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ORIGINAL ARTICLE

Radiofrequency tonsillotomy versus bipolar scissors tonsillectomy for the treatment of OSAS in children: A prospective study

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KEYWORDS
Radiofrequency;
Tonsillotomy;
Tonsillectomy;
OSAS;
Children

Summary
Introduction: Tonsillotomy is an effective treatment for the management of obstructive sleep apnoea syndrome (OSAS) in children with tonsillar hypertrophy and appears to be associated with less pain and postoperative morbidity.
Objective: To compare postoperative morbidity and short-term and intermediate-term efficacy of radiofrequency tonsillotomy (TT) and bipolar scissors tonsillectomy (TE) in children.
Patients and methods: Children with OSAS due to tonsillar hypertrophy were included in a prospective, non-randomized study between February 4, 2008 and March 20, 2010. Exclusion criteria were recurrent tonsillitis (≥ 3 episodes per year), clotting disorders and age less than 2 years. Postoperative complications, efficacy on OSAS, and operating times were evaluated. Pain was evaluated by the Postoperative Pain Measure for Parents score on D0, D1, D7 and D30.
Results: One hundred and ninety-three children were included: 105 in the TE group (age: 4.75 ± 2.37 years) and 88 in the TT group (age: 4.88 ± 2.6 years). The pain score was significantly lower in the TT group than in the TE group during the first postoperative week ($P < 0.05$). A significant difference was observed for the secondary postoperative bleeding rate (1 after TT versus 8 after TE). No significant difference was observed between the two techniques in terms of the efficacy on OSAS. At 1 year, the tonsil regrowth rate in the TT group was 4.5%.
Conclusion: Radiofrequency tonsillotomy is a safe technique for the treatment of obstructive tonsillar hypertrophy in children with good results on OSAS and a reduction of postoperative pain.

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Introduction

Obstructive tonsillar hypertrophy in children can be responsible for snoring, sometimes associated with obstructive sleep apnoea syndrome (OSAS) and possibly resulting in daytime sleepiness, learning difficulties, growth retardation, face and chest deformities and cardiac abnormalities [1]. At the beginning of the 20th century, tonsillotomy was commonly performed without general anaesthesia and was subsequently replaced by tonsillectomy with extracapsular dissection under general anaesthesia [2]. Since the 1990s, tonsillotomy, which consists of performing partial tonsillectomy by resecting only the obstructive part of the tonsils, has been performed by ENT surgeons in Europe and the United States by CO_2 laser [3—7], diode laser [8], cold scissors [9] or bipolar scissors [10], microdebrider [11,12], coblation [13] or radiofrequency [14—16]. Various studies have demonstrated decreased postoperative pain and more rapid postoperative recovery compared to conventional tonsillectomy.

The objective of this study was to compare radiofrequency tonsillotomy (or partial tonsillectomy) (TT group) with bipolar scissors total tonsillectomy, our reference technique, in terms of the efficacy on snoring and obstructive sleep apnoea and postoperative course.

Patients and methods

Patients

A prospective, non-randomized study was conducted between February 4, 2008 and March 20, 2010.

All children presented signs of OSAS associated with clinical tonsillar hypertrophy. The diagnostic criteria for OSAS were based on the clinical signs reported by the parents at clinical interview: snoring, respiratory pauses with noisy resumption of breathing, night sweats, enuresis (in continent children), parasomnia (nightmares), agitated sleep, difficult awakening, morning irritability, daytime sleepiness, anorexia, eating difficulties, mouth breathing, growth retardation, and indirect signs such as disorders of concentration. The diagnosis was based on a combination of all or some of these symptoms [17].

Exclusion criteria were recurrent tonsillitis ($\geq$ 3 episodes per year), clotting disorders and age less than 2 years. Five surgeons participated in the study. One surgeon never performed tonsillotomy, while the other four surgeons freely chose their technique after discussion with the parents. Parents were informed about the risk of tonsil regrowth and the probable reduction of postoperative pain after tonsillotomy.

