

Comparison of Postoperative Pain in Children with Two Intracapsular Tonsillotomy Techniques and a Standard Tonsillectomy

Microdebrider and radiofrequency tonsillotomies *versus* standard tonsillectomies

*Levente Deak,¹ David Saxton,¹ Keith Johnston,² Palma Benedek,³ Gábor Katona³

مقارنة مدى شدة الألم الذي يعقب عملية استئصال اللوزة عند الأطفال باستخدام طريقتي بضع اللوزة داخل المحفظة و الطريقة التقليدية الإنضار الدقيق و الترددات الشعاعية مقابل الطريقة التقليدية

ليفنتي ديك، ديفيد ساكستون، كيث جونسون، بالمبا بينديك، جابور كاتونا

ABSTRACT: Objectives: The aim of this study was to compare the duration and severity of postoperative pain for two different tonsillotomy techniques (radiofrequency [RF] and microdebrider [MD]) with the standard tonsillectomy. **Methods:** This non-randomised retrospective study, carried out from February 2011 to September 2012, investigated 128 children in two independent centres: Heim Pál Children's Hospital in Budapest, Hungary, and Muscat Private Hospital in Muscat, Oman. Those undergoing conventional tonsillectomies acted as the control group. One centre tested the MD technique (n = 28) while the other centre tested the RF technique (n = 31). **Results:** The pain-free period after the tonsillotomies was similar between the two techniques and ranged up to three days. Other indicators of pain resolution, like the use of a single analgesic, reduced night-time waking and the time taken to resume a normal diet, were also similar for the two groups. However, patients benefited significantly from having a tonsillotomy rather than a tonsillectomy. **Conclusion:** The partial resectioning of tonsillar tissue using the MD and RF techniques showed promising outcomes for a better postoperative quality of life when compared to a traditional tonsillectomy. In this study, the results of both the MD and RF tonsillotomy methods were almost identical in terms of the duration of postoperative pain and recovery time.

Keywords: Quality of Life; Postoperative Pain; Obstructive Sleep Apnoea; Tonsillotomy; Tonsillectomy.

المخلص: الهدف: تهدف هذه الدراسة لمقارنة مدة وشدة الألم الذي يعقب عملية بضع اللوزة داخل المحفظة عند الأطفال بطريقتي الإنضار الدقيق والترددات الشعاعية مقابل الطريقة التقليدية. **الطريقة:** أجريت هذه الدراسة الاستيعابية وغير المختارة عشوائيا بين فبراير 2011 وسبتمبر 2012م على 128 طفلا بمركزين مستقلين هما مستشفى هايم بال للأطفال بمدينة بودابست بالمجر، ومستشفى خاص في مسقط بعمان. واستخدمت مجموعة من الأطفال الذين أجريت عليهم عمليات تقليدية لاستئصال اللوزتين كمجموعة ضابطة. وأجريت العمليات بطريقة الإنضار الدقيق في أحد المركزين على 28 طفلا، بينما أجريت بطريقة الترددات الشعاعية على 31 طفلا في المركز الآخر. **النتائج:** لم تكن هنالك فروقات معنوية بين الطريقتين في الفترة الزمنية التي لم يكن فيها ألم عقب العملية، والتي استمرت إلى نحو ثلاثة أيام، ولا في مؤشرات البرء من الألم مثل استخدام مسكن واحد ضد الألم، وتقليل فترة الاستيقاظ ليلا، والوقت اللازم لاستئناف تناول الطعام العادي. غير أن استعادة الأطفال من عمليات بضع اللوزة كانت أكبر منها عقب عمليات استئصال اللوزتين. **الخلاصة:** كانت نتائج القطع الجزئي لأنسجة اللوزة عن طريق الإنضار الدقيق أو الترددات الشعاعية مشجعة في ما يتعلق بنوعية الحياة بعد العملية، وأفضل من نتائجها عند إجراء عمليات تقليدية لاستئصال اللوزتين. وأثبتت هذه الدراسة عدم وجود فروقات معنوية بين نتائج طريقتي الإنضار الدقيق والترددات الشعاعية في مدة الألم الذي يعقب العملية، ومدة الإفاقة.

