Monopolar tonsillotomy versus cold dissection tonsillectomy in children : Prospective study on postoperative recovery

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ABSTRACT

OBJECTIVES: To compare postoperative self-reported recovery results with monopolar tonsillotomy and cold dissection tonsillectomy in children. To evaluate the feasibility of the monopolar technique in tonsillotomy.

METHODS: Children <12 years undergoing tonsillotomy or tonsillectomy between April 2018 and March 2020 who (with a caregiver) were willing to participate in a two-week follow-up formed the study group. They filled in a questionnaire about pain-related outcomes, return to normal activities, weight changes, complications, and length of home care.

RESULTS: Altogether 166 patients were recruited; 103 (62%) returned the questionnaire. The first pain-free day with tonsillotomy was day 5 and with tonsillectomy day 11. After tonsillotomy, patients returned to normal activities faster, e.g. they were able to eat normally 6.5 days earlier than tonsillectomy patients. During the first postoperative week weight dropped after tonsillectomy, but not after tonsillotomy. The length of home care was 6 days with tonsillotomy and 10 days with tonsillectomy. The incidence of postoperative hemorrhage (including minor bleedings at home) was 14% after tonsillotomy and 32% after tonsillectomy. Hemorrhages needing interventions were 0% with tonsillotomy and 2% with tonsillectomy.

CONCLUSION: Children operated on with monopolar tonsillotomy recovered faster and had less postoperative hemorrhage than those undergoing tonsillectomy. They were able to return earlier to

daycare/school and their caregivers back to work. Recovery results with monopolar tonsillotomy were equal to other tonsillotomy techniques reported in the literature, hence the monopolar technique can be considered an alternative method to perform tonsillotomy.

Keywords: Tonsil surgery; Weight loss; Postoperative hemorrhage; Home care

1. INTRODUCTION

Tonsil surgery is among the most common surgeries performed on children worldwide and tonsillectomy (TE) (with or without adenotomy) has earlier been the treatment of choice regardless of tonsil surgery indication [1-4]. TE causes moderate to severe pain lasting several days postoperatively [5, 6]. Many children also suffer from nausea, vomiting, dehydration, poor oral intake, and fever [7-12]. Moreover, there is a risk for postoperative hemorrhage, which may cause significant morbidity, even mortality [13-15]. In recent years, partial TE or tonsillotomy (TT) has replaced TE as the treatment for tonsillar hypertrophy in children with sleep-disordered breathing (SDB) [4, 16, 17]. Compared with TE, TT is associated with less postoperative complications and pain and faster return to daily activities [13, 18, 19]. TT has also been shown to have similar long-term benefits on SDB symptoms as TE [20].

Several tonsillar reduction techniques for TT exist, including microdebrider, coblation, CO2-laser, surgical scissors, radiofrequency, monopolar needle, and bipolar forceps [21]. None of the methods has been shown to be superior to the others [22]. They all aim to reduce tonsillar tissue

and leave the tonsillar capsule and surrounding muscles intact. There are only a few studies where TT has been performed with monopolar electrocautery, even though a monopolar device is found in every operating room. Eviatar et al. [23] reported monopolar TT to be as effective as TE for treating children suffering from obstructive sleep apnea syndrome due to hypertrophic tonsils.

In our tertiary referral center, more than 400 tonsil surgeries are performed annually on children aged up to 16 years and nearly all as day-surgeries [17]. Postoperative recovery takes place at home, and caregivers are responsible for pain and symptom management, emphasizing the role of aftercare instructions. In our practice, we recommend home care for 5 (TT) and 7 (TE) days postoperatively. However, the actual required length of home care, from the perspective of caregivers, has not been investigated. In Finland, planned elective operations do not entitle the caregiver to be absent from work with payment. Thus, in addition to the direct costs of tonsil surgery (surgical procedure plus pain medication), the indirect costs comprise reduction of income for the caregiver and loss of production for the employer [24].

The aim of this study was to assess postoperative recovery after monopolar TT relative to cold dissection TE in children. We also investigated the feasibility of monopolar TT and compared the results with other reported TT techniques.

2. METHODS

This was a prospective non-randomized clinical trial comparing two surgical methods. Children less than 12 years of age with no comorbidities were scheduled for TT or TE (each with or without adenotomy) through normal clinical practice. Indications for surgery are listed in Table 1. In our practice, TT is recommended for SDB and TE for recurrent or chronic tonsillitis. Patients were

recruited at the Department of Otorhinolaryngology – Head and Neck Surgery and at New Children's Hospital, Helsinki University Hospital, Finland between April 2018 and March 2020.

