

# Effectiveness of Low-Temperature Plasma Adenoidectomy Combined with Bilateral Tonsillectomy in the Treatment of Snoring in Children and Its Effect on Sleep Quality

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**Abstract:** *Objective:* To evaluate the therapeutic effect of low-temperature plasma adenoidectomy (abbreviation: adenoid low-temperature plasma excision) coupled with tonsillectomy (bilateral) on snoring in children. *Methods:* Seventy-six cases of snoring children treated in the hospital between November 2020 and November 2023 were selected. 38 cases of children in Group A agreed to surgery and were admitted to the hospital for surgical treatment and were treated with adenoid cryo-plasma excision combined with tonsillectomy (bilaterally), and 38 cases of children in Group B did not agree to outpatient conservative treatment for surgery, and the results of the treatment were compared. *Results:* Before treatment, there was no difference between the ventilation function indexes, sleep quality scores, and quality of life scores of the two groups compared with each other ( $P > 0.05$ ). After treatment, the ventilation function indexes of Group A were better than Group B, and the sleep quality score and quality of life score were higher than that of Group B. The total effective rate of Group A was higher than that of Group B ( $P < 0.05$ ). *Conclusion:* Adenoid cryo-plasma excision combined with tonsillectomy (bilateral) can improve the quality of life, ventilation function, and sleep quality of children with snoring, and can enhance the efficacy.

**Keywords:** Cryo-plasma adenoidectomy; Bilateral tonsillectomy; Children snoring; Sleep quality

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## 1. Introduction

Snoring in children is characterized by intermittent apnea during sleep, which can cause chronic hypoxia, thus affecting the growth and development of children <sup>[1]</sup>. Conservative treatment is the conventional treatment for this disease, which can relieve the symptoms through oral medication and other means, but its curability is generally. Children with this disease can receive surgical treatment, with bilateral excision of tonsil tissue and combined adenoid cryo-plasma excision, which can comprehensively improve the therapeutic effect of children

and reduce their sleep disorders <sup>[2]</sup>. For this reason, 76 children with snoring were selected for this study to evaluate the therapeutic efficacy of adenoid cryo-plasma excision combined with tonsillectomy (bilateral).

## 2. Materials and methods

### 2.1. General information

A total of 76 cases of children with snoring treated in the hospital from November 2020 to November 2023 were included. Children in Group A agreed to surgery and were admitted to the hospital for surgical treatment. Children in Group B did not agree to surgical treatment and were treated conservatively on an outpatient basis. There were 38 cases in Group A, with a total of 21 male children and 17 female children, aged between 3 and 13 years old with a mean age of  $6.18 \pm 1.27$  years, while the duration of the disease was between 0.5 and 4 years with a duration of  $1.86 \pm 0.75$  years. Group B was selected to evaluate the treatment efficacy of adenoidal cryo-plasma excision combined with tonsillectomy (bilateral). Group B consisted of 38 cases, with 22 male children and 16 female children, aged between 4 and 14 years with a mean age of  $6.37 \pm 1.28$  years, while their disease duration was between 0.6 and 4 years with a mean duration of  $1.91 \pm 0.70$  years. The data between the groups were comparable ( $P > 0.05$ ).

### 2.2. Methods

Group B was treated conservatively with oral administration of montelukast sodium (Shandong Lunan Beite Pharmaceuticals, State Pharmaceutical License No. H20083330), the dose of which was 4 mg per oral dose for children between 2 and 5 years old, and once a day; the dose of which was 5 mg per oral dose for children over 5 years old, and once a day. Combined mometasone furoate nasal spray (MSD Belgium BVBA/SPRL, Registration No. H20140100) was also given, with one snap per nasal spray, bilaterally, once a day, for 3 months.

Group A was treated with adenoid cryo-plasma excision combined with bilateral tonsillectomy: The children were kept in the supine position, and after general anesthesia, the upper part of the tonsils, i.e., the mucosa of the tongue and palate arches, was clamped with the help of tonsil grasping forceps and then pulled up to the midline, making it 3 cm away from the outer side of the tongue and palate arches. The mucosa of the tongue and palate arches was peeled off with the help of a plasma cutter from the upper part to the lower part, and then the hemorrhage was stopped, and the tonsils were excised bilaterally. After securing the soft palate, a nasal endoscope was inserted. Under its guidance, the hypertrophic tissue of the adenoids was removed using a low-temperature plasma knife head, exposing the nostrils and pharyngeal tube bilateral pharyngeal orifices. Hemostasis treatment ensured no tissue residues or bleeding points. The instrument was then withdrawn, completing the operation.