Method

A 10—15W Surgitron 4 MHz generator (Ellman International Inc, Hewlet, New York) was used with a fine electrode or ring electrode to perform tonsillotomy according to the technique described by Hultcrantz and Ericsson [16]. The tonsillotomy surgical procedure started with injection of 1% lidocaine and adrenaline into the tonsillar tissue. The posterior pharyngeal wall and uvula were protected by a compress. The tonsillar mucosa was incised over the anterior pillar of the fauces using a fine electrode in cutting/coagulation mode. The obstructive part of the tonsil was then resected using the ring electrode (Fig. 1). Bipolar electrode coagulation was then performed only as necessary. The bipolar scissors tonsillectomy procedure complied with the usual modalities of extracapsular tonsillar resection. Adenoidectomy was performed in both groups, as necessary (nasal obstruction, nasopharyngitis and recurrent acute otitis media). The anaesthetic protocol was identical for the two surgical procedures and comprised: dexamethasone 150 μg/kg on induction, alfentanil 0.2 to 1 μg/kg on induction and 1 to 1.5 μg/kg/h for maintenance, and paracetamol 15 mg/kg.

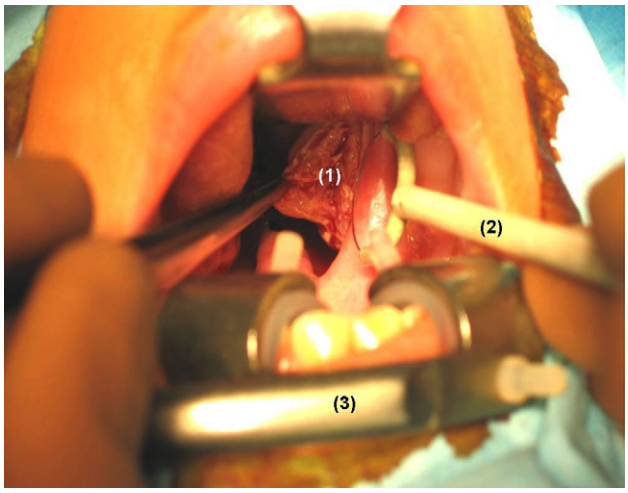

Figure 1 Operative view: section of the right tonsil by a ring electrode. 1: right tonsil incised; 2: ring electrode; 3: open Boyle Davis retractor.

For all children, analgesia comprised paracetamol (15 mg/kg/6 h) and codeine (1/2 mg/kg/6 h). Codeine was prescribed for 5 days after discharge and paracetamol was continued as necessary. We emphasized the need to take analgesics at fixed times, especially 45 minutes to 1 hour before meals.

Children were admitted to a day-only admission unit devoted to this activity with discharge initially planned on D0 after at least 6 hours of postoperative observation in the absence of postoperative complication or insufficient pain control. Children not meeting the medical and social eligibility criteria for day-only admission were hospitalised in a conventional ward [17]. These children were admitted on the day before the operation and were discharged on D1.

The operating time was measured for each operation. Postoperative bleeding were classified as primary bleeding, defined as onset of bleeding during the first 24 postoperative hours, and secondary bleeding in the case of later onset. Postoperative pain was measured by the Postoperative Pain Measure for Parents (PPMP) with a maximum score of 15 (Appendix A). Pain was evaluated by the parents on D0 (between H4 and H6), D1, D7 and at 1 month. PPMP is a validated questionnaire for measurement of the child's pain by the parents. It is particularly appropriate for children between the ages of 2 and 12 years [18]. A pain score higher than 6 is considered to be significant.

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All children attended a postoperative ENT outpatient visit between D7 and D9 and 1 month after the operation. Parents and children brought the PPMP score to these visits. Clinical ENT examination of the child and clinical interview of the parents were performed. The postoperative absence of OSAS was defined according to clinical interview of the parents indicating resolution of the clinical signs reported preoperatively as the basis for the diagnosis of obstructive sleep apnoea. The degree of satisfaction of the parents with the overall management of their child was also recorded.

