An Overview of Sutures in Surgical Practice

Dr Katie Young

July 2013
Volume 3
Issue 1
Doctors Academy Publications

The World Journal of Medical Education and Research (WJMER) is the online publication of the Doctors Academy Group of Educational Establishments. Published on a quarterly basis, it's aim is to promote academia and research amongst all members of the multi-disciplinary healthcare team including doctors, dentists, scientists, and students of these specialties from all parts of the world. The principal objective of this journal is to encourage the aforementioned from developing countries in particular to publish their work. The journal intends to promote the healthy transfer of knowledge, opinions and expertise between those who have the benefit of cutting edge technology and those who need to innovate within their resource constraints. It is our hope that this will help to develop medical knowledge and to provide optimal clinical care in different settings all over the world. We envisage an incessant stream of information will flow along the channels that WJMER will create and that a surfeit of ideas will be gleaned from this process. We look forward to sharing these experiences with our readers in our subsequent editions. We are honoured to welcome you to WJMER.

DOCTORS
ACADEMY
Disseminating Medical Knowledge and Skills Globally

ISSN 2052-1715

WJMER

World Journal of Medical Education and Research

An Official Publication of the Education and Research Division of Doctors Academy

In this edition, these topics and more....

Use of CURB-65 scoring in Community Acquired Pneumonia

Pre-Operative Optimization of Surgical Patients

The Scope of Medical Education in Egypt

Issues Surrounding Childhood Stroke :
A Case Report and Review of the Literature

The Use of Geometric Morphometrics as a New Method to Analyse Glenoid Bone Loss after Shoulder Dislocation

An Overview of Sutures in Surgical Practice

Operating Theatre: Essential Concepts and Procedures

WJMER
World Journal of Medical Education and Research
An Official Publication of the Education and Research Division of Doctors Academy

About WJMER

The World Journal of Medical Education and Research (WJMER) (ISSN 2052-1715) is an online publication of the Doctors Academy Group of Educational Establishments. Published on a quarterly basis, the aim of the journal is to promote academia and research amongst members of the multi-disciplinary healthcare team including doctors, dentists, scientists, and students of these specialties from around the world. The principal objective of this journal is to encourage the aforementioned, from developing countries in particular, to publish their work. The journal intends to promote the healthy transfer of knowledge, opinions and expertise between those who have the benefit of cutting edge technology and those who need to innovate within their resource constraints. It is our hope that this will help to develop medical knowledge and to provide optimal clinical care in different settings. We envisage an incessant stream of information flowing along the channels that WJMER will create and that a surfeit of ideas will be gleaned from this process. We look forward to sharing these experiences with our readers in our editions. We are honoured to welcome you to WJMER.

Editorial Board

Volume 3, Issue 1, 2013, World Journal of Medical Education and Research (WJMER). An Official Publication of the Education and Research Division of Doctors Academy Group of Educational Establishments.

Electronic version published at	:	Doctors Academy, PO Box 4283, Cardiff, CF14 8GN, United Kingdom
Print version printed published at	:	Abbey Bookbinding and Print Co., Unit 3, Gabalfa Workshops, Clos, Menter, Cardiff CF14 3AY
ISBN	:	978-93-80573-31-1
Designing and Setting	:	Doctors Academy, DA House, Judges Paradise, Kaimanam, Trivandrum, 695018, Kerala, India
Cover page design and graphics	:	Sreekanth S.S
Type Setting	:	Viji Shaji
Contact	:	wjmer@doctorsacademy.org.uk

An Overview of Sutures in Surgical Practice

Dr Katie Young, BSc (Hons), MB ChB (Hons).
Academic Foundation Trainee
North Bristol NHS Trust, Bristol.

Address for correspondence: katie.c.e.young@gmail.com

Keywords:

Suture, Needle, Absorbable, Filament, Suture Gauge

Introduction

Suturing has been used throughout the ages to help human tissues heal, by approximating the wound edges and reducing the dead space. Historically, plant or animal fibers were used for thread and the needles were shaped from animal bone or bits of metal. In the modern era, sterilized sutures and needles have mostly replaced these materials but the essential principles remain the same.

