Article published online: 2023-03-29

Original Research

Comparison of Three Tonsillectomy Techniques: Cold Dissection, Monopolar Electrocautery, and Coblation

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Int Arch Otorhinolaryngol

Abstract

Introduction Tonsillectomy is among the most common otolaryngological surgeries.
Objective To evaluate and compare three tonsillectomy techniques: cold steel dissection (CSD), monopolar electrocautery (MEC), and coblation.
Methods The present study retrospectively reviewed the medical records of patients who underwent tonsillectomy between January 2014 and January 2016. Postoperative visual analog scale (VAS) pain scores, analgesic use, surgical duration, time to return to normal activity, and postoperative bleeding status were noted.
Results The CSD group had less analgesic use and shorter return to normal activity than the MEC group ($p = 0.037$ and $p < 0.001$, respectively). The coblation group had lower VAS pain scores than the MEC group only at 1 hour to 4 hours postsurgery ($p < 0.016$). The postoperative bleeding rate was similar in all groups ($p = 0.096$).
Conclusion Cold steel dissection tonsillectomy is associated with less postoperative pain and shorter recovery than MEC. Coblation is better than MEC in terms of postoperative pain at 1 hour to 4 hours only, whereas CSD is associated with less postoperative pain than coblation at 2 days to 7 days.

Keywords
- tonsillectomy
- coblator
- cold steel dissection
- monopolar cautery
- postoperative pain

Introduction

Tonsillectomy is among the most common otolaryngological surgeries. It was first described as a blunt finger dissection technique by Celsus in the first century.[1,2] Since then, a variety of surgical techniques have been developed to minimize surgical morbidity. Traditionally, tonsillectomy has been performed via cold steel dissection (CSD); however, more technologically advanced methods, such as electrocautery, laser dissection, harmonic scalpel, and coblation, have been developed. Coblation (i.e., plasma-mediated ablation) is the newest technique and uses bipolar radiofrequency energy to energize protons to break molecular bonds in tissues.[3] It works by passing a radiofrequency current through a saline medium, leading to the creation of a plasma field of sodium ions. When the plasma field created between the device probe and tissue meets tissue it breaks the molecular bonds, leading to molecular dissociation and tissue “melting.” This can be achieved at lower temperatures (60–70°C) than

received
July 28, 2022
accepted
August 24, 2022

DOI https://doi.org/10.1055/s-0042-1758715.
ISSN 1809-9777.

Thieme Revinter Publicações Ltda., Rua do Matoso 170, Rio de Janeiro, RJ, CEP 20270-135, Brazil

electrocautery (400–600°C), thus minimizing collateral thermal injury.

The current trend is for the use of modern tonsillectomy techniques, such as monopolar electrocautery (MEC) and coblation; however, it remains unclear if these modern techniques are better than the conventional CSD technique.[4] Additionally, there is no consensus regarding which tonsillectomy technique is associated with the least morbidity and lowest complication rate. The present study, therefore, aimed to compare three tonsillectomy techniques in terms of postoperative pain and morbidity parameters.

Methods

The medical records of patients that underwent tonsillectomy in the Department of Otorhinolaryngology of the Kırıkkale University, by the senior surgeon (Özel G.) between January 2014 and January 2016 were retrospectively reviewed. The patients were grouped according to surgical technique, as follows: CSD group; MEC group; coblation group (ArthroCare Corporation, Sunnyvale, CA). Demographic features, surgical duration, number of analgesic tablets used, time postsurgery to return to normal activity, visual analog scale (VAS) pain scores, and postoperative complications were compared between the groups. Postoperative VAS pain scores ranged from 0 (no pain) to 10 (unbearable pain). The Wong-Baker faces pain rating scale was used with children unable to the use VAS. The Wong-Baker scale uses 6 facial expressions, ranging from a smile (no pain) to crying (unbearable pain). Surgical duration was calculated as the time from first incision in the mucosa to the end of hemostasis. Tonsillectomy indications were as follows: $\geq$ 4 acute tonsillitis attacks in 2 consecutive years, tonsillar hypertrophy causing sleep apnea, chronic tonsillitis, a history of peritonsillar abscess, and severe dysphagia. Exclusion criteria were ongoing acute tonsillitis, tonsillar neoplasm, bleeding diathesis, severe cervicofacial anomaly, tonsillectomy performed as a part of uvulopalatopharyngoplasty (UPPP).

