



SUTURES AND WOUND CLOSURE TECHNIQUES

An Introductory Guide

MEDTRONIC SUPPORTING YOUR CLINICAL NEEDS WHILE OFFERING ECONOMIC VALUE



OUR STORY

At Medtronic, we're passionate about helping doctors, nurses, pharmacists, and other medical professionals be as effective as they can be.

Through ongoing collaboration with medical professionals and organizations, we identify clinical needs and translate them into proven products and procedures that yield positive results for life.

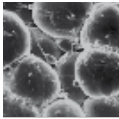
Offering an extensive product line that spans medical devices and medical supplies, we serve the healthcare needs of hospitals, long-term care and alternate care facilities, doctors' offices, and the home.

WHO WE ARE

Medtronic is part of the local fabric of the communities in which we operate. Deriving more than one-third of our sales from outside the United States, our success wouldn't be possible without the dedication of our 38,000 employees. More than two-thirds of our colleagues work in 41 manufacturing facilities in 17 countries. In addition, more than 4,000 sales representatives in more than 50 countries meet our customers' needs every day, and more than 2,000 employees are dedicated to the research and design of new products.



Liver



Morbid Obesity



Urology



Cardiovascular/
Vascular



Gynæcology



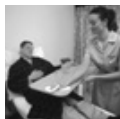
Upper
Gastrointestinal



Thoracic



Colorectal



Day Surgery

Sutures and Wound Closure Techniques

Introduction

This booklet is intended as an introductory guide to sutures and suturing techniques. Whilst sutures create conditions for primary healing, inappropriate selection and technique can have an adverse effect by increasing infection risk, impairing local circulation or causing further tissue injury.

The chapters of this booklet outline wound healing principles, suture classifications, needle types, knot tying, selection criteria and strength retention.

As a leading suture manufacturer, we hope this information will provide a valuable foundation to broaden your knowledge of sutures. Further educational support and training is available on request from your local Medtronic representative.



Wound Healing Principles

The object of all wound treatment is to enable the resulting scar to attain adequate strength. Minimal disturbance of tissue function is desired, and good cosmetic results are required. Injuries heal by either primary or secondary "intention."

Primary Healing

Healing by first intention occurs when wound surfaces are accurately brought together and healing proceeds without complications, with optimal cosmetic results.

Secondary Healing

Healing by second intention occurs when wound surfaces are not approximated but the wound is left open, as in the case of infected wounds. The wound is then filled with granulation tissue and a larger surface is finally covered by epithelium.

Normal Events of Healing

Healing begins at the moment of injury. Tissue and vessels are divided, blood is shed into the wound and haemostasis occurs. Blood supply at the point of injury is diminished by three basic mechanisms:

1. vascular spasm, which contracts the blood vessel walls
2. platelet plug formation
3. blood coagulation

Platelets are activated and release a series of factors that initiate healing, followed by inflammatory cells entering the wound.

In the next few days, macrophages collect, which are critical to repair, and are activated by contact with fibrin. The presence of the macrophages also stimulates collagen synthesis in fibroblasts.

Initially the collagen is deposited in a disorganised pattern, but from about the third week the network is rebuilt in a more organised way and better meets the stresses applied to the scar. Though a net loss of collagen usually results, wound strength continues to rise.

Wound Closure Alternatives

Skin Stapling

(Apose™/Royal™ skin staplers)

This is a relatively quick and easy method of wound closure. Skin staples promote good wound healing because there is less risk of tissue strangulation. They also produce excellent cosmetic results with a minimum of cross hatch scarring.

Tissue Adhesive

Skin adhesives are an easy alternative to sutures when closing easily approximated, low tension wound edges from surgical incisions and trauma induced lacerations. In addition to providing a microbial barrier and good cosmetic results, skin adhesives are a fast and cost-effective alternative to sutures.



Factors Influencing Healing

There are many prerequisites to repair and many ways to influence it in both positive and negative ways.

It is the blood that transports oxygen, nutrients, antibodies and many defensive cells to the site of injury. The blood also plays an important role in the removal of tissue fluid, blood cells that have been depleted of oxygen, bacteria, foreign bodies and debris. These elements would otherwise interfere with healing.

The state of the local circulation which provides required energy and nutrition is the major determinant of healing. Without an adequate local circulation, new vessels cannot grow, cells cannot divide and new collagen cannot grow across the gap. The local circulation can be impaired by poor suture technique and vasoconstriction and by cardiac, vascular or pulmonary disease.