Statistical analysis

Comparison of the results between the two groups and statistical analysis were performed by means of the following statistical tools: Chi-square test with Yates' correction, Fisher's test and Student's test. Results were considered significant for $P < 0.05$.

Results

A total of 198 cases were initially recruited during the study period. One hundred and ninety-three children were finally included: 88 in the TT group and 105 in the TE group, and five cases were excluded due to missing data. Adenoidectomy was performed in 66 children in the TT group and 81 children in the TE group ($P = 0.985$). The main characteristics of the two groups were comparable with a predominance of boys in each group: the female/male sex-ratio was 40% in the TT group versus 41% in the TE group ($P = 0.98$). The age of operated children was also comparable with a mean age of 4.88 ± 2.6 years in the TT group versus 4.75 ± 2.37 years in the TE group ($P = 0.73$). The 1-month success rate on snoring was 95% in the TT group and 99% in the TE group, with no statistically significant difference between the two groups ($P = 0.18$). All children in both groups (except for one child with Down's syndrome in the TT group) no longer presented any signs of OSAS postoperatively. No statistically significant difference was demonstrated between the two groups in terms of mean operating time: 14.68 ± 6.79 minutes in the TE group versus 14.21 ± 5.9 minutes in the TT group ($P = 0.65$). The pain score during the first 24 postoperative hours was not significantly different between the two groups. However, the pain score was significantly lower in the TT group over the following days, during the first postoperative week ($P < 0.05$) (Fig. 2). Three cases of postoperative bleeding were observed in the TT group (two primary bleeds and one secondary bleed) requiring hospitalisation in three cases and redo surgery in one case. Eight cases of secondary postoperative bleeding were observed in the TE group, requiring hospitalisation in all eight cases and redo surgery in three cases. The overall postoperative bleeding rate was not significantly different between the two groups ($P = 0.34$). However, a significant difference was observed for the secondary bleeding rate (OR = 7; $P = 0.04$). Three patients in the TT group required redo surgery by tonsillectomy for symptomatic regrowth at 1 year (3/66, i.e. 4.5%) and only one child in the TT group developed postoperative pharyngitis. At 1 month, the parent satisfaction rate in relation to their expectations concerning resolution of their child's symptoms was 99% in the TT group and 100% in the TE group.

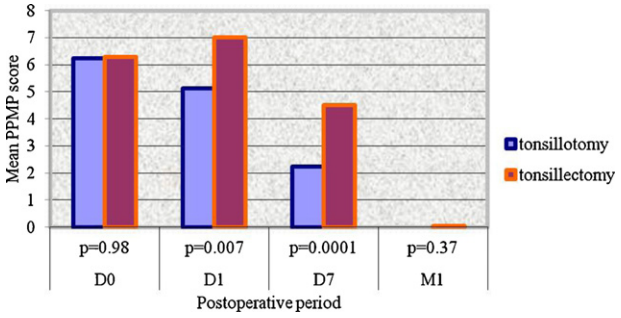

Figure 2 Evaluation of postoperative pain.

Discussion

This comparative, non-randomized study demonstrates the superiority of radiofrequency tonsillotomy compared to bipolar scissors tonsillectomy in terms of postoperative pain and secondary bleeding. The two techniques were comparable in terms of efficacy on snoring and sleep apnoeas. However, the 1-year symptomatic tonsil regrowth rate was 4.5% in this series.

Surgical procedure

Tonsillotomy and tonsillectomy are surgical procedures requiring a similar operating time, as illustrated by the present study as well as that conducted by Hultcrantz [16]. Only Vlastos, who compared conventional tonsillectomy with scissors tonsillotomy, reported a shorter operating time for tonsillotomy with a gain of 2.5 minutes [9]. Modern systems allowing both section and coagulation have been shown to represent an advantage in terms of intraoperative bleeding, which was not evaluated in the present study. Hultcrantz reported a significant reduction of bleeding with radiofrequency tonsillotomy compared to diode laser tonsillectomy [16]. A review of the literature revealed only one prospective, randomized study conducted by Stelter, who compared radiofrequency tonsillotomy with another tonsillotomy technique (CO_2 laser) [4]. No significant difference was demonstrated between the two groups in terms of bleeding or postoperative pain. This study therefore did not provide any arguments in favour of a particular tonsillotomy technique.

