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

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1 Monopolar tonsillotomy versus cold dissection tonsillectomy in children: prospective
2 study on postoperative recovery

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5 **ABSTRACT**

6

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

10

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

15

16 **RESULTS:** Altogether 166 patients were recruited; 103 (62%) returned the questionnaire. The first
17 pain-free day with tonsillotomy was day 5 and with tonsillectomy day 11. After tonsillotomy,
18 patients returned to normal activities faster, e.g. they were able to eat normally 6.5 days earlier than
19 tonsillectomy patients. During the first postoperative week weight dropped after tonsillectomy, but
20 not after tonsillotomy. The length of home care was 6 days with tonsillotomy and 10 days with
21 tonsillectomy. The incidence of postoperative hemorrhage (including minor bleedings at home) was
22 14% after tonsillotomy and 32% after tonsillectomy. Hemorrhages needing interventions were 0%
23 with tonsillotomy and 2% with tonsillectomy.

24

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

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

30

31

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

33

34

35 **1. INTRODUCTION**

36

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

47

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

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

55

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

65

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

69

70 **2. METHODS**

71

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

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

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

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

96

97 2.1. Ethics

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

101 2.2. Statistics

102 The sample size needed for the study was calculated based on previous studies [26, 27] to detect a
103 two-day difference between the groups in time to normal activity with a power of 80% (two-tailed,
104 $\alpha = 0.05$). The power calculation for comparing the means of two groups resulted in a minimum
105 sample size of 40. Statistical analyses were performed using SPSS software (version 25, IBM
106 Corp., Armonk, NY, USA). Categorical variables were reported as frequencies and percentages,
107 and continuous variables as means and medians + interquartile range (IQR). Mann-Whitney U-tests
108 were used to compare the groups, whereas Pearson Chi-Squared tests were used for dichotomous
109 data. A *P*-value of less than 0.05 was considered significant.

110

111

112 **3. RESULTS**

113

114 3.1. Patients

115

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

119

120 3.2. Indications

121

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

127

128 3.3. Postoperative pain

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

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

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

143

144 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

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

168 *3.5.1. Postoperative hemorrhages*

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

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

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

182

183 **4. DISCUSSION**

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

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

189 Another objective was to examine the feasibility of monopolar TT and to compare the results with
190 reports of other TT techniques. Monopolar electrosurgery was chosen because it is easy to use, a
191 monopolar device is found in every operating room, and the price is moderate relative to such
192 devices as radiofrequency, coblator, or microdebrider [29, 30]. Table 3 presents comparison of our
193 results with studies on postoperative recovery after TT performed by different techniques [27, 28,
194 30-33]; monopolar TT results regarding postoperative recovery were equal to other TT methods.
195 Even though monopolar TT produces higher temperatures in the operative area, this did not seem
196 to hinder postoperative recovery relative to other TT techniques (Table 3).

197

198 Tonsil surgery often causes severe pain lasting for days, and pain medication should be given
199 regularly [10]. It has been shown that even if parents recognize that their child is in pain they tend to
200 give inadequate doses of pain medication, and this may eventually lead to re-hospitalization [34,
201 35]. In Finland, there is no national guideline on postoperative pain management in children as in,
202 for instance, Sweden [10]. The analgesics are prescribed by the surgeon and usually comprise
203 paracetamol and NSAID (ibuprofen or naproxen), with a mild opioid (tramadol) added when
204 needed. In our study, analgesics were given by the caregivers for a relatively long period compared
205 with other studies [27, 30, 33]. Nevertheless, the first pain-free day did not differ from other studies
206 [27, 28]. Additionally, in our study, there were only two healthcare contacts after surgery due to
207 insufficient pain management. The parents were apparently willing to treat the pain efficiently
208 according to the prescription with no significant fear of side-effects. As several doctors and nurses
209 discharged the patients, the instructions caregivers received may have varied somewhat and affected
210 the pain medication use. The study revealed that although in our practice tramadol is not
211 recommended for TT patients, for some patients it was prescribed and used. Whether it was actually