### 2.3. Observation indexes

- (1) Ventilation function: Before and after treatment, sleep apnea hypoventilation index (AHI) as well as the lowest arterial oxygen saturation [ $LSa(O_2)$ ] were determined using polysomnography.
- (2) Sleep quality: The Quebec Sleep Questionnaire (QSQ) was distributed, containing social interaction (4 items), daytime symptoms (10 items), emotions (5 items), daytime sleepiness (6 items), and nocturnal symptoms (7 items), with a total of 32 items, each scored from 1 to 7 points, and positively scored for sleep quality.
- (3) Quality of life: The Sleep Apnea Quality of Life Index (SAQLI) was issued, containing 4 items such as daily life and emotional status, with each item assigned a score of 1 to 7, and the average score of 4 items was recorded as the total score, with positive counting of points.

## 2.4. Efficacy evaluation criteria

- (1) Significant efficacy: disappearance of symptoms, frequency of AHI is 5 times/h or less, no snoring and other symptoms;
- (2) Preliminary efficacy: significant improvement of symptoms, frequency of AHI is 5 to 10 times/h, the occasional presence of snoring symptoms;
- (3) No efficacy: no change of symptoms, frequency of AHI is more than 10 times/h, obvious snoring symptoms.

## 2.5. Statistical analysis

Data were analyzed using SPSS 28.0 software, measurement values were compared using the *t*-test and expressed as mean  $\pm$  standard deviation (SD), while count values were compared using the  $\chi^2$  test and expressed as [*n* (%)]. Statistical significance was counted as a *P* value less than 0.05.

## 3. Results

### 3.1. Comparison of ventilation function of children in two groups

Before treatment, there was no difference in the ventilation function between the groups ( $P > 0.05$ ). After treatment, the ventilation function of Group A was significantly better than that of Group B ( $P < 0.05$ ). See **Table 1**.

**Table 1.** Comparison of the ventilation function of children in the two groups before and after treatment (mean  $\pm$  SD)

Group	AHI (times/h)		LSa(O <sub>2</sub> ) (%)	
	Before	After	Before	After
Group A ( <i>n</i> = 38)	15.65 $\pm$ 1.75	2.45 $\pm$ 0.34	75.88 $\pm$ 5.95	93.47 $\pm$ 4.77
Group B ( <i>n</i> = 38)	15.69 $\pm$ 1.88	4.69 $\pm$ 0.61	75.79 $\pm$ 5.91	89.24 $\pm$ 4.58
<i>t</i>	0.096	19.773	0.066	3.943
<i>P</i>	0.924	0.000	0.947	0.000

### 3.2. Comparison of sleep quality scores of children in the two groups

As shown in **Table 2**, before treatment, there was no difference in the sleep quality scores of the two groups compared with each other ( $P > 0.05$ ). After treatment, the sleep quality score of Group A was significantly higher than that of Group B ( $P < 0.05$ ).

**Table 2.** Comparison of sleep quality scores of children in the two groups before and after treatment (mean  $\pm$  SD; points)

Group	Social interactions		Daytime symptoms		Emotions		Daytime sleepiness		Nocturnal symptoms	
	Before	After	Before	After	Before	After	Before	After	Before	After
Group A ( <i>n</i> = 38)	18.25 $\pm$ 2.13	23.65 $\pm$ 2.71	48.25 $\pm$ 4.34	62.03 $\pm$ 2.74	20.15 $\pm$ 2.33	30.26 $\pm$ 2.71	24.15 $\pm$ 2.11	34.15 $\pm$ 2.91	34.15 $\pm$ 3.11	42.35 $\pm$ 3.26
Group B ( <i>n</i> = 38)	18.21 $\pm$ 2.11	20.42 $\pm$ 2.65	48.29 $\pm$ 4.31	57.35 $\pm$ 2.70	20.14 $\pm$ 2.31	27.15 $\pm$ 2.65	24.18 $\pm$ 2.16	30.16 $\pm$ 2.86	34.12 $\pm$ 3.15	38.65 $\pm$ 3.22
<i>t</i>	0.082	5.253	0.040	7.500	0.019	5.058	0.061	6.028	0.042	4.978
<i>P</i>	0.935	0.000	0.968	0.000	0.985	0.000	0.951	0.000	0.967	0.000

### 3.3. Comparison of the quality of life scores of children in the two groups

Table 3 shows that before treatment, there was no difference in the quality of life scores of the two groups compared with each other ( $P > 0.05$ ). After treatment, the quality of life score of Group A was significantly higher than that of Group B ( $P < 0.05$ ).