Sutures, and the needles on which they are mounted, are available in a multitude of shapes, sizes and materials. Each material has its own unique properties, benefits and disadvantages; hence, they are tailored according to the specific requirements of the wound. When closing wounds with sutures, it is important to understand these properties to achieve the best possible healing result.

Types of Sutures

Sutures can be categorized by whether they are natural or synthetic, absorbable or non-absorbable, or if they are monofilament or braided (see glossary for definitions). In modern medicine, especially in developed countries, the vast majority of sutures are synthetic. Natural materials, such as silk, are used to secure surgical drains but other materials such as catgut have been phased out as they can sometimes invoke an inflammatory response.

Absorbable Vs Non-absorbable

Absorbable sutures such as polyglactin (Vicryl) and polydioxanone (PDS) are gradually broken down over time by various processes such as hydrolysis and proteolytic enzymatic degradation and absorbed by the body. These sutures are suitable for tissues that heal rapidly such as the stomach, bowel, bladder and subcutaneous tissues. They retain their tensile strength during the initial tissue mending process, and as tissues heal, the suture strength declines at a known rate for each material type (see Table 1). Absorbable sutures are also commonly used for subcuticular wound closure to which if done in appropriate circumstances can produce better cosmetic results.

Absorbable Sutures					
Name	**Raw materials**	**Type**	**Tensile strength retention in vivo**	**Absorption**	**Tissue reaction**
Monocryl	Poliglecaprone 25	Monofilament	~50-60% at 1 week ~20-30% at 2 weeks 0% within 3 weeks	By hydrolysis 90-120 days	Minimal acute inflammatory reaction
PDS	Polydioxanone	Monofilament	~70% at 2 weeks ~50% at 3 weeks ~25% 4 weeks	By hydrolysis 180-210 days	Slight reaction
Vicryl	Polyglactin 910	Monofilament or braided	~75% at 2 weeks ~50% at 3 weeks	By hydrolysis 56-70 days	Minimal acute inflammatory reaction
Vicryl*rapide*	Modified polyglactin 910	Braided	~50% at 5 days	By hydrolysis 42 days	Minimal to moderate acute inflammatory reaction

Table 1: *Properties of different absorbable sutures.*

Non-absorbable sutures, synthesized from a variety of non-biodegradable materials such as nylon and polypropylene (see Table 2), are indicated for repair of tissues with slow healing times such as ligaments and tendons. They are also used in fixation of hernia meshes to reduce recurrence rates and in blood vessel repair and vascular anastamoses with grafts where loss of tensile strength would have disastrous consequences. Non-absorbable sutures are sometimes used for skin closure, particularly where skin opposition is placed under tension or at risk of infection. In these cases, interrupted suturing technique is more frequently used as the removal of one or two stitches would not affect the wound healing process of the rest of the wound. However, non-absorbable sutures for skin closure will require removal post-operatively, usually between three to fourteen days depending on the healing potential of the patient and the location of the wound (discussed in more detail below).

Non-absorbable sutures					
Name	**Raw materials**	**Type**	**Tensile strength retention in vivo**	**Absorption**	**Tissue reaction**
Silk	Fibroin (organic protein)	Braided	Progressive degradation may lead to gradual loss of tensile strength over time.	Gradual encapsulation by fibrous tissue	Acute inflammatory reaction
Wire	316L Stainless steal	Monofilament or multifilament	Indefinite	Non-absorbable, remains encapsulated in tissue.	Minimal acute inflammatory reaction
Nylon	Polyamide 6 and 6/6	Monofilament	Progressive hydrolysis may lead to gradual loss of tensile strength.	Gradual encapsulation by fibrous tissue	Minimal acute inflammatory reaction
Ethilon	Polyamide 6 and 6/6	Monofilament	Progressive hydrolysis may lead to gradual loss of tensile strength.	Gradual encapsulation by fibrous tissue	Minimal acute inflammatory reaction
Prolene	Stereoisomer of polypropylene	Monofilament	No degradation or weakening by tissue enzymes.	Non-absorbable, remains encapsulated in tissue	Minimal acute inflammatory reaction
Expanded PTFE	Polytetrafluroroet hylene	Monofilament	No degradation or weakening by tissue enzymes.	Gradual encapsulation by fibrous tissue	Minimal acute inflammatory reaction

Table 2: *Properties of different non-absorbable sutures.*

Monofilament Vs multifilament

Monofilament describes a suture made from a single strand. They glide smoothly through tissues with minimal friction, and more importantly, they do not have pockets in which microorganisms can harbor. Monofilament sutures are particularly favoured in vascular, tendon and nerve repairs. However, monofilament sutures can be difficult to handle, especially those with memory (see glossary) as they have a tendency to spring back to their original form. In order to reduce chances of knots unraveling, a minimum of five throws are required as opposed to the usual three throws in a normal surgical tie.