The nutritional elements proved to be necessary for repair are listed in the table below; those which exert a large effect are marked.¹

Nutrition is vital in the healing process since a great demand is placed on the body's store of energy. Protein rich diets are important since most of the cell structure is made from proteins.

The rate of "normal" healing is highly variable and poorly defined. It depends largely upon perfusion and oxygenation. Well-perfused tissues (e.g., facial skin) heal most rapidly.

Age also affects healing. Tissues generally heal faster and leave less obvious scars in the young as they have better blood circulation, better nutritional status and faster cell duplication due to higher metabolic rates.

Sutures are used to bring the sides of a wound together to enable wound healing to take place.

NUTRITIONAL ELEMENTS NECESSARY FOR REPAIR

Oxygen¹

Amino acids (especially methionine, lysine, proline and arginine)

Vitamin A¹

Vitamin B¹

Vitamin B2

Vitamin B6

Vitamin C

Carbohydrates

Vitamin D

Zinc¹

Vitamin K

Iron, copper, manganese

1. Nutritional elements exerting a large effect

Suture Classification

Suture materials can be described in three ways, according to their structure, source and fate within the body.

Structure – Monofilament/Braided/Barbed

Source – Natural or Synthetic

Fate – Absorbable or Non-absorbable

The groups of sutures are shown facing on the product matrix of sutures. Modern standards of quality and performance mean natural monofilament sutures are seldom used.

Synthetic absorbable polymeric sutures are broken down by the process of hydrolysis. The by-products are completely metabolised and excreted via the urinary, digestive and respiratory systems.

Absorbable

These are sutures that are absorbed within the living tissue (in vivo). The two main characteristics of an absorbable suture are its tensile strength retention within the body and its absorption rate. With all absorbable sutures, strength is lost long before absorption takes place.

Non-absorbable

Many sutures classified as non-absorbable do in fact lose their tensile strength within a relatively short time. Silk, linen and even nylon all lose strength within the body. Examples of true non-absorbable sutures are polyesters, polyethylene, polybutester, polypropylene and steel.

Monofilament

These are sutures made of a single strand or filament. They are very smooth and pass easily through tissue, but they are often more difficult to handle, being less flexible than multifilaments.

Braided

These sutures are made by twisting or braiding several strands together. They are more flexible and easier to handle than monofilaments. Braided sutures pass less easily through tissue than smooth monofilaments and the resulting drag can cause tissue trauma. However, this drag is minimised by coating the braid.

Barbed

Barbed suture is an innovative product that supports optimal patient outcomes by closing wounds securely without the need to tie knots. It is manufactured by cutting into the core of a conventional monofilament suture. This process results in numerous anchoring points throughout the length of the strand, which approximates tissue and distributes tension throughout the length of the incision without a knot being tied.

Natural

Natural sutures are made from animal or plant material. They can elicit a pronounced tissue reaction caused by antigenic and pyrogenic responses, and their useful life in tissue varies from a few days for plain gut to several months for silk.

Synthetic

Sutures can be made by synthesising a wide variety of polymers. They cause less tissue reaction than natural fibres and are uniform and predictable in their performance. Because of this, the use of synthetic sutures is increasing whilst the use of natural sutures is declining.



