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Main Article

Coblation tonsillectomy: a prospective, double-blind, randomised, clinical and histopathological comparison with dissection–ligation, monopolar electrocautery and laser tonsillectomies

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Abstract

Introduction: Coblation tonsillectomy is a relatively recently introduced surgical technique which attempts to bridge the gap between 'hot' and 'cold' tonsillectomy methods.

Aim: To compare coblation tonsillectomy with three commonly used surgical techniques: cold dissection–ligation, monopolar electrocautery and CO_2 laser.

Materials and methods: A prospective, randomised, double-blinded clinical trial was undertaken of 60 adult patients divided into three equal study groups. Patients in each group were randomly assigned to have one tonsil removed with coblation and the second with one of the other three tonsillectomy techniques. Ten randomly selected tonsils resected by each method were sent for histopathological evaluation.

Results: Coblation was significantly faster to perform than laser and produced significantly less intra-operative blood loss than both the dissection–ligation and laser techniques. Subjective visual analogue scale comparisons showed a non-significant pain score difference between coblation and dissection–ligation on most post-operative days. Coblation produced consistently highly significantly ($p < 0.001$) less pain, compared with electrocautery up to the 12th post-operative day and laser up to the 10th post-operative day. There was no significant difference in tonsillar fossa healing, comparing coblation to both dissection–ligation and laser techniques. Monopolar electrocautery produced significantly slower healing than coblation after 7 post-operative days, with no significant difference after 15 post-operative days. Histopathological evaluation showed that coblation inflicted significantly less thermal tissue injury than either electrocautery ($p = 0.001$) or laser ($p = 0.003$).

Conclusions: In adult patients, coblation tonsillectomy offers some significant advantages in terms of post-operative pain and healing, compared with other tonsillectomy techniques.

Key words: Tonsillectomy; Coblation; Post-Operative Complications; Post-Operative Pain

Introduction

Tonsillectomy is one of the most commonly performed surgical procedures worldwide. Since the first description of tonsil removal using blunt finger dissection, by Cornelius Celsus of Rome in the first century AD, many surgical techniques have evolved in an attempt to reduce the morbidity of this operation.[1] Traditionally, electrocautery and 'cold' instruments (i.e. scissors, snare or knife) have been the most widely used tools for performing tonsillectomy. Electrocautery lends the advantage of improved haemostasis and shorter operative time, whereas cold tonsillectomy produces less thermal injury and is thus thought to cause less post-operative pain and dehydration. Newer methods of tonsillectomy now in use include harmonic ultrasonic scalpel dissection, microdebrider-assisted intracapsular tonsillectomy, thermal welding and plasma-mediated ablation (coblation).[2–5]

Plasma-mediated ablation energises protons to break molecular bonds between tissues. The device works by passing a bipolar radio-frequency current through a medium of normal saline. This creates a plasma field of sodium ions. These ions are able to break down intercellular bonds and in effect 'melt' tissue at low temperatures (60 to 70°C), with presumably minimal collateral thermal tissue damage.[6] This reduced thermal effect has resulted in the term 'cold ablation' or 'coblation' (ArthroCare, Sunnyvale, California, USA). Plasma-mediated ablation has

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been offered for tonsillectomy since 1998 as a means of creating less thermal injury than that caused by electrocautery (which generates temperatures of between 400 and 600°C),[7] while achieving better haemostasis than with cold instruments alone.

This prospective clinical study was undertaken to compare the results of coblation tonsillectomy with those of three tonsillectomy techniques in common practice, namely: cold dissection–ligation, monopolar electrocautery and laser. A histopathological evaluation of resected tonsil tissue was also performed in order to estimate the actual amount of collateral tissue damage inflicted by each technique and to correlate this with the clinical data obtained.

Materials and methods

Patients

This study was conducted as a prospective, randomised, double-blinded clinical trial. Sixty patients aged 18 years and above, with a history of recurrent tonsillitis requiring tonsillectomy, were recruited from the regular clinical pool at the otolaryngology – head and neck surgery department of the Alexandria Main University Hospital. Exclusion criteria included: a history of peritonsillar abscess; tonsillar hypertrophy related to a neoplastic process; and a history of easy bruising, bleeding disorders, heart disease, diabetes or hypertension (i.e. systolic blood pressure $>$ 160 mmHg). Surgery was only performed for patients who denied having any active infection producing a fever $\geq$38°C, or having a history of tonsillitis within three weeks prior to surgery.

Three treatment groups (A, B and C) were formed, comprising 20 patients each. In each of the three groups, tonsillectomy was randomly performed on one side using coblation, while the other tonsil was resected by either the conventional cold dissection–ligation technique (group A), monopolar electrocautery (group B) or CO_2 laser (group C). Thus, in this study the patients were their own controls, in terms of pain threshold, tissue healing and post-operative dietary intake.

