

ORIGINAL ARTICLE

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# Comparative study of adult tonsillectomy in two methods: harmonic scalpel and classical surgery

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## Abstract

**Background** Tonsillectomy is a common surgery to treat tonsillitis. In addition to cold dissection methods, other new methods are also used for tonsillectomy which has several advantages. We compared the cold dissection methods and the harmonic scalpel method and investigated the complications of both methods.

**Methods** This is a descriptive analytical study on 50 patients in the population of 18 to 60 years who had tonsillectomy conditions based on the inclusion criteria. These patients were divided into two groups, harmonic scalpel method and cold dissection methods, and the duration of the operation, the amount of bleeding during the operation, the pain on the first, fourth, and seventh days after the operation, and the bleeding after the operation were measured in them.

**Results** In this study, 36 men and 14 women were examined. The duration of surgery and the amount of bleeding during surgery were significantly less in the harmonic scalpel method group than in the cold dissection methods group ( $P=0.000$ ). Postoperative pain on days 1 and 4 after surgery was significantly less in the harmonic scalpel method group than in the cold dissection methods group ( $P=0.047$ ).

**Conclusion** According to this study, the amount of bleeding and length of surgery were less in the harmonic scalpel method group. The pain on the first and fourth days after surgery was less in the harmonic group, but the pain on the seventh day was not significantly different from the cold dissection group.

**Keywords** Tonsillectomy, Cold dissection methods, Harmonic scalpel method

## Background

Tonsillectomy is one of the oldest surgeries, so its history goes back to Hindu doctors in 1000 BC [1]. It is a common surgery to treat diseases related to tonsils, mainly used in recurrent tonsillitis or adenotonsillar hypertrophy, which leads to sleep apnea; in tonsillectomy, the entire tonsil along with its capsule is removed, and no

lymphatic tissue remains in the tonsil cavity [2]. Cold dissection method (CDM) or cold dissection tonsillectomy is the most classic method of tonsillectomy, which has been used as a popular method since the nineteenth century [3]. This method is known as the gold standard among existing methods. In this method, the tonsil is taken, and the anterior pillar is cut, and the capsule of the tonsil is separated from the constrictor muscles using a blunt or sharp instrument. Hemostasis is done by suture or electrocautery. Monopolar cautery has been the most common tonsillectomy technique in the last two to three decades because of the greater hemostasis it creates during surgery, but it may prolong the postoperative pain and recovery period [3, 4]. The pain and risk of bleeding

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after tonsillectomy surgery have led to the development of a number of tonsillectomy surgical techniques using cautery, electrocautery, or microdebrider. In this method, the wound is left open to heal secondarily and therefore causes pain and bleeding as two important complications after this operation. These two important complications make many surgeons look for other methods which have less side effects [5].

Newer techniques include laser, ligature, bipolar cautery, coblation, harmonic scalpel method (HSM) scalpel, and intracapsular tonsillectomy, which are introduced and used for tonsillectomy surgery. The use of warm dissection techniques is associated with a low rate of early postoperative bleeding and is therefore useful in tonsillectomy surgery. However, there is still no consensus on the optimal method [6].

Another tonsillectomy method is the harmonic scalpel. This method was introduced in 1992. In this method, an ultrasonic scalpel is used, which, with the help of ultrasonic waves with a frequency of 55,500 Hz and applying strong molecular vibrations in the tissue, leads to heat generation and denaturation of the proteins [7]. This surgical tool simultaneously cuts and cauterizes the tissue; in this way, the ultrasonic energy in the blade is converted into mechanical energy. The advantages of this method include accurate dissection, excellent hemostasis, and less lateral thermal damage than other hot methods [5].

The amount of heat produced by the blades of this device at a distance of 1 mm from the blade is at least 40 °C and a maximum of 100 °C, and at a distance of 2 mm or more, the amount of tissue heat produced is maximum 6 °C [8].

Surgical indications for tonsillectomy in adults include tonsil malignancies, severe airway obstruction due to enlarged tonsils, recurrent acute tonsil infection, chronic tonsil infection, and peritonsillar abscess [9, 10].

Complications during surgery include the following: laryngospasm and bronchospasm, aspiration, trauma (tooth fracture, perioral burn, subcutaneous emphysema, subcondylar fracture of the mandible), and uncontrolled bleeding [11, 12].

Early side effects after surgery (first 24 h) include the following: nausea and vomiting, pain, bleeding, swelling of the uvula, and airway obstruction.

