Traditional Tonsillectomy Compared With Bipolar Radiofrequency Thermal Ablation Tonsillectomy in Adults

A Pilot Study

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Objectives: To assess the morbidity and efficacy of bipolar radiofrequency thermal ablation tonsillectomy and compare it with traditional cold dissection tonsillectomy with diathermy hemostasis.

Design: Prospective, randomized, single-blinded, controlled clinical study.

Setting: Helsinki University Central Hospital, Department of Otorhinolaryngology–Head & Neck Surgery, Helsinki, Finland.

Patients: Forty healthy volunteer patients aged 18 to 65 years admitted for elective tonsillectomy with recurrent or chronic tonsillitis, obstructive tonsillar hypertrophy, or history of quinsy. Two patients were excluded from the study and 1 patient cancelled the operation.

Interventions: Nineteen patients underwent a traditional cold dissection tonsillectomy with diathermy hemostasis, and 18 patients underwent a bipolar radiofrequency thermal ablation tonsillectomy. There was no intergroup difference in age, sex, weight, and indications for tonsillectomy. The subjects were not informed of the type of procedure until the telephone interview 3 weeks after the operation.

Main Outcome Measures: Operating time and intraoperative blood loss; need for anesthetics during the operation; different recovery indicators in the recovery room (ie, duration and medications administered), surgical ward (ie, medications administered, use of corticosteroids, general condition, and status of the uvula on the first postoperative day), and in the 2 weeks following surgery (ie, visual analog scale scores on 6 symptoms, medications needed, the day patients returned to work, use of antibiotics, and retreatment acceptance); and complications and certain laboratory parameters.

Results: There was a statistically significant but clinically insignificant difference in operating time and intraoperative blood loss in favor of the traditional tonsillectomy group. The other outcome measures showed no statistically significant differences.

Conclusion: Bipolar radiofrequency thermal ablation and traditional tonsillectomy were associated with similar postoperative morbidity.


Tonsillectomy is one of the most common surgical procedures performed worldwide. Over the years, various techniques and instruments have evolved to accomplish this operation and have a long history; in fact, the first description of tonsillar removal as a medical procedure is from the first century AD.1

There is still controversy over which is the optimal technique of tonsillectomy with the lowest morbidity rates. The described techniques are blunt dissection, guillotine excision, cryosurgery, monopolar and bipolar diathermy dissection, suction diathermy dissection, bipolar scissor dissection, microscopic bipolar diathermy dissection, ultrasonic removal, and laser dissection.2-10 A few centers perform guillotine excisions, and tonsillotomies are also performed for certain indications.11 All the techniques have certain advantages and disadvantages. Any improvement of this procedure should decrease operating time, blood loss, postoperative hemorrhage, and particularly the postoperative morbidity. With the growing interest in day-case surgery, quick techniques with rapid recovery are favored.

Unlike most operative procedures, which are closed primarily, tonsillectomy produces an open wound that heals by secondary intention. The major postoperative morbidity problems are pain and delayed hemorrhage. The pain is the result of disruption of mucosa and glossopharyngeal and/or vagal nerve fibers followed by inflammation and spasm of the pharyngeal muscles that leads to ischemia and a protracted cycle of pain; it does not completely subside until the muscle becomes covered with mucosa 14 to 21 days after sur-
PATIENTS, MATERIALS, AND METHODS

This study was prospective, randomized, and single blinded. The study protocol was reviewed and approved by the research ethical committee of the Department of Otorhinolaryngology–Head & Neck Surgery, Helsinki University Central Hospital, Helsinki, Finland. Written informed consent was obtained from all patients. Forty patients aged 18 to 65 years admitted for elective tonsillectomy at the ENT unit of Helsinki University Central Hospital entered the study. The indications for tonsillectomy were recurrent infections, chronic infection, airway obstruction, or history of quinsy. Exclusion criteria included patients with bleeding disorders and any significant chronic illness that would interfere with expected recovery. The electrosurgery system was also contraindicated in patients with pacemakers or other electronic device implants. Each patient was randomly assigned to either the TEtrad or TErrfa group by the surgeon’s picking a card from a pack of cards. None of the nursing staff taking care of the patient was aware of the group in which the patient was randomized, and the subjects were not informed of the type of procedure until the telephone interview 3 weeks after the operation. The first author (L.B.) did all the procedures, and the same anesthesiologist (M.P.) administered the anesthesia.

