

# Subtotal intracapsular tonsillectomy may be the first choice for tonsillectomy in children

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Jie Wang , Pan-hong Dang, Huan-huan Chang  
and Zi-han Wang

## Abstract

**Objective:** To investigate the effect and prognosis of subtotal intracapsular tonsillectomy.

**Methods:** All children (n=162) with tonsillar hypertrophy and chronic tonsillitis were randomly divided into two groups: tonsillectomy (n=75) and subtotal intracapsular tonsillectomy (n=87). Tonsillectomy: the tonsillar tissue was completely removed along with the tonsillar capsule. Subtotal intracapsular tonsillectomy: 80% to 90% of the tonsils and the complete epithelium of the tonsillar crypts were removed without damaging the tonsillar capsule. The Face, Legs, Activity, Cry, and Consolability (FLACC) and parents' postoperative pain measure (PPPM) scales were used to evaluate postoperative pain, and the obstructive sleep apnea (OSA)-18 questionnaire was used to assess the children's postoperative quality of life. The patients were followed-up for 2 years.

**Results:** 1. The FLACC and PPPM scales indicated that the children's postoperative pain after subtotal intracapsular tonsillectomy was significantly less than that of children undergoing tonsillectomy. 2. The OSA-18 scale scores indicated that subtotal intracapsular tonsillectomy significantly improved the children's quality of life. 3. Two years after subtotal intracapsular tonsillectomy, no patients required reoperation.

**Conclusion:** Subtotal intracapsular tonsillectomy may be the first choice for tonsillar hypertrophy and chronic tonsillitis patients.

## Keywords

Tonsillectomy, subtotal intracapsular tonsillectomy, pain, recurrence, Face, Legs, Activity, Cry, and Consolability, postoperative pain measure

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Department of Otolaryngology-Head and Neck Surgery,  
The Affiliated Children's Hospital of Xi'an Jiaotong  
University, Xi'an, Shaanxi Province, 710003, China

## Corresponding author:

Jie Wang, Department of Otolaryngology-Head and Neck  
Surgery, The Affiliated Children's Hospital of Xi'an  
Jiaotong University, 69 Xi ju-yuan Road, Xi'an, Shaanxi  
Province 710003, China.

Email: [wangjie0112@icloud.com](mailto:wangjie0112@icloud.com)



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## Introduction

Tonsillectomy with or without adenoidectomy is one of the most common operations in children worldwide, and recurrent tonsillar infection and tonsillar snoring are the most common indications for tonsillectomy.<sup>1,2</sup> Tonsillectomy is divided into total tonsillectomy and partial tonsillotomy. In partial tonsillotomy, surgeons choose to preserve 10% to 70% of the tonsillar tissue.<sup>3</sup> Some doctors choose to remove only the tonsillar tissue that protrudes into the palatoglossal arch and the palatopharyngeal arch,<sup>4</sup> whereas others remove most of the tonsils, leaving only thin tonsillar tissue.<sup>5</sup> The clinical application of partial tonsillotomy is limited because of the different surgical standards. Chinese otolaryngologists are more likely to choose tonsillectomy because of concern about possible recurrence and the postoperative effects after partial tonsillotomy, which may lead to a risk of reoperation and increase doctor-patient conflict.

Humoral and cellular immune function decrease slightly 1 month after tonsillectomy and recover to normal after 3 months.<sup>6</sup> However, a follow-up study of nearly 1.2 million children published in *JAMA* in 2018 found that tonsillectomy increased the long-term risk of respiratory diseases, infectious diseases, and allergic diseases.<sup>7</sup> A retrospective study of patients 20 years after tonsillectomy also found that children who underwent tonsillectomy were prone to develop symptoms similar to chronic pharyngitis, such as dry throat and foreign body sensation, which increased the risk of asthma, ulcerative colitis, goiter, and arterial hypertension.<sup>8</sup>

We must re-examine the application of partial tonsillotomy and standardize the scope of resection. In this study, we compared patients' pain, bleeding rate, recurrence rate, and postoperative quality of life of two surgical methods, and followed the patients for 2 years postoperatively

to investigate the effect and prognosis of each surgery.

