muscle, just caudal to the last rib. This incision is extended caudally through the internal abdominal oblique and *transverses abdominis* muscles to the cranial aspect of the pubis.[1,9,25,78]

In order to achieve adequate exposure to the cranial coelom, the last one to two ribs may be transected. The intercostal blood vessels course along the cranial edge of each rib and require ligation or coagulation. In small birds, these vessels may be coagulated by inserting the indifferent electrode of the bipolar radiosurgical forceps inside the thoracic wall, lightly apposing the electrodes at the cranial edge of the rib and then activating the electrodes. In larger species, it is recommended to clamp these vessel cranial to the ribs, transect the ribs and then apply a hemostatic clip to the respective vessel. Occasionally it is necessary, particularly in larger birds, to transect the last two ribs dorsally and ventrally and remove this section of the rib entirely.[1,9,25,42]

Retraction of the abdominal wall may be maintained by a Heiss, Alm, mini-Balfour or Lone Star retractor. Retraction in smaller patients such as budgerigars may be achieved by gently applying a Halstead or Hartman mosquito forceps to the skin flap. This will avoid hemorrhage that may occur with retractors that penetrate tissue. Alternatively, ophthalmic lid retractors may be used. As the caudal thoracic air sac is entered, the caudal aspect of the lung is visible, including the ostium of the bronchi entering the abdominal air sac. The liver is noted ventrally and the proventriculus dorsally. If the abdominal air sac is entered, the lung will lie dorsolaterally. The intestines are apparent and may be gently manipulated with a moistened cotton-tipped applicator, ring-tipped ophthalmic forceps or microvascular surgical forceps. Toothed forceps traumatize intestinal tissue and may cause perforation. The proventriculus is located medially and is suspended by air sacs and suspensory ligaments. The intestines may be retracted caudally and ventrally to reveal the left kidney located dorsomedially in the coelom. The ovary or left testicle is visible at the cranial edge of the kidney and the adrenal gland noted between the gonad and the cranial division of the kidney. Obesity and organomegaly may alter anatomic location and obscure visualization of certain organs.[1,9,42]

Transected ribs are not surgically reattached during closure, but left in the correct anatomic location surrounded by soft tissues. If the seventh and eighth ribs have been removed, tension-relieving sutures must be placed from the abdominal musculature to the sixth rib. The abdominal musculature is closed with absorbable monofilament suture in a simple interrupted or continuous pattern. Skin closure is routine.[1,9]

A ventral midline, transverse or combination approach to celiotomy provides surgical access to the middle and both sides of the coelomic cavity. These approaches provide access to the small intestine, pancreas, liver, testes, oviduct (when enlarged) and cloaca.[1,9,24]

The patient is positioned in dorsal recumbency and the site surgically prepared. Most avian species have a relatively large superficial vein located subcutaneously on the ventral abdomen. This vein may be coagulated prior to incising the abdominal wall to prevent hemorrhage. The skin is incised on the ventral midline from the caudal sternum to the interpubic space. The linea alba is identified and tented upward midway between the caudal sternum and interpubic space. It is then carefully incised with bipolar radiosurgical forceps, and the surgeon may inspect the underlying tissue for adhesions or other attachments to the peritoneum. If adhesions to the abdominal wall are noted or strongly suspected, the coelomic cavity may be evaluated with the use of an endoscope prior to extending the incision. These adhesions may be broken down with the use of a cotton-tipped applicator or other blunt instrument. If adhesions cannot be broken down, an alternative surgical approach may be necessary. The incision is extended cranially and caudally by inserting the indifferent electrode under the linea alba, apposing the tips with the linea in between them and initiating the current while dragging the forceps cranially and caudally. This will incise the abdominal wall while preventing any hemorrhage. *Extreme caution must be practiced not to extend this incision too deeply to prevent iatrogenic trauma and laceration to the duodenum and pancreas, which lie from left to right just inside the abdominal wall.*[1,9,24]

A transverse and ventral combination celiotomy may be performed to increase exposure to the coelomic cavity. An incision may be performed in the cranial region (5-7 mm from the caudal border of the sternum), mid-abdomen or caudal region (5-7 mm from the cranial border of the pubic region). Care must be taken when making a caudal transverse incision, as intestinal loops often lie just under and may be attached to the abdominal musculature. A transverse incision is performed on one or both lateral sides caudal to the sternum, leaving sufficient tissue caudal to the sternum to allow subsequent closure. The size of the incision should be large enough to provide adequate exposure, but small enough to minimize escape of anesthetic gas and minimize hypothermia. Please refer to Chapter 33, Updates in Anesthesia and Monitoring for a discussion regarding anesthetic considerations for the avian patient during a celiotomy. The abdominal wall is closed using a simple continuous or interrupted pattern with an absorbable monofilament suture. Skin closure is routine.[1,25,57]

Proventriculotomy and Ventriculotomy

Proventriculotomy is indicated for the removal of foreign or toxic material from the proventriculus or ventriculus if endoscopic retrieval is unsuccessful or impossible.[1,9,42,78] The patient is positioned in right lateral recumbency. A left lateral celiotomy is performed to provide the best exposure to the proventriculus and ventriculus. The ventral suspensory structures must be dissected bluntly to retract the proventriculus caudally. Stay sutures are placed in the wall of the ventriculus to exteriorize and manipulate both structures. The proventriculus is fragile and may tear or bruise if manipulated with toothed forceps or if stay sutures are placed in this organ. Certain atraumatic microsurgical instruments may be used to manipulate the proventriculus. The coelomic cavity should be packed with moist gauze sponges to prevent gastric contents from leaking into the coelom and assist in minimizing escape of anesthetic gas.[1,9,42]

The proventriculotomy is initiated at the isthmus (junction of the proventriculus and ventriculus) with scissors. This incision is extended into the body of the proventriculus. Hemorrhage from the cut surface of the proventriculus is controlled by radiocautery. Proventricular contents and foreign material may be removed by suction or with a small curette. The lumen should be well irrigated after foreign body removal, and an endoscope may be used to perform an examination of the proventriculus prior to closure to ensure that all material has been successfully removed. The proventriculus is closed using a simple continuous pattern oversewn with a continuous inverting pattern using a fine, absorbable monofilament suture with an atraumatic needle. The inverting pattern should extend beyond the incision on both ends and the integrity of the closure evaluated with the injection of sterile saline. Abdominal wall and skin closure are routine.[1,9,42]

Postoperative fasting is not necessary and the patient should be offered food and water once completely recovered. The strength of the incision is strongest immediately postoperatively and during the fibroblastic stage. Leakage of gastric contents is not an infrequent occurrence due to the lack of omentum in birds. If the proventricular wall appears thin or friable, it may be necessary to place a duodenal feeding tube for temporary alimentation. This will allow enteral alimentation of the patient while bypassing the proventricular incision during healing (Figs 35.23a-k).[1,9,42]

The ventriculus may be accessed either through a proventriculotomy incision or through the ventriculus itself. The ventriculus is extremely vascular with heavy musculature in psittacine species, and healing postoperatively can be prolonged. Therefore, access to the ventriculus through the previously described proventricular incision is preferred when possible. The incision is initiated at the isthmus and extended into the ventriculus. The entrance into the ventriculus may be gently dilated to insert instruments to remove any foreign material, apply suction and irrigate the lumen. The ventriculus may be assessed with an endoscope to ensure complete removal of any foreign material.

An alternate approach to the ventriculus is through a cranial transverse celiotomy just caudal to the sternum. The ventriculus is identified and gently rotated clockwise to expose the thinnest portion of the ventricular wall. A longitudinal incision is performed with monopolar radiosurgery through the ventricular wall to access the luminal contents. The incision is typically 1 cm in length in a 400-g bird. Material may be removed with an appropriately sized spatula or curette. Foreign material may be removed from the proventriculus as well. The incision is closed using a horizontal mattress pattern with a slowly absorbable or non-absorbable monofilament suture. Care should be taken that the ventricular lumen is not penetrated during closure.[1,9,42]

The serosal surface of the proventriculus or ventriculus also may be biopsied when evaluating a patient for proventricular dilatation disease. It is important to biopsy a vascular region to ensure that the surgeon has obtained nervous tissue. Abdominal wall and skin closure are routine.[1,9,42]

Intestinal Resection/Repair/Anastomosis Surgery

Intestinal surgery may be indicated in the following presentations:

1. Obstructions, either from foreign bodies or secondary to adhesions or scarring.
2. Intestinal neoplasia.
3. Undiagnosed intestinal disease requiring biopsy.
4. Traumatic incidents, often involving bite wounds from predator species.
5. Congenital herniation and strangulation.
6. Repair of iatrogenic damage to the intestine occurring during celiotomy.

The patient is placed in dorsal recumbency and a midline or transverse celiotomy is performed. The vascular supply to the small intestine is via the celiac artery to the duodenum and the cranial mesenteric artery to the jejunum and ileum. Any necrotic bowel is resected gently using microsurgical instruments to prevent damage to healthy intestinal tissue. An anastomosis is performed using a 6-0 to 10-0 absorbable monofilament suture on a one-fourth-circle atraumatic needle. Typically six to eight simple interrupted sutures are necessary for end-to-end anastomosis. Abdominal wall and skin closure are routine.[1,9,25,42]

Proventriculotomy via Left Lateral Celiotomy – Step by Step Figs 35.23a-k

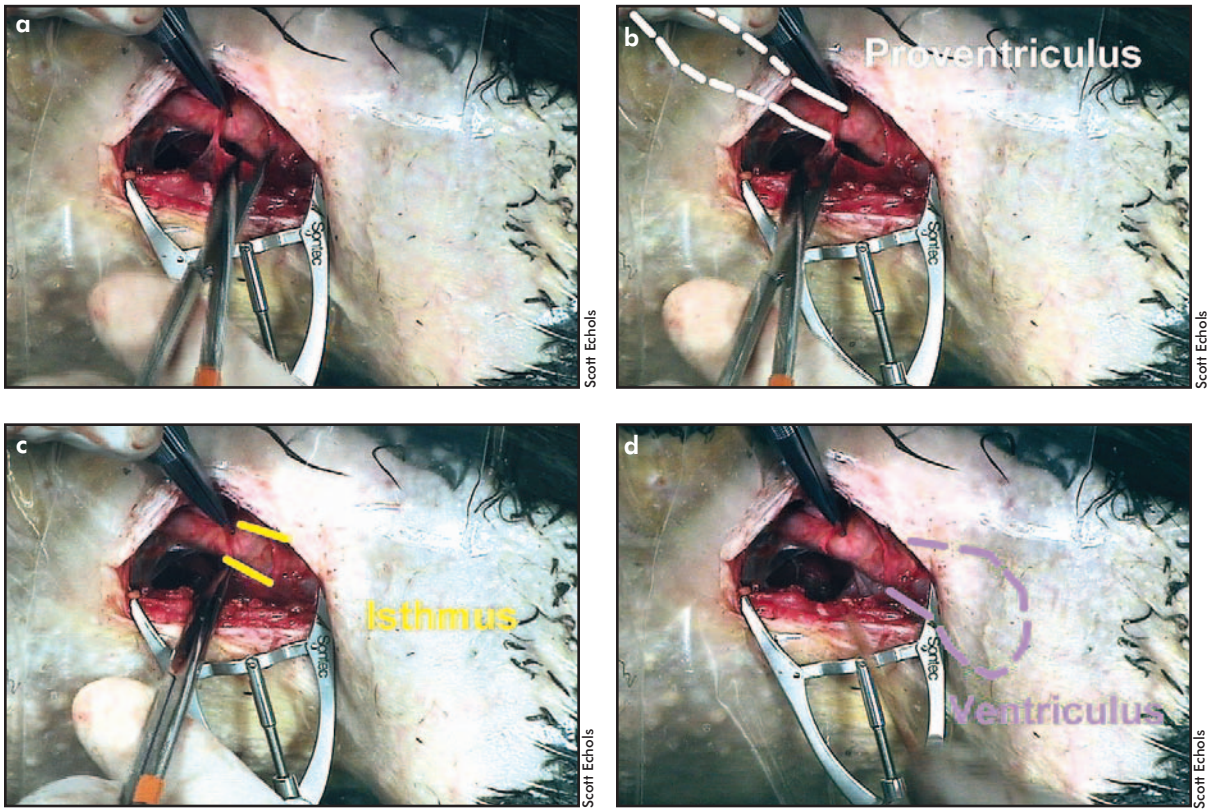


Fig 35.23a-d | Approaching the proventriculus to free it for a proventriculotomy.