A standardized anesthetic technique was used in all patients. The preoperative inquiry was based on a questionnaire completed by the patient. Premedication, if requested by the patient, consisted of 10 mg of oral diazepam. After 2 µg/kg of intravenous fentanyl citrate was administered, anesthesia was induced with an injection of 10 mg/kg of propofol, and 3% isoflurane in oxygen was administered by endotracheal intubation without neuromuscular block. Prior to the start of the tonsillectomy, an additional dose of 1 µg/kg of fentanyl citrate was administered. Anesthesia was maintained with 65% nitrous oxide in oxygen and isoflurane in necessary concentrations (1–2 minimum alveolar concentration). An additional dose of fentanyl was given, if necessary, according to autonomous nervous system signs (eg, a sudden increase in heart rate or blood pressure and reduction of the plethysmographic pulse amplitude). In the recovery room, 0.05 mg/kg of intravenous oxycodone was administered to relieve immediate postoperative pain, and a dose of 0.1 mg/kg of intramuscular oxycodone was allowed in the surgical ward for intractable pain. The numbers of required analgesic doses were used to differentiate the patients between the groups.

The patients were prepared in accordance with our standardized guidelines for tonsillectomy in both groups. Routine prophylactic antibiotic agents were not prescribed. Traditional tonsillectomy was initiated by an incision overlaying the superior pole of the tonsil. The dissection proceeded along the tonsillar fossa in the peri-tonsillar plane keeping as close to the tonsil capsule as possible. Hemostasis was achieved by the application of pressure with packs, and persistent出血 was controlled by a bipolar diathermy coagulation of vessels. The bipolar ENTEC Coblator Plasma Surgery System and ENTEC Plasma Scalpel wand (ArthroCare Corporation) were used in the TErrfa technique. The wand comprises 3 active electrodes located at the distal end of the tip with the exposed portion of the shaft acting as the return electrode just proximal to the active electrodes. Cooled saline was connected to the wand and set to a flow rate of 1 to 3 drops per second through the saline delivery channel. A different suction line was used. The power was set to levels 5 to 7 (192–260 Vrms) during the ablation, and in case of bleeding the coagulation mode was applied. The Coblation tonsillectomy proceeded slowly along the capsular plane. If there was more bleeding or if the wand did not seal the vessel within 5 seconds, the point diathermy coagulation was applied. In both groups, the tonsillar beds were irrigated with water to localize smaller bleeding vessels.

The time taken to perform the operation was measured from the first incision to the removal of the mouth gag. The intraoperative blood loss was measured by volume of suction aspirate. The need for anesthetics during the operation, the time spent in the recovery room, and the need for pain medications in the recovery room were recorded.

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In the surgical ward we registered the need for treatment with pain medications and corticosteroids during the first postoperative day and recovery status the morning after surgery, including patients’ general condition as graded 1 to 4 (grade 1, no problems; grade 2, a minor problem with pain, nausea, or difficulty swallowing, but normal hospital discharge; grade 3, left the hospital in the evening of the postoperative day because of pain, nausea, or difficulty swallowing; and grade 4, stayed in the hospital an additional day because of pain, nausea, or difficulty swallowing) and the swelling of uvula as graded 1 to 3 (grade 1, no swelling; grade 2, the tip of the uvula is swollen but not lying on the tongue base; and grade 3, the tip of the uvula is swollen and lying on the tongue base).

We measured C-reactive protein values, leukocyte counts, and erythrocyte sedimentation rates before surgery and 1 day and 2 weeks postsurgery to evaluate the inflammatory host response induced by the procedure.

The use of a visual analog scale (VAS) has been firmly suggested as a reliable method for reporting pain and other symptoms. Patients were asked to grade their symptoms with a VAS and to start the recording on the evening after surgery. They drew a vertical line crossing a 100-mm line where 0 indicated no symptoms and 100, very intense symptoms. The symptoms evaluated were pain, a swelling sensation of the soft palate, difficulty drinking, difficulty eating, difficulty opening the mouth, and difficulty speaking. On discharge, all patients were given a questionnaire to be completed during the next 2 weeks; they were also asked to keep a diary of the doses and frequency of pain medication use.

The patients were prescribed analgesia as required (100 mg of ketoprofen and a combination of 500 mg of acetaminophen and 30 mg of codeine phosphate). In the analysis of the amount of pain medications used, we converted the milligrams into doses related to the maximum amount of the medication recommended per day (for ketoprofen at 300 mg/d, 1 dose=100 mg; ibuprofen at 3200 mg/d, 1 dose=1000 mg; combination of 500 mg of acetaminophen and 30 mg of codeine phosphate in 8 tablets/d, 1 dose=1 tablet; and tramadol hydrochloride in 8 tablets/d, 1 dose=1 tablet). The total number of doses taken by group A (those treated with ketoprofen, ibuprofen, and acetosalicylic acid) and group B (those treated with acetaminophen-codeine and tramadol) were calculated in 3 different periods: 3 days, 7 days, and 2 weeks.

