

Surgical management of 43 cases of chronic otitis externa in the dog

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Over a seven-year period, chronic otitis externa was surgically managed in 43 dogs at the University Veterinary Hospital of University College Dublin. Lateral ear canal resection (LECR) was undertaken in nine of the 43 dogs: results were unsatisfactory, with a failure of the surgery in five of eight dogs and one dog lost to follow-up. Once end-stage otitis externa, with or without otitis media, is diagnosed, total ear canal ablation and lateral bulla osteotomy (TECA/LBO) is the best treatment option. In this series, 37 of 43 dogs underwent TECA/LBO and of the 29 dogs for which follow-up results were obtained 27 (93%) had an excellent or improved outcome to surgery. Complications following all procedures were most common in cases with a concurrent dermatopathy; therefore, definitive diagnosis and medical treatment for skin and ear disease is essential.

Key words

Dog,
Surgery,
Otitis externa.

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Introduction

Otitis externa in dogs is common in small animal veterinary practice with a prevalence of between 5% and 20% (August, 1988). Although the diagnosis is simple, being based on clinical signs and physical examination, it is a disease of multifactorial aetiology and further investigation to determine the cause(s) is often warranted. The causes of otitis externa (August, 1988; Rosychuk and Luttgren, 2000; Krahwinkel, 2003) are divided into primary, predisposing and perpetuating factors (Table 1). The primary factors are those which initiate otitis externa in otherwise normal ears (Figure 1). These are commonly manifestations of generalised dermatological disease, as the ear canal epithelium is an extension of the skin and, therefore, it is subject to the same diseases (Krahwinkel, 2003). Predisposing factors make the ear more susceptible to the development of otitis externa, but do not cause it alone. Perpetuating factors are those that continue or worsen the ear canal inflammation even if the original primary cause is no longer present or active.

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Abbreviations

LECR	Lateral ear canal resection
VECA	Vertical ear canal ablation
TECA/LBO	Total ear canal ablation with lateral bulla osteotomy

Diagnosis is based on the history and on general, dermatological, and otoscopic examinations of the dog. Further diagnostic evaluations may be performed using cytological examination, bacterial culture and sensitivity testing, and radiographic examination.

Proper medical treatment, aimed at treating the cause(s) of the disease, should be initiated at an early stage (August, 1988; Chester, 1988). Frequently, the disease does not respond favourably or recurs after treatment and otitis externa becomes chronic. If chronic otitis externa progresses, proliferative hyperplastic epithelial changes can occur leading to narrowing of the vertical and horizontal ear canals (Krahwinkel, 1993). The hyperplastic changes eventually become irreversible as the horizontal ear canal becomes stenosed or occluded (Smeak and Kerpsack, 1993). In addition, otitis media may also occur secondary to otitis externa (Spreull, 1964).

Surgical treatment has been an important component of the management of chronic otitis externa (Bradley, 1988; Hobson, 1988; Krahwinkel, 1993). The procedures used (Krahwinkel, 1993) are lateral ear canal resection (LECR; modified Zepps procedure), vertical ear canal ablation (VECA), and total ear

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TABLE 1: Causes of otitis externa

Primary factors	Predisposing factors	Perpetuating factors
Hypersensitivity diseases	Ear canal conformation	Bacteria
External parasites	Temperature and humidity	Yeasts
Foreign bodies	Obstructive ear disease	Contact allergy and irritants
Disorders of keratinisation	Ear canal maceration	Proliferative changes
Autoimmune disease	Systemic disease	Otitis media
Juvenile cellulitis		Inappropriate treatment

canal ablation with lateral bulla osteotomy (TECA/LBO). The correct procedure for an individual case depends on the accurate assessment of the extent of the disease within the external ear canal and tympanic bulla.

In this paper, we evaluate and compare the indications, clinical and surgical findings, complications and long-term outcome of the surgical management of chronic otitis externa in dogs at University College Dublin and emphasise clinically relevant aspects of case management.

Materials and methods

We reviewed the case records of 43 dogs (61 surgical procedures) referred between August 1995 and March 2002 to the University Veterinary Hospital, University College Dublin. All 43 dogs presented with chronic otitis externa in one or both ears. There were six West Highland White terriers, five crossbred terriers, four Labrador retrievers, four Cocker spaniels, four German shepherds, and three Springer spaniels, with no other breed represented more than twice. Ages ranged from three to 14 years, with a median age of seven years. There were 24 males and 19 females.

