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Observation of Posttonsillectomy Wounds Using Endoscopy and Examination of the Postoperative Course by Wound Type

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Abstract

Palatine tonsillectomy is a surgical procedure that novice otolaryngologists should master early and is taught at many medical institutions. Unfortunately, however, the transoral procedure cannot provide a large enough field of view to doctors other than the one performing the operation. Therefore, it is difficult to share the surgical field and provide real-time teaching. Dissection of the wrong layer can cause postoperative bleeding and pain. Our department uses a 70-degree, 4-mm rigid endoscope for palatine tonsillectomy, which makes it possible for preceptors to teach tonsillectomy in real time and to evaluate the condition of the postoperative wound in detail. We classified the postoperative state after tonsillectomy into three stages, based on the degree of residual subcapsular connective tissue. We assessed the association between the amount of residual subcapsular connective tissue and the underlying disease that required indication for tonsillectomy, the postoperative course, and the operation time in 33 patients who had undergone palatine tonsillectomy at our institution between May 2017 and November 2020. We found that the more the subcapsular connective tissue that remained, the less the postoperative pain and bleeding. This association suggests that conserving the subcapsular connective tissue is important. Bringing the endoscope closer to the surgical field to observe the field without blind areas enables adequate hemostasis and easy sharing of the surgical field; therefore, this method is also effective for teaching tonsillectomy to surgical trainees.

Keywords
- confirmation of hemostasis
- endoscopy
- palatine tonsillectomy
- teaching of surgery

Introduction

In August 1895, surgery for tonsillar hypertrophy was listed as "tonsillectomy" in the *Oto-Rhino-Laryngology Journal* (volume 1, number 8), which was the predecessor of the *Journal of the Japanese Society of Otorhinolaryngology–Head and Neck Surgery*.[1] Tonsillectomy has been performed since the dawn of otolaryngological treatment in Japan. In 1906, Ballenger and Griffin published a description of a surgical technique for extracting the palatine tonsils along with the tonsillar capsule.[2,3] The technique for the extraction of the palatine tonsils later became widespread. In 1940, in Japan, Sasaki reported tonsillectomy as a treatment modality and summarized the instruments used in the procedure and the results.[4]

Currently, tonsillectomy remains a common surgical technique in the field of otolaryngology. It is performed in

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patients with varying ages, from children to adults. It is regarded as the primary surgical technique that otolaryngologists should know and is taught at many institutions. This technique is often performed macroscopically via the oral cavity. However, because the field of vision is dependent on the condition of the open mouth and the size of the jaws and only the operating surgeon can view the surgical field, information about the surgical field cannot be shared in real time between a specialist trainee (the operator) and the supervising physician (assistant). Accidents such as separation of an inappropriate layer while the supervisor is not able to observe may result in aggravated postoperative pain and postoperative hemorrhage.

To address this problem, the surgical field was directly screened on a monitor using a paranasal sinus endoscope, and this method was reportedly effective in guiding surgery and confirming hemostasis.[5,6] In addition to endoscopy, other methods of sharing a view of the surgical field include monitoring with headlight-mounted cameras and surgical microscopes. One report indicated that a method of using a surgical microscope during tonsillectomy was effective for separation along the tonsillar capsule.[7] However, images captured using a headlight-mounted camera are unstable because they are affected by the movement of the operator's head, whereas images captured by microscopes are limited by focal distance and narrow field of vision. Moreover, the use of microscopes complicates the procedure.[5] With the use of an endoscope during tonsillectomy, thin blood vessels and cords are easily identified, and separation along the tonsillar capsule is facilitated, which may not only help prevent postoperative hemorrhage but also minimize postoperative pain.[8] At our department (Otolaryngology Department, Yamagata Prefectural Shinjo Hospital), supervising surgeons have used 4-mm rigid endoscopes to teach tonsillectomy to specialist trainees in real time since 2013. After extraction of the palatine tonsils, the endoscope is brought close to the tonsillar bed to closely monitor the state of hemostasis and other conditions, and the exposure of the tonsillar bed after tonsillectomy is assessed in detail.

In this study, we classified the condition of the endoscopically observed posttonsillectomy wound into three grades according to the extent of the residual subcapsular connective tissue. We then examined the correlation between the extent of the remaining tissue and the surgical indications, postoperative course, and surgical duration.