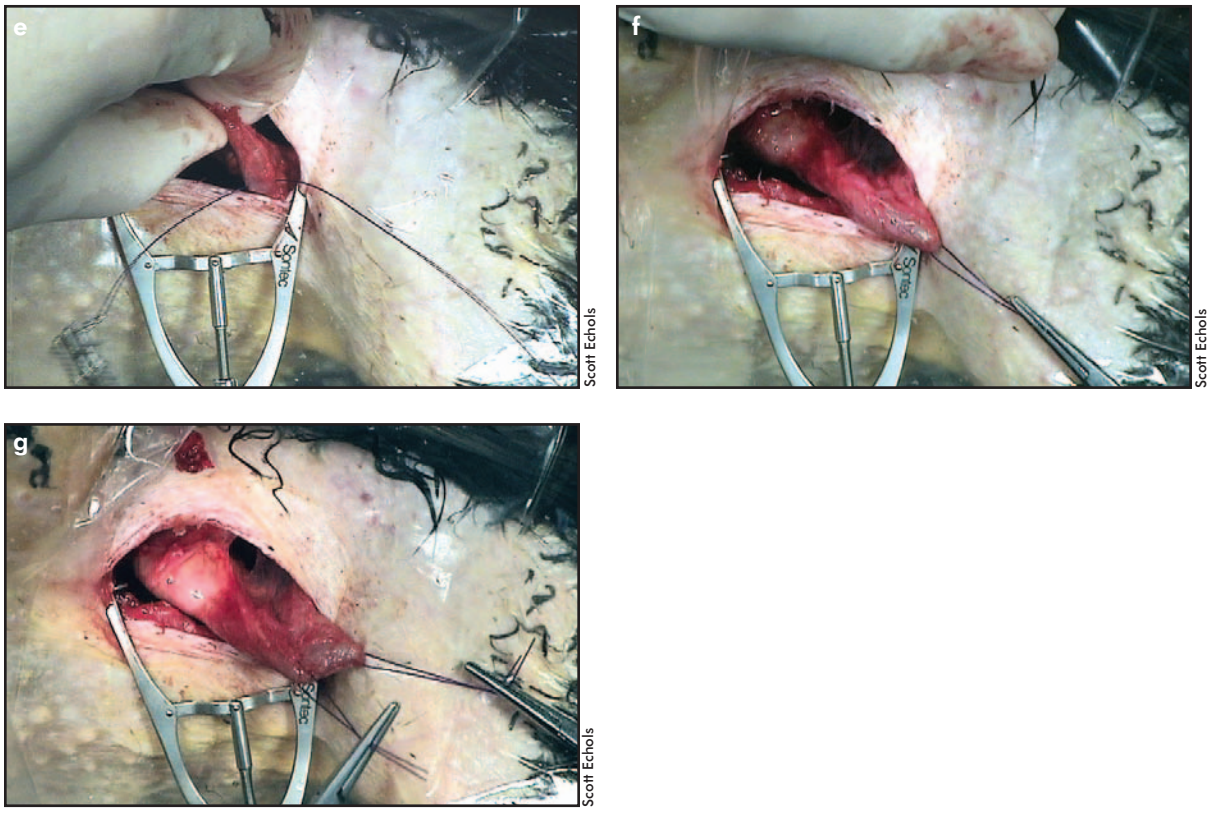
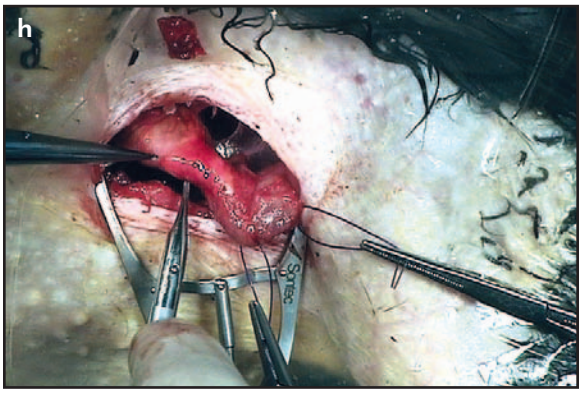
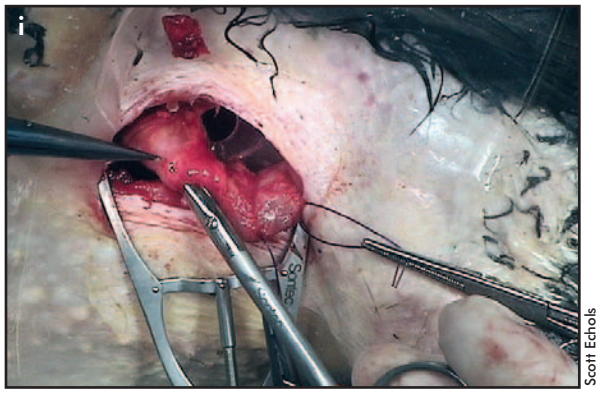


Fig 35.23e-g | Attaching suture to the muscular tissues of the proventricular-ventricular junction and freeing the proventriculus from surrounding attachments to allow exteriorization for the organ entry.





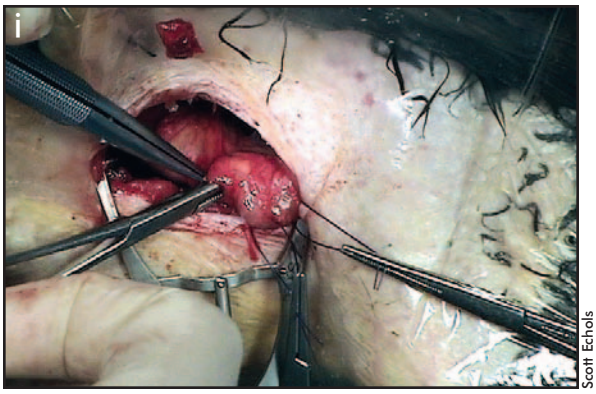


Fig 35.23h-j | Access to the lumen of the proventriculus and removal of contents and metal object noted on radiograph.

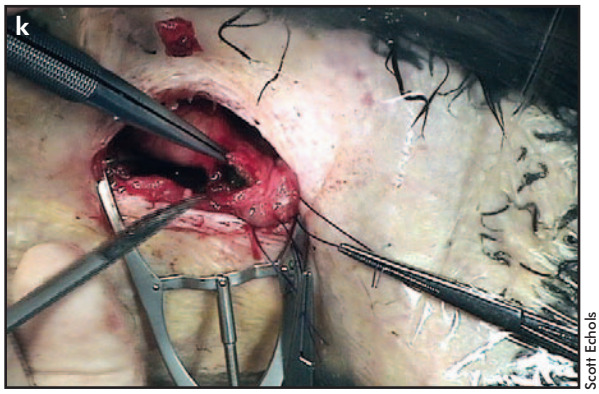


Fig 35.23k | Proventricular closure.

Enteral feeding tubes may be placed in the duodenum. This is indicated if it is necessary to bypass a diseased portion of the alimentary system. The patient is placed in dorsal recumbency and a midline or transverse celiotomy is performed. An indwelling jugular catheter, no less than one-third the diameter of the small intestine, is placed through the left abdominal wall and into the descending duodenal loop. The catheter is then advanced gently through the descending and ascending duodenal loops and the needle withdrawn from the intestine and abdominal wall. One to two sutures are placed with 5-0 monofilament in the intestine and abdominal wall to secure the intestine to the body wall and provide a tight seal. The patency and seal of the catheter is tested by injecting sterile saline solution and the celiotomy is closed routinely. The external portion of the catheter is secured using monofilament suture. The excess catheter is coiled and secured to the patient anterior to the leg and under the wing. An appropriate type and amount of a liquid diet is used to aliment the patient.[1,9,25,42] Hyperosmotic diets may cause an osmotic diarrhea. The amount to be fed should be divided into equal volumes and injected 4 to 6 times daily at a rate of approximately 1 ml/15 seconds to allow the intestine to accommodate for the volume. The catheter should be flushed with warm water or lactated Ringer's solution before and after injecting the food to prevent obstruction of the catheter.[1,9]

The patient and surgical site must be monitored closely for leakage and coelomitis, and for damage to the catheter and/or the incision site. Once the catheter is no longer needed, the suture is cut, the catheter removed and the incision is left to heal by second intention.[1,9,25]

Surgery of the Reproductive Tract

ANATOMY OF THE FEMALE REPRODUCTIVE TRACT

The avian oviduct is divided into five anatomic regions, which are microscopically distinguishable (see Chapter 18, Evaluating and Treating the Reproductive System).

The avian oviduct is suspended via the dorsal and ventral ligaments within the coelomic cavity. The cranial, middle and caudal oviductal arteries run through the dorsal mesentery vascular supply to the oviduct. Species variations exist, but in general the cranial oviductal artery arises from the left cranial renal artery, aorta or external iliac artery. The middle oviductal artery arises from the left internal iliac artery or the pudendal artery. Venous blood from the cranial oviduct enters into the caudal vena cava via the common iliac vein and venous blood from the caudal oviduct enters the renal portal or

hepatic system[24,43,45,59] (see Chapter 7, Emergency and Critical Care Fig 7.16-7.19).

OVOCENTESIS AND MANUAL EGG DELIVERY

Egg binding and dystocia occur in many pet bird species. If medical therapy fails to deliver the egg, ovocentesis or manual delivery may be attempted prior to a celiotomy. The clinician should be prepared to perform a celiotomy when attempting ovocentesis or manual delivery, as retropulsion of the egg and oviductal rupture, resulting in an ectopic egg, shell fragments or yolk coelomitis, are potential complications. A celiotomy with or without salpingohysterectomy may, in some cases, be a more rapid and effective method of resolving dystocia (see Chapter 7, Emergency and Critical Care Fig 7.16-7.19).