Pre-operative evaluation included history, general physical examination, clinical signs, duration of clinical signs and response to previous medication. Haematological and serum biochemical examinations were performed prior to anaesthesia in all dogs greater than five years of age or in dogs with suspected concomitant disease. Otolaryngoscopic examination was performed in all cases with the dog under sedation or general anaesthesia. Skull radiography was performed in certain cases to determine the extent of changes within the horizontal ear canal and tympanic bulla. Standard views included dorso-ventral, lateral, lateral oblique and rostro-caudal (open-mouth: Figure 2) projections. A board-certified radiologist assessed all radiographs. In the majority of cases, specimens for microbiological examination (smears for Gram stain, bacteriological culture and susceptibility to antibiotics) were taken at surgery from either the horizontal canal (LECR) or the tympanic bulla (TECA/LBO). Histopathology was performed on excised tissue where there was a suspicion of neoplasia (such as abnormal masses within the ear canal). Concurrent dermatopathy was defined as the presence of dermatological lesions not affecting the ear canal.

Chronic otitis externa was defined as medically non-responsive

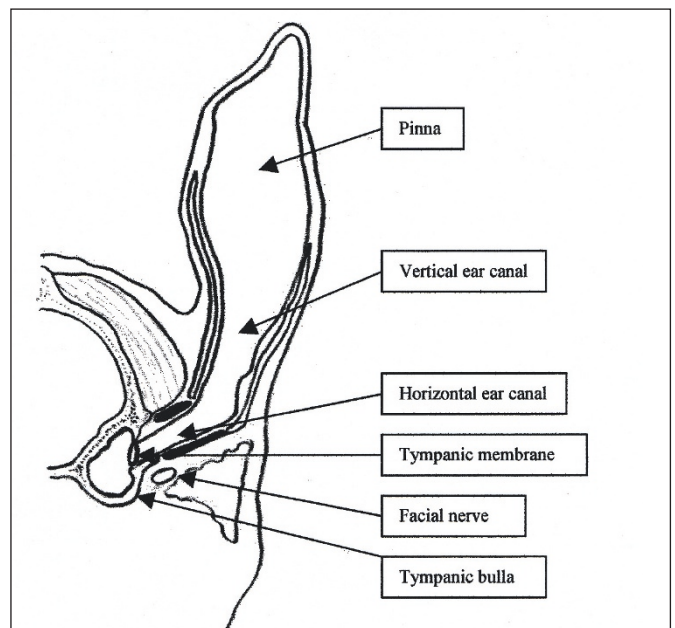


FIGURE 1: Cross-sectional diagram of the external ear canal and middle ear.

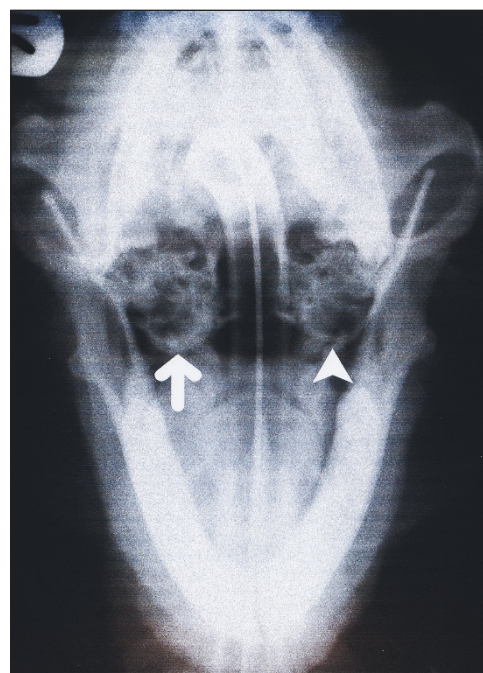


FIGURE 2: Rostro-caudal skull radiograph of Case 20. Arrow indicates thickening of right tympanic bulla wall suggestive of otitis media. Arrowhead indicates normal left tympanic bulla.

or recurrent otitis externa. End-stage otitis externa was defined as chronic otitis externa with marked stenosis and/or calcification of the horizontal ear canal, as determined by otoscopic examination and skull radiography. A tentative diagnosis of otitis media was made if the tympanic membrane was perforated or absent on otoscopic examination or if there was evidence of radiological changes within the bulla. Otitis media was confirmed on surgical exploration of the bulla.