The technique for TT was adopted from Hultcrantz et al. [25]. The used monopolar device was Maxium® (KLS-Martin GmbH, Germany) with dispensable surgical smoke evacuation. A small amount of lidocaine-adrenaline was injected in the tonsillar tissue. With the bent microdissection needle (Colorado®, Stryker, Portage, MI, USA) the protruding part of the tonsil was cut off in the plane of the pillars. TE was performed with cold knife/scissors and blunt dissection. On both occasions, hemostasis was obtained with compression and/or bipolar diathermia. Surgeries were performed by resident or specialist otolaryngologists.

The families received a questionnaire in order to assess recovery during the first 13 postoperative days (POD). Two weeks after surgery, an e-mail was sent as a reminder to return the questionnaire. Pain was assessed each day in the morning and in the afternoon. The child was asked to grade the severity of pain using the Faces Pain Scale (Fig. 1). The prescription of pain management was provided orally and in written form. The amount and frequency of administered analgesics (ibuprofen/naproxen/paracetamol/tramadol hydrochloride) were registered. Other documented variables were disturbances in drinking, eating, playing, and sleeping (also apneas), possible vomiting, and fever. Weight was measured on the operation day at hospital and at home POD 6 and 13. Number of days out of daycare/school, possible postoperative hemorrhages, and possible hospital contacts were registered. We also requested caregivers´ recommendation on suitable length of postoperative home care.

2.1. Ethics

The Helsinki and Uusimaa Hospital District Ethics Committee approved the study protocol, and institutional research approval was granted by Helsinki University Hospital, Finland. Written informed consent was obtained from all caregivers and from children ≥7 years.

2.2. Statistics

The sample size needed for the study was calculated based on previous studies [26, 27] to detect a two-day difference between the groups in time to normal activity with a power of 80% (two-tailed, $\alpha = 0.05$). The power calculation for comparing the means of two groups resulted in a minimum sample size of 40. Statistical analyses were performed using SPSS software (version 25, IBM Corp., Armonk, NY, USA). Categorical variables were reported as frequencies and percentages, and continuous variables as means and medians + interquartile range (IQR). Mann-Whitney U-tests were used to compare the groups, whereas Pearson Chi-Squared tests were used for dichotomous data. A *P*-value of less than 0.05 was considered significant.

3. RESULTS

3.1. Patients

Altogether 166 patients were recruited; 103 (62%) returned the questionnaire and 2 were excluded because of missing data, and thus, 101 patients (50 TE, 51 TT) formed the study group. Baseline characteristics are presented in Table 1.

3.2. Indications

Indications for surgery are listed in Table 1. In our practice, for SDB we recommend TT. However, for 13 children with SDB as the main indication for surgery, TE was performed instead of TT because of regrowth of tonsillar tissue after TT (5 patients), tonsillar hypertrophy with a need for histological analysis (5 patients), tonsillar hypertrophy combined with an anatomically narrow pharynx (1 patient), and parents favoring TE over TT (2 patients).

3.3. Postoperative pain

Pain-related outcomes are presented in Table 2. With TT, there was significantly less pain and the pain period was shorter than with TE. Seven TE patients (14%) and two TT patients (4%) did not have any pain-free days during the follow-up. The median age of those children was 9.6 years (range 4.3-11.8). The first pain-free day was set at POD 14 for study purposes. The need for pain medication was significantly longer with TE than with TT. Opioids were used at home by 28 TE patients (58%) and 8 TT patients (16%). The median age of patients who needed opioids was 8.4 years (range 3.2-11.9), and those with no use of opioids 6.8 years (range 2.7-11.5).

In the TE group, the pain was more intense in the mornings throughout the recovery period. The duration of severe pain was on average (mean) 7 days (median 4, IQR 2-7). After TT, the pain was mild throughout the recovery period, although the pain was slightly more intense in the mornings during the first week. The most painful day was POD 5 after TE and POD 1 after TT (Fig. 2).

To determine whether indication for surgery had an impact on postoperative pain, we did a subgroup analysis on patients with SDB as the indication (TT, n=51 vs. TE, n=13); TT was superior to TE in all aspects of recovery (same variables tested as in Table 2, data not shown).