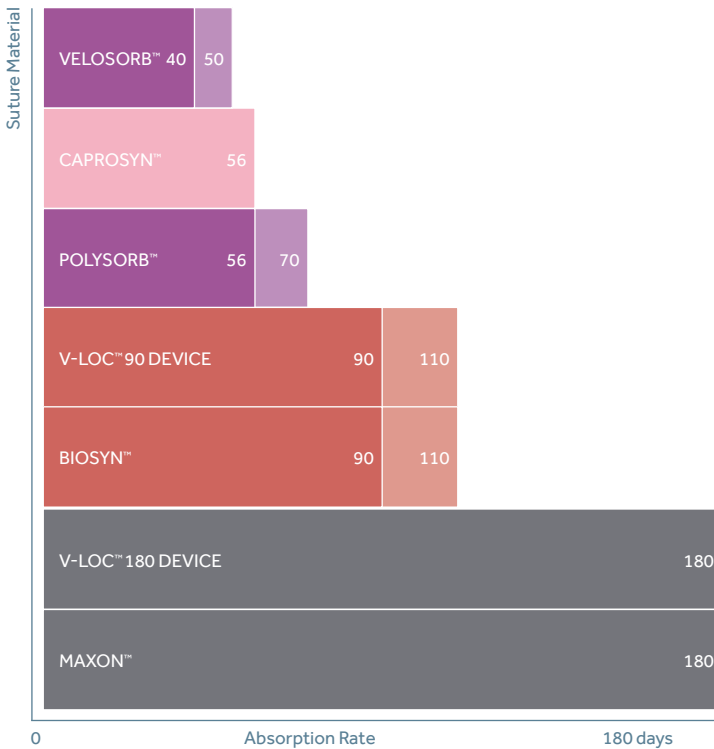
Absorption Rates

The rate at which a suture is absorbed by the body is dependent upon the material from which the suture is manufactured.

The modern synthetic absorbable sutures are broken down by the process of hydrolysis. This is not associated with a strong inflammatory process.

Absorption may be expressed as the time taken in days for a) minimal absorption to occur, b) complete absorption to occur.

SUTURE ABSORPTION RATES



Choice of Suture Material for Various Procedures







Obviously the same type or size of suture will not be appropriate for all procedures. The surgeon must select a suture based on his knowledge of the procedure, the expected holding power

of the tissue, tissue type, whether long-term approximation is required and any underlying patient complications that could compromise wound healing.

SUMMARY OF MEDTRONIC ABSORBABLE SUTURES AND THEIR FREQUENT USES

Suture	Material	Frequent uses
CAPROSYN™	Glycolide, caprolactone, trimethylene carbonate, lactide	Most procedures in which fast absorption of the suture is required, e.g., plastic surgery, gynaecology, subcuticular closure
VELOSORB™	Glycolide and lactide (with a tripolymer coating)	Most procedures in which fast absorption of suture is required, e.g., episiotomies, circumcisions, oral mucosa, subcuticular closure
POLYSORB™	Copolymer of glycolide and lactide (with a tripolymer coating)	Most procedures in which absorption of the suture is required, e.g., general surgery, orthopaedics, gynaecology, plastic surgery
V-LOC™ 90 DEVICE	Glycolide, dioxanone, trimethylene carbonate	Most procedures in which a short-term absorbable suture is preferred, e.g., plastic surgery, gynaecology, urology, orthopedic, general surgery
BIOSYN™	Glycolide, dioxanone, trimethylene carbonate	Most procedures in which eventual absorption of the suture is required, e.g., general surgery, bowel anastomosis, subcuticular closure, plastic surgery
V-LOC™ 180 DEVICE	Copolymer of glycolic acid and trimethylene carbonate	Most procedures in which a long-term absorbable suture is preferred, e.g., plastic surgery, gynaecology, urology, orthopedic, general surgery
MAXON™	Polyglyconate	Most procedures in which eventual absorption of the suture is required, e.g., general surgery, bowel anastomosis, general closure, subcuticular closure, plastic surgery

SUMMARY OF MEDTRONIC NON-ABSORBABLE SUTURES AND THEIR FREQUENT USES

Suture		Material	Frequent uses
NOVAFIL™		Polybutester	A&E department, plastic surgery, hand surgery, any specialty requiring skin closure
V-LOC™ PBT		Polybutester	Plastic surgery, general/bariatric surgery
DERMALON™ MONOSOF™		Polyamide (nylon)	Any specialty requiring skin closure, plastic surgery, general surgery, orthopaedics, ophthalmics, general closure
SURGIPRO™ II		Polypropylene	Cardiovascular, cardiac, general surgery, plastic surgery, gynaecology
TI-CRON™		Polyester-silicone coated	Cardiac surgery, sternal closure
SURGIDAC™		Polyester-silicone coated	Orthopaedics, ophthalmics
SOFSILK™		Siliconised proteinaceous silk thread	General surgery-ligatures, ophthalmology, plastic surgery
STAINLESS STEEL		Stainless steel	Sternal closure
FLEXON™		Stainless with TFE polymer coating	Cardiac pacing
VASCUFIL™		Polybutester coated with polytribolate	Cardiac surgery, vascular surgery
HERCULON™		Ultra-high-molecular-weight polyethylene	Orthopaedics



Sutures Sizes

Sutures come in various sizes depending on their usage. The sizes range from 7, the largest, to 11-0, as shown below.

