

Phases of Robot-Assisted Radical Prostatectomy (RARP)

Robot-Assisted Radical Prostatectomy (RARP) is a structured surgical procedure divided into clearly defined phases. Each event occurring during the procedure requires a specific level of precision in annotation. The required precision is indicated through a predefined color coding system, which specifies whether the exact frame described in the definition must be selected, or whether a frame around the defined time point should be selected with a margin of 1 second or 5 seconds.

A phase always ends when another phase starts. Most events are phase-specific and are stamped while the corresponding phase is ongoing. These events belong to that phase category. However, it is possible that an event belonging to Phase A occurs while Phase B is ongoing. In such cases, the event must still be stamped under Phase A, even though Phase B is currently in progress.

If “START” and “END” are indicated in the stamp placement definition, the event covers a range of frames. Otherwise, the event concerns a single frame.

Regarding the start of dissection or coagulation: when blunt dissection is used (for example scissors without coagulation), the stamp is placed when the blades of the scissors close. When coagulation is used (for example scissors combined with coagulation), the stamp is placed when coagulation starts.

Events that append in 1 frame are:

Out of body, Instrument swap: removal, Instrument swap: insertion, Insert gauze, Remove gauze, Insert hemostatic agents, Remove hemostatic agents, Test image, Inside abdomen, Instrument insertion, Fat removal, Remove needle bladder stretch stitch, Needle removal DVC ligation, Vlock, Cutting the needles, Removing the needles, Threads removal, Vessel loop removal, Hemolock clip removal, Drain placement, Removal of robotic instruments, Camera out of body, Camera stop

Events that have a margin of 1 second are :

Unsuccessful clip placement, Hemostatic metal clip placement, Adhesion removal, Incision peritoneum – left, Incision peritoneum – right, Incision of fascia – right, Incision of fascia – left, Placement stitch for bladder stretch, Start dissection, Visualisation of urethra opening, Grasping catheter tip, Continue posterior dissection, Hemolock clip on bladder pedicle attached to prostate, Identify and dissect vas deferens– left, Clip or coagulate vas deferens – left, Identification and clipping of SV arteries – left, Identify and dissect vas deferens – right, Clip or coagulate vas deferens – right, Identification and clipping of SV arteries – right, Lift both seminal vesicles, Incision of Denonvilliers fascia, Lift right seminal vesicle, Start dissection and cutting right pedicle, Hemolock clip on right pedicle, Metal clip on right pedicle, Lift left seminal vesicle, Start dissection and cutting left pedicle, Hemolock clip on left pedicle, Metal clip on left pedicle, Start dissection DVC, Stitch in DVC before apical dissection, Transection of the urethra, Transection of the urethra, Tighten endobag, Stitch in DVC after apical dissection, Stitch of posterior reconstruction, Stitch in bladder, Stitch in urethra, Tie suture, Final reinforcing suture, Endobag removal.

Finally the events with a margin of 5 seconds are:

Port placement, Needle removal DVC ligation, Leak test

General Rules

For every stamp regarding clip placement, the stamp is placed at the moment when the clip is closed, meaning when the tips of the instrument placing the clip are closed around the tissue. If a clip placement requires multiple attempts and is eventually successful, only the successful attempt is stamped. If the clip placement is unsuccessful (metal or hemolock clip), the “Unsuccessful clip placement” event is stamped instead. If there are multiple unsuccessful attempts and none work, only the final unsuccessful attempt is stamped.

For every stamp regarding grasping or grabbing something, the stamp is placed when the tips of the instrument close to grasp the structure. If multiple attempts are made to grasp an object, only the first intentional attempt is annotated.

For every stamp regarding a stitch, the stamp is placed when the needle enters the tissue.

For every stamp where something is removed (instrument, needle, etc.), the stamp is placed on the last frame where the instrument holding the object is visible in the field of view (FOV) of the endoscope.

General Events

General events are not phase-specific and may occur during any phase of the procedure.

“Out of body” refers to the situation in which the endoscope is removed from the body and the surroundings of the patient and operating room are recorded. The START of this event is when the flaps of the valve of the trocar enter the field of view of the endoscope. The END is the final frame where the flaps of the valve of the trocar are visible.

“Instrument swap: removal” occurs when a robotic instrument is removed from the body before inserting a new one. The stamp is placed when the tip of the removed instrument leaves the field of view of the endoscope.

“Instrument swap: insertion” occurs when a new robotic instrument is inserted into the body after removing the old one. The stamp is placed when the tip of the instrument enters the field of view or becomes visible in the opening of the trocar. This is not stamped for the first insertion at the start of the procedure.

