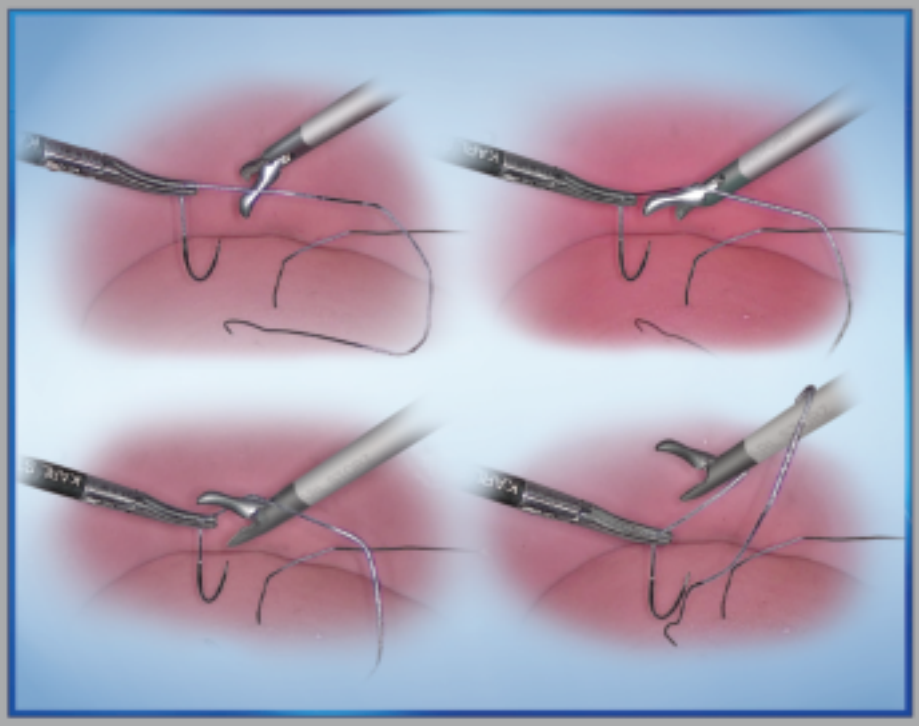
ROMEO'S GLADIATOR RULE: KNOTS, STITCHES AND KNOT TYING TECHNIQUES

A TUTORIAL BASED ON A FEW SIMPLE RULES

NEW CONCEPTS TO TEACH SUTURING TECHNIQUES IN LAPAROSCOPIC SURGERY



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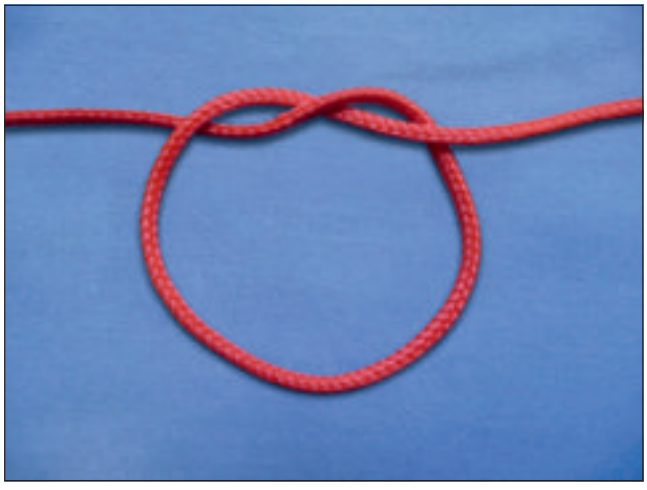
Classification of Knots in Laparoscopy

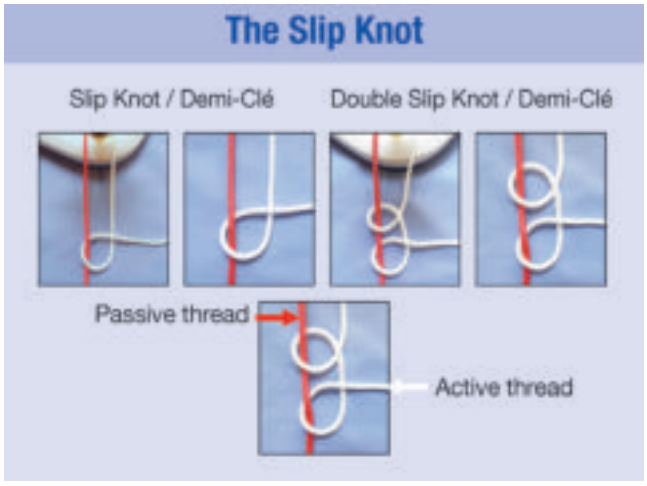
The following knots are the most comonly used in laparoscopy:

- **Basic Knots**
  - *Half knot*
  - *Slip knot / demi-clé*
- **Complete Knots**
  - *Square knot* – sequence of two identical half knots
  - *Surgical knot* – blocking sequence of half knots
  - *Slip knot* – blocking sequence of slip knots / demi-clé
  - *Slip knot – Roeder's knot*

1 Classification of knots most commonly used in laparoscopy.



2 Half knot.



3 The slip knot / demi-clé[i].

1.0 Classification of Knots in Laparoscopy

1.1 Classification

1.1.1 The Half Knot

This is an incomplete and unreliable knot since it is very easy to untie. To tie this knot, both ends of the suture must be pulled in opposite directions with uniform tension in the same plane. The main characteristic is that a hypothetical midline divides this knot in two symmetrically identical parts (**Fig. 2**).

1.1.2 The Slipknot / Demi-Clé[i]

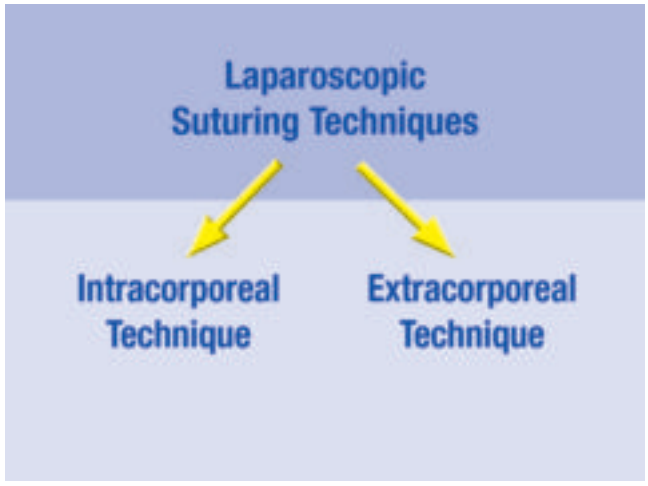
This is another basic, unreliable, incomplete and asymmetric knot which does not have enough strength to maintain approximation of the wound edges. When tying this knot, each thread has a different role, one remains inactive and the other, called active thread, forms the knot by wrapping around the other one (**Fig. 3**).

Active and Passive Threads. The passive thread is the one that remains inactive during tying, and the active thread plays an active role during knotting in that it is always wrapped around the passive thread (**Fig. 3**).

The half knot and the slipknot / demi-clé[i] are the cornerstones of a building called **knot**, which is composed of a correct sequence of half knots and/or slipknots.

Our learning objective is to simplify and standardize laparoscopic suturing techniques. Based on our daily surgical experience, we have developed a training system with exercises designed to enable our students to learn three knots and three suturing techniques that can be easily and safely performed: *Laparoscopic suturing must be uncomplicated and reproducible.*

i from French: *nœd demi-clé*



4 Classification of laparoscopic suturing techniques.

1.2 Laparoscopic Suturing Techniques

Laparoscopic suturing techniques are classified as intracorporeal and extracorporeal (**Fig. 4**).

1.2.1 Intracorporeal Technique

In the intracorporeal technique, the knot is made inside of the abdominal cavity using two instruments; these can be two needle holders or one needle holder and one assistant forceps.

1.2.2 Extracorporeal Technique

In the extracorporeal technique, the knot is made completely outside of the abdominal cavity. Afterwards, it is pushed inside the abdomen with a knot pusher, which could be a slipknot pusher or a Roeder's knot pusher.

1.3 The Knot's Blocking Sequence: Intracorporeal and Extracorporeal

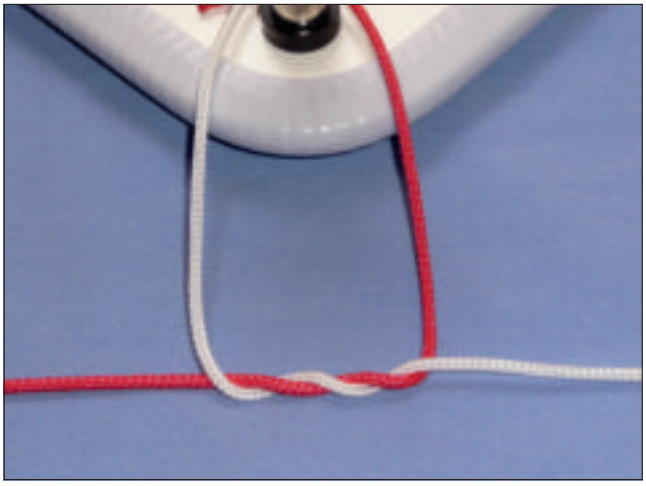
The knot's blocking sequence is a serie of half knots and/or slip knots, that confer to the knot the maximum grip, which is equal to the maximum tensile strength of the suture that will always break close to the knot. The blockade is total and any force applied in an attempt to move the knot in one or the opposite direction will inevitably fail; it will only result in breakage of the suture (**Figs. 5–9**).

Based on our concept, we consider three different knots to be memorized and three knotting techniques for a fast and safe approximation of wound edges. These are easy to learn and the technique is reproducible:

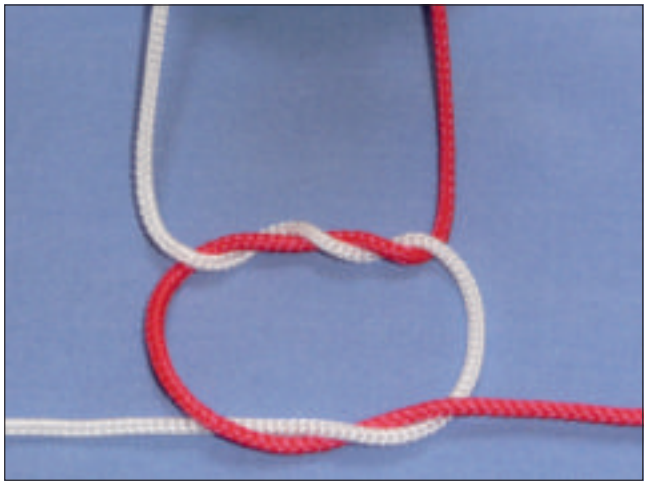
1. Intracorporeal knot (**Fig. 6**)
2. Extracorporeal slipknot (locking sequence of slipknots) (**Fig. 8**)
3. Extracorporeal sliding knot (Roeder's Knot) (**Fig. 9**)

In order to meet all demands of laparoscopic suturing, a good command of the technique is required, essentially involving only a few but well-chosen knots.

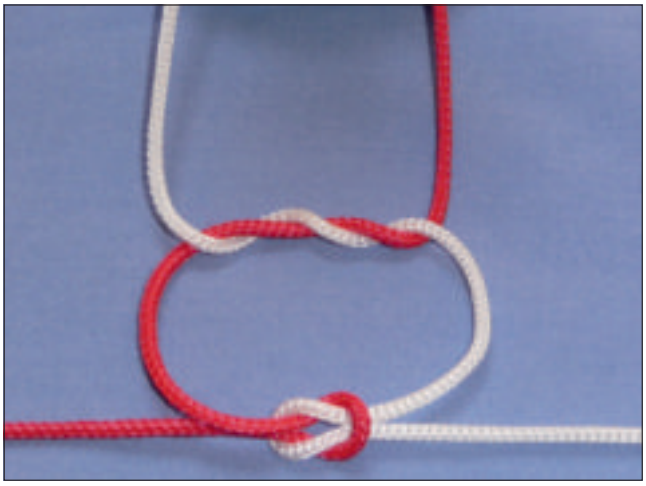
1.3.1 The Blocking Sequence of an Intracorporeal Knot



5 Square knot sequence of two half knots in horizontal line.

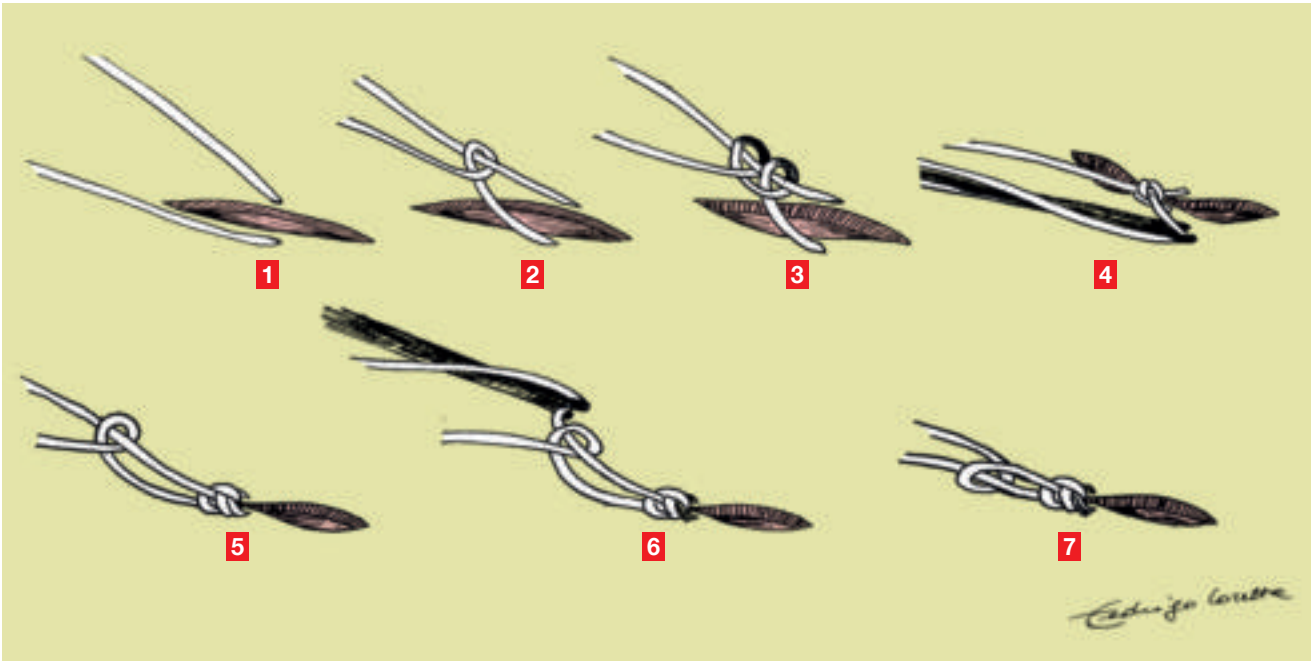


6 Square knot and half knot.



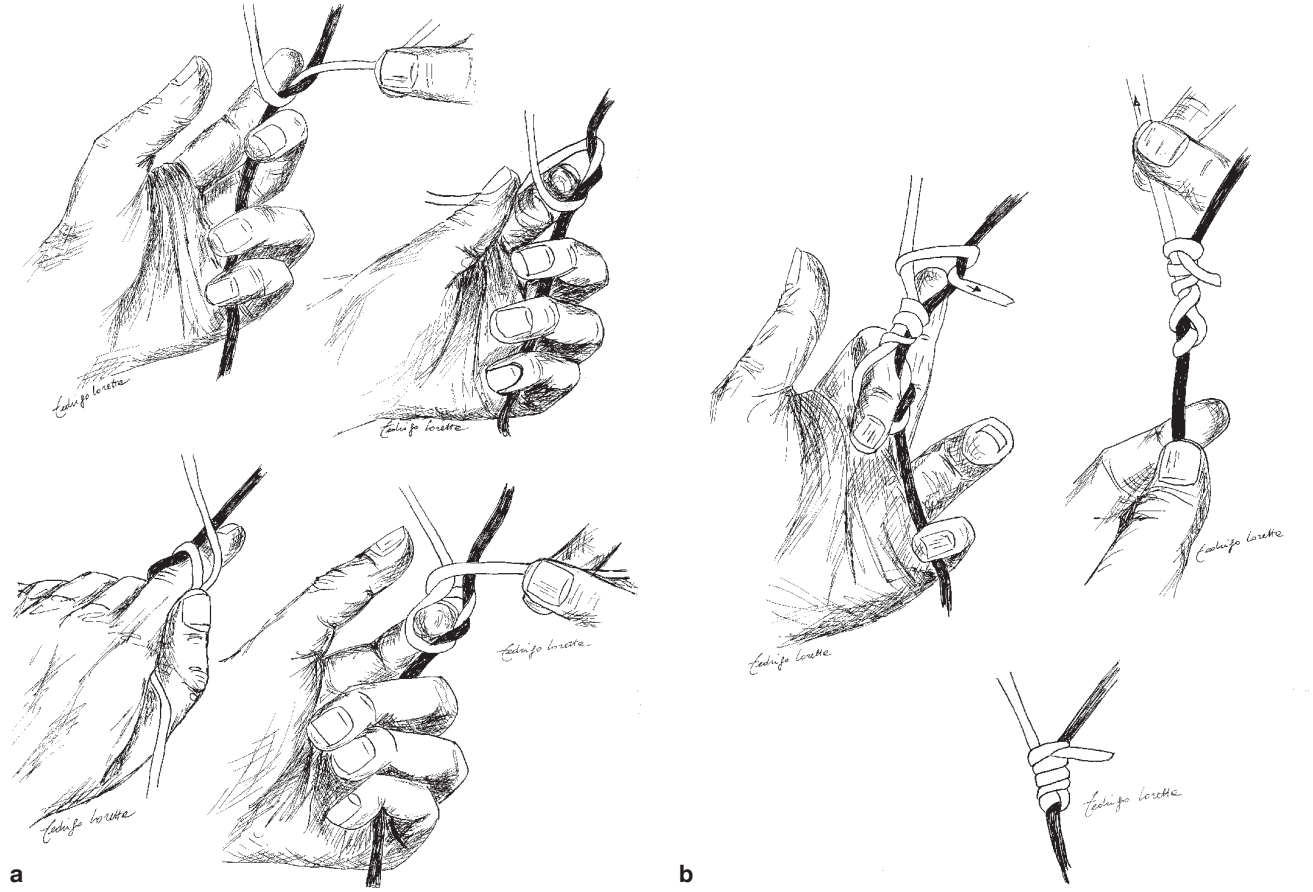
7 Square knot and reverse half knot with half knot or slipknot. This blocking serie is called *surgical knot*.

1.3.2 The Slip Knot Blocking Sequence



8 The blocking sequence of a slip knot.

1.3.3 The Roeder Knot Blocking Sequence



9 The Roeder knot blocking sequence.

2.0 Theory of Parallel Axes: The Ideal or Perfect Stitch and the Gladiator Rule for Knot Tying in Laparoscopy

2.1 Description of Axes, Angles and Planes

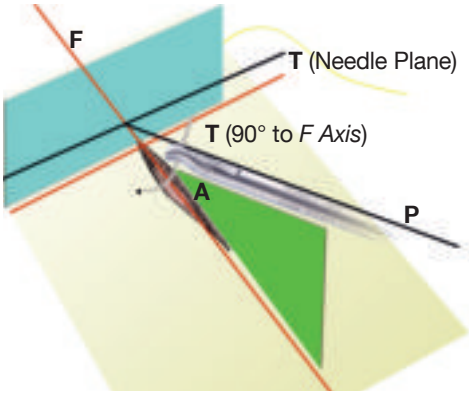
For a better understanding of the perfect stitch, a rationale will be given explaining the relationship between *P* and *F Axes*, *T Plane*, and *Entry Angle A* (**Fig. 1**) because the concept of the perfect stitch is based on a specific combination of these four elements (**Figs. 1–4**).

In the perfect stitch, the needle – perpendicular to the *P axis* of the needle holder – penetrates the tissue with an *entry angle* A of 90° in relation to the *F axis* of the wound. Considering this, it is concluded that both axes, *P* and *F,* are parallel to each other, confirming the theory of parallel axes (**Fig. 4**). This always applies when the entry angle *A* is not greater than 45° (**Fig. 1**).

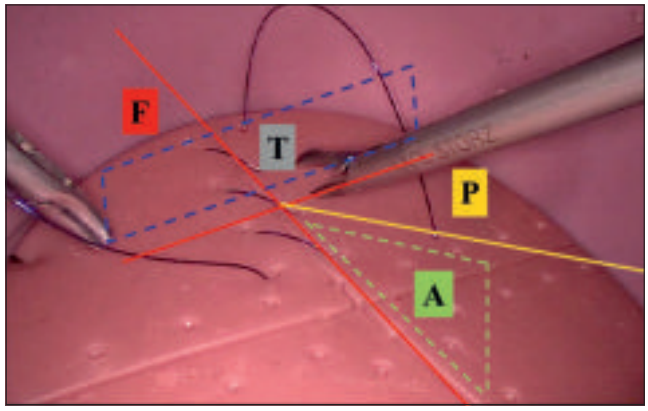
In laparoscopy, due to fixed trocar sites, the perfect point is not always feasible. To overcome this difficulty and in an attempt to get as close as possible to the ideal of a perfect stitch, all surgical skills of the trainee should be focused on the idea that one could use both hands to achieve the best position of the needle holder. Positioning of the needle in the needle holder's jaws at an angle equal or greater than 110° affords the user a greater variety of options regarding the most appropriate trajectory of needle entry, thereby helping to achieve the perfect stitch.

At the beginning of a surgical procedure, the most ergonomic site for trocar placement should be planned in accordance with the area that needs to be sutured. This will facilitate establishing the best parallelism condition between the *P axis* of the needle holder and the *F axis* of the wound, allowing the suture to be made easily.

