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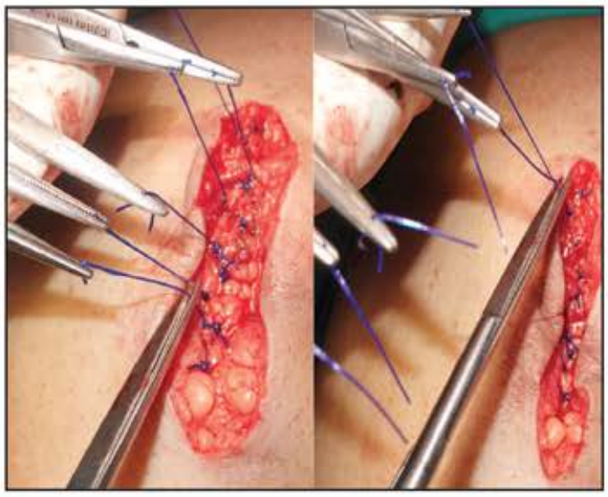
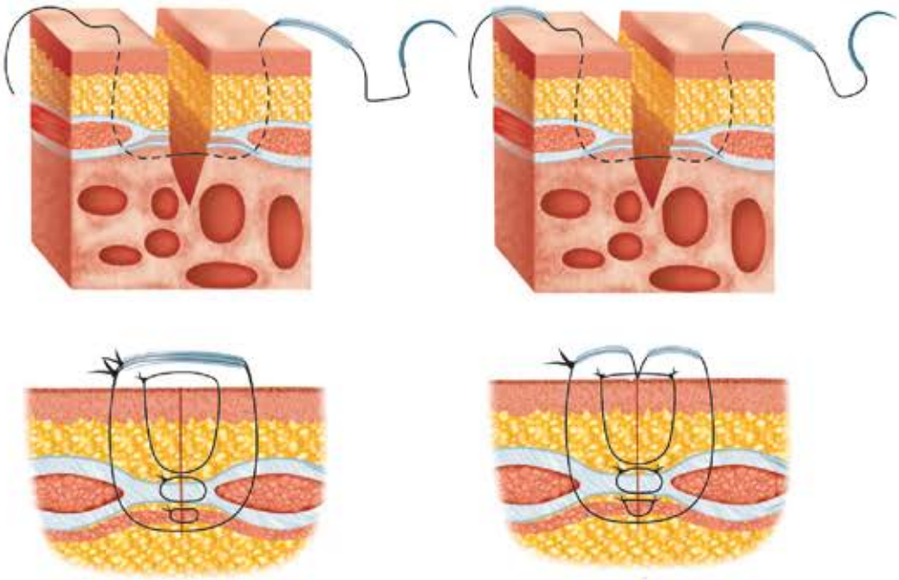
SRB's Atlas of Tissue Approximation with Suturing & Knotting

with Video Demonstration





Sriram Bhat M

Foreword
K Jayarama Shenoy

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CHAPTER 2 Instruments for Suturing

"Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world."
–Albert Einstein

INTRODUCTION

It is always essential to have proper idea about the instruments being used for suturing. Unless surgeon knows the details about the instruments, he may struggle while doing the suturing technique.

For simple suturing, basic suturing instruments are sufficient. For difficult suturing specialized sutures and instruments are needed like in laparoscopic suturing; or in fine suturing wherein loupes are used to achieve magnification.

Basic ergonomics, surgical anatomy, tissue alignment, precise movements at wrist and elbow; adequate length, curvature of the instruments are essential needs. Instrument should function as an extension of surgeon's hands.

Basic instruments ***(Fig. 1)*** *used are:*
- Needle driver (holder)
- Suture materials and needles
- Tissue forceps—toothed and non-toothed
- *Gauze:* Nonwoven gauze (it is better than woven gauze as its wicking property is excellent and it does not unravel) and mop
- Scalpel blade
- Hemostat
- Suture-cutting straight scissor
- Cautery

Instruments are held in two ways: *Better method* is by *finger-tip pressure* wherein thumb and ring fingers are placed in finger bows of the instrument. Precise fine-relaxed movements are essential for proper work-up of the instruments. Bizarre-hurried movements will not give precision. *Second method* of holding the instruments is tight *vise-like grip* using fist of the hand. It gives a good grip but precision may not be adequate. Surgical trainee to begin with prefers this method as he will think that grip is essential part in holding the instrument. Even though this method may be useful in some situations, it is ideal to use the method of finger-tip pressure and practice it for eventual smooth precise work. Middle finger of the surgeon is kept behind the handle and index finger is extended along the length of the handle. It is said that slow, definitive, precise, and nonrepetitive movements actually yield faster surgery than haphazard, frenzied, and rapid movements **(Fig. 2)**.

Holding the instrument: Finger-tip pressure (finger grip) is better to hold instruments than vise grip. But it is finally surgeon's choice and comfort.

Hemostasis is achieved using coagulation cautery. Dissection using coagulation cautery will be hemostatic but causes boiling of fat, more tissue trauma leading into wound infection. Ideally over coagulation of tissues during cautery dissection should be avoided.

Tissues are held using forceps by gentle maneuver. Skin and tough structures are held using toothed forceps; soft, smooth, delicate structures should be held using non-toothed forceps.

Needle holder should be held between thumb and ring fingers to achieve rotation movement using wrist (not pushing movement). Index and middle fingers are used to steady the handle. Needle is laced at the junction of proximal 2/3rd and distal 1/3rd of the distal jaws.

