

Comparison of Two Techniques in Pediatric Tonsillectomy: Erbe Unipolar Electrocautery and Thermal Welding System

ABSTRACT

Objective: The aim of our study was to compare the tissue damage in pediatric tonsillectomy operations performed with Erbe unipolar electrocautery (EUE) and the thermal welding system (TWS).

Methods: This prospective study included patients who had tonsillectomy for recurrent tonsillitis. In the study, 23 patients had tonsillectomy with EUE and 20 had tonsillectomy with TWS. The Faces Pain Scale (FPS) was used for pain assessment on the 1st, 5th and 10th days postoperatively. On postoperative 5th and 10th days, the healing process in the operation sites was evaluated according to fibrin coverage of tonsil beds, with the Visual Analog Scale (VAS). The removed tonsil specimens were evaluated by a single blinded pathologist, to determine deepest necrosis depths and thermal effect under a light microscope (Olympus BX41).

Results: In the study 23 patients who had tonsillectomy with EUE and 20 patients who had tonsillectomy with TWS were included. There was statistically significant difference in the pain scores between the first and fifth days, and in the morphologic intensity of the thermal effect, in favor of the TWS group ($P < .05$). The VAS scores of the healing process in the postoperative 5th and 10th days were slightly better in the TWS group, but the difference was not statistically significant ($P > .05$). Also, there was no statistically significant difference found between the 2 techniques regarding the deepest necrosis depths ($P > .05$).

Conclusions: In our study, tonsillectomy with TWS was found to cause less tissue damage in the surrounding tissue and less pain in the early postoperative period, than EUE.

Keywords: Electrocautery, pain, thermal welding, tonsillectomy



INTRODUCTION

Tonsillectomy is one of the most frequently performed operations in children.¹ The common indications for tonsillectomy operations are recurrent infection and tonsillar hypertrophy with upper airway obstruction.^{1,2}

With the improvements in anesthesia and surgical techniques, the mortality rates of tonsillectomy have decreased. However, postoperative hemorrhage and pain remain the most frequent morbidities.^{3,4} Various surgical methods have been developed to improve outcomes of this surgery over the years. The most commonly used techniques and technologies for performing tonsillectomy are cold steel dissection, electrocautery, coblation, thermal welding system (TWS), and laser. Although these current techniques and technologies provide different advantages, there is still no consensus about the optimal technique and/or technology with minimal postoperative pain and maximum safety in tonsillectomy.^{5,6}

In this study, we compared 2 frequently used and relatively low-cost techniques, the Erbe unipolar electrocautery (EUE) dissection technique, and the TWS dissection technique according to postoperative pain, wound healing, and tissue damage.

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METHODS

This prospective study was reviewed and approved by the Koc University Review Board.

Forty-three patients who underwent tonsillectomy between December 2017 and December 2018, with a diagnosis of recurrent tonsillitis, were included in the study. Caregivers or parents were given verbal and written information by their surgeon before the operation, and all accepted inclusion to the study and signed the informed consent form.

All surgeries were performed by otolaryngologists, who used only TWS or EUE in their own practice. All surgeons were substantially experienced with their method of choice. The patients were positioned properly for the tonsillectomy operation, with a shoulder roll and a Crowe-Davis retractor, and precautions were also taken during positioning.

Total Extracapsular Tonsillectomy was Performed Under General Anesthesia in All Patients

TWS consists of a universal power supply (UPS: Starion Instruments Corp., Sunnyvale, CA, USA) with power level set to 4 for tonsillectomy, sterile forceps (ENTceps; Starion Instruments Corp., Sunnyvale, CA, USA) and a double-controlled foot pedal. The ENTceps were used to grasp the superior pole and to dissect the anterior pillar. Ablation and cutting were done with the forceps, from superior to inferior pole. The same forceps were used to control minor bleeding and also used to prevent bleeding from intact blood vessels in the operation area. If bleeding persisted, pressure application and suturing with 3/0 vicryl were performed to achieve hemostasis.

