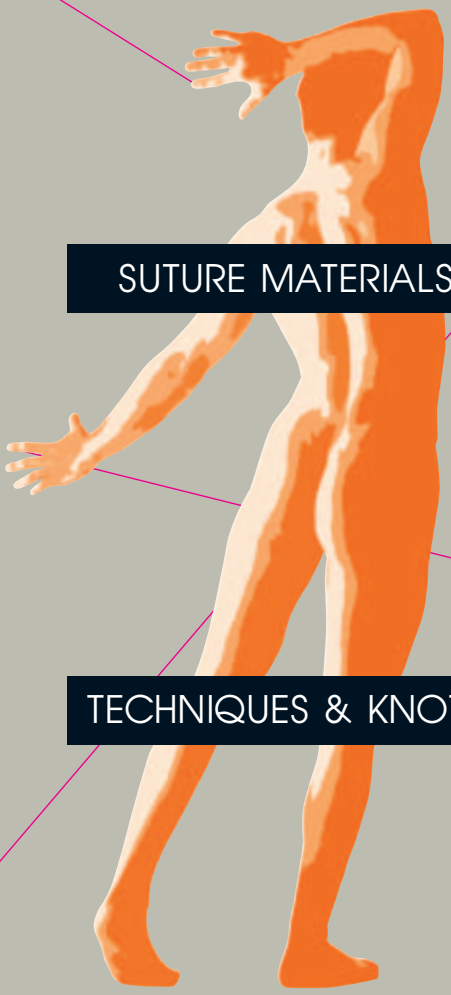
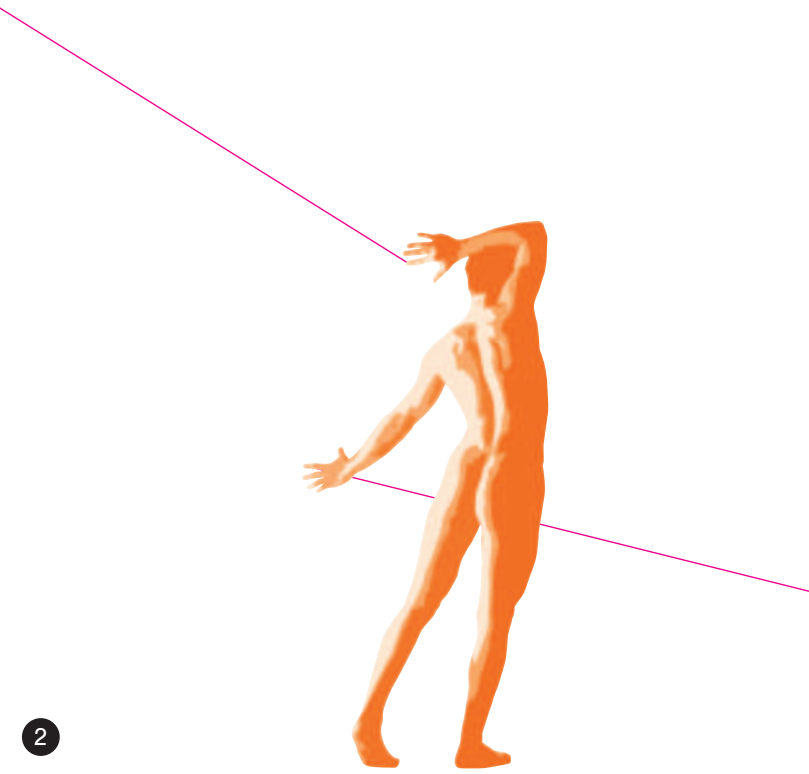
POCKET GUIDE TO



SUTURE MATERIALS

TECHNIQUES & KNOTS

SERAG WIESSNER



Pocket guide to suture materials

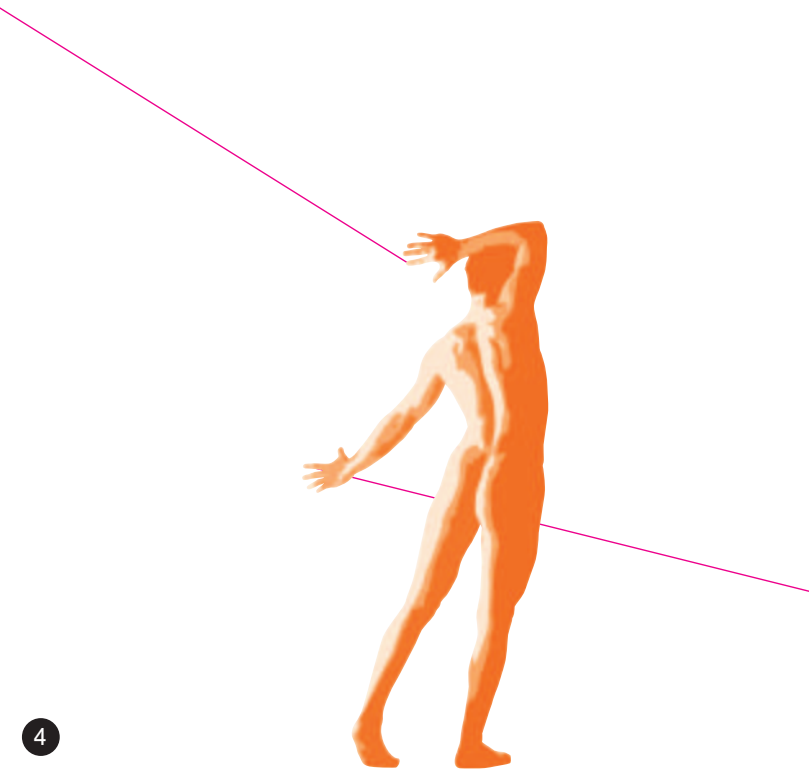
Suture materials are very closely related to surgery and have been throughout its history. Even with the introduction of alternative methods of wound closure such as strips and clips, suture materials are still of paramount importance. It is no exaggeration to claim that hardly any surgical procedure is performed without the use of suture material.

This booklet makes no claim to be an exhaustive review of the subject. As its title implies, it is intended as a handy and uncluttered guide for those working with surgical suture materials. As such, it has been deliberately designed to fit into any pocket.

Our guide to suture material is intended to provide the basis for a more detailed study of the subject and we hope that you find it useful. We are, of course, always grateful for any comments and suggestions.

Sincerely
Serag-Wiessner KG – Naila, Germany

4th revised edition



Contents

THE COMPANY

SERAG-WIESSNER is the longest established German manufacturer of surgical suture materials. In 1866 Carl Wiessner founded a gut string factory in Berlin. Industrial production of sterile catgut was started around 1900. Until that time sterilization had been carried out exclusively by hospitals. After 1945 the company moved to Northern Bavaria. SERAG-WIESSNER came into being via a merger with SERAG Catgutfabrik.

Today the company employs more than 200 people at its sole production site at Naila. In addition to surgical suture materials, SERAG-WIESSNER produces infusion solutions. The independence of this medium-sized, family-owned company has proved to be a major asset. Customers view SERAG-WIESSNER as a flexible and reliable company with short response times and clearly defined responsibilities.

SERAG WIESSNER

The manufacture of surgical suture materials is characterized by a combination of ultra-modern production techniques and a high proportion of manual work. At SERAG-WIESSNER, needle-thread combinations are produced and sterilized in clean rooms via state-of-the-art, computer-controlled techniques that comply with the most exacting international standards. At the same time, many production steps require the sensitive and reliable manual input of employees of many years' standing. In order to ensure constant high quality, SERAG-WIESSNER employs a certified quality management system that complies with international standards DIN EN ISO 9001 and DIN EN 46001 and with the European guideline for medical products. We implemented an environmental management system conforming to DIN EN 14001 to cover all ecological aspects of manufacture. The materials and manufacturing processes used are subject to constant external and internal monitoring. In our control laboratory, which is equipped with the latest measuring instruments and analytical tools, comprehensive checks and tests are performed exclusively by highly qualified specialist staff. SERAG-WIESSNER suture materials always incorporate the latest developments in research and technology.

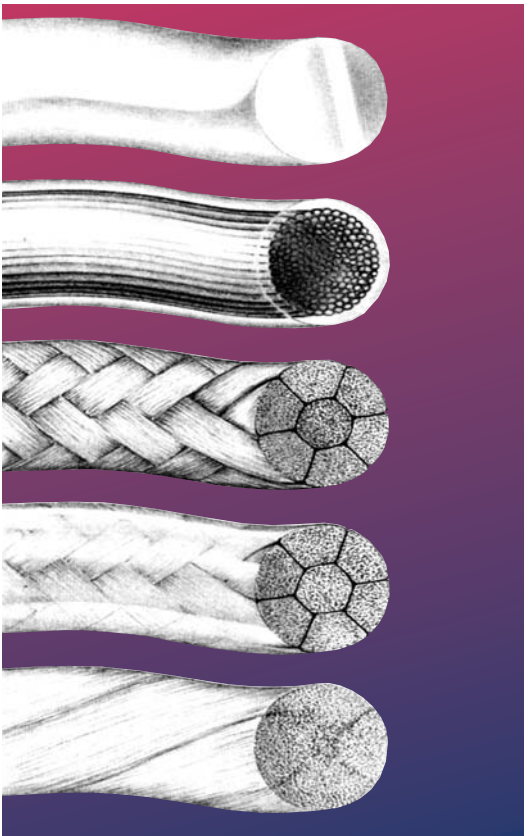
For further information about our company, we will be pleased to send you our corporate image brochure on request.

The history of suture material

The technique of closing wounds by means of needle and thread is several thousand years old. The history of surgical sutures can be traced back to ancient Egypt, and the literature of the classical period contains a number of descriptions of surgical techniques involving sutures.

Before catgut became the standard surgical suture material towards the end of the 19th century, many different paths had been followed to find a suitable material for sutures and ligatures. Materials that had been tried included gold, silver and steel wire, silk, linen, hemp, flax, tree bark, animal and human hair, bow-strings, and gut strings from sheep and goats.

At the beginning of the 19th century metal threads were tested as suture material. At that time inertness of a material with respect to body tissues was considered an advantage. Nevertheless, metal threads had major disadvantages: their stiffness rendered knot-tying more difficult and could easily result in knot breakage; in addition, suppuration of the wound edges occurred frequently.



These negative experiences with metal contributed to the establishment of silk as the number one suture material. Wounds sewn with silk cicatrized within a few days, and the small knot caused no problems. For these reasons most surgeons at that time chose silk for sutures and vessel ligatures.