All surgical procedures were performed under general anaesthesia using a standard surgical technique (Krahwinkel, 1993) by staff surgeons or by surgical residents. Post-operative analgesia was provided using a combination of opioids, non-steroidal anti-inflammatory drugs and bupivacaine 'splash block' (Buback *et al.*, 1996). Post-operative complications were defined as those occurring up to four months after surgery. Results of treatment were obtained by either physical examination of the dogs or telephone follow-up four months or more after surgery.

For LECR and VECA, the results of surgery were evaluated, using the criteria of Gregory and Vasseur (1983), as either:

- excellent – clinical signs were resolved with minimal or no care required by the owner;
- improved – occasional recurrence of clinical signs requiring professional attention;
- poor – no improvement.

For the TECA/LBO procedures, results were evaluated, using the criteria of Mason *et al.* (1988), as either:

- excellent – resolution of clinical signs of ear disease without long-term complication;
- improved – improvement of clinical signs after surgery but continued disease of the remaining medial wall of the pinna requiring treatment, or facial nerve paralysis not requiring treatment;
- poor – continuing ear canal or middle ear disease present, or permanent facial nerve paralysis requiring continued medical treatment.

Results

The duration of ear disease ranged from one to 84 months, with a median of 12 months. Previous medical treatments such as topical and systemic antibiotics and corticosteroids had been used in all cases. Nineteen dogs had dermatological lesions not involving the ears: disorders of keratinisation ('seborrhoea') in three dogs, pyoderma in two dogs, confirmed atopy in one dog and suspected hypersensitivity skin disease (atopy, food allergy, flea-bite allergic dermatitis, contact allergic dermatitis) in 13 dogs. A decision on the appropriate surgical management for each case was made based on the clinical evaluation of the extent of the ear disease and after discussion with the owner. Thirteen ears were treated with LECR (Table 2): one ear in each of five dogs and both ears in four dogs. One dog (Case no. 9, Table 2) had concurrent bilateral otitis media, which was responding to medical treatment at the time of surgery. Follow-

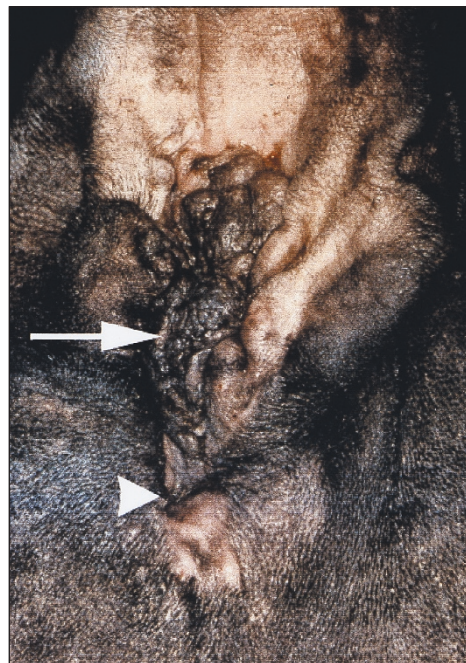


FIGURE 3: Post-operative failed lateral ear canal resection. Arrow indicates the hyperplastic medial wall. Arrowhead indicates occluded horizontal ear canal.

up results were obtained in eight dogs from four to 50 months after surgery. Results were excellent in one dog, improved in two dogs, and poor in five dogs. An excellent result did not occur in any dog that had concurrent dermatological lesions. Two of the dogs that had a poor result following LECR (Case nos. 2 and 8; Table 2) subsequently had TECA/LBO surgery on the affected ear.

One dog, which had chronic otitis externa with ulceration of the medial wall of the vertical ear canal, was treated with VECA. Results were excellent in this dog. VECA is rarely indicated because irreversible epithelial changes in chronic otitis externa are rarely confined to the vertical ear canal.

TECA/LBO was performed in 37 dogs (47 ears); ten dogs had bilateral TECA/LBO. All these dogs had chronic otitis externa, except for one, which presented with para-aural fistulation as a complication of previous TECA without LBO for chronic otitis externa (Case no. 41, Table 2). Prior to TECA/LBO, twelve dogs (14 ears) had undergone previous surgical treatment for chronic otitis externa: LECR (Figure 3) in 11 ears (two of which are reported above: Case nos. 2 and 8; Table 2); VECA in two ears; and TECA in one ear.