Before commencement, the study protocol was approved by the Alexandria University faculty of medicine institutional review board and its ethics committee. Patients were informed about the study protocol prior to initiation of recruitment, and a written, informed statement of consent was obtained from all participating patients. Patients were randomly assigned on the day of surgery to one of the three treatment groups, by means of sealed, opaque envelope allocation. All patients were blinded as to which technique was used to remove each tonsil.

Surgical techniques

All operative procedures were performed under general anaesthesia using endotracheal intubation. The tonsillectomy surgical dissection technique was the same for all methods used, and involved a subcapsular dissection for complete tonsil excision, with effort made to preserve as much pharyngeal mucosa as possible. Power settings for each device used followed the manufacturers' recommendations. The device used for dissection was also used for control of bleeding.

In all patients, coblation tonsillectomy was performed on one side using the ArthroCare ENT Coblator II surgery system with EVac 70 plasma wands. Settings were standardised at seven for coblation and three for coagulation.

In group A patients, contralateral tonsil removal was performed using a conventional cold dissection–ligation technique. All vascular bundles were clamped and ligated using 2-0 silk sutures. No electrocautery was used for haemostasis.

Group B patients received a contralateral tonsillectomy performed using monopolar electrocautery at power settings of between 20–25 W for both coagulation and cutting (Valleylab Force 40 electrosurgical unit, DRE, Louisville, Kentucky, USA), with a flat-tipped blade, electrically insulated down to the tip.

Lastly, group C patients had their contralateral tonsil removed using a SmartOffice Plus CO_2 laser (Deka Medical Electronics Laser, Florence, Italy). Laser safety precautions were followed strictly throughout the procedure. Incisions were made using the superpulsed mode, while dissection was continued using the continuous mode at power levels set at 10–12 W. A lower power laser beam was utilised for haemostasis.

Each tonsillectomy technique was intra-operatively assessed by the surgeon, who recorded: operative time (i.e. time from first incision to complete haemostasis of the tonsillar bed); amount of blood loss for each side; and any difficulties encountered during the operative procedure.

Anaesthesia and recovery room protocols were standardised for all cases. Patients were discharged on the same day of surgery after being given similar prescriptions for post-operative antibiotics (i.e. amoxicillin for seven days, except in penicillin hypersensitivity cases, in which erythromycin was prescribed instead) and pain medication (paracetamol), with doses based on body weight. Patients were instructed to return to the hospital in the event of haemorrhage.

Outcome measures

Patients were given a 14-day daily questionnaire upon discharge, to be completed over the next two weeks. Patients were asked to return these questionnaires on their 15-day follow-up visit. All patients were assessed pre-operatively to ascertain their willingness and ability to complete this daily questionnaire. The questionnaire included a subjective assessment of post-operative pain, using a 10-point visual analogue scale (VAS) chart. These charts consisted of a linear scale with 10 gradations, ranging from one (equating to no pain) to 10 (equating to severe pain). The degree of pain on each side of the throat was to be marked on the scale first thing each morning, before taking any analgesic medication. The daily questionnaire also included a space in which to record any complications or other symptoms (e.g. otalgia) experienced by the patient.

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Patients' throats were examined twice in the out-patients department, at 7 and 15 days post-operatively, by a different surgeon who had not been involved in the tonsillectomy and who was blinded to the technique used to remove each tonsil. The size of the post-tonsillectomy slough was taken as an arbitrary sign denoting the rate of healing. As previously described by other authors,[6,8] five grades were considered: 0, 25, 50, 75 and 100 per cent, according to the size of the slough in comparison with the aerial size of the post-operative tonsillar bed. Daily pain scores and throat examination findings were compared to assess whether there were any differences.

Histopathological study

Ten randomly selected tonsils resected by each of the four tonsillectomy techniques were sent for histopathological evaluation, undertaken by a pathologist blinded to the surgical technique used. On arrival at the pathology laboratory, the specimens were fixed in 10 per cent buffered formalin. Several sections were sampled from each tonsil and were processed by paraffin embedding. Five-micrometre sections were then cut from each tonsil, stained with haematoxylin and eosin and examined by light microscopy. The maximum depth of tonsillar tissue injury on the capsular side of the resected tonsil was calculated for each specimen and recorded. Measurements were made using an ocular micrometer.

Statistical analysis

Statistical analysis was carried out using the Statistical Package for the Social Sciences computer software version 11.5 for Windows (SPSS Inc, Chicago, Illinois, USA). The continuous variable of age was displayed as mean ± standard deviation; the means of continuous variables were compared using one way analysis of variance. For categorical variables (e.g. sex), the chi-square test was used. Other continuous variables were displayed as median and range. Comparisons between pairs of groups were performed by non-parametric methods, using the Wilcoxon matched-pairs signed ranks test for quantitative data, and Sign test for qualitative data, and p values were recorded. Comparisons of histopathological tissue injury depth were performed using the unpaired t-test. Statistical significance was accepted when p was less than 0.05.