Multifilament or braided suture composes of several strands that are twisted together. Braided sutures have the best handling qualities, and are preferred in bowel surgery. However, their interstices can be ideal for bacteria growth that can become problematic as the suture may encourage bacteria to track into the wound. This is known as suture track sepsis. This setback can be greatly reduced by coating the sutures.

Wire sutures

Stainless steel wire sutures are only used in special circumstances such as orthopaedic bone fixation or the closure of sternotomy wounds in cardio-thoracic surgery. Stainless steel is virtually inert, but rate of steel suture breakages are relatively high due to metal fatigue.

Suture Gauge

Suture gauge or diameter of the thread was described traditionally when sutures were thicker and size 1 described the finest suture. However, as sutures became finer, the description system was taken backwards as smaller sutures were called size ‘0’, then size ‘00’ (2/0), ‘000’ (3/0) and such like. In time, these sizes were known by the United States Pharmacopeia (U.S.P.) classification system where 10/0 is extremely fine and used for delicate opthalmogical operations and size ‘0’ are thicker sutures for closing the abdominal wall. The suggested gauge of skin sutures for different body areas are described in Table 3 and the suggested suture gauge for different types of tissue repair are presented in Table 4.

Body Site	Recommended Suture Gauge	Removal of Sutures
Face and Neck	5/0 – 6/0	3 – 5 days
Scalp	3/0	5 - 7 days
Limbs	4/0	7 – 10 days
Trunk	3/0	10 – 14 days
Back	2/0 – 3/0	10 – 14 days

***Table 3:** Suggested suture gage for different body areas and respective timings of suture removal.*

Tissue Repair	Type of Sutures*	Suture Gauge*
Subcuticular closure	Monocryl, Vicryl Rapide	3/0, 4/0, 5/0
Arterial Repair	Prolene	5/0, 6/0
Bowel Repair	PDS / Maxon	2/0, 3/0
Microvascular Repair	Prolene	7/0, 8/0
Nerve Repair	Nylon	8/0, 9/0, 10/0
Closure of laparotomy wounds	PDS	1/0

***Table 4:** Suggested suture type and guage for different types of tissue repair.*

** Examples only. Some surgeons may have other preferences.*

Choosing the Correct Suture

When selecting sutures, the surgeon takes many factors into account such as anatomical location, the type of wound and amount of stress the wound would be enduring after surgery. As discussed above, the type of material is important. In addition, the smallest gauged suture with sufficient tensile strength to support the wound should be selected. Where cosmesis is particularly important, for example wounds on the face, several finer gauge sutures will give a better cosmesis than fewer heavier gauged sutures.

Time for Removal of Sutures

The duration that non-absorbable skin sutures are left in-situ is dependent on the part of the body that the wound is located, as various parts such as the face have a better blood supply and will heal at a faster rate, hence sutures would be required to be removed at an earlier stage (between 3-5 days). Other body parts such as the back have a poorer blood supply and tougher skin, hence sutures are left in-situ for between 10 – 14 days. Other aspects which influence the rate of healing include patient factors such as age, nutritional status, general health and immunological compromise; surgical factors include the surgical technique, the choice of suture and suture material. The recommended times for the removal of sutures in other parts of the body are suggested in Table 3.

Needles

Surgical needles are required to guide sutures through the tissues. Needles must be sharp enough to penetrate the tissue, but not cause inappropriate damage, hence an understanding of different needle types is essential for making the correct choice when suturing.