A fundamental change in the assessment of suture materials followed the publication in 1867 of Lister's research on the prevention of wound suppuration. On the basis of work by Koch and Pasteur, Lister concluded that wound suppuration could be prevented by disinfecting sutures, dressings, and instruments with carbolic acid. Initially Lister used silk as a suture material, on the assumption that it was absorbable and therefore could also be used for ligatures. Later he searched for a more rapidly absorbable material and consequently began to use catgut.

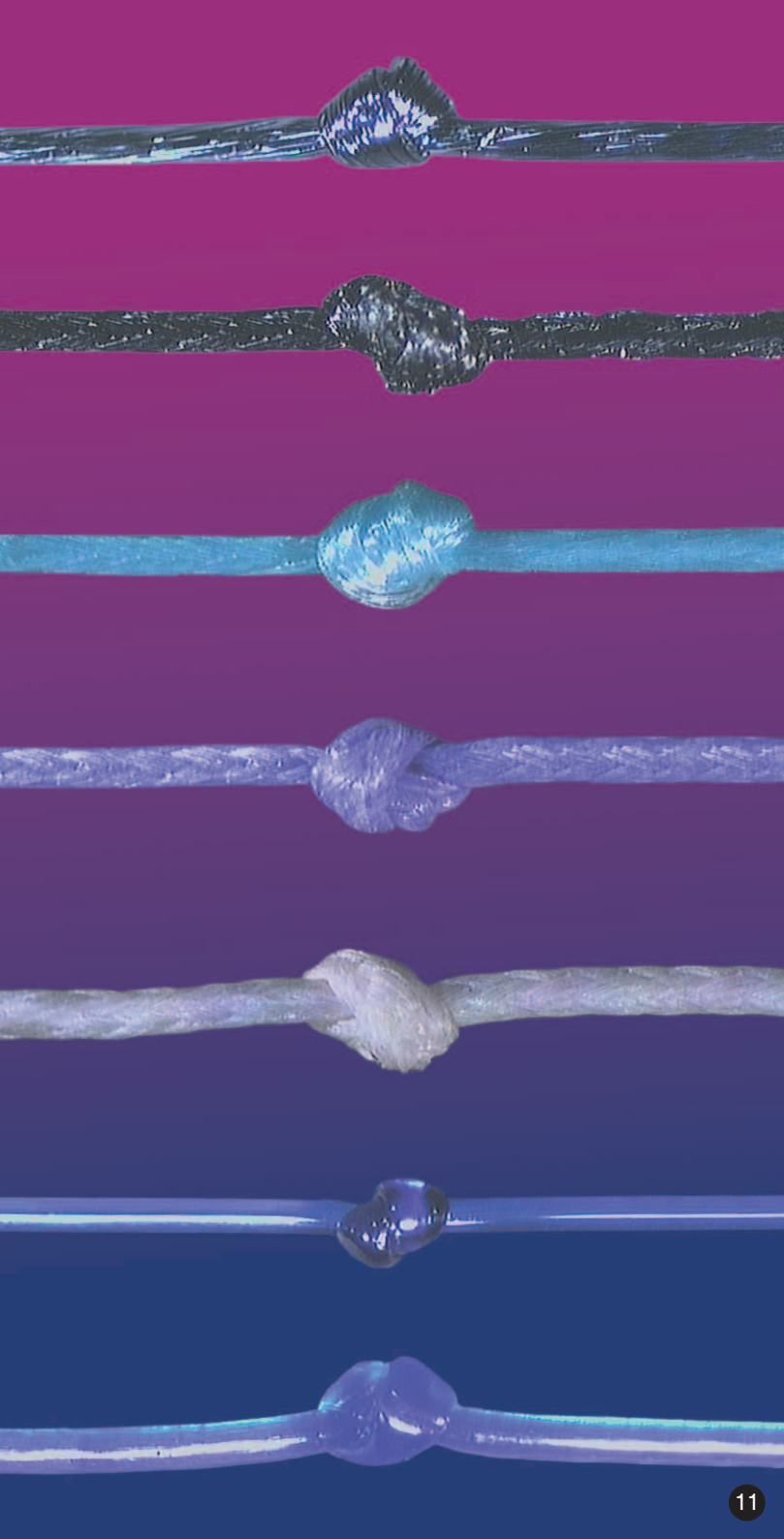
Catgut is produced from animal connective tissue, in particular bovine subserosa. Over the years it gradually emerged that animals born and bred in South America were most suitable because they had the lowest fat content thanks to their natural husbandry conditions.

The use of catgut was never called into question until the appearance of BSE at the beginning of the 21st century.

Alternative products had already been developed by this time. These are the synthetically manufactured absorbable suture materials which have largely superseded catgut in Europe. However, catgut continues to play a major role in woundcare world-wide.

A wide variety of sterilization methods have been tested at various times. Nowadays sutures are mostly sterilized by ethylene oxide or gamma irradiation.

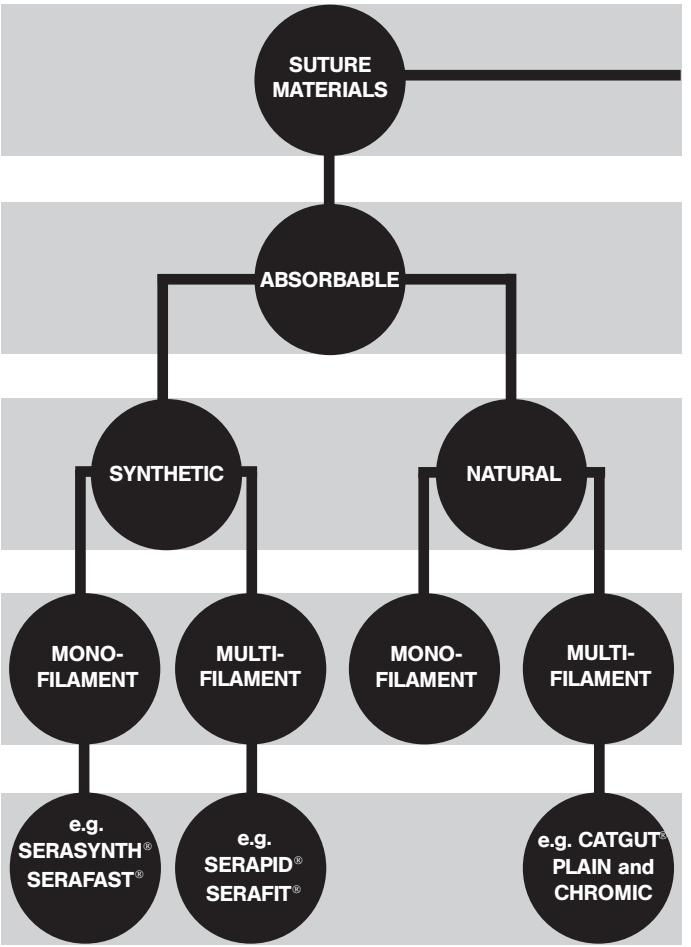
In response to the requirements of modern surgery and thanks to the efforts of users and manufacturers over the last few decades, a wide variety of sutures have now been developed.

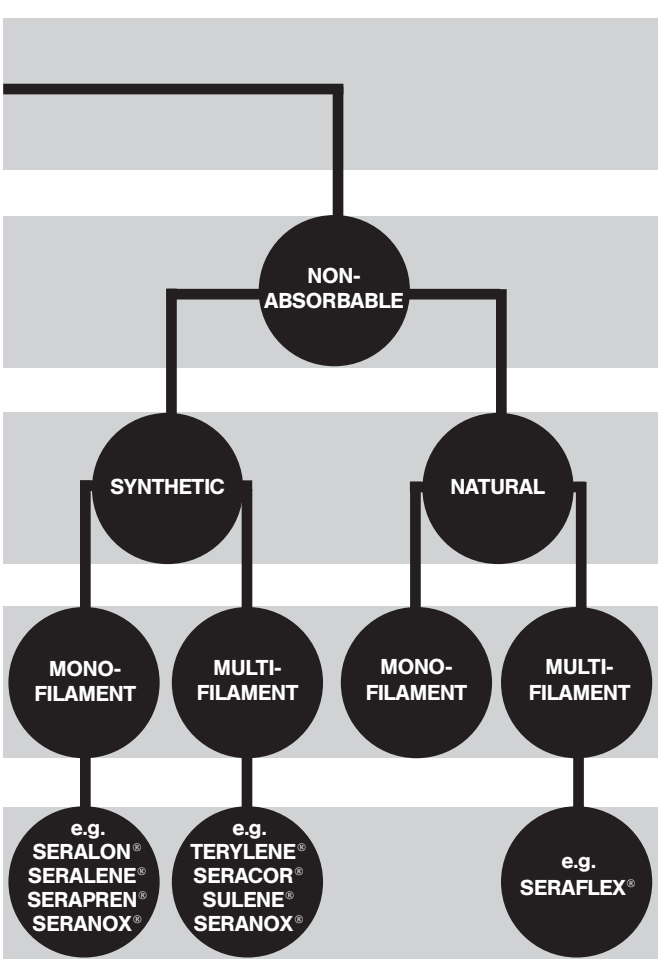


Types of threads

Classification of material

Surgical suture material can be classified on the basis of the characteristics absorbability, origin of material and thread structure. This is illustrated by the following diagram.




NON-
ABSORBABLE
SYNTHETIC
NATURAL
MONO-
FILAMENT
MULTI-
FILAMENT
MONO-
FILAMENT
MULTI-
FILAMENT
e.g.
SERALON®
SERALENE®
SERAPREN®
SERANOX®
e.g.
TERYLENE®
SERACOR®
SULENE®
SERANOX®
e.g.
SERAFLEX®

Absorbability

An important differentiating characteristic of suture material is its absorbability in human tissue. Suture material can be classified as absorbable or nonabsorbable.

Absorption can occur enzymatically, as with catgut, or hydrolytically, as with the absorbable synthetic polymers. An important measure of absorbability is the absorption time or half-life, which is defined as the time required for the tensile strength of a material to be reduced to half its original value. Dissolution time is the time that elapses before a thread is completely dissolved. These times are influenced by a large number of factors including thread thickness, type of tissue, and, not least, the general condition of the patient.

