Course Notes: Surgical Clamps

Introduction to Clamps

From vessel clamping to ligature passing, surgical clamps serve numerous functions. In this topic, we will examine the wide variety of surgical clamps available, as well as explore the many ways that these versatile instruments are used to support veterinary surgery.

Anatomy of a Clamp

Surgical clamps have two handles, or shafts, and two complete finger rings. The rings and shaft are the areas of the instrument gripped by the surgeon when using the tripod grip, also known as the thumb ring finger grip.

Ratchet

Adjacent to the rings is a ratcheting mechanism that locks the jaws into position when the clamps are clicked closed. Most hinged clamps have three ratcheted positions. The first ratcheted position allows for the least amount of pressure to be exerted through the jaws of the instrument, while the third position provides the greatest amount of pressure.

Rings

The two rings of the surgical clamp are designed for inserting the thumb and ring finger during use. Most surgical clamps are only available in the right-handed configuration. To ascertain the configuration, place the clamp in the open palm of your right hand. The ratchet ridges of the thumb ring will face the palm. Surgical clamps can be released without placing the fingers in the rings, and this may help explain why these instruments are generally only available in the right-handed configuration.

Box hinge

The handles of the surgical clamp are bound together with a box hinge.

Jaws

Surgical clamps have specially constructed jaws for grasping tissues. The configuration of these jaws varies greatly from one type of clamp to another. It is mostly the configuration of these jaws that dictate how a given type of clamp can be used in surgery. Note that surgical clamps, especially hemostatic forceps, look very similar to needle holders; however the jaws on clamps are thinner and longer.

Types of Surgical Clamps

Surgical clamps are classified into four functional groups including:

1. Hemostatic clamps primarily used to grab, hold, and crush blood vessels
2. Right-angle clamps primarily used for dissecting around structures and suture passing
3. Crushing clamps that crush non-vascular tissue or tissue that will be removed during the procedure
4. Atraumatic clamps that are used to occlude hollow viscera and to retract and hold soft tissues.

Towel clamps are a related group of instruments that are used to fasten surgical drapes to patients. Although towel clamps are occasionally used for other purposes, such as rib or abdominal wall retraction, their primary use is restricted to draping and will therefore not be covered in this module.

Hemostatic Clamps

Hemostatic clamps are used to occlude blood vessels or a source of blood supply located within a tissue bundle, known as a pedicle. As dictated by their function, all hemostatic clamps feature a set of crushing jaws. Jaw sizes vary among different types of hemostatic clamps, as do handle lengths and configurations.

When choosing the type of hemostatic clamp, the surgeon selects the jaw size relative to the size of the blood vessel or pedicle that needs to be occluded. Generally the large hemostatic forceps, such as the Pean or Carmalt, are used to occlude large blood vessels and pedicles. Pean and Carmalt forceps are frequently used to occlude the ovarian pedicle in an ovariohysterectomy in large patients or highly vascularized areas with large vessels. Medium sized pedicles are typically clamped with Crile or Kelly forceps. The smallest hemostatic clamp is a mosquito hemostat and is used to occlude smaller blood vessels. Hemostatic clamps are also available in two configurations: curved or straight. Generally speaking, curved hemostats are more desirable for hemostatic use because the tips are better exposed when clamping vessels in deep, remote areas, and the surgeon can see the tips of the forceps to be sure their ligature is situated beneath the clamp. In more superficial

hemostatic applications, straight hemostatic forceps will suffice.

Learn more about the hemostatic clamps commonly used in veterinary surgery below.

Mosquito Clamps

Mosquito clamps are short, delicate hemostatic forceps. They have transverse serrations that run from the hinge to the tips of the instrument, making them ideal for occluding vessels within their tips. This tip clamp technique minimizes the amount of peripheral tissue included in the clamp, reducing tissue trauma. Mosquito hemostats can also be used for delicate dissection around structures and for suture tagging. Mosquito hemostats are sometimes referred to as "snaps" in the operating room.

Kelly and Crile Forceps

Kelly and Crile are medium-sized hemostatic forceps that are characterized by long blades and handles. Kelly forceps are used for tip clamping and have transverse serrations that run half way up the jaw. Crile forceps are used for both tip and jaw clamping and have serrations along the entire clamping surface.

Pean Clamps

Pean clamps are long hemostatic forceps characterized by strong jaws. They have transverse serrations on the clamp surface and are well suited to clamping large pedicles.

Carmalt Clamps

Carmalt clamps are long hemostatic forceps characterized by longitudinal serrations that run along the entire surface of the clamp. They are the preferred hemostatic clamp for jaw clamping large pedicles, especially if the pedicle must be held under tension. The longitudinal serrations help to hold tissue more securely than clamps with transverse serrations.