مفتاح الكلمات: نوعية الحياة؛ ألم ما بعد العملية؛ انقطاع النفس النومي الانسدادي؛ بضع اللوزة؛ استئصال اللوزتين.

ADVANCES IN KNOWLEDGE

- The purpose of this study was to promote the intracapsular tonsillotomy technique among surgeons in the Middle East. Previous studies have found that this technique is as effective as the tonsillectomy technique in the management of childhood sleep disorders caused by tonsillar tissue hypertrophy.
- Intracapsular tonsillotomies, performed using either the radiofrequency (RF) or microdebrider (MD) method, could provide a better quality of life for patients after surgery, compared to a standard tonsillectomy.
- Although this study did not look at the long-term results of these methods, it still portrays clear evidence of patient benefit, specifically in the areas of postoperative pain and recovery time.

¹Department of Ear, Nose & Throat, Al Zahra Hospital, Dubai, United Arab Emirates; ²Department of Anaesthesia & Critical Care, Muscat Private Hospital, Muscat, Oman; ³Department of Oto-Rhino-Laryngology & Bronchology, Heim Pál Children's Hospital, Budapest, Hungary

*Corresponding Author e-mail: levente.deak@azhd.ae

APPLICATION TO PATIENT CARE

- Since the tonsillar capsule is left intact during a tonsillotomy, the underlying vulnerable arteries and nerves are not exposed; therefore, the risk of patients developing postoperative bleeding or experiencing uncontrolled pain is reduced with this procedure.
- Postoperative pain after a tonsillotomy can be managed with the use of oral paracetamol alone. In contrast, a patient receiving a tonsillectomy requires a combination of postoperative therapies.
- As the potential for postoperative complications is reduced, a RF or MD tonsillotomy can be performed easily on an outpatient basis as a day case procedure.

THE FREQUENCY OF UPPER RESPIRATORY infections during childhood commonly leads to an enlargement of the adenotonsillar tissue. This, combined with the relatively narrow airway of a child, can ultimately lead to airway obstruction.¹ A partial or complete upper airway obstruction disrupts normal sleeping patterns and is known as obstructive sleep apnoea. This can manifest as daytime sleepiness, poor concentration, morning headaches or developmental problems.²

The management of sleep disorders caused by tonsillar tissue hypertrophy involves surgery. This surgery can either be partial, where the tonsillar capsule remains intact, or total, which involves the removal of the enlarged lymphoid tissue. Both methods have similar long-term beneficial effects on sleeping patterns.^{3,4}

In the past, tonsillar surgery involved bulk tissue reduction by guillotine. Later, with the advent of instruments of greater precision, surgeries were extended to include the removal of the tonsillar capsule. The rationale behind this surgical extension was so as to leave no residual infected tissue behind. As surgical methods have changed, so has the indication for the surgery—from eliminating chronic infection to enlarging the airway by reducing the adenotonsillar tissue size.^{5,6}

Recently, several new tonsillar reduction techniques have been introduced, including microdebrider (MD), radiofrequency (RF), laser and coblation techniques.^{7,8} All of these approaches manipulate the tonsils with the aim of improving a patient's quality of life (QOL) while reducing the operating time and patient blood loss. A recent systematic review of intracapsular *versus* total tonsillectomies indicated that procedures to reduce tonsillar size were as safe as a conventional tonsillectomy,⁹ while Wireklint *et al.* found that a tonsillotomy could provide similar long-term results to that of a tonsillectomy.⁴

As observed in a study by Sorin *et al.*, a patient's QOL during the postoperative period following a tonsillar procedure may be influenced by the technique used to manipulate the tonsils.¹⁰ It follows, therefore, that a partial resection of the tonsillar tissue

can potentially reduce the postoperative complication rate. By keeping the capsules intact, the remaining tonsillar tissue acts as an additional protective layer for the underlying neurovascular tissues. For practical purposes, a partial tonsillectomy is effectively a refinement of the historical tonsillar guillotine method.¹¹