The EUE device was set at a maximum of 20 W, effect II blend mode. The electrocautery was insulated, down till 3-4 mm to the tip. The incision was started from the superior pole and then the dissection was done from the tonsillar capsule to the inferior pole. Similar to the TWS technique, EUE was used to control minor bleeding and to coagulate intact blood vessels in the operation area. In case of persistent bleeding, pressure application and suturing with 3/0 Vicryl were also performed.

To enable realistic evaluation the postoperative pain, no other device for cauterization was used for bleeding in all operations.

After the operation, all patients stayed in the hospital for 1 night and were discharged on the following day. The pain control medication prescribed for all patients was paracetamol, 15 mg/kg

every 4-6 hours on an as-needed basis, and 40 mg/kg/day amoxicillin clavulanic acid was prescribed for all patients for 5 days.

An otolaryngologist, who did not perform the operations and was blinded to the tonsillectomy technique, evaluated the tonsil bed healing process on the postoperative 5th and 10th days according to fibrin coverage of the tonsil bed, with the Visual Analog Scale (VAS).

For pain level assessment, the Faces Pain Scale was used, which consists of a series of 6 faces ranging from neutral expression to expression of the maximum possible pain during eating, on the 1st, 5th, and 10th days postoperatively before taking any analgesics.⁷ All of the caregivers were instructed on the use of this scale preoperatively, with no pain scored as 0 and the worst pain scored as 5. The same diet instructions were given to all caregivers.

The removed tonsil tissues were fixed in buffered 10% neutral formaldehyde and sent to the pathology laboratory. After sectioning, the tonsils were buried in paraffin blocks, which were cut in 4-5 μ sections and stained with the hematoxylin-eosin method. Thermal effect and deepest necrosis depths under light microscope (Olympus BX41) were examined by the same pathologist. The thermal effect was measured at the areas with most intensive necrosis and graded according to morphological intensity as 1=mild (closest to normal tissue), 2=medium (tissue partially selectable), and 3=heavy (tissue with complete loss of normal histology). The deepest necrosis depth was measured with the 3DHISTECH CaseViewer device. In each specimen, the longest distance between the surface of the tissue (where the thermal injury was the most) and the normal tissue border was recorded as the deepest necrosis depth. Images were also photographed with the 3DHISTECH CaseViewer device.

All statistical analyses were performed with Microsoft Excel for Mac 2011 Software, Version 14.5.9. The pain scores, tonsil bed healing scores and level and depth of tissue damage were compared between the groups of the 2 different surgical techniques, using the independent samples *t*-test.

RESULTS

Forty-three patients were included in the study. The tonsillectomy operation was performed with EUE in 23 patients and with TWS in 20 patients.

The mean patient age was 5.65 years in the EUE group and 5.3 years in the TWS group. Totally 10 boys and 13 girls were in the EUE group, and 9 boys and 11 girls were in the TWS group. No statistically significant difference found between 2 groups' demographic data ($P > .05$).

In patients who were operated on with the EUE technique, the pain score average was 3.74 on the postoperative first day and was 0.78 on the fifth day. There was no pain defined on the postoperative 10th day.

Among patients operated on with TWS, the pain score average was 3.20 on the postoperative first day and 0.25 on the fifth day. There was no pain defined on the postoperative 10th day.

MAIN POINTS

- Thermal tissue effect and deepest necrosis depth measurement of pathologic specimens are correlated with postoperative pain and healing scores.
- In pediatric tonsillectomy, the thermal welding system (TWS) is associated with less surrounding tissue damage according to pathological evaluations.
- In the early postoperative period, TWS is related to less tissue damage, less pain, and rapid tonsil bed healing, compared to Erbe unipolar electrocautery (EUE).

In both groups, no primary or secondary postoperative bleeding—in the first 24 hours or later—was observed.

The 2 techniques were compared in terms of postoperative pain scores. The difference between the 2 groups' postoperative pain scores on the first ($P = .003$) and fifth ($P = .011$) days was found to be statistically significant, whereas the pain score difference on the 10th day was not statistically significant ($P > .05$).