Patients and Methods

The study included 33 patients (15 men and 18 women; mean age: 21.4 years) who underwent endoscopy-guided tonsillectomy between May 2017 and November 2020. The indications were tonsillar hypertrophy in 15 patients, recurrent tonsillitis in 16, and tonsillar focal infection in 2. One specialist surgeon performed surgery in 2 patients, and 5 specialist trainees performed surgery in 31 patients.

All patients were under general anesthesia during surgery. Each patient was laid in the dorsal position with the neck in retroflexion, which is the same position as that in normal tonsillectomy. The operator was situated at the patient's head, and the assistant holding the endoscope (the supervising surgeon) was on the left side of the operator. The endoscopic monitor was placed on the right front side of the operator (►**Fig. 1**).

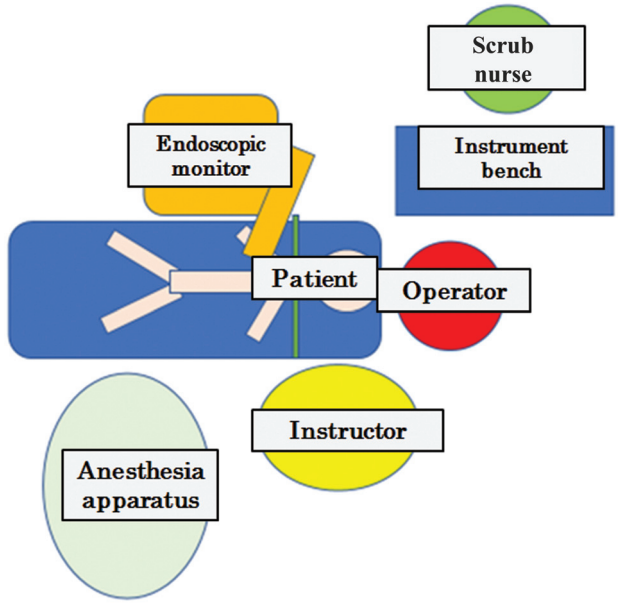

Fig. 1 Intraoperative layout during surgery at our hospital.

Wearing a headlight, the operator performed surgery by directly observing the surgical field until the tonsils were extracted. Simultaneously, the assistant, who was holding the endoscope, checked the surgical field in real time by inserting the endoscope from the left corner of the patient's mouth into the oral cavity at a 70-degree angle. For adult patients, an Angle Wider device was fitted as much as possible to prevent interference between the surgical instruments and the endoscope and to mitigate stimulation of the mouth corners (►**Fig. 2**). Funicular structures such as blood vessels were subjected to bipolar cauterization and then excised. After tonsil extraction, both the operator and the assistant confirmed wound closure on the endoscopic image before completing the surgery.

The posttonsillectomy wounds were retrospectively evaluated on the recorded footage. On endoscopic views of the postoperative tonsillar bed, the postoperative wounds were classified according to the extent of the membranous structure (subcapsular connective tissue) that remained without exposure and cauterization of the muscle layers: type A (≥two-thirds remaining), type B (≥one-third and <two-thirds remaining), and type C (<one-third remaining; ►**Fig. 3**). When the type of the posttonsillectomy wound on the right and left sides differed, we selected the type at the side with less residual subcapsular connective tissue.

We examined the correlation between the type of the posttonsillectomy wounds and the following factors: (1) surgical indications, (2) postoperative course (food intake, degree of postoperative pain, and presence or absence of postoperative hemorrhage), and (3) mean duration of surgery. The mean food intake during hospitalization was