Most of the published literature on the effects of tonsillotomy and tonsillectomy techniques lack standardisation for factors such as steroid or analgesic use, postoperative antibiotic treatment or the surgical method employed, all of which may influence overall patient outcomes.^{12,13} The purpose of this study, therefore, was to study a standardised normative population in order to achieve two research objectives: (1) to define the role of the tonsillar capsule in limiting patients' postoperative QOL, and (2) to investigate whether a MD modified cold steel technique or a temperature-controlled RF method would demonstrate more favourable outcomes when compared with a total tonsillectomy.

Methods

In this prospective non-randomised study, a total of 128 children (78 boys and 50 girls, with an age range of 3–11 years) were recruited among patients of Heim Pál Children's Hospital (HPCH) in Budapest, Hungary, and Muscat Private Hospital (MPH) in Muscat, Oman. All of the patients had been referred for tonsillar surgery by their primary physician due to an obstructed airway, with a diagnosis of adenotonsillar hypertrophy. The protocol for this study was designed by two experienced ear, nose and throat surgeons and the study population was standardised for surgical methodology and postoperative pain management.

A full clinical history was taken from the patients' caregivers during the initial consultation. On clinical examination, tonsillar size was assessed and patients were included in the study if their tonsils occupied at least 50% of the pharyngeal space. Patients with a diagnosis of chronic tonsillitis, suspected severe obstructive sleep apnoea or any congenital deformities were automatically excluded from the study as these

patients require a longer hospitalisation period with specialised care which could have directly influenced the results of the study.¹⁴

All patients who were referred for a tonsillectomy due to adenotonsillar hypertrophy between February and October 2011 at either hospital underwent a standard cold steel tonsillectomy. Those who were referred between November 2011 and September 2012 to either hospital underwent a tonsillotomy. The tonsillectomy groups from each centre acted as control groups in order to measure four specific morbidity points: the severity and duration of postoperative pain and the time taken to return to a normal diet and lifestyle. The control group from HPCH was labelled TTc1 while the control group from MPH was labelled TTc2. The morbidity outcomes for the two control groups were then compared. Since there were no significant differences in the measured outcomes between the two centres, data from each site were used to represent a single control group. Thereafter, MPH elected to perform tonsillotomies using the MD method while HPCH chose to use the RF technique.

The studied patients were all routinely assessed preoperatively by the same anaesthetist who would administer the anaesthesia during their surgical procedure. Since the patients had all been diagnosed as having mild obstructive symptoms, no further sleep studies or cardiac investigations were deemed necessary. In all cases, a full health history and systematic examination was done. As per hospital protocol, a blood test, including a complete blood count and a coagulation measurement, was requested for all patients. Premedication with midazolam and chloral hydrate was avoided due to the potential risk of preoperative airway obstruction. The induction of anaesthesia was either done intravenously or inhalationally, depending on the child. Patients were paralysed using a non-depolarising muscle relaxant and then intubated with a south-facing Ring-Adair-Elwyn tube. The anaesthesia was maintained with sevoflurane. Dexamethasone (5 mg/kg up to a maximum of 25 mg) was also given during the surgery as the use of steroids has been shown to improve postoperative oral intake and reduce vomiting and pain among patients.¹⁴

All surgeries were performed under general anaesthesia. Patients were put in the Rose position with a mouth gag to retract the mandible. Tonsillectomies were performed by standard extra-capsular dissection and bipolar forceps were used for coagulation. Adenoidectomies, if needed, were performed using a standard curettage technique. All procedures were performed by experienced consultants and care was taken to preserve the mucosa around the tonsillar

tissue, uvula and anterior and posterior pillars.