Results and analysis

Patient demographics

Sixty adult patients with ages ranging between 18 and 34 years were enrolled between January 2005 and February 2006. Table I shows the demographic details of the participating patients in the three study groups. No statistically significant difference was found between study groups as regards age ($p = 0.912$) or sex ($p = 0.817$).

Operative time and intra-operative blood loss

For each tonsil side, the operative time was measured in minutes per tonsil, from the start of the mucosal incision until completion of haemostasis in the resected tonsil bed. The tonsillectomy operative time did not differ significantly, comparing coblation and both dissection–ligation and electrocautery techniques. However, the operative time for laser tonsillectomy was significantly longer than that for coblation.

The median estimated blood loss was less using coblation, compared with the other three tonsillectomy techniques. However, this difference was statistically significant only in groups A and C (i.e. dissection–ligation and laser techniques, respectively) (Table II).

Post-operative pain and haemorrhage

All patients fully completed and returned the daily pain questionnaire for the first two post-operative weeks. Table III shows the median and range of daily pain score values for each tonsillectomy side in the three study groups. A graphic representation of median pain ratings by post-operative day is shown in Figures 1 to 3. Comparison of the VAS scores for the two sides, for each individual day, showed a non-significant difference in pain scores for the coblation and dissection–ligation sides in group A patients on most of the post-operative days, except for a slightly significant rise in pain scores on the dissection–ligation side starting on day four and ending on day seven, post-operatively. In comparison, coblation sides had consistently highly significantly ($p < 0.001$) lower pain scores, compared with electrocautery sides (i.e. group B) up until the 12th post-operative day, and compared with laser tonsillectomy sides (i.e. group C) up until the 10th post-operative day.

TABLE I

PATIENTS' DEMOGRAPHIC DETAILS

Parameter	Group A ($n = 20$)	Group B ($n = 20$)	Group C ($n = 20$)	Total ($n = 60$)
Age (years)				
Range	18–32	18–32	18–34	18–34
Mean ± SD	23.5 ± 4.9	22.9 ± 5.3	22.7 ± 4.5	22.9 ± 4.8
Sex				
Male (n (%))	12 (60)	11 (55)	10 (50)	33 (55)
Female (n (%))	8 (40)	9 (45)	10 (50)	27 (45)

SD = standard deviation

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TABLE II

OPERATIVE TIME AND INTRA-OPERATIVE BLOOD LOSS

Parameter	Group A		Group B		Group C	
	CS	DLS	CS	ECS	CS	LS
Operative time (min)						
Median (range)	10.5 (7–35)	14.5 (10–30)	12 (7–40)	10 (6–20)	10 (7–25)	20 (10–45)
p	0.200		0.981		0.001*	
Blood loss (ml/tonsil)						
Median (range)	5 (0–10)	22.5 (10–75)	5 (0–60)	12.5 (0–25)	2.5 (0–50)	20 (5–100)
p	<0.001*		0.214		0.005*	

*Statistically significant. CS = coblation side; DLS = dissection–ligation side; ECS = electrocautery side; LS = laser side

There were no episodes of reactionary or secondary haemorrhage in any patient.

Tonsillar fossa healing

Figure 4 shows the percentage of tonsillar fossa healing on both sides in the three study groups, on the 7th and 15th post-operative days. There was no significant difference in healing between coblation and dissection–ligation tonsillectomies (group A patients). In group B patients, monopolar electrocautery produced statistically significantly slower healing than did coblation after 7 post-operative days, but there was no significant difference after 15 post-operative days. Although more patients in group C demonstrated better healing on the coblation tonsillectomy side than on the CO_2 laser side, this difference did not reach statistical significance (Table IV).

Histopathology

Histopathological evaluation of the tonsillectomy specimens' excision margins revealed marked vascular congestion in tonsils resected by the cold dissection–ligation technique, and to a lesser degree in those resected by CO_2 laser. Tissue charring was only observed with CO_2 laser resection. On the other hand, coagulative necrosis, indicating tissue injury, was seen in all tonsil specimens resected by monopolar electrocautery, CO_2 laser and coblation, with mean injury depths of 303.6 ± 93.9, 214.6 ± 61.2 and 89.2 ± 23.2 μm, respectively (Figure 5). Analysis of these results showed that coblation produced statistically significantly less histopathological thermal tissue injury, compared with both monopolar electrocautery ($p = 0.001$) and CO_2 laser ($p = 0.003$).