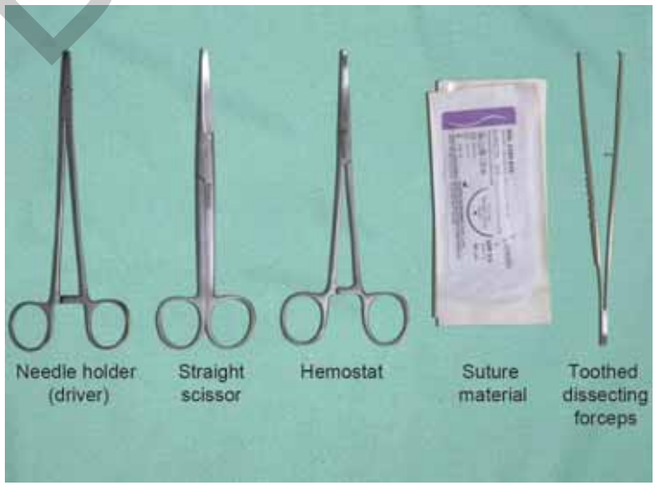

Fig. 1: Basic instruments required for suturing.

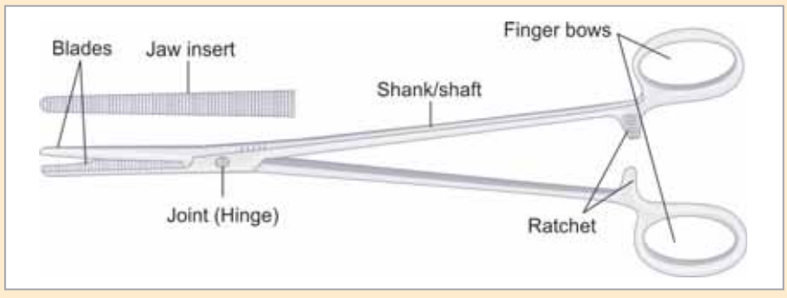

Fig. 2: Parts of a surgical instrument.

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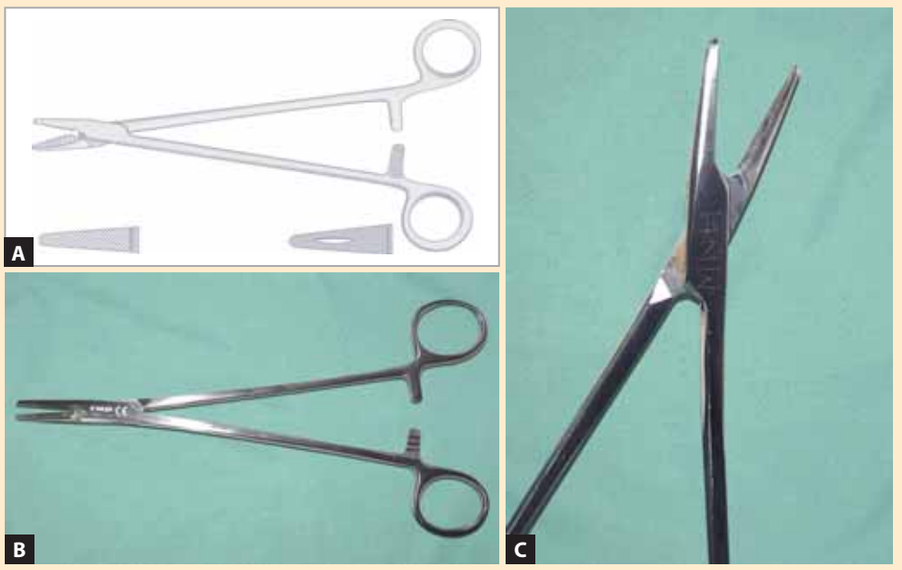

Figs. 3A to C: Parts of the needle holder.



Figs. 4A and B: Needle holder—distal end.



Fig. 5: Mayo Hegar needle holder.

NEEDLE HOLDER (NEEDLE DRIVER)

It is strong and sturdy instrument with long proximal blades and short distal blades **(Figs. 3A to C)**. Ends are rounded distally with their flat inner surface to grasp the needle **(Figs. 4A and B)**. Inner surface can be serrated or nonserrated (smooth jaw); (serrations when present are criss-cross typed); with a groove or without. Serrations add stability and optimum grip to the needle but may damage grasped suture while knotting. Ratio of length of handle (shank/shaft) to blade (jaw) is usually 4:1.

Different needle holders are available with different lengths and curvatures. Fine-needle holders are also available. There are especially designed needle holders for fine-suturing of vessels, and also especially in ophthalmology where microscopy is used for suturing and for this purpose needles are small and precision is important. *Webster–Halsey, Mayo Hegar, Baumgartner*—are different needle holders used **(Figs. 5 and 6)**.

Needle is placed near the end of the needle holder usually at a point at the junction of proximal 2/3rd and distal 1/3rd to have optimal control and grip **(Fig. 7)**. Needle is held near its swaged end or in the middle or toward the tip depending on the arc needed during tissue bite; which is finally assessed by the depth of the tissue and space available in the depth for easy maneuverability. After placing the needle, needle holder is closed firmly usually to its full extent with a single click. Needle should be held firmly to avoid slippage and inadvertent movements; usually ring finger and thumb are used to hold the needle holder. Palming position, grasping position, and holding with thenar prominence are different positions used **(Figs. 8 and 9)**. Holding with fingers is the standard position, but depending on the need, the depth and type of tissues to be approximated, surgeon may change the holding. *Needle holder is usually (ideally) to be held by placing thumb and ring fingers into the finger bows and middle finger supports the bow and index finger supports the shank/shaft of the needle holder.*

TISSUE FORCEPS (DISSECTING FORCEPS)

Tissue forceps are essential instrument in surgery; it is used to hold tissues while dissecting as well as approximating **(Figs 10A and B)**. Different types and sized forceps are available. Usually, it is held like a pen. Fine forceps such as *Adson's forceps* are used in finer tissue apposition. *Bishop Harmon forceps* is used for delicate tissue apposition **(Figs. 11A and B)**. Forceps may be toothed