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

214

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

221

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

227

228 Only a few studies have compared weight loss after TT and TE. Hultcrantz et al. [39] noted a
229 weight increase after TT and a weight loss after TE. In our study, weight loss was registered in both
230 groups, but significantly more after TE during the first week of recovery. The intensity and duration
231 of pain was greater after TE, hence, smaller intake of food and catabolic metabolism due to pain
232 may explain the difference. In small children, even a slight weight loss can be detrimental and
233 needs to be taken into consideration preoperatively. The weight was measured at the hospital before
234 the operation and two other measurements were made by the caregivers at home. The change of the
235 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

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

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

274

275 **5. CONCLUSION**

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

284

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

288

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291

292

293 **REFERENCES**

294

295 [1] Cullen KA, Hall MJ, Golosinskiy A. Ambulatory surgery in the United States, 2006. Natl
296 Health Stat Report. 2009;(11)(11):1-25.

297 [2] Bhattacharyya N, Lin HW. Changes and consistencies in the epidemiology of pediatric
298 adenotonsillar surgery, 1996-2006. Otolaryngol Head Neck Surg. 2010;143(5):680-684.

299 [3] Parker NP, Walner DL. Trends in the indications for pediatric tonsillectomy or
300 adenotonsillectomy. Int J Pediatr Otorhinolaryngol. 2011;75(2):282-285.

301 [4] Borgstrom A, Nerfeldt P, Friberg D, Sunnergren O, Stalfors J. Trends and changes in paediatric
302 tonsil surgery in Sweden 1987-2013: a population-based cohort study. BMJ Open.
303 2017;7(1):e013346,2016-013346.

304 [5] Fortier MA, MacLaren JE, Martin SR, Perret-Karimi D, Kain ZN. Pediatric pain after
305 ambulatory surgery: where's the medication? Pediatrics. 2009;124(4):e588-595.

306 [6] Stewart DW, Ragg PG, Sheppard S, Chalkiadis GA. The severity and duration of postoperative
307 pain and analgesia requirements in children after tonsillectomy, orchidopexy, or inguinal hernia
308 repair. *Paediatr Anaesth.* 2012;22(2):136-143.

309 [7] Tolska HK, Takala AJ, Jero J. Peritonsillar infiltration of lidocaine with adrenaline is associated
310 with increased risk of secondary post-tonsillectomy haemorrhage. *J Laryngol Otol.*
311 2018;132(10):911-22.

312 [8] Hallenstal N, Sunnergren O, Ericsson E, et al. Tonsil surgery in Sweden 2013-2015. Indications,
313 surgical methods and patient-reported outcomes from the National Tonsil Surgery Register. *Acta*
314 *Otolaryngol.* 2017;137(10):1096-1103.

315 [9] Gerbershagen HJ, Aduckathil S, van Wijck AJ, Peelen LM, Kalkman CJ, Meissner W. Pain
316 intensity on the first day after surgery: a prospective cohort study comparing 179 surgical
317 procedures. *Anesthesiology.* 2013;118(4):934-944.

318 [10] Ericsson E, Brattwall M, Lundeberg S. Swedish guidelines for the treatment of pain in tonsil
319 surgery in pediatric patients up to 18 years. *Int J Pediatr Otorhinolaryngol.* 2015;79(4):443-450.

320 [11] Karling M, Hagglof B. Child behaviour after anaesthesia: association of socioeconomic factors
321 and child behaviour checklist to the Post-Hospital Behaviour Questionnaire. *Acta Paediatr.*
322 2007;96(3):418-423.

323 [12] Randall DA, Hoffer ME. Complications of tonsillectomy and adenoidectomy. *Otolaryngol*
324 *Head Neck Surg.* 1998;118(1):61-68.

325 [13] Acevedo JL, Shah RK, Brietzke SE. Systematic review of complications of tonsillotomy
326 versus tonsillectomy. *Otolaryngol Head Neck Surg.* 2012;146(6):871-879.

327 [14] Johnson LB, Elluru RG, Myer CM 3rd. Complications of adenotonsillectomy. *Laryngoscope.*
328 2002;112(8 Pt 2 Suppl 100):35-36.

