CELIOTOMY
There are three commonly performed approaches to the caudal coelom, equivalent to the abdomen of mammals. The ventral midline approach offers limited exposure but avoids entering the air sac system. Lavage can be done if no air sacs have been damaged during the approach. The transverse abdominal approach provides exposure to most abdominal viscera including organs on the right side such as the pancreas and right gonad and kidney. The left lateral approach offers excellent exposure to the gastrointestinal tract, the female reproductive tract, and the left kidney but does not allow adequate visualization of the organs on the right side.

Ventral Midline Celiotomy
A simple ventral midline celiotomy provides limited exposure to most abdominal organs in birds. Through a ventral midline approach, the hepatoperitoneal cavity is entered. This cavity does not communicate with the air sacs which are located lateral to it on each side. The liver, pancreas and intestines are accessible through this approach. The duodenum and pancreas are immediately under the body wall and it is easy to inadvertently incise these structures. This is particularly problematic in birds where disease has resulted in the development of adhesions between the body wall and the viscera. If the liver is of a normal size, it is usually under the sternum making it difficult to access but a ventral midline approach. In birds, ascites is characterized by accumulation of fluid in this cavity. The fluid does not enter the air sacs or lungs. Coelomitis may also cause fluid to accumulate in the hepatoperitoneal cavity. Fluid can be drained and irrigation of the hepatoperitoneal cavity can be safely performed as long as the air sacs are intact. Unfortunately, most of the other abdominal organs are not readily accessible through a ventral midline approach.

Exposure using a ventral midline approach can be improved by creating a flap. A ventral midline celiotomy incision is made and extended along one side of the caudal border of the sternum leaving 2–3 mm of muscle into which sutures may be placed. For example, if approaching the ovary, the incision would be extended along the left side of the sternum. A Y-shaped incision can be made by creating bilateral flaps. This is useful for placing sutures around the last rib on each side for a cloacopexy. Flap approaches often provide the best exposure to mid-abdominal masses, uterine masses, and generalized abdominal disease such as yolk coelomitis. The approach should be limited to the minimum needed to accomplish the task in order to minimize tissue exposure, compromise to the blood supply, and disruption of air sacs. It may be difficult to maintain anesthesia with large abdominal approaches that disrupt air sacs. Closing the incision or
covering the opening with saline moistened sponges for several breaths along with increasing the percent of anesthetic gas will often help with maintenance of anesthesia.

A transverse abdominal approach provides exposure to a large portion of the abdomen. With the bird in dorsal recumbency a transverse incision is made midway between the vent and the caudal extent of the sternum. The body wall is lifted and incised being careful to protect underlying structures. With this approach as with the midline, the duodenal loop and pancreas lie immediately under the body wall. Through a transverse approach, the ventriculus, pancreas and small intestine are most accessible. If there is hepatomegaly, the caudal extent of the liver may also be accessible. The viscera may be reflected or carefully exteriorized to expose the middle and caudal lobes of the kidneys, the cranial cloaca, and the lower reproductive tract (shell gland of females and vasa deferentia of males). The body wall incision is closed in a simple continuous pattern and the skin in a Ford interlocking pattern.

A left lateral approach provides good exposure to most of the abdominal organs. The pancreas and structures on the right side are not very accessible through this approach. The bird is positioned in right lateral recumbency with the left leg retracted caudally. The skin incision is made from the middle of the pubis to the sixth rib dorsal to the uncinate process. After the skin is incised, the left leg can be retracted farther caudally to improve exposure. Branches of the femoral artery and vein are located within the body wall coursing toward midline from the area of the coxofemoral joint. These vessels must be coagulated or ligated before the abdominal musculature is incised. An incision is made through the mid-lateral body wall from the level of the pubic bone to the last rib (8th in most psittacines). Care is taken to protect the underlying structures from accidental incision. In order to gain exposure to the gonad and proventriculus, the last two ribs must often be transected. The intercostal vessels are located just cranial to each rib in the intercostal space. They are coagulated with bipolar forceps or hemostatic clips. The ribs are then transected just dorsal to the junction between the sternal and the vertebral ribs. Care is taken to preserve the lung which may extend as far caudal as the 7th rib. A retractor, such as a Heiss retractor, is placed between the cut ends of the ribs and used to spread the ribs providing exposure to the more cranial abdominal organs. Following completion of the procedure, closure involves apposition of the abdominal and intercostal muscles. No effort is made to unite the cut ends of the ribs. Skin is closed in a Ford interlocking pattern. This approach offers exposure to the male or female reproductive tract, the ventriculus, the proventriculus, the spleen, the left lung, the left kidney and some of the intestines.