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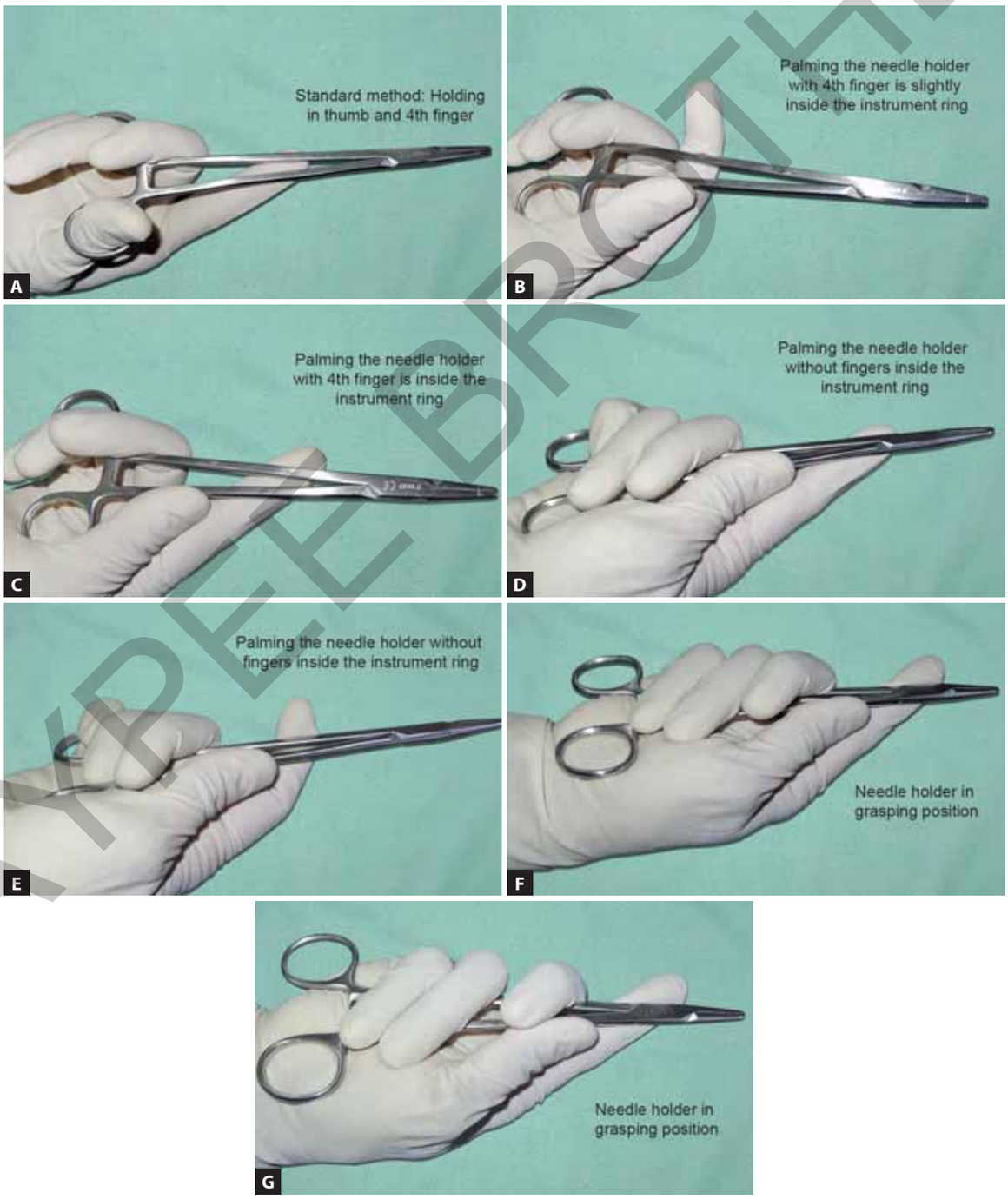
Fig. 6: Baumgartner specialized needle holder.



Fig. 7: Holding the needle holder properly and knowing its movement in rotational axis is important for proper suturing and knotting. It is the precise gentle rotation which is essential; not pushing flimsy movement. The needle holder is held with thumb and ring finger through the rings and with the index finger along the length of needle holder to provide stability and control.



Figs. 8A to G: Different ways of holding the needle holder.