The most important absorption and dissolution times are shown in the following table:

Approximate absorption times of synthetic suture materials

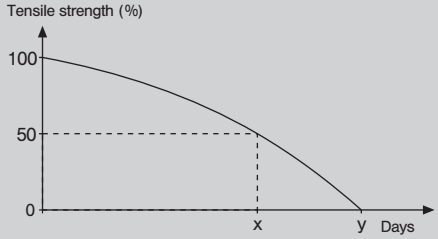
Material	Half-life (days)	Dissolution time (days)
Serapid®	6 - 8	30 - 42
Serafit®	15 - 20	60 - 90
Serasynth®	28 - 42	180 - 210

Origin of material

Suture materials can be classified as being of natural or synthetic origin. The former include silk and catgut. The other main group of suture materials are those produced from synthetic polymers such as polyamide, polyolefines and polyesters. This group also includes absorbable polymers derived from polyglycolic acid.

Absorption

absorbable sutures



x = half-value

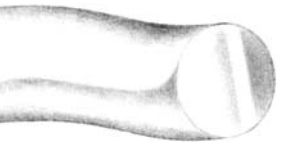
Period in which a 50 % loss of tensile strength occurs.

y = dissolution time

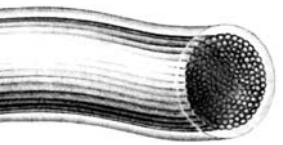
Period in which the suture totally dissolves.

Thread structure

Monofilament and multifilament thread structures are distinguished.



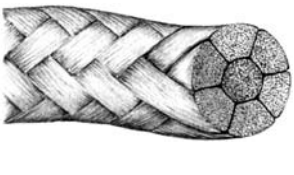
monofilament



multifilament with coating

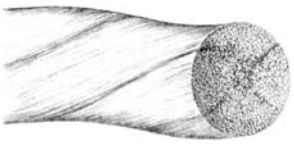
Monofilament threads

Synthetic monofilament threads are produced by a special extrusion process in which molten plastic is extruded under high pressure through fine spinnerets. The monofilament structure is used mostly for thinner threads. With thicker threads the wiriness that is a characteristic of all monofilament threads impairs handling and in particular renders knot-tying more difficult. Because of their smooth, closed surface and completely closed interior, monofilament threads have no capillarity. On the other hand, the ease with which they pass through tissue is unsurpassed.



multifilament, braided

multifilament, braided and coated



multifilament, twisted

Multifilament threads

Multifilament threads are composed of many fine individual threads either twisted or braided together. The direction of the twist is generally right-handed. Twisted multifilament threads include e.g. silk threads. All twisted threads show considerable variation in diameter. Their surface is mostly rough. The longitudinal orientation of the individual filaments within the thread results in relatively high capillarity. In braided threads the individual filaments lie more or less obliquely to the longitudinal axis of the thread. This tends to impede the passage of fluid. The capillarity of braided threads is therefore less than that of twisted threads. Multifilament threads have a rough surface that impairs passage through tissue but results in considerably better knotholding security. Multifilament threads are generally coated. The coating smoothes out the irregular surface and thus facilitates passage through tissue without impairing knot-holding security. Coated multifilament threads are less stiff and wiry than monofilament threads. The coating also reduces capillarity.

Classification of suture material

Size table
Non-absorbable sutures and absorbable synthetic multifilaments

EP (metric)	USP	Ø in mm
0,01	12-0	0,001–0,004
0,05	–	0,005–0,009
0,1	11-0	0,010–0,019
0,2	10-0	0,020–0,029
0,3	9-0	0,030–0,039
0,4	8-0	0,040–0,049
0,5	7-0	0,050–0,069
0,7	6-0	0,070–0,099
1	5-0	0,100–0,149
1,5	4-0	0,150–0,199
2	3-0	0,200–0,249
2,5	–	0,250–0,299
3	2-0	0,300–0,349
3,5	0	0,350–0,399
4	1	0,400–0,499
5	2	0,500–0,599
6	3+4	0,600–0,699
7	5	0,700–0,799
8	6	0,800–0,899
9	7	0,900–0,999
10	8	1,000–1,099
–	9	1,100–1,199
–	10	1,200–1,299

The tensile strength and knot-tying properties of a surgical suture material are determined not only by the starting material and structure, but also by the thickness of the thread. Classification of thread size must therefore be precise. Within the purview of the European Pharmacopoeia (EP), suture size is classified according to a decimal system. This denotes the diameter of the suture as a multiple of 0.1 mm.

Classification of suture material

Size table
Absorbable synthetic monofilaments

EP (metric)		USP	
EP (metric)	Ø in mm	USP	Ø in mm
–	–	12-0	0,001–0,009
–	–	11-0	0,010–0,019
–	–	10-0	0,020–0,029
–	–	9-0	0,030–0,039
–	–	8-0	0,040–0,049
–	–	7-0	0,050–0,069
0,5	0,050–0,094	6-0	0,070–0,099
0,7	0,095–0,149	5-0	0,100–0,149
1	0,150–0,199	4-0	0,150–0,199
1,5	0,200–0,249	3-0	0,200–0,249
2	0,250–0,339	2-0	0,300–0,339
3	0,340–0,399	0	0,350–0,399
3,5	0,400–0,499	1	0,400–0,499
4	0,500–0,570	2	0,500–0,599
5	0,571–0,610	3+4	0,600–0,699
–	–	5	0,700–0,799

Unlike the earlier DAB 6 and USP codes, the new metric code is directly related to the actual diameter of the suture (e.g. EP 3 = 3 x 0.1 mm = 0.3 mm). As the USP system is still commonly used, it is shown in the above table for comparison.

INTERNATIONAL LABELLING SYMBOLS

The European suture material manufacturers worked together to harmonise the symbols given below, which habe appeared on labels and suture holders since 2004:

Absorbable suture material


Surgical suture, absorbable, braided, coated, dyed
e.g. SERAFIT violet


Surgical suture, absorbable, monofilament, dyed
e.g. SERASYNTH


Surgical suture, absorbable, braided coated, undyed
e.g. SERAFIT undyed, SERAPID undyed


Surgical suture, absorbable, monofilament, undyed
e.g. SERAFAST

Non-absorbable suture material


Surgical suture, non-absorbable, braided,
coated, dyed
e.g. TERYLENE green, SULENE green,
SERACOR green, SERAFLEX black


Surgical suture, non-absorbable, braided, dyed


Surgical suture, non-absorbable, twisted, coated, dyed
e.g. SUPRAMID black (USP 4/0 and stronger)


Surgical suture, non-absorbable, twisted, dyed
e.g. SERAFLEX blue


Surgical suture, non-absorbable, monofilament, dyed
e.g. SERAPREN blue, SERALENE blue, SERALON blue, NYLON black, SUPRAMID black (USP 5/0 and finer)


Surgical suture, non-absorbable, monofilament, coated, dyed


Surgical suture, non-absorbable, braided, coated, undyed
e.g. TERYLENE undyed, SERACOR undyed, SERAFLEX undyed


Surgical suture, non-absorbable, braided, undyed
e.g. POLYESTER TAPE undyed


Surgical suture, non-absorbable, twisted, coated, undyed
e.g. SUPRAMID undyed (USP 4/0 and stronger), SERANOX multifilament


Surgical suture, non-absorbable, twisted, undyed
e.g. SERANOX multifilament


Surgical suture, non-absorbable, monofilament, undyed
e.g. SERALON undyed, SERANOX monofilament, SUPRAMID undyed (USP 5/0 and finer)

Needles

Anti-reflective needle

Detachable needle

Basic material of the thread

PA	Polyamide
PDO	Polydioxanone
PET	Polyester
PGACL	Polyglycolic acid-caprolactone
PGA	Polyglycolic acid
PP	Polypropylene
PVDF	Polyvinylidene Fluoride
SILK	Silk
STEEL	Steel

Further symbols on page 48
Needle abbreviations are explained on page 39

SERAFIT® / SERAFIT S®

Material	PGA Polyglycolic acid
Symbol	 VIOLET MULTIFILAMENT (braided) COATED or  UNDYED MULTIFILAMENT (braided) COATED
Size	USP 8/0 to 5 (undyed 6/0 to 2) EP 0,4 to 7 (undyed 0,7 to 5)
Absorption profile	50% tensile strength after ~ 18 days 0% after 60–90 days

Available combinations

Unneedled	Single sutures / multipacks / cassette packs
Needled	DR, DRN, DS, DSL, DSS, FRX, GR, GS, HR, HRT, HRX, HS Single sutures / multipacks Large range of special MIS combinations
Advantages	· good knot stability · outstanding suppleness · minimal saw effect
Uses	Ligatures / dermatology / gastroenterology / gynaecology / MIS / oral and maxillofacial surgery / ophthalmology / urology / veterinary medicine

SERAPID®

Material	PGA Polyglycolic acid
Symbol	 UNDYED MULTIFILAMENT (braided) COATED
Size	USP 6/0 to 2 EP 0,7 to 5
Absorption profile	50% tensile strength after 5–7 days 0% after 42 days

Available combinations

Unneedled	Multipacks
Needled	DR / DS / DSS / FRX / GR / GS / HR / HRN / HRT / HRX / HS / KS Single sutures / multipacks
Advantages	· high knot-pull tensile strength · easy knot gliding · optimal tissue passage
Uses	ENT / gynaecology / paediatric surgery / oral and maxillofacial surgery / plastic surgery / urology

SERAFAST®

Material	PGACL Polyglycolic acid-caprolactone
Symbol	 UNDYED MONOFILAMENT
Size	USP 5/0 to 2/0 EP 1 to 3
Absorption profile	50% tensile strength after 8–13 days 0% after 90–120 days

Available combinations

Unneedled	Multipacks
Needled	DS / DSS / HR Single sutures
Advantages	· unsurpassed handling · outstanding tissue sliding ability · optimal absorption profile
Uses	Ligatures / dermatology / plastic surgery / urology / gynaecology / skin closure

SERASYNTH®

Material	PDO Polydioxanone
Symbol	UNDYED MONOFILAMENT or VIOLET MONOFILAMENT
Size	USP 7/0 to 2 (undyed 6/0 to 2/0) EP 0,5 to 5 (undyed 0,7 to 3)
Absorption profile	50% tensile strength after 28–42 days 0% after 180–210 days

Available combinations

Unneedled	Single sutures / multipacks
Needled	DR / DS / DSS / GR / GS / HR / HRT / HRX / HS Single sutures / multipacks
Advantages	· outstanding sliding ability · high linear and knot-pull tensile strength · very supple handling · reliable absorption behaviour
Uses	Ligatures / dermatology / vascular surgery / orthopaedics / plastic surgery / urology