3.4. Postoperative recovery

145 There was a significant difference in the return to normal diet; TT children were able to eat
146 normally 6.5 days (median) earlier than children undergoing TE. The return to normal activities is
147 shown in Table 2. Sleeping difficulties were reported by 29 TE patients (58%) for 4 days (median,
148 IQR 2-5.5) and by 18 TT patients (35%) for 2 days (median, IQR 1-3) ($P < 0.01$). Caregivers
149 reported sleep apneas in seven patients: two TE patients for 1.5 days (median, IQR 1-NA) and five
150 TT patients for 4 days (median, IQR 1-10) ($P = 0.42$).

151 Nausea and vomiting occurred in 12 TE patients (24%) for 1 day (median, IQR 1-1) and in 5 TT
152 patients (10%) for 1 day (median, IQR 1-2) ($P = 0.33$). Fever was reported to occur in 12 TE
153 patients (24%) for 1 day (median, IQR 1-2) and in 12 TT patients (24%) for 2 days (median, IQR 1-
154 2.8) ($P = 0.43$).

155 Weight was measured at the hospital before the operation for every child and at home at POD 6 for
156 32 TT and 34 TE patients and at POD 13 for 29 TT and 32 TE patients. The operation day weight
157 of TT patients was 23 kg (median, IQR 19.4-27.3) and of TE patients 28 kg (median, IQR 20.4-
158 37.9) ($P < 0.05$). The proportional weight decreased significantly more after TE than after TT
159 during the first postoperative week (Fig. 3).

160 The actual length of home care and caregivers' recommendation for a suitable length are shown in
161 Table 2.

162

163 3.5. Hospital contacts

164 Caregivers of six children (6%) contacted the hospital after surgery. All but one of the contacts
165 were after TE. There were three visits; two hemorrhages (TE and TT, see next section) and one

because of pain (TE), and three phone contacts; two hemorrhages (TE) and one because of pain (TE). No postoperative infections or mortalities occurred.

3.5.1. Postoperative hemorrhages

There were two hemorrhages that led to a visit to hospital. Both were secondary, occurring >24 h postoperatively. One child (TT) was readmitted to hospital for observation at POD 12, but there was no need for hemostasis or return to operating room. The other patient (TE) was readmitted to hospital at POD 11 and the hemorrhage was treated in the operating room. Two additional patients (TE) had minor bleedings at home and parents contacted the hospital by phone, but no interventions were needed.

Additionally, with 13 TE patients (26%) and 6 TT patients (12%), caregivers reported minor hemorrhages, but they did not feel the need to contact the hospital. Most (n=17, 90%) of the bleedings occurred during the first postoperative week.

The total incidence for postoperative hemorrhage was 14% in the TT group and 32% in the TE group, including all bleedings, even minor ones not requiring hospital contact. Incidence of hemorrhages leading to a hospital visit was 2% in both groups, and incidence of hemorrhages requiring intervention was 2% with TE and 0% with TT.

4. DISCUSSION

We evaluated postoperative recovery of 101 children operated on by monopolar TT or cold dissection TE. After monopolar TT, the intensity of pain was lower and the duration shorter, return to daily activities was faster, and the incidence of postoperative hemorrhage was lower than after

TE. These findings are in line with previous studies showing the advantages of TT relative to TE in postoperative morbidity [18, 22, 28].

Another objective was to examine the feasibility of monopolar TT and to compare the results with reports of other TT techniques. Monopolar electrosurgery was chosen because it is easy to use, a monopolar device is found in every operating room, and the price is moderate relative to such devices as radiofrequency, coblator, or microdebrider [29, 30]. Table 3 presents comparison of our results with studies on postoperative recovery after TT performed by different techniques [27, 28, 30-33]; monopolar TT results regarding postoperative recovery were equal to other TT methods. Even though monopolar TT produces higher temperatures in the operative area, this did not seem to hinder postoperative recovery relative to other TT techniques (Table 3).

Tonsil surgery often causes severe pain lasting for days, and pain medication should be given regularly [10]. It has been shown that even if parents recognize that their child is in pain they tend to give inadequate doses of pain medication, and this may eventually lead to re-hospitalization [34, 35]. In Finland, there is no national guideline on postoperative pain management in children as in, for instance, Sweden [10]. The analgesics are prescribed by the surgeon and usually comprise paracetamol and NSAID (ibuprofen or naproxen), with a mild opioid (tramadol) added when needed. In our study, analgesics were given by the caregivers for a relatively long period compared with other studies [27, 30, 33]. Nevertheless, the first pain-free day did not differ from other studies [27, 28]. Additionally, in our study, there were only two healthcare contacts after surgery due to insufficient pain management. The parents were apparently willing to treat the pain efficiently according to the prescription with no significant fear of side-effects. As several doctors and nurses discharged the patients, the instructions caregivers received may have varied somewhat and affected the pain medication use. The study revealed that although in our practice tramadol is not recommended for TT patients, for some patients it was prescribed and used. Whether it was actually

necessary or taken as a precaution remains unknown. Since this study, our postoperative pain medication instructions have been unified.