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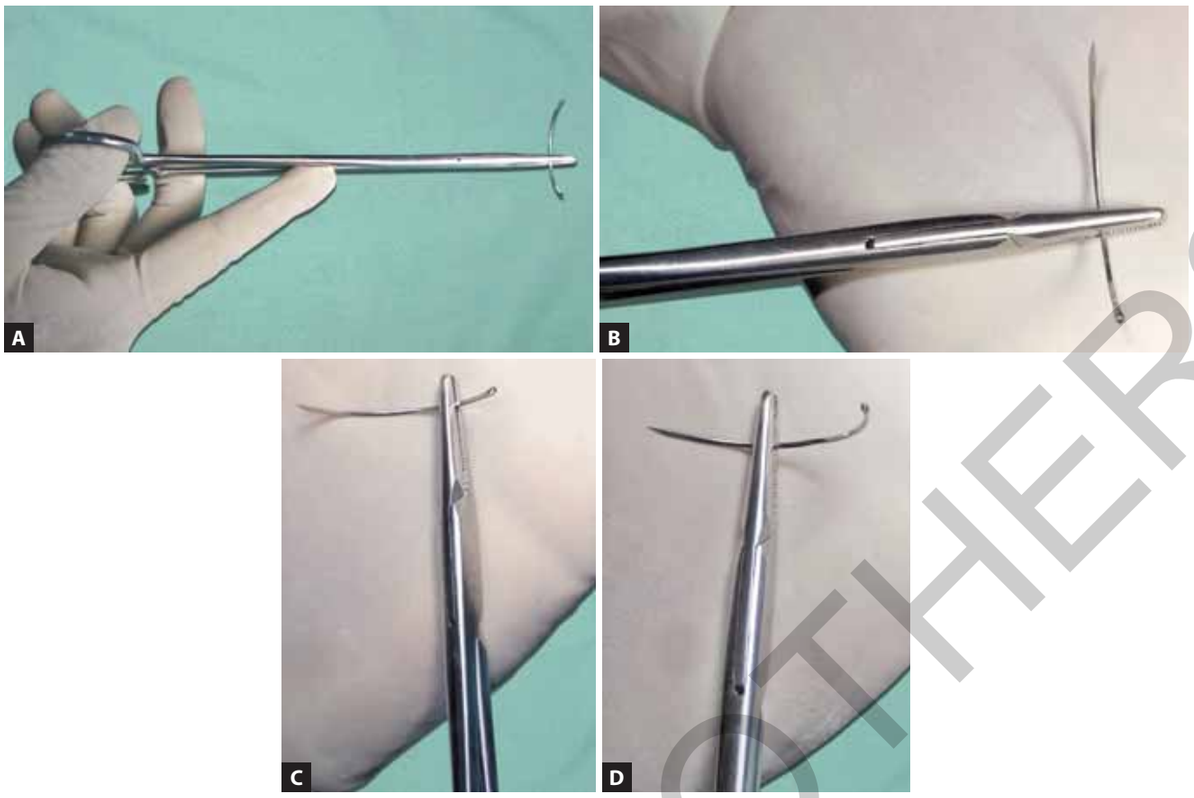
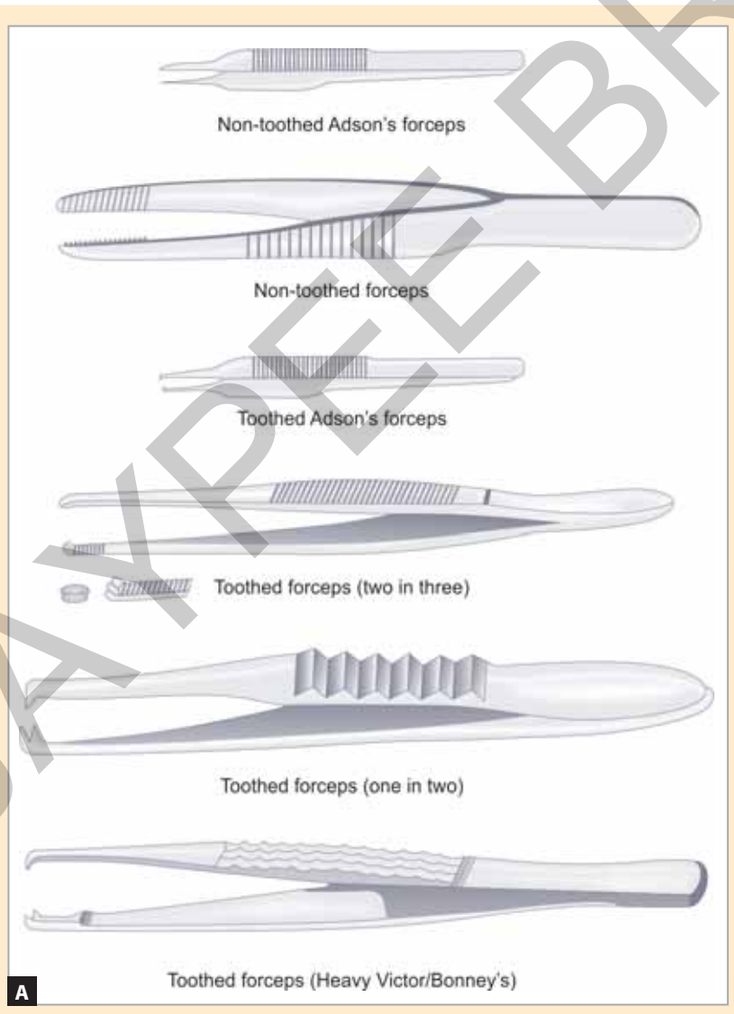
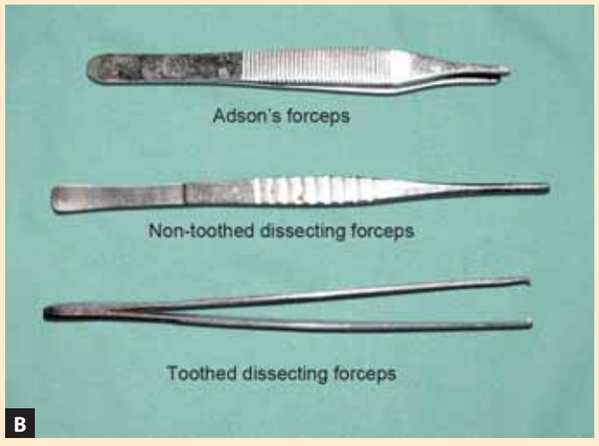


Figs. 9A to D: Placing the needle in needle holder.





Figs. 10A and B: Dissecting forceps used in tissue approximation.