Suture Size		Possible Surgical Use
Metric	USP	
0.1	11-0	Most frequently used in microsurgery/ ophthalmic surgery
0.2	10-0	
0.3	9-0	
0.4	8-0	
0.5	7-0	Most frequently used in plastic/cuticular surgery
0.7	6-0	
1.0	5-0	
1.5	4-0	Most frequently used in general closure obstetric/gynaecologic surgery
2.0	3-0	
3.0	2-0	
3.5	0	
4.0	1	
5.0	2	Most frequently used in retention
6.0	3	
6.0	4	
7.0	5	
8.0	6	
8.0	6	
9.0	7	

Tensile Strength Retention

Tensile strength retention is an indication of the strength of a suture in the body over a period of time, usually stated at 7, 14, 21, 28, and 35 days.

Two methods are used to assess the tensile strength of a suture, which will vary according to suture type and gauge.

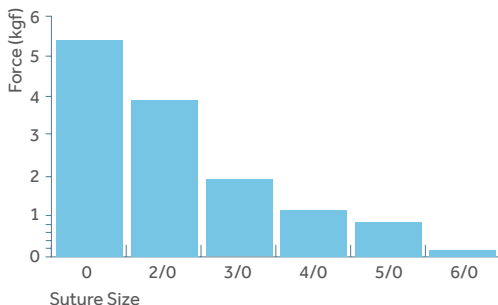
1. Straight-pull test.

This involves the straightforward pulling of the suture until it breaks. Measured using a tensiometer, the force (kgf) needed to break the suture is recorded. See below for a sample graph.

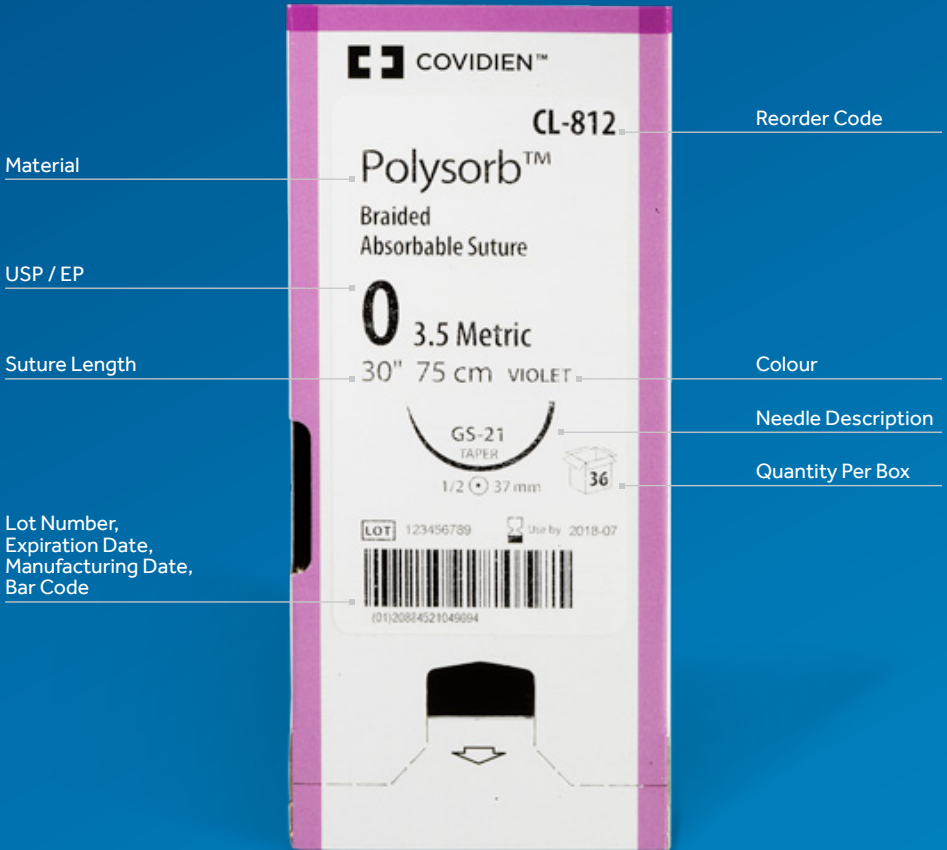
2. Knot-pull test.

