The Basics of Castration.  
Castration reduces aggression and mounting behavior and helps prevent unwanted matings. Bull calves will sell for less per pound than steers of comparable quality and weight due to discounts. Furthermore, cattle buyers and feedlot operators prefer the disposition and handling of steers compared to intact males.  
The method of castration will depend on age and weight of the calf, producer preference, and time of the year. Castration should be performed as early as possible to reduce stress. Baby calves can be castrated shortly after birth with the least amount of stress. While calves castrated early may have a reduce rate of gain, numerous research studies have shown that a proper implant program will compensate for the losses and add to the value of the animal. Try to avoid castrating calves within 3 weeks of weaning to reduce overall stress during this time. Older calves will have a greater setback from the castration procedure, and tend to bleed more following surgical castrations. Furthermore, bull calves castrated later may still have the undesirable appearance and attitude of an intact male. In some situations, such as purebred operations culling unwanted seedstock, castration will need to be performed in older animals. In older animals, regardless of the method used, pain management should be considered prior to castration. Castrations should not be performed during the heavy fly season or in wet or muddy conditions.  
  
**Methods of castration**Castration can be performed surgically or non-surgically. Surgical castration is performed by making an opening in the scrotum and removing the testicles. In baby calves, the bottom 1/3 of the scrotum is removed by a horizontal incision with a sharp blade or scalpel Once exposed, grasp each testicle individually, isolate the spermatic cord and cut or apply even tension on the cord until it breaks free. This procedure can often be done by one person with the rear legs and one front leg of the calf tied, and results in the least amount of stress to the animal. For older males, either a horizontal incision or a vertical incision can be made. The key is to make a large enough incision to allow drainage. Extreme care must be taken not to cut the inside of the calf’s leg, or the handler. A newberry knife is the safest method of making two vertical incisions, one on each side of the scrotum, for testicle removal. Once the scrotal sac is opened, grasp each testicle individually, isolate the spermatic cord and apply tension on the cord. An emasculator is then applied as high as possible to crimp and cut the cord. The testicle can also be removed by applying tension as described in  
younger animals, but there are greater risks of bleeding and internal injury when this is done in older animals. The emasculator should be left on the cord for 15-20 seconds to help control bleedingAdvantages to surgical castration include assurance that the testicles are removed, and less pain and stress to the animal when done properly. Wounds caused by surgical castration will also heal quicker than those created by non-surgical methods. Disadvantages to surgical castration include skill required by the handler, bleeding and swelling at the incision site, risk of infection, and risk of fly strike. A non-irritating antiseptic such as iodine should be applied to the incision when finished, as well as fly spray when needed. Instruments should be properly cleaned and disinfected between animals, and handlers should have clean hands or gloves whenever performing the procedures to reduce the risk of infections Non-surgical castration (or bloodless castration) can be performed using an elastrator band or an emasculatome castration include less blood loss, less risk of infection due to wet or dirty environments, and relative ease of performance. A major disadvantage to non-surgical castration is the risk of tetanus, an often-fatal disease caused by the bacterium Clostridium tetani. When non-surgical methods are used, especially in older animals, it is recommended that tetanus vaccination be given at least 10-14 days prior to the procedure. Ideally, two vaccines should be given 6-8 weeks apart prior to castration for maximum protection.  
An elastrator band can be applied by using an instrument that places a very tight rubber band around the neck of the scrotum. Other methods of applying the band use a drill or specifically designed tool to tighten the rubber. It is important to ensure that both testicles are pulled down and encompassed below the band. The blood supply to the scrotum is cut off and the scrotal tissue and testicles will fall off in approximately 2-3 weeks, sometimes longer. This procedure, while preferred by many when used in older bulls due to less bleeding, has the greatest risk of tetanus and is best when used in animals younger than a  
month of age. Another disadvantage to this method is the possibility of missing a testicle,  
  
resulting in a stag. Breakage of the bands can be a problem if not properly applied or if old bands are used, requiring the scrotum to be cut off or reapplication of the band. An emasculatome, or Burdizzo, resembles a large clamp which will shut off blood supply  
to the testicle resulting in its atrophy and resorption when properly applied. With the calf in standing restraint and tailed to reduce kicking and movement, the neck of the scrotum is held in one hand and the opposite spermatic cord is pushed to the side. The emasculatome is the applied to the cord and closed tightly about 2 inches above the testicle The emasculatome should be left in place for approximately 15-30 seconds. Each cord should be crushed separately in a staggered manner. The major disadvantage to this  
  
method is failure to completely clamp the spermatic cord, resulting in a stag. It is  
important that the emasculatome is in good condition in order to get a good crush of the blood and nerve supply to the testicle.  
**Castrating Beef Calves: Age and Method**