In patients operated with EUE, deepest the necrosis depth levels were between 190 and 630 μm (mean 333 μm). In patients operated with TWS, the deepest necrosis depth levels were between 170 μm and 517 μm (mean 272 μm). Regarding deepest necrosis depths, the difference between 2 techniques was not statistically significant ($P > .05$).

In the pathologic evaluation of thermal effect in specimens, the mean value was 2.78 in the EUE group and 2.30 in the TWS group. Between the 2 groups, the difference was found to be statistically significant ($P = .01$). (Figure 1A, B, and C, Figure 2A and B)

The techniques were also evaluated regarding the VAS scores for postoperative healing in the tonsil bed. On the postoperative 5th day, average fibrin coverage score of the tonsillar bed was 8.43 in the EUE group and 8.60 in the TWS group. On the postoperative 10th day, the average fibrin coverage score of the tonsillar bed was 2.09 in the EUE group and 1.55 in the TWS group. The mean of the healing degree score in the tonsil bed was found to be slightly higher in the TWS group, but the difference was not found to be significant statistically ($P > .05$).

The statistical evaluation results are summarized in Table 1.

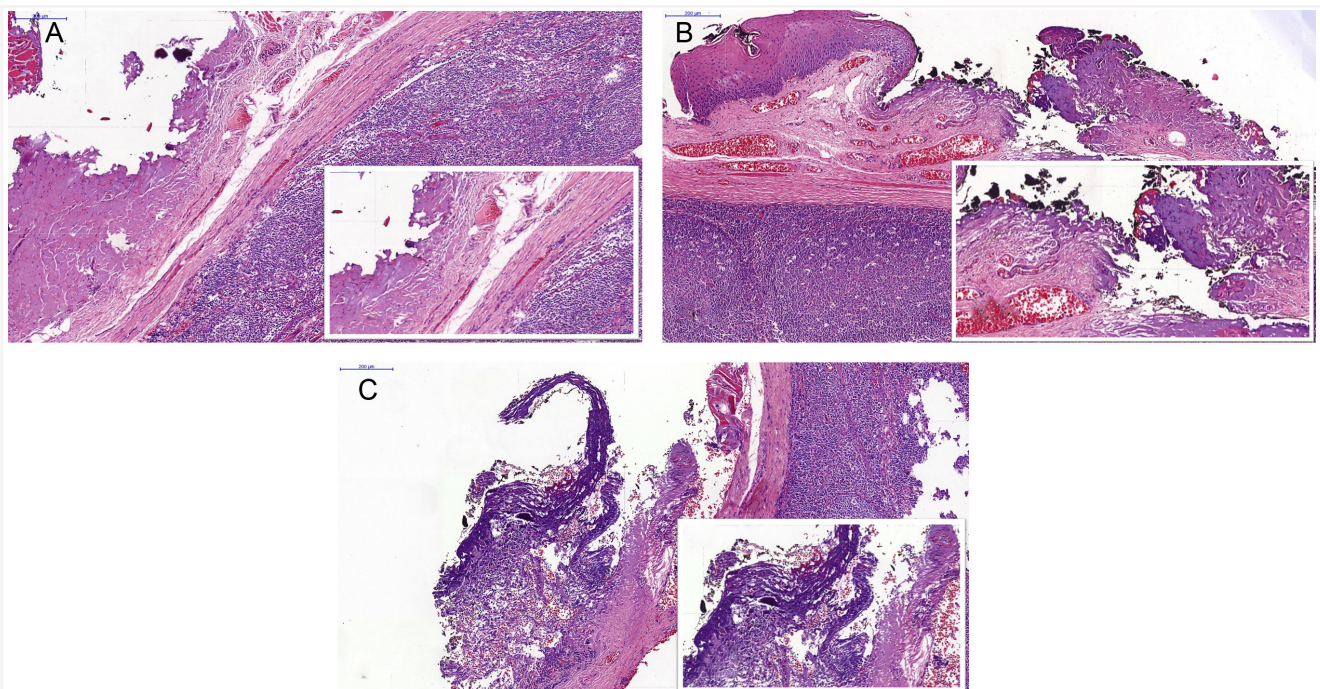


Figure 1. a-c. The thermal effect graded according to morphological intensity with 3DHISTECH CaseViewer. +1, mild, closest to normal tissue (A1-A2); +2, medium, tissue partially selectible (B1-B2); +3, heavy tissue, complete loss of normal histology (C1-C2), (A1, B1, C1 in 10 \times magnification, a2, b2, c2 in 20 \times magnification).

