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A comparison of harmonic and traditional sharp staphylectomy techniques in 15 brachycephalic dogs

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OBJECTIVES: The objective was to compare sharp staphylectomy and staphylectomy using harmonic focus shears, assess surgical time, intraoperative haemorrhage and outcome. Our hypothesis was that harmonic staphylectomy would result in reduced surgical time, decreased intraoperative haemorrhage and greater relative improvement.

MATERIALS AND METHODS: Dogs that were presented to Highcroft Veterinary Referrals between July 2020 and September 2021 with brachycephalic obstructive airway syndrome and underwent surgical correction were prospectively enrolled. Surgical technique was randomised, and surgical time, staphylectomy time, intraoperative haemorrhage, hospitalisation and change in patients' Cambridge BOAS Grade at a 14-day recheck were recorded.

RESULTS: Fifteen dogs were enrolled: seven dogs underwent sharp and eight underwent harmonic staphylectomy. Nine patients returned for follow-up, four of seven and five of eight, respectively. Harmonic staphylectomy was associated with less haemorrhage (0 versus 9 cotton buds) and a shorter average staphylectomy time (3 minutes 36 seconds versus 14 minutes 50 seconds). No statistically significant differences were observed in total surgery time, number of nights hospitalised, or change in Cambridge BOAS Grade. An average of 0.68 mm of thermal necrosis was seen at the cut edges of soft palates removed by harmonic staphylectomy.

CLINICAL SIGNIFICANCE: Harmonic staphylectomy can result in a reduction in staphylectomy time and degree of intraoperative haemorrhage compared to sharp staphylectomy, with no deleterious impact on postoperative recovery or the long-term outcome of patients.

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INTRODUCTION

Staphylectomy to shorten an overlong soft palate and thus relieve laryngeal obstruction is frequently performed in brachycephalic dogs as part of multilevel upper airway surgery to help alleviate symptoms of brachycephalic obstructive airway syndrome (BOAS) (Harvey 1982). A sharp staphylectomy technique, using sharp resection and over sewing, is well reported and described in

many surgical textbooks, along with a more recent alternative, the folded flap palatoplasty (Findji 2009, Johnston & Tobias 2018).

Whilst complications are rare, those reported include but are not limited to haemorrhage, swelling and aspiration of blood or saliva (Torrez & Hunt 2006). The soft palate in brachycephalic patients is often thicker and more vascularised than in mesocephalic dogs, thus increasing the likelihood of intra- or postoperative haemorrhage. Overall incidence of postoperative

complications has been reported to be as high as 20% following surgical correction (Torrez & Hunt 2006).

Harmonic Focus Shears (HFS) were developed by Ethicon (Ethicon Inc, Johnson & Johnson Medtech, Cincinnati, OH, USA) along with other “Harmonic” devices to reduce both intraoperative haemorrhage and surgery time, with the HFS being particularly aimed at human surgeons performing head and neck procedures (Miccoli *et al.* 2010). These devices use an ultrasonic, vibrating blade which cuts and coagulates tissue, avoiding the necessity to over sew the transected region. Unlike monopolar or bipolar electrosurgical devices, carbonisation of surrounding tissue is non-existent which, the manufacturers propose, minimises collateral tissue damage and maximises coagulation efficiency (Miccoli *et al.* 2010).

The aim of this study was to compare the standard staphylectomy technique, with one using the HFS; documenting surgical time, the degree of intraoperative haemorrhage and relative improvement to patients’ Cambridge BOAS Grade (CBG), a grading system developed by the Department of Veterinary Medicine, University of Cambridge (2015) Data S1. Our hypothesis was that harmonic staphylectomy would result in reduced surgical time, reduced intraoperative haemorrhage and a greater relative improvement to patients’ CBG.

MATERIALS AND METHODS

The 15 dogs prospectively recruited into this study were presented to Highcroft Veterinary Referrals with BOAS and underwent surgical correction between July 2020 and September 2021.

At the initial consultation, dogs were assessed, and the severity of their clinical signs graded as per the CBG scale. A course of omeprazole [1 mg/kg orally (po) twice a day] was started following this appointment, to extend until the time of surgery, for a minimum duration of 14 days. When patients had already been started on omeprazole, this was continued, and if not tolerated by the patient, famotidine (0.5 to 1 mg/kg po twice a day) was administered.