Chronic otitis externa had progressed to end-stage otitis externa characterised by irreversible narrowing of the horizontal ear canal in 41 of 47 ears. Otitis media was present in 32 of 47 ears, diagnosed either before TECA/LBO surgery or confirmed at the time of surgery. One dog had sustained a traumatic ear canal separation, which led to chronic otitis externa and otitis media (Case no. 41, previously reported in Connery *et al.*, 2001).

Pre-operative skull radiography had permitted evaluation of 27 of the 32 ears with otitis media. However, nine of 27 ears were negative radiographically for otitis media, representing a false-

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TABLE 2: Case records of 43 dogs presented with chronic otitis externa

Case number	Signalment (breed, age, sex)	Ear	Duration (months) of ear disease to time of surgery and previous surgery	Clinical and surgical findings	Surgical procedure	Concurrent dermatopathy	Postoperative complications (TECA/LBO only)	Follow-up result (months post-op.)
1	Sp.sp., 3y, M	R	24m	COE	LECR	None	-----	Excellent (4m)
		L	24m (same time as R ear)	COE	LECR			
2	York. T., 3y, M	R	24m	COE	LECR	Pyoderma	-----	Poor (50m) - needs TECA/LBO Poor (4m) Improved (46m)
		L	24m (same time as R ear)	COE	LECR			
			28m (4m after LECR)	ESOE	TECA/LBO			
3	WHFT, 6y, M	R	12m	COE	LECR	Ker. disorder	-----	Poor (25m) - euthanasia due to ear disease
		L	12m (same time as R ear)	COE	LECR			
4	WHWT, 7y, F	L	4m	COE	LECR	Suspect hypersensitivity	-----	Poor (4m)
5	Lab., 3y, M	L	8m	COE	LECR	None	-----	Lost to follow-up
6	St. Ber., 3y, M	R	10m	COE	LECR	Suspect hypersensitivity	-----	Poor (4m)
		L	10m (same time as R ear)	COE	LECR			
7	Lab., 8y, M	L	84m	COE	LECR	Suspect hypersensitivity	-----	Improved (6m) Improved (12m)
		R	78m	ESOE	TECA/LBO			
8	St. Ber., 4y, F	L	4m	COE	LECR	None	-----	Poor (4m)
			8m (4m after LECR)	ESOE	TECA/LBO	None	None	Excellent (6m)
9	B. Collie, 5y, F	R	6m	COE, OM	LECR	None	-----	Improved (4m) Excellent (4m)
		L	6m (same time as R ear)	COE, OM	TECA/LBO			
10	C.Sp., 6y, M	R	18m	COE - ulceration of medial wall of VEC	VECA	None	-----	Excellent (11m)
11	GSD, 4y, F	R	36m; LECR	COE, OM	TECA/LBO	Atopy	None	Lost to follow-up
12	Pom., 7y, F	L	12m	ESOE, OM	TECA/LBO	None	None	Lost to follow-up
		R	14m (2m after L ear)	ESOE, OM	TECA/LBO			
13	Rott., 9y, M	R	6m; LECR	ESOE	TECA/LBO	None	None	Lost to follow-up
14	Cairn T., 6y, F	L	14m; LECR	ESOE	TECA/LBO	Ker. disorder	None	Excellent (42m)
15	Boxer, 10y, F	R	60m	ESOE, OM	TECA/LBO	Suspect hypersensitivity	Para-aural fistula, vestibular problem	Poor - euthanasia (6m)
16	Old Eng., 6y, F	R	30m; LECR	ESOE, OM	TECA/LBO	Pyoderma	None	Excellent (34m)
17	WHWT, 12y, M	R	60m	ESOE	TECA/LBO	None	Drooped ear carriage	Excellent (32m)
18	WHWT, 7y, F	R	6m; LECR	ESOE	TECA/LBO	Suspect hypersensitivity	None	Excellent (33m) Excellent (26m)
		L	13m (7m after R ear); LECR	ESOE, OM, para-aural abscess	TECA/LBO			
19	TerrierX, 3y, M	R	12m; VECA	ESOE, OM	TECA/LBO	Suspect hypersensitivity	None	Excellent (32m) Excellent (31m)
		L	13m (1m after R ear);	ESOE, OM	TECA/LBO			