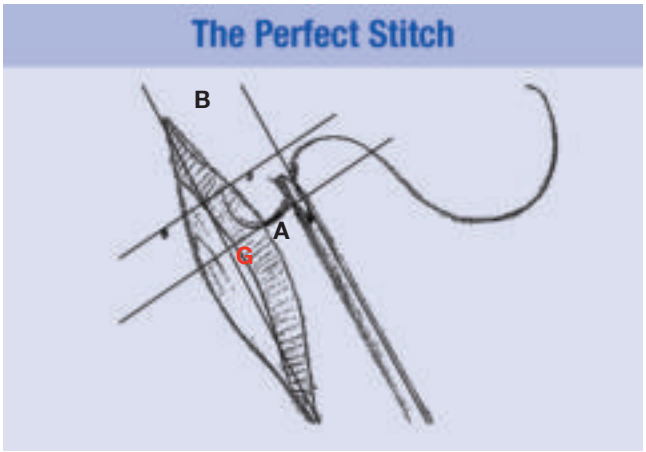
Modifying the angles, the trainee should be able to meet as close as possible the ideal of a perfect stitch. Changing the position of the *P axis* of the needle holder in relation to the *F axis* of the wound, one should always seek for the perfect parallelism condition significantly facilitating the stitch.



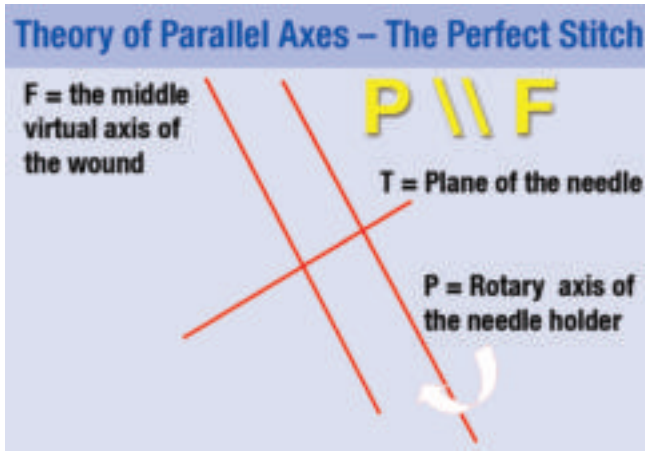
1 **The perfect stitch. P** (main rotation axis of the needle holder), **A** (entry angle in relation to the *F axis* of the wound), **F** (wound's medial virtual axis), **T** (plane of the needle loaded in the needle holder).



3 The perfect stitch.



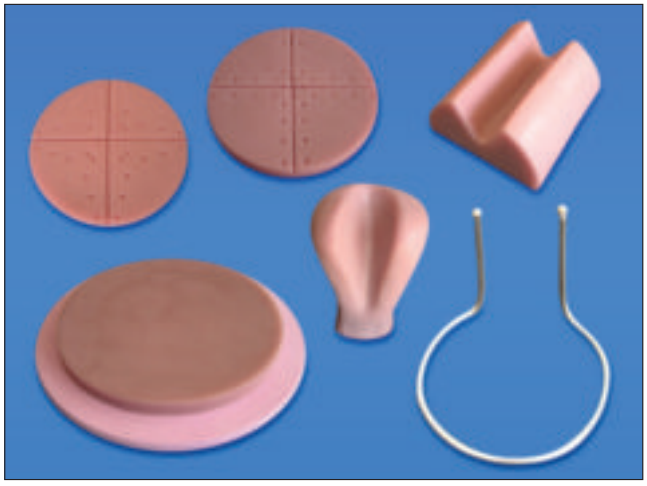
2 **The perfect stitch. Angle Alpha (A)**: 90°, between P axis and T plane, **Angle Beta (B)**: 0°, between P and F axes, **Angle Gamma (G)**: 90°, the crossing angle between T plane and F axis.



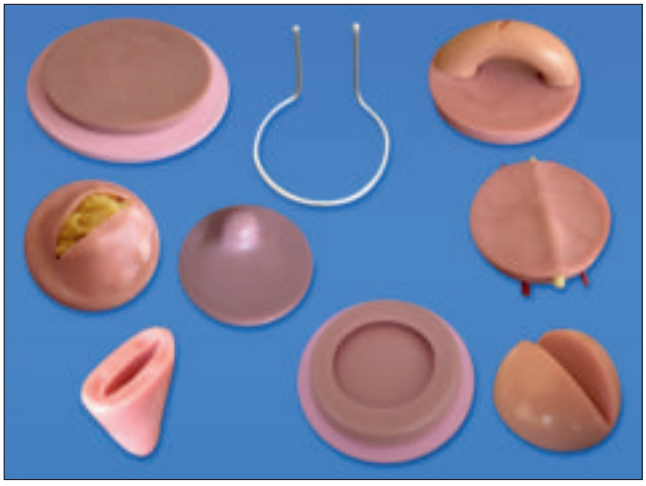
4 The perfect stitch. P and F axes must be parallel.

5 Multiangular training models for suturing (ETR1).

Understanding the interrelations between axes, planes and angles, we conclude that making a stitch consists in 'solving' a geometric problem. From this concept emerges the idea of using in our basic courses models that reproduce the ideal conditions of a perfect stitch. In this way, we are able to establish a training situation, that is different from real surgical conditions. The trainee is gradually moving to a more complex situation that approximates to the real surgical condition, still not matching the ideal, but staying true to the concept of a perfect stitch, choosing from a variety of specifically designed multiangular training models (ETR1, ETR2, ETR3, see **Figs. 5–7**).



6 Multiangular training models for suturing (ETR2).



7 Multiangular training models for suturing (ETR3).

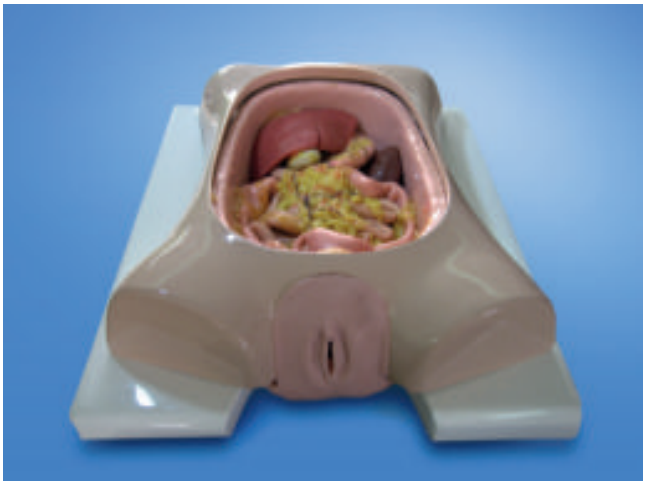
2.2 Realistic Endotrainer and Geometric Models

In order to perform a basic training, it suffices to use the multiangular models with a conventional endotrainer offering ample space, like the 'box trainer'. However, in an advanced training program, teaching suturing angles found in real pathologies, it is mandatory that exercises be performed on special models in a realistic endotrainer designed for training under next-to-realistic anatomic conditions (**Figs. 8–11**).

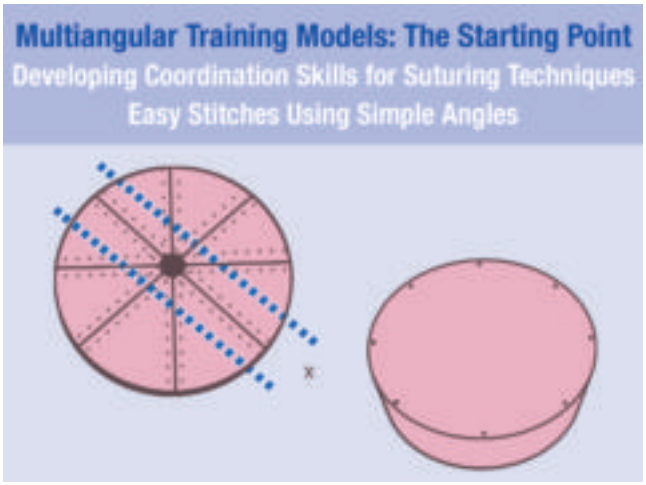
The *Realistic Endotrainer* is a perfect reproduction of human anatomy, that allows:

- to insert synthetic models of abdominal and pelvic organs with and without pathology, even giving the option of simulating bleeding (**Fig. 7**).
- to perform laparoscopic procedures with an assistant while using the same equipment and instruments routinely employed in the OR (using the correct ergonomics).
- to simulate suture angles with the same haptic feedback as in surgery, placing the stitch with the same suture tension, and loading the needle in the needle holder under similar conditions as in daily practice (**Figs. 9, 10**).

Multiangular geometric models allow to develop motor coordination and stereotaxis which are mandatory in laparoscopic surgery for placing perfect stitches. The trainee is well-advised to start with simple suturing angles (stitches placed from left to right with needle holder in the right hand) (**Fig. 9**).

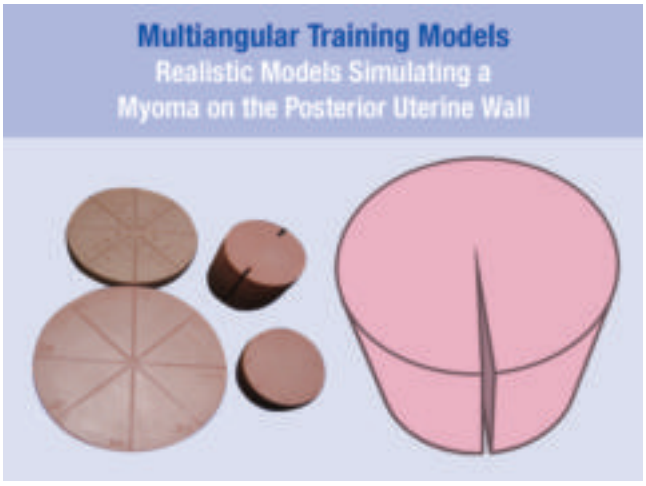


8 Realistic Endotrainer.



9 New multiangular training models. The starting point to learn.

10 Multiangular geometric models.



11 Model for simulating the presence of a myoma on the posterior wall of the uterus. Simulation of suturing angle with vertical *P axis* through the suprapubic trocar.

2.3 The Gladiator Rule: A Universal Suturing Technique

With the *Gladiator Rule* – which will be described below – we are placed in the position to master any entry angle occurring in daily surgical practice; the operating surgeon will never be in trouble, therefore we consider this knotting rule as universal and applicable for suturing in laparoscopy.

To demonstrate the flexibility of the technique, we will propose two essential premises.

The *Gladiator Rule* applies to
- all lengths of the thread,
- all instruments placed in any angle and position

The *Gladiator Rule* anticipates the use of the main needle holder, the jaws of which are constantly kept wide open in order to expedite the knotting phases (**Fig. 12**).

The opened jaws serve as a gripping hook that transforms a portion of the thread's horizon into a condition of parallelism with the *P axis* of the needle holder (see *Theory of Parallel Axes*) and also keeps the thread aligned, thus preventing it from slipping off the surgical instrument.

During knotting, the needle holder performs a clockwise turn (from 6 to 12 o'clock) or counter-clockwise turn (from 12 to 6 o'clock) with jaws opened. The maneuver resembles the *'Pollex Versus' gesture* used by Roman emperors to announce a verdict of condemnation or mercy to losing gladiators.

The *Gladiator Rule* was introduced in 2004 at the IRCAD[i] course on *'Advanced Techniques in Operative Gynecological Endoscopy'*. In October 2006, the rule was presented during the *15th Annual Congress of the European Society for Gynecological Endoscopy (ESGE)* in Strasbourg, France, and was published in Italian in the same year.[ii] A recently published article by *MEREU et al.* refers to the same topic[iii].

According to the *Gladiator Rule*, the main needle holder with jaws opened performs a rotation around the thread's horizon using always the left hand in a coordinated manner. The reverse movement of the left hand is made smoothly, facilitating the thread to wrap around the suture instrument and preventing it from slipping off due to inconvenient movements.

When knot-tying is done with trocars in a lateral position, the *Thread's Horizon* must be placed in the best possible horizontal position, always to the right (**Fig. 12**).

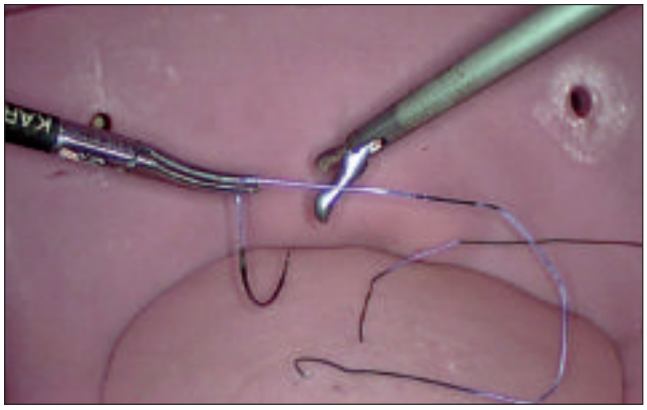
When knotting with the main needle holder in the central position (suprapubic trocar), the *Thread's Horizon* is usually located at a slightly higher level (2 o'clock position), almost forming a diagonal on the monitor (**Fig. 13**).

The more the *Thread's Horizon* is aligned with the P axis of the needle holder, the more simplified is the knotting; a simple, slightly rotational movement of the needle holder around its longitudinal axis is enough to cause the thread to wrap around the shaft. Next, while keeping the thread securely on the shaft of the needle holder, a coordinated movement is made to grasp the end of the suture. The maneuvers to execute this movement are trained in our advanced courses.

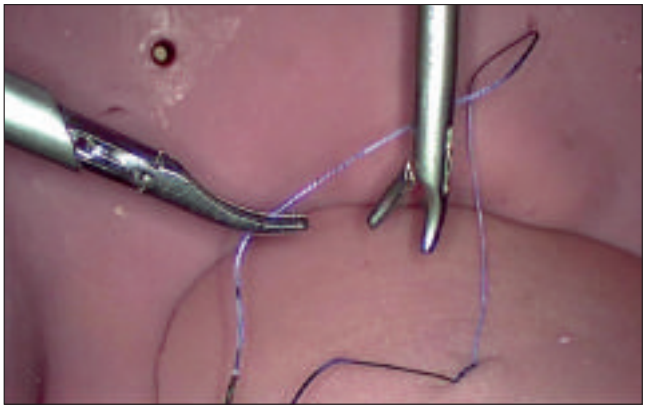
i **IRCAD,** Strasbourg, France.
Institut de **r**echerche **c**ontre le cancer de l'**a**ppareil **d**igestif
(Research Institute against cancer of the digestive tract).

ii ROMEO A, MINELLI L, 2006: Manuale dei nodi e delle tecniche d'annodamento in laparoscopia.
1° edición. Verona, Italia. Edit E.G.E.S. Edizioni. Pp. 17–89

iii MEREU L, CARRI G, ALBIS FLOREZ ED, COFELICE V, PONTIS A, ROMEO A, MENCAGLIA L. Three-Step Model Course to Teach Intracorporeal Laparoscopic Suturing. Journal of laparoendoscopic & advanced surgical techniques Part A. January 2013, 23(1): 26-32.



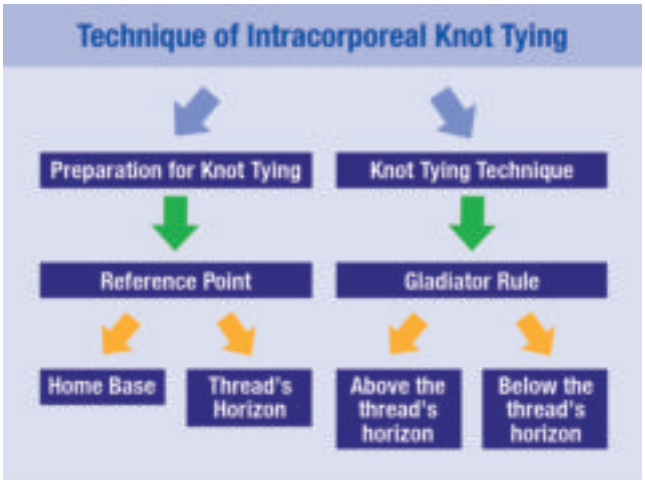
12 The Gladiator rule applied above the thread's horizon.



13 The *thread's horizon* and the main needle holder are in central position.

2.3.1 Preparation for Knot Tying: Reference Points

During preparation for knot tying, a few reference points need to be defined that are highly essential for proper application of the *Gladiator Rule* (**Fig. 14**).w



14 Preparation for knot tying and reference points.

2.3.2 Home Base

The first reference point is the *Home Base,* which is defined as the virtual space or cylindrical area where the knot is placed (**Fig. 15**).

If the trainee remains at the *Home Base* utilizing the maximum length of the thread at all times, it is possible to circumvent the video camera's inherent drawback of two-dimensional vision. As a result, the needle-thread-system is maintained without the need for constant readjustment of tautness.

Successful knot tying requires the trainee to stay as close as possible to the home base. If the opposite is done and the trainee moves away, considerable problems will arise when attempting to perform the maneuver described in section 2.3.

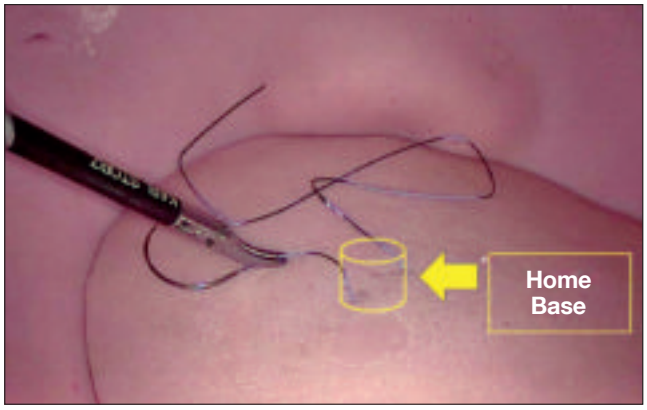
2.3.3 The Thread's Horizon

The second reference point is the *Thread's Horizon,* which is defined as the rectilinear portion of the thread. It is created by displacing the thread to the right, opposite to the assistant forceps (**Fig. 16**).

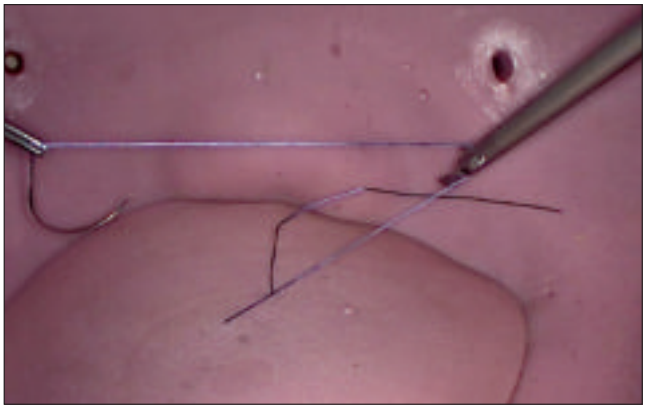
While the assistant forceps maintains a position within a radius of 2–3 cm from the needle's connection point with the thread, the main needle holder is used to tighten the free portion of the suture completely, pulling the strand to the right and, in turn, creating a segment that is as rectilinear as possible, defined as the *Thread's Horizon* (**Fig. 16**).

This maneuver has the dual purpose of approximating the instrument tips allowing them to work in close proximity, almost in touch with each other, and secondly, serves to provide a reference point needed to adequately complete the blocking sequence of the knot.

The *Thread's Horizon* is designed to facilitate wrapping the thread around the needle holder and enables the trainee to define the starting point – either above or below the horizon. This maneuver not only simplifies the decision as to which knot should be made, but always allows to perform the correct blocking sequence!



15 The home base.



16 The thread's horizon.

2.4 The Gladiator Rule: Knot Tying

The sequence of movements required for knot tying is preceded by a maneuver of the main needle holder wrapping the thread around its shaft. Henceforth, both instruments (needle holder and assistant forceps) must work together using back and forth movements without getting in each other's way, particularly during on-axis rotation of the needle holder.

The more the *P axis* of the main needle holder is aligned with – or parallel to – the *Thread's Horizon,* wrapping of the thread around the shaft is facilitated, allowing the first stage of knot tying to be completed.

Once the *Thread's Horizon* has been established according to the *Gladiator Rule*, the main needle holder is ready to go about making the turns with the thread forming the true knot.

2.5 The Gladiator Rule: Exercises

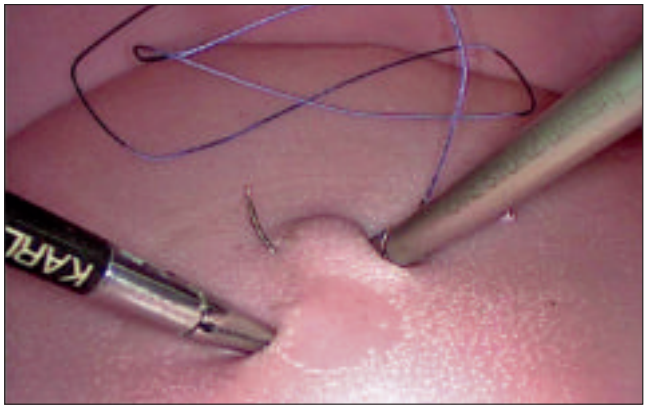
Right hand exercises with *needle holder in the right lateral trocar.*

- The Gladiator Rule applied above the thread's horizon (**Exercise 1**)
- The Gladiator Rule applied below the thread's horizon (**Exercise 2**)

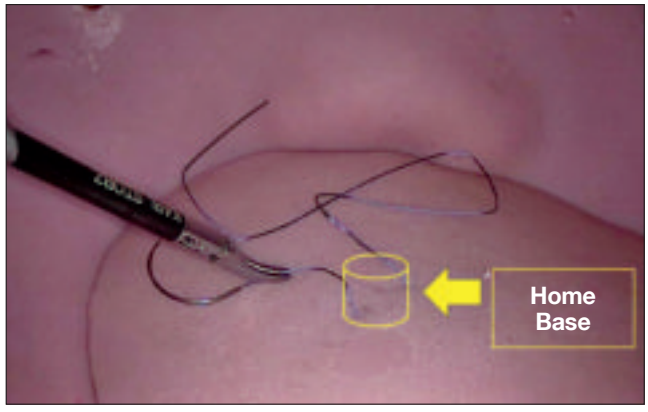
2.5.1 The Gladiator Rule Applied Above the Thread's Horizon

The maneuver involves that the trainee places a perfect stitch in the model while remaining at the *Home Base* (**Figs. 17, 18**).