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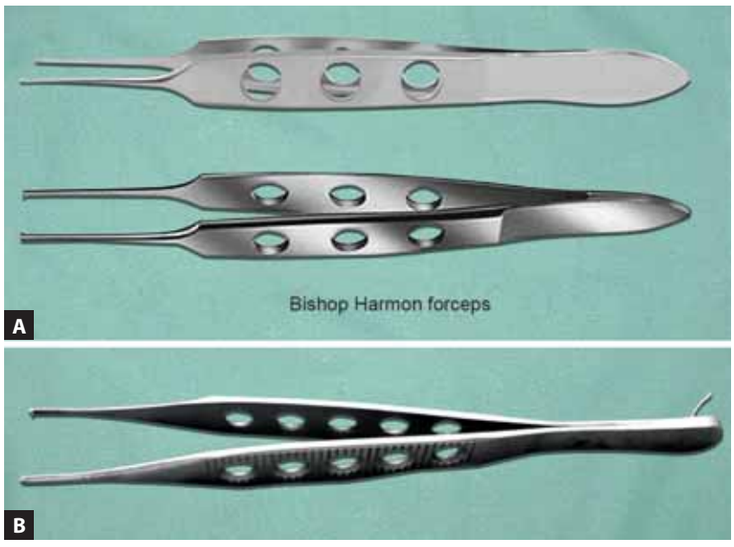
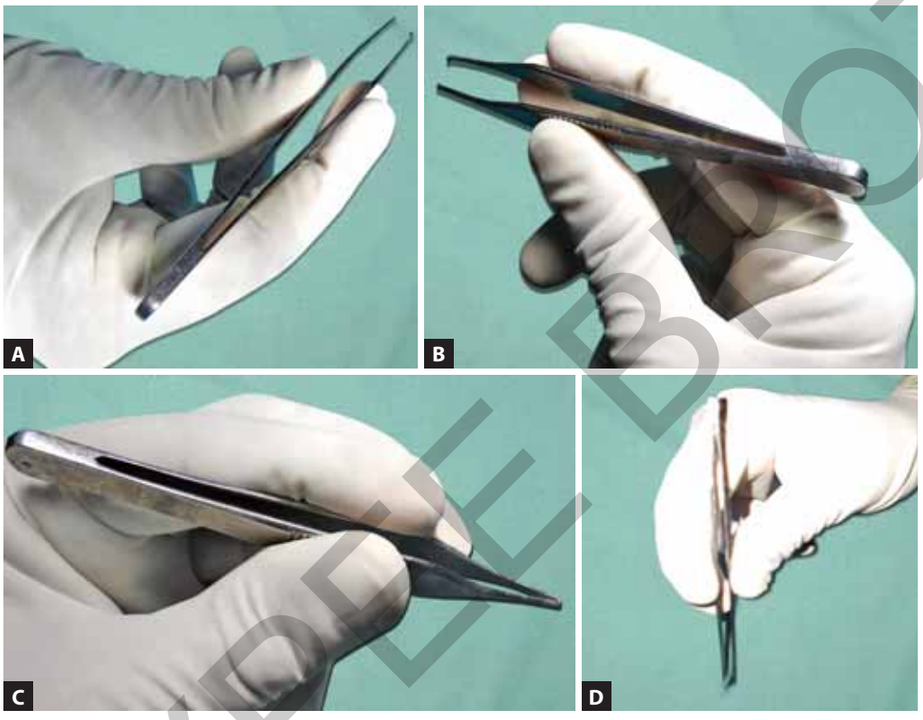
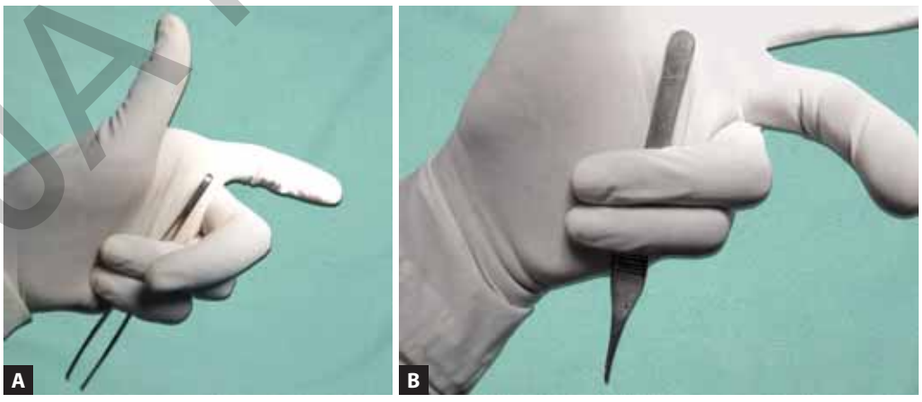


Figs. 11A and B: Bishop Harmon forceps—it is used in fine delicate tissue suturing.



Figs. 12A to D: Technique of holding and using dissecting tissue forceps.



Figs. 13A and B: Forceps is placed in the palm (palming the forceps) while knotting the sutures after taking the bites.

or non-toothed. Skin and tough structures are held using toothed forceps. Muscle, fascia, bowel, and delicate structures are held using nontoothed forceps **(Figs. 12A to D)**. Tip may contain one or more apposing teeth in toothed forceps (one-in-two or two-in-three). Different vascular forceps are also available. Firm grip should be used to hold the tissue properly to prevent slippage and to allow passage of the needle across the tissue for suturing **(Figs. 13A and B)**.

GAUZE

Gauze used can be woven or non-woven. In depth and wider fields mops are used.

Non-woven gauze can be made of natural materials such as cotton, linen, wood pulp, and paper or synthetic materials such as polyester, polypropylene, polyimide and polytetrafluoroethylene (PTFE). Non-wovens are usually lightweight, soft and flexible; offering precise absorbency, fluid retention porosity, low dust and shedding properties; allowing enhanced absorption and retention levels and also allow longer use. Cotton is natural, soft, comfortable, hypoallergenic and naturally absorbent with a greater wet than dry strength and is popular. Natural materials such as viscose, Tencel and lyocell (regenerated cellulose fibers often blended with polyamide or polyester materials) are also used. Biopolymer material like polylactide is new one with a renewable and biodegradable/recyclable option. Mops and gauzes are often having radiopaque lines as an identifying marker **(Fig. 14)**.