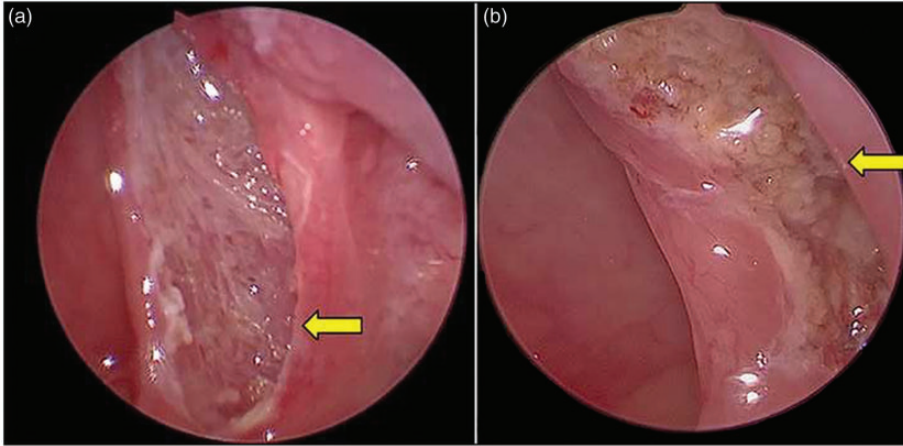
## Materials and methods

### Patients

According to the otolaryngologists' evaluations, all children with tonsillar hypertrophy and chronic tonsillitis<sup>9</sup> were included on the waiting list for tonsillectomy. These children were randomly divided into tonsillectomy and subtotal intracapsular tonsillectomy groups. Randomization was performed from the waiting list (computer-generated, sequentially numbered list). Family members were informed of the study and randomization results before providing written informed consent, and the possible advantages and disadvantages of surgery were discussed. This study was approved by the ethics committee of Xi'an Jiaotong University (XJT2019-P12).

### Surgical methods

After inducing anesthesia, the surgical sites were routinely disinfected, covered with sterile surgical towels, and a mouth opener was used to support the oropharynx. Tonsillectomy: the tonsillar tissue was completely removed using a plasma knife (DQG-E5045-B130; Xi'an Surgical Medical Technology, Xi'an, Shaanxi, China) along with the tonsillar capsule, and hemostasis was performed under endoscopic guidance. Subtotal intracapsular tonsillectomy: First, free tonsillar tissue (the tonsillar tissue protruding from the palatoglossal arch and the palatopharyngeal arch) was removed with a plasma knife. Then, 80% to 90% of the tonsillar tissue was ablated with a plasma knife under endoscopic guidance without damaging the palatolingual arch and tonsillar capsule, and with complete removal of the tonsillar crypt epithelium (Figure 1). All operations were performed by the same associate chief physician. The cutting energy and



**Figure 1.** Plasma knife tonsillectomy. a: Operative cavity in tonsillectomy. The yellow arrow indicates that the palatoglossal arch may be partially damaged by tonsillectomy with a plasma knife. b: Operative cavity in subtotal intracapsular tonsillectomy: 80% to 90% of the tonsillar tissue is ablated with a plasma knife under endoscopic guidance without damaging the palatolinguinal arch, and the epithelium of the tonsillar crypt is completely removed.

hemostatic energy of the low-temperature plasma radiofrequency surgery system were set at 6 and 5, respectively. No children received antibiotics, none used an analgesic pump, and all were encouraged to eat, postoperatively. The Face, Legs, Activity, Cry, and Consolability (FLACC) and parents' postoperative pain measure (PPPM) scales were used to evaluate postoperative pain, and the obstructive sleep apnea quality of life questionnaire (OSA-18) was used to evaluate the children's postoperative quality of life.

### *FLACC Scale*

The FLACC scale is an effective method to evaluate postoperative pain in children.<sup>10</sup> This scale evaluates five main aspects: face, legs, activity, crying, and consolability. The total score ranges from 0 to 15 and is calculated by adding the scores at 6, 12, 18, 24, and 48 hours postoperatively.

### *PPPM Scale*

The PPPM is a parent rating scale for pain 2, 3, 4, 5, 6, 7, and 14 days after surgery.<sup>11</sup> The

scale evaluates 15 items: Is the child more likely to complain than usual? Is the child crying more than usual? Is the child playing less than usual? Does the child not enjoy doing what they usually do? Is the child more anxious than usual? Is the child quieter than usual? Is the child less energetic than usual? Is the child eating less than usual? Does the child cover the painful area? Does the child refuse to eat? Is the child afraid to touch the painful area? Is the child groaning more than usual? Does the child prefer to be close to you? Does the child take drugs that are usually refused? Is the child's face redder than usual?