The MD tonsillotomies were carried out using a Unidrive® S III ECO (Karl Storz GmbH & Co. KG., Tuttlingen, Germany) high-speed drill with both straight and curved blades. A Hurd tonsil dissector and pillar retractor was used to mobilise the *palatoglossus* muscle for better visualisation of the tonsillar tissue during the operation. Initially, a lower rotation rate was selected, permitting the removal of a larger portion of tonsillar tissue. The frequency was increased up to 4,500 rpm upon reaching the core of the tonsil. If minor bleeding was observed at the end of the procedure, the tonsillar bed and residual tissue was covered for a short time with tonsil packs soaked in adrenaline (1:100,000). In most cases, the bleeding was self-limiting, abating during the time taken to complete the procedure on the opposite tonsil. In seven cases, minor bipolar cauterisation (20 W) was applied to the tonsillar surface, taking care to avoid deep thermal damage.

With the temperature-controlled RF tonsillotomies, tonsillar reduction was achieved using the Surgitron® Dual Frequency RF/120 IEC with Empire® microIncision™ needles and loop electrodes (Ellman International, Inc., Hicksville, New York, USA). With the unit set to the cutting/coagulation mode (power = 45 W, frequency = 4 MHz), an incision was started 2 mm from the tonsillar pillar. After marking the height of the resection, the loop electrode was used to reduce the size of the tonsillar tissue from the bed, leaving behind a small amount of tonsillar tissue and the capsule. Following the procedure, both of the tonsillar beds were covered with adrenaline-soaked tonsil packs. In three cases, further coagulation in the device's haemostasis mode was used to complete the haemostasis.

Pain management after tonsillar surgery remains challenging. It is now recommended that physicians avoid prescribing opioid analgesics; once common, this form of pain management is now discouraged due to the possibility of respiratory depression, which could be fatal in patients already prone to sleep disturbances.^{15,16} Instead, non-steroidal anti-inflammatory drugs, which are not associated with an increased risk of postoperative bleeding, are now widely used for postoperative pain management in combination with paracetamol.^{17,18} Studies often employ standardised pain assessment rating scales such as the Visual Analog Scale or the Wong-Baker Faces Pain Rating Scale. However, in this study, an in-house questionnaire was designed to assess specific surrogate factors of pain: the use of either a single analgesic (paracetamol) or combined analgesics (paracetamol and ibuprofen); the number of days

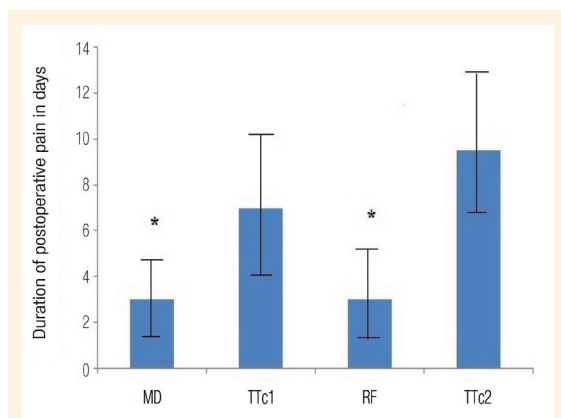


Figure 1: Comparison of the number of days with postoperative pain among the two tonsillectomy control groups, the microdebridatation tonsillotomy group and the radiofrequency tonsillotomy group.

MD = microdebridatation; TTc1 = control group affiliated with Heim Pál Children's Hospital; RF = radiofrequency; TTc2 = control group affiliated with Muscat Private Hospital.

where painkillers were necessary; the number of nights during which the child woke up due to pain; the number of days before the resumption of a normal diet (abated discomfort from swallowing), and the number of days before the child was able to return to school. During the patients' postoperative care, caregivers were instructed to provide analgesics as needed. As a first-line therapy, oral paracetamol (15 mg/kg^{-1}) was given and repeated as necessary up to four times daily. For cases where oral analgesia was not tolerated, or the maximum permissible dose of paracetamol had been reached, ibuprofen (5 mg/kg^{-1}) was provided either orally or as a suppository. Caregivers were asked to keep a record of analgesic use and frequency as well as of the other factors outlined in the pain assessment questionnaire.

