattress suture is placed and a needle is passed to the buccal aspect where again a vertical mattress suture is placed. The needle is wrapped around the tooth to reach the next buccal interdental area and procedure is continued for the whole span. In the final segment, a loop is left which is used to tie a knot and finish the suturing (Katsan medical services, 2022).

In dental surgery, the advantage of continuous sutures in general, is that it allows as many teeth as required to be involved in suturing. It also minimizes placement of knot. Teeth are used to anchor the flap allowing better adaptation of flaps in the interdental area. Moreover, the tension on the flap is equally distributed along the whole span (Davis & Smith, 2021; Brandt & Jenkins, 2012: 281-303).

The main disadvantage of the continuous suture is that if the knot loosens or thread breaks, a portion or the entire flap may loosen, exposing bone, implants, grafts etc. Hence, the knots should be re-checked before cutting the suture thread to ensure its stability. Continuous sutures under tension can be reinforced with separate, simple horizontal mattress sutures (Avoine et al., 2016: 162-170).

SUTURE KNOTS

Two primary knots are utilized in dental practice (Figs 19, 20). They are the surgeon's knot and the granny or surgical slip knot. The surgeons knot is carried out by tying a double overhand throw; then, an additional single overhand throw is placed in the opposite direction to lock the knot. It is used with synthetic suture materials which has the capacity to maintain memory. The surgicalslip suture is performed by making two separate overhand knots in the same direction and then placing an additional overhand throw in the opposite direction to lock the knot. The knot is not recommended when using resorbable or non resorbable synthetic materials (Brandt & Jenkins, 2012: 281-303). The square knot is another common knot used in surgical procedures (Ruralareavet, 2022).

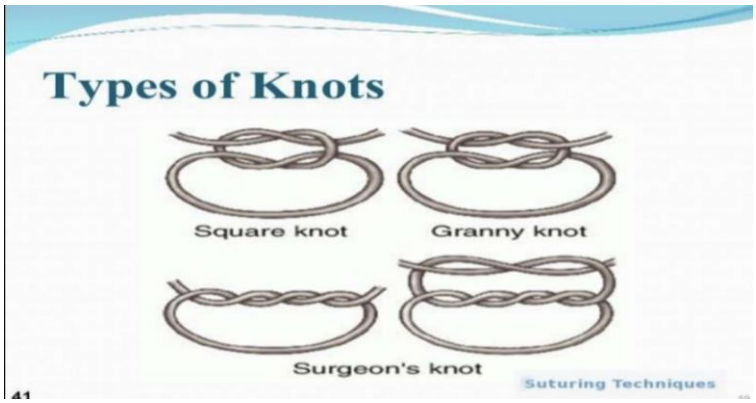


Fig. 19. Types of Knots

COMPONENTS OF SUTURE KNOT (Allen, 2010)

1. Loop created by knot
2. Knot itself which is composed of a number of throws
3. Ears which are the cut ends of the suture

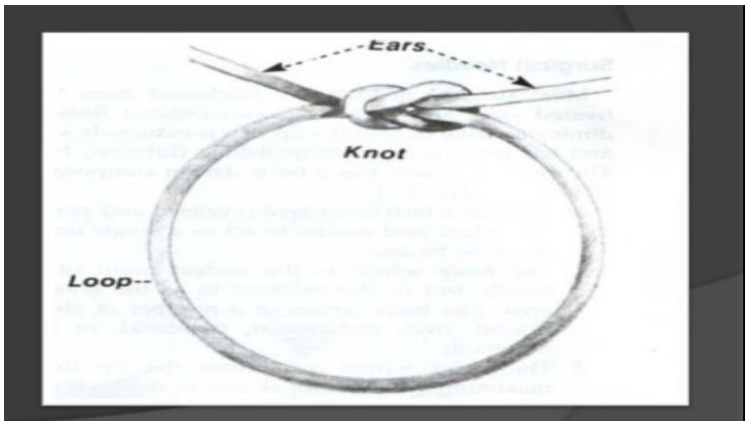


Fig. 20. Components of Knot

PRINCIPLES OF KNOT TYING (Ratner et al., 2020g)

1. Use the simplest knot for the material that must be firm and so tied to prevent slippage
2. Tying the knot as small as possible and cutting the ends of the suture as short as reasonable to minimize foreign body reaction
3. Avoid damage to suture material when handling
4. Avoid excessive tension to prevent breaking of the suture and tissue damage
5. Do not tie sutures too tightly as it strangulates the tissue
6. The surgeon should not hesitate to change stance or position in relation to the patient in order to place a knot securely and flat
7. Maintenance of traction at one end of the suture after the first loop is thrown to avoid loosening of the knot
8. Place the final throw as horizontally as possible to keep knot flat
9. Extra ties to a properly tied the knot should be avoided as they do not add strength but rather contribute to its bulk.

Removal of sutures

Prompt removal of sutures reduces the risk of suture (stitch) marks, infection and tissue reaction. The average wound usually achieves approximately 8%of its expected tensile strength 1-2 weeks after surgery. This is because wounds regain tensile strength slowly. To prevent dehiscence and spread of scar, sutures should not be removed too soon (The Brookside Associates, 2022; Dobrinsky, 2022).

In general, the greater the tension across a wound, the longer the sutures should remain in place. As a guide, sutures on the face can be removed in 5-7 days when the wound gains 5%-10% of final tensile strength. Intra-orally, a good guide is that as soon as sutures begin to get loose they should be taken out and that should translate to between 5-10 days (The Brookside Associates, 2022).