Parts of the needle

The needle is made up of various parts as illustrated in Figure 1. The point is the part of the needle that extends from the tip to where the cross-section reaches its maximum width. The body forms the majority of the needle, and the swage is where the suture is attached and is continuous with the suture. The arc length is the length of the curve of the needle and is the measurement given on suture packages. The cord length, also known as the bite width, is the distance from the point to the swage (see Figure 2). The radius is the distance from the needle body to the centre of the circle along which it curves.

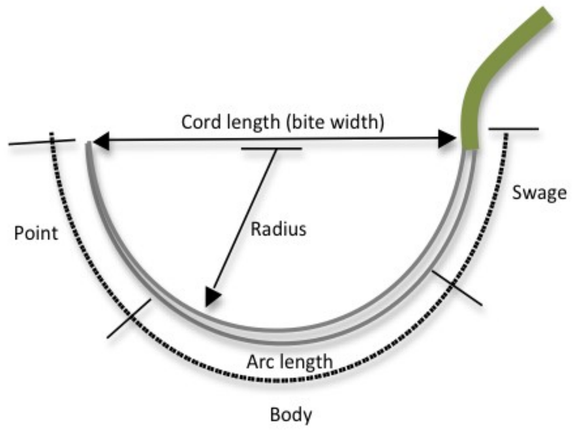

Figure 1: *The parts of a needle.*

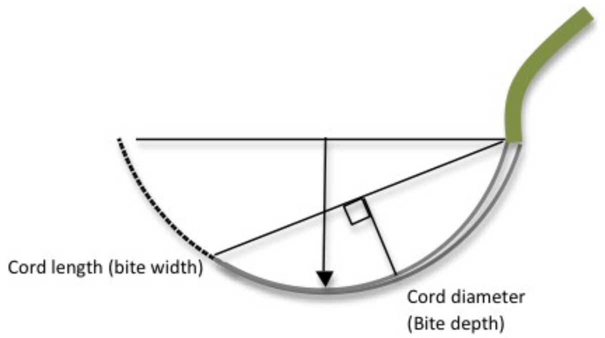

Figure 2: *The anatomy of the needle illustrating bite depth and bite width.*

Needle types

Needle types and shape vary considerably as seen in Figure 3, and their uses are described in greater detail below. Needles also come in different sizes. In general, smaller needles are required for finer work, whilst larger needles are required for penetrating and taking large bites of tissues such as closure of the abdominal wall.

Curved needles

Curved needles are usually mounted on a needle holder, and are used for most types of suturing. Some of the different types of curved needles are as follows:

- 1/2 circle needles - used for most purposes
- 3/8 circle needles - most commonly used for skin closure
- 1/4 circle needles - used for microvascular anastomoses
- 5/8 circle needles - used for hand closure of the abdominal wall
- J-needle - used for closure of laparoscopic port wounds.

Straight needles

Straight needles are hand-held and are used for mainly for subcuticular skin suturing, and securing of surgical drains. It is often quicker and more efficient to use the straight needle in closing skin wounds, but there is a slightly increased risk of needle stick injuries.

Needle tips

Round-bodied needles (Figure 4) have a smooth pointed tip that is designed to guide sutures into tissues by parting the tissue fibres to either side. They can be used for most soft tissues, such as the gut, fat or muscle. After the needle has passed through the tissue, the defect caused by the needle is filled by the suture material, which reduces leakage and is therefore useful particularly in intestinal or cardio-vascular operations.

Blunt taper point needles (Figure 5) have been designed to minimise needle stick injury risk, especially in cases where blood-borne viruses are a concern. The point of the needle is sufficient to penetrate muscle and fascia, but not skin.