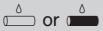
SERALON® / NYLON

Material	PA Polyamid
Symbol	 BLUE (SERALON®) BLACK (NYLON) MONOFILAMENT or  UNDYED (SERALON®) MONOFILAMENT
Size	SERALON®: USP 7/0 to 3+4 EP 0,5 to 6 NYLON: USP 11/0 to 8/0 EP 0,1 to 0,4
Absorption profile	non-absorbable

Available combinations

Unneedled	Single sutures / multipacks / cassette packs
Needled	DR / DRT / DS / DSS / DSX / GR / GS / HR / HRT / HRX / HS / KS / VSP Single sutures / multipacks
Advantages	· best skin suture material · outstanding sliding ability · very high linear and knot-pull tensile strength with finde thread · very pleasant handling · economical large packs
Uses	Ligatures / general surgery / orthopaedics / plastic surgery

SUPRAMID

Material	PA Polyamide
Symbol	 BLACK MULTIFILAMENT (twisted) COATED or  UNDYED MULTIFILAMENT (twisted) COATED USP 5/0 and finer:  or
Size	USP 6/0 to 6 (undyed 5/0 to 6) EP 0,7 to 8 (undyed 0,5 to 8)
Absorption profile	non-absorbable

Available combinations

Unneedled	Single sutures multipacks / cassette packs
Needled	DR / DS / DSF / DSS / FRX / GR / HR / HRT / HS / VSP Single sutures / multipacks
Advantages	· excellent knot stability · outstanding sliding ability · high linear and knot-pull tensile strength · economical large packs
Uses	Ligatures / general surgery / oral and maxillofacial surgery / skin closure

TERYLENE

Material	PET Polyester
Symbol	GREEN MULTIFILAMENT (braided) COATED or UNDYED MULTIFILAMENT (braided) COATED
Size	USP 7/0 to 5 (undyed 6/0 to 6) EP 0,5 to 7 (undyed 0,7 to 7)
Absorption profile	non-absorbable

Available combinations

Unneedled	Single sutures / multipacks / cassette packs
Needled	DR / DRT / DS / DSS / FRX / GR / GS / HR / HRN / HRT / HRX / HS / KS / LR / VSP Single sutures / multipacks
Advantages	· universal suture material · outstanding sliding ability · very high linear and knot-pull tensile strength · very pleasant handling · economical large packs
Uses	Ligatures / holding sutures / marking / universal use

SULENE®

Material	PET Polyester
Symbol	GREEN MULTIFILAMENT (braided) COATED
Size	USP 6/0 to 5 EP 0,7 to 7
Absorption profile	non-absorbable
Available combinations	
Unneedled	Single sutures / multipacks / cassette packs
Needled	DR / DS / DSS / FRX / GR / HR / HRT / HRX / HS / KS Single sutures / multipacks
Advantages	· universal suture material · optimal sliding ability · very high linear and knot-pull tensile strength · economical large packs
Uses	Ligatures / holding sutures / marking / MIS / universal use

SERACOR®

Material	PET Polyester
Symbol	 GREEN MULTIFILAMENT (braided) COATED or  UNDYED MULTIFILAMENT (braided) COATED
Size	USP 6/0 to 1 (undyed 6/0 to 0) EP 0,7 to 4 (undyed 0,7 to 3,5)
Absorption profile	non-absorbable

Available combinations

Needled	DRT / HR / HRT Single sutures / multipacks with and without pledgets
Advantages	· special suture material for cardiac surgery · oval pledgets for simple, secure placement · outstanding tissue tolerability
Uses	Cardiac surgery Special heart valve sutures, also for paediatric cardidac surgery with small pledgets

SERAPREN®

Material	PP Polypropylene
Symbol	BLUE MONOFILAMENT
Size	USP 10/0 to 1 EP 0,2 to 4
Absorption profile	non-absorbable

Available combinations

Needled	DR / DRM / DRT / DS / DSL / DSS / HR / HRT / HRX / HSL / VSP Single sutures / multipacks / long pack / intracutaneous sutures
Advantages	· best results for skin wound closure · very high tensile strength · high knot stability · outstanding tissue tolerability · long pack minimises memory effect
Uses	Ligatures / vascular surgery / microsurgery / orthopaedics / plastic surgery

SERALENE®

Material	PVDF Polyvinylidene Fluoride
Symbol	 BLUE MONOFILAMENT
Size	USP 10/0 to 1 EP 0,2 to 4
Absorption profile	non-absorbable

Available combinations

Needled	DR / DRM / DRT / DS / DSS / FRX / GR / GS / HR / HRT / HRX / HS / KS / LR Single sutures / multipacks Award-winning long pack
Advantages	· sustained tensile strength · high knot stability · scarcely any memory effect after stretching · best results in vascular surgery
Uses	Ligatures / vascular surgery / microsurgery / plastic surgery

SERAFLEX®

Material	SILK Silk
Symbol	 BLACK (until size USP 7/0) MULTIFILAMENT (braided) COATED or  UNDYED MULTIFILAMENT (braided) COATED or  BLUE (from size USP 8/0 on) MULTIFILAMENT (twisted)
Size	USP 8/0 to 5 EP 0,4 to 7
Absorption profile	non-absorbable

Available combinations

Unneedled	Single sutures / multipacks / cassette packs
Needled	DR / DRT / DS / DSL / DSS / DSX / GR / GS / HR / HRT / HRX / HS / HSM / KS / VSP Single sutures / multipacks
Advantages	· high knot stability · outstanding sliding ability · very pleasant handling · economical large packs
Uses	Ligatures / holding sutures / marking / oral and maxillofacial surgery / ophthalmology

SERANOX®

Material	STEEL STEEL
Symbol	MULTIFILAMENT (twisted) or MULTIFILAMENT (twisted) COATED MONOFILAMENT
Size	USP 5/0 to 8 EP 1 to 10
Absorption profile	non-absorbable

Available combinations

Unneedled	Single sutures / multipacks
Needled	DS / GR / GS / HRK / HRT / HS Single sutures / multipacks / long packs Special combinations for trauma surgery and cardiac surgery
Advantages	· highest tensile strength · various accessories available · with special needles for sternal closure
Uses	Cardiac surgery (sternum) / orthopaedics / trauma surgery

Steel quality for needles

Today it can be assumed that, at least with respect to European manufacturers, stainless steel (i.e. non-rusting steel) needles are generally used for surgical suture materials.

The following groups of stainless steel are used for the needles:

- 420 steel: standard quality steel, martensitic, low ductility, low bending strength
- 455 steel: better 400 quality steel, martensitic, higher ductility, higher bending strength
- 300 steel: best quality steel, austenitic, highest ductility, highest bending strength, frequently offered exclusively for cardiovascular surgery; used by SERAG-WIESSNER for nearly all suture materials.

Reference values for comparison

Type of needle	Steel quality	Ductility [illegible]	Ductility [number of 180° movements]	Bending strength [N]
HR-22	420 455 300	90 300 700	0 2 4	3.6 3.6 6.4
HR-26	420 455 300	80 400 500	0 2 3	4.3 5.0 6.0
HR-36	420 455 300	100 400 700	0 2 4	5.3 5.9 6.6

Comments:

- The penetration force of a needle depends in the first line on its shape and the polished and etched microsection of the tip, and less on the quality of the steel
- Ductility: how often a needle can be bent back and forth before it breaks
- Austenite: microstructure of steel. Austenitic microstructure is face-centred cubic, forms at high temperatures above approx. 1300°C and only remains stable at these temperatures. The addition of alloy components such as nickel and manganese, however, maintains this structure at room temperature.
- Martensite: microstructure of steel. Martensitic microstructure forms at high temperatures. It is extremely hard and the structure can be maintained by rapid cooling (“quenching”).

Needles

In addition to the thread, the needle is an essential component of sutures. In the classical procedure, a non-needled suture is fitted with a spring eye or regular eye surgical needle by the user only at the time of use. Nowadays, atraumatic sutures are widely used.

Atraumatic Needles

Atraumatic sutures are defined as needle-suture combinations, where the needle is firmly attached to the suture in order to reduce tissue trauma. Combined with our suture threads our customers are offered a wide choice of atraumatic needles. These stainless steel needles of high bending resistance and outstanding penetration capacity permit a safe and easy work. The designations of our atraumatic needles consist of a letter-number combination as per suggestion of the Technical Commitee of the Association of Manufacturers of Surgical Sutures. The first letter indicates the needle shape, the second letter indicates the needle type. If a third or fourth letter follows, these refer to special characteristics of the needle. The number after the letters indicates the overall length of the needle in mm.

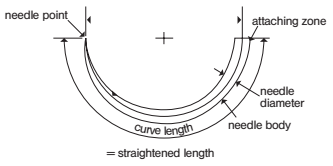
Needle shape
A = fish-hook-shaped
D = 3/8 circle
F = 5/8 circle
G = straight
H = 1/2 circle
K = semi-curved
L = spoon-shaped
V = 1/4 circle

Needle type
R = round-bodied
S = reverse cutting

Special characteristics
A = asymptotic
F = slim needle
L = lancet point
M = micro point
N = blunt, round-bodied
S = slim
SP = spatula needle
T = trocar needle
X = extra strong
K = short inlying blade

Examples

DSS 15	D	3/8 circle
	S	reverse cutting
	S	slim
	15	15 mm long (straigthened length)
DS 18	D	3/8 circle
	S	reverse cutting
	18	18 mm long (straigthened length)
HRX 22	H	1/2 circle
	R	round-bodied
	X	extra strong
	22	22 mm long (straighthened length)

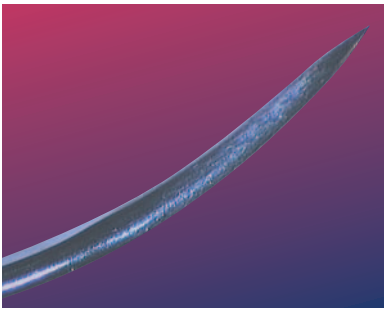


NEEDLE OVERVIEW Atraumatic needles

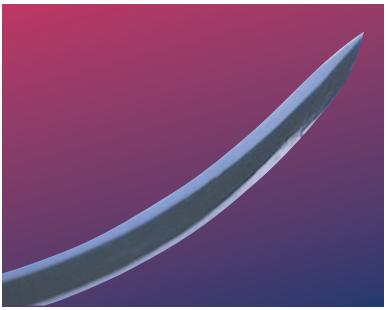
DR		3/8 circle, round-bodied needle, e.g. DR-25
DRM		3/8 circle, round-bodied needle with micro-point, e.g. DRM-6
DRT		3/8 circle, round-bodied needle with trocar point, (trocar needle), e.g. DRT-26
DS		3/8 circle, reverse cutting needle, e.g. DS-25
DSL		3/8 circle, cutting needle with lancet point, e.g. DSL-6
DSLA		3/8 circle, cutting needle with lancet point, asymptotic, e.g. DSLA-4
DSMF		3/8 circle needle with micro-point fine needle, e.g. DSMF-18
DSS		3/8 circle, reverse cutting needle, special point, slim, e.g. DSS-24
FRN		5/8 circle, round-bodied, blunt, e.g. FRN-27
FRX		5/8 circle, round-bodied needle (extra strong needle), e.g. FRX-27
GR		straight, round-bodied needle, e.g. GR-20
GS		straight, reverse cutting needle, e.g. GS-20