Table 2: continued overleaf>>>

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Case number	Signalment (breed, age, sex)	Ear	Duration (months) of ear disease to time of surgery and previous surgery	Clinical and surgical findings	Surgical procedure	Concurrent dermatopathy	Postoperative complications (TECA/LBO only)	Follow-up result (months post-op.)
20	TerrierX, 10y, M	R	66m	ESOE, OM	TECA/LBO	None	Drooped ear carriage	Excellent (29m)
21	Afghan, 11y, M	L	12m	COE, OM	TECA/LBO	None	None	Poor - deep aural pain (10m) - euthanasia
22	GSD, 4y, F	R	24m	ESOE, OM	TECA/LBO	None	None	Excellent (29m)
23	TerrierX, 10, F	R	12m; LECR; TECA only	Para-aural fistula, OM	TECA/LBO	None	Facial nerve paralysis (present at 6 weeks post-op.)	Lost to follow-up
24	C.Sp., 10y, M	R	12m	ESOE	TECA/LBO	Suspect hypersensitivity	None	Excellent (27m)
		L	12m (same time as R ear)	ESOE	TECA/LBO		None	Excellent (27m)
25	GSD, 4y, F	R	12m	ESOE, OM	TECA/LBO	Ker. disorder	Major wound dehiscence	Improved (26m)
26	York. T., 14y, F	L	24m	ESOE, OM	TECA/LBO	Pyoderma	Mild wound dehiscence	Improved (26m)
27	Lab., 8y, M	R	6m	ESOE, OM	TECA/LBO	None	Mild wound dehiscence	Lost to follow-up
28	Sp.sp., 10y, M	R	7m	ESOE	TECA/LBO	None	None	Excellent (19m)
		L	7m (same time as R ear)	ESOE	TECA/LBO		None	Excellent (19m)
29	Pointer, 8y, M	R	6m	ESOE	TECA/LBO	Suspect hypersensitivity	None	Improved (22m)
		L	6m (same time as R ear)	ESOE	TECA/LBO		None	Improved (22m)
30	TerrierX, 14y, F	L	24m	ESOE, OM	TECA/LBO	None	Permanent facial nerve paralysis; drooped ear	Improved (6m)
31	Shih-tzu, 3y, M	R	5m	ESOE, OM	TECA/LBO	None	None	Excellent (6m)
32	Lab., 3y, M	R	36m	ESOE	TECA/LBO	Suspect hypersensitivity	Minor wound dehiscence	Improved (4m)
33	GSD, 3y, F	L	4m	ESOE, OM	TECA/LBO	None	None	Excellent (4m)
		R	4m (same time as L ear)	ESOE, OM	TECA/LBO		None	Excellent (4m)
34	WHWT, 10y, F	R	24m	ESOE, OM, para-aural abscess	TECA/LBO	Suspect hypersensitivity	None	Improved (18m)
		L	30m (6m after R ear)	ESOE, OM	TECA/LBO		Temporary vestibular problem; minor wound dehiscence	Improved (14m)

negative rate of 33%. Eighteen of 27 ears with otitis media had been successfully diagnosed pre-operatively using skull radiography (Figure 2): therefore, this represented a true-positive rate of 67%. There were no radiographically-positive ears that were negative on surgical exploration, which represented a false-positive rate of zero.

Bacteriological culture was performed on specimens taken from 30 dogs with chronic otitis externa (including LECR and VECA cases). Mixed bacterial populations were found in 20 dogs. The most common isolates were *Pseudomonas* spp. (15), *Streptococcus* spp. (12), *Escherichia coli* (nine), *Staphylococcus intermedius* (eight), *Proteus* spp. (six), and *Staphylococcus aureus*

(four). Histopathology was carried out on the excised tissue of three ears that underwent TECA/LBO. All results were consistent with a chronic active inflammatory process and neoplastic changes were not found in any sample.

Observations recorded at the time of TECA/LBO surgery included haemorrhage from the retroarticular vein (five ears); marked capillary haemorrhage (one ear); stretching of the facial nerve (one ear); and para-aural abscessation (three ears). Post-operative complications (Table 2) following TECA/LBO were recorded in 16 of 47 ears and included wound dehiscence (seven ears), facial nerve deficits (five ears), vestibular disease (three ears), para-aural abscessation and fistula formation (one