GASTROINTESTINAL SURGERY

Crop Surgery
The ingluvies (crop) is a storage organ of the avian digestive tract. Because it is often full and protruding, it is susceptible to trauma. It may also be the site where a foreign body has lodged. Hand fed baby birds may suffer from crop burns from overheated food. Fortunately, the crop has a good blood supply and heals well.

The patient should be anesthetized and intubated to prevent aspiration of crop contents. If possible, the head should be maintained elevated to prevent liquid from getting into the pharynx
and being aspirated. Foreign bodies can often be retrieved using blunt, atraumatic forceps or by massaging the object, gently, from the crop. When ingluviotomy is necessary, the skin incision is made in the left lateral cervical region over the crop to minimize disruption of the vasculature and complications associated with tube feeding in the recovery period. Stay sutures are placed and the incision in the crop is made to a length approximately 1/2 the length of the skin incision. Closure is accomplished using a continuous appositional or inverting pattern. The skin is closed separately over the ingluviotomy incision. This approach is used for retrieval of a foreign body or for passing a rigid endoscope into the proventriculus in larger birds where the scope may not be long enough to reach the proventriculus using an oral approach.

Crop biopsy is also indicated as a tool for diagnosing proventricular dilation syndrome. The skin over the crop is incised and dissected off the surface of the crop. The biopsy must be taken in a location where there are blood vessels in order to obtain nerves which might demonstrate the typical histologic changes. Once the biopsy is obtained, hemostasis is achieved and closure is routine.

When the crop is burned or traumatized, there may be loss of significant portions of tissue. In some birds there will be a true fistula with food material dropping out of the hole. In more acute burns, it may be difficult to distinguish viable from devitalized tissues. In these cases it is best to wait 3-5 days for a line of demarcation between necrotic and viable tissue to develop. The wound edges should be debrided until the skin can be separated from the crop wall. The skin and crop are sutured closed as separate structures. Placing a rubber feeding tube into the crop will help identify the lumen especially where there is major tissue loss. In cases where there is significant loss of crop tissue it is best to maintain the longitudinal integrity of the esophagus (crop) as there is a much higher likelihood of stricture formation with resection and anastomosis.

**Proventriculotomy and Ventriculotomy**

Proventriculotomy or ventriculotomy is most commonly indicated for removal of foreign objects (such as lead) from the proventriculus or ventriculus not retrievable with an endoscope. Ventriculotomy is considered more likely to leak postoperatively as it is difficult to seal the incision with sutures and birds do not have an omentum to help seal enterotomy incisions. Very fine monofilament material must be used and accurately placed. Sealing the incision with a product like Surgicel may help provide a seal.

A left lateral approach is used. The suspensory tissues surrounding the ventriculus are bluntly dissected and stay sutures placed into the white tendinous portion of the ventriculus to elevate the isthmus into the field. Stay sutures should not be placed into the proventriculus or in the pink muscular component of the ventriculus as these tissues are weak and the sutures will tear through them. Moistened sponges should be used to isolate the proventriculus and contain any gastric contents that may spill. A stab incision is made in an avascular area of the isthmus using a scalpel or scissors (electrosurgery is not used as this causes lateral heat damage that might predispose to incisional leakage). The incision is then extended orad using scissors for a proventriculotomy or aborad for a ventriculotomy. Leakage is controlled with suction. Careful irrigation and suction are used to evacuate the contents. The air sac will be open and irrigation fluids can enter the lung through the ostium. The proventriculotomy incision is closed with a fine monofilament absorbable material on a small atraumatic needle using a simple continuous
pattern. For a ventriculotomy, the incision is closed in a simple interrupted pattern with fine monofilament material on a small atraumatic needle. No attempt is made to repair the suspensory tissues. The abdominal viscera are gently cleaned prior to abdominal closure.

**Enterotomy**

Enterotomy is NOT frequently indicated in avian patients. It usually occurs as the result of trauma or accidental incision during celiotomy. Historically, enterotomy has carried a guarded to poor prognosis. With the use of magnification and fine monofilament absorbable material on a small atraumatic needle, accurate closure is more easily accomplished with a much better prognosis. Midline, flap, or transverse approaches may be used depending on the location of the lesion. Magnification and microsurgical techniques are generally required. The intestines receive their blood supply from the celiac (duodenum) and cranial mesenteric (jejunum and ileum) arteries. 6-0 to 10-0 suture in a simple appositional pattern is used. As with microvascular anastomosis, avian intestinal anastomosis usually requires 6-8 sutures.