The total score ranges from 0 to 15, and scores > 6 (daily) are considered to indicate significant pain. The total score is calculated by adding the scores on postoperative days 2, 3, 4, 5, 6, 7, and 14.

### *OSA-18 scale*

The OSA-18 evaluates postoperative quality of life in children with tonsillar hypertrophy.<sup>12</sup> The questionnaire evaluates five

aspects: physical symptoms, daytime effects, sleep disorders, adverse emotions, and the impact on child guardians. The higher the score, the more serious the impact of surgery on quality of life. The total score is the sum of the scores of each item in the questionnaire, and ranges from 18 to 126. Scores < 60 indicate a mild decrease in quality of life, scores of 60 to 80 indicate a moderate decrease, and scores > 80 indicate a severe decrease.

### **Statistical analyses**

Data are presented as means  $\pm$  standard deviations (SDs). One-way analysis of variance (ANOVA) was used for statistical analysis, and  $P < 0.05$  was considered statistically significant. Analyses were performed using SPSS version 13.0 (SPSS Inc., Chicago, IL, USA).

## **Results**

### **Patients**

A total of 162 children were recruited, 76 boys and 86 girls, all aged 3 to 9 years (median age: 6.2 years). Seventy-five children underwent tonsillectomy, and 87 underwent subtotal intracapsular tonsillectomy; 90% (146/162) of the children underwent concurrent adenoidectomy and tonsillectomy. Four cases were lost during the 2-year follow-up.

### ***Postoperative pain in children undergoing subtotal intracapsular tonsillectomy was less than that of children undergoing tonsillectomy***

After tonsillectomy, doctors used the FLACC scale, and family members used the PPPM scale to evaluate postoperative pain. When the pain score was > 3 points, ibuprofen and/or acetaminophen were given to relieve pain, with 1 point recorded

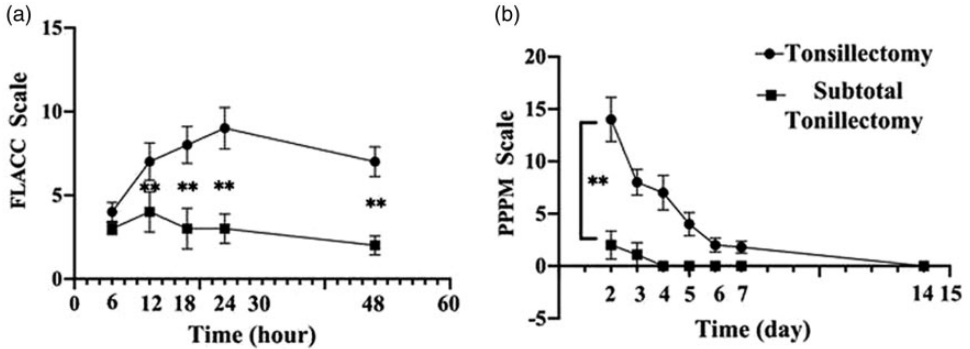
for single use and 2 points for multiple use. The FLACC scale indicated that postoperative pain within 48 hours in children who underwent subtotal intracapsular tonsillectomy was significantly less than that of children who underwent tonsillectomy. The PPPM scale indicated that after subtotal intracapsular tonsillectomy, pain resolved on the 4th postoperative day; after tonsillectomy, pain could last for 2 weeks, and the pain scores in the two groups were statistically different within 2 weeks of when the pain disappeared (Figure 2).

### ***Subtotal intracapsular tonsillectomy can improve quality of life***

Some doctors are concerned about the surgical effect of subtotal intracapsular tonsillectomy. To address this concern, we used the OSA-18 scale to evaluate the children's quality of life. Tonsillectomy and subtotal intracapsular tonsillectomy can significantly improve the quality of life of snoring children, and we found no significant difference between tonsillectomy and subtotal intracapsular tonsillectomy in this regard (Figure 3).