SALPINGOHYSTERECTOMY

Salpingohysterectomy involves removal of the oviduct. Salpingohysterectomy is indicated to prevent egg production, resolve disease conditions associated with egg production, infectious/inflammatory disease of the oviduct, oviductal neoplasia, oviductal torsion, oviductal prolapse, and weakening or herniation of the abdominal wall secondary to chronic reproductive activity.[3,9,24,34,51,76] It is not typically performed as a preventive procedure due to possible risks, namely hemorrhage, to the patient during the procedure. However, techniques such as endoscopic salpingohysterectomy in juvenile cockatiels have been described as preventive procedures for removal of the oviduct in juvenile birds.[72] During sexual and egg-laying activities, the oviduct is hypertrophied and blood supply to the ovary and oviduct is significant. It is recommended to delay surgery if possible until the reproductive tract is in an inactive state, thereby reducing the risk of hemorrhage to the patient. Egg production may be stopped, and ovarian and oviductal size and vascularity may be reduced by medical therapy prior to surgery. Please refer to Chapter 18, Evaluating and Treating the Reproductive System for a complete description of medical therapy to reduce egg production.[1,9,24]

The size and condition of the oviduct varies with the reproductive and physiologic state of the patient. Birds suffering from previous reproductive disease, particularly coelomitis, may have significant adhesions, which complicate surgical removal of the oviduct. These may include adhesions between the oviduct and the kidney, the cloaca and other coelomic structures. Caution must be taken when separating these adhesions, as hemorrhage and tearing of the affected tissue may occur. A hormonal feedback loop presumably exists between the uterus and the ovary to control follicular development and ovulation. In many birds following salpingohysterectomy, follicles will develop but will not progress to ovulation. However, some birds, namely Anseriformes, will develop large follicles and ovulate freely into the coelom. These ova may be resorbed without incident, but some birds will develop coelomitis. Clients should be informed of this potential and medical therapy to control ovulation, ovariectomy or cryosurgery of the ovary may be considered in these patients.[9,24,43]

For salpingohysterectomy, the patient may be placed in right lateral recumbency and a left lateral celiotomy is performed. Alternatively, the patient may be placed in dorsal recumbency and a ventral midline celiotomy with or without a midabdominal transverse incision may be performed.[9,24,49] The ovary is visible at the cranial pole of the left kidney, adjacent to the adrenal gland. It may be necessary to retract the proventriculus and ventriculus ventrolaterally to improve exposure of the oviduct. The convoluted oviduct lies along the dorsal body wall in proximity to the caudal vena cava. The ventral ligament, responsible for these oviductal convolutions, courses caudally and becomes a muscular cord at the vagina. This ligament is dissected with bipolar radiosurgery to allow the oviduct to be released and positioned in a linear fashion.[1,9,76]

The fimbria of the funnel portion of the infundibulum lies caudal to the ovary and is elevated to expose the dorsal attachments. The dorsal ligament that suspends the uterus and a branch of the ovarian artery course(s) caudally along the uterus from the base of the infundibulum. A small blood vessel is identified from the ovary through the infundibulum and is coagulated and transected with bipolar radiosurgical forceps or ligated with a hemostatic clip. If it is accidentally transected without coagulation, it retracts dorsal to the ovary and is irretrievable. Manual pressure and application of a small piece of absorbent gelatin sponge or beaded polysaccharide powder may be used to achieve hemostasis. The remaining suspensory tissue may be dissected with bipolar radiosurgical forceps.[1,9,24]

The oviduct is retracted ventrocaudally once the infundibulum is free. This exposes the dorsal suspensory ligament, several small blood vessels and branches of the ovarian artery, which should be coagulated or ligated with hemostatic clips. As the dissection is continued caudally toward the cloaca, the ureter is identified as a white, tubular structure extending from the kidney to the cloaca. The ureter courses along the terminal colon and enters the cloaca, and should be identified and avoided. The uterus is ligated at its junction with the cloaca with hemostatic clips, using caution not to trap the left ureter (Figs 35.24a-j).[1,9,24]

Alternatively, if the oviduct does not contain any infectious material, two hemostatic clips may be placed at the

mid-magnum region and the tissue between them transected. This results in the removal of two shorter sections. The cranial portion is retracted ventrally and bipolar radiosurgical forceps are used to coagulate vessels and transect the oviductal ligament, thereby freeing the cranial oviductal section from the dorsal body wall and facilitating its removal. Once the cranial portion is removed, the caudal portion is retracted ventrally and bipolar radiosurgical forceps are used to coagulate vessels and transect the oviductal attachments caudally toward the cloaca. The ureter is identified and avoided. A hemostatic clip or ligature is applied at the junction of the uterus and cloaca, avoiding the ureter, and the uterus is transected with radiosurgical forceps or scissors and removed. It is important to ligate the entire circumference of the uterus to prevent any postoperative reflux and leakage of feces and urates from the cloaca into the coelom. Closure is routine and previously described. Samples are collected for cytology, bacterial culture and histopathologic examination, when indicated.[1,9,24]

CAESAREAN SECTION/OVIDUCTAL-SPARING CELIOTOMY

It is often recommended that a salpingohysterectomy be performed when a celiotomy is necessary for reproductive problems such as removal of an egg that is bound. However, it may be necessary to salvage the reproductive capabilities of some avian patients. In addition, it may be prudent in some patients to initially remove the problematic egg without performing a hysterectomy, employ medical therapy to reduce the size and vascularity of the oviduct, and perform a salpingohysterectomy at a later time. The surgical approach varies with the location of the egg. If located cranially, a left lateral celiotomy is recommended, and if caudally located, a ventral midline approach with or without a transverse incision provides optimal exposure. The oviduct is incised directly over the egg, avoiding obvious blood vessels, and the egg removed. The oviduct is examined for gross abnormalities and samples are collected for cytology, bacterial culture and histopathologic examination. The oviduct is closed with a simple interrupted or continuous pattern using an absorbable monofilament suture. An inverting pattern is not recommended since this may reduce the oviductal luminal diameter. Abdominal and skin closure are routine. It is recommended to rest the hen from reproductive stimuli for a minimum of 2 to 4 weeks and if possible for the remainder of the reproductive season or longer, based on culture and histopathologic results. It is crucial to identify and correct the etiology that initiated dystocia prior to resuming breeding.[24]

REMOVAL OF THE OVARY AND OVARIAN BIOPSY

Partial or complete ovariectomy may be indicated in patients that suffer from ovarian neoplasia, ovarian granulomas, persistent follicular activity, oophoritis and ovarian cysts that do not resolve with medical therapy. It is a challenging procedure and often poses great risk to the patient. Due to this risk, medical alternatives including hormonal manipulation and intralesional chemotherapeutic administration should be explored. It also is important to note that none of these procedures have been satisfactorily studied in pet birds. Laparoscopic ovarian biopsy is generally preferred. Hemorrhage is a significant potential complication and the clinician should be prepared to perform an emergency celiotomy during the laparoscopic procedure.[1,24,57]

The avian ovary is attached to the cranial kidney and the dorsal body wall by the mesovarian ligament and receives its blood supply from the ovarian artery, which originates from the left cranial renal artery or directly from the aorta. Accessory ovarian arteries also may arise from adjacent arteries. The ovarian artery further divides into many branches, with the greatest blood flow directed to any large preovulatory follicles that are present. Ovarian veins join to form the main anterior and posterior veins that drain into the overlying vena cava. Multiple left ovarian veins may be present and drain into the cranial oviductal vein. Venous blood then enters the common iliac vein and finally the vena cava. The cranial oviductal vein may be too short or too poorly developed to identify. Multiple short veins appear to enter the common iliac vein over the length the dorsal base of the ovary.[24,34,43,45,59]

The ovary is tightly adhered to its dorsal attachments. This makes complete excision of the ovary extremely difficult and poses significant risk of hemorrhage to the patient. The avian ovary is attached to the cranial renal artery by a short stalk and the attachment to the common iliac vein is intimate and extensive. Life-threatening hemorrhage often occurs from a lacerated common iliac vein during ovariectomy.[24]

Ovariectomy and salpingohysterectomy may be attempted in the juvenile bird as an effort to prevent future reproductive disease. Ovariectomy has been described in many poultry studies. Unfortunately, most articles poorly elucidate the exact technique or associated complications.[52,66,70,81,86] Any of these procedures still pose significant risk to the hen, and clients should be well counseled regarding the potential for hemorrhage and complications. A ball-tipped electrocautery probe may be used to coagulate ovarian follicles of immature hens. However, this procedure results in ovarian regeneration

Salpingohysterectomy via Left Lateral Celiotomy – Step by Step Figs 35.24a-j

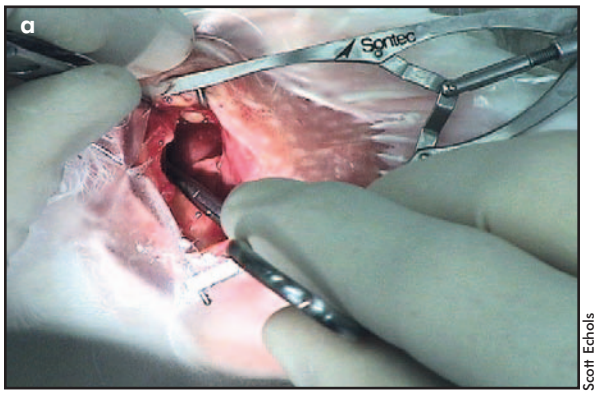


Fig 35.24a | From the left lateral approach with the leg caudal, the bird will undergo a salpingohysterectomy.

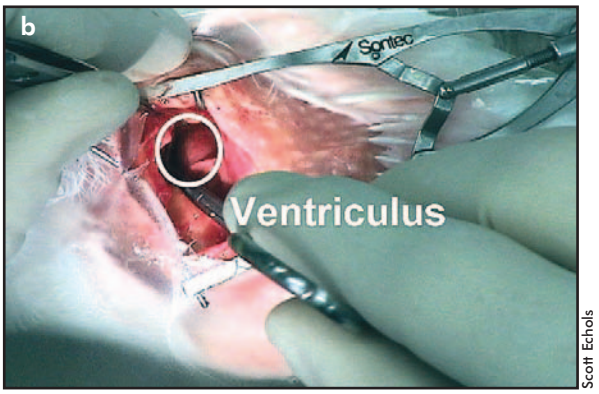
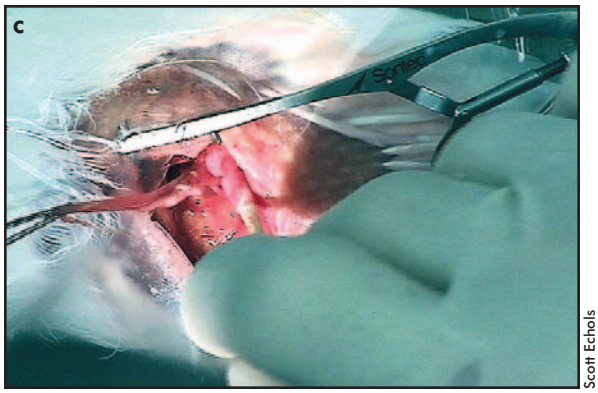
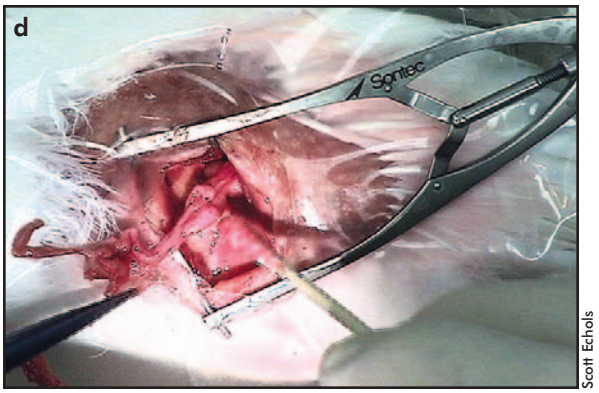
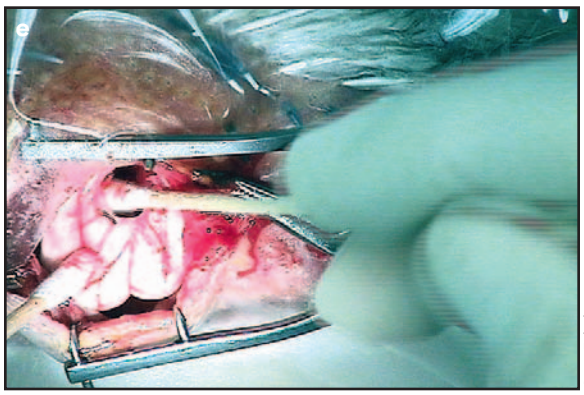


Fig 35.24b | Opening the confluent wall of the air sacs and the suspensory tissues of the proventriculus to allow entry into the hepatoperitoneal cavity.