**Cloacotomy**

The cloaca is the cavity into which the kidneys, colon, and reproductive tract empty. The vent is the opening of the cloaca to the environment. The vent sphincter muscle provides continence. Cloacotomy is indicated for a thorough evaluation of the internal structures of the cloaca as would be necessary in treating cloacal papillomatosis or other masses within the cloaca. Through this approach the surgeon is able to visualize the coprourodeal fold and the uroproctodeal fold as well as the colonic, ureteral and oviductal openings. The openings of the vasa deferentia are generally too small to visualize.

Insert a moistened cotton tipped applicator stick into the cloaca. Using the monopolar electro surgical tip, incise through the skin, the muscle of the cloacal sphincter, and the mucosa of the cloaca from the vent to the cranial extent of the cotton tipped applicator. Alternatively, small scissors may be inserted into the cloaca and the ventral wall including skin, body wall, and cloaca cut all at once. Using this technique you should not enter the coelomic cavity. Inspect the cloaca and on the dorsal surface you should be able to visualize the ureteral openings and urine/urates flowing into the cloaca. Close the cloacal mucosa using 6-0 monofilament absorbable material in a simple continuous pattern beginning at the cranial extent of the incision. The vent sphincter muscle is closed with a single mattress suture of 4-0 absorbable material. The skin is closed as the last layer over the cloaca and vent sphincter muscle.

**Cloacopexy**

Cloacopexy is indicated for treatment of chronic cloacal prolapse. This appears to occur most commonly in Old World species of psittacines (primarily cockatoos) and is associated with reduced or lost tone of the vent sphincter. Some have associated this problem with chronic *E. coli* infection. Therefore, the cloaca should be cultured and the bird placed on appropriate antibiotic therapy prior to surgery. Several procedures have been recommended for the treatment of chronic cloacal prolapse. Because the exact cause of the problem has not been determined, recurrence is observed with all techniques described. Even if permanent adhesions between the cloaca and the body wall are created, the sphincter is stretched out and atonic. The cloaca itself often stretches and the redundant tissue prolapses out the vent which has the appearance of a recurrence.
I use a combination of three procedures to reduce the prolapse, maintain its position, and reduce the size of the vent opening. Make a ventral midline incision in the abdomen. Extend the incision parasternal on both sides to provide access to the last rib on each side. Isolate the serosal surface of the cloaca and remove any fat from the ventral surface as fat will inhibit the formation of strong adhesions. Insert an appropriate structure (gloved finger for large birds, thermometer or cotton tipped applicator for smaller birds) into the cloaca to distend the structure and define its limits. The circumcostal cloacopexy uses the last rib to which the cloaca is sutured to maintain reduction. In order for the cloaca to reach the last rib, it must be stretched out beyond what would be considered normal. In birds with cloacal prolapse, there is generally not too much tension when this is done. As an alternative, the organ can be sutured to the caudal border of the sternum. Pass 2 sutures are passed around the rib on each side or through the cartilaginous border of the sternum and full thickness through the cloaca. For the rib cloacopexy, sutures are passed around each rib at the junction of the sternal and vertebral portions. These are preplaced and tied once all are in position. This will anchor the organ in a reduced position; however, it is unlikely that permanent adhesions will form at these locations. The suture will eventually stretch, break, or cut through resulting in failure. To prevent recurrence, permanent adhesions must be created. Therefore, following the placement of these sutures, close the ventral midline incorporating the cloaca. Scarify or incise the ventral aspect of the cloaca to create a raw surface. Pass the suture through one side of the body wall incision, full thickness through the cloaca, and through the other side of the body wall. This encourages the cloaca to heal within the body wall forming permanent adhesions between these structures. The third procedure is a ventplasty.

Ventplasty is indicated in birds with chronic cloacal prolapse where the vent sphincter has become atonic. This may be the result of chronic straining or a primary neuropathy. The result is that the sphincter is incompetent and is no longer able to prevent the cloacal tissues from prolapsing. Ventplasty (analogous to canthoplasty of the eyelids) is used to decrease the size of the vent opening.

Incise the skin over the vent sphincter at the lateral commissures of the vent exposing the underlying muscle. Place fine monofilament absorbable suture transversely in the mucosa of the cloaca from cranial to caudal. Next, the vent sphincter muscle is apposed with a synthetic absorbable in a mattress pattern between the cranial aspect of the sphincter and the caudal aspect of the sphincter. Finally, the skin edges are apposed cranial to caudal using a synthetic absorbable material. Remove enough tissue from each side so that ultimately, only 1 or 2 cotton tipped applicators can be placed into the cloaca. Postoperatively, the patient is monitored to assure that it can still void urine, urates, and fecal material. Some birds will develop stricture a few weeks after this procedure. If this occurs, under general anesthesia, stretch the sphincter with a cotton tipped applicator in a circular motion. In all birds that have had strictures, I have only had to do this procedure once.