AMC
Animal Medical Center
SINCE 1910

# Hypophysectomy at the Animal Medical Center

What is transsphenoidal hypophysectomy and why is it performed?

The sphenoid bone comprises the middle part of the skull supporting the ventral aspect of the brain. Within the sphenoid bone is a depression that accommodates the pituitary gland, or hypophysis, as it sits beneath the brain attached by its stalk or infundibulum. In people this area is accessed via a transnasal route. Differences in cranial anatomy make a transoral route preferable in dogs and cats. The procedure is considered minimally invasive; here an existing orifice is used to access a difficult to reach area thereby avoiding extensive tissue disruption and improving post-operative recovery. To reach the sphenoid bone an incision is made in the soft palate and the mucoperiosteum of the nasopharynx. Thereafter the ventral bone of the pituitary fossa is removed with a high-powered burr (figure 1). This fossa is aptly named the *sella turcica* after its resemblance to a Turkish saddle.

Due to its location at the middle base of the skull the area surrounding the pituitary gland has presented a challenge to neurosurgeons. Despite common knowledge of benign tumors of the pituitary causing various endocrinopathies the potential for surgery to address these diseases as been elusive. The primary limiting factors involve: (1) the complex anatomy and difficulty identifying the surgical landmarks; and (2) poor visualization of the surgery site due to lack of illumination and the small size of the surgical corridor.

These same factors have proved challenging to human neurosurgeons as well. Anatomical similarities between dogs, cats and people have allowed for the direct translation of surgical skills and approaches between species. Recent technological developments have helped to address these factors in people and have been applied to dogs and cats. Improvements in the surgical localization of the pituitary fossa and better intra-operative visualization have led to the expansion of transsphenoidal surgery in people. Today surgery is the mainstay of treatment of various functional disorders of pituitary such as hyperadrenocorticism and acromegaly. Transsphenoidal hypophysectomy to remove functional pituitary tumors is the most successful long-term therapy in people. The same could be said for dogs and cats where there is access to these technologies. Thus far access to facilities performing these types of surgeries in the United States has been limited. Worldwide there are only a handful of centers offering these procedures in dogs in cats. In 2017 the Animal Medical Center joined this handful of institutions. Washington State University is the only other hospital performing these procedures commonly in the United States.

To better address the challenge of localizing the surgical site via the transoral route a real-time neuronavigation system is employed. The system used at the Animal Medical Center is the Brainsight2 (Rogue Research, Montreal, Canada) which was developed exclusively for veterinary patients (Figure 2). Prior to surgery detailed MRI studies are performed to highlight the tumor and relevant anatomy. Computed tomographic (CT) angiography is also performed to visualize important blood vessels in the surgical field. These images are then used to generate a virtual 3D model of the surgical site. At the time of anesthesia a temporary marker is placed on the patient that will be used to navigate at surgery. In the operating room the MRI/CT images are co-localized to the patient by the use of an infra-red camera system that allows real time tracking of surgical instrumentation along the 3D images generated in the pre-op planning phase. In this way the pituitary fossa can be accurately localized and major arteries, venous structures and cranial nerves avoided when operating around this delicate anatomy (Figs 2 and 3).

The challenge of visualization and poor anatomy have been eliminated by the use of a high-definition video based telescope system (VITOM, Karl Storz Endoscopy, Tuttlingen, Germany). This system has replaced the use of surgical microscopes and has improved surgical outcomes by increasing magnification and visualization (see figs 4). Improved efficacy and safety using the VITOM system was recently reported in dogs undergoing transsphenoidal hypophysectomy to remove functional pituitary adenomas causing hyperadrenocorticism.* These dogs showed a sustained remission rate of 95% at 1 year. It should be noted that the median tumor volume of the pituitary masses removed by this method was 9 times that reported in previous studies not employing new techniques of localization and visualization. Also this remission rate exceeds that noted with medical therapy with Mitotane or Trilostane.

By utilizing advanced imaging techniques coupled with real-time neuronavigation and superior intra-operative visualization surgery of the pituitary fossa is being expanded. Tumors in this area of the brain can be categorized as functional or nonfunctional. The most common functional masses are adenomatous hyperplasia/neoplasia causing hyperadrenocorticism and hypersomatotropism (e.g. acromegaly) in dogs and cats, respectively. ** The incidence of nonfunctional tumors of the pituitary fossa is not known. These types of cases represent approximately 50% of the cases referred to the Neurology Department at the Animal Medical Center with the chief complaint of a pituitary mass. There are no published studies of removal of nonfunctional pituitary masses in cats. Until recently radiation therapy was the only definitive option for these patients. An example of such a case is provided accompanying this article (see Case study: Nonfunctional Pituitary Tumor in a Cat).