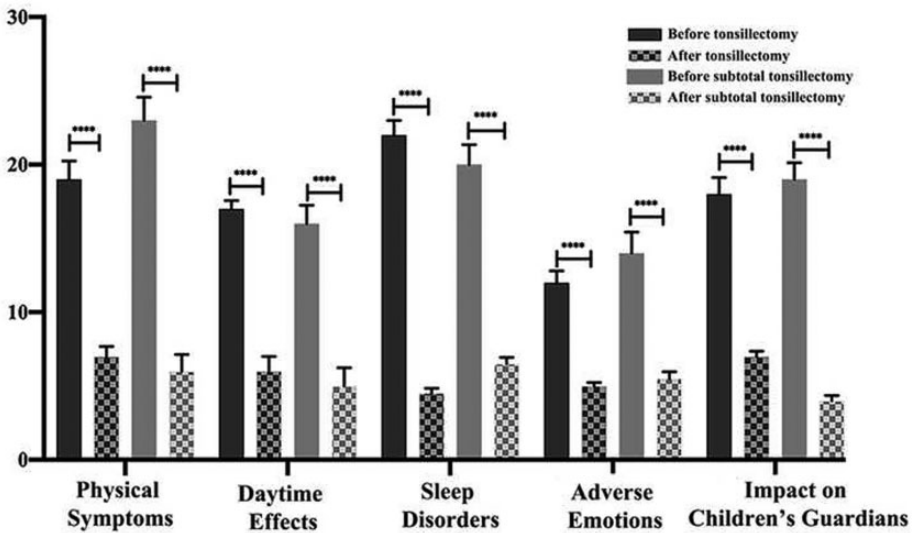
### ***Two years after subtotal intracapsular tonsillectomy, no children required reoperation***

Among the 87 cases, 30 cases underwent subtotal intracapsular tonsillectomy because of recurrent tonsillar infection. Only one patient had a small amount of salivary blood owing to an oral infection (halitosis and thick white membrane), and no active bleeding was found after gargling with chlorhexidine. No children required reoperation because of tonsillar hypertrophy or tonsillar infection. Among the 75 cases, 2 cases (2.67%) undergoing tonsillectomy had postoperative bleeding; both were treated by reoperation.



**Figure 2.** Postoperative pain scores. a: The FLACC scale indicated that postoperative pain in the children undergoing subtotal intracapsular tonsillectomy was significantly less than that of children undergoing tonsillectomy, 12, 16, 18, 24, and 48 hours postoperatively. b: The PPPM scale indicated that after subtotal intracapsular tonsillectomy, pain disappeared on the 4th postoperative day, and after tonsillectomy, pain could last for 2 weeks. The pain scores in the two groups were statistically different within 2 weeks of surgery (\*\* $P < 0.01$ )

FLACC, Face, Legs, Activity, Cry and Consolability; PPPM, postoperative pain measure.



**Figure 3.** OSA-18 quality of life scores. Tonsillectomy and subtotal intracapsular tonsillectomy can improve children's quality of life according to five aspects: physical symptoms, daytime effects, sleep disorders, adverse emotions, and the impact on children's guardians. There was no significant difference between tonsillectomy and subtotal intracapsular tonsillectomy (\*\* $*P < 0.001$ )

OSA, obstructive sleep apnea.

### Discussion

A plasma knife is a useful and safe device in tonsillectomy. Compared with cold dissection

and bipolar electrocautery, using a plasma knife reduces intraoperative blood loss and provides a fast tonsillectomy with acceptable morbidity.<sup>13</sup> Plasma knife tonsillectomy and

adenoidectomy are the main choice in China. The vision with endoscopic surgery is clearer, and hemostasis is more thorough. After hemostasis under tonsillar endoscopy, doctors can directly perform adenoidectomy to completely remove the adenoid tissue blocked by the posterior nostril, to avoid damaging the Eustachian tube tonsil and other structures.

Partial tonsillotomy is recommended in Sweden for the treatment of tonsillar-associated upper airway obstruction in children.<sup>13,14</sup> Partial tonsillotomy can accelerate healing, and reduce pain and inflammation because it does not damage the muscular layer,<sup>15</sup> and the bleeding rate is lower.<sup>16,17</sup> Children who underwent partial tonsillotomy were able to return to a normal diet and participate in normal activities more quickly than those who underwent tonsillectomy.<sup>18</sup> However, both doctors and patients have concern regarding the possibility of reoperation after partial tonsillotomy. A literature review revealed that the recurrence rate after tonsillotomy was approximately 3%, younger children had a higher risk of recurrence, and the most common cause of reoperation was snoring.<sup>16,17,19</sup> Waldeyer's ring is composed of numerous lymphoid follicles in the lamina propria of the pharyngeal mucosa, which integrates into adenoid lymphoid tissue and forms a ring. The lymphoid tissue in Waldeyer's ring restricts the growth of tissue in both areas, so we often find after tonsillectomy combined with adenoidectomy that the cause of nasal obstruction and snoring is tonsillar hypertrophy of the eustachian tube.

