

# Coblation tonsillectomy under surgical microscopy: A retrospective study

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## Abstract

**Objective:** A retrospective study to compare surgical parameters and postoperative pain in patients undergoing coblation tonsillectomy with or without microscopic guidance.

**Methods:** Data regarding duration of surgery and hospital stay, intraoperative blood loss, incidence of haemorrhage and postoperative pain scores were retrieved from the medical records of adult patients undergoing coblation tonsillectomy under direct vision or with microscopic guidance.

**Results:** The incidence of secondary haemorrhage (>24 h postoperatively) was significantly lower and the duration of hospital stay was significantly shorter in the microscope group ( $n = 92$ ) than the direct vision group ( $n = 76$ ). Pain scores both at rest and while swallowing reached  $\leq 3$  (no significant impact on quality-of-life) significantly faster in the microscope group than the direct vision group.

**Conclusions:** Microscope-assisted coblation tonsillectomy decreases the duration of hospital stay and the incidence of postoperative secondary haemorrhage, and results in an early improvement in postoperative pain scores.

## Keywords

Surgical microscope, tonsillectomy, haemorrhage

Date received: 22 September 2015; accepted: 31 December 2015

## Introduction

Tonsillectomy is a common surgery that was first performed 3000 years ago.<sup>1</sup> Cooling instruments are frequently used to minimize heat-induced tissue damage during conventional tonsillectomy by dissection; newer technologies include electric knives, lasers, harmonic scalpels, coblation, and microdebrider tonsillectomy.<sup>2–6</sup> Coblation tonsillectomy has been studied worldwide and is

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generally used by otolaryngologists in China because it causes little tissue damage.<sup>7-9</sup>

Tonsillectomy is a relatively minor surgery, and is generally performed by direct vision in order to complete the procedure quickly and decrease patient discomfort caused by the use of multiple pieces of equipment during surgery. The small and narrow surgical field makes visualization of the lower pole of the tonsil difficult, however. In addition, only the surgeon can view the surgical process, thereby excluding the assistant. Attempts to perform tonsillectomy using an endoscope have been reported, but the endoscopic surgical field is not three-dimensional.<sup>10</sup>

We have performed coblation tonsillectomy using a surgical microscope. On the basis of our experience, we hypothesized that the surgical microscope allows for minimally invasive tonsillectomy with less damage and intraoperative blood loss, and a more radical resection than conventional tonsillectomy. The present retrospective study compared the surgical duration, intraoperative blood loss, incidence of haemorrhage, postoperative pain, and length of hospital stay after surgery in patients undergoing coblation tonsillectomy with or without microscopic guidance. The use of a microscope during surgery does not simply enlarge the field of vision, it offers an innovative change to the surgical approach. Therefore, this article also summarizes the key technical aspects of this surgical approach.

## **Patients and methods**

### *Study population*

This retrospective study retrieved the medical records of adult patients (>18 years old) who underwent tonsillectomy at the Department of Otolaryngology, The Fifth People's Hospital of Shanghai, Fudan University, Shanghai, China, between January 2010 and December 2013. Diagnosis of and treatment for tonsillar

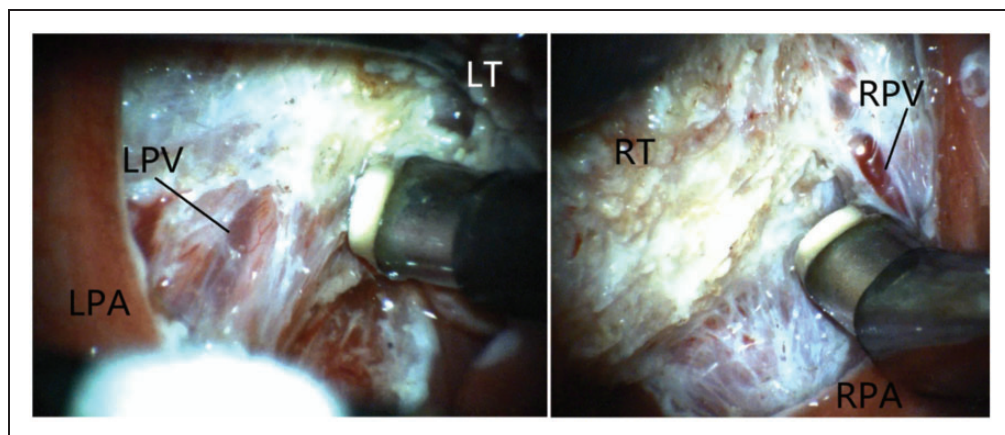
hypertrophy and chronic tonsillitis were performed by a single surgeon with a decade of experience in various types of tonsil surgeries (Y.P.). Exclusion criteria were: history of acute tonsil infection within the previous 2 weeks; peritonsillitis; systemic diseases such as heart disease and coagulopathies. Patients undergoing tonsillar biopsy, unilateral tonsillectomy, tonsillectomy for known carcinoma, and tonsillectomy in conjunction with palatal surgery were also excluded.