HR		1/2 circle, round-bodied needle, e.g. HR-26
HRK		1/2 circle, round-bodied needle, short inlying blade, e.g. HRK-48
HRT		1/2 circle, round-bodied needle with trocar point (trocar needle), e.g. HRT-26
HRX		1/2 circle, round-bodied needle (extra strong needle), e.g. HRX-25
HS		1/2 circle, reverse cutting needle, e.g. HS-25
HSL		1/2 circle, cutting needle with lancet point, e.g. HSL-5
HSM		1/2 circle, cutting needle with micro point, e.g. HSM-8
HSP		1/2 circle, spatula needle, e.g. HSP-9
HSX		1/2 circle, reverse cutting needle (extra strong needle), e.g. HSX-25
KS		semicurved, reverse cutting needle, e.g. KS-22
LR		spoon-shaped, round-bodied needle, e.g. LR-25
VSP		1/4 circle, spatula needle, e.g. VSP-8

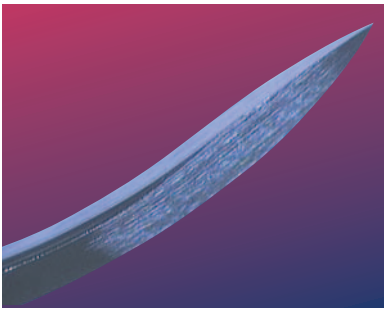
without picture DRX, DSF, DSX, HRM



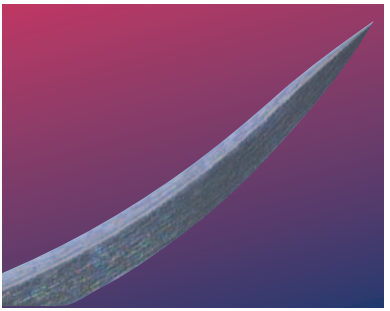
round-bodied needle



round-bodied needle with trocar point



reverse cutting needle



reverse cutting needle, special point, slim

Spring eye surgical needles
Spring eye surgical needles are made of 300-series stainless steel. This generation of needles is characterised by optimum resistance to bending, the best possible ductility and outstanding tissue penetration. This guarantees safe and simple working conditions.

Like our atraumatic needles, our spring eye needles are designated by a letter-number combination. The needle codes thus correspond to those of the atraumatic needles.

Spring eye

Recommendations for the selection of suture material

Only recommendations

Field of Surgery	Organ/Tissue	Suture Material/ Product
General surgery	skin	Seralon®, Serapren®, Seralene, Supramid Serafast
	vessel ligation ligature	Serafit®
	fascia	Serafit® Serasynth
	closure of abdominal wall	Serafit® Serasynth
Gastroenterology	hernia repair	Serapren®, Seralene Seramesh
	stomach and small intestine	Serafit®
	large intestine	Serafit®
	biliary ducts	Serafit®
	peritoneum	Serafit®
Cardiac surgery	heart valves	Seracor®
	coronary arteries	Serapren® Seralene®
Vascular surgery	blood vessels	Serapren®, Seralene
Plastic surgery	skin	Seralon®, Serapren®, Seralene, Serafit®, Serapid®, Serafast
Microsurgery	blood vessels	Nylon, Serapren®, Seralene®
	nerves	Serapren®, Seralene®

Size		Needles
EP	USP	
1-3	5/0-2/0	DSS, DS
1-3	5/0-2/0	non-needled
1,5-3,5	4/0-0	HS, HR, HRX
3-3,5	2/0-0	HR
2-3	3/0-2/0	HR
1,5-3	4/0-2/0	HR, DR
1,5-2	4/0-3/0	HR
1,5-3	4/0-2/0	HR
1-2	5/0-3/0	HR
1,5-3	4/0-2/0	HR, HRT
0,5-1	7/0-5/0	DR
0,5-2	7/0-3/0	DR, DRM DRT, HR, HRT
0,7-1	6/0-5/0	DSS
0,1-0,4	11/0-8/0	DR, DRM
0,3-1,5	9/0-4/0	DR

Field of Surgery	Organ/Tissue	Suture Material/ Product
Ophthalmology		Nylon
Dental surgery		Seraflex, Serafit®, Serapid®, Sulene
Urology	kidneys	Serafit® Serasynth®
	urinary tracts	Serasynth® Serafit®
	phimoses	Serapid®
Gynaecology	vagina	Serafit®, Serapid®
Thoracic surgery	lungs	Serafit®
	thorax closure	Seranox Serasynth®
Orthopaedics	tendons	Serasynth® Seranox Serapren® Seralon®
	ligaments	Serasynth®
	semilunar cartilage	Serasynth®
	bone	Seranox Serasynth® Bone Wax

Size		Needles
EP	USP	
0,2-0,4	10/0-8/0	DSL, DSLA, HSL, VSP
1,5-3	4/0-2/0	HS, HR, HRT
2-3,5	4/0-2/0	HR
1,5-2	4/0-3/0	HR, HRX, FRX
1-2	5/0-3/0	DS, DSS, HS
3-4	2/0-1	HR, HRX
1,5-3	4/0-2/0	HRT
2-3,5 3-8	3/0-0 2/0-6	DS HS, HRK, HRT
0,7-3	6/0-2/0	DS, HS, GR
0,7-3	6/0-2/0	DS, HS
2	3/0	DS, HS
3-3,5	2/0-0	GS

Explanation of symbols for medical devices

Because many different languages are spoken within the European Union, symbols are used for better understanding and easier identification of medical devices. These symbols are standard throughout Europe and comply with the norm **DIN EN 980**.

The following symbols are relevant to surgical sutures:

Symbol for
„DO NOT REUSE“

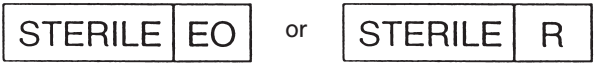
Symbol for
„PLEASE OBSERVE INSTRUCTIONS FOR USE“
This symbol refers to the instructions for use inside the package.

Symbol for
„BATCH NUMBER“
This symbol is accompanied by the batch number (alongside the symbol).

Symbol for
„EXPIRY DATE“
This symbol is accompanied by the date (four digits for the year and two for the month).

Symbol for
„PRODUCT NUMBER“

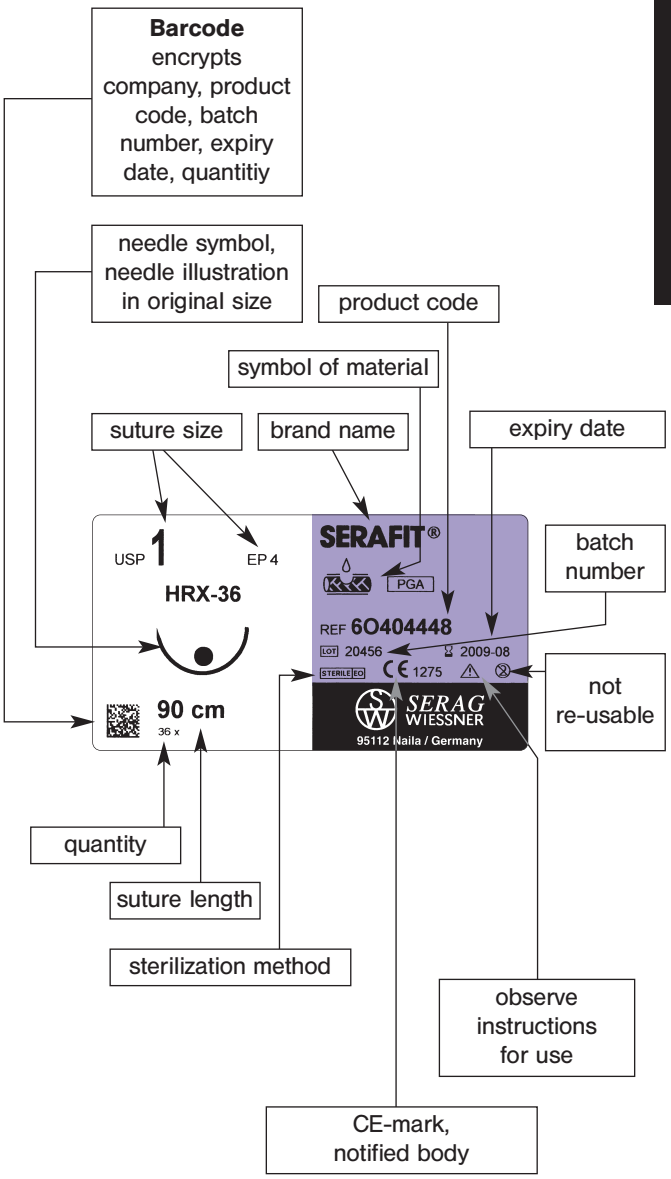
CE-mark,
notified body



Symbol for
„STERILE“
including **„STERILIZATION METHOD“**
e.g. symbol for
„ETHYLENE OXIDE STERILIZATION“ or IRRADIATION

Further symbols on page 20/21

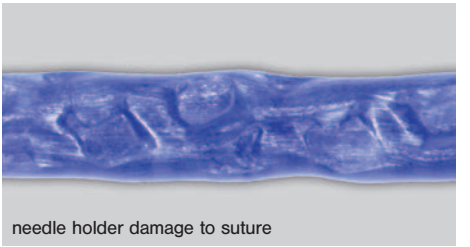
Product labelling



Handling

To prevent needle damage when suturing, it is recommended that you hold the needle between the middle and one third from the end. Holding the needle near its tip or at the end where the thread is loaded (end of the needle) can adversely affect its penetration and cause the needle to break.