Curved and Right-Angle (Mixter) Clamps

Right-angle clamps are characterized by curved or angled jaws. Some have an abrupt 90-degree angle, while others have gently curved and angled jaws. Hemostatic forceps in this class are useful for clamping hard-to-reach vessels. They can also be used to place sutures or dissect behind or around a structure, such as a vessel or a nerve. The shorter right-angle forceps are used to precisely dissect small superficial structures, whereas longer-handled, right-angle forceps are chosen for deeper dissection and deep suture passing. Right-angle clamps are sometimes referred to as Mixter clamps and a right-angle forceps with a suture attached is sometimes called a "tie on a passer."

Common Crushing Clamps

Crushing clamps are used to securely hold tissue through crushing force. By definition, crushing clamps damage tissue; therefore, these clamps must only be used on tissue that will be removed from the patient.

Learn more about the two most common types of crushing clamps used in veterinary surgery below.

Allis Forceps

Allis tissue forceps are long, usually straight clamps. They have a ratcheted handle, inwardly curved arms, and transverse serrated ends featuring a variable number of teeth. Allis tissue forceps are used to forcibly clutch or retract tissues or structures. For example, Allis forceps can be used to securely hold the edge of the ear canal cartilage during ear canal ablation or the margin of a mass during a lumpectomy. Note that in both examples, the area crushed by the clamp is later removed with the excised tissue.

Allen Forceps

Allen tissue forceps are long and slender clamps that are used to crush and securely seal the end of an intestine. They feature a ratchet handle and jaws that are long, straight, and thin. The jaws have longitudinal serrations and a rat-tooth tip. The rat-teeth prevent slippage of the intestine from the jaws during clamping. Once the selected area of the bowel is isolated and crushed at either end, the surgeon incises the intestine just outside the clamped areas, removing the segment containing the crushed tissue.

Common Atraumatic Clamps

Atraumatic clamps are used to retract soft tissues, such as lung or stomach, or to occlude hollow organs that have been opened to prevent leakage. Although atraumatic clamps are less damaging to tissues, keep in mind that their grasp is also less secure than that provided by the crushing clamps. Learn more about the two most common types of atraumatic clamps used in veterinary surgery below.

Doyen Forceps

Doyen intestinal forceps are non-crushing, occluding forceps with shallow longitudinal serrations. Their jaws are flat, bowed, and somewhat malleable. They are used to temporarily occlude the lumen of stomach

or intestine during gastrectomy, enterectomy, and enterotomy, to prevent soilage of the peritoneal cavity.

Babcock Forceps

Babcock forceps are characterized by somewhat malleable arms that are connected to a loop-like flat grasping tip. The tip is non-serrated and is designed to hold viscera with minimal trauma to the tissue.

Using Surgical Clamps

Surgical clamps serve numerous functions from occluding bleeding vessels to ligature passing and suture tagging. In this topic, we will demonstrate how to use surgical clamps to perform common surgical functions.

Hemostatic forceps are frequently applied to bleeding vessels to achieve hemostasis. There are two methods used to apply the clamps: the tip technique and the jaw technique. Let's take a closer look at how to perform each technique and their surgical applications.

To apply the hemostats using the tip clamp technique, first insert the thumb and ring finger into the instrument's rings using the tripod grip. Then clamp the vessel in the tip of the jaws, minimizing the amount of surrounding tissue included in the clamp. The main function of tip clamping is to occlude vessels in delicate areas such as a small vessel near the ureter. Using this technique, vessels can be ligated or electrocoagulated without risk of crushing or thermal injury to delicate surrounding tissues. Tip clamping also minimizes the risk of accidentally trapping vital structures, like a ureter, when ligating nearby vessels.

In the jaw technique, the vessel is clamped in the middle or greater curvature of the jaw, with the tip pointing away from the vessel. A good example of jaw clamping is when a fat-filled ovarian pedicle is jaw clamped during an ovariohysterectomy. In this video sequence, notice that we are using the jaw clamp technique for mass clamping of the short gastric vessels during splenectomy. Note that the long axis of the vessels is perpendicular to the jaws of the forceps. The main purpose of jaw clamping is to facilitate the placement of a secure ligature. Jaw clamping leaves the tip of the forceps exposed well beyond the pedicle, assuring that a ligature is safely under the clamp when tying the knot. However, jaw clamping does include more tissue than tip clamping. Therefore viable tissue is sacrificed in order to minimize the risk of ligature avulsion during knot tying.

When a large vessel traverses the surgical field and needs to be transected, first apply two curved hemostats across the vessel, with the tips pointed towards the region to be transected. Then sever the vessel between the clamps. The assistant can then rotate the tips upward to improve exposure so you can then ligate both ends of the vessel.

If a vessel is inadvertently severed prior to controlled isolation and ligation, you can tip-clamp the severed vessel end to control hemorrhage. Apply the tips of the hemostat to the vessel end with the tips pointing towards the patient. An important concept in this situation is that, if the bleeding vessel is not effectively grasped on the first attempt, the clamp should be left with the tissue so that the second clamping attempt does not end up in the same location. Once the vessel is securely clamped, hand the clamp across the surgical field to the assistant. Notice that when the clamp is handed to the assistant, the tips of the clamp are now facing away from the patient to facilitate better visualization of the vessel for ligation.