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Case number	Signalment (breed, age, sex)	Ear	Duration (months) of ear disease to time of surgery and previous surgery	Clinical and surgical findings	Surgical procedure	Concurrent dermatopathy	Postoperative complications (TECA/LBO only)	Follow-up result (months post-op.)
35	C. Sp., 12y, F	L	6m	ESOE, OM	TECA/LBO	None	None	Excellent (12m)
36	CKCS, 5y, M	L	36m; LECR	ESOE, OM, pre-op. head tilt, facial nerve paralysis	TECA/LBO	None	Continued head tilt and facial nerve paralysis. Resolved by 12m post-op.	Excellent (12m)
37	C. Sp., 7y, F	L	6m	ESOE, OM	TECA/LBO	None	Permanent facial nerve paralysis	Improved (10m)
38	R. collie, 6y, M	R	36m	ESOE, OM	TECA/LBO	None	Minor wound dehiscence	Lost to follow-up
		L	36m (same time as R ear)	ESOE, OM	TECA/LBO		None	
39	TerrierX, 3y, F	L	12m, LECR	ESOE, OM	TECA/LBO	Suspect hypersensitivity	None	Excellent (10m)
		R	18m, LECR	ESOE, OM	TECA/LBO		None	Excellent (4m)
40	Bulldog, 5y, M	L	1m	COE, OM	TECA/LBO	None	Temporary facial nerve paralysis	Excellent (18m)
41	Sp.sp., 8y, M	R	24m	Traumatic ear canal separation, para-aural abscess, OM	TECA/LBO	None	Temporary vestibular disease	Excellent (12m)
42	WHWT, 11y, M	L	36m	ESOE, OM	TECA/LBO	Suspect hypersensitivity	None	Excellent (4m)
43	WHWT, 6y, M	L	12m	ESOE, OM	TECA/LBO	Suspect hypersensitivity	None	Excellent (6m)
<p>COE = chronic otitis externa, ESOE = end-stage otitis externa, LECR = lateral ear canal resection, OM = otitis media, TECA/LBO = total ear canal ablation with lateral bulla osteotomy, VEC = vertical ear canal, VECA = vertical ear canal ablation.</p> <p>F = female, L= left, M = male, R = right.</p> <p>B. Collie = Border collie, Cairn T. = Cairn terrier, CKCS = Cavalier King Charles spaniel, C. Sp. = Cocker spaniel, GSD = German shepherd, Lab. = Labrador retriever, Old Eng. = Old English sheepdog, Pom. = Pomeranian, Rott. = Rottweiler, R. Collie = Rough collie, Sp.sp.= Springer spaniel, St. Ber. = Saint Bernard, TerrierX = crossbred terrier, WHFT = Wire Haired Fox terrier, WHWT = West Highland White terrier, York. T. = Yorkshire terrier.</p> <p>Ker. disorder = disorder of Keratinisation</p>								

ear), and loss of ear carriage (three ears). Three ears had multiple post-operative complications. Facial nerve paralysis was temporary in two dogs and permanent in two dogs, with the one dog lost to follow-up. One of the cases of temporary facial nerve paralysis, a bulldog (Case 40, Table 2), was treated with synthetic tear solution (Liquifilm; Allergan) until recovery of the palpebral reflex.

Follow-up results four or more months after surgery were obtained in 29 of 37 dogs after TECA/LBO, with the remaining eight dogs lost to follow-up. Results were excellent in 19 dogs, improved in eight dogs, and poor in two dogs. Of the poor cases, one developed a para-aural fistula in the post-

operative period and the other developed deep aural pain of unknown origin ten months after surgery. Both owners elected euthanasia without further investigation for these dogs. Of the improved cases, six had continued dermatological problems of the pinna requiring intermittent treatment, and two had permanent facial nerve paralysis, which did not require treatment.

Owners observed post-operative hearing loss after TECA/LBO in some dogs, but they did not think this problem significant when weighed against the improvement of other signs after surgery, except in one dog, where hearing loss was thought to have contributed to the dog being injured by a motor vehicle.

Discussion

Surgical treatment has been an important part of the proper management of chronic otitis externa, especially after medical treatment has failed and any underlying systemic disease, which could predispose to otitis externa, has been cured or controlled. LECR and VECA have been used to improve the environment within the horizontal ear canal (Grono, 1970), to permit drainage of the ear canal and to facilitate further examination, cleaning and medication of the ear canal. However, for these procedures to be successful, they must be completed before there is irreversible narrowing of the horizontal ear canal and they must be followed with continued medical treatment of the ear disease (Krahwinkel, 2003). In cases of chronic irreversible otitis externa, TECA/LBO, a salvage procedure, is considered the best treatment option (Mason *et al.*, 1988; Beckman *et al.*, 1990; Matthiesen and Scavelli, 1990; White and Pomeroy, 1990; Devitt *et al.*, 1997; Krahwinkel, 2003) with the principal aim of making the animal more comfortable by removing the infected tissue (Smeak and DeHoff, 1986).