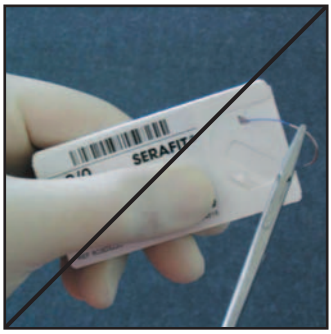
If touched at all, suture material should only be held by forceps or needle holders at the end of the thread. Each time it is held, the suture is damaged – and this is considerably more serious with monofilament threads. Any damage has an effect on the tensile strength of the suture.



needle holder damage to suture

Our specialists are continuously working on further ways of ensuring safe, problemfree removal of the suture from the suture holder. In recognition of this, our long pack vascular set was awarded the German Packaging Industry prize.

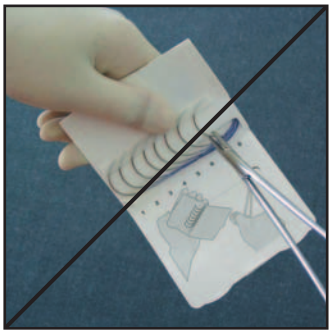
And a few tips for the problem-free removal of sutures from the holder:



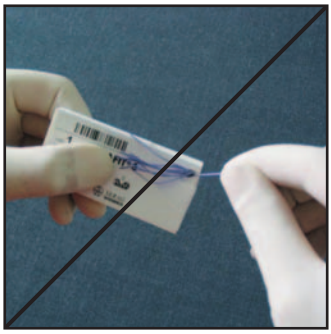
wrong right

When removing the suture material, grasp the suture holder in such a way that your thumb does not block the suture thread lying inside.

The same applies for all other types of suture holder:



wrong right



wrong right

Suture technique

The surgeon's choice of suture type depends on a number of considerations. Sutures can be divided into two basic types, namely individual (interrupted) and continuous sutures. Each of these has its advantages and disadvantages:

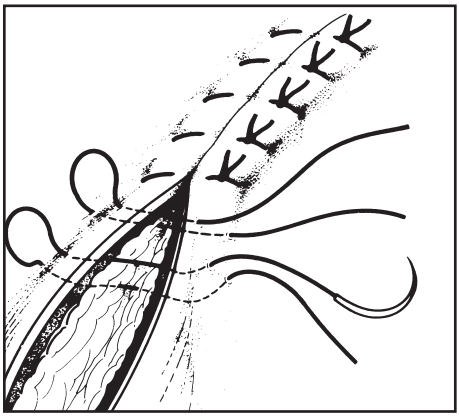
Interrupted sutures permit very precise adaption of the wound edges. The risk of wound dehiscence is less than with continuous sutures, as the coming undone of a single suture does not result in the entire suture line coming apart. Also, the amount of suture material buried in the tissue is less and there is less interference with the blood supply of the wound area. On the other hand, interrupted sutures are more time-consuming to insert, and require considerably more suture material than continuous sutures.

The advantage of continuous sutures is that they permit more even approximation of the two sides of the wound. They are also chosen for wounds that must prevent the passage of gas and fluids. The thread presses the lips of the wound firmly together along their entire length and in this way seals the wound completely. On the other hand, the resulting higher tension poses a threat to the nutrition of the wound area. Continuous sutures are quicker to insert and require less suture material.

Examples of interrupted sutures

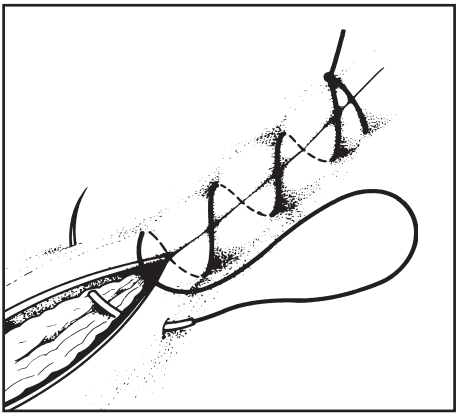
Interrupted over-and-over suture

Interrupted vertical mattress suture (Donati)

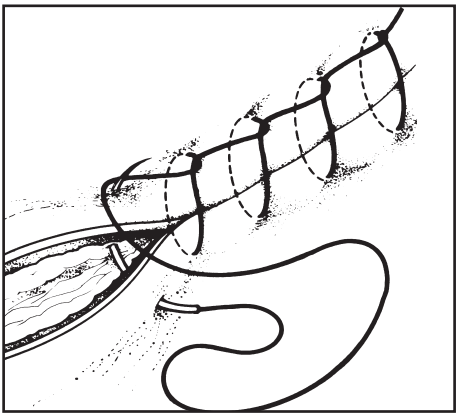


Interrupted vertical mattres suture (Allgöwer)

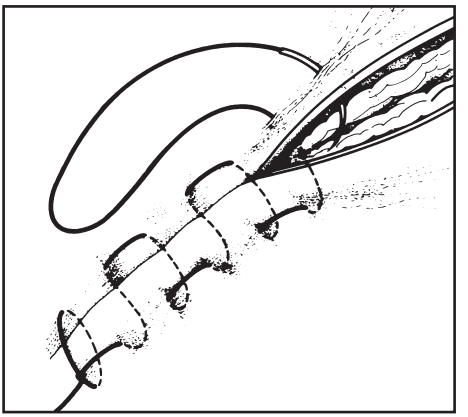
Examples of continuous sutures



Continuous over-and-over suture



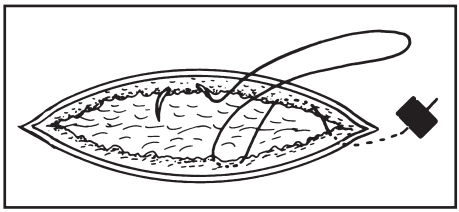
Continuous interlocking suture



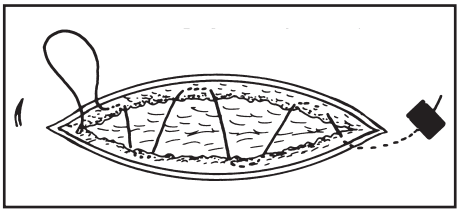
Continuous everting mattress suture

Special sutures

Intracutaneous suture

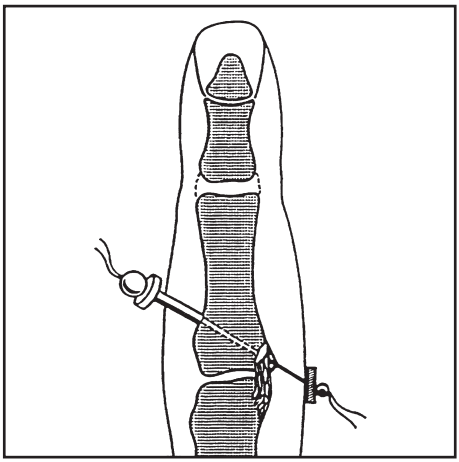


incutifix ®
Fixation of subcuticular sutures greatly simplified with special clips.

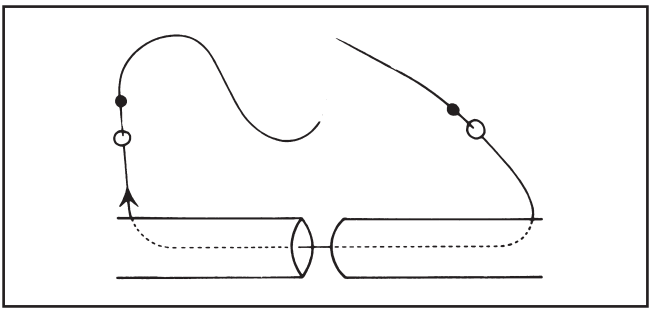


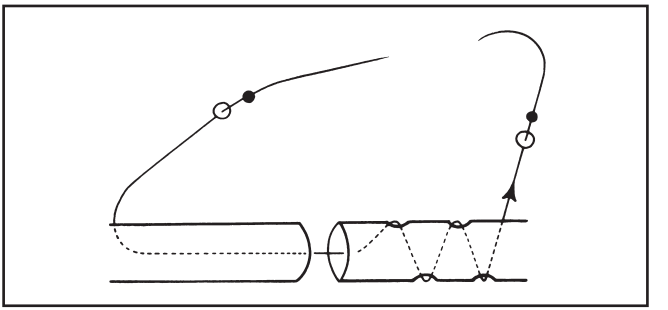
Tendon suture

according to Reck:
Set of armed multifilament steel wire with accessories

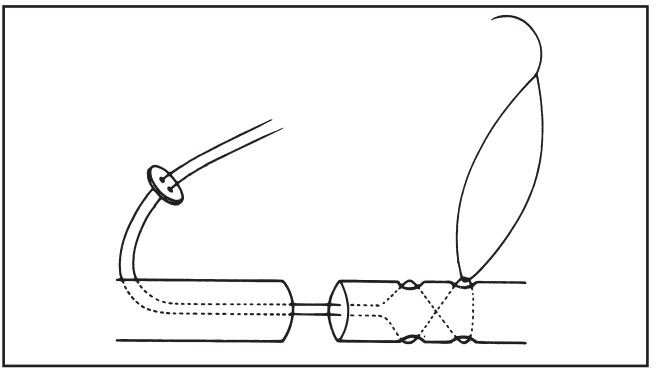


according to Lengemann:
Set of double-armed multifilament steel wire for extractable tendon sutures.



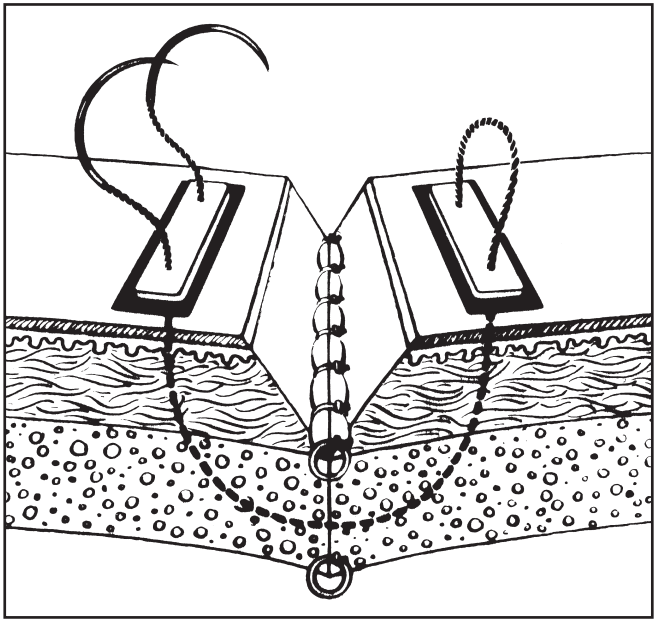


according to Bunnell:
Extractable combination of steel wire or Seralene



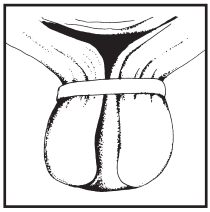
Tension suture

Double-armed Terylene thread or covered steel wire with accessories for reinforcement of primary suture line in abdominal wounds.