SCALPEL HANDLE AND BLADE

Bard Parker's handle (BP handle) is a flat stainless steel (very sharp and resist dulling from frictions in tissues) or carbon steel (more sharp but prone for early dulling) instrument with a slot on narrower side on both surfaces to attach scalpel blade. 3, 4, 5, and 7 numbered blades are available. Number 4 handle is wider. Scalpel blades 10, 11, 12, and 15 fit in to Bard Parker handle numbers 3, 5, and 7. Scalpel blades 18, 19, 20, 21, 22, 23, and 24 fit into slot of Bard Parker's blade number 4. New blade is used into the slot of the handle for each



Fig. 14: Surgical gauze used during suturing.

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Figs. 15A to C: Different types of Bard Parker (BP) scalpel handles.



Fig. 16: Beaver handle is specialized knife handles which are used in fine incisions and in ophthalmology.

patient and so sharpness of the blade is maintained. BP handle is sterilized by autoclave. Disposable handles even though not commonly practiced are often used with attached blades. Number 3 BP handle with number 15 blade and number 4 handle with number 22, 21, or 10 blades. Number 7 BP handle works like number 3 allowing corresponding blades but is lengthier **(Figs. 15A to C)**. *Beaver handle* is another handle but needs specialized blades. It is used in microsurgery and in ophthalmology. 15C blade, a specialized one, is often used which is smaller than 15 blade **(Fig. 16)**.

Blades are usually of detachable one. Number 11 blade is a stab knife blade which is used in incision and drainage of an abscess and in making small incision like for drains. Number 12 blade is curved one, used for tonsillectomy. Here cutting edge faces surgeon. Number 15 is used in plastic surgery, head and neck surgery, face surgeries. Numbers 20, 22, and 24 are used in skin incisions of major surgeries such as laparotomy, thoracotomy, craniotomy, and incisions in limb. Blades are sterilized by gamma radiation with aluminum foil packing. Commonly blades are used only once and then disposed. If sterilization is needed, then it is done by immersing in cetrimide/lysol solution (not autoclave or boiling). Scalpel is also used for dissections of fascial planes, raising skin flaps, hernial sac, etc. Fine lateral oblique strokes are used for such dissections. One should have a control over the depth of dissection. When scalpel is used in the abdomen like while cutting the bowel, it should be used in such a way that sharp edge of the blade should face forward so that to avoid inadvertent injury to deeper vital structures. Bowel is cut from mesenteric margin toward antimesenteric surface. Number 3 and 4 Bard Parker knives are used commonly for different detachable blades.

Diamond knives are used in ophthalmology—Handles are made from titanium and high-quality aluminum and blades are honed from gem-quality diamonds.

SCISSORS

Scissors are used for tissue cutting, dissection, and cutting the suture removal. Curved scissor is used for dissection. Straight scissor of different types is used for suture cutting. Fine scissors with different curvatures are available and used depending on the need, field, and precision in surgery **(Figs. 17A and B)**.

HEMOSTAT

Different types of hemostats are available—Medium-sized hemostat (artery forceps), large artery forceps, and Halsted fine

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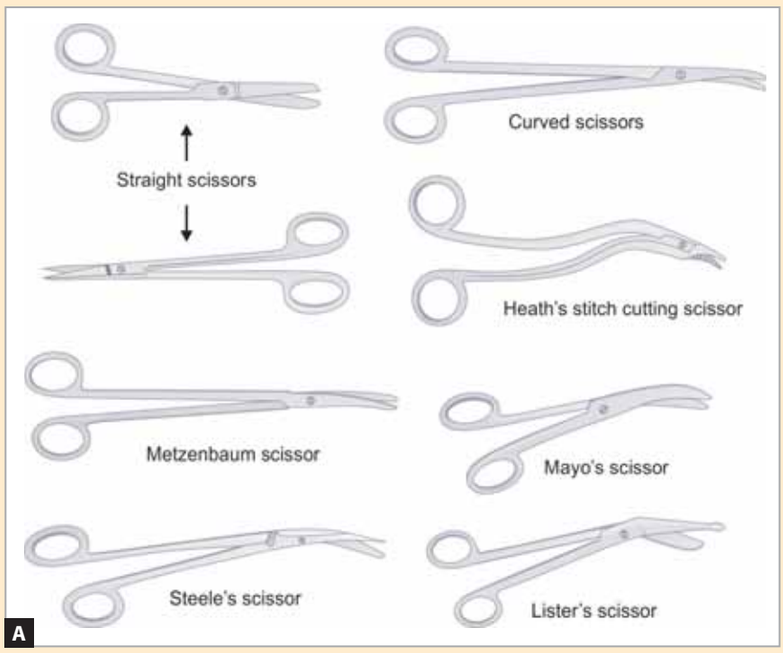



Figs. 17A and B: Different scissors used in surgical practice.

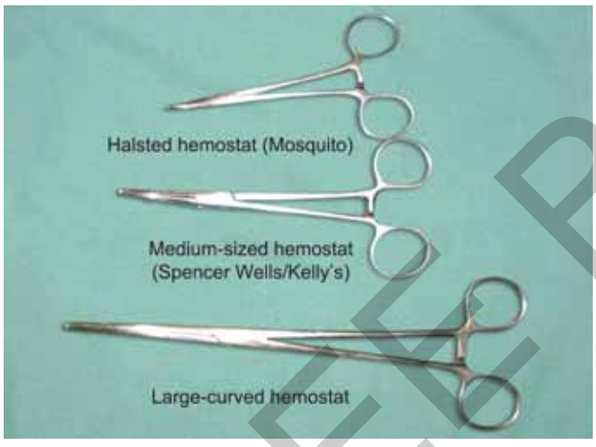

Fig. 18: Hemostats used during suturing to catch bleeders while suturing.