We believe that the balance of Waldeyer's ring that remains after partial tonsillotomy can prevent eustachian tube tonsillar hypertrophy. Second, doctors and parents must correctly understand the concept of recurrence. Tonsillar tissue recurrence occurs only when the tonsils become hyperplastic again and cause corresponding

clinical symptoms. In our study, no children required reoperation during the follow-up after subtotal intracapsular tonsillectomy. We consider that subtotal intracapsular tonsillectomy removes 80% to 90% of the tonsils. Therefore, most of the tonsillar tissues have been removed, and the possibility of secondary hyperplasia causing clinical symptoms is low. However, the follow-up time in this study was short at only 2 years.

In our study, the subtotal intracapsular tonsillectomy group did not exclude children with chronic tonsillitis. In a retrospective survey, 51 chronic tonsillitis patients underwent partial tonsillotomy. The frequency of tonsillitis was significantly reduced, which led to a significant reduction in antibiotic treatment.<sup>20</sup> The tonsillar crypt epithelium consists of stratified squamous epithelium and reticular epithelium. The M cells in the reticular epithelium are activated phagocytes, which release antigens to the subcutaneous area without degradation. It is reported that 90.9% of children with chronic tonsillitis had obvious keratinization of the crypt epithelium.<sup>21</sup> Therefore, we believe that thorough removal of the crypt epithelium can prevent recurrent tonsillar infection after subtotal resection. Retrospective studies have also confirmed that remnant tonsils after partial tonsillotomy do not increase the tonsil infection rate.<sup>22,23</sup> There was no significant difference regarding controlling recurrent tonsillitis between the intracapsular dissection tonsillectomy and extracapsular dissection tonsillectomy groups, in one study.<sup>24</sup> Amin and Lakhani presented 7.4-month prospective data from 500 pediatric cases undergoing intracapsular tonsillectomy for both obstructive and infective indications. The authors reported excellent symptom control, with similar trends for obstructive and infective conditions.<sup>25</sup>

Subtotal intracapsular tonsillectomy removes 80% to 90% of the tonsils, and is suitable for patients with tonsillar

hypertrophy and chronic tonsillitis. However, the number of cases in this study was small, and the follow-up time was short. Higher numbers of cases and longer follow-up times are needed, and the surgical effect of subtotal intracapsular tonsillectomy and its long-term impact on quality of life must be further evaluated.


### Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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### ORCID iD