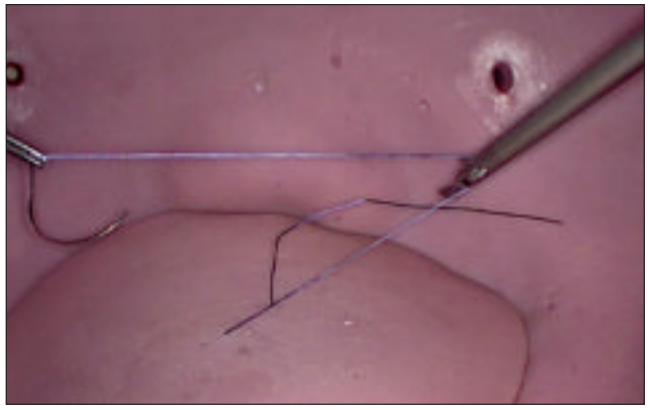
The *Thread's Horizon* will be located in lateral (3 o'clock) position, forming a horizontal line parallel to the base of the monitor (**Fig. 19**).



17 The stitch.



18 The home base.

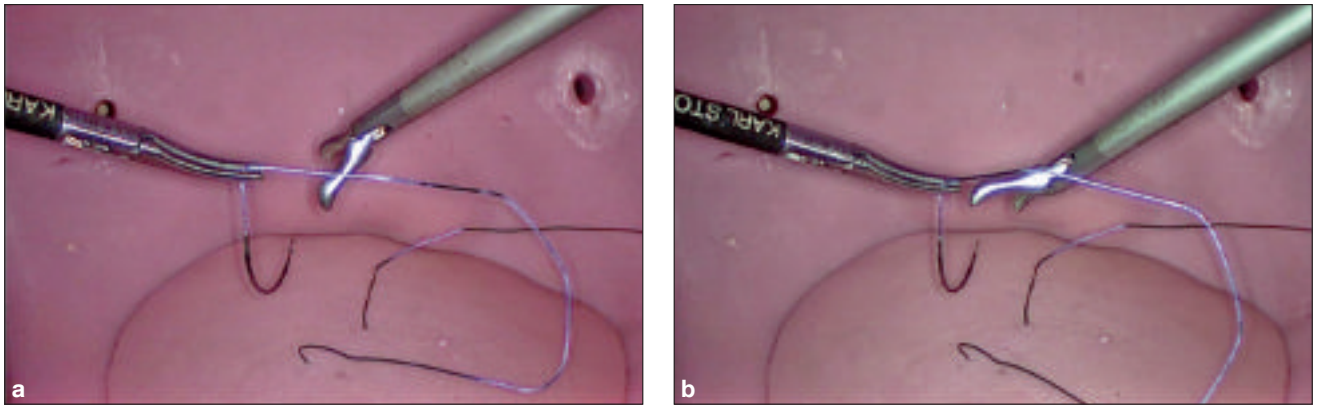


19 The thread's horizon.

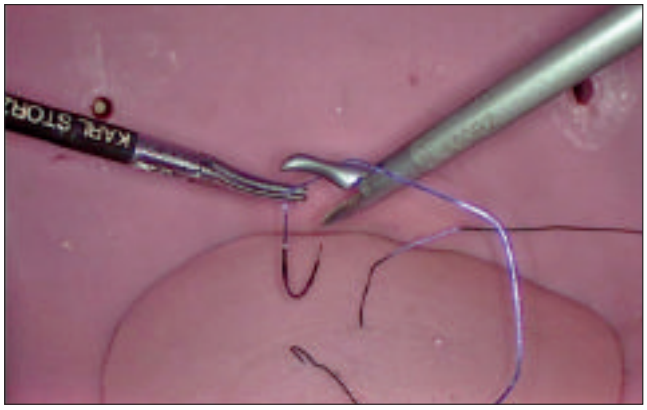
To perform the maneuver and make the turns of the needle holder above the thread's horizon, the following should be done: starting above the *Thread's Horizon*, the main needle holder with jaws opened is rotated on-axis (**Fig. 20**), first performing a 180°-clockwise rotation downward ('*Pollex versus' movement*), followed by another 180°-clockwise rotation upward, and ending up with the jaws in 12 o'clock position (**Fig. 22**).

The next starting point of the needle holder's jaws is the 6 o'clock position. A clockwise circular movement is performed, passing through 9 o'clock position, nearly touching the jaws of the assistant needle holder, and finally arriving at 12 o'clock position (jaws upward). While completing the 180°-upward rotation, the assistant forceps is guided upward, parallel and close to the *P axis* of the main needle holder, to ensure that the suture does not slip off the needle holder (**Figs. 20–22**).

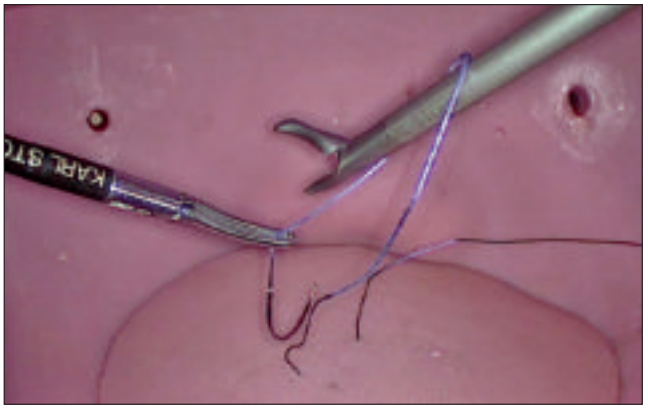
During intracorporeal suturing, when the needle holder starts knot tying above the thread's horizon, and if the second half knot is a blocking one, the maneuver must be performed with the needle holder in an inverted position (below the *Thread's Horizon*). This is a typical example of a blocking sequence.



20 Applying the Gladiator rule: the needle holder is located above the thread's horizon with opened jaws facing downwards (*Pollex versus movement*).



21 Clockwise on-axis rotation of the needle holder, passing through 9 o'clock position and nearly touching the assistant forceps.



22 The maneuver is completed with opened jaws in 12 o'clock position.

2.5.2 The Gladiator Rule Applied Below the Thread's Horizon

To perform the maneuver and make the turns of the needle holder below the thread's horizon, the following should be done: contrary to the previous exercise, the starting point of the needle holder's opened jaws is the 12 o'clock position (**Fig. 23**). Once the suture has been taken up, the needle holder performs a 180°-turn counter-clockwise on its *P axis,* passes through 9 o'clock position, and finally arrives at 6 o'clock position (**Figs. 23, 24**).

The circular movement of the needle holder is done on its *P axis*; the authors therefore propose the auxiliary notion, that the laparoscopic surgeon should regard the main needle holder as a 'screwdriver' or a 'fork' that is twirled to wrap spaghetti around its tines, but without completing a 360° rotation. The needle holder should make a 180° turn until arriving at the 6 o'clock position. Following the *Gladiator Rule,* a second knot is made above the *Thread's Horizon* by rotating the needle holder clockwise and ending up with opened jaws in 12 o'clock position. In this way, the *surgical knot* is completed.

In order to facilitate suture knotting, the trainee should start with the main needle holder in the right hand, which is convenient for the general surgeon who remains in triangular position with the assistant forceps, however this configuration is anti-ergonomic for the gynecologist.

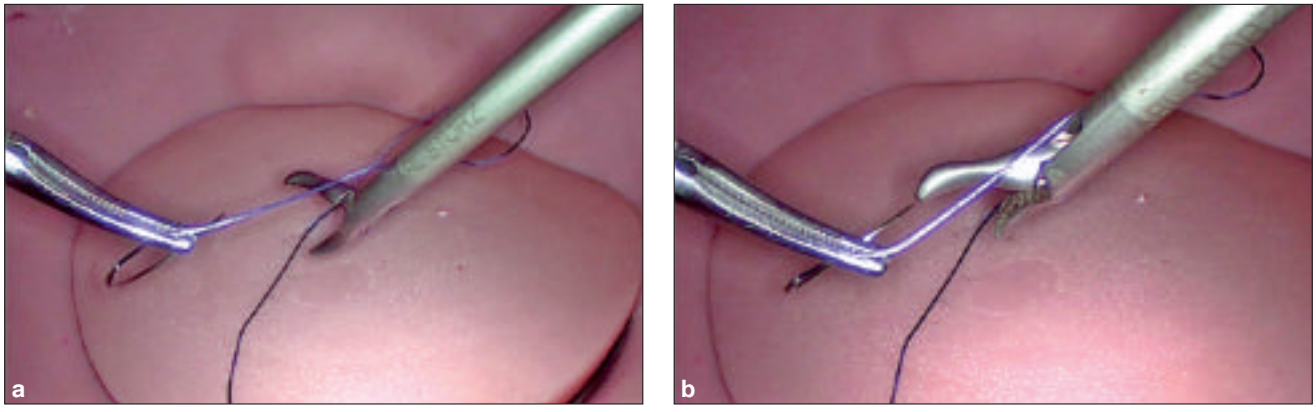
2.6 Real Situation in Gynecology: Ergonomics of Intracorporeal Suturing Through a Suprapubic Trocar

In order to simulate more complex circumstances of knot tying a gynecologist is commonly faced with in daily practice, the *Gladiator Rule* is applied by using the main needle holder at a more vertical *P axis* through a suprapubic trocar.

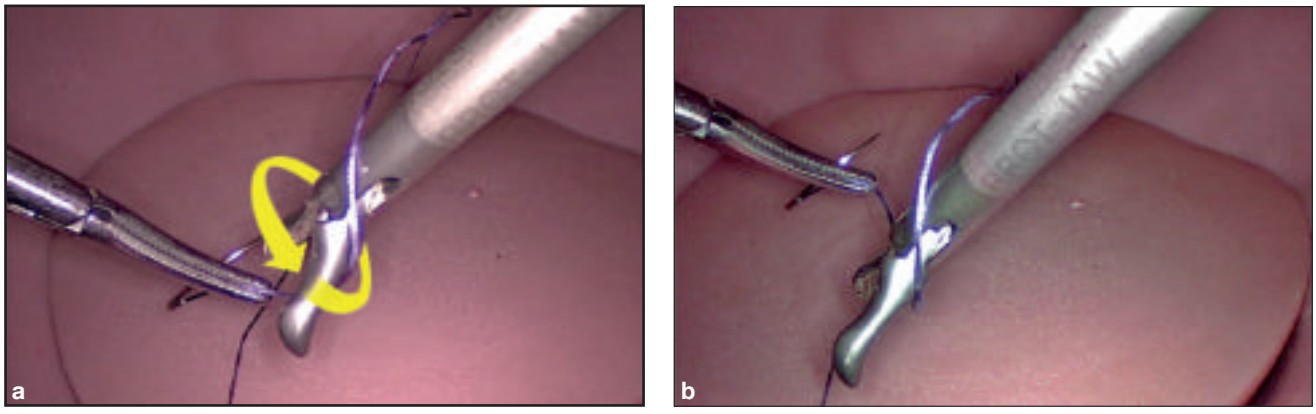
While introducing the main needle holder – which is always used in the dominant right hand – through a central suprapubic trocar (**Fig. 27**), the left hand is now more involved in the surgical field. The task now at hand requires that the trainee have obtained a certain level of proficiency through a regular training regime.

The objective of our technique in gynecology is to perform knot tying easily and quickly using the needle holder in the right hand through a suprapubic trocar, since this hand almost always will be in the most ergonomic position and most proximal to the workspace.

With regular training it will be possible to achieve a good command of the technique allowing the trainee to make sutures with both hands, swiftly and in an almost fatigue-free way. During initial stages of training, the right hand performs the finest movements while the left hand is being trained to assist in knot tying.



23 The Gladiador Rule applied below the thread's horizon.



24 The needle holder performing a counter-clockwise turn.

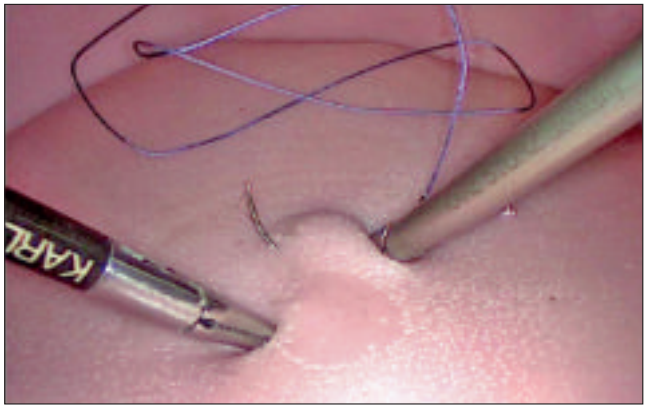
2.7 The Gladiator Rule in Gynecology (Suprapubic Position): Exercises

The dominant (right) hand guides the main needle holder through the suprapubic trocar:

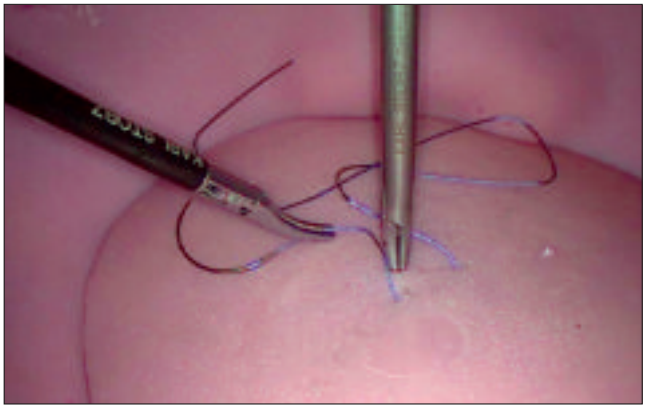
- Applying the *Gladiator Rule* with clockwise movement (**Fig. 27**)
- Applying the *Gladiator Rule* with counter-clockwise movement (**Fig. 32**)
- Maneuvers used to tighten the knot properly (**Fig. 31**)

In suprapubic position, the stitch must be done with the right hand in lateral position to achieve a moderate entry angle not exceeding 45° (**Fig. 25**). Subsequently, we start the knotting maneuver in an extremely vertical position with an entry angle of 90° relative to the suture plane (*P axis* angled 90° in relation to *F axis* of the wound) (**Figs. 26, 27**).

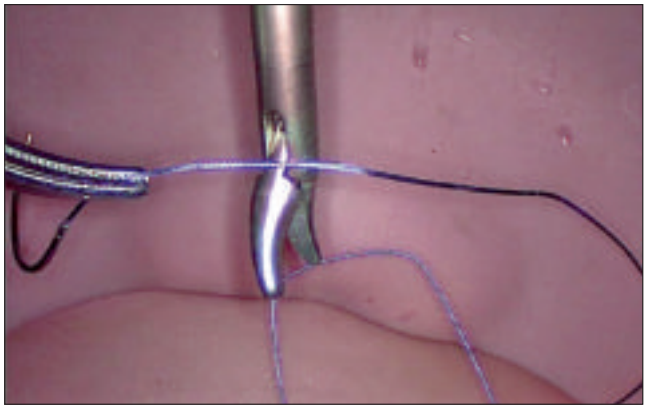
This is a typical ergonomic position in gynecology, but has shown to be also useful in the training of a general surgeon because it teaches to deal smoothly and rapidly with complex angles *impeding a perfect triangulation*.



25 Placing a stitch with the needle holder in the right lateral trocar.



26 Knot tying with the needle holder in suprapubic position (as is the case in gynecology).



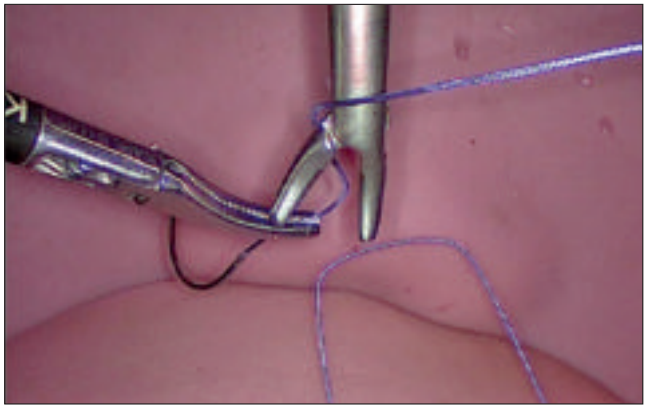
27 The thread's horizon.

2.7.1 The Gladiator Rule Applied Clockwise with the Right Hand in Central Position (Low Suprapubic Trocar)

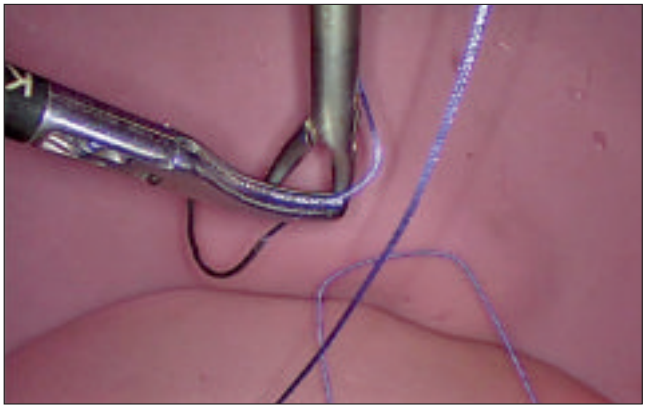
The needle holder is behind the *Thread's Horizon* relative to the viewer's position, in this case, with opened jaws (**Fig. 27**).

The assistant forceps brings the *Thread's Horizon* close to the needle holder. The *Thread's Horizon,* in this case, should be positioned at a higher level and aligned as parallel as possible to the *P axis* of the needle holder. Initially, an opposite movement is made with the needle holder to take up the suture, followed by a 180°-clockwise rotation, during which the assistant forceps in the left hand facilitates the downward movement and the crossover for wrapping up the thread. Once the needle holder has passed the *Thread's Horizon* and the turn is complete, the assistant forceps in the left hand is raised a bit toward the *P axis* to prevent slippage of the suture (**Figs. 28–31**).

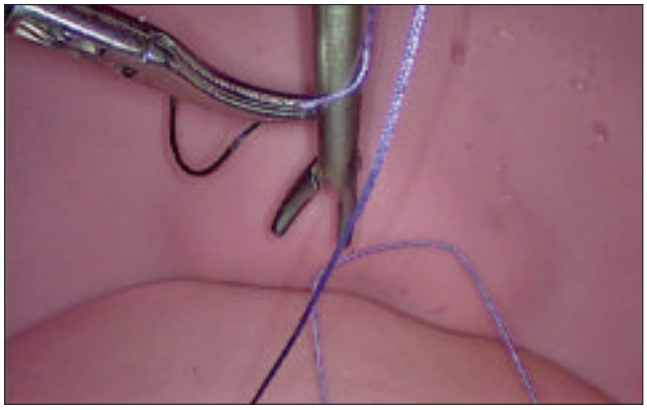
In order to perform the blocking sequence, in the next step, the thread always needs to be pulled opposite to the movement previously made. In this case, the needle holder is placed in front of the *Thread's Horizon* with opened jaws facing away from the camera. (See *2.7.2 The Gladiator Rule Applied Counter-Clockwise*).



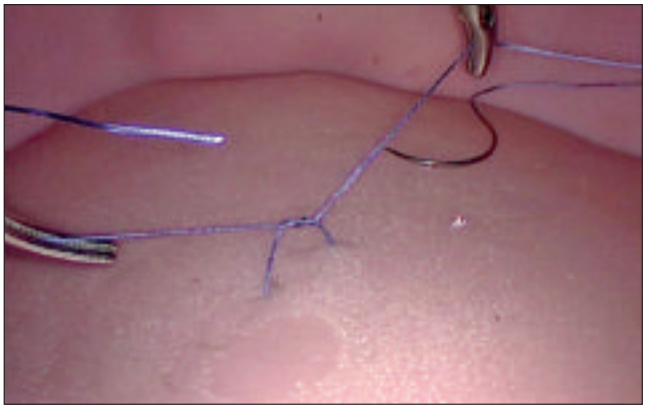
28 The needle holder performs a clockwise turn.



29 Using the left hand, the assistant forceps facilitates the descending movement and the crossover for wrapping the thread.



30 The assistant forceps in the left hand is raised a bit toward the *P axis* to prevent slippage of the suture.



31 Flat knot.

2.7.2 The Gladiator Rule Applied Counter-Clockwise

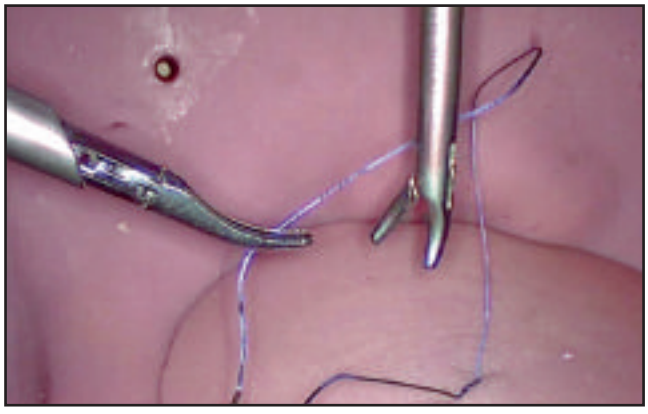
In order to make the second turn, the needle holder is placed in front of the *Thread's Horizon* relative to the viewer's position while performing a 180° clockwise rotation. Prior to completing the next turn, the needle holder has to resume its initial position (**Figs. 32–35**).