Fig. 19: Bayonet forceps with curves in the handle used in bipolar cautery. Bent and straight types are available.

mosquito forceps. It is used to catch the bleeders and to control hemorrhage **(Fig. 18)**.

CAUTERY

Cautery is an essential tool in surgical field. Both monopolar and bipolar cautery are used. Bipolar is better for hemostasis which does not require earthling **(Figs. 19 and 20)**.

SKIN STAPLER

It is a device to appose the skin wound edge by placing series of stapler pins. It is quick and saves time. It causes less inflammatory reaction and so less postoperative wound pain. Removal is easier using a specialized device. But it is not hemostatic; wound edge eversion cannot be achieved properly. It is used mainly after laparotomy, limb surgeries and in quick closure of lengthy skin wounds **(Figs. 21A to C)**. It is not much useful in cosmetic surgeries.

SUTURE REMOVAL SET OR CLIP REMOVAL

Suture removal is done in skin sutures whether it is simple or mattress sutures. Absorbable suture (subcuticular) is usually not removed. Straight scissor is used for stitch removal. Heath's specialized scissor is also useful **(Figs. 22A to C)**. Toothed tissue forceps is essential to hold the knot ends (ears of the suture). Suture is cut away from the wound and pulled out toward the wound edge. 11 number blade also can be used to remove the stitch. Straight scissor is also used to cut the knot ends after knotting the suture. Curved scissor should be used to cut the tail ends of the knot in the depth and close to the vital structures. Suture area is first clean with normal saline. The suture is grasped with non-tooth dissecting forceps and lifted above the epithelial surface. Scissors are then passed through one loop and then transected close to the surface to avoid dragging contaminated suture materials through tissues. The suture is then pulled toward the incision line to prevent dehiscence **(Fig. 23)**. If suture entrapped in a scab, then application of hydrogen peroxide/normal saline is necessary. Clip removal is done with specific instrument which widens the clip ends outward and removes the clip-like a "W" **(Figs. 24 and 25)**.

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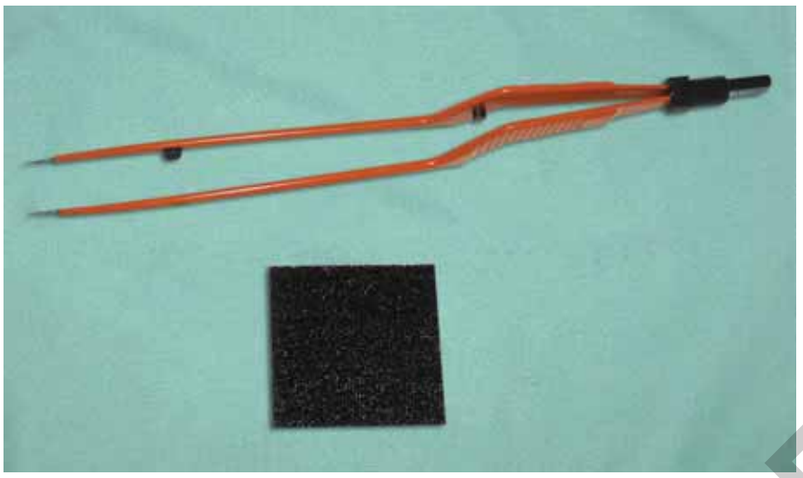
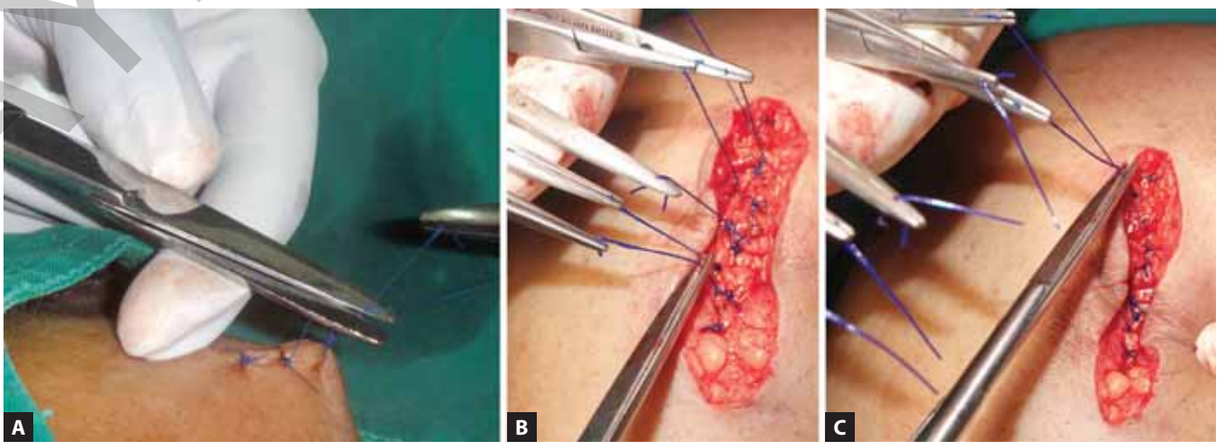


Fig. 20: Nonsticky bipolar cautery.



Figs. 21A to C: Skin stapler and stapled wound.



Figs. 22A to C: Straight scissor is used to cut the tails of the suture after knotting. 4-mm tail ends are left to avoid knot slippage and later to make suture removal easier.