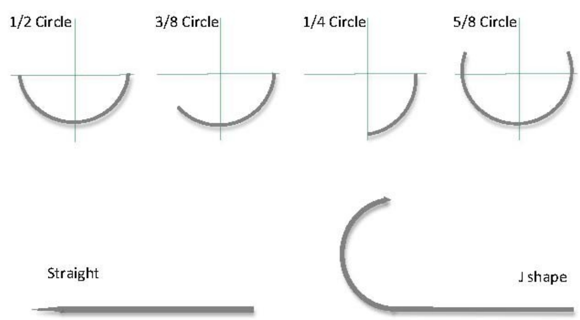

Figure 3: *Types of needle curves and bodies.*

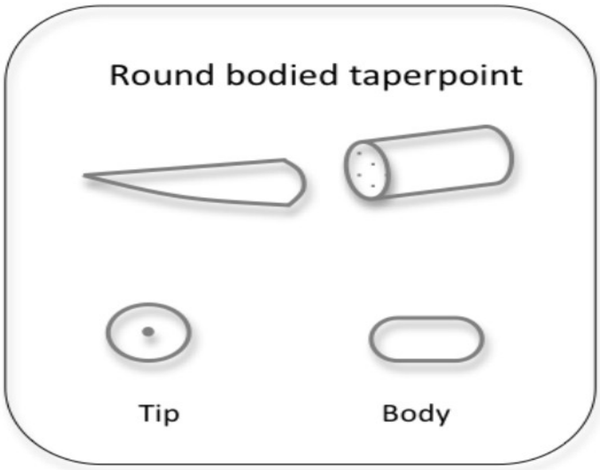

Figure 4: *Needle tips - round bodied taperpoint.*

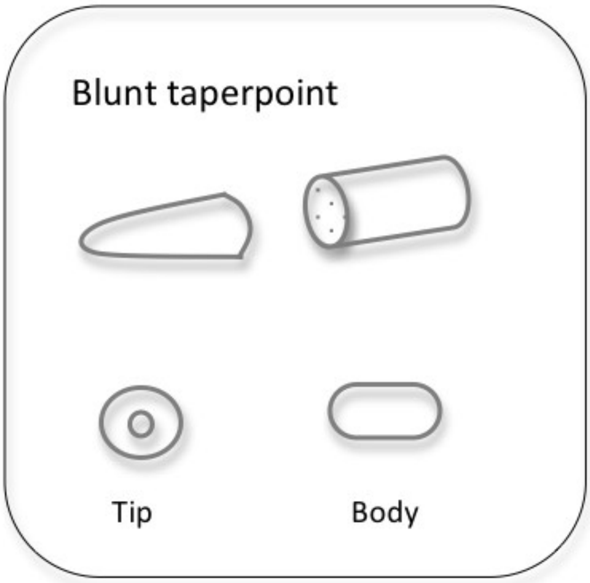

Figure 5: *Needle tips - blunt taperpoint.*

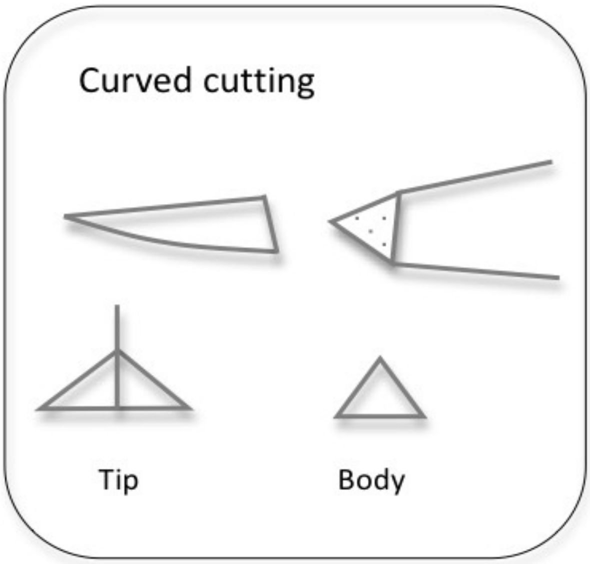

Figure 7: *Needle tips - curved cutting.*

Tapercut (semi cutting) needles (Figure 6) combines aspects of both the cutting and the round bodied needles. The tip has a triangular profile but the needle then tapers out to that of a smooth round-bodied profile and are used to suture moderately tough tissues, for example atherosclerotic arteries or fascia.

The reverse curved cutting needle (Figure 8) is triangular in cross-section with the apex of the triangle on the convex surface (i.e., on the outside surface of the needle curve). The reverse curved cutting needle is stronger than the conventional cutting needle and has less propensity to cause tissue tear as the apex of the cutting edge is directed away from the wound.