“Insert gauze” refers to a gauze being inserted into the body by a laparoscopic instrument. The stamp is placed when the gauze enters the field of view of the endoscope. “Remove gauze” is stamped when the instrument holding the gauze leaves the field of view.

“Insert hemostatic agent” refers to the insertion of a hemostatic agent into the body (different types are possible). The stamp is placed when the hemostatic agent enters the field of view. “Remove hemostatic agent” is stamped when the instrument holding the agent leaves the field of view. However, insertion and removal of a hemostatic agent are not always paired, since some types can remain in the body.

“Unsuccessful clip placement” refers to an unsuccessful placement of a metal or hemolock clip, causing the clip not to be placed and to be taken out. The stamp is placed when the clip closes around the tissue. In case of multiple attempts of the same clip, only the final attempt is stamped.

“Hemostatic metal clip placement” refers to the placement of a metal clip at an unusual point in time, often to stop bleeding. The stamp is placed when the clip applicator closes around the tissue.

“Test image” refers to the camera being switched off and a combination of colored blocks being displayed. START is the first frame where the colored blocks are visible. END is the last frame where the colored blocks are visible.

The events “Idle time” and “Suction only” are included in the ontology but should not be annotated.

Phase 1: Port Insertion and Surgical Access

This phase includes the installation of trocars and instruments and the preparation to start the robotic procedure. It includes everything that happens before the incision of the peritoneum in Phase 2. However, “Inside abdomen” should always be stamped, even if a different phase is ongoing.

“Inside abdomen” refers to the moment when the endoscope enters the abdomen for the first time. If the video starts inside the abdomen, this is stamped at frame 0. If the video does not start inside the abdomen, it is stamped when the flaps of the valve in the trocar are no longer visible.

“Port placement” refers to insertion of the trocars into the body through the abdominal wall. If this happens multiple times, each trocar is indicated separately. The stamp is placed when the trocar obturator punctures through the abdominal wall.

“Instrument insertion” refers to robotic instruments being inserted into the body. This can occur multiple times and should be indicated for every instrument separately. The stamp is placed when the tip of the instrument enters the field of view of the endoscope or is visible in the opening of the trocar.

“Adhesion removal” refers to the start of removal of adhesion tissue. The stamp is placed when the scissors make the first incision or coagulation of the adhesion tissue.

Phase 2: Bladder Detachment

This phase consists of detachment of the bladder from the peritoneum.

“Incision peritoneum – left” refers to the first incision of the peritoneum approaching from the left side. “Incision peritoneum – right” refers to the first incision from the right side. In both cases, the stamp is placed when the scissors make the first incision from the corresponding side.

“Fat removal” refers to fat tissue being detached from the prostate and removed from the body by an assisting instrument. The stamp is placed when the assisting instrument holding the fat tissue leaves the field of view.

“Incision peritoneum” should not be confused with “Adhesion removal.” Incision peritoneum describes incision of the peritoneum, often at the top of the scene, with the intent of detaching the bladder.

Phase 3: Endopelvic Fascia Incision

This phase consists of incision of the endopelvic fascia in order to allow visibility of the lateral prostate.

“Incision of fascia – right” refers to opening up the fascia on the right side of the prostate. The stamp is placed when the scissors make the first manipulations of the right-side fascia, either by incision or by pulling it open.

“Incision of fascia – left” refers to opening up the fascia on the left side of the prostate. The stamp is placed when the scissors make the first manipulations of the left-side fascia, either by incision or by pulling it open.

The fascia described here is the connective tissue on either side of the prostate. After bladder detachment, the prostate is typically located centrally in the image, and the endopelvic fascia is the connective tissue on both sides of the prostate.

Phase 4: Bladder Neck Dissection

This phase consists of dissection of the bladder neck, separating the bladder and the prostate.

“Placement stitch for bladder stretch” refers to a stitch placed in order to stretch the bladder neck by pulling the stitch upwards. The stamp is placed when the needle enters the tissue.

“Remove needle bladder stretch stitch” refers to removal of the needle used for the bladder stretch stitch. The stamp is placed when the laparoscopic instrument holding the needle leaves the field of view of the endoscope.

“Start dissection” refers to the start of dissection of the bladder neck using the scissors. The stamp is placed when the scissors make the first dissection or coagulation of the bladder neck.

“Visualisation of urethra opening” refers to opening up the urethra and exposing the catheter that is inside. The stamp is placed when the catheter can be seen for the first time in the opening of the urethra.

“Grasping catheter tip” refers to a robotic instrument grasping the catheter and pulling it upwards. The stamp is placed when the robotic instrument closes around the catheter.