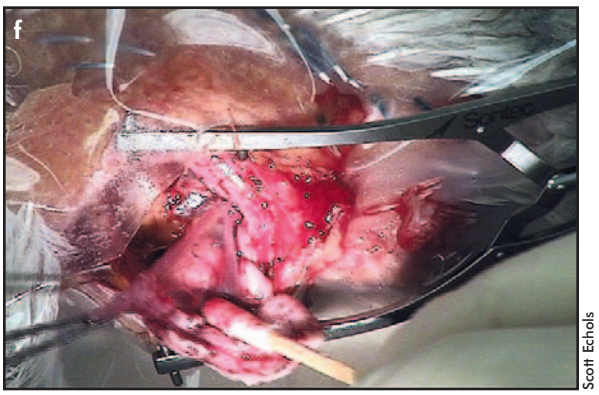


Fig 35.24c-f | Identifying and exteriorizing uterine tissues for a salpingohysterectomy and/or ovary removal. The use of cotton-tipped applicators allows the very fragile uterus to be manipulated. The blood supply comes from the dorsal aspect of the salpinx and uterus, or from vessels via the ovarian or cloacal areas. Exteriorizing the body of the uterus and transecting it, allows the maximum visualization of the vessels and surrounding tissue that must not be traumatized. Bisecting a large uterus as shown in the lower example can simplify exteriorization.

in mature hens. A procedure to remove the ovary of juvenile hens includes manually removing the ovary in toto. The caudal end of the ovary is grasped with angled hemostats and pulled gently in a cranial direction with clear separation from the dorsally located common iliac vein. When performing this procedure it is important to stop immediately if any resistance occurs to prevent tearing of the overlying vein.[9,24]

Ovariectomy in the adult hen must include removing ovarian follicles or cysts, debulking the mass of the ovary and then removing the ovary just ventral to its blood supply. The patient is placed in right lateral recumbency and a left lateral celiotomy is performed. Any large preovulatory follicles are either manually debulked or aspirated. Blood-filled follicles may represent previously ruptured blood vessels from an invasive mass and caution must be taken when removing these to prevent hemorrhage. Ovarian cysts should be aspirated. When aspirating

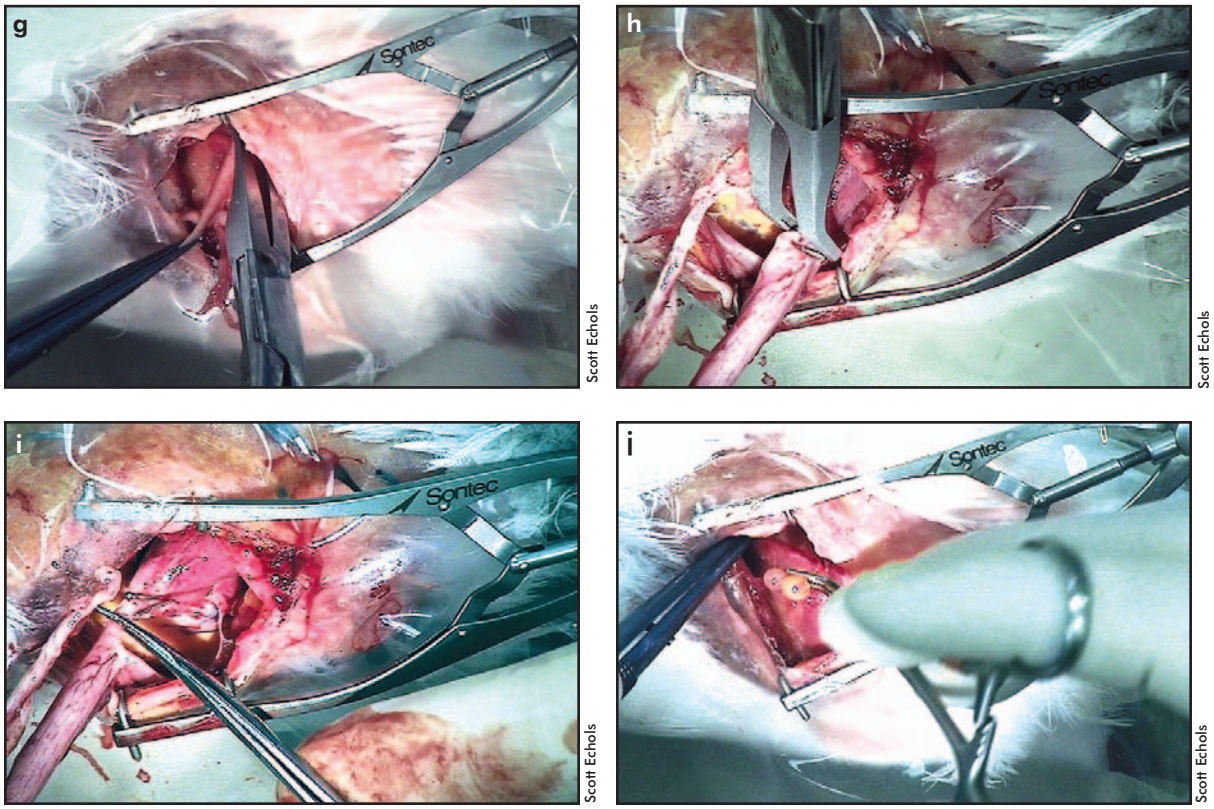


Fig 35.24g-j | Hemostatic clips are applied to the portion of the uterus that attaches to the cloaca. The uterus can then be transected and removed. The anterior vessels from the uterine ligament are ligated with hemoclips in a similar manner (Sealing these vessels with radio current alone is not sufficient). If hemostasis is not achieved in a rapid and thorough manner, the accurate placement of oxidized regenerated cellulose mesh may be required. Closure is routine. Some birds (especially budgies) have very thin paralumbar musculature and sutures tend to tear easily. Including the medial tissues of the thigh and encircling a rib with suture and then a layer of the cellulose mesh to fill the deficit has worked in such cases. Topical and systemic analgesics are needed.

follicles or cysts, a small (23-25 gauge) butterfly catheter may be inserted into the most avascular region to prevent hemorrhage and the contents aspirated. Care must be taken not to spill aspirated contents, particularly in conditions such as oophoritis, which could result in development of infectious coelomitis. Once follicles and/or cysts have been removed or aspirated and collapsed, the ovarian surface is visible and prepared for debulking. Leakage of cystic contents does not typically result in coelomitis in non-infectious conditions.[24]

An angled DeBakey neonatal vascular clamp is applied dorsal to the ovary to occlude the vascular supply. This clamp is atraumatic, remains in the surgical site without obstructing the surgeon's view and provides hemostasis. This clamp must be applied parallel to the spine to avoid entrapping the aorta and peripheral nerves. The ovarian tissue is excised with the use of a monopolar radiosurgical wire loop until very little tissue protrudes through the hemostatic clamp. The vascular hemostat is carefully opened, but left in place while the area is monitored for hemorrhage. If hemorrhage occurs the hemostat may be replaced. If possible, the vascular clamp is then opened, moved dorsally and reapplied to the ovarian base. This process is continued until the overlying vasculature is clearly visible and the course of the common iliac vein may be seen.[24]

Once the bulk of the ovary has been removed, the vascular supply must be securely ligated and the remaining ovarian tissue excised. One to two hemostatic clips are applied dorsal to the vascular clamp with 90° clip applicators. It is recommended to apply the first clip in a caudal-cranial direction and the second clip in a cranial-caudal direction to incorporate the entire vascular supply. The remaining ovarian tissue is excised with the use of a monopolar radiosurgical wire loop. Another procedure may be pursued if the ovarian attachment to the common iliac vein is too extensive to apply hemoclips, or if there is erosion into the overlying vessel, as with some invasive ovarian neoplasia. The common iliac vein is ligated with a hemoclip just caudal to the ovary and cranial to its junction with the caudal renal vein. When performed properly, the ovarian artery and common iliac veins are effectively clamped. This allows the surgeon to carefully dissect the ovarian tissue from the overlying vessels. If necessary, the ventral wall of the common iliac vein may be safely removed. It is important to note that

there is a significant risk of damaging the left adrenal gland, significantly altering blood flow through the renal portal system and the cranial renal division, and damaging the overlying kidney and lumbar and/or sacral nerve plexus. Closure is routine and the patient must be monitored for postoperative hemorrhage.[9,24]

There are reports of carbon dioxide laser ablation and cryosurgical destruction of the ovary and neoplastic tissue (R. Wagner, personal communication, 2003). These techniques may allow for more complete removal of ovarian tissue and less risk of hemorrhage, however, ablation must be strictly controlled to prevent damage to the adrenal gland, vascular supply to the left kidney and local nerves. Removal of avian gonads with laser often resulted in severe hemorrhage intra- and postoperatively.[2]

ANATOMY OF THE MALE REPRODUCTIVE SYSTEM

The male avian reproductive system includes the testes, the epididymis and the ductus deferens. The testes are located just ventral to the cranial division of the kidneys and are connected to the dorsal body wall by the mesorchium. The epididymis is located at the testicular hilus at the dorsomedial aspect of the testes, and continues caudally lateral to the ureter and terminates at the urodeum as papillae ventral to the ureteral ostium. The testicular artery arises from the cranial renal artery and provides most of the arterial blood supply to the testes. Budgerigars and passerines have a seminal glomus at the distal ductus deferens that forms a prominent projection and serves for sperm storage. There may be an accessory artery that arises directly from the aorta. Venous blood either returns directly to the vena cava or forms a common vessel with the adrenal veins. Testicular vasculature may vary among avian species or individuals.[24,46,48,59]

ORCHIDECTOMY AND TESTICULAR BIOPSY

Indications for orchidectomy include testicular neoplasia, testicular cysts, and infectious and inflammatory conditions of the testicle(s) that are unresponsive to medical therapy.[1,9,24,30,83] Laparoscopy is the preferred method for testicular biopsy.[15-17]

Castration techniques have included simple extraction in chickens (caponization), laser ablation, intravascular suction and complete surgical excision. Testicular regrowth is extremely common unless the entire testicle is completely removed. Removal of testicles carries significant risk of hemorrhage and should not be used in place of behavioral therapy, environmental manipulation, or exogenous hormone therapy for testosterone-related behavioral disease. In addition, castrated Gamble's and scaled quail maintained ornate breeding plumage and exhibited overt aggression, demonstrating that these behaviors were either learned or resulted from the influence of hormones other than testicular-produced testosterone.[24,60]

Medical therapy is instituted prior to surgery to reduce the size of active testicles. Several surgical approaches have been described. The patient may be placed in dorsal recumbency and a ventral midline celiotomy with or without a transverse flap is performed. This provides access to both the left and right testicles if both are to be removed. Alternatively, a lateral celiotomy may be performed to gain access to either the left or right testicle. It is possible to access the opposite testicle from a lateral incision by incising the midline junction of the corresponding air sacs.[9,24]

The testicle is gently retracted ventrally and a 90° vascular hemostat or hemostatic clip is applied to the base of one testicle with 90° clip applicators incorporating its vascular supply. The hemostat or clip must be applied parallel to the spine to avoid entrapping the aorta and peripheral nerves. If possible, a second clip is applied just ventral to the first. One clip is applied in a cranial-caudal direction and the second clip in a caudal-cranial direction to incorporate the entire vascular supply. The base of the testicle is incised between the hemostat or clip and the ventrally applied clips with a scalpel blade, scissors or radiosurgery. Alternatively, the testicular tissue may be debrided with the use of a monopolar radiosurgical wire loop or excised with scissors until very little tissue protrudes through the hemostatic clips. The vascular hemostat is carefully opened, but left in place while the area is monitored for hemorrhage. If hemorrhage occurs the hemostat may be replaced and another hemostatic clip applied dorsal to the previous clips, or if hemorrhage is minor a small piece of hemostatic gelatin sponge or beaded polysaccharide powder may be placed over the area. Any remaining testicular tissue that protrudes through the hemostatic clip may be ablated with electrocautery or a laser. Residual testicular tissue may result in tissue hyperplasia and produce reproductive hormones. Closure is routine and the patient must be monitored for postoperative hemorrhage.[9,24]