329 [15] Nokso-Koivisto J, Blomgren K, Aaltonen LM, Lehtonen L, Helmio P. Patient injuries in
330 pediatric otorhinolaryngology. *Int J Pediatr Otorhinolaryngol.* 2019;120:36-39.

331 [16] Windfuhr JP, Werner JA. Tonsillotomy: it's time to clarify the facts. *Eur Arch*
332 *Otorhinolaryngol.* 2013;270(12):2985-2996.

333 [17] Sakki A, Makinen LK, Roine RP, Nokso-Koivisto J. Changing trends in pediatric tonsil
334 surgery. *Int J Pediatr Otorhinolaryngol.* 2018;118:84-89.

335 [18] Eriksson M, Nilsson U, Bramhagen AC, Idvall E, Ericsson E. Self-reported postoperative
336 recovery in children after tonsillectomy compared to tonsillotomy. *Int J Pediatr Otorhinolaryngol.*
337 2017;96:47-54.

338 [19] Vicini C, Eesa M, Hendawy E, et al. Powered intracapsular tonsillotomy vs. conventional
339 extracapsular tonsillectomy for pediatric OSA: A retrospective study about efficacy, complications
340 and quality of life. *Int J Pediatr Otorhinolaryngol.* 2015;79(7):1106-1110.

341 [20] Wireklint S, Ericsson E. Health-related quality of life after tonsillotomy versus tonsillectomy
342 in young adults: 6 years postsurgery follow-up. *Eur Arch Otorhinolaryngol.* 2012;269(8):1951-
343 1958.

344 [21] Windfuhr JP, Savva K, Dahm JD, et al. Tonsillotomy: facts and fiction. *Eur Arch*
345 *Otorhinolaryngol.* 2015;272(4):949-969.

346 [22] Walton J, Ebner Y, Stewart MG, April MM. Systematic review of randomized controlled trials
347 comparing intracapsular tonsillectomy with total tonsillectomy in a pediatric population. *Arch*
348 *Otolaryngol Head Neck Surg.* 2012;138(3):243-249.

349 [23] Eviatar E, Kessler A, Shlamkovitch N, Vaiman M, Zilber D, Gavriel H. Tonsillectomy vs.
350 partial tonsillectomy for OSAS in children--10 years post-surgery follow-up. *Int J Pediatr*
351 *Otorhinolaryngol.* 2009;73(5):637-640.

352 [24] Gudnadottir G, Tennvall GR, Stalfors J, Hellgren J. Indirect costs related to caregivers' absence
353 from work after paediatric tonsil surgery. *Eur Arch Otorhinolaryngol.* 2017;274(6):2629-2636.

354 [25] Hultcrantz E, Ericsson E. Pediatric tonsillotomy with the radiofrequency technique: less
355 morbidity and pain. *Laryngoscope.* 2004;114(5):871-877.

356 [26] Ericsson E, Hultcrantz E. Tonsil surgery in youths: good results with a less invasive method.
357 Laryngoscope. 2007 Apr;117(4):654-661.

358 [27] Hultcrantz E, Ericsson E. Pediatric tonsillotomy with the radiofrequency technique: less
359 morbidity and pain. Laryngoscope. 2004;114(5):871-877.

360 [28] Borgstrom A, Nerfeldt P, Friberg D. Postoperative pain and bleeding after adenotonsillectomy
361 versus adenotonsillotomy in pediatric obstructive sleep apnea: an RCT. Eur Arch Otorhinolaryngol.
362 2019;276(11):3231-3238.

363 [29] Thottam PJ, Christenson JR, Cohen DS, Metz CM, Saraiya SS, Hauptert MS. The utility of
364 common surgical instruments for pediatric adenotonsillectomy. Laryngoscope. 2015;125(2):475-
365 479.

366 [30] Wilson YL, Merer DM, Moscatello AL. Comparison of three common tonsillectomy
367 techniques: a prospective randomized, double-blinded clinical study. Laryngoscope.
368 2009;119(1):162-170.

369 [31] Ericsson E, Lundeborg I, Hultcrantz E. Child behavior and quality of life before and after
370 tonsillotomy versus tonsillectomy. Int J Pediatr Otorhinolaryngol. 2009;73(9):1254-1262.