There are two methods for removing clamps from a ligated vessel or pedicle. In the first method, the thumb and ring finger are placed just into the rings of the forceps, using the tripod grip. The ratchet lock is then slowly disengaged in a well-controlled manner, rather then being "snapped" off the wound. This method is preferred when removing hemostatic clamps from important structures. However, the tripod grip does limit the rotation of the forceps during ligation and it is more difficult to discard the forceps after ligation.

In less critical situations, it is acceptable to remove the hemostats without putting the fingers through the rings. To disengage the ratchet this way using your right hand, the thumb, ring, and little fingers pinch the left ring, while the index finger pushes up on the right ring and shank. To perform the same releasing technique using your left hand, grasp the left ring between the thumb and index finger and disengage the lock by exerting upward pressure on the right ring with the middle, ring, and little fingers. This method of disengaging the ratchet lock is less controlled than the tripod grip. However, because the fingers rest outside the rings, the forceps can be rotated and turned in many angles to facilitate ligation and hemostat removal.

Regardless of which release method you use, always close the ratchet with one click before returning the forceps to the instrument table.

Hemostatic clamps can also be used to help place ligatures around vessels or structures prior to transection. In one method, known as a "tie on a passer," the suture is clamped in the jaw tips of a curved or right-angle hemostatic clamp. The hemostat is then used to place a ligature around the occluded vessel.

An alternative passing method involves an assistant using a "tie on a passer" to feed suture to a waiting hemostat that is held by the surgeon. When utilizing this method, be certain that the assistant fully removes the forceps before pulling the suture around the structure. Failure to do so might cause accidental avulsion of the vessel and hemorrhage when the surgeon attempts to pull the tethered suture around the pedicle.

Clamps can be used to facilitate suturing. After knot tying a stitch, surgeons sometimes leave the knot ears long, or may choose to place a series of stitches without knotting the ends. Hemostats can be used to "tag" these ends for the surgeon in order to keep the ends away from the surgeon's work or to expose the tissue to facilitate placement of an adjoining stitch.

Hemostats can also be used to hold the suture ends together to facilitate future knot tying, called preplacement of sutures. Preplacement is indicated when the tissue edges are drawn tightly together, creating poor exposure of the tissue plane for the next stitch. If the preplaced suture is tagged, the surgeon can open the wound more easily to expose the tissue plane for the next stitch. Sutures are often preplaced in deep perineal hernias, in urethral tears deep within the pelvic cavity, or when suturing in the oral cavity to help the surgeon identify and repair tissue layers accurately.

Hemostatic forceps are useful instruments for blunt dissection. Hemostats can be used to probe and spread tissue, as well as to isolate vessels and other structures to be "tagged." When both blunt and sharp dissection is required, it is generally more efficient to use scissors for the job. Alternatively however, the surgeon can bluntly dissect and then elevate the tissue above the spread jaws of the clamp while an assistant transects the tissue with scissors or electrosurgical wand. This technique helps to protect the structures beneath the dissection plane.

Surgical clamps can be used to hold and retract tissue. While tissue forceps are useful for temporarily holding or retracting tissue, surgical clamps can hold tissue securely over long periods of time without fatigue. The selection of the particular clamp is based on the strength of the tissue and whether the tissue will be removed. Ideally, only atraumatic clamps should be used to hold or retract tissue that will not be removed during surgery. Therefore, although a crushing hemostat like the Allis tissue forceps does provide a secure grasp of the tissue, they are generally too traumatic to use on intact viscera or skin. Instead, Allis tissue forceps should be restricted to jobs like grasping the margin close to a neoplasm that will be excised.

To retract or hold hollow organs atraumatically, surgeons often use "stay sutures." A stay suture is placed partial thickness through the hollow organ, and the ends are left long and clamped with small hemostats, like mosquito forceps. An assistant can then use the "tagged" sutures as handles to manipulate the organ. Alternatively, if an assistant is unavailable to hold the stay sutures, the sutures can be clamped to the drape material.

Clamps are frequently utilized during visceral surgery. Atraumatic clamps, like the Doyen forceps, are designed to clamp off the lumen of a hollow viscera to control leakage of its contents. They are most commonly used in intestinal anastomosis. Ingesta is milked away from the proposed anastomosis area, and an atraumatic clamp is placed on the bowel to temporarily hold back the contamination until the repair is complete. Crushing clamps are also frequently used during visceral surgery.

Crushing clamps, like the Allen forceps, are used to remove lesions. They can also be used as a guide for cutting through the hollow viscera. Note that the crushed area must always be removed with the lesion.

Course Credits

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