Three weeks after surgery, the first author (L.B.) conducted a telephone interview with each patient. All the bleeding episodes were evaluated according to the following: (1) by report only; (2) witnessed (patients were observed and treated conservatively); (3) treated with local care; and (4) controlled in the operating room. Primary bleeding occurred during and secondary bleeding after the first 24 hours postoperatively. We also asked about any eventual antibiotic requirement, the day each patient returned to work, and each patient’s retreatment acceptance.

We chose a clinically significant difference of 20 mm on the VAS, which is considered reasonable. A sample size of 15 patients per group was calculated to reveal a clinically significant difference of 20 mm on the VAS with a probability of 80% in our power calculations.

The Friedman test was used to determine whether changes from the baseline to the final measurements in the laboratory parameters were significant. Pairwise multiple comparison procedures with the Dunnett method were performed if the change was significant. Nonrepeated, nonparametric data were compared using the Mann-Whitney test (MWT). For the VAS scores, area under the curve (AUC) values were calculated from the time points of postoperative days 1 through 14 to evaluate the total discomfort of the 14 postoperative days. Day-by-day calculations were made using the MWT. A learning curve of the new TErfta method was drawn to evaluate the influence of experience on operating time and intraoperative blood loss. Correlations were calculated using nonparametric Spearman rank correlation.

Results are expressed as medians and range, and they were generated using a computerized statistical package (SPSS version 9.0 and Sigma Stat version 3.0; SPSS Inc, Chicago, Ill). We considered P<.05 to be statistically significant.
ferences between the groups in the occurrence and man-
agement of primary and secondary bleeding (\(P = .56\) and 
\(P = .82\), respectively, MWT). In 2 (5%) of 37 patients the he-
mostasis was performed in the operating room, and in 7
(19%) of 37 patients the bleeding was managed locally
(Figure 2). Regarding the general condition of the pa-
tients and the swelling of the uvula the morning after sur-
gery, the use of antibiotics and the patients’ retreatment
acceptance showed no statistically significant differ-
ences (Figure 3). The patients in both groups returned
to work in a median time of 14 days (range, 14-27 days
[TEtrad group] vs 14-21 days [TErfta group]; \(P = .92\,
MWT).

The VAS questionnaires on the different symptoms
showed no statistically significant differences either in
the day-by-day analysis \((P > .05, \text{MWT})\) or in the whole
postoperative period analysis \((P > .05 \text{ for AUC, MWT;}
Figure 4). The use of pain medications during the post-
operative periods of 3 days, 7 days, and 2 weeks did not
show statistically significant differences between the
groups \((P > .05, \text{MWT; Figure 5}).

The laboratory parameters showed a statistically sig-
nificant change from the baseline to the final measure-
ments, suggesting that an inflammatory host response is
induced by the procedure \((P < .001, \text{Friedman test}).
According to the pairwise multiple comparison proce-
dures with the Dunnett method, the change in the eryth-
rocyte sedimentation rate was statistically significant on
the first postoperative day and 2 weeks after the opera-
tion with both techniques. A statistically significant change
occurred in C-reactive protein values for both tech-
niques in the first postoperative day, but in the TErfta
group this statistically significant change also occurred
2 weeks postsurgery. Thus, the only difference between
the groups was a statistically significant C-reactive pro-
tein value change in the TErfta group but not in the
TEtrad group (Figure 6).

### Demographic Data of the TEtrad and TErfta Groups

<table>
<thead>
<tr>
<th></th>
<th>TEtrad</th>
<th>TErfta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median (range) age, y</td>
<td>31.0 (20-50)</td>
<td>29.5 (19-63)</td>
</tr>
<tr>
<td>Sex, M/F</td>
<td>7/12</td>
<td>8/10</td>
</tr>
<tr>
<td>Median (range) weight, kg</td>
<td>69 (52-116)</td>
<td>74 (54-113)</td>
</tr>
<tr>
<td>Chronic and/or recurrent tonsillitis</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>History of quinsy</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
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* TEtrad indicates traditional tonsillectomy; TErfta, bipolar radiofrequency thermal ablation (Coblation [Arthrocare Corporation, Sunnyvale, Calif] tonsillectomy. Unless otherwise indicated, data are number of patients.
Figure 3. The 2 operative techniques, traditional tonsillectomy (TEtrad) and bipolar radiofrequency thermal ablation (Coblation) tonsillectomy (TErfta), compared in relation to 3 recovery parameters (A, uvula swelling; B, general condition; and C, need for antibiotics) following tonsillectomy and the retrement acceptance (D).