Delayed complications after the operation (2–21 days) include the following: pain, bleeding, dehydration, infection of the operation site, infection and abscess of the neck, and fasciitis.

Long-term complications include the following: VPI, pharyngeal stenosis, tonsil retention, subacute endocarditis, cranial nerve damage, and taste disturbances [11–13].

The risk of bleeding after tonsillectomy in adults is up to 10 times higher than in children, and also, the pain after the operation is relatively higher in the adult age group to the extent that it sometimes prevents the person from sleeping. And on the other hand, fortunately, we did not have any cases of other inadvertent complications in the patients, so we only focused on examining these two main complications: bleeding and pain.

In this study, we have compared the cold dissection and harmonic methods and examined the complications of both methods so that by choosing the right method, we can help reduce the amount of pain and bleeding in patients undergoing treatment and reduce the duration of tonsillectomy surgery.

## Methods

This study was a descriptive analytical study that was conducted by census method and was performed on people aged 18 to 60 who were candidates for tonsillectomy in one of the hospitals in Tehran from 2017 to 2019. The reason for the study on adults is that in our previous experiences, the occurrence of pain and bleeding in adults was problematic, and in the pediatric group, these two complications were not very obvious.

The surgical indication of these patients included chronic tonsillitis. Exclusion criteria included any simultaneous surgery, hypertrophy of tonsils, acute tonsillitis, peritonsillar abscess, mental or language dysfunction, and bleeding disorders. The intervention was performed as a one-way blind randomization. The patients were randomly divided into two equal groups of 25 people, including the first group of tonsillectomy with HSM and the second group of tonsillectomy with CDM. Harmonic scalpel method surgery has a higher cost, but fortunately, the insurance system in our country provided the necessary coverage, so no extra cost was imposed on the patients.

In the surgical group of HSM, the patient was placed on the bed in a supine position with the neck slightly extended and the mouth open. The tonsil was grasped by forceps and slightly pulled inwards. The HSM scalpel was set at level 3, and an incision was made at the upper pole level close to the anterior pillar. After identifying the anterior pillar near the base of the uvula, the tonsil capsule was exposed. Then, the surface of the tonsil was separated from the muscles by the HSM blade. This work continued until the tonsil capsule was freed from the pillars and muscles, and at the end, the connection of the lower bridge of the tonsil was also separated. When separating the upper and lower bridges, the minimum power level of the device was used for more hemostasis; Ethicon Endo Surgery device was used for surgery.

The HSM handle consists of a generator device: a cutting hand piece with a connecting cable and a blade with a foot pedal. This blade oscillates at a frequency of 55.5 kHz. The back and forth movement of the cutting tip of the blade leads to fragmentation of the cavity and separation of the tissue plates. High frequency of vibration due to friction with internal tissue leads to coagulation of small vessels. Larger vessels require longer secondary heat for coagulation. The power of the generator can be varied between levels 1 and 5, which changes the amplitude of the blade oscillation during one cycle. The frequency is kept constant at all power levels. The blade is set at power level 3, which simultaneously cuts and coagulates tissue. It depends on the adjustment of the generator force, blade contact surface, and pressure and tissue tension by the blade. The higher the generator power setting, the faster the dissection, but the less coagulation is achieved. The most coagulation occurs at level 1.

The transfer of mechanical energy to the tissue causes protein denaturation and thus creates a clot that causes homeostasis. This process creates heat between 40 and 100 °C. Thermal damage to peripheral tissues and postoperative pain are proportional to temperature. Therefore, the HSM method causes less thermal damage compared to electrocautery and laser, where the temperature can rise up to 400 °C. Also, this less thermal damage, with minimal smoke, keeps the field of view clear for the surgeon [6]. In the second group, tonsillectomy was done to CDM. In this method, after proper exposure, the tonsil is first taken with Alice, pulled inwards, and causes the mucus to be stretched. The incision is made parallel to the anterior pillar at the border of the tonsil capsule, and the subcapsular dissection starts from the upper bridge of the tonsil and continues towards the lower bridge. The dissection plan is between the tonsil capsule and pharyngeal constrictor muscles and is largely avascular except for the upper and lower pole vessels. Care should be taken of the anterior and posterior tonsillar pillars to prevent velopharyngeal insufficiency (VPI). Blood sampling in this group was done by suturing the upper and lower bridges with 0.3 cut chrome thread.

During surgery, the time was calculated using a chronometer from the incision to the end of coagulation. Intraoperative bleeding was calculated by measuring intra-suction blood and counting blood gases (using and counting standard tonsil gauze, each gauze weighs about 1 g and, when completely wet, contains approximately 5 cc of blood). No topical or surface anesthesia or other oral or injectable analgesics were prescribed before surgery.