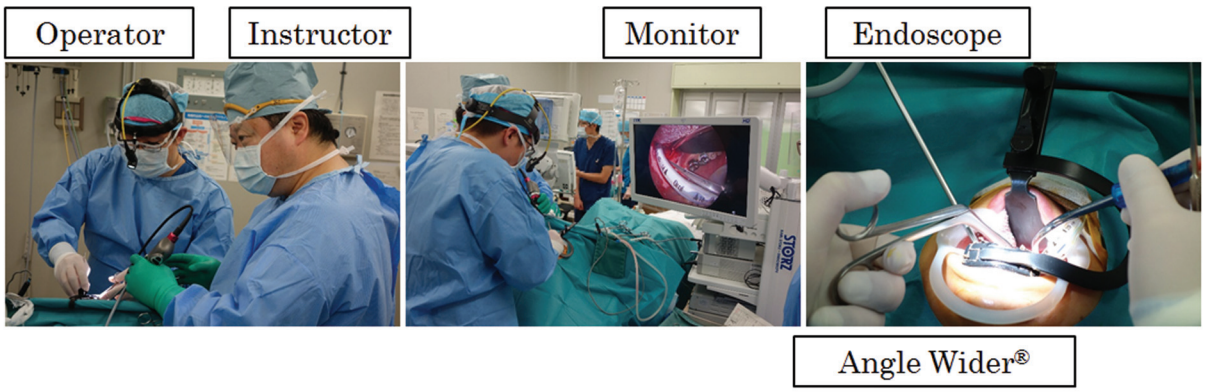

Fig. 2 Tonsillectomy as performed at our hospital.

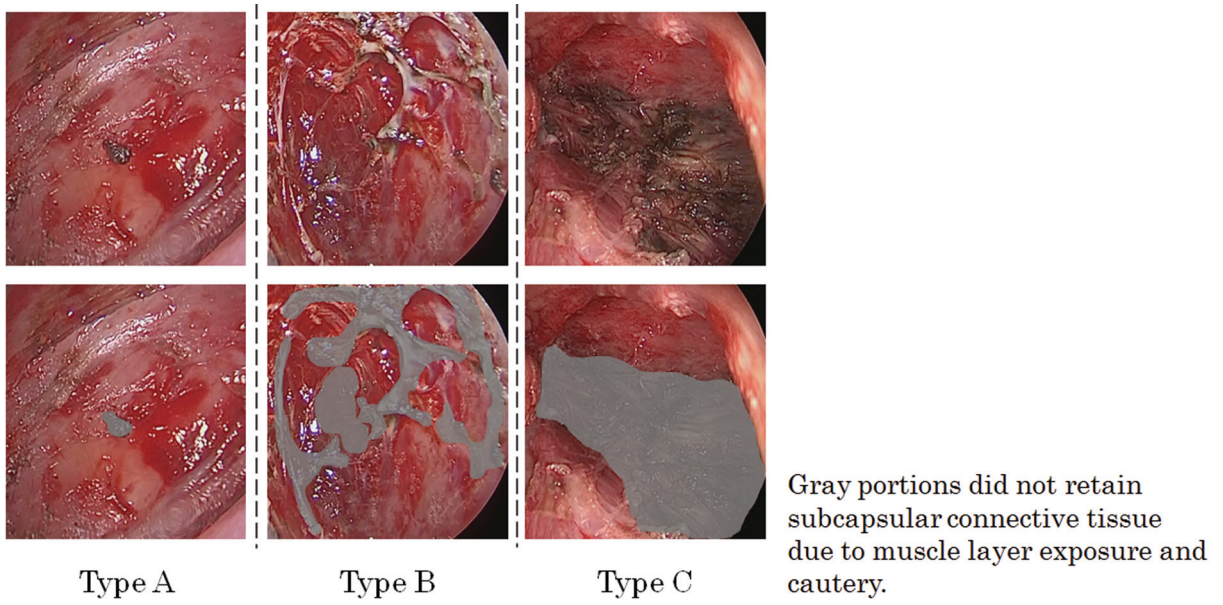

Fig. 3 Classification of posttonsillectomy wounds. Note: Classified into three groups based on the extent of the remaining subcapsular connective tissue in the posttonsillectomy tonsillar bed: (type A: ≥two-thirds remaining; type B: ≥one-third and <two-thirds remaining; and type C: <one-third remaining).

assessed differently for the adult and pediatric patients according to the nursing records (as "almost all," "more than half and less than all," or "less than half"). Data on the food intake of the adult and pediatric patients were analyzed separately. Postoperative pain was evaluated only for the adults according to the numerical rating score (NRS) listed in the nursing records. Postoperative hemorrhage was considered "present" when blood was identified in the mouth or throat postoperatively or when areas of bleeding were confirmed (including cases in which only conservative treatment was administered and cases in which hemostasis was established while the patient was under general anesthesia). StatMate statistical software was used for analysis, and the χ^2 test and Kruskal–Wallis test were performed.