Upper airway examinations were performed by one of the authors (ID) on induction and any abnormalities documented.

Anaesthesia was induced using propofol intravenously (iv) to effect, and maintained using isoflurane in 100% oxygen, administered via an endotracheal tube. Amoxicillin (20 mg/kg iv) was administered perioperatively and meloxicam (0.2 mg/kg iv) postoperatively on recovery.

A random number generator was used to allocate a number to the patient preoperatively, patients with even numbers were assigned to sharp staphylectomy with over sewing and patients with odd numbers assigned to harmonic staphylectomy. The primary surgeon was informed regarding the chosen staphylectomy technique at the start of surgery.

All surgeries were performed by a specialist in surgery or a surgical resident under direct supervision. Patients were positioned in inclined sternal recumbency; with a metal frame used to support the maxilla, allowing an intraoral approach. Tonsillectomy using the harmonic shears and vertical wedge rhinoplasty were

performed during the same procedure, with the technique standardised across both groups. A stopwatch was used by the theatre team to record the time taken to perform the staphylectomy and the number of cotton buds used for haemostasis during the staphylectomy was recorded; with the degree of cotton bud saturation being recorded to the nearest half a cotton bud. Where haemorrhage could not be stymied by the use of cotton buds alone, this was recorded, then gauze swabs and/or suction were used as per the preference of the surgeon.

For sharp staphylectomy, the soft palate was grasped at the tip with an Allis tissue forceps to facilitate manipulation of the soft palate. Metzenbaum scissors were used to shorten the soft palate at the level of the caudal border of the palatine tonsils, over sewing with 3-0 monocryl as the resection was performed incrementally. For harmonic staphylectomy, harmonic shears were used to shorten the soft palate on their maximum setting, at the level of the caudal border of the palatine tonsils. No over sewing of the soft palate was performed.

All dogs were recovered by the anaesthesia team and returned to wards once extubated and in sternal recumbency. The endotracheal tube was maintained whilst it was tolerated by the patient. Dogs received buprenorphine (0.02 mg/kg iv every 6 hours) postoperatively for 24 hours or until Glasgow Composite Pain Score was less than 5. Meloxicam was administered for 3 days (0.1 mg/kg po once a day) postoperatively, paracetamol (10 mg/kg po three times a day) for 5 days and omeprazole or famotidine continued at the preoperative dose for 28 days. Food and water were withheld until the following morning, when balls of wet food were hand fed. Patients were then discharged as long as close monitoring or iv opioids were no longer required. If patients suffered from non-obstructive respiratory distress following surgery, sedation with acepromazine (0.005 mg/kg iv as needed) was administered, along with active cooling measures as appropriate. For patients where this was required, a note was made in the study data. Patients were reviewed in the hospital after 14 days, with a final CBG assessment performed at this consultation by the same individual who performed the preoperative grading.

Following staphylectomy, the soft palates were placed in 10% buffered formalin in individual numbered sample pots, randomised before submission for histopathology. Once fixed, each specimen was assessed, trimmed and microscopically examined by the same board-certified pathologist (MD). The cut surface was identified, and a single 4-mm slice of tissue trimmed, perpendicular to the cut surface, midway along the cut edge. Sections were processed for routine histopathology, sectioned at 4 µm and stained with haematoxylin and eosin. For each section, any areas with histological changes consistent with crush and/or cauterisation were identified and measured where they extended the maximal depth into the tissues.

Statistical analyses were performed in Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) using a two sample *t*-test assuming unequal variance.

Ethics statement

This research commenced following assessment of the study outline and acceptance by the internal ethical review board of CVS Group plc.

RESULTS

Nineteen dogs presented for surgery and of the 15 dogs recruited, 13 were French Bulldogs, one was a Pug and one was an American Bulldog. The average age of the patients was 1.3 years (1 to 3 years) and the average body condition score was 5.67/9 (4/9 to 7/9). Of the 15 patients, seven underwent sharp staphylectomy and eight underwent harmonic staphylectomy. Nine patients returned for follow-up CBG, five of which were from the harmonic staphylectomy group and four from the sharp staphylectomy group. Harmonic staphylectomy was associated with less haemorrhage (a mean of 0 cotton buds used, compared to a mean of 9 cotton buds for sharp staphylectomy, $P < 0.001$) and a shorter average staphylectomy time (3 minutes 36 seconds and 14 minutes 50 seconds, $P < 0.001$). No statistically significant differences were observed in total surgery time (37 minutes 15 seconds and 47 minutes 52 seconds, $P = 0.079$), nights hospitalised (0.75 and 1, $P = 0.17$) or change in the CBG (1.6 and 1.5, $P = 0.70$).