Jie Wang  <https://orcid.org/0000-0001-6766-0028>

### References

- Parker NP and Walner DL. Trends in the indications for pediatric tonsillectomy or adenotonsillectomy. *Int J Pediatr Otorhinolaryngol* 2011; 75: 282–285.
- Patel HH, Straight CE, Lehman EB, et al. Indications for tonsillectomy: a 10 year retrospective review. *Int J Pediatr Otorhinolaryngol* 2014; 78: 2151–2155.
- Chaidas KS, Kaditis AG, Papadakis CE, et al. Tonsilloplasty versus tonsillectomy in children with sleep-disordered breathing: short- and long-term outcomes. *Laryngoscope* 2013; 123: 1294–1299.
- Ericsson E, Graf J, Lundeborg-Hammarstrom I, et al. Tonsillotomy versus tonsillectomy on young children: 2 year post surgery follow-up. *J Otolaryngol Head Neck Surg* 2014; 43: 26–29.
- Pruegsanusak K, Wongsuwan K and Wongkittithawon J. A randomized controlled trial for perioperative morbidity in microdebrider versus cold instrument dissection tonsillectomy. *J Med Assoc Thai* 2010; 93: 558–565.
- Bitar MA, Dowli A and Mourad M. The effect of tonsillectomy on the immune system: a systematic review and meta-analysis. *Int J Pediatr Otorhinolaryngol* 2015; 79: 1184–1191.
- Byars SG, Stearns SC and Boomsma JJ. Association of long-term risk of respiratory, allergic, and infectious diseases with removal of adenoids and tonsils in childhood. *JAMA Otolaryngol Head Neck Surg* 2018; 144: 594–603.
- Johansson E and Hultcrantz E. Tonsillectomy—clinical consequences twenty years after surgery? *Int J Pediatr Otorhinolaryngol* 2003; 67: 981–988.
- Mitchell RB, Archer SM, Ishman SL, et al. Clinical practice guideline: tonsillectomy in children (Update). *Otolaryngol Head Neck Surg* 2019; 160: S1–S42.
- Fox MA, Ayyangar R, Parten R, et al. Self-report of pain in young people and adults with spastic cerebral palsy: interrater reliability of the revised Face, Legs, Activity, Cry, and Consolability (r-FLACC) scale ratings. *Dev Med Child Neurol* 2019; 61: 69–74.
- De Azevedo CB, Carezzi LR, De Queiroz DLC, et al. Clinical utility of PPPM and FPS-R to quantify post-tonsillectomy pain in children. *Int J Pediatr Otorhinolaryngol* 2014; 78: 296–299.
- Wu CR, Tu YK, Chuang LP, et al. Diagnostic meta-analysis of the Pediatric Sleep Questionnaire, OSA-18, and pulse oximetry in detecting pediatric obstructive sleep apnea syndrome. *Sleep Med Rev* 2020; 54: 101355.
- Sadikoglu F, Kurtaran H, Ark N, et al. Comparing the effectiveness of "plasma knife" tonsillectomy with two well-established tonsillectomy techniques: cold dissection and bipolar electrocautery. A prospective randomized study. *Int J Pediatr Otorhinolaryngol* 2009; 73: 1195–1198.
- Walton J, Ebner Y, Stewart MG, et al. Systematic review of randomized controlled trials comparing intracapsular tonsillectomy with total tonsillectomy in a pediatric population. *Arch Otolaryngol Head Neck Surg* 2012; 138: 243–249.

15. Acevedo JL, Shah RK and Brietzke SE. In Response to "Re: 'Systematic review of complications of tonsillotomy versus tonsillectomy'" from Walton et al. *Otolaryngol Head Neck Surg* 2012; 147: 1164–1165.
16. Alsawaf MM and Garlapo DA. Influence of tooth contact on the path of condylar movements. *J Prosthet Dent* 1992; 67: 394–440.
17. Odhagen E, Sunnergren O, Hemlin C, et al. Risk of reoperation after tonsillotomy versus tonsillectomy: a population-based cohort study. *Eur Arch Otorhinolaryngol* 2016; 273: 3263–3268.
18. Edmonson MB, Eickhoff JC and Zhang C. A population-based study of acute care revisits following tonsillectomy. *J Pediatr* 2015; 166: 607–612.
19. Attard S and Carney AS. Paediatric patient bleeding and pain outcomes following subtotal (tonsillotomy) and total tonsillectomy: a 10-year consecutive, single surgeon series. *ANZ J Surg* 2020; 90: 2532–2536.
20. Foki E, Seemann R, Stelter K, et al. The effect of tonsillotomy on chronic recurrent tonsillitis in children. *Acta Otolaryngol* 2017; 137: 992–996.
21. Sathe N, Chinnadurai S, McPheeters M, et al. Comparative effectiveness of partial versus total tonsillectomy in children. *Otolaryngol Head Neck Surg* 2017; 156: 456–463.
22. Wang ZN, Xu ZQ, Wang SF, et al. Immunologic histochemical observation of anti-crypt keratin of cryptic epithelium of tonsil in children with chronic tonsillitis. *Lin Chuang Er Bi Yan Hou Ke Za Zhi* 2000; 14: 122–123.
23. Koempel JA, Solares CA, Koltai PJ, et al. The evolution of tonsil surgery and rethinking the surgical approach to obstructive sleep-disordered breathing in children. *J Laryngol Otol* 2006; 120: 993–1000.
24. Eviatar E, Kessler A, Shlamkovitch N, et al. Tonsillectomy vs. partial tonsillectomy for OSAS in children–10 years post-surgery follow-up. *Int J Pediatr Otorhinolaryngol* 2009; 73: 637–640.
25. Amin N and Lakhani R. Intracapsular versus extracapsular dissection tonsillectomy for adults: a systematic review. *Laryngoscope* 2020; 130: 2325–2335.