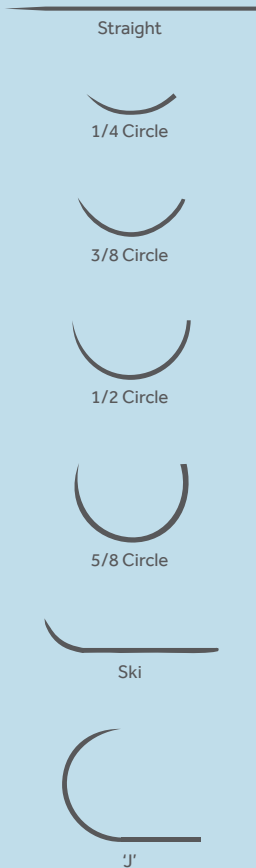
A surgeon's knot is tied in the suture and a pull test is carried out as above.

STRAIGHT-PULL TENSILE STRENGTH



How to Read a Suture Label





Surgical Needle Shapes

The function of a surgical needle is to guide a suture through tissue with the minimum amount of trauma.

Every surgical needle has three basic components:

1. Point
2. Body
3. Swage
(the area of attachment of the suture)

The point of the needle is selected depending on the tissue to be sutured. Cutting edges can be placed on the point to enable passage through tough tissues. The body of the needle is shaped.

The selection of shape is determined by the ease of access or the tissues to be sutured. The more confined the operative site, the greater the curvature required.

Needles may be coated with silicone to maintain their performance through tissue as long as possible. As this coating is gradually wiped off after multiple passes, the performance will deteriorate. Recent advances in manufacturing have enabled the coating to remain on the needle longer, prolonging the performance.










Swaged Surgical Needles

All Medtronic surgical needles are atraumatic. Special laser technology allows the suture to be connected on even the smallest of needles and provides a secure and smooth junction between the needle and suture. There is no need for the suture to be threaded through the eye of a needle.



POINT PROFILES

This is a cross-section view of how the points look.

Taper Point/ Round Bodied		<p>Round bodied needles are primarily used in suturing soft tissue. The smooth round body tapers to a fine sharp point which penetrates tissue without tearing or cutting. A flattened section along the shaft ensures stability in the needle holder.</p>
Diamond Point		<p>Particularly useful in certain vascular and cardiovascular indications for calcified tissues, the diamond point needle combines the advantages of a cutting needle and a round bodied needle. The diamond point needle, with its four cutting edges at the tip, penetrates even the toughest tissue, whilst the round bodied shaft enables the needle to be used in soft tissue without the danger of needle cut-out.</p>
Tapercutting		<p>Round bodied needle with a cutting edge that forms a 'Y' combines the advantages of a Taper Point needle with a cutting edge that allows penetrating tough and calcified tissues. Frequent uses for bronches, tendons, trachea, uterus and ligaments.</p>
Penetrating Taper		<p>The penetrating taper needle has cutting edges that forms a 'Y'. This ensures excellent cutting edges and has the advantage of a round body needle. For throughout calcified tissue as coronary, valve, ligaments, tendons, bronchus, trachea, uterus.</p>
Blunt Point		<p>This needle is specifically designed for fragile soft tissue, e.g., liver.</p>
Protect Point™		<p>The Protect Point™ needle is designed to protect against needle stick injury. It has a round body with a blunted point and has no cutting edges. Frequently used for fascia.</p>
Reverse Cutting		<p>To penetrate the toughest tissue, the reverse cutting needle has three effective cutting edges along the full length of its shaft. With its third cutting edge on the outer curvature of the needle, the reverse cutting is stronger and more resistant to bending. The needle cuts into the tissue away from the wound edges, minimising the danger of postoperative suture cut-out.</p>
Conventional Cutting		<p>Three effective cutting edges with the third cutting edge on the inside curvature which cuts towards the edge of the incision. Primarily used in general skin closure, subcutaneous tissue, sometimes for ligaments, sternum but also for ophthalmic surgery and plastic or reconstructive surgery.</p>
DermaX™		<p>The DermaX™ needle is a four-sided cutting edge plastic surgery needle that features a unique geometry and ultra sharp cutting edge. Because of its geometry, the needle also facilitates depth placement and precision control during sub-cuticular approximation.</p>
Slim Blade Reverse		<p>Placing fine sutures in tough tissue and producing good cosmetic cutting results demands special needles. The SBE, slim blade reverse cutting, and PRE, precision point reverse cutting needles are hand-honed to produce a fine triangular profile to minimise tissue trauma whilst maintaining strength and stability in the needle holder.</p>
Spatula Side Cutting		<p>Specifically designed for corneal and scleral layers, this spatula design gives a strong cutting tip that is very effective in splitting tissue layers without needle cut-out.</p>

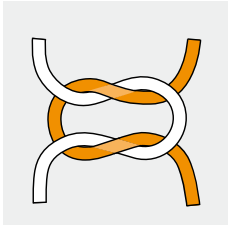
Knot Tying

There are a variety of methods of wound closure stitches, all of which have different applications, e.g., subcuticular stitch for skin closure and looped sutures for abdominal closure.