**Table 3.** Comparison of the quality of life scores of children in the two groups before and after treatment (mean  $\pm$  SD; points)

Group	Before treatment	After treatment
Group A ( $n = 38$ )	4.15 $\pm$ 0.68	5.98 $\pm$ 0.91
Group B ( $n = 38$ )	4.11 $\pm$ 0.61	5.04 $\pm$ 0.86
$t$	0.270	4.628
$P$	0.788	0.000

### 3.4. Comparison of the total effective rate of children in two groups

The total effective rate of children in Group A is significantly higher than that of Group B ( $P < 0.05$ ), as shown in Table 4.

**Table 4.** Comparison of the total effective rate of children in the two groups [n (%)]

Group	Significant efficacy	Preliminary efficacy	No efficacy	Overall efficacy
Group A ( $n = 38$ )	20 (52.63)	17 (44.74)	1 (2.63)	37 (97.37)
Group B ( $n = 38$ )	15 (39.47)	16 (42.11)	7 (18.42)	31 (81.58)
$\chi^2$	-	-	-	5.029
$P$	-	-	-	0.025

## 4. Discussion

The causative factors of snoring are complex, with flow hypoventilation and apnea during sleep as typical manifestations, and accompanied by nasal congestion<sup>[3]</sup>. The disease mainly occurs in children, and the prolonged course of the disease may affect the physical development and intellectual level of the children, and even lead to drowsiness, memory loss, irritability, and other manifestations<sup>[4]</sup>. Conservative treatment is the conventional treatment for this disease, which can reduce snoring and other symptoms through standardized medication, and the children's tolerance of the treatment is high. However, the cure rate of conservative treatment is low and the long-term recurrence rate is high. In comparison, surgical treatment of the disease has a higher success rate and is more scientific. Adenoid hypothermia-plasma resection utilizes hypothermia-plasma technology for resection operation, which can completely remove the adenoids, improve the precision of the operation, and reasonably control the resection strength, which does not easily cause damage to the surrounding tissues<sup>[5]</sup>.

The results showed that after treatment, the ventilation function index of Group A was better than that of Group B, the sleep quality score was higher than that of Group B, the quality of life score was higher than that of Group B, and the total effective rate of Group A was higher than that of Group B ( $P < 0.05$ ). The reason is that the combined surgery can accurately resect the adenoid tissue, reduce the efficiency of the shedding of the white membrane, and alleviate the postoperative pain, and the surgical operation belongs to the acute separation, which can avoid excessive pulling of the mucosal tissues and muscular tissues, and with the help of nasal endoscopy to carry out the corresponding resection operation, it can shorten the surgical time, and reduce the adenoids are not

completely resected, and prevent pharyngeal wall muscle damage<sup>[6]</sup>. In addition, the delivery medium used in adenoid cryo-plasma resection is saline, which generates a thin layer of plasma only between the tissue and the electrode during the surgical operation, preventing the tissue from coming into direct contact with the cutter head, so that there is fewer postoperative complications and the surgical results are more satisfactory<sup>[7]</sup>. In addition, the low-temperature plasma tip can be effectively integrated into the surgical cutting operation and suction operation, which can accurately separate the tonsillar peritonsillar membrane and suction the blood at the same time, which can reduce the amount of intraoperative hemorrhage, and it can significantly shorten the operation time, reduce the discipline of tissue residue, and significantly improve the effect of removing the hypertrophic tissues. After surgical removal of tonsil tissue and adenoid tissue, the apnea symptoms of the children can disappear, so the quality of sleep as well as the quality of life is significantly improved<sup>[8]</sup>.

In conclusion, adenoid cryo-plasma excision combined with tonsillectomy (bilateral) can improve the sleep quality of snoring children, shorten the operation time and postoperative recovery time, reduce intraoperative bleeding, and improve the ventilation function of children, which has a more ideal therapeutic effect.

## Disclosure statement

The authors declare no conflict of interest.

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