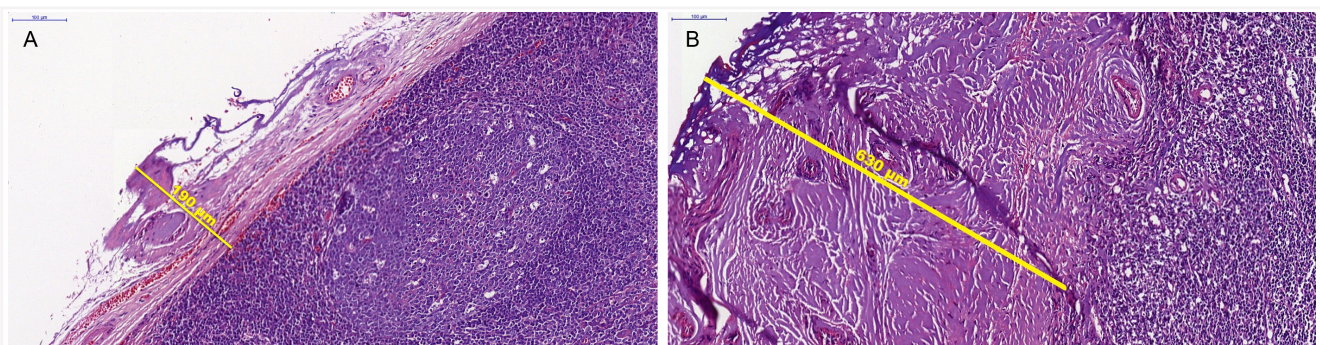


Figure 2. a-b. (A) Two different tonsillar necrotic depths are shown in 20 \times magnification with 3DHISTECH CaseViewer. (B) Two different tonsillar necrotic depths are shown in 20 \times magnification with 3DHISTECH CaseViewer.

Table 1. Erbe Unipolar Electrocautery (EUE) and Thermal Welding (TWS) Tonsillectomy - Pain Scores of the 1st and 5th days, Deepest Necrosis Depth, Thermal Effect, the Healing Scores of the 5th and 10th days, and Statistical Evaluation Results

	Erbe Unipolar Electrocautery Group (Mean Values)	Thermal Welding Group (Mean Values)	Statistical Evaluation (<i>P</i> < .05)
1st day pain score	3.74	3.20	.003
5th day pain score	0.78	0.25	.011
10th day pain score	0	0	>.05
Deepest necrosis depth	33.30	27.20	.09
Thermal effect	2.78	2.30	.01
5th day tonsil bed healing	8.43	8.60	.68
10th day tonsil bed healing	2.09	1.55	.12

No statistical analyses were performed for 10th days' pain scores, which were 0 in both groups

DISCUSSION

After tonsillectomy operations, pain is usually observed because of open mucosal wounds, tongue compression with oral retractors, and/or inflammation in the surrounding soft tissue.^{4,8,9}

Postoperative pain after tonsillectomy not only causes morbidity with oral intake restriction and activity limitation, it restricts the pharyngeal muscle activity and decreases the tonsil bed clearance, which may cause infection and bleeding.^{3,10}

There are many different technologies, like coblation, plasma blade, argon plasma coagulation, EUE, and TWS, which are being used in tonsil surgery. All these techniques have been developed to decrease postoperative pain and to improve quality of life after tonsil surgery, but limited data are available on these aspects for most of these parameters and larger comparative studies are still needed to name the gold standard in tonsillectomy technique.^{5,11,12}

In our study, we compared the 2 frequently used tonsillectomy techniques/technologies, EUE and TWS, in terms of clinical and pathologic outcomes in children. We did not find any similar study comparing the pathological evaluation of tissue damage of these 2 techniques in the literature.