Results

Following tonsillectomy, the types and indications were grouped as follows. In type A ($n=11$), 27% of patients ($n=3$) had tonsillar hypertrophy and 73% ($n=8$) had chronic tonsillitis; in type B ($n=14$), 64% of patients ($n=9$) had tonsillar hypertrophy and 36% ($n=5$) had chronic tonsillitis; and in type C ($n=8$), 38% of patients ($n=3$) had tonsillar hypertrophy and 62% ($n=5$) had chronic tonsillitis (►**Fig. 4**). While chronic tonsillitis was majorly observed in types A and C, tonsillar hypertrophy was more prevalent in type B.

Following tonsillectomy, the status of food intake in the adult patients by type was as follows: in type A ($n=6$), 83% of patients ($n=5$) ate "almost all" and 17% ($n=1$) ate "less than half"; in type B ($n=5$), 40% of patients ($n=2$) ate "almost all," 40% ($n=2$) ate "more than half and less than all," and 20% ($n=1$) ate "less than half"; and in type C ($n=4$), 50% of patients ($n=2$) ate "almost all" and 50% ($n=2$) ate "more than half and less than all" (►**Fig. 5**). In type A, 83% of the patients consumed almost all the food, whereas the percentages of patients who consumed almost all the food in types B and C were lower (40 and 50%, respectively).

Following tonsillectomy, the status of food intake in pediatric patients by type was as follows: in type A ($n=5$), 40% of the patients ($n=2$) ate "almost all," 40% ($n=2$) ate

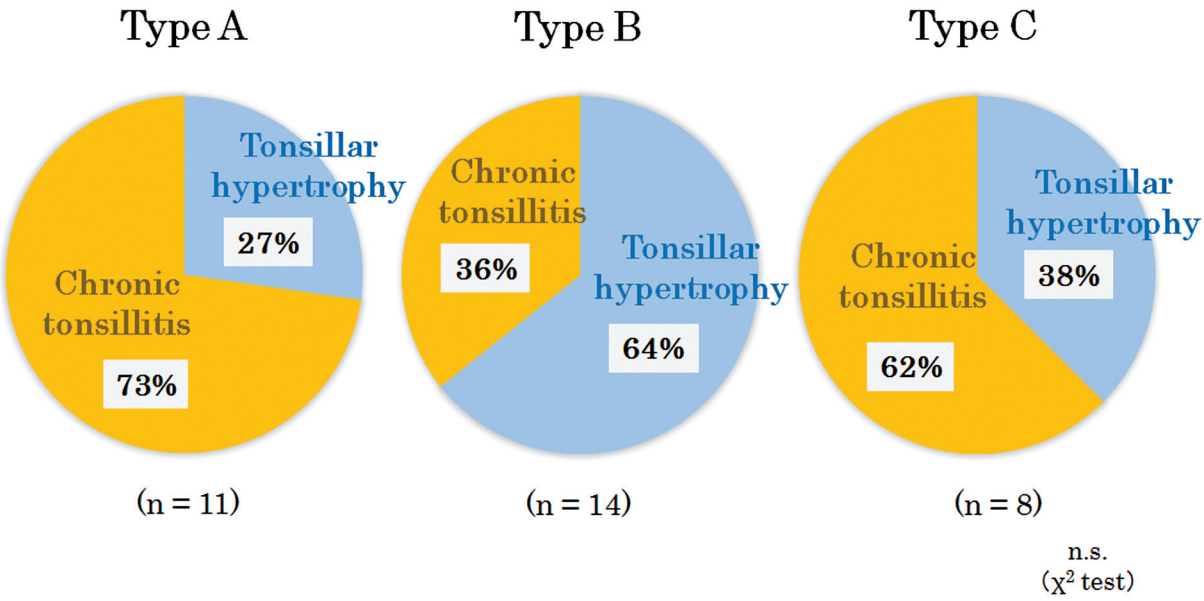

Fig. 4 Percentages of surgical indications by type. Note: Chronic tonsillitis was the major condition in types A and C, whereas tonsillar hypertrophy was prevalent in type B.