Histopathological examination revealed that sharp staphylectomy was associated with significantly reduced tissue trauma or thermal necrosis, with none observed on any of the sections, whilst an average of 0.68 mm (0.41 to 1.17 mm) was observed on the harmonic staphylectomy specimens (Fig 1).

Two minor perioperative complications were recorded; both in patients which were undergoing sharp staphylectomy and where

brisk haemorrhage was encountered, necessitating the use of suction and gauze swabs in addition to cotton buds. In the first of these cases, following weighing of swabs, the total blood loss was estimated to be 14.1 mL and in the second case, 20 cotton buds were saturated and the use of suction was also required, so total blood loss could not be calculated. Only one postoperative complication was recorded; where one dog that had undergone harmonic staphylectomy developed increasing moderate stertor between 4 and 6 weeks postoperatively along with episodes of restlessness, found to be the result of fibrous adhesions between the soft palate and oropharynx, with a 5-mm diameter stoma maintaining nasopharyngeal patency. This patient underwent revision surgery to restore patency between the nasopharynx and oropharynx by dividing the soft palate in the sagittal plane at the level of the stoma in the midline using sharp instrumentation, before oversewing the cut edges of the soft palate with 3-0 monocril in an inverting suture pattern to improve nasopharyngeal patency and to try to prevent recurrence. Re-examination and intraoral examination under general anaesthesia 3 weeks postoperatively revealed the patient to have made good clinical progress with a CBG of 1 (improved from two preoperatively) and that nasopharyngeal patency was maintained.

DISCUSSION

No study that directly compares sharp staphylectomy to staphylectomy performed using harmonic focus shears and includes clinical outcome data has previously been described in the veterinary literature. Searches were performed on the June 19, 2022 on both PubMed and RCVS Knowledge, with the search terms: "canine" AND "harmonic" AND "staphylectomy."