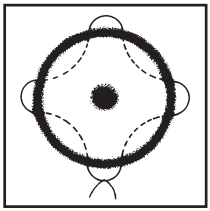


Cervical suture

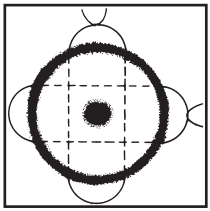
Polyester tape (Shirodkar) or thread (McDonald, Wurm-Hefner) for cerclage procedures in cervical incompetence during pregnancy.



acc. to Shirodkar



acc. to McDonald



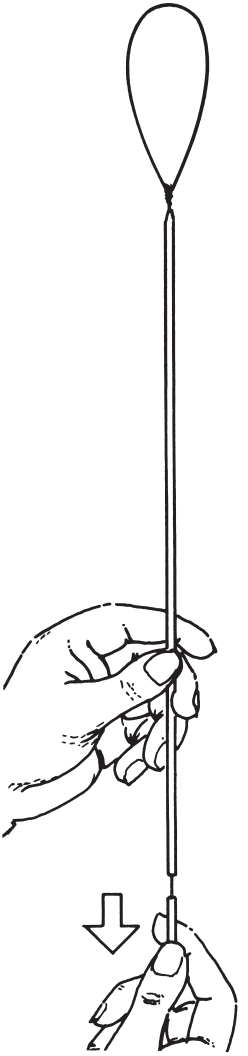
acc. to Wurm-Hefner

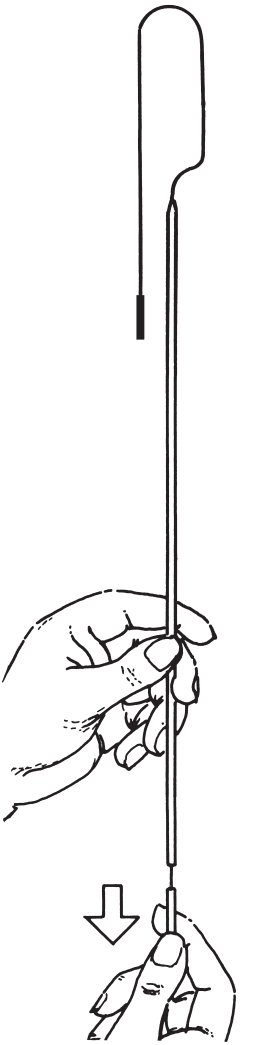
Serag Ligator

Prefashioned Roeder loop in knot pusher for endoscopic ligation of transected vascular structures

Endo Suture

Needle-suture combination in knot pusher for endoscopic suturing with extra- or intracorporeal knot-tying





Guidelines for knot-tying

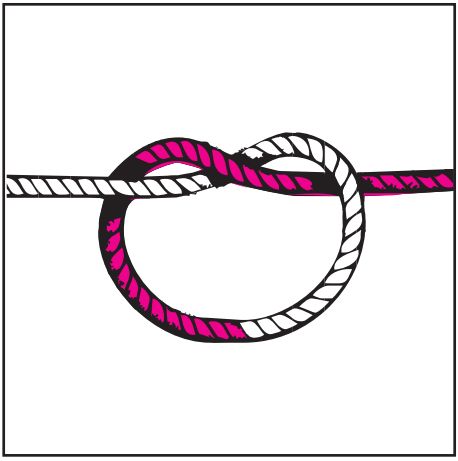
The surgeon must be able to tie a reliable knot as quickly as possible in every situation. The securest knots are fashioned with the tips of the fingers. The loops must be even and correctly orientated for tightening. Suture filaments must not be unravelled by twisting the loop in the opposite direction. The suture material should be stressed as little as possible and correct tension applied to each particular tissue. The knot-tying technique must be suited to the properties of the suture material and the requirements of the suture. The safest sutures are achieved by a sound knot-tying technique that exploits the properties of the suture material. The way in which the knots are tied is irrelevant. The essential thing is that the individual loops end up correctly positioned and aligned. Each knot can be tied correctly, regardless of how the suture ends are grasped, whether parallel or crosswise. The surgeon must therefore have mastered several knot-tying methods.

The following illustrations show how a reef knot is tied with two hands, one hand, and wholly or partly using surgical instruments. Endoscopic knot-tying techniques are also shown.

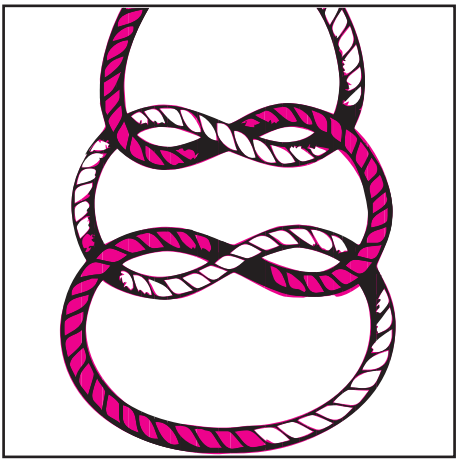
Generally, the two-handed knot is preferred, because suture tension is most easily controlled with the sensitive pads of the fingers. However, experienced surgeons find one-handed knots slightly faster. The instrument tie uses the least amount of suture material, but the thread may be damaged by the instrument.

Types of knot

A secure knot is created only when one loop or throw is placed over another. The first throw can be made in various ways depending on the circumstances, and in every case determines the tension and position of the knot. The second throw is there only to prevent slippage and is therefore placed firmly against the first. Every suture material acts as a foreign body in tissue. Buried knots are therefore kept as small as possible and the ends cut short. However, suture swelling must be borne in mind when using catgut. The most commonly used knots are illustrated:

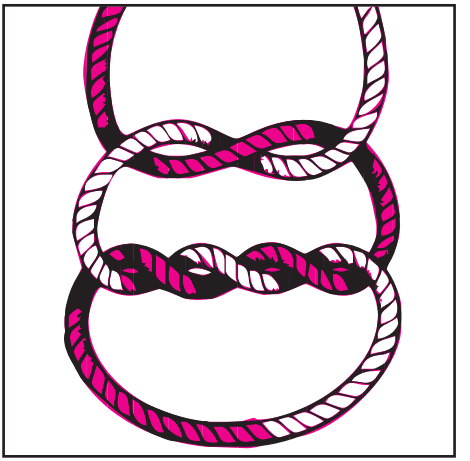


Half-hitch
First throw of a reef (square) or granny knot



Reef (square) knot

Two mirror-image half-hitches placed against each other. The suture ends are parallel. When pulled, the knot is increasingly tightened. This results in high knot-holding security.



Surgical knot

The first half-hitch is doubled and is therefore already relatively secure. This is the advantage of this knot. The drawbacks are that the knot is bulky and requires much suture material.

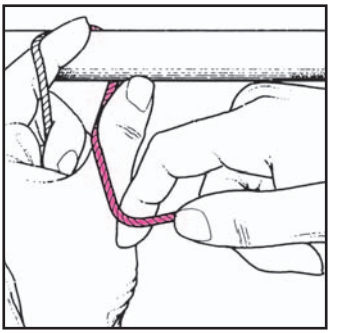
The following pages illustrate knot-tying techniques such as:

- the two-handed knot
- the one-handed knot
- instrument ties
- knot-tying technique in endoscopy
  - extracorporal
  - intracorporal
- instrument tie with pre-inserted „O“
- knotting recommendations for the Serasynth® Endosuture

Knot-tying technique

Two-handed knot

Both hands play an equal role in tying.



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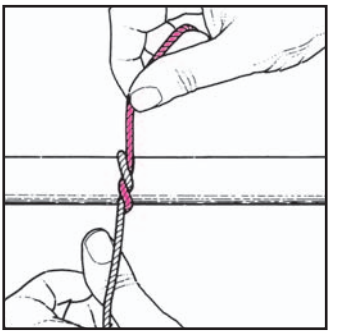

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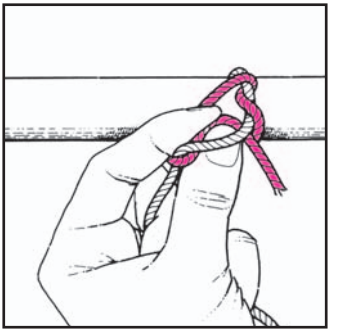

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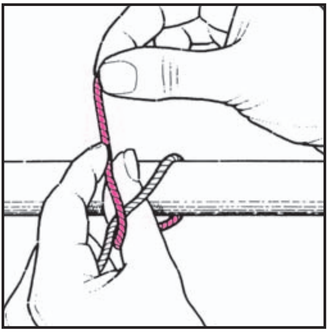

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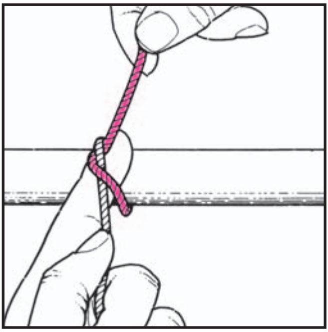

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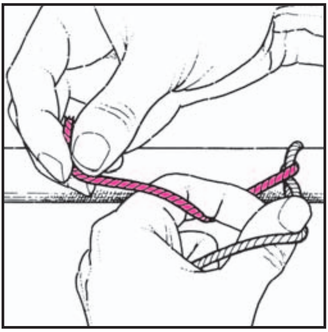

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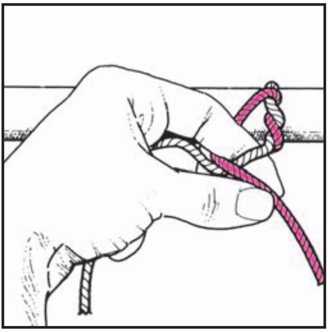

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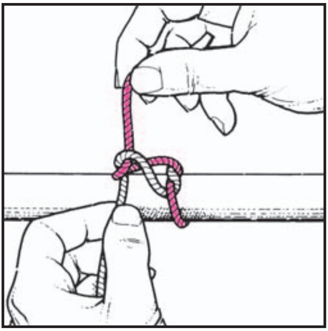

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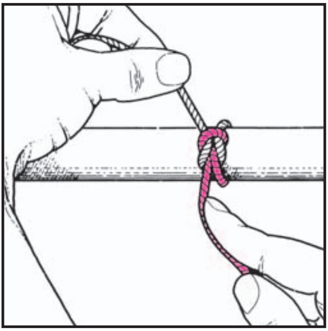
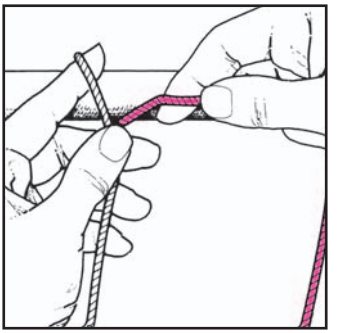


9

One-handed knot

One hand holds the suture end in position while the other ties.