All the patients underwent surgery by an experienced surgeon under general anesthesia with endotracheal intubation. A Boyle-Davis mouth gag was used for exposure. Subcapsular dissection and complete removal of the tonsils were performed in all patients. Dry gauze packing was used to achieve hemostasis. Bipolar diathermy was used in some patients in the CSD group when packing alone was not sufficient to control bleeding. A coblation wand was used for hemostasis in the coblation group. All patients were discharged 1 day after surgery, and then followed-up within 7 days. All patients received amoxicillin 80 mg/kg for 1 week and paracetamol for pain if necessary. Erythromycin was prescribed in cases with penicillin hypersensitivity. Postoperative hemorrhage was defined as any postoperative bleeding event that necessitated inpatient follow-up and treatment, including gargling with ice water, adrenaline-soaked gauze compress, and electrocoagulation under general anesthesia. Primary hemorrhage was defined as bleeding during the first 24 hours postsurgery, whereas secondary hemorrhage was defined as bleeding after the first 24 hours postsurgery. The study protocol was approved by the Kırıkkale University Ethics Committee (date: 06.30.2021; no. 2021.06.08). The present study was conducted as a retrospective chart review, so no written informed consent was obtained.

Statistical analysis was performed using IBM SPSS Statistics for Windows v.25.0 (IBM Corp., Armonk, NY, USA) and Microsoft Excel (Microsoft Corp., Redmond, WA, USA). Descriptive analysis was performed, and the normality of the distribution of data was determined using the Shapiro-Wilk normality test and normal distribution parameters. Data are shown as median (range) for non-normally distributed continuous variables, mean + standard deviation (SD) for normally distributed parameters, and frequency and percentage for categorical variables. Categorical variables were compared using the chi-squared test and the Fisher exact test for small-sample data. The Kruskal-Wallis test was used for non-normally distributed independent variables in multiple groups. When significant differences between groups were noted via the Kruskal-Wallis test, individual groups were compared using the Mann-Whitney U test. After applying Bonferroni adjustment for multiple (3 different comparisons of 3 groups, $[n \times (n-1)/2]$) comparisons, $p < 0.05/3 = 0.0166$ was accepted as statistically significant in pairwise comparisons of groups using the Mann-Whitney U test. One-way analysis of variance (ANOVA) was used to compare normally distributed parametric variables in multiple groups. The homogeneity of variances was determined using the Levene test. The post-hoc Tamhane test was used to compare normally distributed variables with non-homogenous variance. The level of statistical significance was set at $p < 0.05$; all reported P values are 2-sided.

Results

The study included 123 patients: 61 patients (49.6%) in the CSD group, 32 (26%) in the MEC group, and 30 (24.3%) in the coblation group. There were no significant differences in age, gender, or surgical duration between the groups (►**Table 1**). Analgesic use was significantly lower in the CSD group than in the MEC group ($p = 0.013$); however, the difference between the CSD and coblation groups was not significant ($p = 0.64$). Time to return to normal activity was shortest in the CSD group, and the difference between the CSD group and MEC group was significant ($p < 0.001$). Time to return to normal activity did not differ significantly between the MEC and coblation groups ($p = 0.096$) or between the CSD and coblation groups ($p = 0.061$). All instances of postoperative bleeding were secondary hemorrhage, which occurred between postoperative days 5 and 10. The postoperative bleeding rate did not differ significantly between the 3 groups. No other post-tonsillectomy complications were noted. All the patients had their first oral intake 4 hours postsurgery.

►**Table 2** shows the VAS pain scores over time in each group. The postoperative VAS pain score in the coblation group was the lowest during the first 4 hours postsurgery, and the difference between the MEC and coblation groups was significant ($p < 0.016$). The difference in the VAS pain

Table 1 Demographic and clinical features of the patients according to surgical technique

	CSD	MEC	Coblation	*p-value*
Patients, *n*	61	32	30	
Age in years, median (range)	7 (3–55)	8 (3–44)	7 (3–39)	0.733
Male/Female, *n*	30/31	21/11	17/13	0.332
Surgical duration, mean ± SD (min)	28.98 ± 4.8	30.75 ± 3.8	29.43 ± 2.8	0.157
Analgesic (paracetamol) tablets used, median (range)	1 (0–3)**	2 (0–3)**	1 (0–2)	**0.037***
Time to return to normal activity, days	7.11 ± 1.1***	8.75 ± 1.6***	7.87 ± 1.5	< **0.001**
Postoperative bleeding, yes/no	1/60	4/28	2/28	0.096

Abbreviations: CSD, cold steel dissection; MEC, monopolar electrocautery; SD, standard deviation.
Bold indicates statistically significant difference.
*Bonferroni adjustment was applied for pairwise comparison of groups. $p < 0.0166$ was accepted as statistically significant.
**Indicates statistically significant difference between the CSD and MEC groups, regarding analgesic use ($p = 0.013$).
***Indicates that time to return to normal activity was significantly shorter in the CSD group than in the MEC group (post-hoc Tamhane test, $p < 0.001$).