All operations were performed under general anesthesia. All patients received equal doses of acetaminophen after surgery. On the first day after surgery,

acetaminophen suppository 325 every 8 h and the following days, acetaminophen syrup 125 every 6 h, 10 cc. Pain after surgery was recorded using the visual pain measurement scale (VAS) and numerical pain scale (zero to ten: zero no pain and ten unbearable pain) on the 1st, 4th, and 7th days after the operation by filling in the pain questionnaire by the patients and compared between the two groups.

In addition, all patients were examined for secondary bleeding and rehospitalization. Information about age, volume of bleeding during surgery, time of surgery, and postoperative pain score on days 1, 4, and 7 after surgery and postoperative bleeding between the two groups were analyzed.

#### Pain questionnaire

The amount of pain in this study was measured by the linear VAS, which is standardized for measuring pain. The linear visual measurement scale of pain from zero to ten is divided as follows:

- Zero to 1: No pain
- Two to 3: Little pain
- Four to 5: A lot of pain
- Six to 7: Very bad pain
- Eight to 9: Maximum pain
- Ten: Unbearable pain

First, how to use the questionnaire was explained to the patients. People had to mark only 1 point on the continuum according to their pain level. All patients filled out the pain questionnaire on the 1st, 4th, and 7th days after the operation about the degree of throat pain after the operation.

The collected data of the patients were stored in the SPSS (V. 20) software bank. Quantitative data were expressed as mean, standard deviation, median, and percentage, and qualitative data were expressed as percentage. In the comparison of qualitative variables between two groups, chi-square test and quantitative variables were checked for normality of distribution by K-S test. If the distribution was normal, independent *T*-test was used, and if it was not normal, non-parametric tests were used. The significance level for data difference was considered 0.05.

#### Results

Among the patients in the HSM group, 20 (80%) were males, and 5 (20%) were females, and in the CDM group, 16 (64%) were males, and 9 (36%) were females. The average age of patients in the HSM group was 28.44 years with a standard deviation of 8.412. The youngest age was 19, and the oldest was 56. In the CDM group, the average

age of the patients was 24.32 years with a standard deviation of 4.571, with the lowest age being 18 and the highest age being 38 years (Table 1).

**Duration of surgery:** The average length of surgery in the HSM (HST) tonsillectomy group was 13 min and 30 s with a standard deviation of 1.932, and the highest value was 19, and the lowest value was 10 min and 24 s, and in the cold dissection (CDM) tonsillectomy group, the average duration of surgery was 33 min and 55 s with a standard deviation of 8.999, and the highest value was 61, and the lowest value was 23 min. In the analysis of the data of the two groups, a statistically significant difference was seen in terms of the length of surgery between the two groups ( $P=0.000$ ) (Table 2).

**Bleeding:** In the data analysis, the average bleeding volume in the HST group was 6.76 cc with a standard deviation of 3.257, and the highest value was 18, and the lowest value was 2 cc, and in the CDM group, the average bleeding volume was 148.08 cc with a standard deviation of 66.038, and the highest value was 330. And the lowest amount was 40 cc. In the analysis, a statistically significant difference was seen in terms of the volume of surgical bleeding between the two groups ( $P=0.000$ ) (Table 2).

Pain after surgery in this survey was conducted on the first, fourth, and seventh days, and the results of the statistical analysis of the data were as follows: the average

pain on the first day after surgery in the HSM group was 4.12 with a standard deviation of 1.201, and the highest value was 6, and the lowest value was 1, and in the CDM group, the average pain on the first day was 6.40 with a standard deviation of 1.354. The highest value was 9, and the lowest value was 4. Statistically, a significant difference was found between the two groups in terms of average pain on the first day after surgery ( $P=0.000$ ).

The average pain on the fourth day after surgery in the HSM group was 4.92 with a standard deviation of 1.115; the highest value was 7, and the lowest value was 3. In the CDM group, the average pain on the fourth day was 5.52 with a standard deviation of 0.963 with the highest value of 7 and the lowest value of 4. Statistically, a significant difference was found in terms of average pain on the fourth day after surgery between the two groups ( $P\text{-value}=0.047$ ).

The average pain on the seventh day after surgery in the HSM group was 3.80 with a standard deviation of 0.913, and the highest value was 5, and the lowest value was 2, and in the CDM group, the average pain on the seventh day was 3.72 with a standard deviation of 1.100 with the highest value 6 and the lowest value was 2. Statistically, no significant difference was found in terms of average pain on the seventh day after surgery between the two groups ( $P\text{-value}=0, 0.781$ ).