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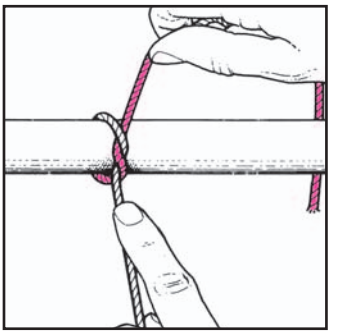

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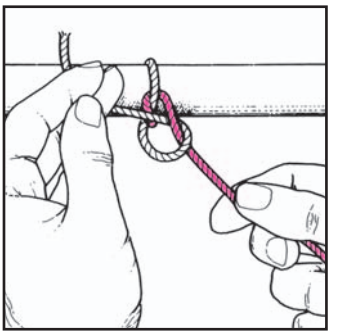

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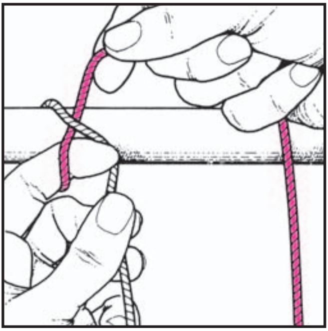

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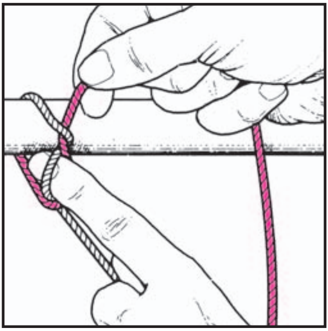

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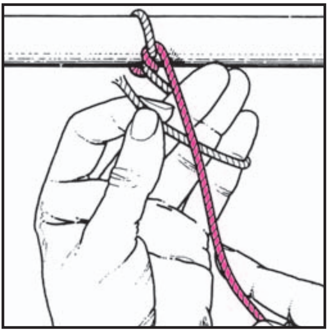

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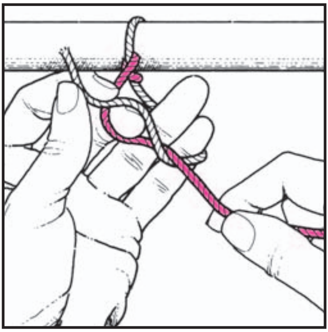

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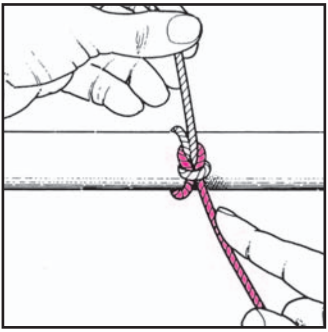
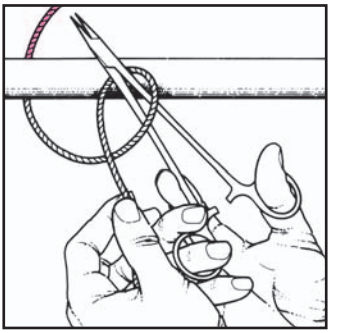


8

Instrument ties

The suture ends are held and manipulated wholly or partly with the aid of instruments.



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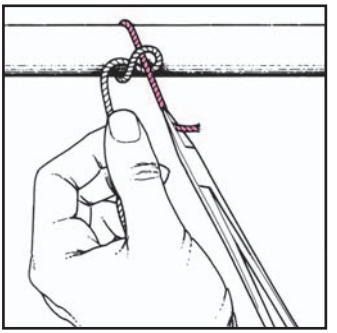

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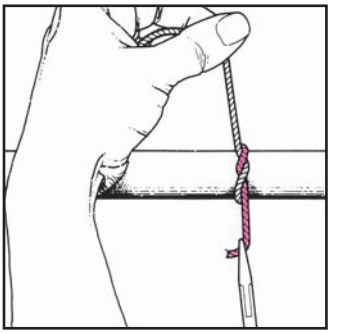

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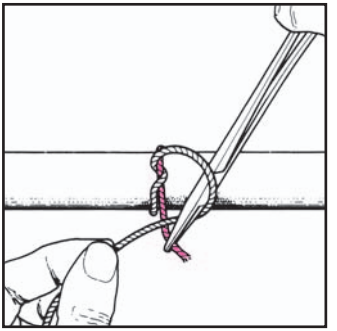

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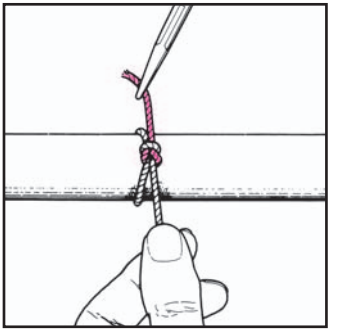
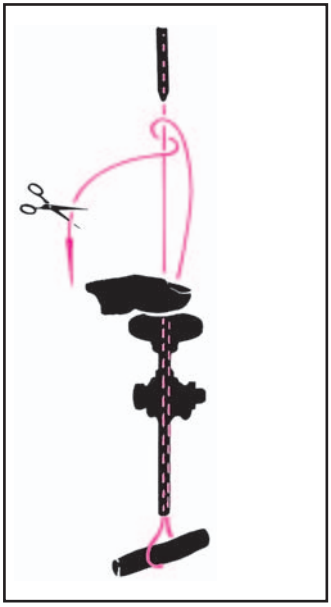


5

Knot-tying technique in endoscopy
Extracorporeal knot



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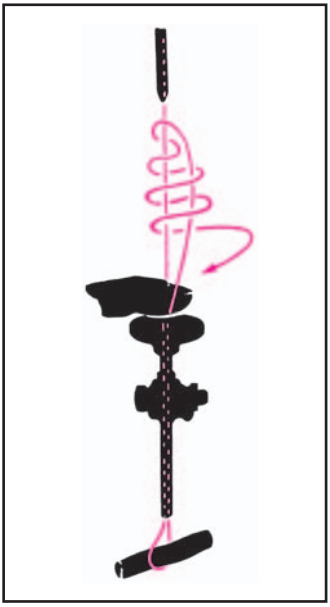

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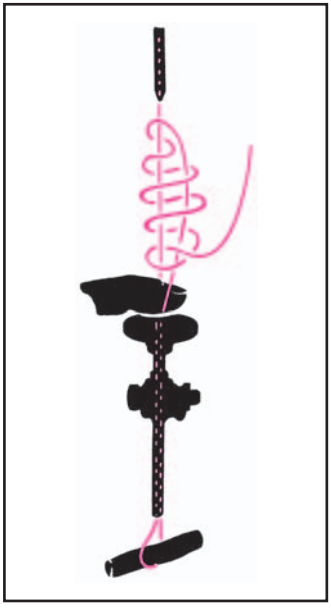

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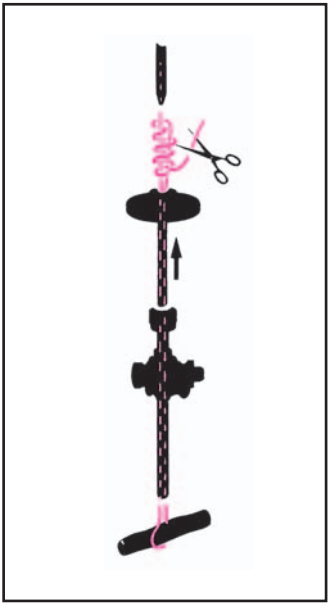


4

Knot-tying technique in endoscopy

Intracorporeal surgical instrument knot

1

2

3

4

5

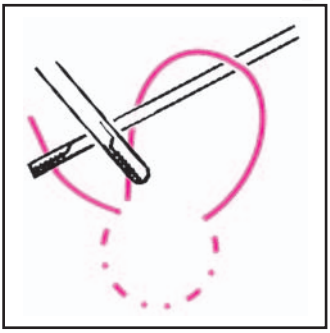
6

Alternative instrument tie with pre-inserted thread „O“ (Serafit stiffened).
This type of knot is rendered secure by repeated counterdirectional knotting.

1

2

3



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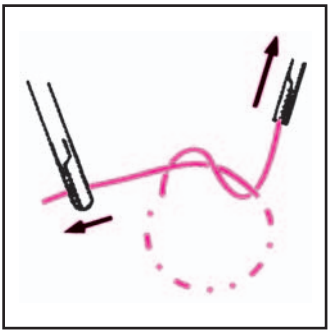
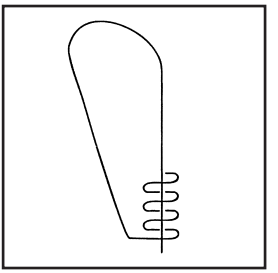


6

Knotting recommendations for
the Serasynth Endosuture

Due to its material characteristics, not all the conventional knots are suitable for the Serasynth Endosuture. Serag-Wiessner has developed a novel knot which is marked by its ease of tying and good knot security. Please proceed as shown in the diagram:



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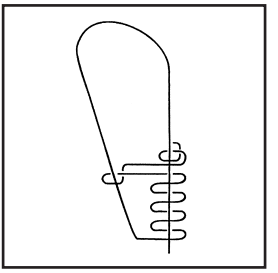

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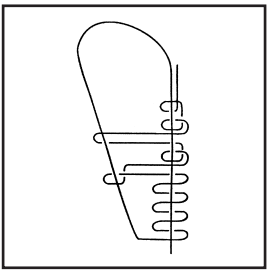

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