Table 2 Visual analogue scale pain scores at each time point according to surgical technique

Hours	CSD, Median (range)	MEC, Median (range)	Coblation, Median (range)	*p-value**
1 hour	6 (1–9)	7 (2–9)§	3 (1–9)§	**0.026**
4 hours	3 (0–8)**	5 (1–8)§, **	3 (2–8)§	**0.005**
12 hours	3 (0–8)**	5 (2–8)**	3 (2–8)	**0.001**
24 hours	2 (0–7)**	3 (1–6)**	3 (2–3)	**0.025**
Days				
day 2	2 (0–3)**µ	2 (1–3)**	2 (1–4)µ	**0.002**
day 5	0 (0–3)**µ	1 (0–3)**	1 (0–3)µ	**0.001**
day 7	0 (0–3)**µ	1 (0–3)**	0 (0–3)µ	< **0.001**

Abbreviations: CSD, cold steel dissection; MEC, monopolar electrocautery.
*Bold indicates statistically significant difference. Bonferroni adjustment was applied for pairwise comparison of groups. $p < 0.0166$ was accepted as statistically significant for the pairwise Mann-Whitney U test.
**Indicates that the VAS pain score in the CSD group was significantly lower than in the MEC group between 4 hours and 7 days postsurgery ($p < 0.016$).
µIndicates that the VAS pain score in the CSD group was significantly lower than in the coblation group between days 2 and 7 postsurgery ($p < 0.016$).
§Indicates that the VAS pain score in the coblation group was significantly lower than in the MEC group the first 4 hours postsurgery ($p < 0.016$).

score between the MEC and CSD groups at 1 hour postsurgery was not significant ($p = 0.144$); however, the VAS pain score was significantly lower in the CSD group than in the MEC group at each time point between 4 hours and 7 days postsurgery. The VAS pain score was lower in the CSD group than in the coblation group at each time point between 2 days and 7 days postsurgery.

Discussion

Tonsillectomy is among the most commonly performed otorhinolaryngologic surgeries. Postoperative morbidity (bleeding and pain), and time to return to normal diet and activity remain a concern as they can negatively affect patient health and quality of life. Traditionally, conventional techniques such as CSD and MEC have been used for tonsillectomy; however, the efficacy of newer tonsillectomy techniques, including coblation and harmonic scalpel, is being investigated. Nevertheless, there is a lack of consensus regarding which technique is associated with the lowest complication and morbidity rates; as such, the present study aimed to compare 3 tonsillectomy techniques in terms of postoperative pain, time to return to normal activity, surgical duration, and complications.

Post-tonsillectomy pain is an important factor that negatively affects oral intake and quality of life. It occurs due to mucosal cutting and transection of glossopharyngeal and/or vagal nerve fibers, followed by pharyngeal muscle spasm and inflammation.[5] Inadequate postoperative pain management can lead to dehydration, prolonged recovery, and normal activity limitations. It is known that pain assessment is a difficult task, as it is based on the subjective perception of pain, which can be affected by differences in pain thresholds leading to interpatient variability; however, as in earlier studies, pain evaluation in the present study relied on subjective VAS pain scores in adults and on the Wong-Baker scale in children. In the present study, the CSD group had lower pain scores than the MEC group 4 hours to 7 days postsurgery, which was supported by the lower number of analgesic tablets used in the CSD group than in the MEC group. Coblation was associated with significantly lower pain scores than MEC only during the early postoperative period (1 hour to 4 hours). Furthermore, the CSD group had lower pain scores than the coblation group during the late postoperative period (day 2 to day 7); however, the difference in analgesic use between the coblation and CSD groups was not significant.