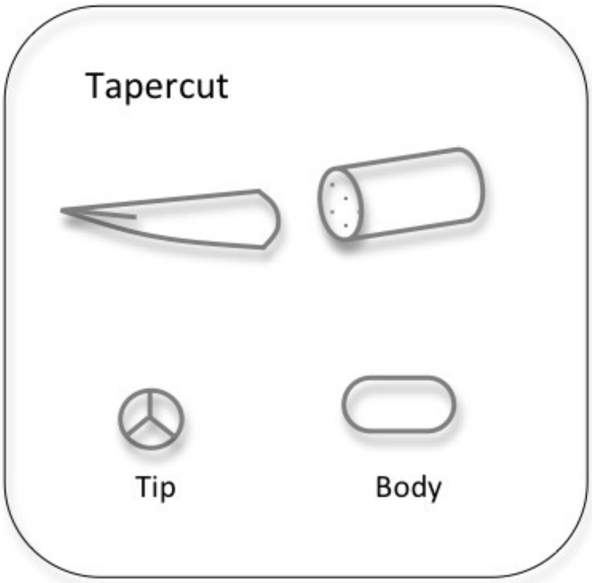

Figure 6: *Needle tips -tapercut.*

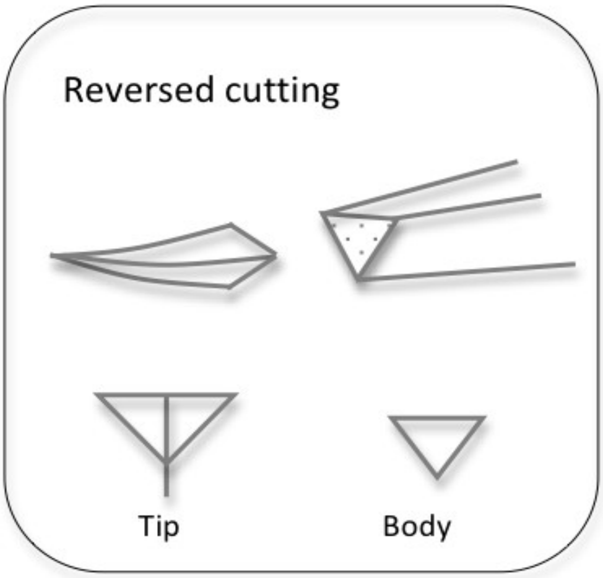

Figure 8: *Needle tips - reversed cutting.*

Cutting needles (Figure 7) are used for suturing tough or dense tissues, such as the skin. The curved cutting needle has three cutting edges, is triangular in cross-section with the apex of the triangle on the concave aspect of the curvature (i.e., inside surface of the needle curvature).

Summary

There are a variety of different sutures and needles. In order to select the most appropriate type, surgeons must have a working knowledge about the properties of the suture material and the rate of healing of different tissues. Although reading imparts theoretical knowledge, it is only when working with tissues and sutures that one truly appreciates these aspects.

Terms	Definition
Suture	The thread.
Needle	The sharp end to which the suture is attached. It guides the suture through tissues.
Gauge	The diameter of the suture. The greater the number, the finer the suture.
Tensile Strength	The stress (force per unit area) that a knotted suture can withstand before breaking.
Memory	The suture’s inherent propensity to maintain its original form.
Braided	Suture made from several strands that are twisted together.
Monofilament	Suture made from a single strand.

Glossary.

References:

1. Davey A, Ince C. Fundamentals of Operating Department Practice. Cambridge University Press, [printed in New York]. 1999, p.191.

The World Journal of Medical Education & Research (WJMER) is the online publication of the Doctors Academy Group of Educational Establishments. It aims to promote academia and research amongst all members of the multi-disciplinary healthcare team including doctors, dentists, scientists, and students of these specialties from all parts of the world. The journal intends to encourage the healthy transfer of knowledge, opinions and expertise between those who have the benefit of cutting-edge technology and those who need to innovate within their resource constraints. It is our hope that this interaction will help develop medical knowledge & enhance the possibility of providing optimal clinical care in different settings all over the world.

DOCTORS ACADEMY
Disseminating Medical Knowledge and Skills Globally

9 7 8 - 9 3 - 8 0 5 7 3 - 3 1 - 1

WJMER
World Journal of Medical Education and Research
An Official Publication of the Education and Research Division of Doctors Academy