2.8 Maneuver to Tighten the Knot

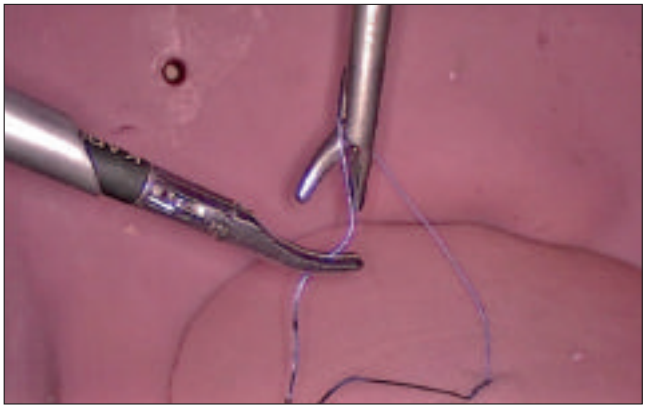
Based on our concept, the first square knot is made applying a simple rule, called the *Crossing Rule:*

Crossing of instruments to create a flat knot is permissible only in the case of stitches made from right to left.

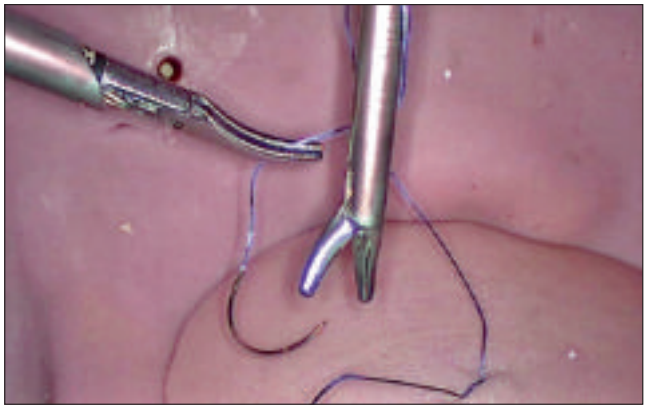
The first intracorporeal knot needed in a laparoscopic setting will be a *square knot* (sequence of two throws), which in this case is created by crossing instruments, as soon as the thread – which has already been twisted once – is pushed downward to complete the first knot (see page 20, **Fig. 36**).



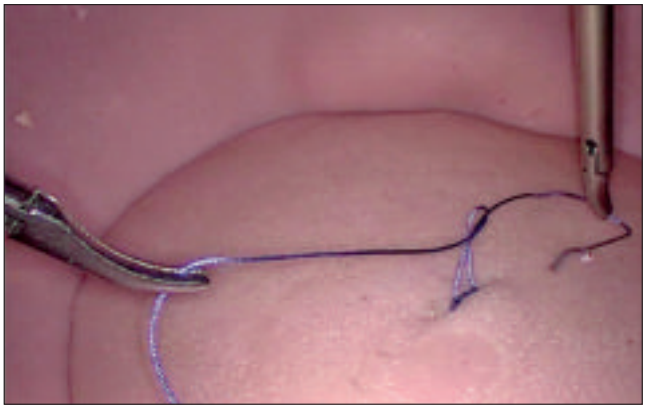
32 Thread's horizon more vertical to approximate to the *P axis*.



33 Needle holder 180° counter-clockwise rotary movement to wrap the suture.



34 The left hand rises in direction of *P axis* to prevent the thread from slipping off.

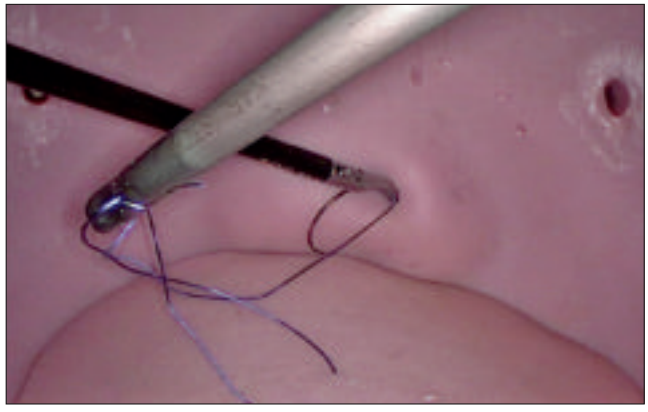


35 Blocking sequence of the knot with needle holder in suprapubic position.

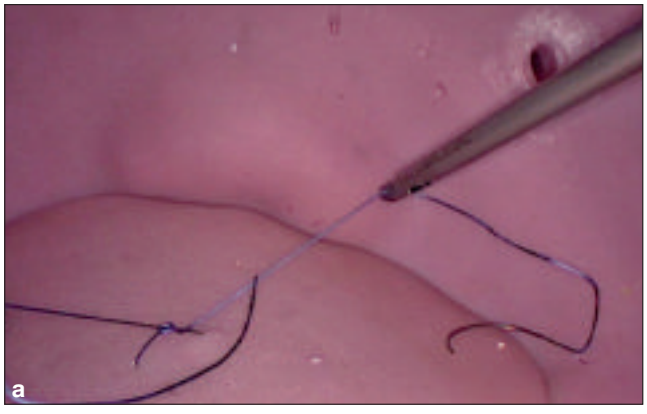
In order to facilitate the *crossing maneuver*, a few simple considerations should be borne in mind. Taking as a reference the point where the stitch has been made from right to left relative to the wound, and thus with the thread aligned rectilinear, the tip of the suture faces to the right while the needle faces to the left, the crossing rule is defined as follows:

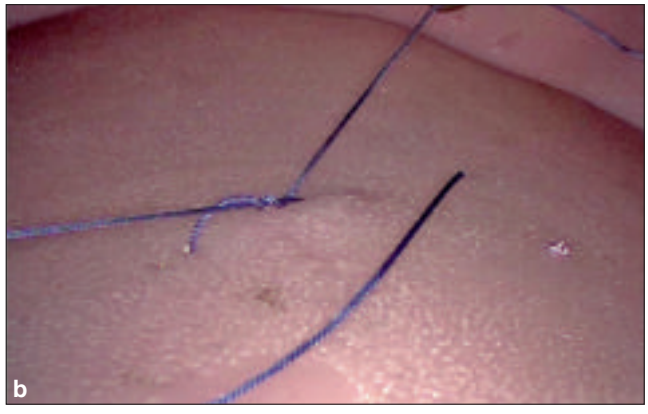
The starting point of the knotting maneuver is located above the *Thread's Horizon*. A flat knot is created by crossing the instruments such that the assistant forceps passes over the needle holder (which simultaneously passes underneath). For this rule to be applied properly, the thread should be wrapped around the needle holder which is rotated clockwise for this purpose (**Fig. 36**).

Once the *flat knot* has been made, both forceps again pick up the ends of the thread in proximity to the knot. The knot is tightened by pulling the strands into opposite directions along the axis that crosses the knot; this will produce the desired approximation of tissue edges (**Fig. 37**).



36 Crossing of instruments for creating a flat knot.





37 Square flat knot.

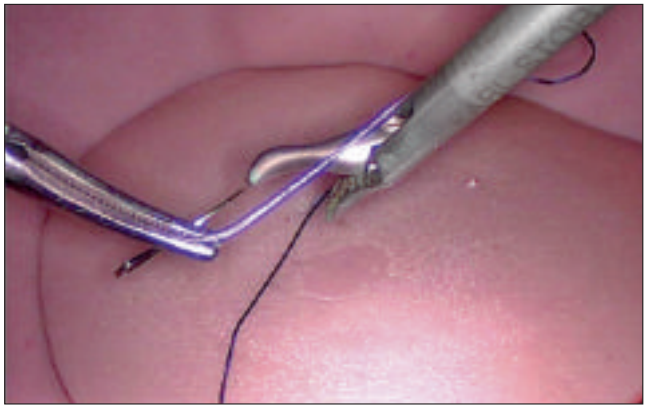
The starting point of the second half knot is located below the *Thread's Horizon.* The needle holder performs a turn, which is always made in opposite direction to the one performed for the first knot, but in this case, the thread is already in the correct position and there is no need to cross it (**Fig. 38**). We usually encourage the trainee to block the flat knot immediately and not to wait until the second half knot is formed, because any traction applied to the knot during its construction can increase tension in the square knot and result in accidental migration of tissue edges (**Figs. 38–40**).

Some expert surgeons recommend the use of the non-dominant (left) hand instead of the dominant one, also for knot tying and for guiding the needle holder. The technique gives the benefit of eliminating the need to cross instruments, because a flat knot is automatically formed when the primary needle holder is used with the non-dominant hand to establish the *Thread's Horizon* on the left side.

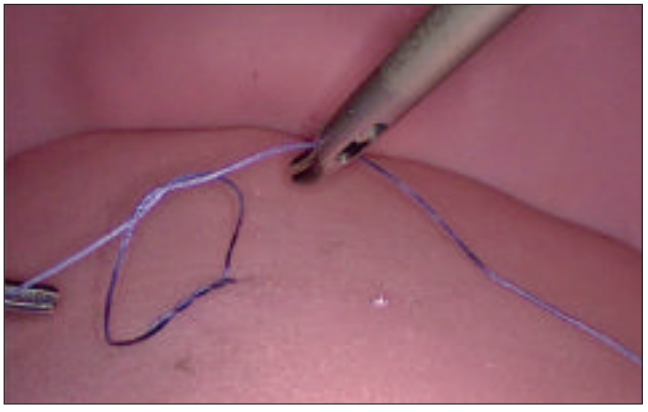
In our basic and advanced courses we advise our participants only to improve dexterity of the non-dominant (left) hand, but we do not teach them to use it for knot tying. Instead, our preference is to enhance the natural accuracy of the dominant (right) hand for knot tying, since 90% of surgeons are natural right-handers. Taking advantage of the fluidity of motion of a right-handed person, we can teach more easily how to perform knot tying with shorter threads, where accuracy is critical. We advise our participants to gradually develop motor skills of the right hand in suprapubic position where knot tying is facilitated if centesimal precision movements are made.

Shaping dexterity of the non-dominant (left) hand in order to use it as the dominant hand is a key aspect only in our *Master Courses* and *Top Master Courses,* addressing any kind of suturing and knotting techniques. In terms of knot tying, the authors advise candidates of these courses to go about shaping dexterity of the non-dominant (left) hand only after an adequate level of perfection allows them to swiftly perform sutures and knots with the dominant (right) hand, at any angle and with any length of thread.

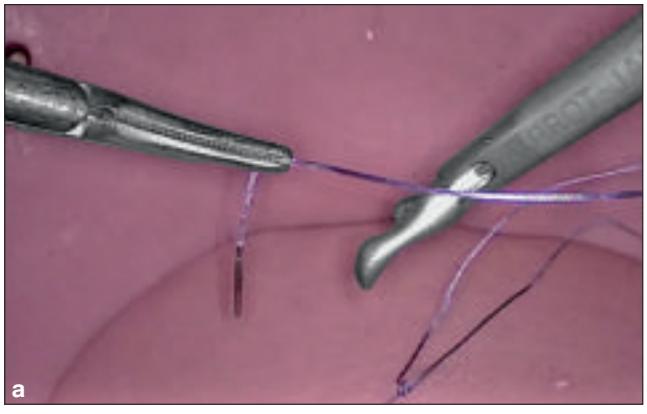
A basic rule that is usually followed in gynecology is, that stitches be made with the left or right hand, whereas knot tying, in both cases, should be restricted to the dominant (right) hand in the center or suprapubic position. Therefore, the authors believe it is reasonable to 'pay the price' of one more surgical step (crossing of instruments, needed to get the flat knot into position) and in turn, to profit from better ergonomics.

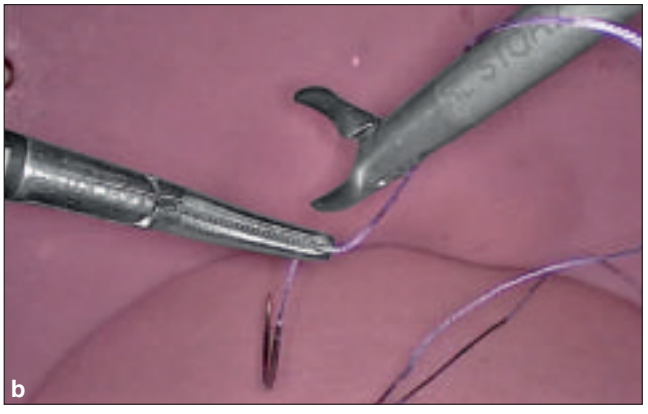


38 The second half knot is made in opposite direction to the first one. Initially, a 180°-clockwise rotation upward is made, with the jaws finally arriving in 12 o'clock position.

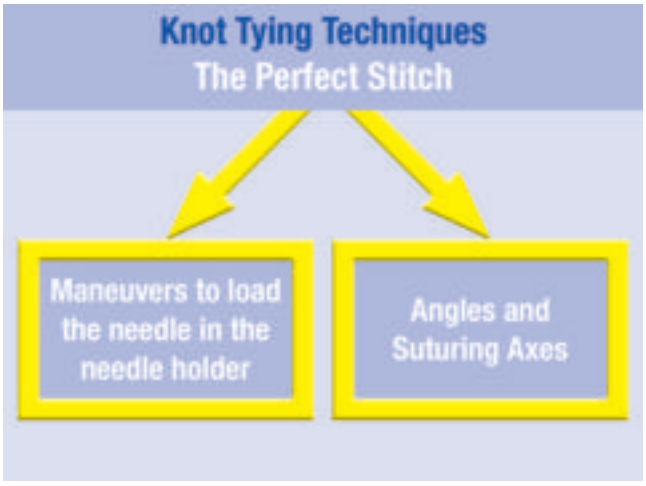


39 Both instruments pick up the thread close to the center of the knot, which is tightened by evenly pulling the strands into opposite directions.

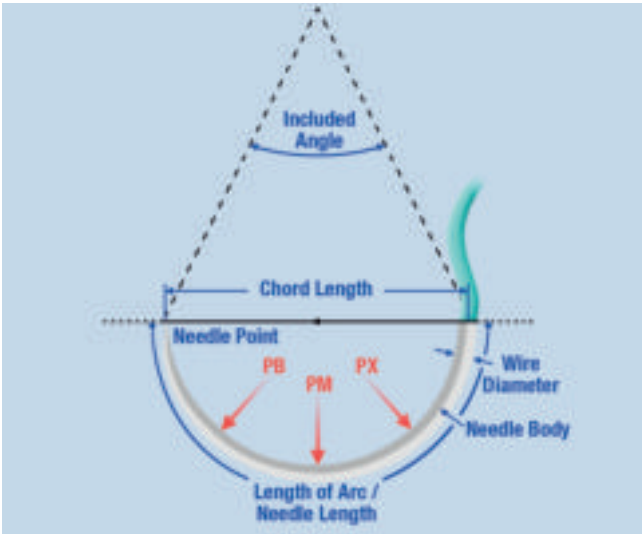




40 The second half knot of the blocking sequence is made in opposite direction to the first one.



1 Knotting technique and maneuvers to load the needle in the needle holder.



2 The needle and its points of equilibrium. **PM** = Medium needle point, **PX** = junction point between the middle third and the last third of the needle, **PB** = junction point between the first and the second third of the needle.

3.0 The Stitch and Maneuvers to Load the Needle in the Needle Holder

3.1 Loading the Needle in the Needle Holder: The Equilibrium Points of the Needle

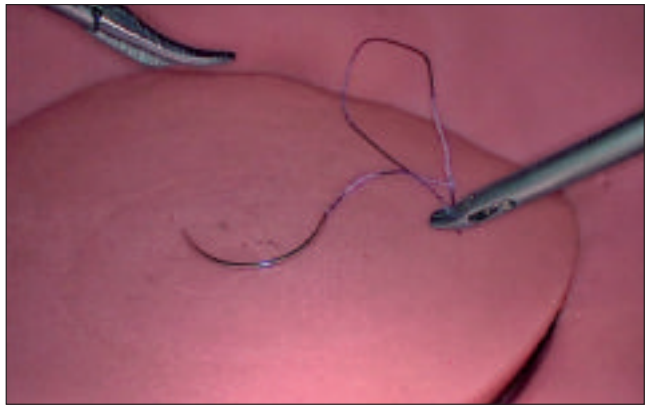
3.2 The Needle: Exercises for Loading it Properly in the Needle Holder

Prior to placing a stitch, it is mandatory that you have made yourself familiar with the technique used to load the needle in the needle holder. A few basic rules on how to load the needle correctly and definitions on equilibrium points (*PM, PX* and *PB)* are worth making yourself familiar with since they will facilitate proper handling of the needle (**Figs. 1, 2**).

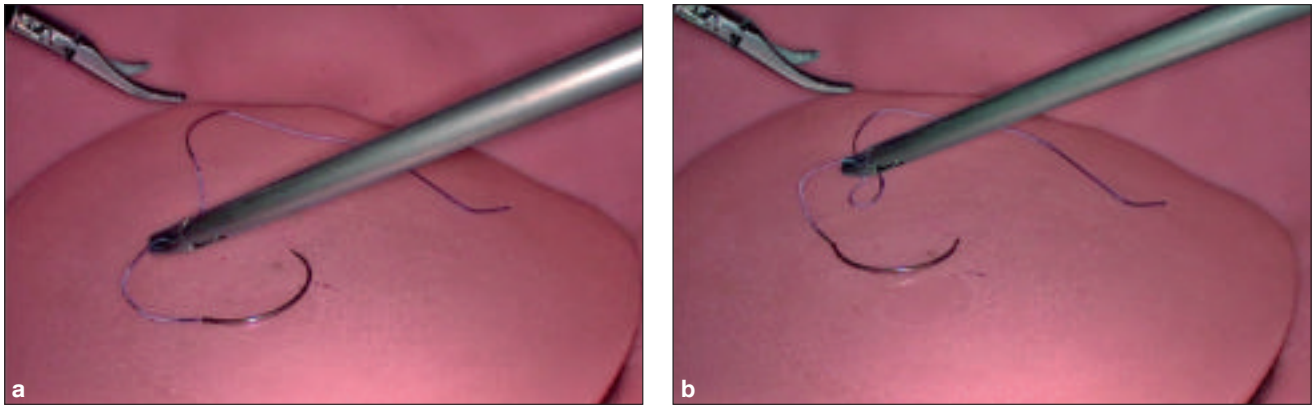
3.2.1 The Needle and its Orientation

To orientate the needle, the suture must be picked up with the assistant forceps, approximately 5 cm from the connection point of the thread and the needle.

The needle should be handled like a puppet (via the thread), that is suspended on strings in the air or placed in the operative field with the convex surface facing toward the viewing point and the needle tip showing to the left allowing the user to proceed in a right-to-left direction when placing the stitch with the right hand (**Fig. 3**).



3 The needle tip showing to the left.



4 The tip of the needle showing to the right.

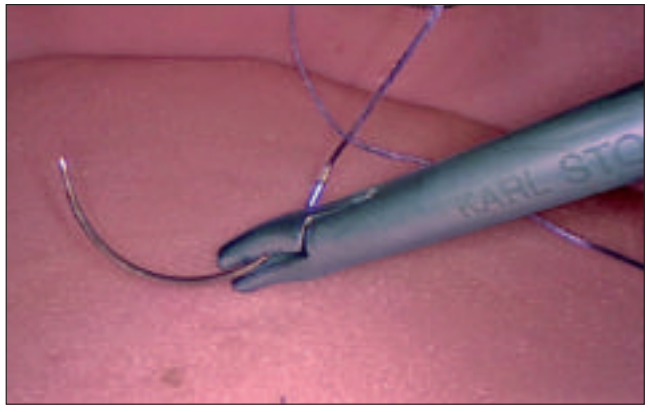
In order to place a reverse stitch, the needle should be positioned with its convex surface facing toward the viewing point but with the needle tip showing to the right allowing the user to proceed in a left-to-right direction with the right hand (**Fig. 4**).

Of course, the inverted orientation of the needle – i.e., from left to right for a reverse stitch made with the right hand – is also a feasible option for a stitch made from left to right with the left hand.

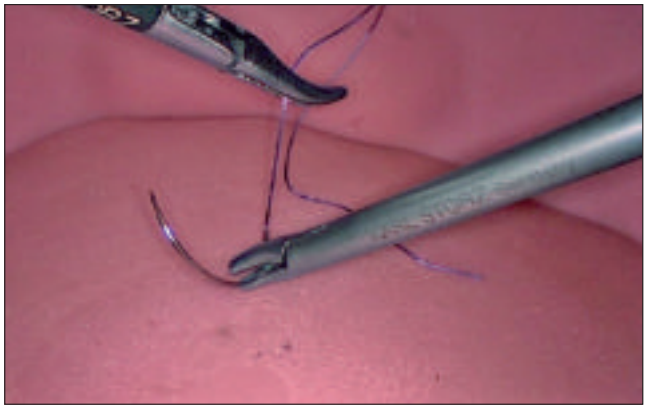
Even though we are fully aware of the importance of training motor skills of the left hand when placing a stitch and tying laparoscopic knots, we will not go into details here, because this manual covers mainly right-hand basic exercises.

3.2.2 Use of the PX Point to 'Wake Up the Needle' and Perform the 'Hair Pulling Maneuver'

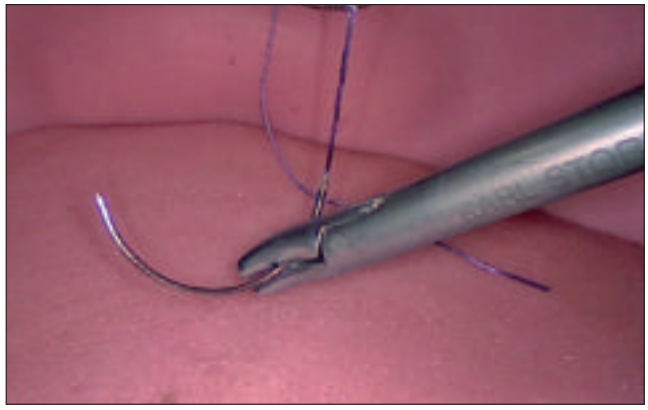
The *PX point* is located at the junction between the middle third and the last third of the needle. It is the ideal site to pick up the needle and perform a maneuver called *'hair pulling',* which in a figurative sense means, that the needle is transformed in an *'awake state',* with the concave surface showing upward. While keeping the needle securely loaded in the main needle holder, the assistant forceps pulls the thread tight, exerting traction in a vertical direction toward the abdominal wall. Finally, the proximal end of the needle should be angled at 110° with respect to the needle holder's *P axis* (**Figs. 5–7**).