Studies that compared tonsillectomy techniques have reported inconsistent findings. In one of the largest randomized controlled trials, Prussin et al. did not observe any difference in postoperative pain between MEC and coblation.[6] Of note, pain scores in their coblation group 1 day postsurgery were significantly lower than in their MEC group, which was mostly similar to the pain scores of MEC and coblation groups within 1 day postsurgery in the present study.[6] Tan et al. also did not note any difference in pain scores between their coblation and MEC groups; however, Magdy et al. reported that coblation was associated with less pain than MEC.[3,5] In contrast to MEC, coblation and CSD cause minimal thermal injury and it is therefore important to compare their other possible pain-causing effects. In an effort to do this, Shapiro et al. compared CSD and coblator-assisted adenotonsillectomies, but did not observe a significant difference in daily pain scores.[7] Moreover, a meta-analysis that included 3139 patients did not report any difference in postoperative pain between coblation, CSD, and MEC.[8] Subasi et al. confirmed these findings in pediatric patients; however, a meta-analysis of pediatric patients showed that coblation tonsillectomy causes less pain than CSD.[9,10] These conflicting results highlight the lack of strong evidence that coblation tonsillectomy has a positive effect on postoperative pain.[11]

Time to return to normal activity is another parameter clinicians can use to measure postoperative burden. The present study did not precisely define the meaning of 'normal,' which was determined individually by each patient. In the present study, time to return to normal activity was significantly shorter in the CSD group than in the MEC group. Although time to return to normal activity was shorter in the coblation group than in the MEC group, and longer in the coblation group than in the CSD group, the differences were not significant. Earlier studies reported findings similar to those in the present study regarding shorter return to normal activity for CSD versus coblation and MEC versus coblation.[6,7] Surgical duration is also an important factor affecting the choice of tonsillectomy technique. The level of surgeon experience, and familiarity with a particular technique and the equipment used is inversely correlated with surgical duration. In the present study, surgical duration did not differ according to surgical technique, whereas earlier findings are inconsistent. Paramasivan et al. and Ragab reported that surgical duration was shorter in their coblation group as compared with conventional methods; however, some studies report conversely that surgical duration was longer in the coblation group than in the MEC or bipolar scissors groups.[12–16] Stoker et al. did not observe any difference in surgical duration between coblation and electrosurgery groups, as in the present study.[17] A meta-analysis that compared coblation and conventional techniques did not note any differences in surgical duration.[8]

Post-tonsillectomy hemorrhage is a potentially life-threatening complication, with a reported incidence of 3.3 to 4.5%.[2,18,19] It sometimes subsides with outpatient recommendations or emergency room intervention; however, some cases require inpatient follow-up and surgical intervention to control the bleeding. In addition to tonsillectomy technique, patient age (pediatric versus adult) and tonsillectomy indication (chronic tonsillitis versus hypertrophy) are important factors that affect post-tonsillectomy bleeding. Given that MEC causes the most thermal injury, one may expect that it leads to more post-tonsillectomy bleeding; however, despite the fact that, in the present study, post-tonsillectomy bleeding occurred most commonly in the MEC group, the difference between the 3 groups was not significant. Earlier studies reported that coblation causes more post-tonsillectomy bleeding than other techniques; however, more recent studies on MEC versus coblation and CSD versus coblation report there are no differences in bleeding rates, which might be attributed to gains in surgical proficiency over time.[6,11,20–22] In contrast, a 2013 review reported that CSD was associated with the least delayed post-tonsillectomy bleeding.[23] Differences in the reported rates of post-tonsillectomy bleeding might be due to non-homogenous patient groups and nonstandardization of surgical techniques (e.g., using a combination of 2 techniques).

In addition to medical advantages and disadvantages, it is important to consider surgical cost and waste when choosing the tonsillectomy technique, especially because tonsillectomy is among of the most commonly performed otolaryngologic surgeries worldwide. Meiklejohn et al. recently investigated these factors and reported that CSD was associated with the least waste and the lowest cost, as compared with MEC and coblation.[24]

The retrospective nature of the present study is a limitation, which we think is compensated for by an unbiased cross-sectional design. As the present study included pediatric and adult patients, the associated heterogeneity of the study population can make it difficult to generalize the results. In addition, bipolar diathermy was used in the CSD group when necessary, which may have had a confounding effect. Given the small number of patients in the present study, additional well-designed, larger scale, prospective and randomized trials are warranted to clarify which tonsillectomy technique is the best.

Conclusion

Cold steel dissection is better than MEC in terms of post-tonsillectomy pain and recovery. Coblation is better than MEC in terms of pain only during the very early postoperative period (1 hour to 4 hours). The risk of complications is similar for CSD, MEC, and coblation. In general, CSD can be considered much better than MEC and slightly better than coblation.

Funding Sources

The present research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interests

The authors have no conflict of interests to declare.

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