PRINCIPLES OF SUTURE REMOVAL ()

The area should be first irrigated with normal saline to remove gross debris. A swab containing an antiseptic e.g. providone iodine, should be used to clean the area around the sutured site to remove encrusted necrotic debris, blood, and serum and decontaminate the area. A no. 23 explorer or tweezers helps lift the sutures if within the sulcus or close opposition to the tissue. A sharp suture scissor should be used to cut the loops of the suture. The suture material should be cut as close as possible to the tissue because it will prevent the suture material, which was exposed to the oral environment and has been laden with bacteria from passing through tissue while suture is removed.

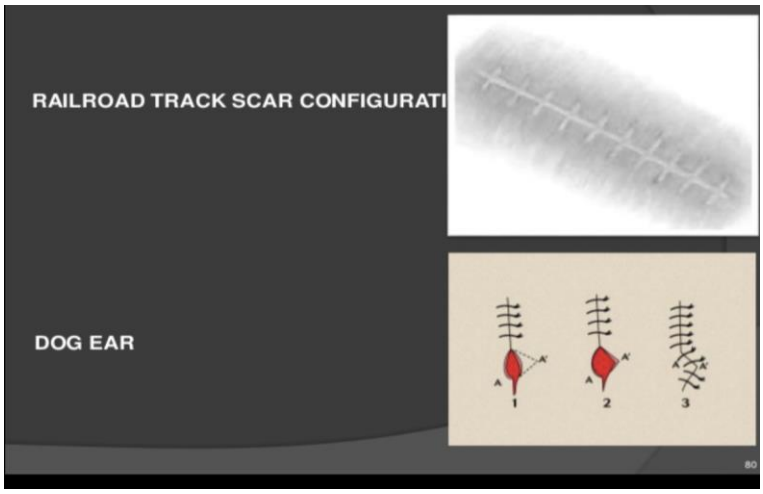
Sutures can then be pulled gently, up and towards the wound at 45^0 with the help of a sterile forceps or haemostat. The knots should be removed first so that their accidental entrapment into the tissue can be prevented [65].

Possible suturing complications

The following are possible suture complications:

1. Scar or stitch mark: this is a visible or noticeable growth of tissue or alteration in the appearance of the tissue marking the spot where the skin has healed after a surgical wound closure. It can be painful, itchy or restricts movement. It results from genetic predisposition of the patient to scar tissue formation or delayed removal of sutures following suturing for wound closure. It can be managed by revision surgery or medically by scar massage, along with moisturising lotions or by use of medications e.g corticosteroids.

2. Dog ear: this is the characteristic puckering of the skin on one or both margins following surgical wound closure. It is always iatrogenic and arises from error of failing to plan an appropriate technique for each surgical wound closure. It is corrected by revision surgery either at the time of initial surgery or at a later date.



3. Wound breakdown and delayed healing: wound dehiscence and poor wound healing results from failure of sutures on account of lack of care for sutures during the healing period. It may also result from poor suture technique during suturing. It is important to keep the wound clean and dry and also avoid vigorous activities that may put strain on the sutured area. Wound breakdown and delayed healing normally heal by secondary intention. On occasions there may be need for revision surgery, along strict compliance to post-operative instructions to facilitate healing

4. Surgical site infection (SSI): surgical site infection is an infection that occurs after surgery in the part of the body where the surgery took place. It can sometimes be superficial infections involving the skin only. It may present with fever within 48 hours of suturing, redness, swelling, increased pain, excessive or persistent ooze, pus discharge from surgical site. The common causes of SSI are staphylococcus aureus, coagulalase negative staphylococcus and enterococcus. They are associated with substantial morbidity and mortality. SSI can be prevented by observing strict adherence to sterile surgical procedures like hand washing , proper hair removal in the area of surgery,use of sterile instruments, clothing, drapes, surgical theatres and suture materials, optimizing patient health before, during and after surgery. SSI are mostly treated by medications

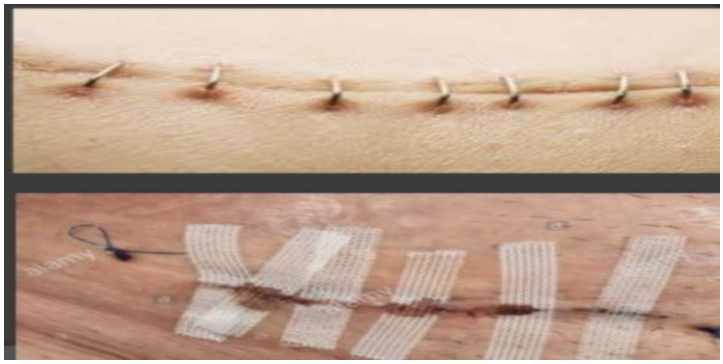
(antibiotics). Sometimes, patients with SSI also need revision surgery to treat the infection.

5. Suture abscess: if non-resorbable sutures like silk are left in place for a longer duration they may lead to stitch abscess. It managed by surgically by incision and drainage, along with medications.

ALTERNATIVES TO SUTURES

The following are some of the alternatives to sutures:

1. Staples
2. Tissue adhesive
3. Tape
4. Steri strips



Conclusion

Suture materials and suturing techniques should be carefully selected for a particular case. Inappropriate suturing may adversely hamper the healing process. All suturing principles should be followed during suture placement. Clinicians are encouraged to update their knowledge and skill in suture and suturing techniques in order to achieve success in wound closure and optimize healing.

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