All dogs in this report presented with chronic otitis externa, but usually with a long duration of disease (median 12 months). LECR was undertaken in nine of the 43 dogs. The follow-up results for this group of dogs were unsatisfactory, with a complete failure of the surgery in five of eight dogs. This compares with previously reported poor responses to surgery of 34.9% (Tufvesson, 1955), 47% (Gregory and Vasseur, 1983) and 55% (Sylvestre, 1998). Otitis externa is a complex disease with multiple causes, not all of which respond favourably to lateral ear canal resection (Gregory and Vasseur, 1983). Unsatisfactory results can be expected if there is an underlying otitis media present at the time of surgery (Lane and Little, 1981). Otitis media can occur secondary to otitis externa and has been reported in 16% of cases of early otitis externa (Spreull, 1964) and between 52% and 83% of dogs with chronic otitis externa (Spreull, 1964; Cole *et al.*, 1998). It is important to remember that otitis media can be difficult to diagnose as it has been reported that the tympanic membrane is intact in 71% of cases with otitis media (Cole *et al.*, 1998).

An excellent result was not obtained in any dog in this series that had a concurrent dermatopathy; therefore, definitive diagnosis and appropriate treatment for the skin and ear disease is essential. TECA/LBO is indicated over LECR if owners are unable or unwilling to treat skin or ear disease appropriately (Smeak and Kerpsack, 1993). TECA/LBO is also indicated if previous surgical management (LECR, VECA, or TECA alone) of otitis externa has failed (Figure 3). Case selection for LECR is critical. Better results are expected with: early surgical intervention for correctly selected cases; appropriate diagnosis and treatment of the primary cause of the otitis externa; appropriate medical treatment of concurrent otitis media if present and commitment by owners to ongoing post-operative medical management.

Once end-stage otitis externa, with or without otitis media, is

diagnosed, TECA/LBO is considered the best treatment option (Mason *et al.*, 1988; Beckman *et al.*, 1990; Matthiesen and Scavelli, 1990; White and Pomeroy, 1990; Devitt *et al.*, 1997; Krahwinkel, 2003; White, 2003). Total ear canal ablation alone is contraindicated due to the high risks of a concurrent otitis media (Spreull, 1964; Cole *et al.*, 1998) leading to post-operative para-aural fistulation (Smeak and DeHoff, 1986). Combining TECA with lateral bulla osteotomy (LBO) gives access to the tympanic bulla. This allows not only the removal of any infected tissue and exudate, but also encourages growth of granulation tissue into the bulla, a result that is believed to prevent abscess formation (McAnulty *et al.*, 1995).

Of the 37 dogs in which TECA/LBO was performed, 17 dogs (46%) had generalised skin disease, a finding that compares with previously reported figures of between 64% and 80% (Mason *et al.*, 1988; White and Pomeroy, 1990). An underlying dermatopathy is often the primary cause of the otitis externa (August, 1988) and the reason that initial surgery often fails unless this is adequately treated (Lane and Little, 1986). Ongoing disease of the remaining medial wall of the pinna was the cause of continuing problems following TECA/LBO in six of the eight improved cases in the present series. The early treatment of skin disorders affecting the ear can prevent the progression of disease, but treatment must also be continued after ear canal surgery.

Radiography is useful in diagnosing otitis media and in revealing changes within the ear canal such as stenosis and calcification of cartilage. However, it is not a highly sensitive tool in the diagnosis of otitis media. The false-negative rate - the probability of negative radiographic findings in the presence of otitis media - in this series was 33%, which compares with previously reported false-negative rates of 25% (Remedios *et al.*, 1991) and 14% (Devitt *et al.*, 1997). Negative radiographic findings do not rule out otitis media and should not discourage surgical exploration if clinical signs suggest the presence of disease (Remedios *et al.*, 1991). Positive radiographic findings of otitis media and narrowing or calcification of the horizontal ear canal were used in this series as an indication to perform TECA/LBO.

The bacteriological culture results in this series were similar to those previously reported (August, 1988; Beckman *et al.*, 1990; Matthiesen and Scavelli, 1990; Devitt *et al.*, 1997; Vogel *et al.*, 1999). During TECA/LBO surgery, all specimens were collected from the tympanic bulla. This is important as differences in total microbiological isolates and antibiotic susceptibility patterns have been found between the horizontal ear canal and middle ear in up to 90% of ears with chronic otitis externa (Cole *et al.*, 1998). Broad-spectrum antibiotics were administered in all cases in the post-operative period; however, antibiotic susceptibility testing of cultured pathogens is still important, to verify efficacy of the selected antibiotic.