Discussion

As with most surgical procedures, the techniques used for tonsillectomy have been refined over the years, in an effort to reduce morbidity and increase surgical efficiency. A wide variety of surgical techniques for tonsillectomy is now available. This plethora of techniques argues against the clear superiority of any single method. A new technique for tonsillectomy should be: comparable to or better than existing techniques; safe to use; have a short learning curve; and be cost-effective. In particular, such a new technique would preferably be associated with less post-operative pain, less intra-operative blood loss, a quicker return to normal diet and activity, and a lower risk of both reactive and secondary haemorrhage.[9]

TABLE III

POST-OPERATIVE DAILY PAIN SCORES

Post-op day	Group A			Group B			Group C		
	CS	DLS	*p*	CS	ECS	*p*	CS	LS	*p*
1	7 (1–9)	8 (3–9)	0.039*	7 (2–9)	8 (3–9)	0.003*	7 (2–9)	7 (1–9)	0.452
2	7 (1–9)	7 (1–9)	0.127	7 (2–8)	8 (3–9)	0.001*	7 (1–8)	7 (1–9)	0.032*
3	6 (1–7)	6 (1–7)	0.093	5.5 (1–7)	7 (3–9)	<0.001*	6 (1–8)	8 (3–9)	<0.001*
4	5 (1–6)	6 (1–7)	0.001*	5 (1–6)	7 (3–9)	<0.001*	5.5 (1–7)	7 (3–9)	<0.001*
5	5 (1–6)	7 (1–8)	0.001*	5 (1–5)	7 (3–9)	<0.001*	5 (1–6)	7 (1–9)	<0.001*
6	5 (1–5)	5 (1–6)	0.004*	4 (1–5)	7 (3–9)	<0.001*	5 (1–6)	7 (1–9)	<0.001*
7	4 (1–5)	4 (1–5)	0.046*	4 (1–5)	6.5 (3–9)	<0.001*	4 (1–5)	6.5 (1–8)	<0.001*
8	3 (1–4)	3 (1–5)	0.169	3 (1–4)	5 (2–9)	<0.001*	3 (1–4)	5 (1–6)	<0.001*
9	3 (1–3)	3 (1–3)	0.157	3 (1–3)	5 (2–7)	<0.001*	2.5 (1–3)	5 (1–5)	<0.001*
10	2 (1–3)	2 (1–3)	0.157	2 (1–2)	4 (1–6)	<0.001*	2 (1–3)	4 (1–6)	<0.001*
11	1	1.5 (1–2)	0.002*	1.5 (1–2)	3 (1–4)	<0.001*	1.5 (1–2)	3 (1–3)	0.002*
12	1	1	1.000	1	3 (1–3)	<0.001*	1	1.5 (1–2)	0.002*
13	1	1	1.000	1	1.5 (1–2)	0.002*	1	1	1.000
14	1	1	1.000	1	1	1.000	1	1	1.000

Data are presented as median (range). *Statistically significant. Post-op = post-operative; CS = coblation side; DLS = dissection–ligation side; ECS = electrocautery side; LS = laser side

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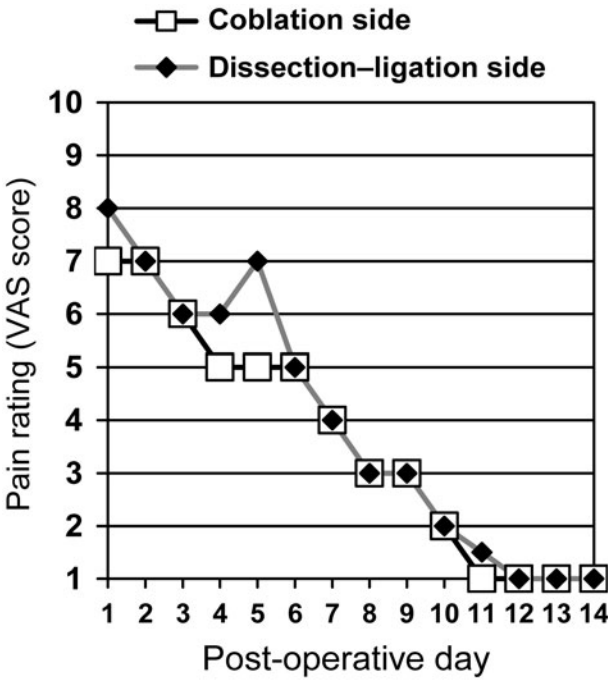

FIG. 1
Group A median subjective pain ratings (as visual analogue scale (VAS) scores), by post-operative day.