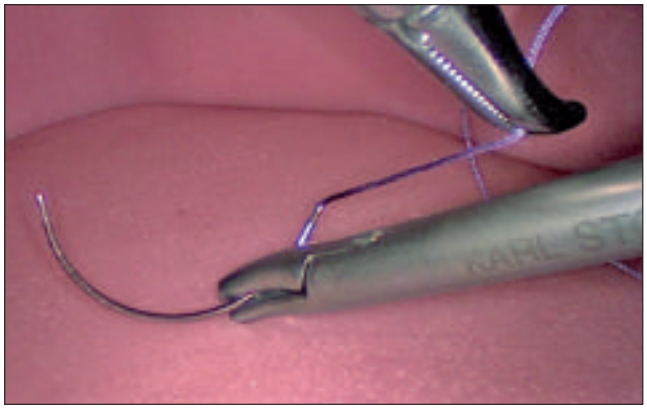
5 Here, the needle is grasped at the PX point.



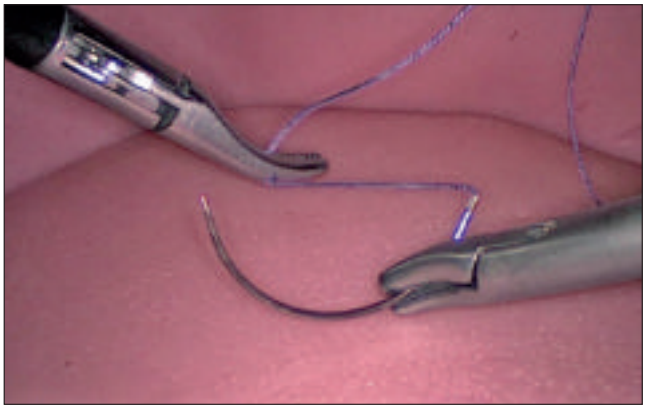
6 The *Hair Pulling Maneuver.* The thread is pulled tight with the assistant forceps exerting traction in a vertical direction toward the abdominal wall.



7 The needle is in an 'awake state' and its proximal end is angled at 110° with respect to the needle holder's *P axis.*

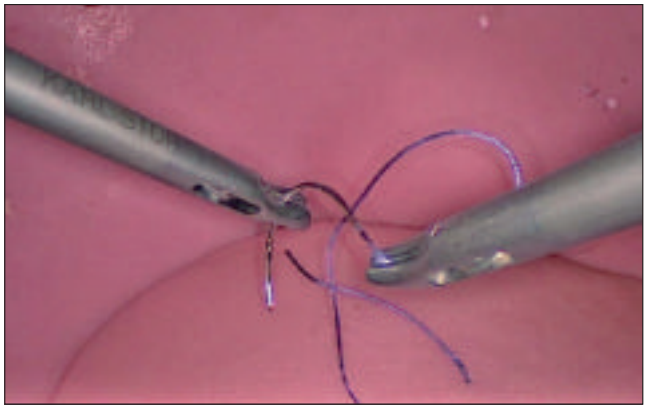


8 The suture is pulled proximally and parallel to the *P axis* of the needle holder.



9 The suture is pulled distally and parallel to the *P axis* of the needle holder.

Keep in mind that the needle should always be manipulated like a puppet. Once put in an 'awake state' with the '*Hair Pulling' Maneuver,* the needle's position and orientation can be fine-tuned by pulling the suture proximally or distally, always parallel to the *P axis.* In this way, the angle of the needle's alignment with respect to the needle holder's *P axis* can be opened or closed as required (**Figs. 8, 9**).



10 The needle is loaded at the *PM point*. Shown is the *'Grinding Coffee Maneuver'* performed in horizontal direction.

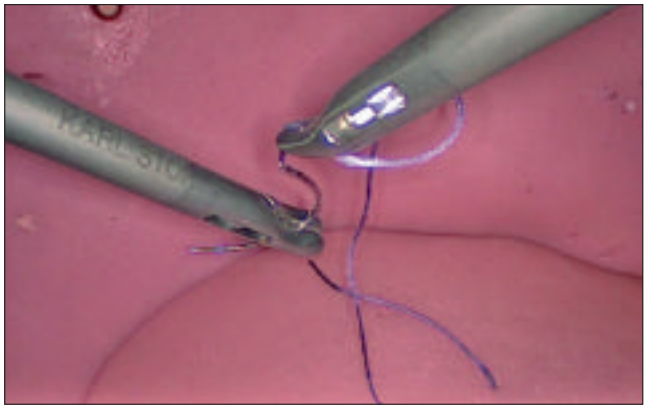
3.2.3 Use of the PM Point for the 'Grinding Coffee Maneuver'

The *PM Point* is located exactly in the center of the needle. Once the needle has been loaded, the equilibrium point is installed by exerting traction to the thread allowing the needle to be rotated, and the loading position to be readjusted accordingly. To perform rotation, either the needle holder or the assistant forceps may be used depending on the suture position.

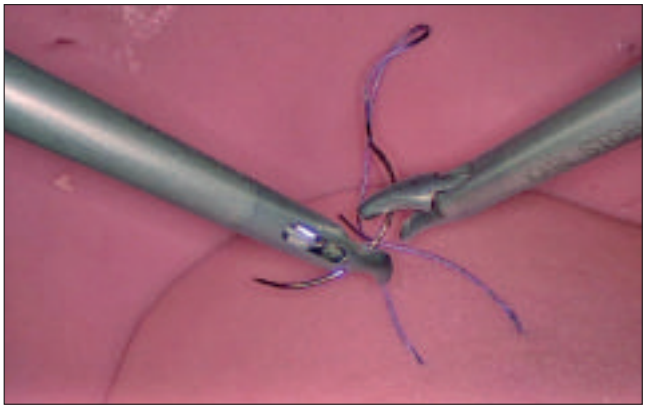
It is of paramount importance that the thread be always readily accessible to the forceps which applies traction, finally resulting in a 180° rotation of the needle. We therefore called it the *'Grinding Coffee Maneuver',* which can be performed in a vertical or horizontal direction.

'Grinding Coffee Maneuver' in Horizontal Direction

The needle is picked up at the *PM point* with the needle holder or assistant forceps and is kept in equilibrium, while the jaws are not in a fully closed position. The needle should always be loaded leaving the free end of the thread on the side of the contralateral hand that exerts traction on the suture. The thread is grasped at about 5 cm (**Fig. 10**) from the proximal end of the needle (*swage*) which makes a 180° rotation in horizontal direction. Upon completion of this maneuver, the orientation of the needle's convexity has been turned upside down or vice versa, thereby changing the direction of the needle tip (**Figs. 10–12**).



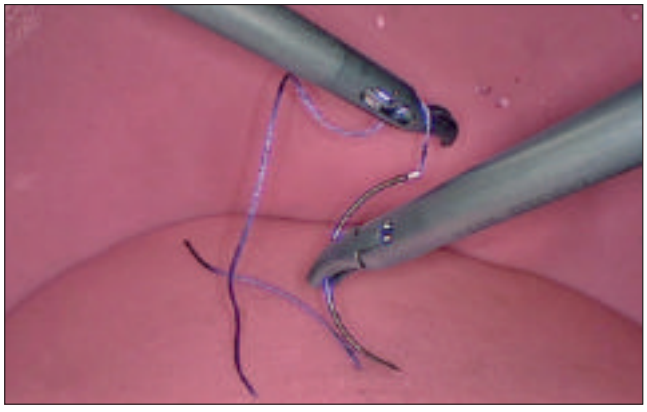
11 Rotation of the needle in horizontal direction.



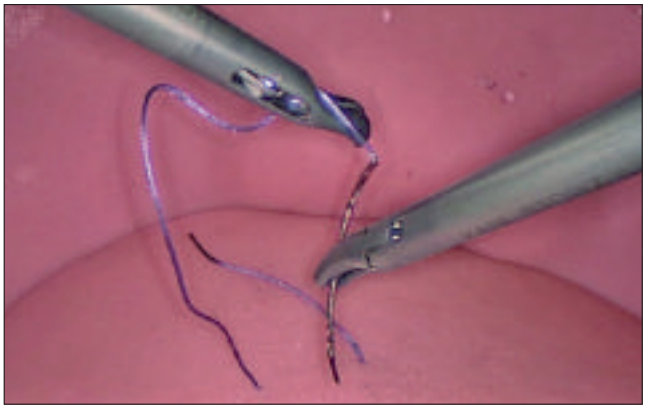
12 The orientation of the needle's convexity and the direction of the tip have been changed.

'Grinding Coffee Maneuver' in Vertical Direction

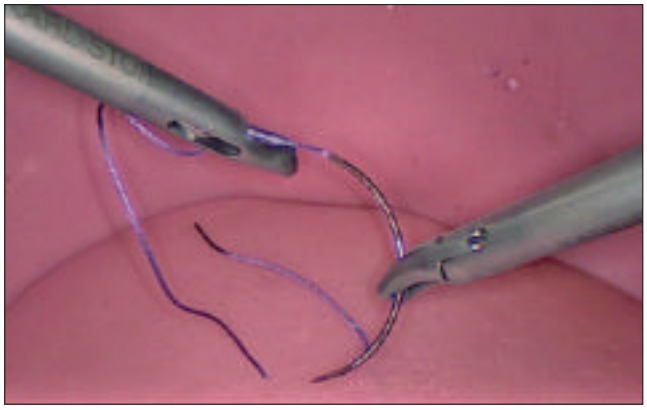
The needle is picked up at the *PM point* with the needle holder or assistant forceps. Always keep in mind, that the needle should be loaded with the free end of the thread running on the side of the contralateral hand that exerts traction on the suture. The thread is grasped at about 5 cm from the swage to perform a 180° turn, in this case, in vertical direction. Upon completion of this maneuver, the orientation of the needle's convexity has been turned from right to left or vice versa, thereby changing the direction of the needle tip (**Figs. 13–15**).



13 Assistant needle holder with the needle loaded at *PM point*. *'Grinding Coffee Maneuver'* in vertical direction.



14 Rotation of the needle in vertical direction.

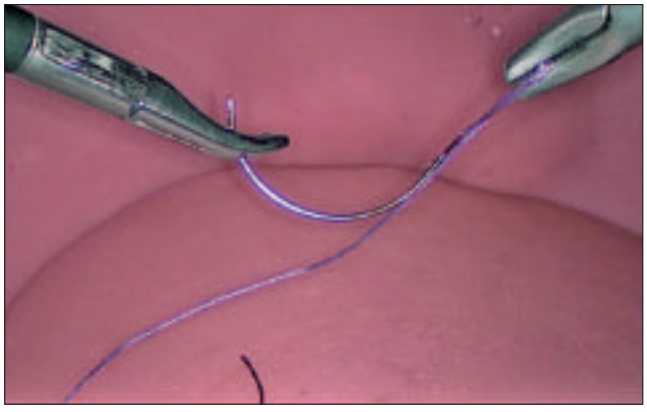


15 The orientation of the needle's convexity and the direction of the tip have been changed.

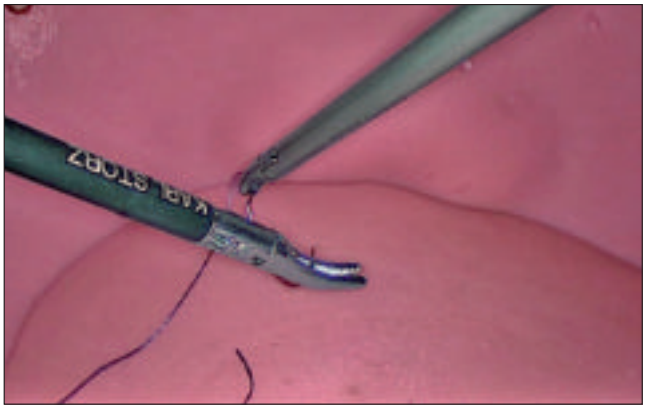
3.2.4 The Flag Point (PB)

The *Flag Point (PB)* is the needle's *'strategic equilibrium point'* used to perform the so-called *'Flag Maneuver'*, which allows to change the needle's direction.

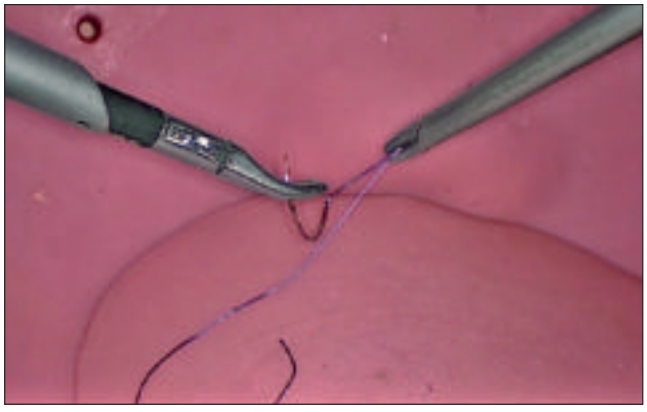
Shown below is how repositioning of the needle from right to left is performed by a simple rotation, without a change in the orientation of the needle's convexity, which always faces downwards, with the fulcrum running through the *Flag Point* (PB) (**Figs. 16–19**).



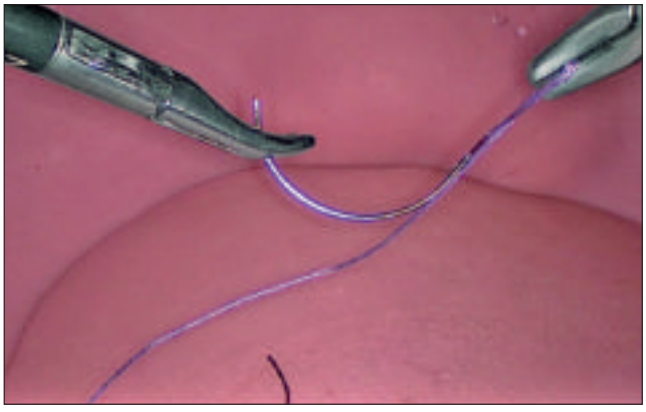
16 The assistant forceps grasps the needle at the PB point.



17 Change in the needle's direction from right to left.



18 Change in the needle's direction from left to right.

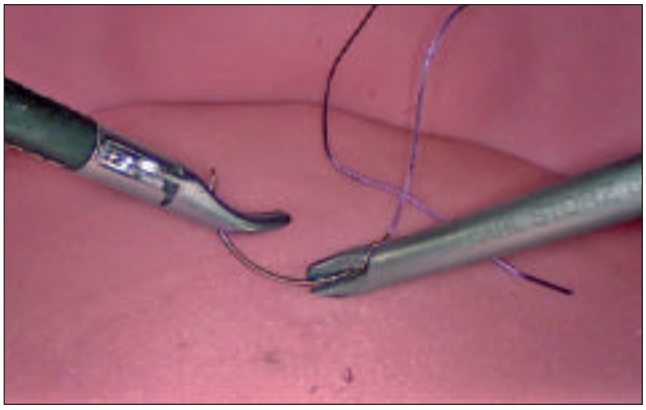


19 Change in the needle's direction from left to right.

3.3 Fine Adjustment of the Needle

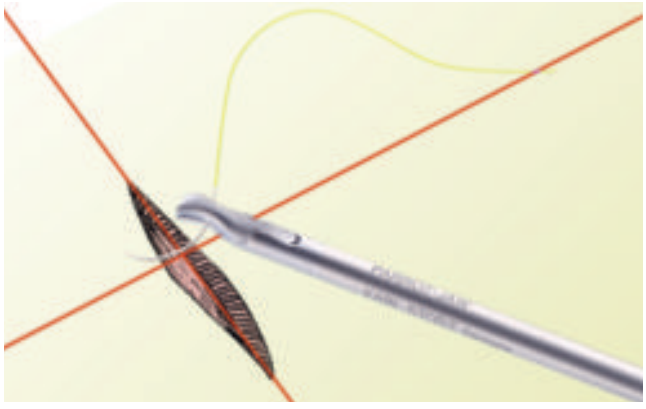
Once the needle has been loaded in the needle holder and assumes a *'convexity downward position'* at an angle of 110° with respect to *P axis*, we can use one last maneuver called '*Fine Adjustment'*. In order to increase or reduce the angle between the needle's longitudinal axis and the P axis of the needle holder, the assistant forceps is used to apply little pressure at the needle's *PB Point* (to increase the angle) or at the *PM Point* (to reduce the angle) (**Fig. 20**).

The resulting angulation of the needle with respect to the needle holder's *P axis* can be evaluated and checked against the anticipated path that the needle will take (and thus, the exit site where it will emerge, once it has been passed blindly through the tissue), with the so-called *'Cross Verification Maneuver'* (**Fig. 21**). The maneuver involves that the needle be loaded in the needle holder at the point of maximum convexity while drawing an imaginary line that traverses the wound margins or anatomical structure to be pierced through. This should allow to accurately define the path the needle will usually follow during tissue transfixion. The trajectory that the needle will take is identical with this imaginary line (**Fig. 21**).



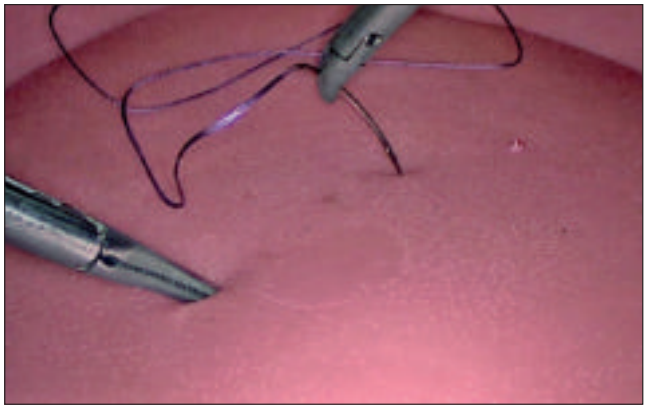
20 Fine adjustment of the needle's position.

The depth of tissue transfixion will depend on the position and entry angle at which the needle is pierced through the tissue. Keeping the arm in a neutral position, a smooth counter-clockwise rotation of the wrist is made first to place the needle such, that its concavity faces completely toward the tissue (**Fig. 22**). Next, a 180° turn is made clockwise to pass the needle deeply through the tissue (**Figs. 23–24**).

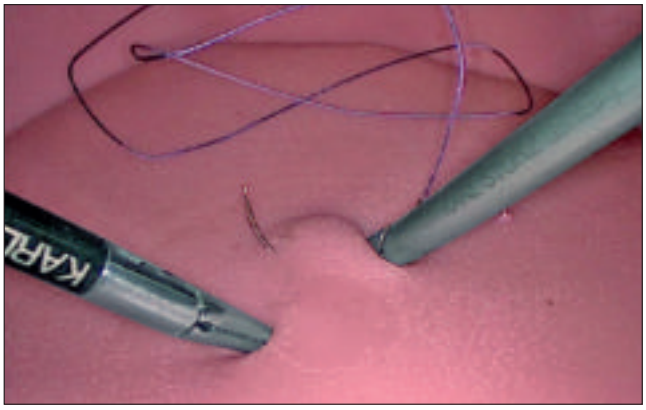


21 *Cross Verification Maneuver.*

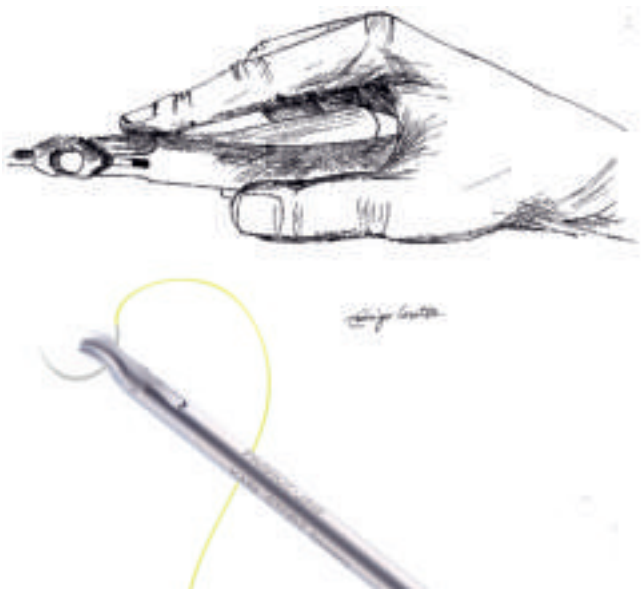
22 Keeping the arm in a neutral position, a smooth counter-clockwise rotation of the wrist is made first to place the needle such, that its concavity faces completely toward the tissue.



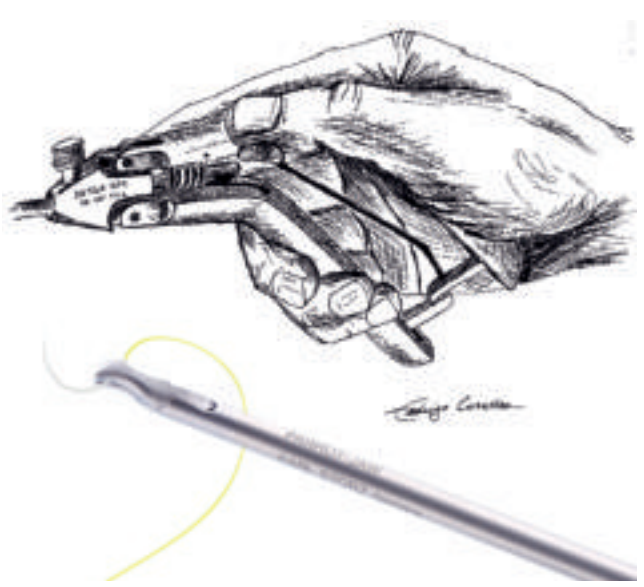
23 A 180° turn is made clockwise to pass the needle deeply through the tissue



24 After having completed a 180° rotation, the tip of the needle emerges from the tissue surface.



25 Stitch of intermediate depth.



26 Stitch of superfical depth.

Performing an intermediate rotation of the wrist while keeping the arm in a neutral position allows the needle to be passed at an intermediate depth through the tissue (**Fig. 25**).

If a minimum rotation of the wrist is made with the arm in neutral position, the needle will be passed through the tissue at a superficial depth (**Fig. 26**).

27 Use of a geometrical model for training the perfect stitch. The model is temporarily anchored to the endotrainer with a toothpick.