Castration is the disruption of testicular function, usually by removal of the testes of male animals, and has been a routine management procedure for most bull calves since ancient times. Historically, bulls were castrated to prevent propagation of inferior genetics and to simplify management, especially of draught animals. Bulls are still castrated to prevent reproduction and simplify management, but, most importantly, cattle are castrated to improve marbling and tenderness of the finished beef, which improves calf marketability.

Castration methods are generally divided into two categories: surgical or bloodless. Surgical castration involves excision of the testes by splitting or removing the lower third of the scrotum and removing the testes by severing the spermatic cord in a manner that minimizes bleeding, usually with an emasculator Henderson castrating tool, or knife. Bloodless castration is generally accomplished by using an emasculatome (i.e., burdizzo; Figure 2) or elastic band. When using an emasculatome, the scrotum remains intact while the spermatic cord of each testicle (within the scrotum) is placed in the jaws of the tool and crushed. The resulting damage causes a loss of blood flow to the testes and eventual testicular atrophy within the scrotum. Banding involves using an elastrator (Figure 3) to place a heavy elastic band around the neck of the scrotum with both testes inside. The band cuts off blood flow to the testes and scrotum, which atrophy over a short period of time and slough off. This guide summarizes research comparisons of methods of castration and age at which castration is performed so that managers can make informed decisions about castration method and timing.

**Pain**

Pain is inherently a part of castration and cannot be avoided. The pain of castration occurs first as acute, short-term pain associated with the actual castration procedure. Chronic pain is the longer-lasting pain that occurs in the days following castration until the injury is healed. Minimizing castration-induced pain is important for animal welfare, growth performance, and immune suppression that may be associated with castration. While consideration of acute pain is important, chronic pain should be given more weight when making management decisions due to the length of time chronic pain is experienced.

Pain is difficult to quantify in animals; however, blood concentration of the adrenal hormone cortisol is often used as an indicator of stress that is related to pain. According to researchers at the University of Nebraska, using blood cortisol as an indicator, calves experience acute stress immediately after castration. However, this stress generally lasts only 3 to 8 hours. The sensation and effects of chronic pain may be best measured by evaluating weight change following castration. Two studies in Ireland showed that calves lost weight during the first 7 days after castration, but by 35 days after castration there was generally no difference in calf weight between castrated and uncastrated calves. These results indicate that the chronic pain associated with castration lasts around 1 week.

In several European countries, regulations require that castration be accompanied by anesthetics and longer-term analgesics, while other countries require the use of anesthetics when castrating animals over a certain age (e.g., 2 months in the UK). The use of local anesthetics alone has yielded mixed results in reducing castration stress, and the results seem to depend on castration method. However, researchers in New Zealand showed that the combination of local anesthetic (lidocaine) and a systemic anti-inflammatory agent (ketoprofen) eliminates the cortisol increase (stress) during the first 8 hours after castration. Using similar methods, scientists in Ireland reported similar weight gain in both castrated and uncastrated calves for the first 7 days after castration when local anesthetic and anti-inflammatory agents were used. In the U.S., there is no systemic anti-inflammatory pharmaceutical labeled for use for controlling pain in cattle, and the need to restrain calves twice to administer analgesics prior to castration limits the likelihood of broad scale adoption of this practice.

Comparisons of castration methods have yielded mixed results, especially where average daily gain is considered. Generally, surgical castration elicits the most acute pain and least chronic pain. Conversely, banding normally causes the least acute pain (measured by cortisol response), but is associated with the longest duration of chronic pain. Calves studied in New Zealand castrated by a banding and emasculatome combination method took more than 20 days longer to reach the same stage of wound healing as calves castrated using surgical methods.