VASECTOMY

Indications for vasectomy in birds include providing "teaser males" and to control reproduction. This procedure is not typically performed in pet birds. In the budgerigar, the patient is placed in dorsal recumbency and a 3- to 7-mm incision is made lateral to the cloacal sphincter. The fat and abdominal musculature is carefully dissected to enter the coelomic cavity. An operating microscope is used to locate the ductus deferens and a 5-mm section of the ductus deferens is excised. The skin

is closed routinely. It is recommended to repeat the procedure on the other side 2 weeks later.[24,77]

In the finch, a 3-mm incision is made 5 mm lateral to the cloaca with the use of an operating microscope. The fat and abdominal musculature is incised to access the seminal glomera. The ductus deferens is carefully separated from the ureter and one or more sections excised without ligation. The skin is closed routinely.[11,24]

Vasectomy in larger avian patients is performed via transection of the ductus deferens via lateral or transverse celiotomy or laparoscopy. This procedure has been described in Japanese quail (*Coturnix japonica*). During a laparoscopic approach, the patient is placed in right or left lateral recumbency and the leg pulled cranially. A laparoscope is inserted at the apex of an inverted V created by the semitendinosus muscle as it passes over the last rib. The testis and ductus deferens are identified and distinguished from the kidney, adrenal gland, ureter and common iliac vein. The proximal ductus deferens is isolated and grasped with biopsy forceps. This section of the ductus deferens is transected and removed through the biopsy sheath. Care must be taken not to damage the ureter and common iliac vein. Closure is routine. The patient is repositioned on the contralateral side and the procedure repeated.[24,44]

Cloacal Surgery

CLOACAL PROLAPSE REPAIR

Cloacal surgery is indicated in those patients suffering from prolapse of the cloaca for removal of cloacoliths, and for cloacal papilloma debridement. Old World psittacines, particularly cockatoos, may develop intermittent or permanent prolapse of the cloaca. Reduced sphincter tone, chronic masturbation and straining, and chronic bacterial cloacitis have been implicated as causes for this disease. A thorough history and medical evaluation often elicits the cause. Medical therapy may include appropriate antibiotics based on cytology and bacterial culture and sensitivity and counseling clients to create a non-reproductive environment.[1,9,24]

If unresponsive to medical therapy, surgical intervention may be necessary to prevent the cloaca from prolapsing. Minor prolapse may be resolved by placing temporary mattress sutures on both sides of the vent or by placing two transverse sutures across the vent. Sutures should not be placed in the vent itself due to potential damage to the innervation. Purse-string suture of the vent is contraindicated due to frequent postoperative cloacal atony. Any procedure involving the surgical fixation of the cloacal wall to the abdominal musculature or ribs will interfere with the normal physiologic movement during voiding and egg laying, and may result in significant discomfort to the patient.[1,9,24]

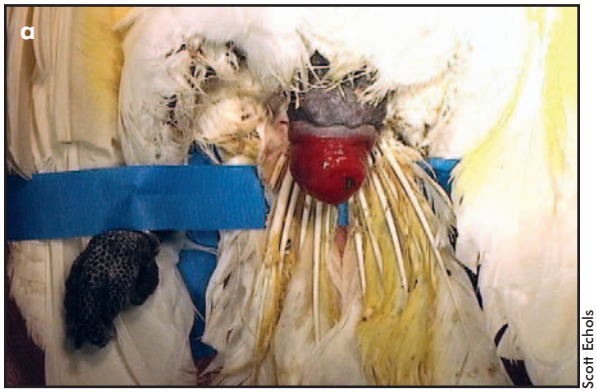
Occasionally, cloacal prolapse is due to or results in atony of the vent sphincter. Narrowing the diameter of the vent or performing a ventplasty may treat this condition. This may be accomplished by one of two procedures. Two triangular-shaped wedges are excised from the superficial surfaces of each side of the vent, without traumatizing the muscular or nervous tissue. This creates a reduction in the vent opening by one-third to one-fourth. Simple interrupted sutures are placed with monofilament nylon through the skin and subcuticular tissues. Another procedure to accomplish reduction of the vent opening includes incising one-half to three-fourths of the margin of the circumference of the vent to provide a cut surface for healing. Simple interrupted sutures are placed from one side of the vent to the other to partially close the vent opening, thereby preventing prolapse of the cloaca[1,9,24] **(Figs 35.25a-l)**.

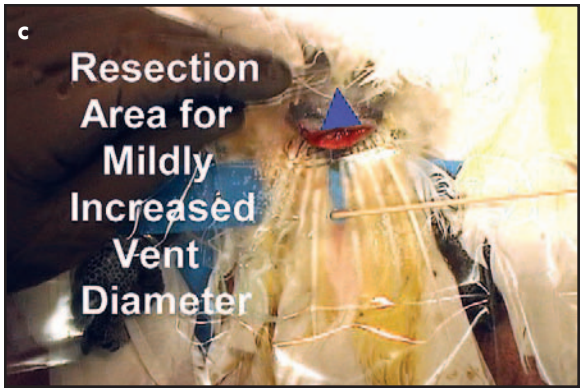
Current theory attributes cloacal prolapse, in many cases, to behavioral and/or nutritional causes. In the interim, however, surgical reduction of cloacal prolapse may be required. Cloacopexy, following various techniques (see text) tends to be a temporary fix at best, unless underlying causes are addressed.

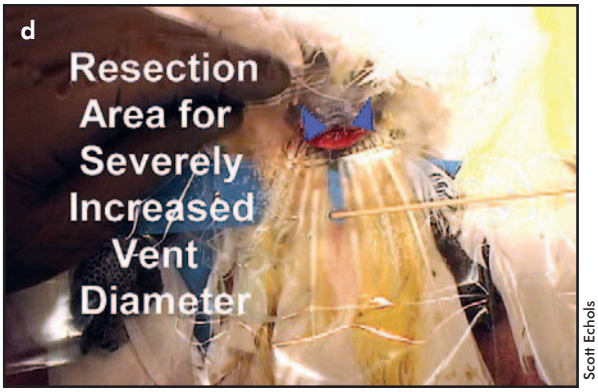
A percutaneous cloacopexy may be performed. This may offer only a temporary resolution, but it is much less invasive than the more extensive procedures later described. *(Ed. Note: With behavioral modification and hormonal manipulation, many practitioners are finding the need for more invasive cloacopexy unnecessary. The percutaneous technique has, in these editors' experience, supplied sufficient support to allow for the institution of medical and environmental therapy).*

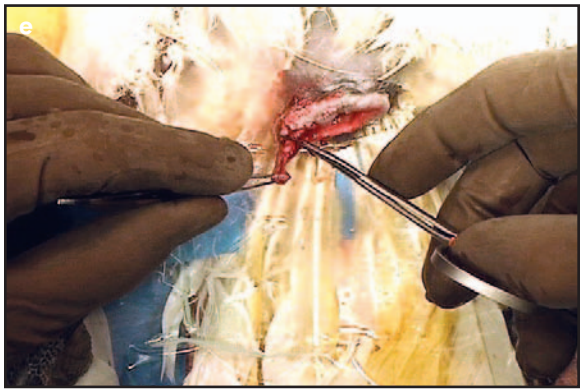
The patient is placed in dorsal recumbency and the abdomen surgically prepared from the caudal sternum to the pubis. The prolapsed tissue is replaced manually or with a lubricated cotton-tipped applicator or gloved lubricated index finger. The applicator may be left in the cloaca to delineate the location of the ventral cloacal wall, or finger or appropriately sized syringe case may be inserted into the cloaca. Two to three percutaneous sutures are placed using monofilament nylon while the intracloacal object gently holds the ventral cloacal wall against the abdominal wall. This aids in displacing intracoelomic organs so as not to entrap them in between the abdominal and cloacal walls. Potential complications include entrapment or perforation of the ureters, rectum, duodenum and pancreas. This is avoided if the suture placement is restricted to the ventral aspect of

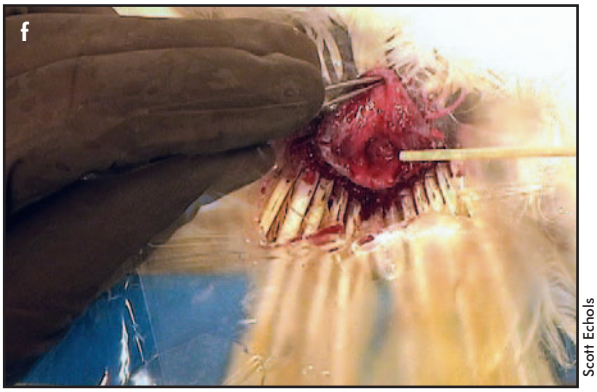
Prolapsed Cloacal Repair - Vent Resection and Reduction – Step by Step Figs 35.25a-l

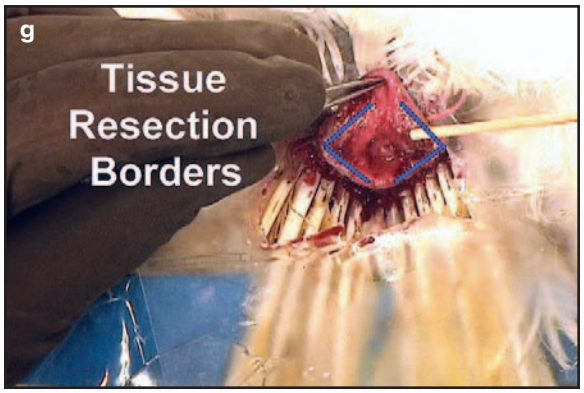




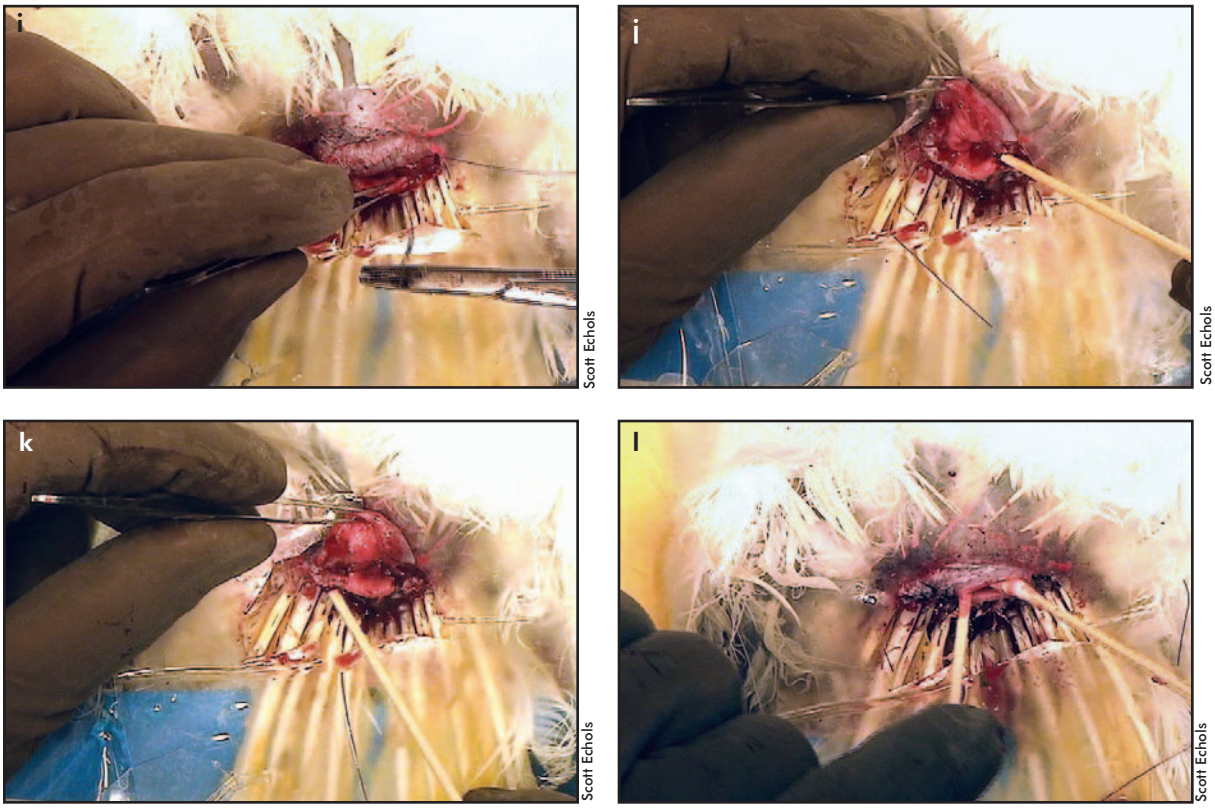








Figs 35.25a-h



Figs 35.25i-l

Figs 35.25a-l | Prolapsed cloaca is currently considered a malnutritional and/or behavioral disorder. Until corrections for such problems become effective, the prolapses need to be replaced and maintained with some surgical method. Cloacopexy has been used for years, but often proves insufficient for long term treatment. Ventplasty is used to reduce the diameter of the orifice. A thin, superficial dermal layer is removed (c-i) and a routine closure is made. Appropriate space must be maintained to allow passing of droppings but retention of tissues. Over-closing results in retention of droppings. Adjusting the opening in such a case should occur within a matter of hours. Such surgery is often done in cockatoos (notorious self-mutilators) and devices applied to the neck to avoid mutilation are advised, as are pain medicines both systemically and topically.