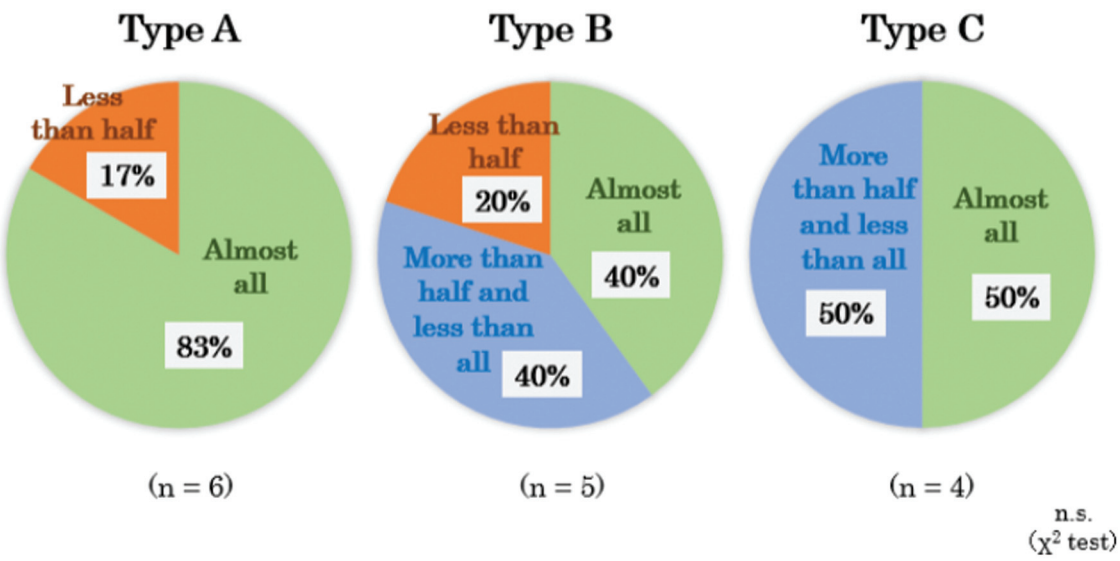

Fig. 5 Status of food intake by type (adults). Note: In types A, B, and C, 83, 40, and 50% of the patients consumed almost all the food, respectively.

"more than half and less than all," and 20% ($n = 1$) ate "less than half"; in type B ($n = 9$), 11% of the patients ($n = 1$) ate "almost all," 56% ($n = 5$) ate "more than half and less than all," and 33% ($n = 4$) ate "less than half"; and in type C ($n = 4$), 25% of the patients ($n = 1$) ate "almost all" and 75% ($n = 3$) ate "more than half and less than all" (►**Fig. 6**).

Following tonsillectomy, the mean NRS for postoperative pain in the adult patients by type was 1.65 in type A ($n = 6$), 1.58 in type B ($n = 5$), and 2.63 in type C ($n = 4$). The score was significantly higher in type C than in types A and B, and there was no significant difference between types A and C ($p < 0.05$) (►**Fig. 7**).

Following tonsillectomy, the percentage of postoperative hemorrhage by type was 9% ($n = 1$) in type A ($n = 11$), 21% ($n = 3$) in type B ($n = 14$), and 38% ($n = 3$) in type C ($n = 8$). While one patient in type C required hemostasis under general anesthesia, the others were able to achieve control only by fasting during the follow-up period. Although no significant differences were noted, the rate of hemorrhage slightly increased in the order of types A, B, and C (►**Fig. 8**).

The mean duration of tonsillectomy by type was 70.1 minutes in type A ($n = 11$), 81.5 minutes in type B ($n = 14$), and 110.6 minutes in type C ($n = 8$). The mean duration increased in the order of types A, B, and C, with a