The amount of postoperative pain in the group of tonsillectomy by HSM and scalpel method is less than the group of tonsillectomy by CDM. In the present study, the amount of pain on the 1st, fourth, and seventh day of the patients was recorded with the pain score and the patient's self-report.

Respectively, in the HSM group, it was 4.12, 4.92, and 3.80, compared to the CDM group which was 6.4, 5.52, and 3.72, respectively; the pain level of the patients on the first and third days dissection was significantly less in the HSM group than in the CDM group (Table 3).

In this study, the complications of pain and bleeding were investigated; the reason for not mentioning other complications of tonsillectomy is that no evidence of other complications was seen in any of the patients.

**Table 1** Gender and sex distribution table in patients

Group		HSM	CDM	
<b>Age</b>	Number	25	25	
	Minimum	19	18	
	Maximum	56	38	
	Mean	28.44	24.32	
	Std. deviation	8.412	4.571	
<b>Sex</b>	<b>Female</b>	Frequency	5	9
		Percent	20	36
		Cumulative percent	20	36
	<b>Male</b>	Frequency	20	16
		Percent	80	64
		Cumulative percent	100	100

**Table 2** Duration of surgery and volume of bleeding in two groups

	Group	Number	Minimum	Maximum	Mean	Std. deviation	p-Value
<b>Duration</b>	HSM	25	10.4	19	13.5	1.932	0.000
	CDM	25	23	61	33.92	8.999	
<b>Bleeding</b>	HSM	25	2	18	6.76	3.257	0.000
	CDM	25	40	330	148.08	66.038	

**Table 3** Pain after surgery in two groups

Post operation pain	HSM group	CDM group	p-Value
First day	4.12 ± 1.201	6.40 ± 1.354	0.000
Fourth day	4.92 ± 1.115	5.52 ± 0.963	0.047
Seventh day	3.80 ± 0.913	3.72 ± 1.100	0.781

## Discussion

The first hypothesis of the current research was that the amount of postoperative pain in the HSM group is lower than the CDM tonsillectomy group. The findings confirmed this hypothesis. This result was consistent with the results of Dr. Karimi et al.'s study [14]. In Dr. Karimi's study, a dose of dexamethasone was used before the operation and doses of acetaminophen after the operation. Also, the results of our study were consistent with the results of Lachanas et al.'s study in 2007 [15], in which the pain on the 1st and 3rd days after the operation in the HSM scalpel group was significantly less than the CDM group, but in the Lachanas study, the pain on the 7th day in the HSM group was less in the CDM group, which was not consistent with our study.

In Kamal's study (2005), which was conducted on 280 patients aged 3 to 69 years, 90 patients underwent tonsillectomy. Before the operation, ibuprofen and paracetamol were given to the HSM group, and the CDM group received codeine in addition to ibuprofen and paracetamol. In this study, postoperative pain in the first week in all patients of the HSM group was significantly less than the CDM group [6].

In Oko's study on children aged 5 to 13 years, only tonsillectomy was performed, and both groups were given the same doses of acetaminophen based on weight; after the operation, the pain in the HSM group was significantly higher on the first and third days after the operation, and the CDM group was not consistent with our results [16]. In the Akural study, tonsillectomy was performed on 32 patients aged 18 to 48 comparing HSM on one side and cold dissection on the other side. The amount of pain in the first 10 h after surgery was significantly higher on the cold side than on the HSM side, which was consistent with the results of the first day in our study [17]. Also, the results of Collison's study in 2004 were completely consistent with the results of our study, so that in both studies, the pain on the first day was significantly different in the two groups, but the amount of pain on the seventh day was not statistically significantly different between the two groups [18]. Also, the results of the meta-analysis conducted in 2011 comparing the surgical complications of tonsillectomy using the traditional method with new surgical methods show that there is no significant

difference between the pain on the first and seventh days of the cold method and HSM. This report confirms the results of our study on the seventh day [19].