A necessary consequence of pituitary gland removal is the need for post-operative hormone supplementation. Specifically corticosteroid and thyroid hormone are supplemented; these are required for the life of the pet in most cases. In many cases diabetes insipidus follows resection of the pituitary. However need for supplementation is transient in the majority of cases with normal water balance resuming at 4-8 weeks post-operatively.

Surgery via a transsphenoidal approach has advanced our ability to treat disease in this area of the brain. Outcomes are similar to tumor resection elsewhere in the brain. The development of a minimally invasive surgical corridor with improved exposure and visualization is a huge step in advancing neurosurgical therapy in dogs and cats. In time this may be expanded to include the entire skull base; an area heretofore considered inaccessible.

*Mamelak et at. Transsphenoidal surgery using a high definition video telescope for pituitary adenomas in dogs with pituitary dependent hypercortisolism: methods and results. Vet Surg 2014; 43:369-379
**see previous article Endocrine Update: Your Patient May Have a Brain Tumor

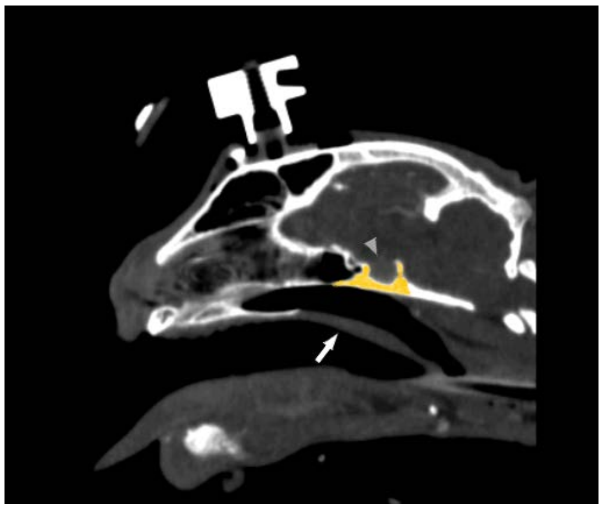

Figure 1. Post-contrast sagittal CT image of a cat with acromegaly treated at the AMC. The sphenoid bone is highlighted in yellow with a faintly contrast enhancing mass in the "sitting" in the fossa of the sella turcica (arrowhead). This bone is removed following an incision in the soft palate (arrow). A fiducial marker has been placed on the skull for navigation purposes.

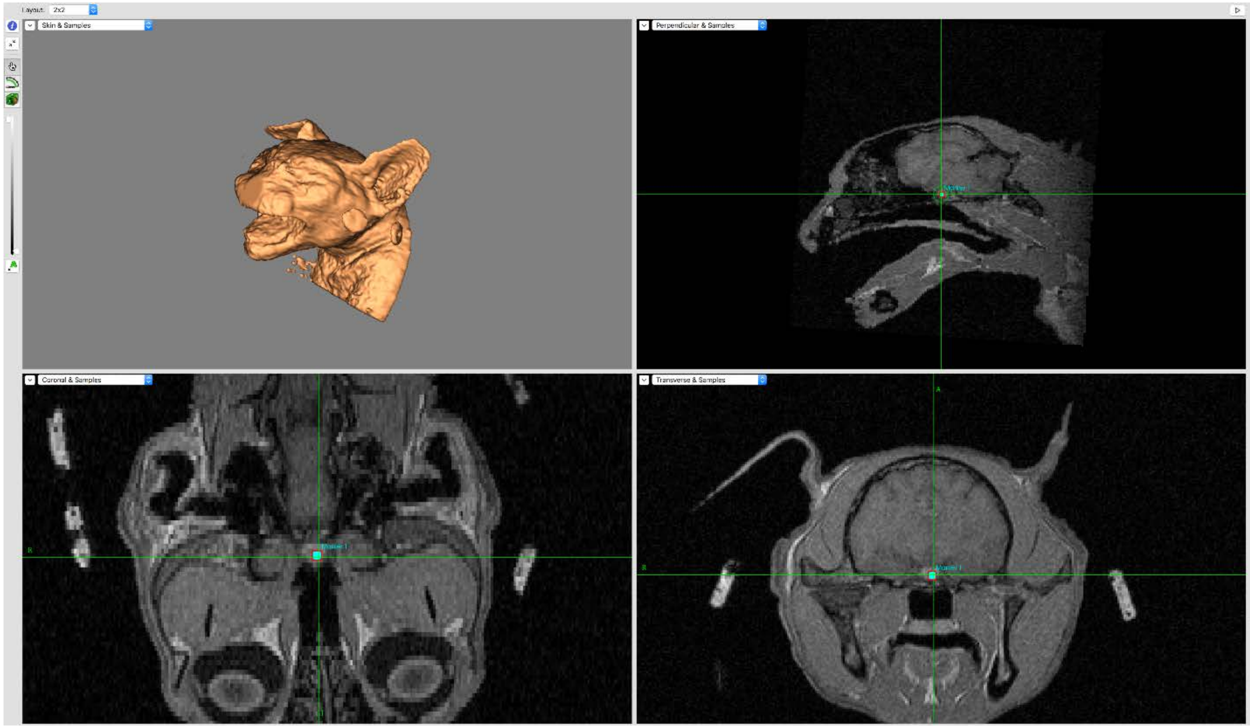

Figure 2. Example of a neuronagivation plan using the Brainsight 2 system. The site of the pituitary gland is center at the crosshairs and viewed in 3 planes. A 3D reconstruction of the patient with an open-mouthed surgical position is seen in the top panel for reference. Discoid fiducial markers are seen around the patient.