A research assistant at each centre was assigned to coordinate the patients' follow-up using the in-house pain assessment questionnaire. This was done with each patient's caregiver either personally or over the phone after seven postoperative days. For those still recovering, a second interview was scheduled after a further seven days. Postoperative days were counted from the first day after surgery (24 hours after the procedure). Data were excluded in cases where the pain assessment questionnaire was either incomplete or not attempted at all.

For the statistical analysis, the non-parametric Mann-Whitney U test was used and data were presented as mean \pm standard deviation. Statistical significance was established at $P < 0.05$.

This study was approved by the Institutional Ethical Committees of HPC in Budapest, Hungary, and MPH in Muscat, Oman (approval nos. 01/2011

and EC/MPH/11/2010, respectively). Informed consent was received from the caregivers of all patients included in the study.

Results

During the study period, 69 tonsillectomies were performed in the TTc1 ($n = 39$) and TTc2 ($n = 30$) groups, while 28 patients underwent an MD tonsillotomy and 31 patients underwent an RF tonsillotomy. In two cases, the patients' caregivers declined the tonsillotomy and requested a tonsillectomy. All of the patients were discharged one day after their surgery, with no patients requiring prolonged hospitalisation.

In terms of the postoperative pain evaluation, those undergoing a tonsillectomy were pain-free after 7 ± 3.4 and 9 ± 2.1 days in the TTc1 and TTc2 groups, respectively. The difference was not statistically significant. A total of 25 patients (64%) from the TTc1 group and 16 (53%) from the TTc2 group reported the need for combined analgesics (paracetamol and ibuprofen). Pain severity was also measured by the supplementary use of analgesics during the night. Among the control groups, 19 patients (48%) in the TTc1 group and 17 patients (56%) in the TTc2 group requested a supplementary night-time dose of analgesics.

The extent of analgesic use among the tonsillotomy groups (MD and RF) was also assessed. Those who had had a partial tonsillectomy using the MD reported a mean painful period of 3 ± 1.7 days. When compared with one of the control groups (TTc1), this difference was statistically significant ($P < 0.01$) [Figure 1]. A combination of paracetamol and an NSAID was necessary in only one of the 28 patients, and none of the children from this group awoke during the night due to pain. Patients treated by the RF procedure reported a mean painful period of 3 ± 2.4 days. This was again statistically significant ($P < 0.01$) when compared with the control group (TTc2). Three RF patients required the use of combined analgesics, and seven patients (23%) needed a supplementary dose of an analgesic during the night.

When assessing the time taken for the patient to resume a normal diet of solids after their initial fluid diet, the mean time for the MD subjects was 3 ± 1.3 days. This was significantly reduced in comparison to the TTc1 group which took 6.2 ± 4 days ($P < 0.05$). For those in the RF group, the transition took longer, with a mean duration of 5 ± 2.8 days. However, this was still significantly reduced in comparison to the control group (TTc2) which took 9.5 ± 5 days ($P < 0.05$). A

comparison between the time taken in both the RF and MD groups was not statistically significant.

One of the specific postoperative outcomes assessed was whether the children were able to return to school within 1–2 weeks following the operation. In this study, all patients were currently attending either a nursery or primary school. If the sixth and seventh postoperative days coincided with a weekend, these were considered to be two extra recovery days. A total of 26 children (91%) in the MD group and 25 children (80%) in the RF group returned to school within seven postoperative days. In the control groups, none of the 69 children were able to resume their school activities within the first postoperative week.

In terms of postoperative complications, all three methods were found to be safe, with none of the cases requiring surgical intervention due to postoperative bleeding. Of the patients from the tonsillectomy control groups, three out of 69 had to be readmitted for observation due to reports of blood in the sputum.