the body wall, directly lateral to the linea alba. It is important to note that any surgery that places the cloaca in a fixed position will interfere with the dynamic action of the cloaca during defecation and micturition.[1,9,24]

Birds with chronic cloacal prolapse often have elongated the distal colon from constant straining and subsequent protrusion from the vent. Therefore, although care is taken to remain ventral in the placement of the cloacopexy sutures, this distended colon may be forced to make a "U" turn when the ventral cloaca is sutured too extensively in a cranial direction. This can result in folding of the colon on itself and a functional colonic obstruction. If fecal material is not produced within a reasonable period of time post-cloacopexy, the veterinarian should consider removal of the most cranial abnormal cloacopexy suture.

A circumcostal or rib cloacopexy may be performed in patients suffering from severe cloacal prolapse. The patient is placed in dorsal recumbency and a ventral midline celiotomy is performed. Placing a lubricated cotton-tipped applicator, gloved finger, or syringe case will facilitate identification and manipulation of the cloaca. The cloacal wall is identified and bluntly dissected from the surrounding fat and subcutaneous tissues. Fat tissue on the ventral surface of the cloaca must be excised for a successful outcome. The ribs are pushed caudally while the abdominal incision is elevated manually. This will bring the ribs into view to facilitate suture placement. An absorbable monofilament suture material is passed around the last rib on the right and left sides. These sutures are then passed through the full thickness of the ventral aspect of the craniolateral extent of the urodeum. Large tissue sections must be used for suture placement and it appears to be necessary to penetrate the cloacal lumen. The sutures are tied with enough tension to slightly invert the vent. Several other sutures are then placed between the body and cloacal walls. The cloaca also may be sutured to the caudal border of the sternum instead of the ribs if excessive inverting tension is placed on the cloaca when sutured to the ribs. There may be increased discomfort associated with this surgical

procedure when compared to others.[9,24]

A third cloacopexy technique includes fixing the coprodeum to the abdominal wall. A 2-to 5-mm incision is made in the serosal surface of the coprodeum approximately 5 to 10 mm lateral to the ventral midline of both the right and left sides. Corresponding paramedian incisions are made in the peritoneal surface of the body wall cranial enough so as to result in slight inversion of the vent. Three to four absorbable monofilament sutures are placed in the serosal surfaces of the coprodeum and body wall so as to appose the subserosal surfaces.[9]

An additional cloacopexy technique involves closure of a celiotomy incision to include the cloacal and body wall. The patient is placed in dorsal recumbency and a ventral midline celiotomy is performed. The cloaca is reduced and the lubricated cotton-tipped applicator left in the cloaca to aid in identification and manipulation of the cloaca. Fat is excised from the ventral cloacal surface. The abdomen is closed incorporating the cloacal wall. An absorbable monofilament suture is passed through one side of the body wall, through the full thickness of the cloaca and through the other side of the body wall in a simple interrupted pattern. The overlying skin is closed routinely. Performing the same procedure via a caudal transverse celiotomy approach offers similar benefits, but additionally it avoids incising the cloaca should a future ventral midline celiotomy be necessary.[9]

CLOACAL MASS EXCISION

Internal papillomatosis is reported in New World psittacine species including macaws, Amazon parrots, hawk-headed parrots and conures. Papillomas may be found on the mucosal surface of the cloaca, oropharynx, esophagus/crop, proventriculus, ventriculus, bile ducts and pancreatic ducts. Cystic regression and recurrence is extremely common and *E. coli* and *Clostridium* spp., are often isolated from the cloacas of affected birds. Surgical removal is recommended, particularly if the mass is causing secondary cloacal infection, fecaliths, hematochezia, cloacal prolapse or if the bird is straining to defecate, indicating a mechanical obstruction. In addition, cloacal leiomyosarcoma has been reported in a blue-fronted Amazon parrot (*Amazona aestiva*).[9,28,68]

Methods for removal of cloacal papillomas include silver nitrate cauterization, cryosurgery, radiocautery, laser surgery and excision with a scalpel. The mass and affected cloacal wall may be everted manually and the mass debulked with any of these methods. If silver nitrate is used, the area must be profusely flushed with saline to prevent cauterization of normal mucosa as soon as sufficient tissue has been cauterized to debulk the mass **(Figs 35.18a-c)**.[1,9]

A cloacotomy may be performed to increase exposure to the affected mucosa and allow complete removal of a large occlusive mass. The patient is placed in dorsal recumbency and the abdomen surgically prepped from the caudal edge of the sternum to the vent. A ventral midline incision with or without a caudal transverse incision is made with a scalpel blade, scissors, radiosurgery or laser through the skin from the mid-abdomen to the ventral vent opening. The underlying vent sphincter muscle and the cloacal mucosa are incised with scissors to expose the entire cloaca. The mass may be removed with chemical cauterization, cryosurgery, radiocautery, laser surgery or excision with a scalpel. When chemical cauterization is used during a cloacotomy, extreme caution must be taken due to increased potential of damage to normal adjacent tissue. Hemorrhage may be controlled with radiocautery. The cloacal mucosa is apposed where the mass is excised with a small, absorbable monofilament suture in a simple continuous pattern. The cloacal mucosa is closed in a simple continuous pattern and the vent sphincter is apposed using a horizontal mattress pattern, both utilizing absorbable monofilament suture. The skin is closed in a simple continuous or interrupted pattern with a monofilament suture. An appropriate antibiotic should be used peri- and postoperatively. Surgical complications may include hemorrhage, scarring, stricture formation, fecal and urate retention, and incontinence.[1,9,23]

Mucosal stripping has been reported in a lilac-crowned Amazon parrot (*Amazona finschi*) for removal of cloacal papillomas. Recurrence of the papilloma occurred at the mucosal border adjacent to the sphincter 4 weeks postoperatively and cloacal anatomy was severely disrupted. Significant pain, lethargy, prolonged recovery, weight loss, leukocytosis and stricture of the cloaca also occurred. Therefore, mucosal stripping is reserved for cases where extensive debulking, is necessary. This may need to be done in a step wise fashion; resecting only a portion of the mucosa is less invasive.[2]

COELOMITIS

Coelomitis may occur secondary to ectopic ovulation, inflammatory and infectious conditions of the gastrointestinal, respiratory and reproductive systems. Many patients will recover with medical therapy and those patients that do require surgical intervention may benefit from medical treatment and supportive care prior to surgery.[12,13,31]

If appreciable coelomic fluid is present, it is recommended to either delay surgery or perform an abdominocentesis prior to surgery. Abdominocentesis, if performed, must be accomplished precisely on the ventral midline to prevent coelomic fluid from escaping from

peritoneal cavities and gaining access to the respiratory system. This escape of peritoneal fluid into the air sacs also can occur during celiotomy. This may result in life-threatening respiratory disease.[9,24]

The patient is placed in dorsal recumbency with the head and cranial body slightly elevated. Coelomic fluid is aspirated as described above, if indicted a ventral midline celiotomy is performed. A ventral midline approach may avoid transection of the air sacs and any fluid may be suctioned or drained. It may be necessary to adjust the vaporizer setting, as anesthetic depth may be altered when depth of respiration changes. The intestines are retracted atraumatically to gain exposure to the reproductive tract and other coelomic organs. Yolk material and tissue debris are gently removed and the coelomic cavity examined for abnormalities including tissue adhesions.[24] A salpingohysterectomy with or without ovariectomy should be performed to prevent future disease. There is risk of respiratory compromise to the patient if air sacs are transected and additional intracoelomic fluid accumulates postsurgically. There often are significant adhesions present between coelomic structures, particularly between the oviduct, and the kidney, ureter and the cloaca. Salpingohysterectomy requires breaking down these adhesions to allow excision of the oviduct. Tearing of these structures and hemorrhage are potential complications. Occasionally oviductal adhesions are too extensive to allow removal of the oviduct. Patients frequently have abdominal distension and muscular dysfunction postoperatively.[9,24] Some clinicians alleviate this by removing excess muscular tissue or by rolling the muscular tissue to create a muscular stent prior to closure of the coelomic cavity.

Miscellaneous Surgical Procedures

AMPUTATION

Limb amputation appears to be well tolerated by psittacines, however, emotional concerns of the owners often arise and may present a need for careful counseling by the surgeon prior to committing the bird to the surgery. When amputation is recommended not as a result of severe trauma to the bird, but rather due to neoplasia, nonunion fractures or chronic infection, the surgery may be postponed for 1 to 2 days to allow the owner time to reach a decision.

In cases of amputation due to neoplasia or infection, pre-operative radiographs are necessary to assure that affected bone, which may extend proximal to the visibly affected skin and soft tissue, is completely excised.

Prior to performing an amputation, the surgeon should make sure that the surgical team and equipment are prepared for the potentially life-threatening hemorrhage that can occur. At a minimum, a preoperative hematocrit and total protein should be performed to provide an indication of the overall health status of the patient. Extreme care must be taken in small avian patients and patients with a low hematocrit, as death can occur in these patients from the loss of a relatively small amount of blood. The use of a tourniquet is recommended as a means of controlling intraoperative hemorrhage during most amputations. Commercially available rubber small-animal tourniquets have the potential for causing severe skin trauma. These types of tourniquets can be used if they are well padded. A soft nylon rope, 1/2" rolled gauze, rubber band held by a hemostat, or piece of thick (>1-0) catgut suture provide alternatives. An assistant is necessary to hold the ends of the rope or suture and control the amount of pressure exerted. Ideal pressure will occlude the blood flow to the distal portion of the limb without causing trauma to the skin and underlying tissue. If skin trauma is noted, the placement of the tourniquet must be altered. If it is determined preoperatively that a tourniquet is not to be used, then careful dissection and ligation of the blood vessels is necessary. This may significantly increase the length of the surgery, but is absolutely necessary to prevent hemorrhage. If a tourniquet is not initially applied, it should be kept readily available in the event of severe hemorrhage. Being able to rapidly apply a tourniquet intraoperatively may mean the difference between life and death for an avian patient.[5]

Appropriate perioperative analgesia will significantly decrease the stress to the patient. If possible, it also is recommended that the avian patient be preconditioned to an Elizabethan collar or "sweater," which will prevent picking at the sutures of the amputation site until the skin is fully healed. Use of these devices and this period of adjustment are especially important for reducing the stress to the patient and decreasing postoperative complications The potential for hemorrhage makes prevention of postoperative picking at the skin and sutures critical.