The study was approved by the ethics committee of the Fifth People's Hospital of Shanghai, Fudan University, and all patients provided written informed consent.

### *Surgical technique*

Microscope-assisted ablation tonsillectomy was introduced in our institution in 2011. Patients were not randomized because surgical approach was determined by admission date. All tonsillectomies were performed by a single attending surgeon (Y.P.) with assistance from one of two residents (J.H. or S.H.), using a COBLATOR<sup>®</sup> II (ArthroCare<sup>®</sup>, Smith & Nephew, London, UK). For surgeries performed under a microscope (OPMI<sup>®</sup> PRO magis; Carl Zeiss Microscopy GmbH, Munich, Germany), images were magnified 3–8 times (Figure 1).

The surgical approach when using a microscope differs from that without a microscope in several ways. When using a microscope, an incision is made at the junction of the palatoglossal arch and the tonsils using a coblation plasma wand (EVAC<sup>®</sup> 70 XTRA HP; Smith & Nephew). The upper poles of the tonsils are gradually pulled to allow separation from the incision to the tonsillar capsule. Compared with conventional surgery, the incision is closer to the tonsils to avoid damage to the palatoglossal arch mucosa around the uvula as far as possible and prevent postoperative uvular oedema. During the



**Figure 1.** Surgical view of microscope-assisted coblation tonsillectomy. LT, left tonsil; LPA, left palatoglossal arch; LPV, left paratonsillar vein; RT, right tonsil; RPA, right palatoglossal arch; RPV, right paratonsillar vein.

gradual separation of the tonsil, the microscopic angle can be adjusted to accommodate the surgical site. Use of the microscope thus allows better visualization of the surgical field, particularly for treatment of the lower poles of the tonsils, as there is no residual lower pole tissue.

Intraoperative ablation with a plasma wand is performed only for the loose tissue between the capsule and pharyngeal muscles during microscope-assisted surgery, thereby avoiding direct damage to the parapharyngeal muscles. In contrast to coblation tonsillectomy without microscopic guidance, the white envelope of the tonsils can be completely distinguished, along with fine (0.1–0.2 mm diameter) blood vessels around the tonsils. Only the nourishing blood vessels penetrating the tonsils and entering the envelopes are occluded during surgery. Damage to tonsillar arteries and paratonsillar veins is effectively avoided by the use of the microscope. In our experience, damage to the paratonsillar vein (external palatine vein) is a major cause of blood loss during treatment of the upper pole using conventional surgery. Use of a microscope allows this vein to be

effectively distinguished, and occlusion of only the vein network exported from the capsule of the tonsil is easily avoided, limiting blood loss. All surgeries were performed under general anaesthesia with sterilized drapes. A Boyle–Davis gag was used to expose the surgical field.

### Outcomes

Patient data included those recorded during surgery, intraoperative blood loss and duration of postoperative hospital stay. Intraoperative blood loss was calculated by a nurse as the volume of fluid drained via suction minus the volume of saline flush (minimum quantifiable volume 5 ml). Postoperative haemorrhage was defined as continuous bleeding that patient had to spit out or swallow and was considered to have occurred if the wound actively bled and required management by the responsible clinician (including local oppression, haemostasis, haemostyptic or surgical rebleeding), or bled again after improvement. Primary haemorrhage occurred within the first 24 h postoperatively, and secondary haemorrhage occurred after 24 h postoperatively.

### Follow-up

Tonsillectomy in China generally requires 2–4 days of hospitalized postoperative observation. In addition, at our hospital, special staff members perform postoperative telephone follow-up, during which doctors guide the patients to take oral analgesics regularly and answer the patients' questions to establish good communication and ensure compliance. All patients routinely received oral nonsteroidal anti-inflammatory drugs (300 mg ibuprofen, twice daily) for analgesia during the first 5 postoperative days, with instructions to use medications as needed for the next 6 – 10 days. Postoperative pain was graded on a scale of 0 to 10 using a Visual Analogue Scale (VAS), where 0 indicates no pain, 1–3 represents mild pain, 4–7 represents moderate pain, and 10 indicates extreme pain. A score of  $\leq 3$  was set as the cut-off value as it was considered to indicate a level of pain that did not affect the patient's quality-of-life or sleep. A nurse recorded pain scores at rest and on swallowing daily at the same time for the first 10 postoperative days by face-to-face or telephone inquiry. The number of days until a patient reported a pain score of  $\leq 3$  was recorded.