In current worldwide practice, probably the commonest techniques used for tonsillectomy involve the use of cold instruments (i.e. knife, scissors, dissectors or snare) or 'hot' excision (using electrocautery). Although proponents of cold tonsillectomy expect a less painful recovery, hot dissection is advocated for faster excision and less intra-operative bleeding.[10]

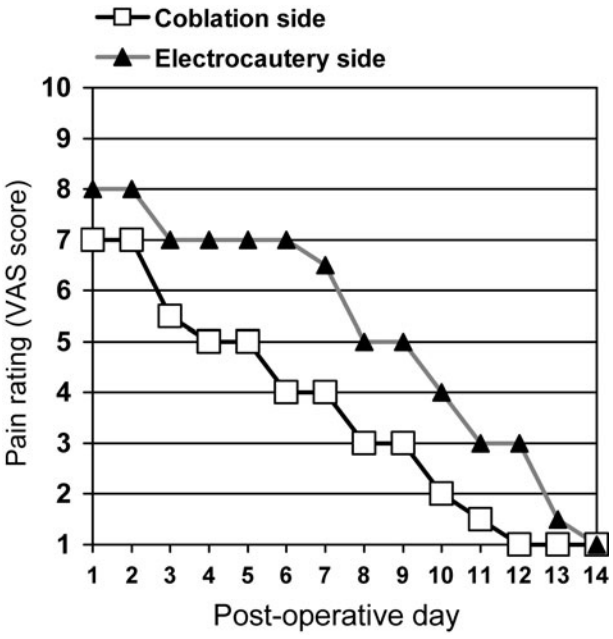

FIG. 2
Group B median subjective pain ratings (as visual analogue scale (VAS) scores), by post-operative day.

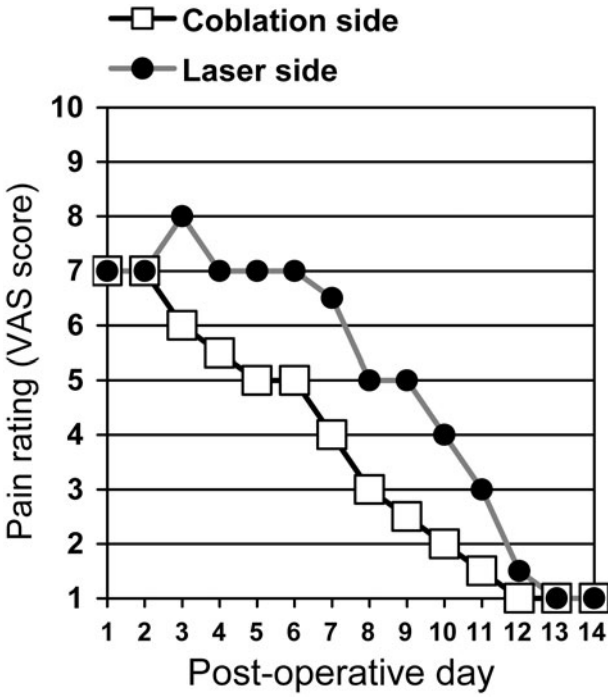

FIG. 3
Group C median subjective pain ratings (as visual analogue scale (VAS) scores), by post-operative day.

Compared with electrocautery, CO_2 laser has been shown to produce less tissue damage and faster wound healing.[11] For this reason, CO_2 laser is becoming a widely accepted alternative in otolaryngology practice. However, its role in tonsil surgery has been usually reserved for the tonsillotomy procedure.[12,13]

Coblation tonsillectomy is a relatively recently introduced surgical technique, offered since 1998 as a means of bridging the gap between cold and hot techniques. It has thus attracted interest in the literature since the beginning of this decade. Coblation promises better excision haemostasis than cold tonsillectomy methods, while transmitting less heat to the pharynx than electrocautery.

The current study was designed to compare coblation tonsillectomy with three different tonsillectomy techniques (i.e. cold dissection–ligation, monopolar electrocautery and CO_2 laser). Only adult patients were enrolled to ensure the efficiency and adequacy of post-operative subjective pain assessment. Each patient acted as his or her own control, in order to eliminate any interpersonal variability in pain thresholds and healing capability. Surgical indications were limited to chronic tonsillitis, in order to provide homogeneity in the study groups. None of the patients included in the study received an adenoidectomy, thus excluding pain resulting from this procedure. As described in other studies,[8,14] outcome measures were assessed up to two weeks after the operation, in order to allow for complete recovery tracking.