3.4 The Perfect Stitch: Step-by-Step Exercises

The following step-by-step exercises involve the use of various training models. A series of perfect stitches are made using the main needle holder in the right hand.

1. Use of a geometrical model placing stitches via the right lateral trocar at an angle not exceeding 45°.
2. Use of a hemicylindrical model placing via the right lateral trocar.
3. Use of a cylindrical model placing stitches via the suprapubic trocar (vertical *P axis*).
4. Use of a hemicylindrical model placing stitches via the suprapubic trocar.

3.4.1 Use of a Geometrical Model Placing Stitches Via the Right Lateral Trocar At An Angle Not Exceeding 45°

Consistent with the *Concept of the Perfect Stitch* all maneuvers and underlying rules described herein so far, need to be applied in this training session.

First, a geometric model is placed on the cover plate of the endo-trainer's Douglas pouch, making sure that the *F axis* of the wound is parallel to the *P axis* of the needle holder.

One stroke of the *'Figure-of-X'* shown on the geometrical model needs to be parallel to the projection of the needle holder's *P axis* onto the surface plane of the model. The needle holder is inserted in the right lateral trocar and aligned at a working angle ranging from 45° to 60° to establish the parallelism condition required for the perfect stitch.

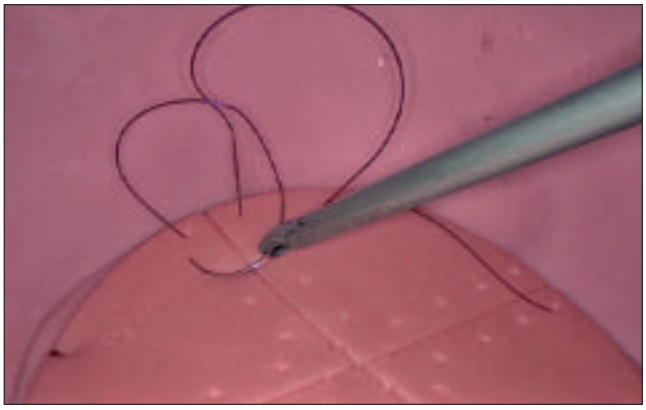
As shown in **Fig. 27,** the model needs to be anchored temporarily to the cover plate of the Douglas pouch using a toothpicks or pins.

Prior to going ahead and placing the first stitch in the model, all maneuvers that have already been learned – how to load the needle in the needle holder, how to align the needle holder, and how to perform the cross verification maneuver – should be completed successfully (**Fig. 28**).

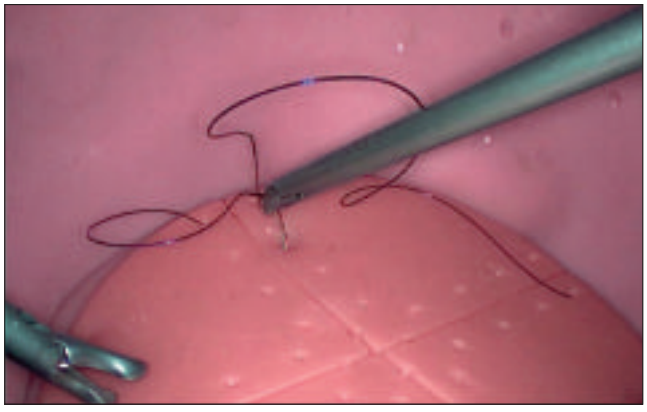
In the next step, a few stitches are made from right to left with the needle holder in the right lateral trocar, following the small perforations on the model, beginning at the posterior outer margin and ending in the center, which should not be crossed (**Figs. 29–31**).

The exercise should be repeated as often as necessary until the stitches are perfectly parallel to each other, (see **Fig. 31**), making sure that the exit stitches run precisely through the perforations on the training model.

Using both hands in a coordinated manner is mandatory while pulling out the running suture, which is started at the posterior outer margin of the training model (**Fig. 32**).

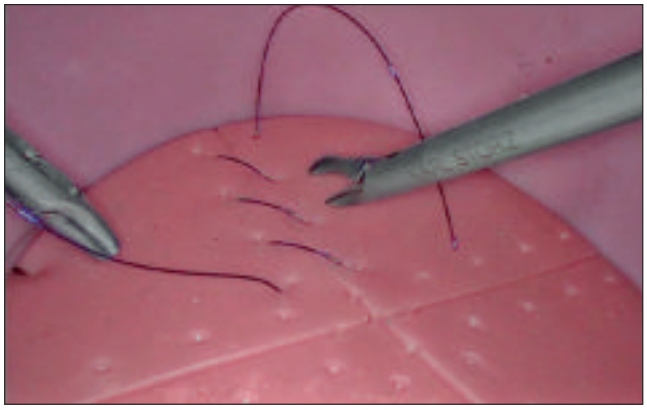


28 The *Cross Verification Maneuver*.

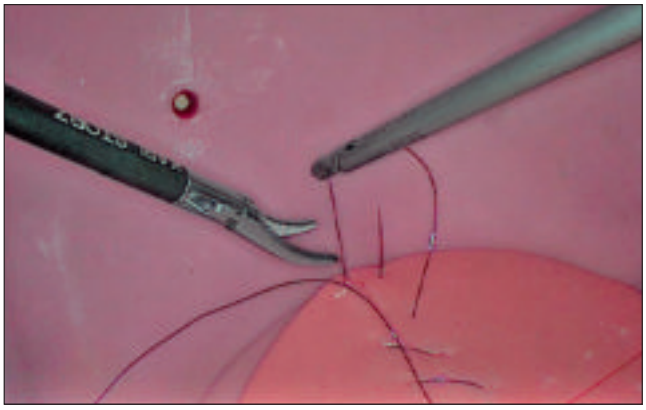


29 The needle tip pierces the tissue.

30 The stitches are placed using the needle holder in the right hand guiding the needle from right to left.



31 A continuous sequence of perfect stitches: running suture.

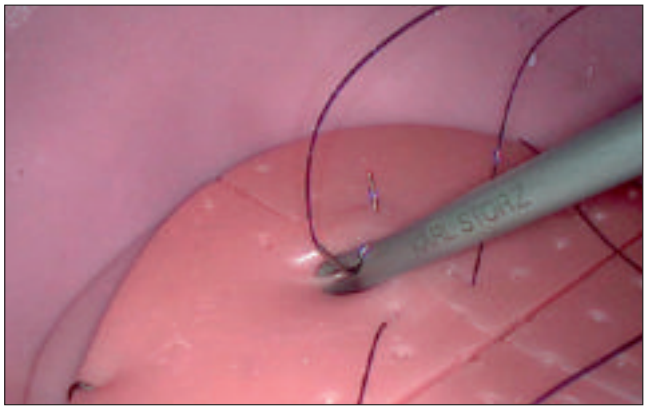


32 At the end of the exercise, the running suture is removed.

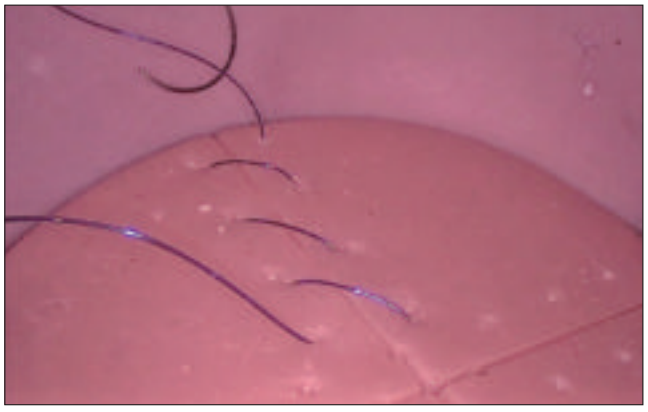
33 The stitches are placed using the needle holder in the right hand guiding the needle from left to right (reverse direction).

Prior to proceeding with the first stitch of this exercise, all maneuvers that have already been learned – how to load the needle in the needle holder, how to align the needle holder, and how to perform the cross verification maneuver – should be completed successfully. In the next step, the starting point of the running suture is the center of the training model. This time, the stitches are placed in reverse direction, i.e., from left to right using the right hand (**Figs. 33–35**).

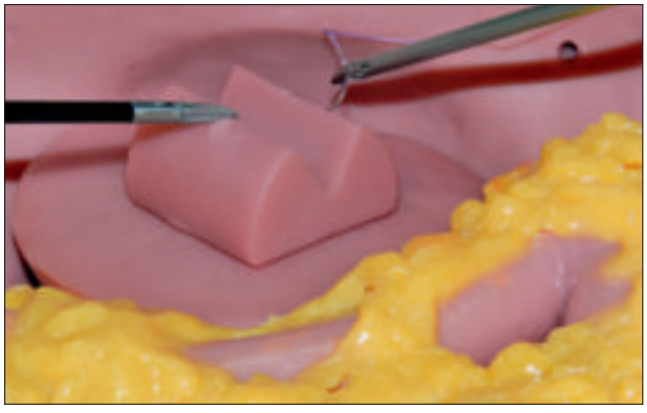
The exercise should be repeated as often as necessary until the stitches are perfectly parallel to each other (see **Fig. 31**), making sure that the exit stitches run precisely through the perforations on the training model.



34 Running suture placed from the center toward the outer margin of the model.



35 A sequence of identical perfect stitches: reverse running suture.



36 Hemicylindrical model. Practicing *Figure-of-X* invaginating sutures.

3.4.2 Use of a Hemicylindrical Model Placing Stitches Via the Right Lateral Trocar

Take care that the *F axis* (of the wound) is parallel to the *P axis* of the needle holder which is inserted in the right lateral trocar.

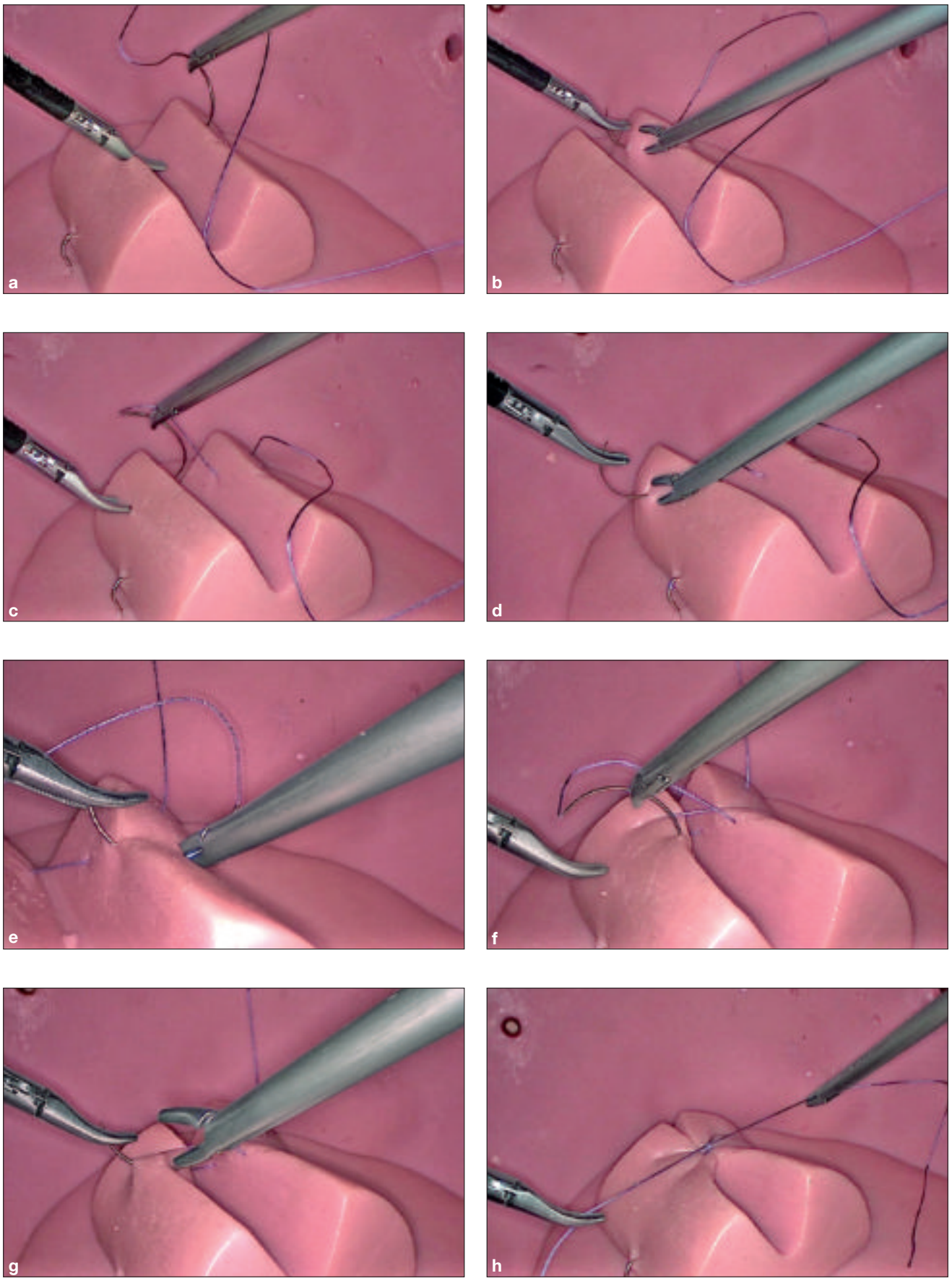
The hemicylindrical model is placed on the cover plate of the Douglas pouch making sure that the *F axis* (wound) is aligned with a diagonal that runs from 10 o'clock to 4 o'clock (**Fig. 36**).

The medial axis of the groove in the model should be parallel to the projection of the needle holder's *P axis* onto the base of the model. The needle holder is inserted in the right lateral trocar and aligned at a working angle ranging from 45° to 60° to establish the parallelism condition required for the perfect stitch.

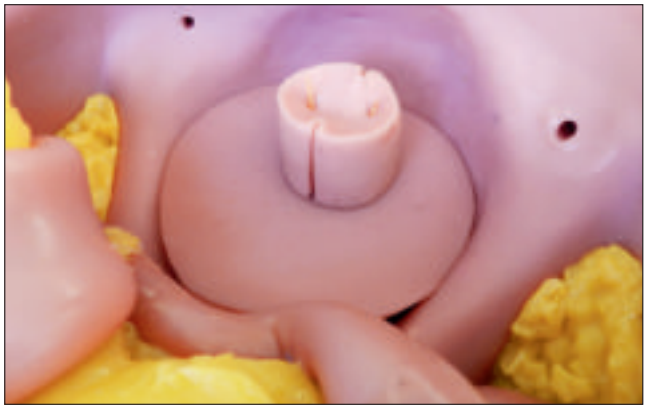
Following proper alignment of the model, it is anchored in the Douglas pouch with toothpicks or pins.

All maneuvers that have already been learned – how to load the needle in the needle holder, how to align the needle holder, and how to perform the cross verification maneuver – should be completed successfully.

Once the first '*Figure-of-X*' stitch has been placed, the *Gladiator Rule* is applied to tie the knot, completing the step with the correct blocking sequence. The exercise aims at practicing '*Figure-of-X*' invaginating sutures. The first stitch is inserted deeply for hemostasis and the second one serves to approximate wound margins. In this training situation, the stitch is inserted at a blind spot when suturing on the left side of the model (**Fig. 37**).



37 '*Figure-of-X*' stitch with application of Romeo's gladiator rule for knot tying with the correct blocking sequence.

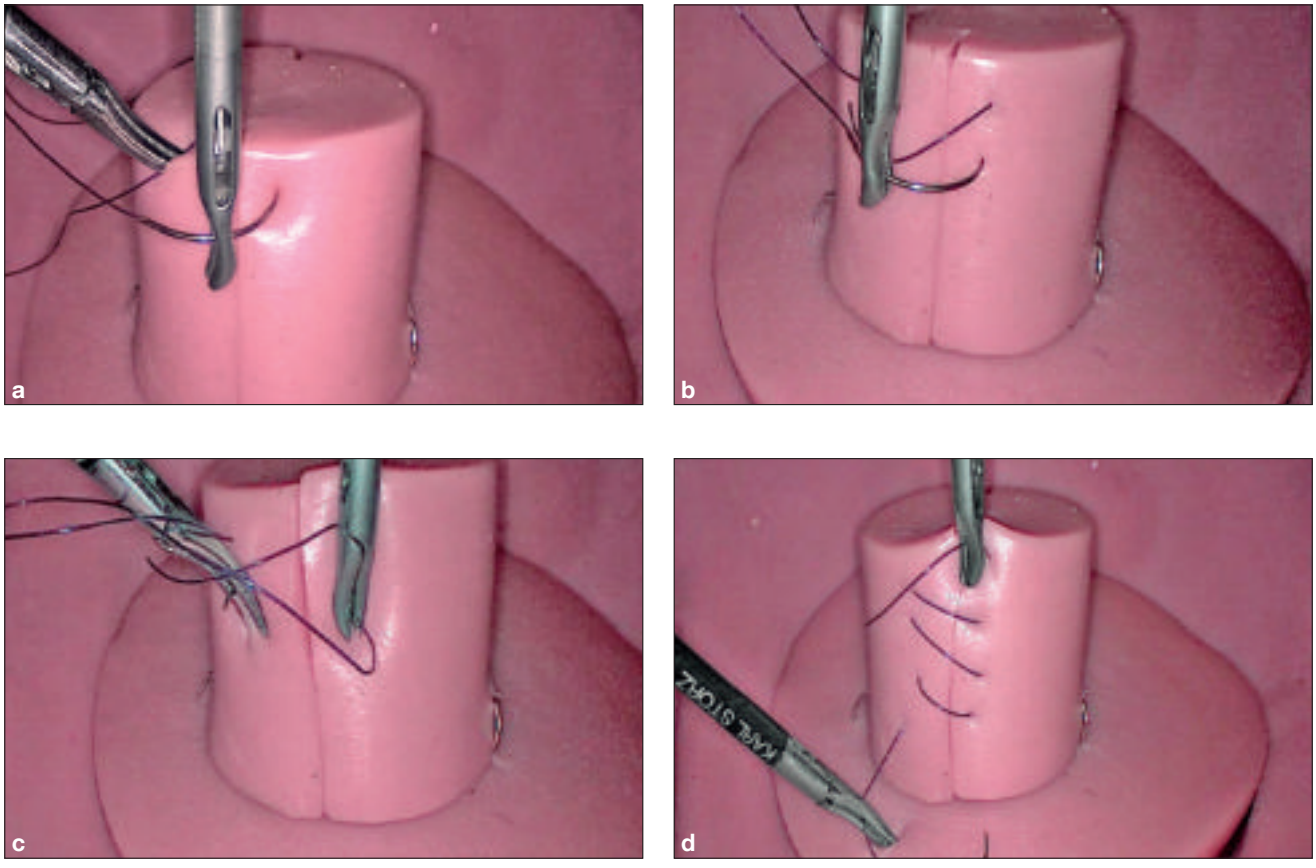


38 Cylindrical model mimicking anatomical circumstances that involve a vertical *F axis* (wound).

3.4.3 Use of a Cylindrical Model Placing Stitches Via the Suprapubic Trocar (Vertical P Axis)

In this training section, the working angle is 0°. The *P axis* of the needle holder should be parallel to the *F axis* of the wound. The theory of parallelism is once again confirmed by an exercise, where the site of the needle holder is changed to a suprapubic position. Therefore, the *P axis* of the needle holder is aligned in a fully vertical position, which is a common situation in modern laparoscopic gynecology.

The exercise involves that a cylindrical model is placed on the cover plate of the Douglas pouch taking care that the F axis is in a fully vertical position. The model should be temporarily anchored in this position with toothpicks or pins (**Figs. 38, 39**).

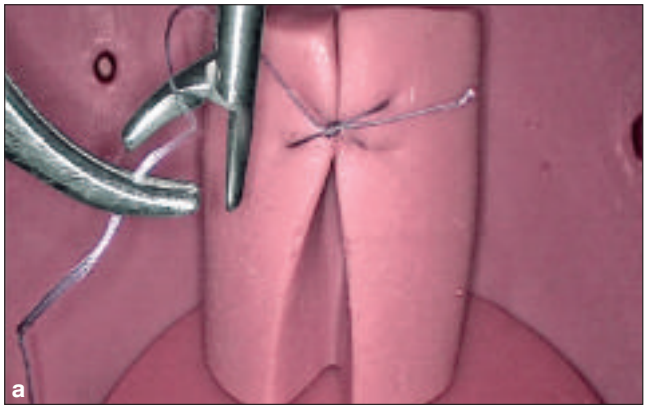


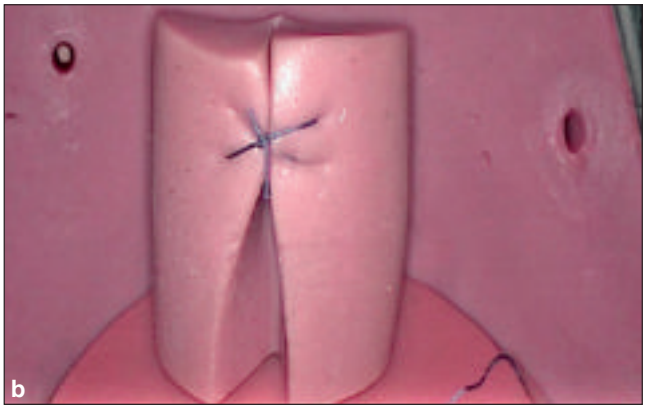
39 Placement of a running suture with vertical *P axis* via the suprapubic trocar.

3.4.4 Use of a Hemicylindrical Model Placing Stitches Via the Suprapubic Trocar (Vertical P Axis)

Similarly to the previous one, this exercise also involves that the model is placed on its base resulting in a working angle of 0°. Again, the *P axis* of the needle holder is aligned parallel to the *F axis* of the wound. In this exercise, wound closure is practiced by placing three '*Figure-of-X*' stitches by guiding the needle holder via the suprapubic trocar (**Figs. 40, 41**).

40 The hemicylindrical model is placed on its base resulting in a vertical *F axis*.





41 '*Figure-of-X*' stitches placed on a hemicylindrical model with the needle holder's *P axis* in a fully vertical position.