“Continue posterior dissection” refers to continuation of the dissection on the posterior side using the scissors, after the catheter has been pulled up. The stamp is placed at the first dissection of the scissors after catheter pull.

“Hemolock clip on bladder pedicle attached to prostate” refers to placement of a hemolock clip on a bladder pedicle. The stamp is placed when the clip closes around the tissue.

Phase 5: Vas Deferens and Seminal Vesicles

This phase consists of dissection of the vas deferens down to the seminal vesicles, after which the vesicles are further dissected to reveal the Denonvilliers fascia.

“Identify and dissect vas deferens – left” refers to dissection of the left vas deferens down to the tip of the seminal vesicle. Alternation with the right vas deferens is possible, and a stamp should be placed with every switch. The stamp is placed when the left vas deferens is grasped or dissected by the scissors, the first time and every time after manipulation of the right vas deferens.

“Clip or coagulate vas deferens – left” refers to clipping and cutting or coagulating the left vas deferens. The stamp is placed when the clip closes around the tissue or when coagulation starts on the tissue.

“Identification and clipping of SV arteries – left” refers to placement of a metal clip on a left seminal vesicle artery, after which the artery is cut. The stamp is placed when the metal clip closes around the tissue.

The same events apply symmetrically for the right side:

- “Identify and dissect vas deferens – right”
- “Clip or coagulate vas deferens – right”
- “Identification and clipping of SV arteries – right”

The vas deferens are tubular structures lying next to the bladder and connected to the prostate. They lie centrally in the image, and distinction between left and right should be made. The seminal vesicles are glands connected to the vas deferens and are revealed after vas deferens dissection. They contain several arteries that are clipped using metal clips.

Every time a metal clip is placed, the instrument administering the clips immediately pushes a new clip ready to be placed. Because of this, it might seem that no clip is placed while in fact there was one. Extra attention may therefore be necessary.

Phase 6: Dissection of Posterior Space Between Prostate and Rectum

This phase consists of separation of the prostate from the rectum by incising the Denonvilliers fascia.

“Lift both seminal vesicles” refers to the seminal vesicles being held up by the instruments in order to reveal the Denonvilliers fascia. The stamp is placed when an instrument grasps one or both seminal vesicles with the intention of lifting them up to expose the Denonvilliers fascia. If multiple tries or instruments are involved, only the first attempt is indicated.

“Incision of Denonvilliers fascia” refers to incision of this fascia using the scissors. The stamp is placed at the first incision of the Denonvilliers fascia, usually the first incision after lifting the seminal vesicles.

The Denonvilliers fascia is the connective tissue below the seminal vesicles.

Phase 7a: Right Lateral Dissection of the Prostate

This phase consists of dissection and clipping of the right prostatic pedicle and dissection of the right neurovascular bundle.

“Lift right seminal vesicle” refers to the first time the right seminal vesicle is lifted in order not to obstruct the right lateral prostate, which is to be dissected. The stamp is placed when an instrument grasps the right seminal vesicle or vas deferens with the intention of lifting it. Only the first time is stamped.

“Start dissection and cutting right pedicle” refers to the start of dissection or cutting of the right pedicle using the scissors. The stamp is placed when the scissors make the first manipulation or cut of the right pedicle.

“Hemolock clip on right pedicle” refers to placement of a hemolock clip on the right pedicle. The stamp is placed when the hemolock clip closes on the tissue.

“Metal clip on right pedicle” refers to placement of a metal clip on the right pedicle. The stamp is placed when the metal clip closes on the tissue.

Phase 7b: Left Lateral Dissection of the Prostate

This phase mirrors Phase 7a on the left side.

“Lift left seminal vesicle” refers to the first time the left seminal vesicle is lifted to expose the left lateral prostate. Only the first time is stamped.

“Start dissection and cutting left pedicle” refers to the start of dissection or cutting of the left pedicle using the scissors. The stamp is placed when the scissors make the first manipulation or cut.

“Hemolock clip on left pedicle” and “Metal clip on left pedicle” are stamped when the respective clips close on the tissue.

Phase 8: Dorsal Venous Complex (DVC) Dissection

This phase consists of dissection and potentially ligation of the Dorsal Venous Complex (DVC).

“Start dissection DVC” refers to the start of dissection of the DVC. The stamp is placed when the scissors make the first cut in the DVC.

“Stitch in DVC before apical dissection” refers to placement of a suture in the DVC in order to tighten it during ligation. The stamp is placed every time the needle enters the DVC tissue.

“Needle removal DVC ligation” refers to removal of the needle used for DVC ligation. The stamp is placed when the instrument holding the needle leaves the field of view.