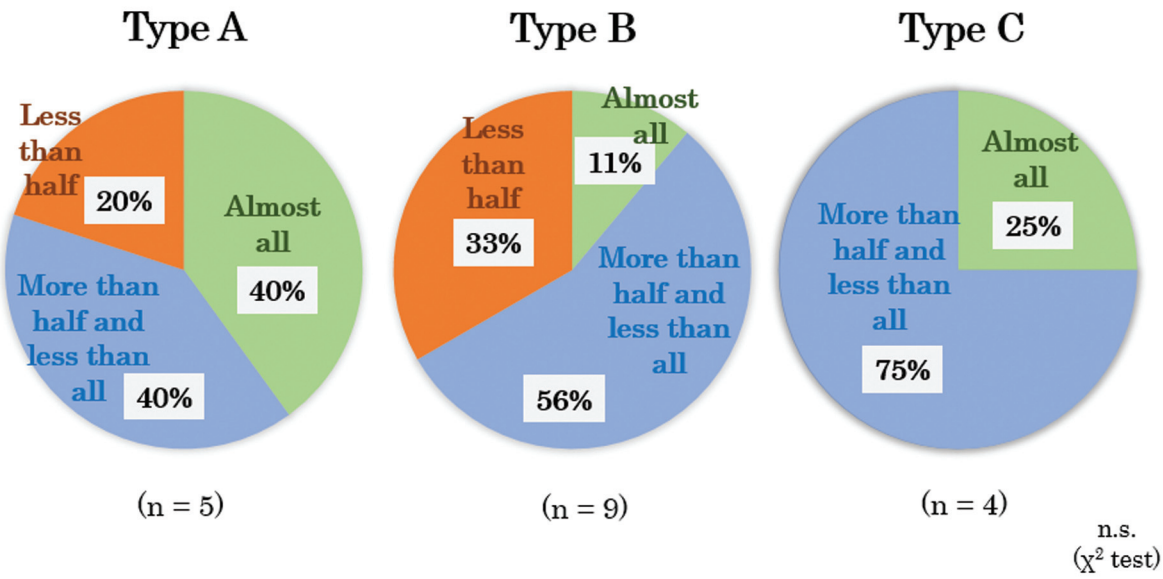

Fig. 6 Status of food intake by type (children). Note: In types A, B, and C, 40, 11, and 25% of the patients consumed almost all the food, respectively.

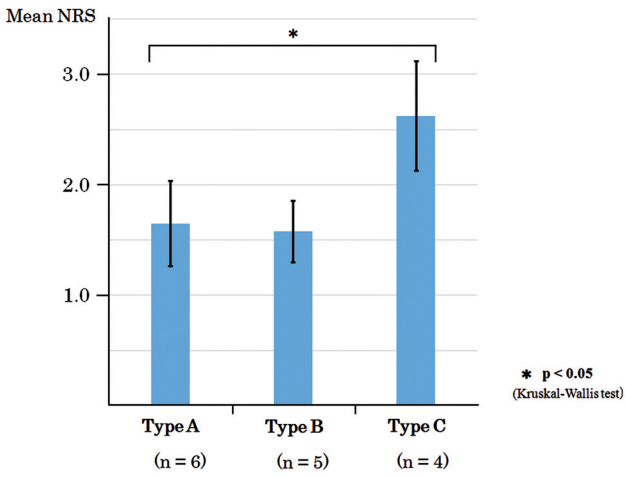

Fig. 7 Severity of postoperative pain by type (adults). Note: The pain score was higher in type C than in types A and B, with a significant difference noted between types A and C.

significant difference between types A and C ($p < 0.05$) (►**Fig. 9**).

Discussion

Due to a recent decline in birthrate in Japan, the population of 0- to 14-year-old children within our hospital's secondary medical area has decreased from 14,000 in 2000 to 7,670 in 2020 (calculated from the future estimated population survey in Shinjo City and Mogami County, Shinjo Chamber of Commerce (January 2006), excerpt from censuses and National Institute of Population and Social Security Research). According to future population projections, the population of this age group is predicted to reach 3,489 in 2045.[9] Given these circumstances, our hospital has performed fewer tonsillectomy operations for children per specialist trainee, resulting in a relative increase in the number of adult adhesion cases. This has contributed to the impression that the overall surgical procedure has become difficult, forcing the instructors to devise new instructional methodologies. To address this issue, our hospital introduced endoscopy-guided tonsillectomy in 2013, creating a system in which the operator and assistant can share surgical fields of view for real-time instructions. We believe that the use of endoscopy is effective for confirming whether or not (1) local anesthetics are properly injected, (2) mucosal incision is performed without problems, (3) separation operations are performed along the tonsillar capsule, and (4) the hemostatic procedure is performed adequately. While the assistant needs to become accustomed to operating the endoscope, it is also considered beneficial to training if the instructor can perform surgery and explain the process by sharing images on the monitor with the assistant, a novice at tonsillectomy.