In our patients, discomfort after tonsil surgery was greater in the mornings than in the afternoons, possibly due to dehydration, open mouth breathing, and interruption of analgesics dosing during the night, as has also been shown in other studies [36, 37]. Thus, caregivers should be informed of more intense pain in the mornings and the importance of regular administration of pain medication. If the morning pain is severe, to prevent flare-ups of pain children may be woken up during the night for the medication.

At least with young children, evaluating pain alone is not the most reliable way to monitor recovery. Recovery is a complex process and adequate postoperative oral intake of food and liquids promotes and reflects the level of recovery [38]. In our study, after TT, children returned to normal diet significantly earlier than after TE (one day vs. one week). Similar results have been reported in previous studies [13, 18].

Only a few studies have compared weight loss after TT and TE. Hultcrantz et al. [39] noted a weight increase after TT and a weight loss after TE. In our study, weight loss was registered in both groups, but significantly more after TE during the first week of recovery. The intensity and duration of pain was greater after TE, hence, smaller intake of food and catabolic metabolism due to pain may explain the difference. In small children, even a slight weight loss can be detrimental and needs to be taken into consideration preoperatively. The weight was measured at the hospital before the operation and two other measurements were made by the caregivers at home. The change of the measuring scale equipment could be considered as a source of bias. However, our sample size

236 adequately took into account these variations, and the weight was presented as the proportional
237 changes in time, which will give the overview of the weight evolvement during follow-up.
238
239
240 In our practice, we have recommended that children stay home 5 days after TT and 7 days after TE.
241 In this study, the median length of home care after TT was 5 days, and caregivers' opinion on a
242 suitable length of stay was 6 days. After TE, the children stayed at home 10 days, and this was also
243 a suitable length in caregivers' opinion. According to these results, the recommended duration for
244 home care was adequate when performing TT, but not for TE. A shorter need for home care can be
245 seen as a strength of TT. Children return to daycare or school and caregivers back to work earlier
246 than after TE. As a result, the indirect costs, i.e. those resulting from absence of the employee, lost
247 production expenses, and loss of income for the caregiver, will decrease [24]. As for TE patients,
248 recommendations for a longer home care period warrant consideration.
249
250 In this study, also minor bleedings at home not leading to a hospital contact were registered. As
251 shown, they were considerably more common after TE than after TT. With all bleedings included,
252 the incidence of postoperative hemorrhage after TE was high (32%). In many studies, small
253 bleedings go unnoticed since only clinically diagnosed hemorrhages or hemorrhages requiring
254 interventions in the operating room are reported. Incidence of TE hemorrhages needing hospital
255 visit or intervention was 2% in this study, and this figure is similar to other studies reporting 3-15%
256 [40-42] and to our previous study with a result of 6% [17].

257 One source of bias for recovery parameters' difference in this study might be the different
258 indications for TE and TT; TT was performed only to treat tonsillar hypertrophy, not cases with
259 recurrent or chronic tonsillitis. Peritonsillar tissue might be more fibrotic in infective cases, which
260 may affect postoperative recovery. Thus, we conducted a subgroup analysis with patients who had a

diagnosis of hypertrophy as the indication for TT and TE. Results showed that TT was superior to TE in all aspects of recovery also in this subgroup analysis, so the indications did not explain the difference in recovery in favor of TT when operated because of SDB. Another limitation of the study was that the study groups differed from each other regarding age: 5.6 years (TT) vs 8.6 years (TE). However, the age difference was relatively small and results of the association between children's age and the postoperative pain are contradictory [43-45].

A weakness of this prospective study was that it was not randomized. In our clinical practice, TT is not used in patients with recurrent tonsillitis. Also, as many international studies have shown the superiority of TT over TE in terms of morbidity, to randomize patients with tonsillar hypertrophy to undergo TE could be considered unethical. Another weakness is that the Faces Pain Scale is not validated. It was chosen since it is easy to use for both parents and children of different ages. Otherwise, the questionnaire was precise and well-designed to detect different aspects of recovery in children.