TECA/LBO is a technically difficult procedure and a high complication rate has been reported (Mason *et al.*, 1988;

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Beckman *et al.*, 1990; Matthieson and Scavelli, 1990; White and Pomeroy, 1990; Devitt *et al.*, 1997). There is potential for iatrogenic damage to the vital structures surrounding the external ear canal and tympanic bulla such as the facial nerve, inner ear, superficial temporal and great auricular vessels, retroarticular vein, and branches of the external carotid artery. Facial nerve injury is a common surgical complication, characterised most commonly by palpebral reflex deficit and drooping of the ipsilateral muscles of facial expression. In our case series, temporary or permanent facial nerve deficits were observed in five of 37 ears (14%). Devitt *et al.* (1997) combined data from previous studies (Smeak and DeHoff, 1986; Mason *et al.*, 1988; Beckman *et al.*, 1990; White and Pomeroy, 1990; Matthieson and Scavelli, 1990; Devitt *et al.*, 1997) and found that facial nerve deficits occurred in approximately 24% of dogs undergoing TECA/LBO. They also found that the facial nerve deficits were permanent in 10% of dogs; however, this rarely caused long-term complications for the dogs (White and Pomeroy, 1990).

TECA/LBO must deal with the presence of infected tissue and debris within the bulla or the horizontal canal. Careful removal of all pus, exudate and potentially infective material, vigorous flushing of the surgical site with sterile saline, and appropriate antibiotic administration are necessary to prevent wound dehiscence and post-operative para-aural abscessation (Vogel *et al.*, 1999). Para-aural abscessation and fistulation is a serious complication, which can be more difficult to treat than the original problem (Smeak and Kerpsack, 1993; Smeak *et al.*, 1996). Recent reports document para-aural abscessation and fistulation occurring in less than 10% of dogs after TECA/LBO (Smeak and DeHoff, 1986; Mason *et al.*, 1988; Beckman *et al.*, 1990; White and Pomeroy, 1990; Matthieson and Scavelli, 1990; Devitt *et al.*, 1997). This complication led to the euthanasia of one dog in the present study.

The tympanic membrane has an epithelial surface and should be removed during surgery, as it can become a nidus for infection and may be associated with abscessation (McAnulty *et al.*, 1995). Hearing is effectively lost after TECA/LBO (McAnulty *et al.*, 1995), although it has already been lost pre-operatively in many dogs with end stage otitis externa as the ear canal and bulla are not patent. Dermatitis at the surgical site is the most common complication (Devitt *et al.*, 1997). This problem was seen in six of the 10 dogs that had an improved or poor outcome in this series. Therefore, in those cases with concurrent skin disease, ongoing treatment of the dermatopathy is required following TECA/LBO.

In this series, 27 of 29 dogs (93%) undergoing TECA/LBO for which follow-up results were obtained had an excellent or improved outcome to surgery. This compares favourably with previous reports that have documented that TECA/LBO has resolved the original ear disease in 76% to 95% of dogs (Mason *et al.*, 1988; Beckman *et al.*, 1990; White and Pomeroy, 1990; Matthieson and Scavelli, 1990).

Conclusion

Otitis externa is a common disease which, although easy to diagnose, requires correct identification and proper medical treatment of its cause(s) at an early stage. Surgical management is indicated if medical treatment fails to correct the cause(s) or if episodes of otitis externa are recurrent. The correct selection of a surgical procedure for an individual case is important and is completely dependent on an accurate assessment of the ear canal and tympanic bulla using otoscopy, cytology, microbiology and radiography. If the ear canal is normal or there are early reversible changes, then lateral ear canal resection (LECR) is indicated. In the unusual situation where irreversible changes are confined to the vertical ear canal, then vertical ear canal ablation (VECA) is indicated. However, either technique alone is not a cure for otitis externa and, to provide a reasonable prognosis, they must be carried out early in the disease before horizontal ear canal changes and otitis media occur and they must be followed with continued medical treatment. Once there are irreversible changes within the horizontal ear canal, with or without otitis media, total ear canal ablation and lateral bulla osteotomy (TECA/LBO) is the treatment of choice. This is a technically demanding surgery with a potentially high complication rate for the inexperienced surgeon; however, in this case series an excellent result was recorded in the majority of cases.

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