There are few reports on the postoperative conditions and course following tonsillectomy. This study was based on the detailed endoscopic observation of postoperative wounds. No fixed trends were noted between the surgical indications and the types of posttonsillectomy wounds. Even in cases of tonsillar hypertrophy, which is generally considered easily separable, specialist trainee operators failed to retain sufficient connective tissue directly under the capsule and had extensively exposed muscular layers in the tonsillar bed after surgery in some cases. This indicates that caution should be exercised while the surgical procedure is taught. The food intake and postoperative pain were not necessarily proportional to the amount of residual subcapsular connective tissue. This was probably because other factors, such as individual sensitivity to pain, were strongly involved. Meanwhile, the food intake in the pediatric patients was not necessarily correlated with the types, suggesting that the influence of "picky eating," which is distinctive to small

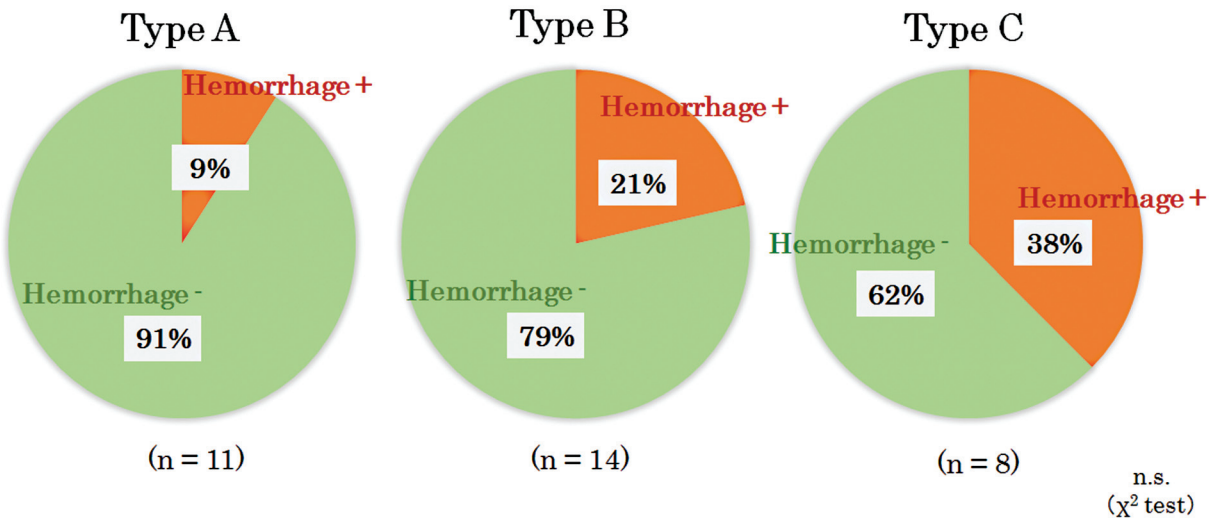

Fig. 8 Presence/absence of postoperative hemorrhage by type. Note: The hemorrhage rates were higher in ascending order of types A, B, and C (no significant differences between the types).

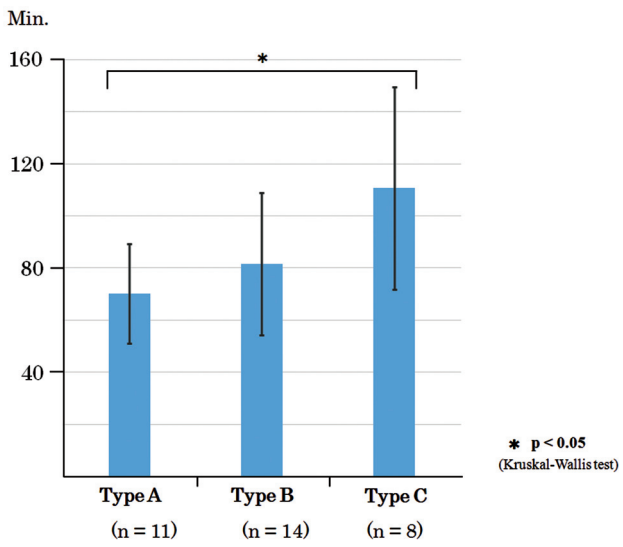

Fig. 9 Surgical duration by type. Note: Surgical durations were longer in ascending order of types A, B, and C, with a significant difference noted between types A and C.