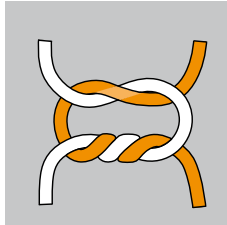
Whatever type of suturing is used, the knot is always the weakest part of a suture. It is therefore very important to tie an appropriate knot.

Knots can be tied by hand using one or two hands or using instrument holders. Below are diagrams showing a basic square knot using the instrument tie technique.

TYPES OF SURGICAL KNOTS



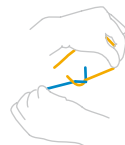
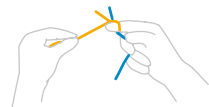
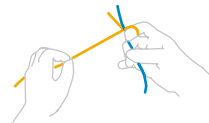
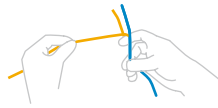
Square knot



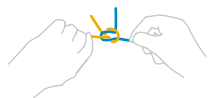
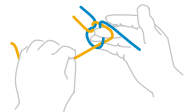
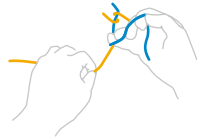
Surgeon's (or friction) knot

INSTRUMENT TIE TECHNIQUE

First Throw

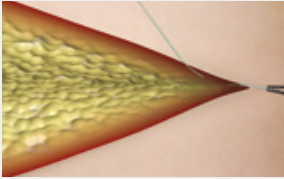


Second Throw

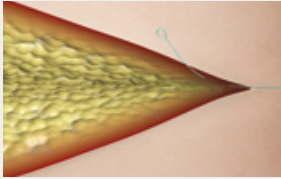


Using V-Loc™ Device

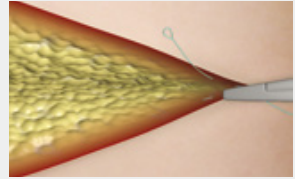
This step-by-step guide shows how the V-Loc™ device can be used for secure dermal wound closure with little or no adjustment to the surgeon's technique.



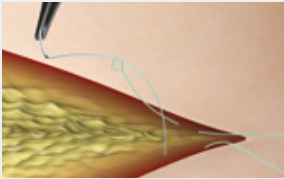
1. Begin the closure by taking a backward, split-thickness bite through the dermis, exiting at the commissure of the incision.



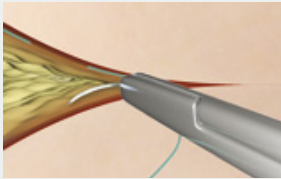
2. Exit the needle directly opposite the looped-end. Pull so that the looped-end is drawn into the dermis.



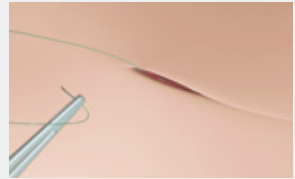
3. Take a single, forward split-thickness bite away from the commissure on the contralateral edge of the skin incision. The arc of the bite should be such that the needle exits the skin directly opposite the looped-end.



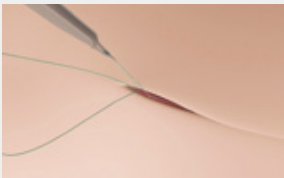
4. Pass the needle through the looped-end, applying gentle traction to carefully appose the skin edges.



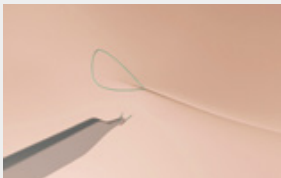
5. Beginning with a sinusoidal bite on the same side as the looped-end, close the skin incision in standard fashion with a continuous intradermal pattern. Take care not to pull too tightly as this will cause the incision to pucker and inhibit the release of tension.



6. Complete the wound closure. Take a bite so that the needle emerges at the terminal commissure of the incision.



7. Next take a single backward bite away from the commissure.



8. To anchor, pass the needle across the incision and take a split-thickness bite perpendicular to the incision and exit the skin.



9. While applying gentle traction, cut the V-Loc™ 180 device flush with the skin.



Medtronic

IMPORTANT: Please refer to the package insert for complete instructions, contraindications, warnings and precautions.
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