Efficacy on snoring and obstructive sleep apnoea

The primary objective of tonsillotomy is to treat obstructive symptoms. Several studies based on clinical interview and clinical examination show that tonsillotomy achieves good results on snoring and sleep apnoea regardless of the surgical technique used [13,19,20]. Only polysomnography is currently able to confirm the diagnosis of OSAS. A polysomnographic study also confirmed the significant impact of tonsillotomy on Apnoea-Hypopnoea Index (AHI) and minimum oxygen saturation (minimum SaO_2) [21]. Although there appears to be a relatively good correlation

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Table 1 Postoperative pain: discussion.

	Study	Number of patients	Pain score	Conclusion
Our study	RF TT vs bipolar scissors TE	88 TT vs 105 TE	PPMP	Less pain during the first postoperative week after TT
Hultcrantz and Ericsson, 2004 [16]	RF TT vs Conventional TE	49 TT vs 43 TE	VAS	Less pain at H2; children pain-free 3 days earlier after TT
Vlastos et al., 2008 [9]	Scissors TT vs Cold scalpel TE	243 TT vs 780 TE	Qualitative pain score	Less pain on 1st and 7th postoperative days after TT
Koltai et al., 2003 [12]	Microdebrider TT vs Electric scalpel TE	243 TT vs 107 TE	Qualitative pain score	Less pain, more rapid recovery after TT
Arya et al., 2005 [13]	Coblation TT vs Coblation TE	18 TT vs 18 TE	VAS	No difference during the first 24 postoperative hours
Lister et al., 2006 [11]	Microdebrider TT vs Electric scalpel TE	25 TT vs 25 TE	Faces Pain Scale Revised	Less pain from D1 to D9 after TT

RF: radiofrequency; TE: tonsillectomy; TT: tonsillotomy; VAS: visual analogue scale.

between AHI and clinical assessment [22], in routine clinical practice this examination remains reserved to high-risk children: morbid obesity, craniofacial or upper airways malformation, neuromuscular disease, clotting disorder, cardiac malformation [17].

In our study, as also reported in the literature, no significant difference was observed between the efficacy of tonsillotomy and tonsillectomy on obstructive symptoms. However, the results of the present study must be interpreted cautiously in view of the short postoperative follow-up period (1 month). Nevertheless, the results appear to remain stable even after a longer follow-up, as reported in the study by Eviatar with a follow-up of 10 years after tonsillotomy [20].

Evaluation of postoperative pain

The pain experienced by children after tonsillectomy is often underestimated by parents and healthcare personnel (Table 1) [23]. A review of the literature and the results of the present study show that tonsillotomy is less painful than tonsillectomy during the first postoperative week [10—12,16], which can be explained by preservation of the pillars of the fauces and constrictor muscles inducing less inflammation. In the study by Hultcrantz [16], radiofrequency tonsillotomy induces less pain than tonsillectomy during the first 24 postoperative hours. In contrast, in our study and in the study by Arya [13], no significant difference in pain severity was observed during this period, but a significant difference was observed over the following days, related to more intense pain after tonsillectomy with a pain peak between D2 and D4 [24]. According to Hultcrantz et al., there is no correlation between the quantity of analgesics consumed and the pain experienced by the child, as dispensing of analgesics by the parents corresponds more to the doctor's prescription than the child's pain [16].

Postoperative bleeding

The main risk of tonsillectomy is postoperative bleeding. Gunzel demonstrated three periods of peak incidence of postoperative bleeding: at 24 hours, on D5—D7 and on D9—D15 [5]. The postoperative bleeding rate after tonsillectomy reported in the literature is about 3% [5,24]. This rate did not vary according to the surgical technique in the various published series [6].