According to the American Veterinary Medical Association, calves castrated by elastic band have been observed to exhibit a pain response to palpation of the scrotal area after castration up to 4 weeks longer than calves castrated by emasculatome or surgery, indicating that greater chronic pain sensation is associated with the banding castration method. Researchers in Nebraska, Australia, and New Mexico observed that inadequate band tension allows some blood flow to the scrotum and testes, causing swelling and hemorrhaging within the scrotum. This can result in delayed detachment of the testes and scrotum that leads to persistent wounds. This condition may be a result of the band not being tight enough for very young calves, or from using bands that are old and do not adequately return to shape once stretched. Persistent wounds have also been observed in calves castrated by elastic bands, even after the scrotum has sloughed off.

Castration by emasculatome is an appealing approach because it seems to cause less chronic pain than elastic banding and less acute pain than surgical castration, but has all the benefits of bloodless castration. However, Swiss researchers reported that calves castrated by emasculatome when younger than 12 to 16 weeks may retain functional testes. It is not known whether the testes remained functional because the spermatic cord was too small at that age to fully crush or that regeneration occurred. Additionally, castration failure due to tool operator error has been reported more often for the emasculatome method than for other methods. Some studies have reported less weight loss for calves castrated using an emasculatome versus surgical castration. The greatest advantage of the emasculatome over other methods is that, because the spermatic cords are crushed within the scrotum, no open wound is exposed to the environment, protecting the injury from flies, mud, and infectious agents.

Most of the research done on castration indicates that method of castration does not affect lifetime performance or health of calves. However, when differences among methods were reported, it was generally during the first 7 days after castration, with almost no differences thereafter. Therefore, producers should use the castration method most appropriate to minimizing pain, depending on the situation and age of the calf.

**Castration Age**

It has been speculated that, because intact bull calves may grow more rapidly than steer calves, delaying castration until weaning (around 6 months old) can yield similar benefits to growth promoting implants administered when the calves are 1 to 3 months of age, but without additional cost. However, a University of Arkansas study showed that calves castrated near birth had the same lifetime average daily gain as those castrated after weaning (implanted in feedyard only). At slaughter, there were no differences in hot carcass weight, yield grade, quality grade, or marbling score. Researchers at Kansas State University reported that, following a 28-day backgrounding period, calves that were castrated at 90 days of age (early) and received a growth promoting implant had a 17-lb weight advantage over calves that were castrated at weaning (late; 226 days of age) or castrated early without implanting. Early castrated calves that were not implanted and late castrated calves performed similarly. These results indicate that early castration paired with growth promoting implants may yield more total pounds than either early or late castration alone when using a backgrounding program.

Timing of castration also affects morbidity. Research has shown that calves castrated on arrival at the feedlot are at higher risk for disease than steers castrated earlier in life. A study at Texas Tech University found that calves castrated on arrival had more than twice the morbidity rate (17.5% vs. 38.4%) and almost double the mortality (4.0% vs. 7.6%) of steers that were castrated at an earlier age. This is supported by more recent work conducted in Arkansas, which revealed a 17 to 58% increase in morbidity when calves were castrated on arrival compared to calves that arrived as steers (i.e., castrated at a younger age). As a result, calves arriving as steers had up to $5.56/head lower medical costs.

Collectively, these studies suggest that there is no lifetime performance advantage to waiting to castrate calves until weaning, but there is a risk of negatively impacting carcass quality by delaying castration and a high probability of receiving lower prices when marketing intact calves through conventional channels. When considering how age at castration affects animal welfare, the consensus is that the younger the calf is at time of castration, the less impact castration has on its welfare and performance.

**Developing Technology**

In the future, castration may be possible through vaccination (immunocastration). Studies conducted in California, Canada, and Brazil found that vaccinating cattle against gonadotropin-releasing hormone (GnRH) produces effects similar to traditional castration methods. This method is effective because GnRH regulates the production of sex hormones, and once immunized against GnRH, the production of sex hormones is reduced to the point that the testes actually degenerate. Immunocastrated calves have testosterone levels similar to calves castrated by traditional means. However, there is currently no vaccine of this nature commercially available. The risk of harmful side effects in the event of a human receiving an accidental injection may make acquiring FDA approval difficult.