Both EUE and TWS have the disadvantage of using high temperature, causing pharyngeal spasm as a result of damage in the surrounding mucosal and muscular tissue. Electrocautery devices sometimes create more than 400°C temperature for tissue ablation.^{13,14,15,16} The Erbe device produces constant voltage and variable wattage, whereas conventional devices produce variable voltage and constant wattage. In conclusion, while working with the conventional electrocautery devices, the type of tissue encountered has no effect in the device's working parameters. However, the Erbe device maintains constant voltage, with varying wattage appropriate to tissue resistance. Stanford et al.¹⁷ demonstrated that Erbe electrocautery causes less acute injury in the surrounding tissue than conventional cautery.

In TWS, a thin wire filament generates the heat, which reaches 300-400°C, to dissect and coagulate the tissue. TWS has an insulating element, to prevent unnecessary tissue damage while using this method. This insulating element helps to keep temperature below 100°C at distances greater than 500 µm from the

TWS active part located at the jaw of the instrument. This may cause less tissue damage in pharyngeal musculature, leading to less pharyngeal spasm and less postoperative pain.^{3,6} In their study, Sanlı et al.⁶ also concluded that in terms of tissue damage, TWS is a reliable method compared to other hot-tonsillectomy techniques.

In our study, the TWS technique resulted in less pain on the first and fifth days. Correspondingly the deepest necrosis depth levels were slightly higher in the EUE group, but this difference was not found to be significant statistically. On the other hand, the higher thermal tissue effect in the EUE group was found to be statistically significant. Karatzias et al.¹⁸ compared TWS, and bipolar electrocautery techniques, and they found significantly less pain and no thermal injury in surrounding tissues in the TWS group. They also reported slight edema in peritonsillar area and uvula in bipolar electrocautery group. However, Cunningham et al.¹⁵ reported no statistically significant difference in pain levels with electrocautery and TWS.

The VAS results of tonsil bed healing and the necrosis depth were slightly better in the TWS group in our study. These are in parallel with thermal effect evaluation results, also concordant with the TWS working principle. Similar to our results, Ozkiris et al.¹⁹ reported that the amount of re-epithelization of the tonsillar fossae was better in the TWS group, compared with the bipolar electrocautery dissection technique.

The extent of thermal tissue damage and the pain levels of the first and fifth days were correlated, and found to be significantly less in the TWS group in our study. Accordingly, evaluation of the thermal tissue damage can give a clue about the probable postoperative pain status of the patients for any tonsillectomy technique, which affects the timing of patients' discharge from hospital and the total cost of these operations.

Bogrul et al.⁸ also reported that the pathologic evaluation of the tonsil bed better reflects the surrounding tissue damage. The measurement of necrosis depth in the tonsillectomy specimen, and its correlation with postoperative pain levels, supports this assumption.

Hinton-Bayre et al.²⁰ reported in a review of techniques used by consultant surgeons that there was no significant difference in secondary posttonsillectomy bleeding across the group. They also mentioned that the surgical experience is probably more

important than the technology of the equipment used in these operations, as a risk factor for bleeding. We did not observe secondary postoperative bleeding in any patient.

In our study, pathologic examinations are performed in tonsillectomy specimens, instead of tonsil bed specimens, which would directly reflect the healing process. Such a study can be designed on animal models.

CONCLUSION

Of the many factors which lead surgeons to prefer a certain tonsillectomy technique, postoperative pain is one of the most important. The necrosis depth in tonsillectomy specimens and the pathologic evaluation of the thermal tissue damage correlate with postoperative pain and healing. In our study, tonsillectomy with TWS was found to cause less tissue damage in the surrounding tissue, according to pathologic evaluation, and causes less postoperative pain than EUE. Furthermore, before using a new technology in tonsil surgeries, evaluating surrounding tissue damage may give an idea about the expected level of the pain after these surgeries.

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