### Statistical analyses

Data were expressed as mean  $\pm$  SD. Duration of surgery, intraoperative blood loss, and duration of postoperative stay were analysed using Student's independent two-sample *t*-test. Postoperative haemorrhage was analysed using  $\chi^2$ -test. Multiple linear regression analysis was used for between-group comparison of postoperative pain scores, using postoperative day and surgery type as independent variables and pain score as dependent variable. Between-group differences in the number of days required for a patient to report a score of  $\leq 3$  were compared using Student's *t*-test.

Statistical analyses were performed using Stata<sup>®</sup> version 12 (StataCorp LP, College Station, TX, USA). A *P*-value of  $< 0.05$  was considered statistically significant.

### Results

The study retrospectively reviewed the medical records of 411 patients. After exclusions, the final analysis included 168 patients (82 males/86 females; mean age  $25.1 \pm 6.9$  years; age range 18 – 53 years). Patients were stratified according to the use of a surgical microscope: direct vision group ( $n=76$ ; 37 males/39 females; mean age  $23.6 \pm 7.2$  years; age range 19 – 46 years) and microscope group ( $n=92$ ; 45 males/47 females; mean age  $26.4 \pm 6.5$  years; age range 18 – 53 years). Similar proportions of patients in each group were prescribed analgesia in the first 5 days after surgery (direct vision group, 92.4% [85/92]; microscope group, 89.5% [68/76]). After day 5, 39.1% (36/92) of patients in the direct vision group and 44.7% (34/76) in the microscope group continued to take analgesic medication.

Clinical data are shown in Table 1. There was no significant between-group difference in duration of surgery, intraoperative blood loss, or the incidence of primary haemorrhage. The incidence of secondary haemorrhage and duration of hospital stay were significantly lower in the microscope group than the direct vision group ( $P < 0.05$  and  $P < 0.01$ , respectively; Table 1).

Multivariate linear regression analysis found that postoperative day and surgery type were significantly associated with postoperative pain scores both at rest and on swallowing ( $P < 0.05$  for each comparison). Pain scores were significantly lower in the microscope group than the direct vision group, both at rest ( $-1.005$  points, 95% confidence interval [CI]  $-1.125$ ,  $-0.886$ ) and while swallowing ( $-0.934$  points, 95% CI,  $-1.074$ ,  $-0.794$ ). Pain scores both at rest and while swallowing reached  $\leq 3$

**Table 1.** Clinical parameters in adult patients undergoing coblation tonsillectomy via direct vision or with microscope guidance.

Parameter	Direct vision group <i>n</i> = 76	Microscope group <i>n</i> = 92
Duration of surgery, min	37.3 ± 3	36.1 ± 5
Intraoperative blood loss, ml	<5	<5
Primary haemorrhage <sup>a</sup>	1 (2.6; 95% CI 0.03, 7.11)	0 (0; 95% CI: 0, 3.93)
Secondary haemorrhage <sup>b</sup>	5 (6.6; 95% CI 2.17, 14.69)	0 (0; 95% CI: 0, 3.93)*
Duration of hospital stay, days	1.7 ± 1.3	1.0 ± 1.2**
Time to VAS pain score ≤ 3, days		
At rest	6.323 ± 0.738	3.525 ± 0.911***
While swallowing	7.243 ± 0.893	4.882 ± 1.103***

Data presented as mean ± SD or *n* of patients (%; 95% confidence intervals [CI]).

<sup>a</sup> < 24 h postoperatively.

<sup>b</sup> > 24 h postoperatively.

\**P* < 0.05, \*\**P* < 0.01, \*\*\**P* < 0.001 vs non-microscope group; Student's *t*-test or  $\chi^2$ -test

significantly faster in the microscope group than the direct vision group (*P* < 0.001 for each comparison; Table 1).