Many otolaryngologists perform tonsillectomy using monopolar electrocautery, knowing that it reduces intra-operative bleeding, thereby making the dissection quicker and less technically

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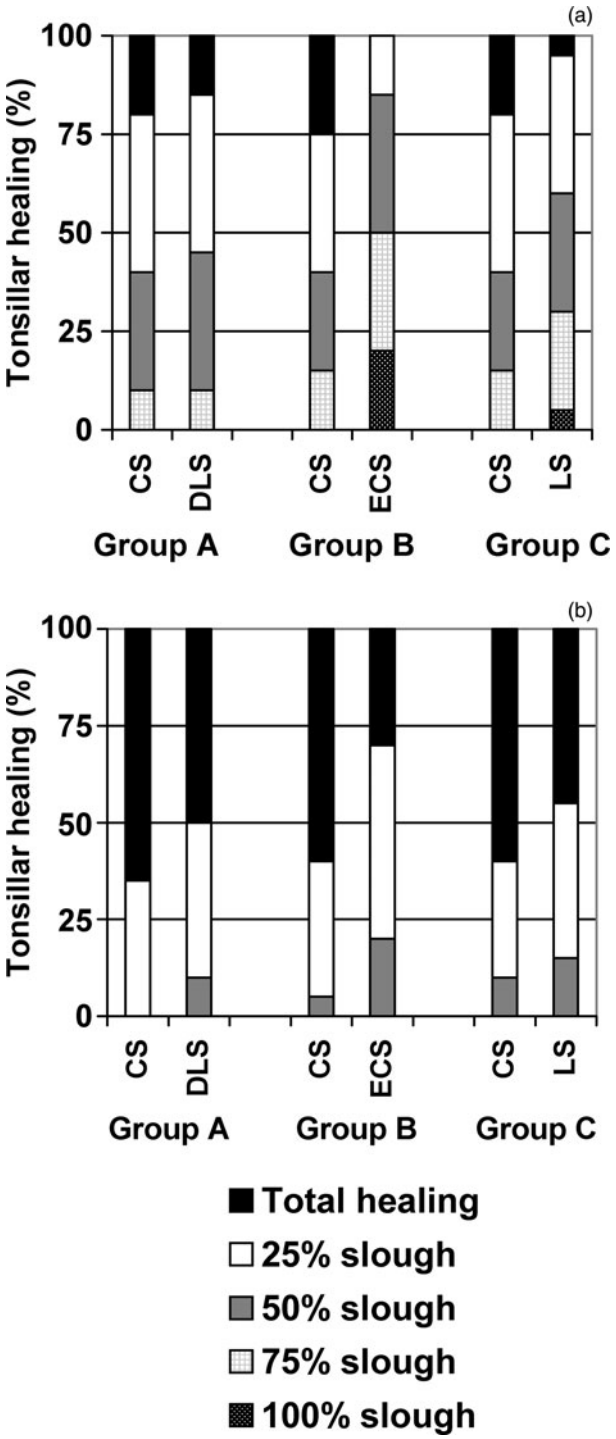

FIG. 4

Percentage tonsillar fossa healing at (a) 7 days and (b) 15 days post-operatively, among the three groups. Bars show the percentage of patients in each healing category. CS = coblation side; DLS = dissection–ligation side; ECS = electrocautery side; LS = laser side

demanding.[15] The current study shows that, in adult patients, neither intra-operative bleeding nor operative time significantly differed, comparing monopolar electrocautery and coblation. In a similar study in adult patients which compared these two techniques, Noordzij and Affleck[8] found that coblation took a statistically longer time than did electrocautery (8.22 *vs* 6.33 minutes for one tonsil, respectively), and led to less intra-operative bleeding (2.44 *vs* 5.39 ml/tonsil, respectively). However, these authors commented that these differences, although statistically significant, were too small to be of importance when choosing a dissection technique. On the other hand, our study demonstrated that coblation was statistically much quicker and less bloody to perform, compared with CO_2 laser. This finding may be attributed to the sometimes suboptimal haemostatic capability of the CO_2 laser for blood vessels larger than 0.5 mm diameter. Compared with the cold dissection–ligation method, coblation led to statistically significantly less intra-operative bleeding and was in most cases quicker to perform (although this latter difference was not statistically significant). One of the more salient features of the coblation device is that its EVac wand allows for simultaneous tonsil removal, haemostasis and suction, thus eliminating the need to switch devices mid-procedure in order to stop bleeding or perform suction.

Post-operative pain continues to be a major drawback in tonsillectomy surgery, especially in adults, who often require up to 14 days of convalescence after tonsillectomy before being able to return to work.[8] One of the first and most commonly quoted studies in the literature regarding the benefits of coblation tonsillectomy was reported by Temple and Timms in 2001.[16] Their results, from a group of 38 children (and a later study of 10 adults),[6] showed a marked difference in post-operative pain and speed of return to normal diet, in favour of coblation. Several prospective, randomised, controlled studies have since been published to compare coblation with electrocautery;[2,8,14,17–20] a few have compared coblation with cold dissection,[21,22] with various results. To our knowledge, our study is the first to compare coblation with subcapsular CO_2 laser tonsillectomy. We found that coblation produced significantly less post-operative pain, compared with electrocautery and CO_2 laser tonsillectomy techniques. Coblation tonsillectomy even compared favourably with the cold dissection–ligation technique, which presumably is associated with the least histological tissue damage.