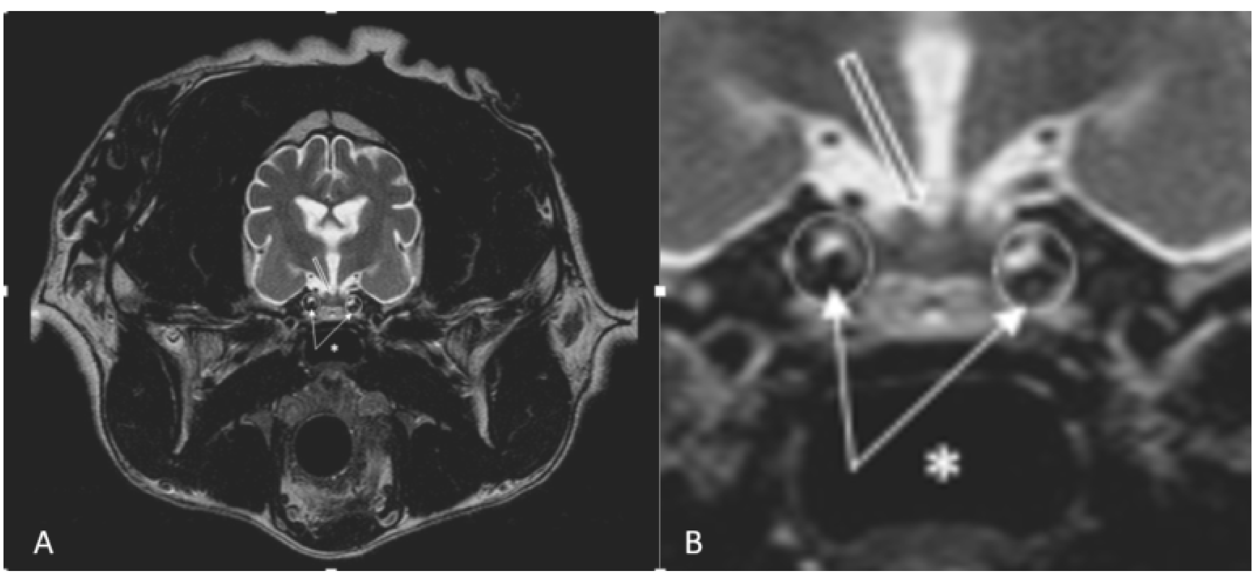


Figure 3. Transverse T2w MRI at the level of the pituitary gland in a normal dog. The relevant anatomy is magnified in panel B. In A and B: the nasopharynx is highlighted with an (*); the pituitary is shown with an open arrow. The dotted circles denote the paired cavernous venous sinus, a blood filled

structure which conveys the internal carotid (paired arrows) and cranial nerves III, IV, VI and the ophthalmic and maxillary branches of CN V (these are contained as group within the circled area.

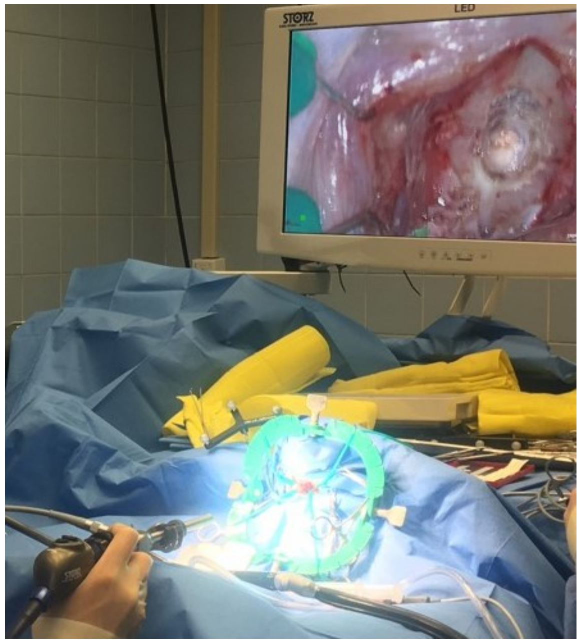


Figure 4.  Intra-operative picture showing the VITOM exoscope in the lower left corner being positioned for ideal viewing angle.  The small surgical field is depicted on the screen in the upper right in high-definition offering unparalleled illumination and magnification.