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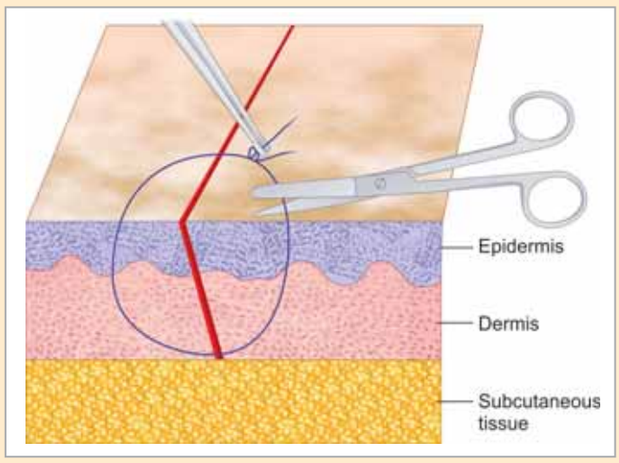
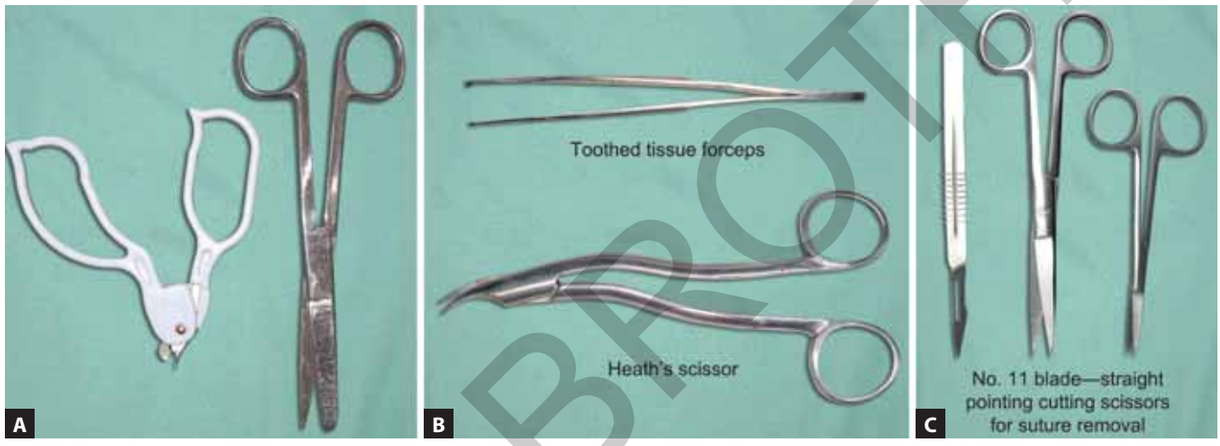


Fig. 23: Suture is removed after cutting the suture very close to skin surface on the opposite side of the wound; after cutting the knot that is held, it should be pulled toward the wound side, not away from the wound site. Both ends of the loop should not be cut; if done it will cause retaining of the suture material inside the wound creating complications.



Figs. 24A to C: Clip removal and suture removal set.



Figs. 25A to C: Skin stapler clip removal.

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LAPAROSCOPIC NEEDLE HOLDER (FIGS. 26A AND B)

Coaxial handle needle holder is better than pistol handle needle holder. Handle is ringless which facilitates better maneuverability. Handles are heavy and strong to have a firm grip. Tip is either straight or curved to place the needle. Only one of the jaws in the tip opens. Right and left hand needle holders (two-needle holders) are better to have easy suturing technique; but commonly we use needle holder in one hand and serrated non-toothed grasper or Maryland instrument in another. Tip with jaws should be strong and hold the needle firmly without any slippage during movements while taking bites from the tissues.

BIOADHESIVES

Bioadhesive-like iso-amyl-2 cyanoacrylate is used for apposition of skin especially in small incisions, laparoscopic port-site incisions, etc. **(Fig. 27)**. Few adhesives materials are tried in fixing the synthetic material like mesh also.



Figs. 26A and B: Laparoscopic needle holder.



Fig. 27: Bioadhesive-like iso-amyl-2 cyanoacrylate is used for skin apposition in small incisions.

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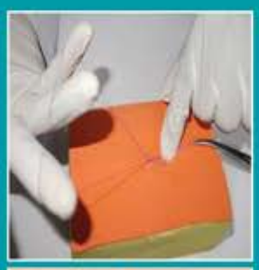
SRB's Atlas of Tissue Approximation with Suturing & Knotting







Salient Features

- It is unique in giving clear-cut idea about suturing and tissue approximation with perfect technical details step by step
- Includes seven chapters. Chapters 1 to 3 highlight the history of suturing, instruments, suture materials and needles, which are basic foundation of the tissue approximation. Chapters 5 and 6 deal with detailed outline of technical aspects of different suturing, their advantages and disadvantages. Chapter 7 explains basics of laparoscopic suturing which is essential for current surgical practice.
- All discussions are supported by excellent illustrations which will help student/learner to understand the complex suturing in easier way.
- This atlas is also supported by videos of basic suturing technique.

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A dedicated teacher, adored by his students for he has been an unending source of motivation and inspiration at viewing and understanding surgery as the subject it is. A simple person by nature, it is his love and dedication towards his profession that has made him what he is at present. With a teaching experience of 30 years, it will be no exaggeration that the art of teaching naturally comes to him.

He, under the aegis of Manipal Academy of Higher education (MAHE), has lived upto the principles and expectations of the profession. He is also a popular Practicing Surgeon in Mangaluru.

He has also written other books also, namely *SRB's Manual of Surgery, SRB's Clinical Methods in Surgery, SRB's Surgical Operations: Text and Atlas,* and *SRB's Bedside Clinics in Surgery*.

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