Pain is a very difficult response to study, as it is a highly subjective symptom with significant person-to-person variability. Our study design enabled effective comparative assessment of pain and post-operative healing, regarding coblation versus other tested surgical techniques, by using the patient as his or her own control, thus eliminating interpatient pain threshold variability.

However, one obvious drawback of our study design was that it could not test the time required to resume normal diet and daily activities. Tan *et al.*, [20] in a recent prospective, double-blind, randomised, controlled study involving 67 adult patients, showed that coblation tonsillectomy allowed patients

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TABLE IV

POST-OPERATIVE TONSILLAR FOSSA HEALING

Healing parameter	Group A (*n* (%))		Group B (*n* (%))		Group C (*n* (%))	
	CS	DLS	CS	ECS	CS	LS
7 days post-op						
Total healing	4 (20)	3 (15)	5 (25)	0 (0)	4 (20)	1 (5)
25% slough	8 (40)	8 (40)	7 (35)	3 (15)	8 (40)	7 (35)
50% slough	6 (30)	7 (35)	5 (25)	7 (35)	5 (25)	6 (30)
75% slough	2 (10)	2 (10)	3 (15)	6 (30)	3 (15)	5 (25)
100% slough	0 (0)	0 (0)	0 (0)	4 (20)	0 (0)	1 (5)
p	0.774		0.004*		0.388	
15 days post-op						
Total healing	13 (65)	10 (50)	12 (60)	6 (30)	12 (60)	9 (45)
25% slough	7 (35)	8 (40)	7 (35)	10 (50)	6 (30)	8 (40)
50% slough	0 (0)	2 (10)	1 (5)	4 (20)	2 (10)	3 (15)
p	0.629		0.065		0.388	

*Statistically significant. CS = coblation side; DLS = dissection–ligation side; ECS = electrocautery side; LS = laser side; post-op = post-operatively