Discussion

The concept of a partial tonsillectomy, otherwise known as a tonsillotomy, was conceived by Hultcrantz,¹⁹ Koltai⁷ and Friedman,⁸ who used different methods to achieve the same result: a reduction in the bulk of tonsillar tissue. The main advantage of an intracapsular tonsillotomy is the protection of the arteries and nerves behind the tonsillar capsule, which can be damaged during the operation or exposed to local infections during the postoperative period. It has been shown that retaining a small amount of tonsillar tissue between the anterior and posterior pillar can significantly reduce the postoperative recovery time.^{9,11} However, it should be noted that there are some possible disadvantages of leaving residual tissue in tonsillotomy surgeries, as a later progression to lymphoid hyperplasia may be possible. Theoretically, the remaining tissue could also be a focus point for chronic inflammation, which may later require a tonsillectomy. However, this possibility is low (1–3%) and is offset by the increased morbidity associated with tonsillectomies.¹⁰

Although three out of 69 children undergoing tonsillectomies in the current study had to be readmitted for observation due to reports of blood in the sputum, no conclusions could be made regarding the relative risk of postoperative haemorrhage among the different methods due to the relatively small sample size. All three methods were found to be safe, with none of the cases requiring surgical intervention due to postoperative bleeding.

The results of this current study clearly demonstrate the benefits of tonsillotomies over tonsillectomies, since patients from both the RF and MD groups required postoperative pain relief for approximately four days only. This is significantly shorter than the mean seven days required by the tonsillectomy control groups. Additionally, the postoperative pain among the children undergoing tonsillotomies was easier to manage since most of the patients required paracetamol alone (96% and 90% in the MD and RF groups, respectively); within the tonsillectomy groups, between 53–64% of the children required a combination of analgesics (paracetamol with ibuprofen), suggesting more severe pain in these groups. Other surrogate factors, like the earlier resumption of a normal diet and return to school, indicate that the less traumatic approach of a tonsillotomy has a significant positive impact on postoperative QOL among children. These recorded values and findings closely correlate with those of other researchers investigating the outcomes of tonsillotomies.^{9,19}

A previous study by Leinbach *et al.* has shown that thermal injury, occurring as a result of the cauterisation of the tonsillar *fossa*, correlates directly with the extent of postoperative pain, due to injury to the underlying branches of the glossopharyngeal and vagal nerves.¹¹ The RF tonsillotomy technique generates heat at around 40–70 °C, which could potentially cause such a thermal injury, although this temperature range is lower than that produced during electrocautery.⁸ This temperature range during RF surgery might explain why more RF patients required a combination of analgesics (10% *versus* 4% in the MD group) and why 23% needed supplementary doses of analgesics due to night-time waking in comparison to 0% among the MD group. However, the average recovery time between the MD and RF groups was the same.

The results of this study should be interpreted with caution as the sample size used was too small to infer any statistical significance. Further studies with larger cohorts would be useful in determining any differences between the two tonsillotomy methods.

Conclusion

In all previously published studies, tonsillotomy methods have been compared to the standard tonsillectomy surgery without using standardised controls. Using standardised methodology, meaningful comparisons can be made when considering surgery for tonsillar hypertrophy. The results of this standardised study demonstrated that the recovery period after a tonsillotomy is superior to that

required after a tonsillectomy. A comparison of the two tonsillotomy methods showed no difference in the duration of postoperative pain or time taken to recover. Therefore, a tonsillotomy by either MD or RF methods should be considered as the first choice of surgery for tonsillar tissue reduction. These techniques are recommended for surgeons in the Middle East and around the world.