Calves can be castrated at any age but are typically castrated within the first week to first few months of life and early castration is recommended. Newborn calves are easier to restrain and handle and experience less bleeding and lower infection rates. Production parameters such as weight gain are also minimally affected when surgery is performed in the younger calves compared to later in life.

Generally producers and owners castrate their calves. Rarely would a vet be called to perform routine castration but vets may be asked to train new owners or to work with rescue groups. General types of castrations and tools are bloodless (burdizzos, banding) or open (blades).

**Open castratio**

Newbury knife

Open castration is more common in northern climates and in colder weather. Fly control is necessary and is harder to achieve in the south.  After the testicles are pushed up toward the body, either a scalpel blade may be used to remove the bottom third of the scrotum or a special knife (Newbury knife; left) can be used to open the scrotum down both sides. The newbury knife has a guarded blade for extra safety.

Once the testicles are exposed, they may be removed by manually pulling the cord apart (hold the proximal end well and pull steadily on the testicle until the cord breaks) or by using tools. With the pull method, the trauma causes vascular spasm and vessel clotting. This works best in young animals (<3 mo old) with smaller cords and arteries).Twisting or tearing of vessels stimulates the clotting cascade; cutting doesn’t.

Banding

After the testicles are pushed down into the scrotum n elastrator tool is used to stretch the rubber rings so they can be passed over the bottom of the scrotum and released on the cord above both testicles. The scrotum and testicles fall off in 30-40 days. Elastrator bands can lead to tetanus and seem to have the most significant effects on the calves in terms of pain and discomfort. They should not be used on older calves as the crush may not be sufficient to cause ischemia. It is also easy to miss a testicle that slides up and out of the way, leading to incomplete castration. The Callicrate bander operates on similar principles to the elastrator tool but can be used on adult bulls. Generally, banding in older animals should be avoided due to the prolonged discomfort associated unless analgesics are used post-banding. This may be needed when the risk related to open incisions is high. The literature suggests most pain and inflammation occurs within the first few days after banding.

Burdizzo

The Burdizzo emasculatome also crushes the cord without cutting the skin. With this technique, the testicles atrophy but the scrotum does not slough. The clamp is placed on each cord individually and at different levels. The staggered crush saves blood supply to the skin while still damaging the cord to each testicle. The crush should be held for ~10 seconds on each side. The Burdizzo is used on calves with slightly larger cords that can be readily palpated and identified.

Analgesia and anesthesia

Local anesthesia using lidocaine (testicular, cord blocks or epidurals) mitigates the distress of the procedure but does not prevent the cortisol response or postoperative behavior changes. Preoperative NSAIDs improve the cortisol response but are not sufficient pain control for the procedure. The combination is ideal- give both preop NSAIDs and use local blocks. Meloxicam added to the milk ration at least 3 hours prior to castration makes a noticeable difference. If the procedures are to be done early in the morning, the drug can be given the night before. Cattle are not super sensitive to lidocaine (high dose is ~ 8 mg/kg) but younger animals are less able to metabolize lidocaine so some caution with larger volumes is warranted.

**Surgical methods**

This is the most commonly used method of castration in Australia.

An incision is made at the bottom of the scrotum using a scalpel blade to expose the testicle. In some cases the testicles proper may still be hidden behind a thick whitish membrane – the tunica vaginalis. If this is the case it will be necessary to make an incision in the tunica to completely expose the testicle. A deep initial incision ensures the testicle is exposed immediately. The attached ligaments and vas deferens (sperm cord) can be separated from the testicle with the fingers and/or blade.

The testicle can be removed by pulling on the exposed testicle (this is less suitable for older calves) or by rubbing the sharp blade sideways on the exposed cord to scrape the blood vessels. Do not make a clean sharp incision of the cord as this may lead to excessive bleeding. The most desirable method is to remove the exposed testicle using triple crush emasculators which crushes and cuts the blood vessels and hence minimises bleeding. Emasculators are the preferred option for older calves and for castrations done in hotter weather.

Good hygiene is essential when castrating. It is preferable that the scalpel and emasculators are soaked in disinfectant between operations and that the disinfectant is changed after every 20 animals. Poor hygiene may lead to infection which delays healing and may set back growth. Fly control should be considered at certain times of the year. Calves should be vaccinated against tetanus.