Appendix

Setup of the Realistic Endotrainer for Training Laparoscopic Suturing

1 Realistic Endotrainer.

2 Endotrainer with upper part opened.

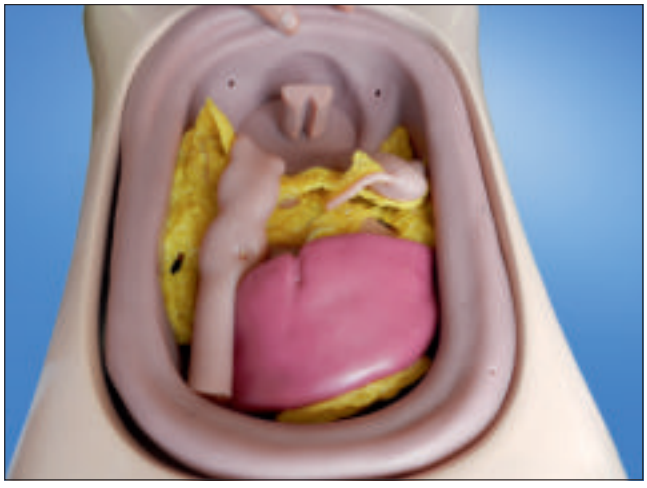
3 Abdominal cavity with synthetic abdominal organs.

4 In order to prepare the endotrainer, uterus and intestine are lifted out of the pelvic region.

5 Both uterus and intestine are fixed to the upper abdomen with toothpicks or pins.

6 Cover plate for the Douglas pouch.

7 Cover plate attached to the Douglas pouch.



8 Hemicylindrical model placed in the Douglas pouch.

Recommended Literature

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2. CRISPI C, MALCHER F, et.al. 2012: Tratado de Endoscopia Ginecológica – Cirurgia Minimamente Invasiva. 3a. edición. Río de Janeiro, Brasil. Edit. Revinter. P.p. 164–175
3. MEREU L, CARRI G, ALBIS FLOREZ ED, COFELICE V, PONTIS A, ROMEO A, MENCAGLIA L: Three-step model course to teach intracorporeal laparoscopic suturing. J Laparoendosc Adv Surg Tech A. 2013 Jan;23(1):26-32. doi: 10.1089/lap.2012.0131. Epub 2012 Dec 6.

Recommended Set for Basic Course (per working station)

26003 AA **1** **HOPKINS® II Straight Forward Telescope 0°,** enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: green

26003 BA **1** **HOPKINS® II Forward-Oblique Telescope 30°,** enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: red

26120 JL **1** VERESS **Pneumoperitoneum Needle,** with spring-loaded blunt inner cannula, LUER-Lock, **autoclavable,** diameter 2.1 mm, length 13 cm

30103 MVR **1** TERNAMIAN **EndoTIP Cannula,** with thread and rotatable insufflation stopcock, size 11 mm, working length 8.5 cm, color code: green-white

30120 GH **1** **Trocar,** with conical tip, without insufflation stopcock, size 6 mm, working length 6 cm, color code: black-white, for use with instruments size 5 mm

30120 H **2** **Trocar only,** with conical tip, size 6 mm

33332 MD **1** **CLICKLINE®** KELLY **Dissecting and Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm

33332 ML **1** **CLICKLINE®** KELLY **Dissecting and Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation,with LUER-Lock irrigation connector for cleaning, double action jaws, long, size 5 mm, length 36 cm

33332 CC **1** **CLICKLINE®** CROCE-OLMI **Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, single action jaws, atraumatic, fenestrated, curved, size 5 mm, length 36 cm

33332 SN **1** **CLICKLINE®** SCHNEIDER **Lymph Node Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, atraumatic, size 5 mm, length 36 cm

33332 ME **1** **CLICKLINE®** MANHES **Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, with multiple teeth, width of jaws 4.8 mm, for atraumatic and accurate grasping, size 5 mm, length 36 cm

33332 K **1** **CLICKLINE® Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with irrigation connection for cleaning, double action jaws, atraumatic, fenestrated, size 5 mm, length 36 cm

33332 KW **1** **CLICKLINE®** MATKOWITZ **Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm

34321 MS **1** **CLICKLINE®** METZENBAUM **Scissors,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock connector for cleaning, double action jaws, curved, size 5 mm, length 36 cm

34321 EK **1** **CLICKLINE® Hook Scissors**, rotating, dismantling, with connector pin for unipolar coagulation, with irrigation connection for cleaning, single action jaws, tips of jaws not crossing, size 5 mm, length 36 cm

26173 SP **1** SZABO-BERCI **Needle Holder "PARROT-JAW®",** with diamond coated jaws, straight handle, with ratchet, size 5 mm, length 33 cm, for suture material 2/0 – 4/0, needle size SH (Ethicon), EN-S (Ski), V 20 (USSC), for use with trocars size 6 mm

26173 KAL **1** KOH **Macro Needle Holder,** with tungsten carbide insert, ergonomic straight handle with disengageable ratchet, ratchet position right, jaws curved to left, size 5 mm, length 33 cm, for use with suture material size 0/0 to 7/0 and needle sizes BV, SH or CT-1

26173 KAR **1** KOH **Macro Needle Holder,** with tungsten carbide insert, ergonomic straight handle with disengageable ratchet, ratchet position left, jaws curved to right, size 5 mm, length 33 cm, for use with suture material size 0/0 to 7/0 and needle sizes BV, SH or CT-1

26596 CL **1** CICE **Knot Tier,** CLERMONT-FERRAND model, for extracorporeal knotting, size 5 mm, length 36 cm

26596 D **1** **Knot Tier,** for extracorporeal knotting, with open and closed end, size 5 mm, length 36 cm

20 0450 01-EN **1** **TELE PACK X,** endoscopic video unit for use with TELECAM one-chip camera heads and video endoscopes, incl. 50 W HiLux light source, 15" LCD TFT screen, USB/SD memory module, color systems PAL/NTSC, with integrated Image Processing Module, power supply 100 – 240 VAC, 50/60 Hz

20 2121 40 **1** **TELECAM One-Chip Camera Head,** color system **NTSC, autoclavable,** soakable, gassterilizable, with integrated Parfocal Zoom Lens, f = 14 – 28 mm (2x), 2 freely programmable camera head buttons, including plastic container 39301 ACT for sterilization

20 2120 40 **1** **TELECAM One-Chip Camera Head,** color system **PAL, autoclavable,** soakable, gas-sterilizable, with integrated Parfocal Zoom Lens, f = 14 – 28 mm (2x), 2 freely programmable camera head buttons, including Plastic Container for Sterilization and Storage 39301 ACT for sterilization

495 NCS **1** **Fiber Optic Light Cable,** with straight connector, extremely heat-resistant, diameter 4.8 mm, length 250 cm

26344 L2 **1** LYRA **Laparoscopic Simulator,** for laparoscopic and robot- assisted surgery, including the urinary tract, complete

26344 LE **2** **Neoderme Organ,** abdominal wall

Recommended Set for use in Master and TOP Master Courses (per working station)

26003 AA **1** **HOPKINS® II Straight Forward Telescope 0°,** enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: green

26003 BA **1** **HOPKINS® II Forward-Oblique Telescope 30°,** enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: red

26120 JL **1** VERESS **Pneumoperitoneum Needle,** with spring-loaded blunt inner cannula, LUER-Lock, **autoclavable,** diameter 2.1 mm, length 13 cm

30103 MVR **1** TERNAMIAN **EndoTIP Cannula,** with thread and rotatable insufflation stopcock, size 11 mm, working length 8.5 cm, color code: green-white

30120 GH **1** **Trocar,** with conical tip, without insufflation stopcock, size 6 mm, working length 6 cm, color code: black-white, for use with instruments size 5 mm

30120 H **2** **Trocar only,** with conical tip, size 6 mm

33332 MD **1** **CLICKLINE®** KELLY **Dissecting and Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm

33332 ML **1** **CLICKLINE®** KELLY **Dissecting and Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation,with LUER-Lock irrigation connector for cleaning, double action jaws, long, size 5 mm, length 36 cm

33332 CC **1** **CLICKLINE®** CROCE-OLMI **Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, single action jaws, atraumatic, fenestrated, curved, size 5 mm, length 36 cm

33332 SN **1** **CLICKLINE®** SCHNEIDER **Lymph Node Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, atraumatic, size 5 mm, length 36 cm

33332 ME **1** **CLICKLINE®** MANHES **Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, with multiple teeth, width of jaws 4.8 mm, for atraumatic and accurate grasping, size 5 mm, length 36 cm

33332 K **1** **CLICKLINE® Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with irrigation connection for cleaning, double action jaws, atraumatic, fenestrated, size 5 mm, length 36 cm

33332 KW **1** **CLICKLINE®** MATKOWITZ **Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm

34321 MS **1** **CLICKLINE®** METZENBAUM **Scissors,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock connector for cleaning, double action jaws, curved, size 5 mm, length 36 cm

34321 EK **1** **CLICKLINE® Hook Scissors**, rotating, dismantling, with connector pin for unipolar coagulation, with irrigation connection for cleaning, single action jaws, tips of jaws not crossing, size 5 mm, length 36 cm

26173 SP **1** SZABO-BERCI **Needle Holder "PARROT-JAW®",** with diamond coated jaws, straight handle, with ratchet, size 5 mm, length 33 cm, for suture material 2/0 – 4/0, needle size SH (Ethicon), EN-S (Ski), V 20 (USSC), for use with trocars size 6 mm

26173 HS **1** **Handle Attachment,** ergonomic, for use with Needle Holders 26173 SC/SE/CQ/CE/SP and Assistant Needle Holders 26173 SA/SD/DR/DQ/QR, **autoclavable**

26173 KL **1** KOH **Macro Needle Holder,** with tungsten carbide insert, ergonomic handle with ratchet, ratchet position on top, jaws curved left, size 5 mm, length 33 cm, for use with suture material size 0/0 to 7/0 and needle sizes BV, SH or CT-1

30173 RAO **1** KOH **Macro Needle Holder,** dismantling, with LUER-Lock irrigation connector for cleaning, single action jaws, jaws curved to right, with tungsten carbide inserts, with ergonomic handle, axial, disengageable ratchet, ratchet position top, size 5 mm, length 33 cm, for use with suture material size 0/0 – 7/0

30173 LAO **1** KOH **Macro Needle Holder,** dismantling, with LUER-Lock irrigation connector for cleaning, single action jaws, jaws curved to left, with tungsten carbide inserts, with ergonomic handle, axial, disengageable ratchet, ratchet position top, size 5 mm, length 33 cm, for use with suture material size 0/0 – 7/0,

26173 KE **1** KECKSTEIN **Needle Holder,** size 5 mm, length 33 cm, for use with Handle Attachment Set 26173 KEA/KEB/KEC

26173 KEA **1** **Handle Attachment Set,** small, **autoclavable,** for 26173 KE

26173 CN **1** CADIERE **Needle Holder,** with tungsten carbide insert, straight handle, with ratchet and large Handle Attachment, size 5 mm, length 33 cm

26173 RG **1** CUSCHIERI **Needle Holder ROTAGRIP,** with rotating handle, straight jaws, size 5 mm, length 33 cm

26596 CL **1** CICE **Knot Tier,** CLERMONT-FERRAND model, for extracorporeal knotting, size 5 mm, length 36 cm

26596 D **1** **Knot Tier,** for extracorporeal knotting, with open and closed end, size 5 mm, length 36 cm

26596 MA **1** MANGESHIKAR **Knot Tier,** for extracorporeal knotting, size 5 mm, length 36 cm

26596 K **1** KECKSTEIN **Knot Tier,** size 5 mm, length 36 cm

26596 SK **1** KOECKERLING **Knot Tier,** for extracorporeal knotting, size 5 mm, length 36 cm

22 202011U110 **1** **IMAGE1™ HD Camera Control Unit SCB,** with ICM module, for use with IMAGE1™ FULL HD three-chip camera heads, max. resolution 1920 x 1080 pixels, with integrated ICM (Image Capture Module), KARL STORZSCB and digital Image Processing Module, power supply 100 – 240 VAC, 50/60 Hz,

22 220061-3 **1** **IMAGE1™ H3-ZA Three-Chip FULL HD Camera Head,** 50/60 Hz, **autoclavable,** max. resolution 1920 x 1080 pixels, progressive scan, soakable, gasand plasmasterilizable, with integrated Parfocal Zoom Lens, focal length f = 15–31 mm (2x), 2 freely programmable camera head buttons, for use with color systems **PAL/NTSC**

20 133101-1 **1** **Cold Light Fountain XENON 300 SCB,** with KARL STORZ-SCB, with integrated anti-fog pump, 300 Watt Xenon bulb and KARL STORZ light connection, power supply 100-125/220-240 VAC, 50/60 Hz

495 NCS **1** **Fiber Optic Light Cable,** with straight connector, extremely heat-resistant, diameter 4.8 mm, length 250 cm

9526 NBL **1** **26" HD Monitor with LED Backlight,** wall-mounted with VESA 100 adaption, color systems **PAL/NTSC,** max. screen resolution 1920 x 1080, image format 16:9, power supply 100 – 240 VAC, 50/60 Hz

9526 SF **1** **Pedestal,** for monitors

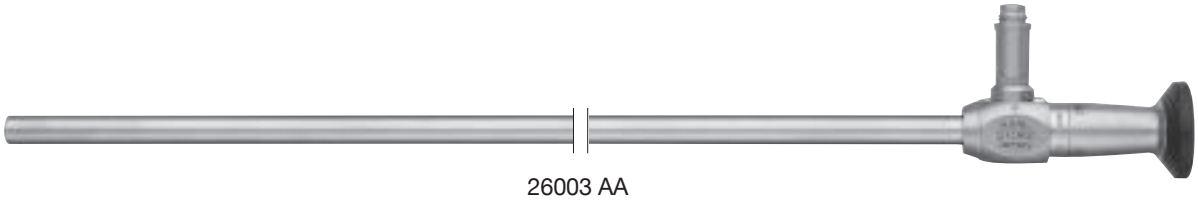
26344 L2 **1** LYRA **Laparoscopic Simulator,** for laparoscopic and robot- assisted surgery, including the urinary tract, complete

26344 LNF **1** **Neoderme Organ,** suturing model, for use with LYRA laparoscopy and NOTES Trainer

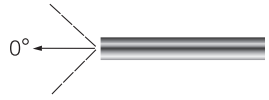
26344 LE **2** **Neoderme Organ,** abdominal wall

HOPKINS® II Telescopes

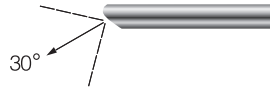
Diameter 10 mm, length 31 cm
Trocar size 11 mm



26003 AA

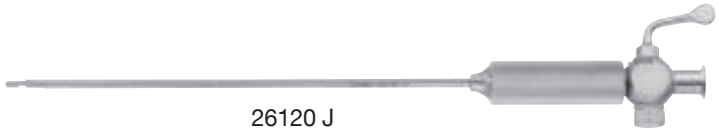


26003 AA **HOPKINS® II Straight Forward Telescope 0°,**
enlarged view, diameter 10 mm, length 31 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: green



26003 BA **HOPKINS® II Forward-Oblique Telescope 30°,**
enlarged view, diameter 10 mm, length 31 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: red

VERESS **Pneumoperitoneum Needles**



26120 J

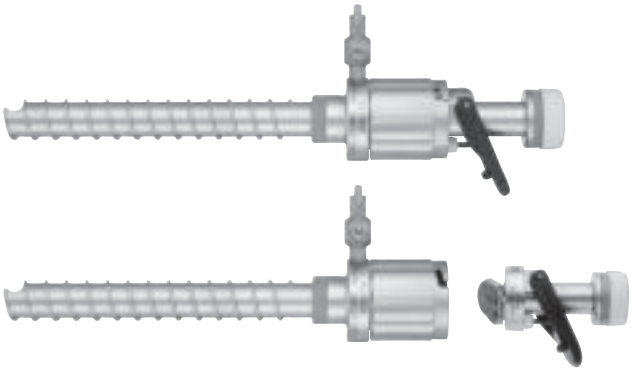
26120 JK VERESS **Pneumoperitoneum Needle,**
with spring-loaded blunt inner cannula,
LUER-Lock, **autoclavable,**
diameter 2.1 mm, length 13 cm

TERNAMIAN **EndoTIP Cannula**

Size 11 mm

with connector for insufflation
for use with telescopes diameter 10 mm

United States patents 5,478,329 and 5,630,805



Cannula

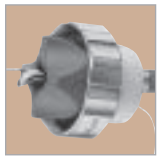
Multifunctional Valve

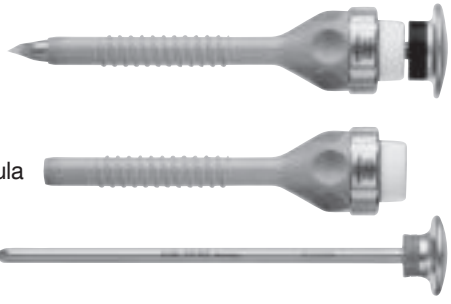
Size:		**11 mm:**
Working length: Color code:		8,5 cm green-white
	TERNAMIAN **EndoTIP Cannula** including: **Cannula,** with thread and rotatable insufflation stopcock **Multifunctional Valve**	**30103 MVR** 30103 T5 30103 M1
Accessory 	**Telescope Stopper,** sterile, for single use, package of 12	30103 CS

Trocars

Size 6 mm

without connector for insufflation NEW
for use with instruments size 5 mm





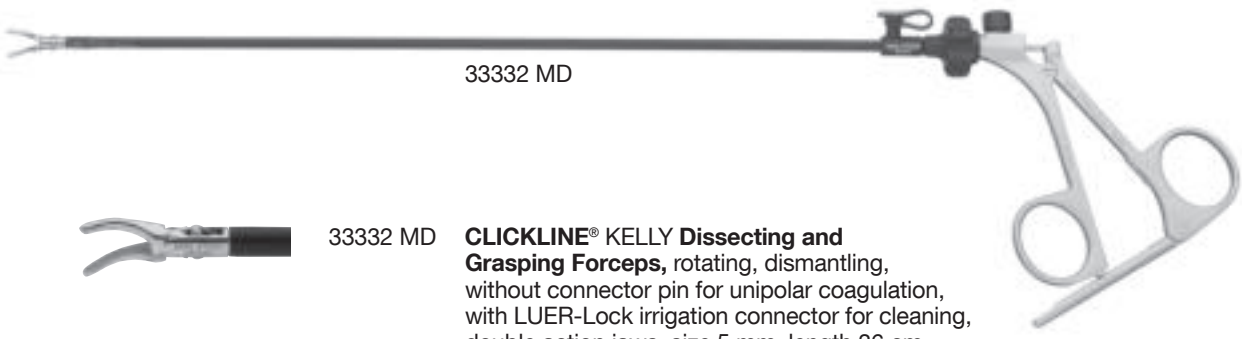
Cannula

Trocar only

Size:		**6 mm:**
Working length: Color code:		6 cm black-white
	**Trocar,** with conical tip including: **Plastic Cannula,** with thread and silicone leaflet valve **Trocar only**	**30120 GH** 30120 G 30120 H

CLICKLINE® Dissecting and Grasping Forceps

Size 5 mm, length 36 cm



33332 MD

33332 MD **CLICKLINE®** KELLY **Dissecting and Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm,
including:
MANHES **Metal Handle,** with ratchet
Outer Sheath, insulated
Forceps Insert

33332 ML **CLICKLINE®** KELLY **Dissecting and Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, long, size 5 mm, length 36 cm,
including:
MANHES **Metal Handle,** with ratchet
Metal Outer Sheath, insulated
Forceps Insert

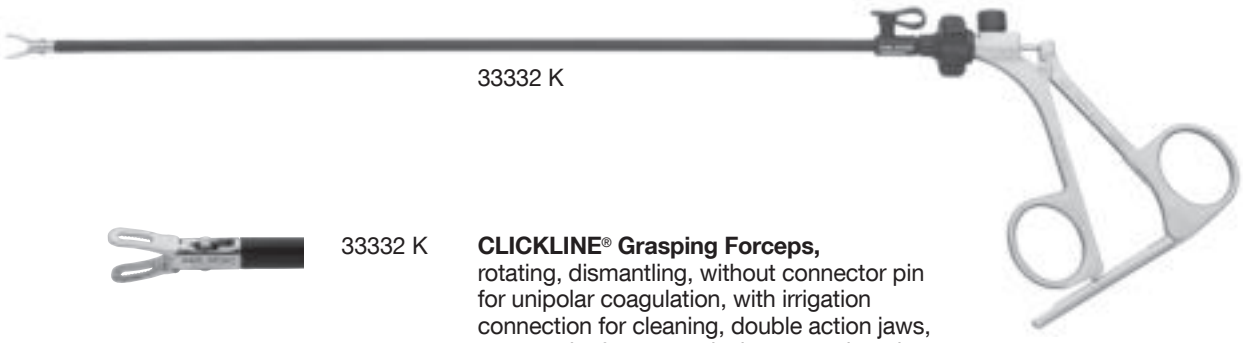
33332 CC **CLICKLINE®** CROCE-OLMI **Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, single action jaws, atraumatic, fenestrated, curved, size 5 mm, length 36 cm,
including:
MANHES **Metal Handle,** with ratchet
Outer Sheath, insulated
Forceps Insert

33332 SN **CLICKLINE®** SCHNEIDER **Lymph Node Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, atraumatic, size 5 mm, length 36 cm,
including:
MANHES **Metal Handle,** with ratchet
Outer Sheath, insulated
Forceps Insert

33332 ME **CLICKLINE®** MANHES **Grasping Forceps,** rotating, dismantling, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, with multiple teeth, width of jaws 4.8 mm, for atraumatic and accurate grasping, size 5 mm, length 36 cm,
including:
Metal Handle, with MANHES style ratchet
Metal Outer Sheath, insulated
Forceps Insert