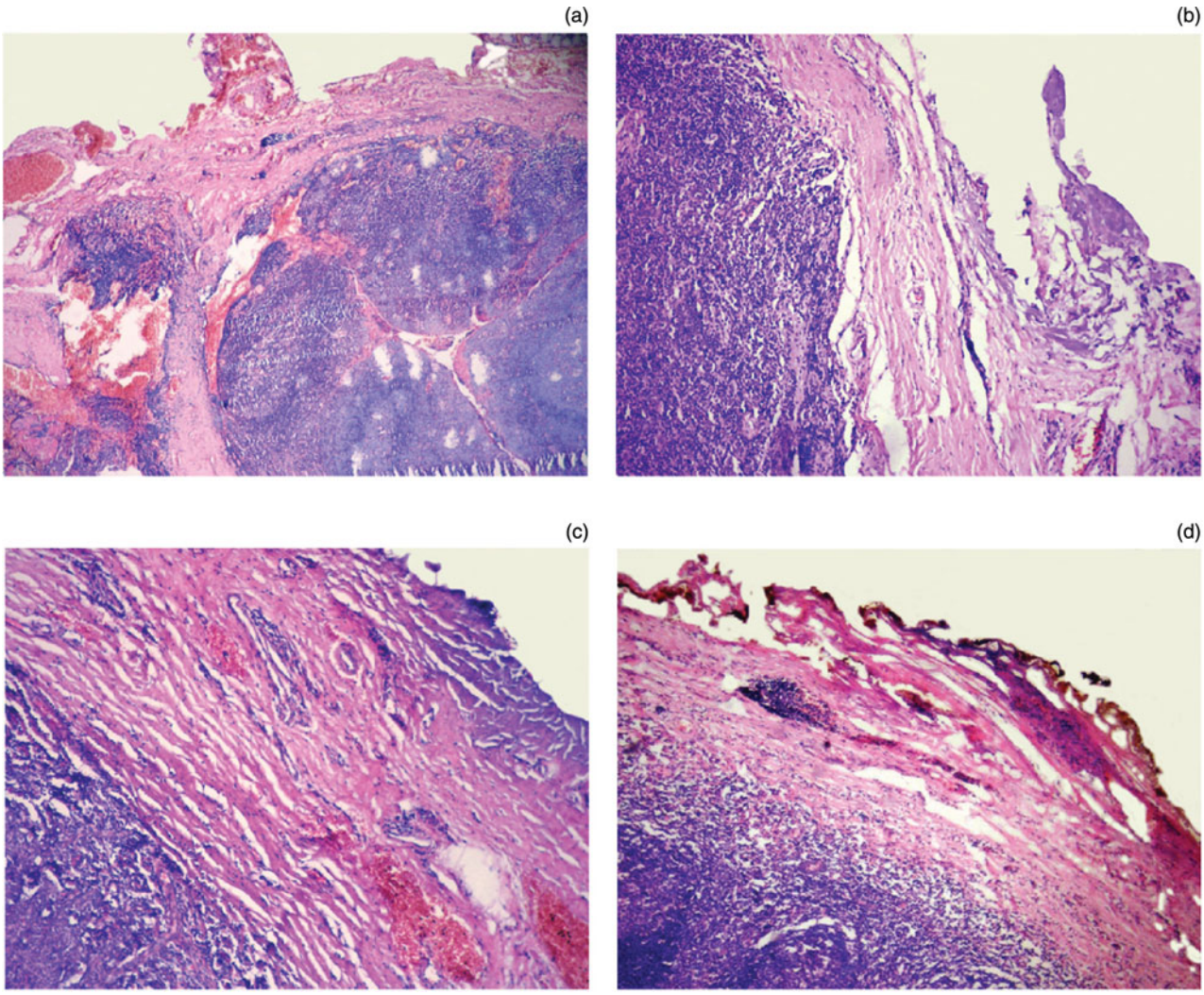

FIG. 5

Histopathological evaluation of tonsillectomy specimens. (a) Cold dissection–ligation specimen showing severe, widespread capsular and tonsillar congestion with absent necrosis and charring (H&E; ×40). (b) Coblation specimen showing a small area of coagulative necrosis at the excision margin (H&E; ×100). (c) Monopolar electrocautery specimen showing a wide area of coagulative necrosis at the excision margin as well as moderate capsular congestion (H&E; ×100). (d) Laser specimen showing tissue charring at excision margin, overlying an area of coagulative necrosis (H&E; ×100).

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to return to a normal diet earlier, compared with electrocautery tonsillectomy.

- **Plasma-mediated ablation ('coblation') has been offered for tonsillectomy since 1998, as a means of creating less thermal injury than electrocautery, while achieving better haemostasis than with 'cold' instruments**
- **This prospective, randomised, double-blinded clinical study compared coblation subcapsular tonsillectomy with three tonsillectomy techniques in common use (i.e. cold dissection–ligation, monopolar electrocautery and CO_2 laser) in adult patients**
- **Coblation tonsillectomy did not significantly differ from dissection–ligation in most of the outcome measures tested**
- **Coblation was found to produce a significant reduction in post-operative pain, compared with electrocautery and laser**

As expected, none of the four surgical methods tested in this study resulted in a pain-free recovery. There are certainly other factors which alter pain, aside from the surgical instrument used. A meticulous, gentle surgical technique (i.e. staying in the proper surgical plane, gentle handling of tissues, preservation of pharyngeal mucosa and so on) is universally accepted as a significant factor in post-operative pain and healing. However, when surgeons use an atraumatic, correct surgical technique, the instrument used may result in an additional benefit to the patient.[2]

Some authors have suggested that the risk of post-operative haemorrhage is increased in patients undergoing coblation tonsillectomy.[23–25] However, other investigators have not found this to be the case.[26–28] Belloso *et al.*, [27] in a large, prospective, observational cohort study, even found an overall lower incidence of secondary haemorrhage after coblation tonsillectomy, compared with blunt dissection using bipolar diathermy haemostasis (2.25 *vs* 6.19 per cent). The current study cannot address this question, as none of our patients experienced post-operative haemorrhage.

Experimental evidence suggests that tonsillar fossa healing after coblation tonsillectomy should be faster than that following electrocautery tonsillectomy. Chinpairoj *et al.*, [7] in an elegantly designed study using a rat model, proved that coblation produces less intra-oral tissue injury and faster wound healing in the first two post-operative weeks, compared with conventional electrocautery. The only published histopathological evidence from a human study was reported by Shah *et al.*[17] This small sample size study confirmed the anticipated reduction in histopathological thermal injury with coblation, compared with monopolar electrosurgery. Tonsils excised by means of coblation showed only a 0.13-mm depth of injury, compared with a 0.63 mm depth of thermal damage in those excised by electrocautery. This reduced thermal effect, however, did not translate into improved recovery. Timms and Temple[6] demonstrated that wound healing was greatly improved after coblation subcapsular tonsillectomy, compared with bipolar electrocautery tonsillectomy. At nine days after tonsillectomy, these authors found that seven of 10 adult patients undergoing coblation had fully healed tonsillar fossae, whereas none of the patients undergoing electrocautery had fully healed.

The present study further augments the conclusion that, compared with electrocautery, coblation tonsillectomy produces less histopathological tissue damage and faster wound healing. This improved effect on tissue damage and wound healing was still present, although less evident, when coblation was compared with CO_2 laser. Coblation tonsillectomy wound healing was also statistically comparable to that seen after cold knife dissection, which, as expected, produced the least histopathological tissue damage.

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