DVC ligation can occur either before or after Phase 9. If it happens before, it should be stamped as part of Phase 8.

Phase 9: Apical Dissection

This phase consists of transection of the urethra, dissection of the posterior part of the prostate, and bagging of the prostate.

“Transection of the urethra” refers to the start of transection where the urethra is cut completely. The stamp is placed when the scissors make the first cut in the urethra.

“Prostate bagging” refers to placing the detached prostate inside the endobag. The stamp is placed when the specimen retriever holding the endobag enters the field of view.

“Tighten endobag” refers to closing the endobag by tightening it after insertion of the specimen. The stamp is placed when the bag is completely tightened closed.

After the urethra is completely cut, the remaining tissue attached to the prostate is dissected, but this is not explicitly stamped.

Phase 10: Posterior Reconstruction

This phase consists of potentially ligating the DVC and placing sutures for posterior reconstruction.

“Stitch in DVC after apical dissection” refers to placement of a suture in the DVC after apical dissection. The stamp is placed every time the needle enters the DVC tissue.

“Needle removal DVC ligation” is stamped when the instrument holding the needle leaves the field of view.

“Stitch of posterior reconstruction” refers to placement of stitches in the Denonvilliers fascia, the connective tissue below the former location of the seminal vesicles. The stamp is placed every time the needle enters the Denonvilliers fascia.

Posterior reconstruction should not be confused with VU-anastomosis. Posterior reconstruction places sutures in the Denonvilliers fascia, located below the bladder neck and the urethra, whereas VU-anastomosis sutures the bladder neck and urethra themselves.

If DVC ligation occurs after Phase 9, it should be stamped as part of Phase 10.

Phase 11: VU-Anastomosis

This phase consists of connection of the bladder to the urethra using a series of sutures, thereby finishing the procedure.

“Stitch in bladder” refers to a stitch placed in the bladder neck. The stamp is placed every time the needle enters the tissue of the bladder neck.

“Stitch in urethra” refers to a stitch placed in the urethra. The stamp is placed every time the needle enters the urethral tissue. Usually, the catheter retracts to allow needle penetration.

“Tie suture” refers to fixing the suture in place by making a knot. The stamp is placed every time the wires are tied together.

“Vlock” refers to fixation of the suture by pulling the needle and wire through the loop of the Vlock. The stamp is placed when the needle passes through the loop.

“Final reinforcing suture” refers to additional sutures made at the end of the anastomosis. These sutures do not connect the bladder neck to the urethra but pull both structures strongly together. The stamp is placed when the needle enters the tissue.

“Leak test” refers to testing the connection between bladder neck and urethra for leaks by instilling water. The stamp is placed when the bladder neck starts bloating because of the incoming water.

“Cutting the needles” refers to cutting the needles loose from the suture wire when they are no longer needed. The stamp is placed when the scissors cut the wire, separating the needle from the rest of the suture.

“Removing the needles” refers to removal of the needles from the body. The stamp is placed when the laparoscopic instrument holding the needles leaves the field of view.

Phase 12: Specimen and Instrument Removal

This phase consists of removal of all items that cannot be left inside the body.

“Threads removal” refers to removal of a piece of thread or suture wire from the body. The stamp is placed when the instrument grasping the thread leaves the field of view.

“Vessel loop removal” refers to removal of a vessel loop. The stamp is placed when the instrument grasping it leaves the field of view.

“Hemolock clip removal” refers to removal of a hemolock clip. The stamp is placed when the instrument grasping the clip leaves the field of view.

“Endobag removal” refers to removal of the endobag containing the specimen. The stamp is placed when the endobag wire is grasped with the goal of extraction, or if grasping is not visible, when the grasper holding the wire enters the field of view.

“Drain placement” refers to placement of a drain. The stamp is placed when the drain enters the field of view.

“Removal of robotic instruments” refers to final removal of a robotic instrument without inserting a new one. The stamp is placed when the tip of the removed instrument leaves the field of view.

Some of these actions may also occur earlier in the procedure and are not strictly limited to this phase.

Phase 13: End of Operation

This phase consists of the final moments of the recording, when the endoscope is removed and the camera eventually stops.

“Camera out of body” refers to removal of the camera from the body at the end of the procedure, without reinsertion. The stamp is placed when the flaps of the valve of the trocar enter the field of view of the endoscope.

“Camera stop” refers to the camera stopping at the end of the recording or being unplugged, possibly causing a test image to be shown. The stamp is placed at the final frame of the endoscopic view, meaning the final frame of the video or the final frame before the test image.