5. CONCLUSION

Children operated on with monopolar TT recovered faster and had less postoperative pain than children undergoing cold dissection TE. They were able to return earlier to daycare or school and their caregivers to work. The beneficial effects of TT in tonsil surgery were similar with the monopolar technique to the other TT techniques reported in the literature. A monopolar electrosurgical device, found in every operating room, is easy to use, cost-effective, and, according to our results, as good as any other TT method. The use of the monopolar device in TT reduces the cost of surgeries and the overall costs of healthcare since tonsillar surgeries are among the most frequent ear, nose, and throat surgeries performed.

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Conflict of Interest: The authors declare that they have no conflict of interest.

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Table 1. Baseline characteristics of children having tonsil surgery.

	Tonsillectomy (%)	Tonsillotomy (%)
N	50	51
Male gender*	29 (58)	27 (53)
Median age (years) at surgery (range)	8.6 (3.2-11.9)	5.6 (2.7-11.1)
Indication:		
Tonsillitis	19 (38)	0
SDB	13 (26)	51 (100)
SDB and tonsillitis	13 (26)	0
Periodic fever	5 (10)	0
Surgeon:		
Resident*	23 (46)	26 (51)
Specialist*	27 (54)	25 (49)

SDB=sleep-disordered breathing
*no significant difference between the groups (Pearson Chi-Squared test)

Table 2. Postoperative outcomes after tonsillectomy and tonsillotomy in children.

	TE (IQR)*	TT (IQR)*	*P* value**
First day of child reporting no pain	11 (9.3-13)	5 (3-8)	< 0.001
First day of child reporting pain ≤ 3	7 (3-9)	1 (1-2)	< 0.001
First day with no analgesics (paracetamol/NSAID)	11 (10-13)	7 (5-9)	< 0.001
First day with no tramadol	2.5 (1-8)	1 (1-1)	< 0.001
First day with return to normal drinking	1 (1-6.3)	1 (1-1)	< 0.001
First day with return to normal diet	7.5 (3-10.3)	1 (1-3)	< 0.001
First day with return to normal playing	2 (1-8)	1 (1-2)	< 0.001
Length of home care (days)	10 (7-12.5)	6 (4-6)	< 0.001
Caregivers' opinion: needed length of home care(days)	10 (7-12)	5 (3.8-7)	< 0.001

TE=tonsillectomy, TT=tonsillotomy, IQR=interquartile range, NSAID=nonsteroidal anti-inflammatory drug
*results are presented as medians
** Mann-Whitney U-test

Table 3. Studies on postoperative recovery after tonsillotomy performed by different techniques.

Study	n	Device	Age	First day with no pain	Days with analgesics	First day with no analgesics	Duration of pain
Hultcrantz, 2004	49	RFA	8.7 (mean)	5.7 (mean)	4.2 (mean)		
Ericsson, 2009	35	RFA	4.8 (mean)	4 (median)	5 (median)		
Chan, 2004	27	Coblator	6.4 (mean)	6.5 (median)		6.4 (median)	
Borgstrom, 2019	39	Coblator	3.9 (mean)	5 (median)		7 (median)	
Wilson, 2009	53	Coblator	5.8 (median)		3.8 (mean)		4.5 (mean)
Derkay, 2006	150	Microdebrider	5 (median)		4 (median)		
Wilson, 2009	53	Microdebrider	6.1 (median)		4.4 (mean)		4.8 (mean)
Present study	50	Monopolar	5.6 (median)	5 (median)	6 (median)	7 (median)	4 (median)
			6.1 (mean)	5.5 (mean)	6.5 (mean)	7.6 (mean)	4.8 (mean)

RFA= Radiofrequency ablation

454 Figure legends

455

456 **Fig. 1** Faces Pain Scale: 1=”no pain”, 2=”mild pain”, 3 =”moderate pain”, 4=”intense pain”,

457 5=”intolerable pain”

458 Vainio, A. Pain management. Helsinki, Finland: Duodecim Publishing Company Ltd; 2004

459

460 **Fig. 2** Experienced postoperative pain (mean) during a 13-day follow-up after tonsillotomy (TT)

461 and tonsillectomy (TE) in children

462

463 **Fig. 3** Proportional change in weight from operation day to postoperative day (POD) 6 and to POD

464 13 after tonsillotomy (TT) and tonsillectomy (TE)

465

466 **Table 1** Baseline characteristics of children having tonsil surgery

467

468 **Table 2** Postoperative outcomes after tonsillectomy and tonsillotomy in children

469

470 **Table 3** Studies on postoperative recovery after tonsillotomy performed by different techniques