CLICKLINE® Grasping Forceps and Scissors

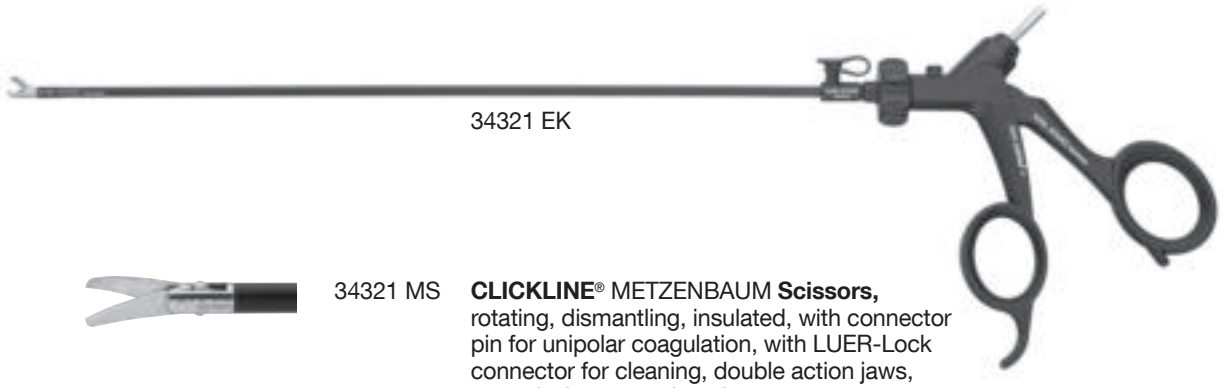
Size 5 mm, length 36 cm



33332 K

33332 K **CLICKLINE® Grasping Forceps,**
rotating, dismantling, without connector pin for unipolar coagulation, with irrigation connection for cleaning, double action jaws, atraumatic, fenestrated, size 5 mm, length 36 cm,
including:
MANHES **Metal Handle,** with ratchet
Outer Sheath, insulated
Forceps Insert

33332 KW **CLICKLINE®** MATKOWITZ **Grasping Forceps,**
rotating, dismantling, without connector pin for unipolar coagulation, with irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm,
including:
MANHES **Metal Handle,** with ratchet
Metal Outer Sheath, insulated
Forceps Insert



34321 EK

34321 MS **CLICKLINE®** METZENBAUM **Scissors,**
rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock connector for cleaning, double action jaws, curved, size 5 mm, length 36 cm,
including:
Plastic Handle, without ratchet
Metal Outer Sheath
Scissors Insert

34321 EK **CLICKLINE® Hook Scissors,**
rotating, dismantling, with connector pin for unipolar coagulation, with irrigation connection for cleaning, single action jaws, tips of jaws not crossing, size 5 mm, length 36 cm,
including:
Plastic Handle, insulated, without ratchet
Outer Sheath, insulated
Scissors Insert

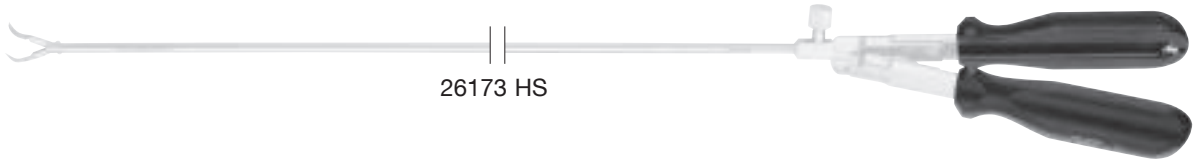
SZABO-BERCI **Needle Holders "PARROT-JAW®"**

Special features:

- **Diamond coating for optimum safety in securing the needle in every position**
- **Ease of operation, precise adjustable ratchet or easy and safe positioning of the needle**

26173 SP

26173 SP SZABO-BERCI **Needle Holder "PARROT-JAW®",**
with diamond coated jaws, straight handle, with ratchet,
size 5 mm, length 33 cm, for suture material 2/0 – 4/0,
needle sizes SH (Ethicon), ENS (Ski), V 20 (USSC),
for use with trocars size 6 mm



26173 HS

26173 HS **Ergonomic Handle Attachments,**
for use with Needle Holders
26173 SA/SC/SE/DR/SD/CQ/CE/QR/DQ/SP

Please note:
Using the needle holder with a needle larger than recommended may result in a mechanical damage to the instrument.

KOH **Macro Needle Holders**

Size 5 mm
Operating instruments, **lengths 33 and 43,**
for use with trocars size 6 mm

Length	Instrument
33 cm	
43 cm	

Distal Tip	Instrument	
	26173 KAL	KOH **Macro Needle Holder,** with tungsten carbide insert, ergonomic straight handle with disengageable ratchet, ratchet position right, jaws curved to left
	26173 KAR	KOH **Macro Needle Holder,** with tungsten carbide insert, ergonomic straight handle with disengageable ratchet, ratchet position left, jaws curved to right

Length	Instrument
33 cm	

Distal Tip	Instrument	
	26173 KL	KOH **Macro Needle Holder,** with tungsten carbide insert, ergonomic handle with ratchet, ratchet position on top, jaws curved to left

KOH **Macro Needle Holder** NEW

dismantling, size 5 mm
Operating instruments, **lengths 33 and 43 cm,**
with axial handle for use with trocars size 6 mm

Length	Handle
	30173 AO
33 cm	
43 cm	

Single action jaws

Working Insert	Complete Instrument
30173 R	30173 RAO
	KOH **Macro Needle Holder,** jaws curved to right, with tungsten carbide inserts, for use with suture material size 0/0 – 7/0
30173 L	30173 LAO
	KOH **Macro Needle Holder,** jaws curved to left, with tungsten carbide inserts, for use with suture material size 0/0 – 7/0

Metal Outer Sheaths

Size 5 mm

30173 A

30173 A **Metal Outer Sheath,**
with LUER-Lock connector for cleaning,
size 5 mm, length 33 cm

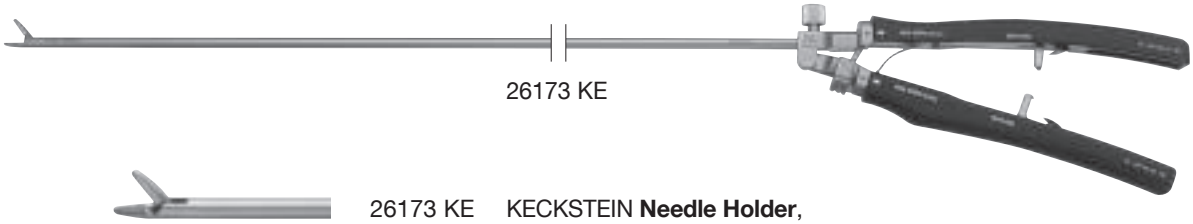
30178 A **Same,** length 43 cm

KECKSTEIN **Needle Holder** NEW

with detachable handles, size 5 mm
Operating instruments, **length 33 cm,**
for use with trocars size 6 mm

Special Features:

- **1 needle holder, 3 different handle jackets (small, medium, large)**
- **For different-sized hands**
- **Fully autoclavable**
- **Easily clicked into place**
- **Lightweight, plastic handle jackets fit comfortably in the hand**



26173 KE

26173 KE KECKSTEIN **Needle Holder**,
size 5 mm, length 33 cm,
for use with Handle Attachment Set
26173 KEA/KEB/KEC

26173 KEA

26173 KEA **Handle Attachment Set,** small,
autoclavable, for 26173 KE

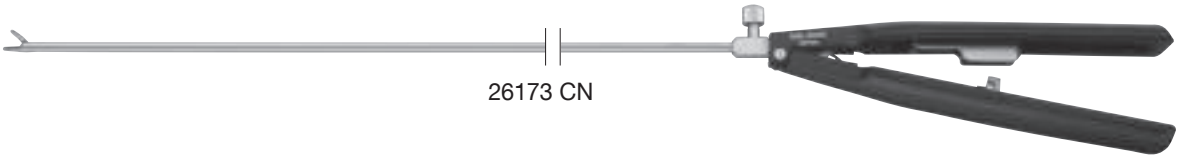
Please note:
Using the needle holder with a needle larger than recommended may result in a mechanical damage to the instrument.

CADIERE **Needle Holder** NEW

Size 5 mm
Operating instruments, **length 33 cm,**
for use with trocars size 6 mm

Special Features:

- **Lightweight construction with plastic handles**
- **Large handles are also suitable for surgeons with larger hands**
- **Proven ratchet functionality**
- **Distal 2-cm marking at 5 and 10 cm**
- **Jaws curved to left**



26173 CN

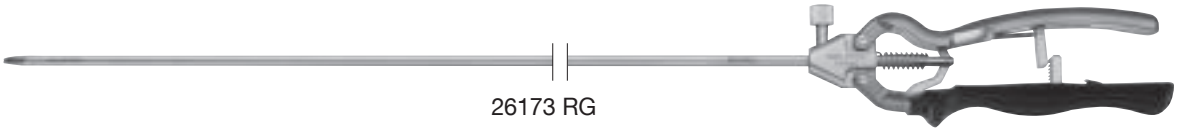
26173 CN CADIERE **Needle Holder**,
with tungsten carbide insert, straight handle,
with ratchet and large handle attachments,
size 5 mm, length 33 cm

CUSCHIERI **Needle Holder ROTAGRIP** NEW

with rotating handle attachment, size 5 mm
Operating instruments, **length 33 cm,**
for use with trocars size 6 mm

Special Features:

- **Ergonomic and rotating handle attachment: Muscle exertion is distributed among all five fingers when closing the grip holder**
- **Striated grip for a better hold**
- **Removable handle attachment for hygienic purposes**
- **Straight jaw**



26173 RG

26173 RG CUSCHIERI **Needle Holder ROTAGRIP**,
with rotating handle, straight jaw, size 5 mm,
length 33 cm

Please note:
Using the needle holder with a needle larger than recommended may result in a mechanical damage to the instrument.

Knot Tiers

Size 5 mm
Operating instruments, **length 36 cm,**
for use with trocars size 6 or 11 mm with reduction sleeve

26596 CL

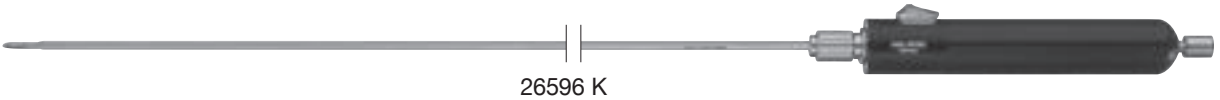
26596 CL **CICE Knot Tier,** CLERMONT-FERRAND model,
for extracorporeal knotting, size 5 mm, length 36 cm

26596 D

26596 D **Knot Tier,** for extracorporeal knotting,
with open and closed end, size 5 mm, length 36 cm

26596 MA

26596 MA MANGESHIKAR **Knot Tier,** for extracorporeal knotting,
size 5 mm, length 36 cm



26596 K

26596 K
NEW
KECKSTEIN **Knot Tier,** size 5 mm, length 36 cm
including:
Handle
Outer Sheath, with knife
Thread Guide

26596 SK

26596 SK KÖCKERLING **Knot Tier,** for extracorporeal knotting,
size 5 mm, length 36 cm

TELE PACK X NEW

Sample Configuration

20 045001-EN

20 045001-EN	**TELE PACK X**

endoscopic video unit for use with TELECAM onechip camera heads and video endoscopes, incl. 50 W HiLux light source, 15" LCD TFT screen, USB/SD memory module, color systems **PAL/NTSC,** with integrated Image Processing Module, power supply 100 – 240 VAC, 50/60 Hz

including:

USB Silicone Keyboard, with touchpad, US character set

USB Flash Drive, 4 GB

Mains Cord

Mains Cord, US version

Specifications:

Power input	100 W
Power supply	100-240 VAC
Dimensions w x h x d	450 x 350 x 150
Weight	7 kg
Interface	- video interface: DVI-D (in/out) - audio: 3.5 mm phonejack (1x lateral, 1x rear), Line in, Line out - footswitch port: 5-pin socket for two-pedal footswitch - printer port: USB - printer language: PostScript
Light source	- lamp: Metal halid 50 W - color temperature: 5700 K - average service life: approx. 1000 h

Image format	JPG
Video codec	MPEG-4
Video format	PAL/NTSC
Memory interface	USB 2.0; SD memory card (SDHC compatible)
TFT monitor	- screen size: 15" - resolution: 1024 x 768 - contrast: 700:1
Loudspeaker output	2 W

TELECAM SL II

Camera Head

20 212040 / **20** 212140

20 212040	**PAL**	**TELECAM One-Chip Camera Head**
20 212140	**NTSC**	

color systems **PAL/NTSC, autoclavable,** soakable, gassterilizable, with integrated Parfocal Zoom Lens, f = 14 – 28 mm (2x), 2 freely programmable camera head buttons, including plastic container 39301 ACT for sterilization

IMAGE 1 SPIES™ Camera System NEW

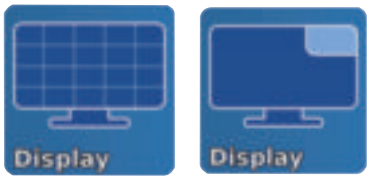
:spies™

Economical and future-proof

- **Modular design**
- **Forward and backward compatibility with flexible video endoscopes and FULL HD camera heads**

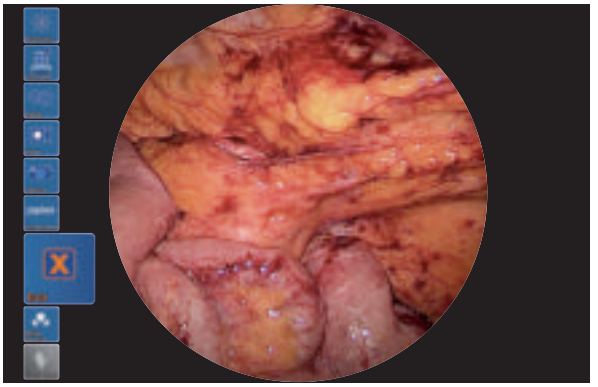
Innovative Design

- **Intelligent icons – Intuitive, graphic display of current status**
- **Dashboard – Quick overview at system start**
- **Live menu available during operating procedure**



"Intelligent icons"

"Dashboard"



"Live menu"

IMAGE 1 SPIES™ Camera System NEW

:spies™

TC 200EN

TC 200EN* **IMAGE 1 CONNECT,** connect module,
for use with up to 3 link modules,
resolution 1920 x 1080 pixels,
with integrated KARL STORZ-SCB and
digital Image Processing Module, 50/60 Hz
including:
Mains Cord, length 300 cm
DVI-D Connecting Cable, length 300 cm
SCB Connecting Cable, length 100 cm
USB Flash Drive, 32 GB

*__Available in the following languages:__ DE, ES, FR, IT, PT, RU

Specifications:

HD video outputs	- 2x DVI-D - 1x 3G-SDI
Format signal outputs	1920 x 1080p, 50/60 Hz
LINK video inputs	3x
USB interface SCB interface	4x USB, (2x front, 2x rear) 2x 6-pin mini-DIN

Power supply Power frequency	100 – 120 VAC, 50/60 Hz 200 – 240 VAC, 50/60 Hz
Protection class	I, CF-Defib
Dimensions w x h x d	305 x 55 x 318 mm
Weight	2.1 kg

TC 300

TC 300 **IMAGE 1 H3-LINK,** link module, for use with
IMAGE 1 FULL HD three-chip camera heads 50/60 Hz,
for use with IMAGE 1 CONNECT TC 200
including:
Mains Cord, length 300 cm
Link Cable, length 30 cm

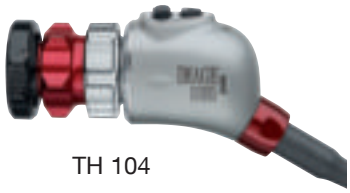
Specifications:

Camera System	**TC 300 (H3-Link)**
Supported camera heads/video endoscopes	TH 100, TH 101, TH 102, TH 103, TH 104, TH 106 (fully SPIES-compatible) **22** 2200 55-3, **22** 2200 56-3, **22** 2200 53-3, **22** 2200 60-3, **22** 2200 61-3, **22** 2200 54-3 (not SPIES-compatible)
LINK video outputs	1x
Power supply Power frequency	100 – 120 VAC, 50/60 Hz 200 – 240 VAC, 50/60 Hz
Protection class	I, CF-Defib
Dimensions w x h x d	305 x 55 x 318 mm
Weight	1.86 kg

IMAGE1 SPIES™ Camera Head NEW

:spies™

For use with IMAGE1 SPIES camera system IMAGE1 CONNECT Module TC 200, IMAGE1 H3-LINK Module TC 300 and with all IMAGE1 HUB™ HD Camera Control Units



TH 104

TH 104 **IMAGE1 H3-ZA SPIES Three-Chip FULL HD Camera Head,** SPIES-compatible, **autoclavable,** max. resolution 1920 x 1080 pixels, progressive scan, soakable, gas- and plasma-sterilizable, with integrated Parfocal Zoom Lens, focal length f = 15 – 31 mm (2x), 2 freely programmable camera head buttons, for use with IMAGE1 SPIES and IMAGE1 HUB™ HD

Specifications:

IMAGE1 FULL HD Camera Heads	H3-ZA SPIES
Product no.	TH 104
Image sensor	3x ⅓" CCD chip
Pixel output signal H x V	1920 x 1080
Dimensions w x h x d	39 x 49 x 100 mm
Weight	299 g
Optical interface	integrated Parfocal Zoom Lens, f = 15–31 mm
Min. sensitivity	F 1.4/1.17 Lux
Grip mechanism	standard eyepiece adaptor
Cable	non-detachable
Cable length	300 cm

Cold Light Fountain XENON 300 SCB

20133101-1 **Cold Light Fountain XENON 300 SCB** with built-in antifog air-pump, and integrated KARL STORZ Communication Bus System SCB power supply: 100–125 VAC/220–240 VAC, 50/60 Hz

including:

Mains Cord

Silicone Tubing Set, autoclavable, length 250 cm

SCB Connecting Cable, length 100 cm

20133027 **Spare Lamp Module XENON** with heat sink, 300 watt, 15 volt

20133028 **XENON Spare Lamp,** only, 300 watt, 15 volt

Fiber Optic Light Cable

495 NCS **Fiber Optic Light Cable,** with straight connector, extremely heat-resistant, diameter 4.8 mm, length 250 cm

KARL STORZ Monitors

9627 NB/NB-2

9627 NB	**27" HD Monitor,** wall-mounted with VESA 100 adaption, color systems **PAL/NTSC,** max. screen resolution 1920 x 1080, image format 16:9, power supply 85 – 264 VAC, 50/60 Hz including: **External 24 VDC Power Supply** **DVI-D Connecting Cable** **BNC Video Cable** **SVGA Monitor Cable** **S-Video (Y/C) Connecting Cable**
9627 NB-2	**Same,** with double video outputs

9826 NB

9826 NB	**26" FULL-HD Monitor,** wall-mounted with VESA 100 adaption, color systems **PAL/NTSC,** max. screen resolution 1920 x 1080, image format 16:9, power supply 100 – 240 VAC, 50/60 Hz including: **External 24 VDC Power Supply** **Mains Cord**
9526 SF	**Pedestal,** for monitors

KARL STORZ Monitors

KARL STORZ HD and FULL HD Monitors	19"	26"	27"	
Wall-mounted with VESA 100 adaption	9619 NB	9826 NB	9627 NB	9627 NB-2
Inputs:				
DVI-D	1x	1x	1x	2x
Fibre Optic	optional	–	optional	optional
3G-SDI	1x	1x	–	optional
RGBS/VGA	1x	1x	1x	2x
S-Video	1x	1x	1x	2x
Composite/FBAS	1x	1x	1x	2x
Outputs:				
DVI-D	1x	1x	1x	1x
S-Video	1x	1x	1x	1x
Composite/FBAS	1x	1x	1x	1x
3G-SDI	1x	1x	1x	optional
Signal Format Display:				
4:3	●	●	●	●
5:4	●	●	●	●
16:9	●	●	●	●
Picture-in-Picture	●	●	●	●
PAL/NTSC-compatible	●	●	●	●

Optional accessories:

9526 SF **Pedestal,** for monitor 9826 NB

9626 SF **Pedestal,** for 96xx monitor series

Specifications:

KARL STORZ FULL-HD Monitor	19"	26"	27"
Desktop with pedestal	optional	optional	optional
Wall-mounted with 100 adaption	9619 NB	9826 NB	9627 NB/NB-2
Brightness	170 cd/m² (Typ)	500 cd/m² (typ)	240 cd/m² (typ)
Max. viewing angle	178° vertical	178° vertical	178° vertical
Pixel distance	0.29 mm	0.3 mm	0.3 mm
Reaction time	5 ms	8 ms	12 ms
Contrast ratio	500:1	1400:1	3000:1
Mount	100 mm VESA	100 mm VESA	100 mm VESA
Weight	10 kg	7.7 kg	9.8 kg
Rated power	38 W	69 W	45 W
Operating conditions	0–40°C	0–40°C	0–40°C
Storage	-20–60°C	-20–60°C	-20–60°C
Relativ humidity	max. 80%	max. 85%	max. 80%
Dimensions w x h x d	469.5 x 416 x 75.5 mm	643 x 396 x 87 mm	696 x 445 x 55 mm
Power supply	100–240 VAC	100–240 VAC	85–264 VAC

LYRA **Laparoscopic Simulator** NEW

26344 L2

26344 L2 LYRA **Laparoscopic Simulator,**
for laparoscopic and robot-assisted surgery, including the urinary tract, complete

including:

LYRA **Body Laparoscopic Simulator**
Neoderm Organ, liver
Neoderm Organ, spleen
Neoderm Organ, stomach
Neoderm Organ, peritoneum
Neoderm Organ, bowel
Neoderm Organ, abdominal wall
Neoderm Organ, cul-de-sac
Neoderm Organ, vaginal block
Neoderm Organ, uterus
Neoderm Organ, suturing model

Optional Accessories

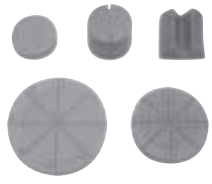
26344 LF **Neoderm Organ Set,** with bowels and organs, for use with LYRA Laparoscopic Simulator 26344 L2

Trainers

LYRA Laparoscopic Trainer

26344 LE **Neoderm Organ,** abdominal wall
26344 LNF **Neoderm Organ,** suturing model

26344 LE



26344 LNF

WITH COMPLIMENTS OF
KARL STORZ—ENDOSKOPE