Amputation of the Wing

When a wing amputation is performed, it is desirable to perform the surgery as distal as possible. This will allow retention of a portion of the normal function of the wing for balance. Some avian patients may traumatize the amputation site and a more proximal amputation site may be necessary. Wing amputation can be divided into three different categories: distal, mid-wing and proximal. A distal wing amputation can be defined as an amputation performed distal to the carpal joint. Indications for this surgery include inoperable neoplasia of the

distal wing, severe trauma or chronic infection. These typically occur in small birds such as budgies, lovebirds or cockatiels, making the need for amputation not uncommon in these species.[26,40]

Birds weighing less than 150 g should be anesthetized and placed in dorsal recumbency. The feathers distal to the carpal joint should be removed and the area aseptically prepared. Depending on the size of the bird, one or two hemostatic clips can be placed across the distal portion of the carpal joint firmly enough to crush the bone. The portion of the wing distal to the hemoclips can then be removed with a scissors leaving 5 mm of tissue. This small amount of tissue allows for the placement of skin sutures and provides tissue in the event of the hemoclip slipping. The incision is then closed with non-absorbable 5-0 monofilament suture with an atraumatic needle of equal size or smaller than the suture. The hemoclips can typically be removed in 2 to 6 weeks. Appropriate postoperative pain management is necessary. The bird should be observed carefully postoperatively to ensure that it is not picking at the hemoclips or sutures. If necessary, an Elizabethan or tube collar can be applied.[5,9]

Mid-wing or elbow joint disarticulation is indicated for small to medium-sized birds with trauma, nonunion radial or ulnar fractures, neoplasia or infection of the distal third of the wing. By performing the amputation at this point, the bird will lose its ability to fly but will maintain the use of the wing for balance. The bird should be anesthetized and placed in lateral recumbency. If possible, the feathers 1 to 2 cm proximal and the feathers distal to the elbow joint should be removed and the skin aseptically prepared. A tourniquet can be applied at the level of the mid-humerus to decrease the risk of severe hemorrhage.[9,20,40]

A circumferential skin incision is made distal to the elbow joint with a radiosurgical unit, laser or scalpel. Care must be taken to make the incision such that sufficient skin remains to allow closure of the incision. The insertion of the antibrachial muscles and related soft tissues are transected with radiosurgical forceps at the level of the elbow joint. The ligaments of the elbow are transected and the articular cartilage of the humeral condyles is carefully removed with rongeurs or scissors. Horizontal mattress sutures with an appropriately sized, absorbable monofilament suture are used to suture the muscle over the distal humerus. If large vessels are identified, they should be ligated with absorbable monofilament suture. The tourniquet is carefully loosened and the sutured tissue examined for any signs of hemorrhage. Hemostasis can be provided by coagulation with a bipolar radiosurgical forceps, identifying and ligating bleeding vessels, or applying very small hemoclips. The skin is closed in a horizontal mattress pattern with an appropriately sized, non-absorbable monofilament suture. Placing the suture deep into the muscle is desirable to prevent the possible formation of a hematoma postoperatively. The skin of the wing is very fragile and avoiding the formation of a hematoma may be difficult. It is important to provide postoperative pain management and an Elizabethan collar may be necessary to prevent picking at the incision.[9]

A proximal or proximal-humeral amputation is indicated for chronic trauma to the distal wing, neoplasia, nonunion or open, severely contaminated fractures and severe infection. The bird will lose the ability to utilize its wing for balance, but most psittacines appear to be able to adjust to this without complications. The patient should be anesthetized and placed in dorsal recumbency. The feathers should be removed and the skin aseptically prepared. The distal portion of the wing can be wrapped or covered with appropriate surgical draping material. Application of a soft tourniquet significantly decreases the possibility of severe hemorrhage. The tourniquet should be placed on the proximal humerus. If a mid-humeral amputation is to be performed, the tourniquet should be placed around the shoulder joint, incorporating the insertion of the pectoral muscles. If a proximal humeral disarticulation is to be performed the tourniquet should be placed around the shoulder joint including the brachial plexus.[9]

A circumferential incision at the mid-humerus is made using a radiosurgical unit, laser or scalpel. It is important to leave sufficient tissues to allow for closure of the skin. Also, it should be noted that despite the presence of a tourniquet, some hemorrhage may occur. Ligatures are placed around the distal portion of the muscles using appropriately sized, absorbable monofilament suture. The suture size should be based on the size of the bird and large enough that when tightened, there is compression without cutting of the tissue. The muscles are then transected at their musculotendinous junctions near the elbow joint using a radiosurgical unit. Blood vessels are identified and coagulated or ligated with 3-0 or 4-0 absorbable monofilament suture prior to being transected. The tourniquet should be loosened and any bleeding vessels ligated or coagulated with the radiosurgical unit. The muscles of the humerus are bluntly dissected from their tendinous attachments to the bone. The humerus is transected in the proximal third of the bone or, alternatively, the proximal humeral joint is disarticulated and the synovial tissues of the glenoid fossa are removed with appropriately sized rongeurs. The pneumatic nature of the proximal humerus makes good tissue coverage of the end of the bone very important. Inserting a piece of gelatin or collagen foam into the

distal portion of the remaining bone will ensure that blood does not travel through the humerus into the rest of the respiratory system. Impregnating this material with an appropriate antibiotic may be useful in preventing or aiding in the treatment of soft tissue or bone infection. The muscles are then sutured over the stump using a horizontal mattress or simple interrupted pattern with 3-0 or 4-0 absorbable monofilament suture. The skin and subcutis are apposed using 3-0 or 4-0 nonabsorbable monofilament suture in a simple interrupted or horizontal mattress pattern. The incision site should be monitored carefully for postoperative hemorrhage. Due to the potential for hemorrhage through the pneumatic portion of the humerus, the patient should be observed carefully for signs of respiratory distress. This surgery can be very stressful to the avian patient and may necessitate several days of hospitalization postoperatively. As with all amputations, postoperative analgesics are imperative (Figs 35.26a-g). Injection of a lidocaine derivative intraoperatively in the area of the radial nerve will also decrease post-operative pain.[9,40]

Amputation of the Leg

Most companion avian species function well with only one leg, especially psittacines. Care must be taken when considering leg amputation in avian patients. If the leg is amputated distally, the avian patient will attempt to use the remaining stump for ambulation. Contraindications for leg amputation include obesity, osteoarthritis of the contralateral leg or if the bird is unable to utilize its wings to assist in balancing. It is important to provide appropriate perching material to allow ease of grip and prevent perch-associated pododermatitis postoperatively. Amputation is indicated in avian patients with severe non-union fractures, severely contaminated open fractures, neoplasia, severe trauma or infection of the distal leg. Because a large portion of the femur is located within the skin of the body wall, a midfemoral amputation provides for adequate tissue to cover the end of the bone, prevents self-mutilation and is cosmetically acceptable. In captive raptors, postoperative pododermatitis of the contralateral foot is a common sequela, however, it is rarely observed in psittacines fed an appropriate diet and supplied with appropriate perches.[9,20,29,58,74]

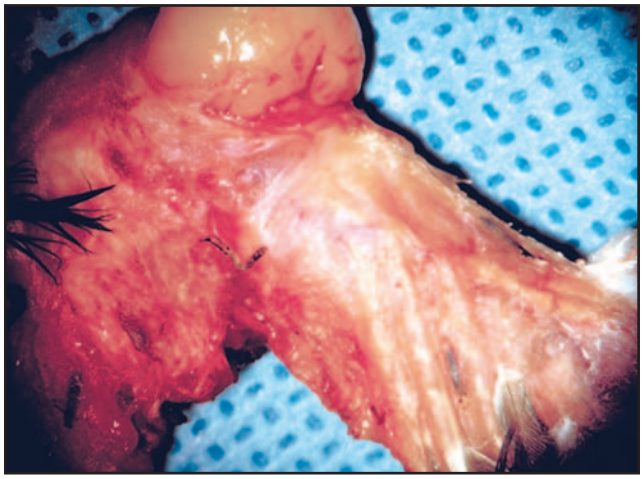
The patient should be anesthetized, placed in dorsal or lateral recumbency, and the feathers removed from the ventral abdomen distally to the stifle joint. The skin is aseptically prepared utilizing a standard orthopedic technique. The skin incision is made with a radiosurgical bipolar forceps along the web of the knee in the contour of the abdomen and semicircular incisions are made at the level of the stifle. Sufficient skin must remain to provide for closure without undue tension. Ligatures are placed around the distal portion of the muscles using 1-0 or 2-0 absorbable monofilament suture. Blood vessels are identified and ligated with 3-0 or 4-0 absorbable monofilament suture prior to being transected. A periosteal elevator is utilized to elevate the muscles from the proximal femur to the mid diaphyseal region. A bone cutter, osteotome, Gigli wire or other instrument appropriate for the patient's size is used to transect the femur. The muscles are then sutured over the stump with 3-0 or 4-0 absorbable monofilament suture in a simple interrupted or horizontal mattress pattern. The skin and subcutaneous tissues are apposed using 3-0 or 4-0 nonabsorbable monofilament suture in a horizontal mattress pattern. As with proximal humeral amputations, this surgery is very stressful for the avian patient and may necessitate several days in the hospital postoperatively. Appropriate pain management is imperative.[9,58,74]

Amputation of the Digit

Toe amputation is indicated in the event of severe trauma, neoplasia, avascular necrosis or infection of any of the digits. The tissue damage may be so severe or multiple toes may be involved such that amputation of the distal portion of the foot is also required. The same surgical techniques are utilized for both the toes and the feet. The patient is anesthetized, placed in dorsal recumbency and the distal portion of the leg aseptically prepped. It should be noted that the avian patient may present to the hospital with a large amount of fecal material on their feet. This requires careful cleaning prior to surgery because of the added risk for contamination and infection of the surgical site. Appropriate postoperative antibiotic therapy is necessary.[9,35]

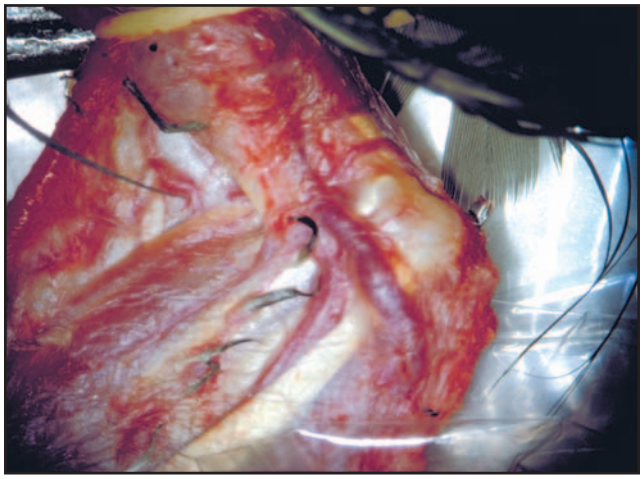
It is possible to perform two types of digit amputations, a proximal joint disarticulation and a phalangeal mid-diaphyseal amputation. A tourniquet composed of a thick suture material or a soft nylon rope is applied to the mid-tibiotarsal bone to control hemorrhage for both procedures. The site of a joint disarticulation of a digit should be at the joint proximal to the affected area. The skin should be incised distal to the stump to allow for sufficient skin for closure. A bipolar radiosurgical unit or scalpel blade can be used to make parallel horizontal incisions on either side of the toe. Alternatively, an incision is made around the dorsal two-thirds of the toe. It is important not to incorporate the plantar aspect of the digit with this approach. The phalanx is amputated at the proximal end of the bone. The joint may be disarticulated utilizing rongeurs, a scalpel blade, laser or electrosurgical unit. Any exposed joint surface can be removed prior to skin closure. Close in a horizontal mattress pattern with appropriately sized (3-0 to 5-0), nonabsorbable monofilament suture. If a horizontal incision was made, the edges of the skin are apposed with the knot tied on the dorsal surface of the skin. If a plantar

Wing Amputation – Step by Step Figs 35.26a-g



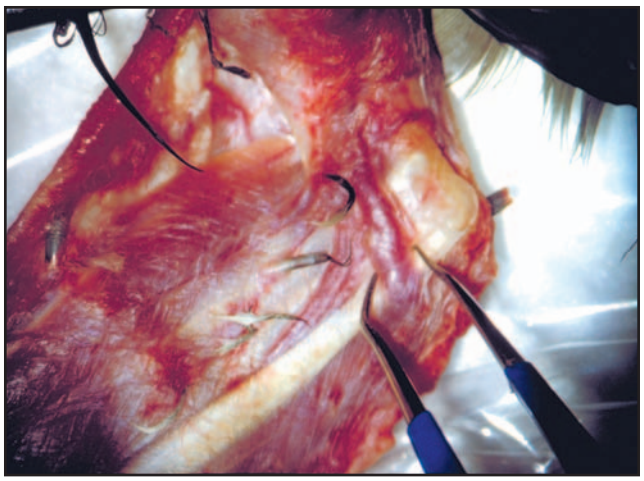
Greg J. Harrison

Fig 35.26a | An aggressive tumor involving the carpus was an indication for wing amputation. Harrison prefers to amputate at a joint, thus the elbow was the chosen site.