371 [32] Chan KH, Friedman NR, Allen GC, et al. Randomized, controlled, multisite study of
372 intracapsular tonsillectomy using low-temperature plasma excision. Arch Otolaryngol Head Neck
373 Surg. 2004;130(11):1303-1307.

374 [33] Derkay CS, Darrow DH, Welch C, Sinacori JT. Post-tonsillectomy morbidity and quality of
375 life in pediatric patients with obstructive tonsils and adenoid: microdebrider vs electrocautery.
376 Otolaryngol Head Neck Surg. 2006;134(1):114-120.

377 [34] Finley GA, McGrath PJ, Forward SP, McNeill G, Fitzgerald P. Parents' management of
378 children's pain following 'minor' surgery. Pain. 1996;64(1):83-87.

379 [35] Warnock FF, Lander J. Pain progression, intensity and outcomes following tonsillectomy.
380 Pain. 1998;75(1):37-45.

381 [36] Kim MS, Choi HG, Park EK, Kim SY, Kim JH, Park B. Natural course of tonsillectomy pain:
382 A prospective patient cohort study. *Auris Nasus Larynx*. 2018;45(3):508-513.

383 [37] Sutters KA, Miaskowski C, Holdridge-Zeuner D, et al. A randomized clinical trial of the
384 efficacy of scheduled dosing of acetaminophen and hydrocodone for the management of
385 postoperative pain in children after tonsillectomy. *Clin J Pain*. 2010;26(2):95-103.

386 [38] Eriksson M, Nilsson U, Bramhagen AC, Idvall E, Ericsson E. Self-reported postoperative
387 recovery in children after tonsillectomy compared to tonsillotomy. *Int J Pediatr Otorhinolaryngol*.
388 2017;96:47-54.

389 [39] Hultcrantz E, Linder A, Markstrom A. Tonsillectomy or tonsillotomy?--A randomized study
390 comparing postoperative pain and long-term effects. *Int J Pediatr Otorhinolaryngol*.
391 1999;51(3):171-176.

392 [40] Odhagen E, Stalfors J, Sunnergren O. Morbidity after pediatric tonsillotomy versus
393 tonsillectomy: A population-based cohort study. *Laryngoscope*. 2019;129(11):2619-2626.

394 [41] Chang DT, Zemek A, Koltai PJ. Comparison of treatment outcomes between intracapsular and
395 total tonsillectomy for pediatric obstructive sleep apnea. *Int J Pediatr Otorhinolaryngol*. 2016;91:15-
396 8.

397 [42] Sarny S, Habermann W, Ossimitz G, Stammberger H. What lessons can be learned from the
398 Austrian events? *ORL J Otorhinolaryngol Relat Spec*. 2013;75(3):175-181.

399 [43] Palermo TM, Drotar D. Prediction of children's postoperative pain: the role of presurgical
400 expectations and anticipatory emotions. *J Pediatr Psychol*. 1996;21(5):683-698.

401 [44] Chieng YJ, Chan WC, Liam JL, Klainin-Yobas P, Wang W, He HG. Exploring influencing
402 factors of postoperative pain in school-age children undergoing elective surgery. *J Spec Pediatr*
403 *Nurs*. 2013;18(3):243-252.

404 [45] Crandall M, Lammers C, Senders C, Braun JV. Children's tonsillectomy experiences:
405 influencing factors. *J Child Health Care*. 2009;13(4):308-321.

406 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)

407 SDB=sleep-disordered breathing

408 *no significant difference between the groups (Pearson Chi-Squared test)

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

	TE (IQR)*	TT (IQR)*	<i>P</i> 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

422 TE=tonsillectomy, TT=tonsillotomy, IQR=interquartile range, NSAID=nonsteroidal anti-
 423 inflammatory drug
 424 *results are presented as medians
 425 ** Mann-Whitney U-test
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436 Table 3. Studies on postoperative recovery after tonsillotomy performed by different techniques.
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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)

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440 RFA= Radiofrequency ablation

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454 Figure legends

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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

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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