children, could be responsible. The degree of postoperative hemorrhage increased in the order of types A, B, and C, suggesting that, unlike food intake, the presence of residual subcapsular connective tissue is critical in preventing postoperative hemorrhage. Postoperative hemorrhage can be classified into early-stage hemorrhage that occurs within 24 hours postoperatively and late-stage hemorrhage that occurs 4 to 7 days postoperatively.[10] In previous studies, a bimodal pattern was noted, in which patients were most susceptible to postoperative hemorrhage on the day of surgery and approximately 1 week postoperatively.[11–13] Reports state that early-stage hemorrhage is attributed to an intraoperative procedure (insufficient hemostasis during surgery), whereas most late-hemorrhage cases are caused by the detachment of scabs and loosening of ligatures.[14] Other studies argue that the activation of the fibrinolytic system on the day of and approximately 1 week after surgery may also be involved.[15] Odagiri et al examined 298 tonsillectomy procedures conducted at their institution and reported that while 2.6% of patients in the nonendoscopic group had early-stage hemorrhage, none in the endoscopic group experienced it.[6] In this study, no patient developed early-stage hemorrhage. This indicates that bringing the endoscope close to the lesion and observing the surgical site thoroughly without blind spots may have resulted in adequately performed hemostasis, thereby preventing early-stage hemorrhage. Moreover, the use of endoscopy is considered beneficial in the following regards: (1) videos can be recorded and stored; (2) the instructor can easily monitor and supervise the operative maneuvers; and (3) the operator/instructor can easily confirm hemostasis and other conditions in the postoperative tonsillar bed by sharing images.

The palatine tonsils are situated within the tonsillar sinus and are surrounded by the anterior palatine arch (palatoglossal muscle) and the posterior palatine arch (palatopharyngeal muscle). On their lateral side is the superior pharyngeal constrictor muscle, which forms the sinus floor.[16] Otsuka et al reported that only 23.4% of patients had the superior pharyngeal constrictor muscle extending to the lower part of the palatine tonsils and widely underlying the tonsillar bed, whereas 55.1% of patients had a gap between the superior and middle pharyngeal constrictor muscles, with some muscular layers missing.[17] Furthermore, 21.5% had a larger gap between the superior and middle pharyngeal constrictor muscles, and the tonsillar bed extensively lacked underlying muscular layers, with the tonsillar capsule directly contacting the parapharyngeal gap over a wide area.[17] The distance between the internal carotid artery traversing the parapharyngeal gap and the tonsillar bed was as short as 1 cm,[18] and the lingual branch of the glossopharyngeal nerve, which is a one-third the posterior area of the

tongue and controls general perception and the sense of taste, runs in the vicinity of the tonsillar bed.[16] If a gap exists between the superior and middle pharyngeal constrictor muscles and the underlying muscular layers are missing, these structures may be damaged when a surgical operation is performed beyond the tonsillar capsule. Moreover, extensive cauterization for hemostatic purposes may hinder wound healing, increasing the risk of postoperative hemorrhage.[19] This study indicated that preserving the subcapsular connective tissue on the muscular layer side while retaining thin blood vessels may help alleviate postoperative pain and prevent postoperative hemorrhage. However, the relatively small sample size of 33 patients and the absence of quantitative evaluation for classification of the types are the limitations of this study. Further studies will be needed to establish the classification of types based on quantitative evaluation.

Conclusion

This study showed that larger the residual area of the subcapsular connective tissue in the posttonsillectomy wound, the less severe was the degree of postoperative pain and hemorrhage in the patients. This indicates that bringing the endoscope close to the lesion and observing the surgical area thoroughly without blind spots facilitates adequate hemostasis. Furthermore, the use of endoscopy facilitated the exchange of surgical area information during tonsillectomy, which benefits both the operator and instructor.

Conflict of Interest
None declared.

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