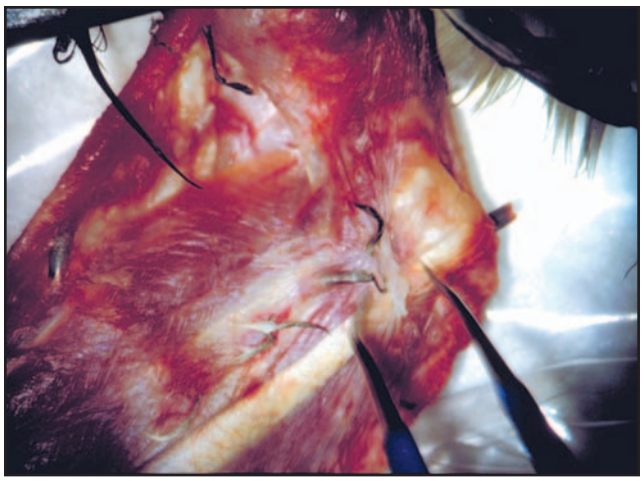
Greg J. Harrison

Fig 35.26b | The brachial vein is the first vessel encountered when amputating a wing at the elbow joint. Note the rubber band tourniquet that is secured by a hemostat.



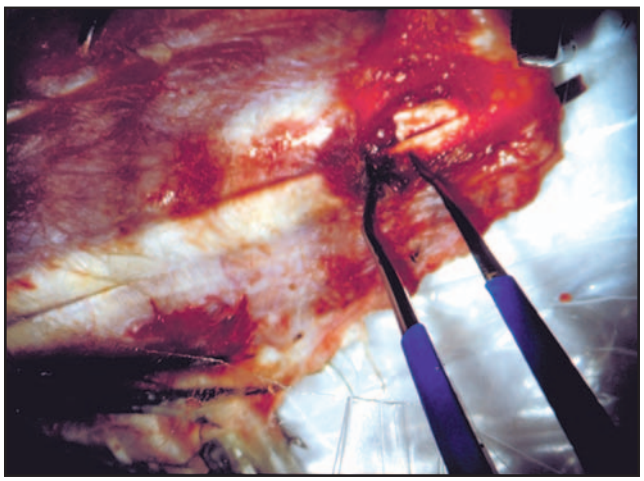
Greg J. Harrison

Fig 35.26c | The radiosurgery forceps are placed around the vessel and the coagulation setting is used to seal the vessel.



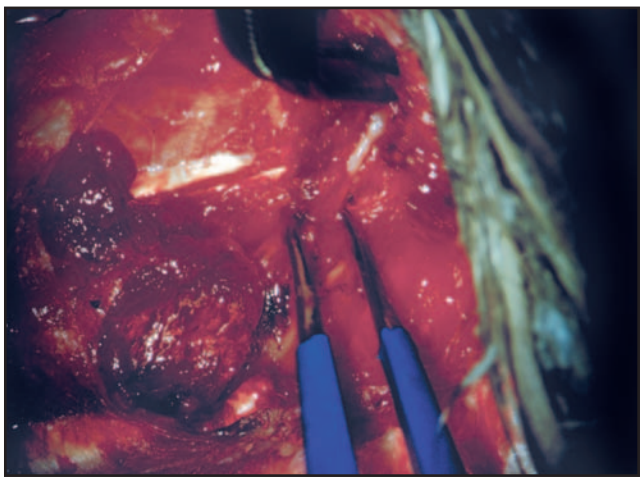
Greg J. Harrison

Fig 35.26d | The cutting current is used to incise the vessel and surrounding tissue.



Greg J. Harrison

Fig 35.26e | Vessels, ligaments and tendons are transected in a similar manner. Transection of muscle is avoided whenever possible.



Greg J. Harrison

Fig 35.26f | If the upper wing is involved, the wing can be amputated at the proximal ⅓ of the humerus or at the shoulder joint. Larger diameter vessels in this area will require more extensive and careful ligation. Muscles will require transection, however, sufficient musculature should be retained to cover the remaining portion of humenal bone in the case of amputation at this level. If amputation is performed by disarticulation of the shoulder joint, muscle should be retained and sutured to fill the dead space and prevent seroma formation.


Espen Odberg

Fig 35.26g | Skin closure after proximal wing amputation.

skin flap was created, the skin is sutured to cover the end of the bone. Placing the most dorsal suture initially will allow for symmetrical apposition of the sides. The thicker skin of the plantar surface of the toe will provide additional protection for the end of the bone.[9,35]

A mid-diaphyseal amputation is generally performed on small avian species. The skin is cut proximal to the affected tissue in a circumferential manner utilizing a radiosurgical unit or scalpel blade. The skin is then carefully retracted, exposing the underlying bone. The diaphysis of the bone is transected using rongeurs or scissors. The skin is then pulled distally to cover the exposed bone. Sufficient tissue is removed from the dorsal portion of the remaining skin of the toe to create a flap of plantar skin that will cover the end of the bone. The skin is then sutured using 4-0 or 5-0 non-absorbable monofilament suture in a horizontal mattress pattern. The affected toe and incision should be monitored closely for postoperative signs of infection. An Elizabethan collar or bandaging of the foot, can be utilized to prevent picking at the incision postoperatively.[9]

ABDOMINAL WALL HERNIA REPAIR

Abdominal wall hernias may be congenital or acquired. The etiology is undetermined, but several disease conditions have been implicated. Hyperestrogenism leading to weakening of the abdominal musculature has been suggested as a predisposing cause in budgerigars (*Melopsittacus undulatus*) and cockatiels (*Nymphicus hollandicus*). Chronically egg-laying hens and changes in calcium metabolism may contribute to muscular atony. Lack of exercise, malnutrition, obesity, space-occupying masses, organomegaly, trauma, or chronic masturbation and straining may result in weakening of the abdominal musculature and abdominal distension.[9,50,53,56]

Most "abdominal hernias" in birds do not in fact have an opening in the aponeurosis of the abdominal muscles. A true hernia is defined as a protrusion of an organ through connective tissue or through the abdominal wall in which it is usually enclosed. Therefore, a thorough examination is crucial to accurately diagnose an abdominal hernia. Herniation may include separation of the aponeurosis of the abdominal musculature at the ventral midline, allowing coelomic viscera to displace outside the muscular body wall. Clinical signs may include disease associated with entrapment of intestinal loops. "False hernias" or abdominal distension requires investigation of primary etiologies, therefore, a thorough examination and diagnostic protocol is important to accurately assess the patient's condition. In many patients, false hernias are of little clinical consequence and do not require surgery. In addition, surgical repair may carry significant risk. Respiratory compromise may result when reducing the coelomic contents due to increased pressure on the abdominal and thoracic air sacs. Herniorrhaphy is indicated if the abdomen is being traumatized due to distension causing abrasion or ulceration by contact with the perch or floor, herniation of coelomic viscera poses risk to the patient, secondary clinical disease such as egg binding, intestinal obstruction, cloacal urolithiasis or difficulty expressing urates develop. Abdominal hernia and distension have been associated with hepatic lipidosis, reproductive tract disease, intracoelomic lipomas and peritoneal cysts.[9,50]

Pre-operative radiographs, with gastrointestinal contrast media if needed, will identify the location of structures within the distended or herniated abdomen.

The patient is placed in dorsal recumbency and a ventral midline or an elliptical incisional celiotomy is performed. Caution must be taken when making the midline incision to avoid iatrogenic trauma to underlying viscera. Herniated viscera are gently replaced and the hernia repaired while patient respiration is closely monitored. The distended abdominal wall is trimmed on either side of the linea alba to create a normal anatomic abdominal wall. The abdominal wall is then sutured in a simple interrupted or continuous pattern with absorbable monofilament suture and the overlying skin closed routinely. If the body wall defect is extremely large, a mesh implant may be considered for repair.[1,9]

ABDOMINAL MASS EXCISION OR BIOPSY

Surgical excision or biopsy of neoplastic masses is indicated for several different types of disease conditions. Removal often requires prolonged anesthesia, strict

hemostasis and careful anatomic dissection. This predisposes the patient to hypothermia, hemorrhage and metabolic compromise. Surgical procedure varies with the organ affected. Laser surgery may show some promise for removal of neoplastic and granulomatous masses.[3,9,51]

When a biopsy and histopathologic diagnosis are obtained, or when complete surgical resection carries an unacceptable risk, alternative treatments may be preferred. Recent advances in oncology, including intralesional cisplatin and carboplatin, have shown promise for various abdominal neoplasias (see Chapter 20, Overview of Tumors).

LIPOMA EXCISION

Lipomas are frequently the result of obesity. Some species demonstrate a predisposition to development of lipomas (see Chapter 13, Integument). Correction of malnutrition, obesity and increased activity level often will reduce the size of lipomas.[9] Medical treatment including supplementation with L-carnitine, or levothyroxine if a hypothyroid condition has been accurately diagnosed, has not met with consistent results.[19,75] It is important to note that liposarcomas, leiomyosarcomas and other masses that mimic lipomas have been reported in pet psittacines.[56]

Lipomas that are well encapsulated are generally simple to excise. However, large, diffuse or broader-based lipomas can pose a significant patient risk when excision is attempted. Occasionally, loss of adequate vascular supply will result in central necrosis and ulceration. Large abdominal lipomas may be prone to inadvertent trauma and damage to the overlying skin.[9] The Cavitron ultrasonic surgical aspirator (CUSA) has been used to safely resect lipomas in budgerigars. This ultrasonically powered aspirator selectively fragments and aspirates parenchymal tissue while sparing vascular and ductal structures. Preliminary evaluation suggests that the CUSA may provide reduced tissue necrosis and hemorrhage, increased visibility, shortened operating and anesthetic duration, and reduced recovery time when compared to blade resection, bipolar cautery and CO_2 laser excision.[85]

RENAL BIOPSY

Biopsy of the kidney may be performed through a lateral, ventral midline or combination ventral midline-transverse celiotomy.[9] In addition, a dorsal pelvic approach has been described.[80] Renal biopsy may be performed via laparoscopy. The reader is referred to Chapter 24, Diagnostic Value of Endoscopy and Biopsy for a complete description of this procedure.

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a. Vascular clamps, Sontec Instruments, www.sontecinstruments.com
b. Weck Hemoclips, Solvay Animal Health, Inc., Mendota Heights, MN, USA
c. Gordon Laboratories, Upper Darby, PA, USA
d. HemoBlock, Abbot Laboratories, North Chicago, IL, USA
e. Silverglide Nonstick, Select-Sutter, Germany

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