The post-tonsillotomy bleeding rate in the present study was similar to that reported by Hultcrantz [16] (3.4% of primary bleeding in our study; 2/46 [4%] in Hultcrantz's study).

However, other studies have reported very low postoperative bleeding rates after radiofrequency, CO_2 laser, scissors or laser diode tonsillotomy and some studies have even reported no cases of postoperative bleeding [3—5,20,25]. In the present series, the secondary postoperative bleeding rate after tonsillotomy (1.10%) was significantly lower than that after tonsillectomy (7.6%), which can be explained by the tonsillar tissue left in place and the absence of trauma to the superior pharyngeal constrictor muscle, allowing more rapid healing. However, the secondary bleeding rate observed after tonsillectomy in this study was higher than the 3% rate reported in the literature [25]. Primary bleeding after tonsillotomy is often due to inadequate intraoperative haemostasis.

Symptomatic tonsil regrowth

Symptomatic tonsil regrowth is the major disadvantage of tonsillotomy and is essentially observed in children under

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Table 2 Symptomatic tonsil regrowth after tonsillotomy: discussion.

	Surgical technique	Child's age	Symptomatic tonsil regrowth	Time to onset of symptoms
Our study	Radiofrequency	2 to 5 years	3/60 = 5%	16—24 months
Ericsson et al., 2006 [14]	Radiofrequency	—	2/49 = 4%	3 years
Celenk et al., 2008 [15]	Radiofrequency	2.4 to 6 years	5/42 = 11%	Mean: 9.3 months
Vlastos et al., 2008 [9]	Scissors	—	2/57 = 3.5%	Mean: 18 months
Unkel et al., 2005 [3]	CO_2 laser	1 to 5 years	5/75 = 6.5%	11—21 months

the age of 6 years (Table 2) [6]. The mean time to tonsil regrowth after surgery is 18 months (range: 9 to 24 months) [3,9,15,26]. The tonsil regrowth rate after tonsillectomy reported in the literature is about 5%, regardless of the technique used [10,15].

Conclusion

This study confirms the efficacy of tonsillotomy for the treatment of tonsillar hypertrophy with OSAS in children. Radiofrequency tonsillotomy achieves better results than bipolar scissors tonsillotomy in terms of postoperative pain during the first week. This technique is also associated with a lower secondary bleeding rate. The main disadvantage of tonsillotomy concerns the risk of tonsil regrowth in about 5% of cases at 2 years. Parents must be informed about this risk. Tonsillotomy is currently the treatment of choice for symptomatic tonsillar hypertrophy in the absence of recurrent tonsillitis.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Appendix A. PPMP scale: Postoperative Pain Measure for Parents for evaluation of pain by parents of children aged 2 to 12 years

For each item: score 0 (sign absent) to 1 (sign present). Total out of 15.

Day											
Hour											
Whine or complain more than usual											
Cry more easily than usual											
Play less than usual											
Not do the things she/he normally does											
Act more worried than usual											
Act more quiet than usual											
Have less energy than usual											
Refuse to eat											
Eat less than usual											
Hold the sore part of his/her body											
Try not to bump the sore part of his/her body											
Groan or moan more than usual											
Look more flushed than usual											
Want to be close to you more than usual											
Take medication when she/he normally refuses											
TOTAL SCORE											

Chambers CT, Reid GJ, Mc Grath PJ, Finley GA. : Development and preliminary validation of a postoperative measure for parents. Pain 1996, 68 : 307-313.
Chambers CT, Finley GA, Mc Grath PJ, Walsh TM. The parents' postoperative pain measure : replication and extension to 2-6-year-old children. Pain. 2003, 105 : 437-43.
Finley GA, Chambers CT, Mc Grath PJ, Walsh TM. Construct validity of the parents' postoperative pain measure. Clin J Pain. 2003, 19 : 329-34.
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