As a result, it seems that according to the sharing of data from different studies, there is no difference in the amount of pain on the seventh day of the two methods, which could be due to the restoration of the mucosal tissue that has taken place after 1 week at the tonsillectomy site. Since the degree of pain is related to the amount of damage to the soft tissue, it was expected that by using the HSM method, the amount of pain after the operation will also decrease [20]. Considering the difference in the results of the pain level of the present study on the first day with some studies and considering the sameness of the tools used, it can be concluded that the skill of the surgeon can be effective in the level of pain. At the same time, it should be kept in mind that the studies were conducted on different age groups, with sometimes different indications and with differences in the way painkillers are used before and after surgery, which can affect the results. In assessing pain with a quantitative scale, various variables such as age, gender, anxiety, and different pain thresholds can affect the study. In our study, adult patients were selected for a more accurate assessment of pain intensity.

It is suggested that painkillers be given to patients before surgery and by injection (lidocaine and propiocaïne) at the surgery site. Also, painkillers such as gabapentin should be used after surgery.

The other hypothesis of the present study was that the amount of intraoperative bleeding in the HSM scalpel tonsillectomy group is lower than the CDM tonsillectomy group. The results of the present study showed that the amount of bleeding during surgery was significantly different between the HSM group (6.76) and the CDM dissection group (148.08), so that this amount was lower in the HSM group. The results of our study were consistent with the results of the study by Karimi et al. [14] and the study conducted by Collison et al. [18] as well as the meta-analysis conducted by Alexiou et al. in 2011 [19]. The most important reason for confirming this finding is the nature of the HSM method, which, by creating tissue coagulation and not damaging the surrounding tissues, greatly reduces the amount of bleeding during the operation, which is a significant advantage in adult patients who are candidates for tonsillectomy. The HSM technique can be particularly useful for patients who cannot tolerate blood loss, such as children, patients with anemia, or patients on anticoagulant therapy. The amount of bleeding after the operation in the HSM tonsillectomy group was lower than the CDM tonsillectomy group.

In the present study, there were no cases of postoperative bleeding in the HSM group, but one patient in

the CDM group experienced postoperative bleeding and needed surgery and blood sampling again.

In Kamal's study in 2005, it was reported that among 180 cases that were in the HSM group, there was no case of postoperative bleeding that required hospitalization and re-surgery [6], and this is a significant advantage of HSM over the cold method.

Postoperative bleeding is one of the most dangerous, rare, but potentially serious complications of tonsillectomy. This complication is often self-limiting but can be serious and in rare cases fatal. Preoperative drugs, patient's age, male gender, infections, and lack of experience of the surgeon are some of the factors that have been associated with increased bleeding after surgery [11].

The third hypothesis of the present study was that the operation time in the HSM tonsillectomy group is less than the CDM tonsillectomy group. The results confirmed the hypothesis; the duration of surgery in the HSM method (30/13 min) was significantly less than the cold dissection method (55/33 min). This result was consistent with the results of Karimi et al.'s study [14] as well as the study of Collison et al. [18] But it was different from the results of Alexi et al.'s study [19]. Due to the technique of HSM operation and simultaneous coagulation with dissection and no need for other blood collection methods such as suturing, the duration of surgery in this method is much less than the classical method.

## Conclusion

According to this study, the amount of bleeding and the duration of tonsillectomy surgery in the harmonic scalpel method were less than the cold dissection method. Therefore, the harmonic scalpel method can be used to reduce surgery time and reduce bleeding, especially in patients who cannot tolerate blood loss, such as children, patients with anemia, or patients who use anti-coagulant treatment. Regarding pain after surgery, the pain on the first and fourth days after surgery was less in the harmonic group, but the pain on the seventh day was not significantly different from the cold dissection tonsillectomy group. One of the limitations of this study was the small number of people studied, so it is suggested that larger studies with a larger sample size and multiple centers be conducted to compare these methods.

## Abbreviations

CDM	Cold dissection method
HSM	Harmonic scalpel method
VPI	Velopharyngeal insufficiency
VAS	Visual pain measurement scale

## Acknowledgements

We thank all the patients participating in this research as well as the clinic and hospital personnel for their participation. This study was part of the residency thesis and was approved by the Ethics Committee of Baqiyatallah University of Medical Sciences, Tehran, under the code of IR.BMSU.REC.1399.573.

## Authors' contributions

AB, supervision, study design, and methodology. AN, project administration, data gathering, and interpretation of data. AT, validation, study design, and review. MS, validation, study design, and review. MH, draft preparation, writing, and review and editing. The authors read and approved the final manuscript.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

This study was part of a thesis and was approved by the Ethics Committee of Baqiyatallah University of medical sciences, Tehran, Iran, under the code IR.BMSU.REC.1399.573. Informed written consent to participate in the study was provided by all participants.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

Received: 28 November 2022 Accepted: 24 March 2023

Published online: 28 April 2023

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