References

- Bhattacharyya N, Lin HW. Changes and consistencies in the epidemiology of pediatric adenotonsillar surgery, 1996-2006. *Otolaryngol Head Neck Surg* 2010; 143:680-4. doi: 10.1016/j.otohns.2010.06.918.
- Baldwin CM, Quan SF. Sleep disordered breathing. *Nurs Clin North Am* 2002; 37:633-54. doi: 10.1016/S0029-6465(02)00030-0.
- Stewart MG, Liotta DR. Is partial tonsillectomy equivalent to total tonsillectomy for obstructive symptoms? *Laryngoscope* 2011; 121:6-7. doi: 10.1002/lary.21340.
- Wireklint S, Ericsson E. Health-related quality of life after tonsillotomy versus tonsillectomy in young adults: 6 years postsurgery follow-up. *Eur Arch Otorhinolaryngol* 2012; 269:1951-8. doi: 10.1007/s00405-012-1990-y.
- Curtin JM. The history of tonsil and adenoid surgery. *Otolaryngol Clin North Am* 1987; 20:415-19.
- Koempel JA, Solares CA, Koltai PJ. The evolution of tonsil surgery and rethinking the surgical approach to obstructive sleep-disordered breathing in children. *J Laryngol Otol* 2006; 120:993-1000. doi: 10.1017/S0022215106002544.
- Koltai PJ, Solares CA, Mascha EJ, Xu M. Intracapsular partial tonsillectomy for tonsillar hypertrophy in children. *Laryngoscope* 2002; 112:17-19. doi: 10.1002/lary.5541121407.
- Friedman M, LoSavio P, Ibrahim H, Ramakrishnan V. Radiofrequency tonsil reduction: Safety, morbidity, and efficacy. *Laryngoscope* 2003; 113:882-7. doi: 10.1097/00005537-200305000-00020.
- Walton J, Ebner Y, Stewart MG, April MM. Systematic review of randomized controlled trials comparing intracapsular tonsillectomy with total tonsillectomy in a pediatric population. *Arch Otolaryngol Head Neck Surg* 2012; 138:243-9. doi: 10.1001/archoto.2012.16.
- Sorin A, Bent JP, April MM, Ward RF. Complications of microdebrider-assisted powered intracapsular tonsillectomy and adenoidectomy. *Laryngoscope* 2004; 114:297-300. doi: 10.1097/00005537-200402000-00022.
- Leinbach RE, Markwell SJ, Colliver JA, Lin SY. Hot versus cold tonsillectomy: A systematic review of the literature. *Otolaryngol Head Neck Surg* 2003; 129:360-4. doi: 10.1016/S0194-5998(03)00729-0.
- Steward DL, Grisel J, Meinzen-Derr J. Steroids for improving recovery following tonsillectomy in children. *Cochrane Database Syst Rev* 2011; 8:CD003997. doi: 10.1002/14651858.CD003997.pub2.
- Dhiwakar M, Clement WA, Supriya M, McKerrow W. Antibiotics to reduce post-tonsillectomy morbidity. *Cochrane Database Syst Rev* 2010; 7:CD005607. doi: 10.1002/14651858.CD005607.pub3.
- Schwengel DA, Sterni LM, Tunkel DE, Heitmiller ES. Perioperative management of children with obstructive sleep apnea. *Anesth Analg* 2009; 109:60-75. doi:10.1213/ane.0b013e3181a19e21.
- Duedahl TH, Hansen EH. A qualitative systematic review of morphine treatment in children with postoperative pain. *Paediatr Anaesth* 2007; 17:756-74. doi: 10.1111/j.1460-9592.2007.02213.x.
- Warwick JP, Mason DG. Obstructive sleep apnoea syndrome in children. *Anaesthesia* 1998; 53:571-9. doi: 10.1046/j.1365-2044.1998.00370.x.
- Pickering AE, Bridge HS, Nolan J, Stoddart PA. Double-blind, placebo-controlled analgesic study of ibuprofen or rofecoxib in combination with paracetamol for tonsillectomy in children. *Br J Anaesth* 2002; 88:72-7. doi: 10.1093/bja/88.1.72.
- Riggin L, Ramakrishna J, Sommer DD, Koren G. A 2013 updated systematic review & meta-analysis of 36 randomized controlled trials: No apparent effects of non steroidal anti-inflammatory agents on the risk of bleeding after tonsillectomy. *Clin Otolaryngol* 2013; 38:115-29. doi: 10.1111/coa.12106.
- Hultcrantz E, Linder A, Markström A. Tonsillectomy or tonsillotomy? A randomized study comparing postoperative pain and long-term effects. *Int J Pediatr Otorhinolaryngol* 1999; 51:171-6. doi: 10.1016/S0165-5876(99)00274-8.