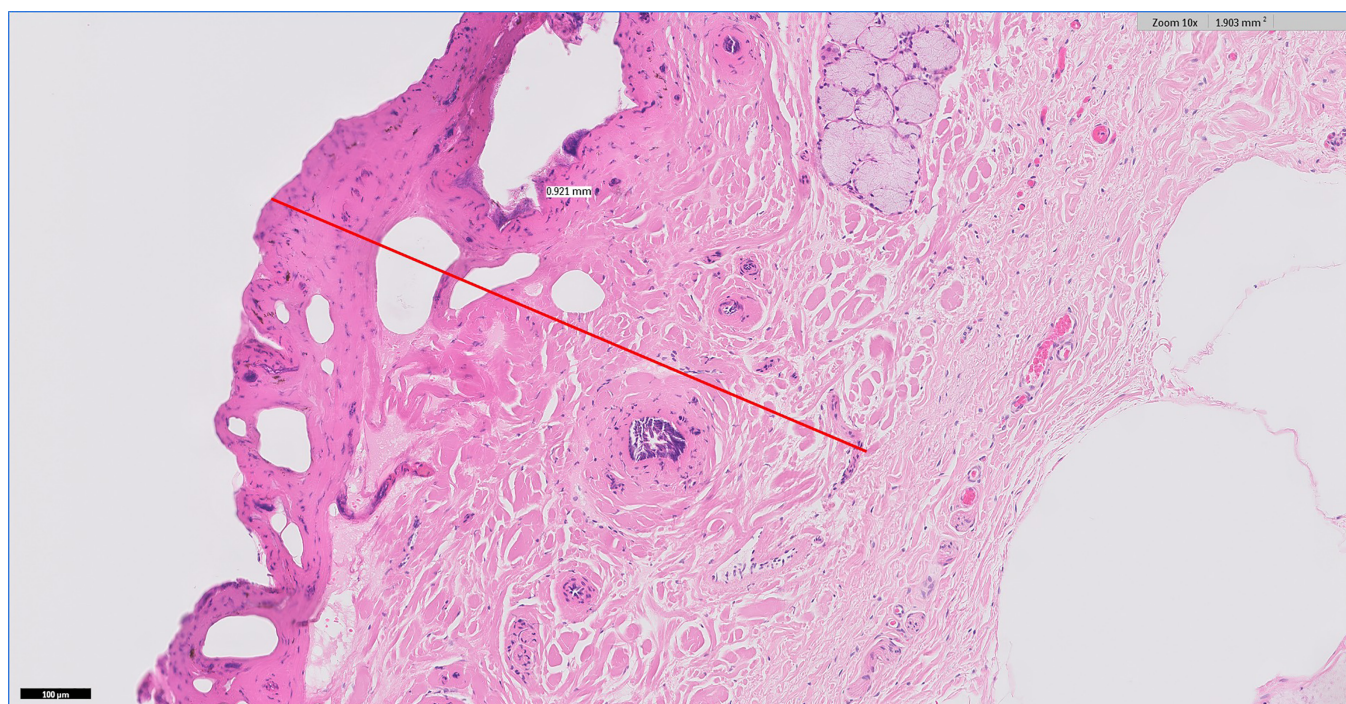


FIG 1. Histopathological section through a soft palate removed by harmonic staphylectomy, with extent of thermal necrosis denoted by red line

Harmonic staphylectomy was found to be associated with less haemorrhage and shorter average staphylectomy time. No statistically significant difference was observed in total surgery time, nights hospitalised or change in the CBG of patients when compared to the sharp staphylectomy technique. Perioperative haemorrhage was not encountered in any of the harmonic cases and the average time taken for staphylectomy was significantly shorter in this group. That no significant difference was found in the length of hospitalisation or the average change in CBG was observed, suggests that long-term outcome in these patients was similar.

No perioperative complications were documented with harmonic staphylectomy and in our patients, no issues were encountered with use of the HFS, regardless of the thickness of the palate. However, a single postoperative complication was reported, where the cut surface of the soft palate formed adhesions to the oropharynx. It is impossible to suggest with any confidence why this complication developed in this specific patient, though it is possible that this could be the result of postoperative silent reflux, as is common in these patients (Fenner *et al.* 2020). Further study is needed to know whether this is a risk particular to harmonic staphylectomy and whether additional time employed to over sew a soft palate shortened using harmonic shears, to try to reduce the incidence of this complication, is a justifiable measure. A limitation of the technique is that unlike traditional sharp staphylectomy, additional equipment is required. The cost of the generator and handpieces, which are designed to be single-use, amounts to a significant investment which may not be worthwhile for clinics that do not perform significant numbers of corrective airway surgeries.

Histopathology of the excised soft palates revealed no clear differences between the two techniques, other than those removed using harmonic staphylectomy showing thermal necrosis at the cut edge. We assume that this histopathology is representative of the tissue left in situ, but it is difficult to be certain of this. The degree of thermal necrosis reported in this study compares favourably to that reported in other studies describing the use of electro-surgical devices for intraoral surgery in canine patients (Belch *et al.* 2017).

A limitation associated with our study is the relatively small number of cases; however, we believe that the significant differences between the two populations are clear despite this shortcoming.

We believe that harmonic staphylectomy is a safe and efficient technique for shortening the soft palate in brachycephalic

patients. Our study has demonstrated the technique can result in shorter anaesthesia time and a reduction in the incidence of perioperative complications, with no deleterious impact observed upon postoperative recovery or the long-term outcome of patients.

Conflict of interest

None of the authors of this article has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

Author contributions

O. Gilman: Conceptualization (equal); data curation (lead); formal analysis (lead); funding acquisition (lead); investigation (lead); methodology (equal); project administration (equal); resources (lead); software (lead); validation (lead); visualization (lead); writing – original draft (lead). **L. Moreira:** Data curation (equal); investigation (equal). **M. Dobromylskyj:** Data curation (equal); formal analysis (equal); investigation (equal); methodology (equal); supervision (equal). **I. Doran:** Conceptualization (equal); methodology (equal); project administration (equal); supervision (lead); writing – review and editing (lead).

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Supporting Information

The following supporting information is available for this article:

Data S1: Supporting Information