## Discussion

Tonsillectomy has been traditionally regarded as a minor surgery, and otolaryngologists have therefore not always considered the need for further optimization and innovation in this field. Coblation tonsillectomy has the primary advantage of limited thermal damage compared with alternative forms of surgery. Derived from “controlled ablation,” the name refers to the non-heat driven process of surgically dissociating soft tissue using bipolar radio-frequency energy to excite electrolytes in a conductive medium (such as saline solution) to create a precisely focused plasma field with a surface temperature of 40–70°C.<sup>11</sup> Coblation tonsillectomy is an improvement over electrosurgery using monopolar blades or bipolar suction, with respect to damage deep in the surgical cavity.<sup>12–19</sup>

The primary advantage of surgery using a microscope over direct vision is the ability to observe the detailed anatomy of the extracapsular loose tissues of the tonsil. In

addition, surgical assistants and students can directly observe the surgical process through a secondary mirror or external monitor. Even with the application of new techniques, the majority of tonsillectomies are performed under direct vision. Surgeons commonly perform this procedure using a 2.5–5× surgical loupe and a headlamp, although the magnification, lighting and image field are inferior to those achieved with a microscope. In contrast to loupes and headlamps, the magnification of a microscope can be adjusted at any time during surgery; it can be set to 3× at the beginning of surgery and increased to 6–8× when required for the precise separation of surrounding blood vessels. Moreover, surgical microscopes have a mechanical arm bracket for positioning that prevents the field of view from moving and is very flexible. The visual and light axes are almost parallel, allowing deep illumination and visualization of the surgical site. These features improve visualization of the tonsillar surgical cavity. Microscopes result in better representation of the colour, brightness and clarity of light than loupes and headlamps, and can be connected to an image display system to facilitate teaching.



The use of a microscope for tonsillectomy results in the procedure being minimally invasive. In our experience, minimally invasive tonsil surgery results in a decrease in primary and secondary haemorrhage rates and less tissue damage. Wide ablation is unnecessary and thermal damage to tissues is limited. The severity of postoperative pain and the average time to achieve the cut-off pain score of 3 were significantly lower in the microscope group than the direct vision group in the present study. This is likely to be related to decreased intraoperative damage to surrounding tissues, confirming the results of others.<sup>18,20-23</sup> Pain records and statistical aspects may be influenced by the use of oral medication, however, and although each patient received ibuprofen, variations in compliance can cause bias.

Coblation tonsillectomy has been shown to result in less intraoperative blood loss than conventional tonsil dissection with cooling instruments.<sup>24-32</sup> The majority of tonsil dissections involve a blood loss of <40 ml and, although this volume is not harmful to patients, reduced blood loss allows a clearer surgical field and facilitates simplified surgery. Haemostasis was achieved at the end surgery in the present study, and the incidence of primary haemorrhage was significantly lower than that reported after conventional tonsil dissection with cooling instruments (7.4%).<sup>33</sup> It has been found that the incidence of secondary haemorrhage after coblation tonsillectomy was higher than that after surgery with cooling instruments.<sup>34-36</sup> The denatured collagen formed by thermal damage can result in a thin protective layer covering the surface of the tonsillar fossa.<sup>36</sup> This postoperative protective layer in the surgical cavity is thicker than that formed after conventional tonsillectomy, slowing the infiltration of inflammatory cells and formation of fibrous tissue, and resulting in an increase in the incidence of delayed

postoperative haemorrhage.<sup>37</sup> There was no significant between-group difference in the incidence of primary, short-term haemorrhage in the present study, but there were significantly fewer cases of secondary haemorrhage in the microscope group than the direct vision group. We believe that the technical precision provided by surgical microscopy decreased the degree of thermal damage in the surgical cavity compared with conventional surgery. In addition, the use of a microscope decreased the damage to the extracapsular vessels, particularly the paratonsillar vein.

This study has several limitations. First, postoperative bleeding after tonsillectomy is uncommon, therefore the sample size for this event was small. A further limitation was the retrospective design and small overall sample size. Although all suitable patients were included, the sample size was determined by the number of patients that fulfilled the inclusion criteria within the study period. In addition, because it was not possible to determine the precise daily medication use of patients there was an inevitable bias with regard to the use of analgesia. There were no obvious between-group differences in prescription of analgesics, however. Additional prospective studies with a larger sample size are required to confirm the findings of this study.

In conclusion, the use of a surgical microscope during coblation tonsillectomy decreases the duration of hospital stay and the incidence of postoperative secondary haemorrhage, and results in an early improvement in postoperative pain scores. This technique is also useful for medical teaching.

### **Acknowledgements**

We would like to thank Dr. Beizheng Xu, MD, Xin Hua hospital affiliated to Shanghai Jiaotong University, for her assistance in statistical analysis.

## Declaration of conflicting interests

The authors declare that there is no conflict of interest.

## Funding

This research received no specific grant from any funding agency in the public, commercial, or not for-profit sectors.

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