Figure 4. The visual analog scale (VAS) scores obtained daily for 2 weeks on different symptoms (A, pain; B, swelling sensation; C, difficulty drinking; D, difficulty eating; E, difficult opening the mouth; and F, difficulty speaking) following elective tonsillectomy with the traditional tonsillectomy (TEtrad) and bipolar radiofrequency thermal ablation (Coblation) tonsillectomy (TErfta) techniques. The data points represent the median value for the group on each day.
The variations on the learning curves in the TErfta group on operating time and intraoperative blood loss diminished, but they showed no statistically significant correlations with the number of procedures performed: nonparametric Spearman rank correlation for number vs operating time was $r = 0.185$ ($P = .46$) and for number vs intraoperative bleeding, $r = -0.099$ ($P = .70$; Figure 7).

**COMMENT**

The reduction of posttonsillectomy morbidity is important, not only for patient comfort, but also because reducing pain improves oral intake, reducing the risk of dehydration, infection, and postsurgery hemorrhage. Electrosurgical instruments and lasers all achieve cutting and simultaneous hemostasis by sealing the blood vessel lumina by virtue of tissue heating. Several studies support the hypothesis that the extent of diathermy used in tonsillectomy has a direct influence on the delayed postoperative morbidity and healing of the mucosal wounds. The degree of pain must be related to the degree of soft tissue damage.

Radiofrequency current applied to surgical tools was used to generate a plasma field to remove tissue volume without heat as the primary means. This technology (Coblation) is fundamentally different from electrocautery and monopolar thermal radiofrequency ablation. Bipolar administration of radiofrequency current results in less electricity being leaked to distant tissues, theoretically decreasing the morbidity following tonsillectomy.

Questionnaires were used extensively in this investigation to gather data on the subjective variables such as pain, swelling sensation of the soft palate, swallow-
ing problems, and difficulties opening the mouth and speaking. Pain is moderate or intense after tonsillectomy and requires treatment with pain medication for up to 2 weeks, even if laser equipment is used.

Our aim was to evaluate several different postoperative symptoms in our VAS questionnaires, and we thought that it would be difficult to evaluate differences between sides. Therefore we chose to randomize the patients into 2 treatment groups.

Our study did not show a statistically significant difference in postoperative morbidity between the 2 techniques, TEtrad and TEftra. Differences in intraoperative blood loss and operating time were statistically significant but clinically insignificant in otherwise healthy adults (median time, 18 minutes for the TEtrad group [range, 12-33 minutes] and 27 minutes for the TEftra group [range, 18-43 minutes]; median blood loss, 20 mL for the TEtrad group [range, 5-100 mL] and 80 mL for the TEftra group [range, 5-300 mL]).

Although there were no statistically significant differences between the groups in the occurrences of primary and secondary bleeding, their frequencies were higher than usual in our practice. This might have been a function of the study setting (ie, the patients were advised to contact the ENT ward immediately when there were signs of bleeding) or chance.

During the operation, the need for diathermy was common in the TEftra group, indicating there might be deeper thermal damage to the surrounding tissue. Thus, both groups sustained the same thermal injury at least in portions of the tonsillar beds, and the possible benefit of TEftra was eliminated by the use of cautery. This can affect the postoperative morbidity in a significant manner. In 1 patient in the TEftra group, the peritonsillar plane was partly obliterated by scar tissue, and sharp scissor removal was therefore required. When learning a new technique, these procedural flaws may be corrected; however, this was not shown in this pilot study with small groups. Apparently the Coblation technique does not positively affect the factors that cause postoperative pain. The laboratory parameters showed minor differences in the inflammatory host response in favor of the TEtrad group, but its clinical significance cannot be evaluated in this study.

CONCLUSIONS

Patients with elective TEftra did not show any significant advantages compared with the traditional technique in this study. Both techniques were safe and resulted in similar postoperative morbidity. The controversy is not resolved over which tonsillectomy technique is preferable and which has the lowest morbidity rates.

Accepted for publication March 27, 2001.

This study was supported by the Helsinki University Central Hospital Funds.

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REFERENCES