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(RESEARCH ARTICLE)

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Comparative study between tonsillectomy with thermal welding and conventional cold steel techniques

Mohammed Radef Dawood [1,*] and Ehsan Abdullah Othman [2]

[1] *Otolaryngology Department, College of Medicine, Mustansiriyah University, Baghdad, Iraq.*
[2] *Otolaryngology department, Al-Yarmouk teaching hospital, Baghdad, Iraq.*

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Abstract

Various tonsillectomy techniques had been adopted for many years; however, the ambition is the access to an entirely safe and efficient modality. This study aims to compare efficacy of thermal welding and cold steel dissection tonsillectomy techniques. A prospective study, in Al-Yarmouk teaching hospital, Baghdad, Iraq, from 2017 to 2018, were done, in whom 100 eligible patients for tonsillectomy, were evenly and randomly divided into group "A" whom underwent thermal welding tonsillectomy, and group "B" whom underwent cold steel dissection tonsillectomy. The outcomes of both groups were assessed for operative time, intraoperative blood loss, postoperative hemorrhages, postoperative pain, speed of tonsillar fossae healing process, and time return to normal diet. Results shown operative time was 11.0±1.4 min in group "A", and 29.6±12.4 min in group "B", P=0.001, mean amount of intraoperative blood loss was 17.4±1.3 ml in group "A", and 53.2±18.8 ml in group "B", P=0.001, primary and secondary postoperative hemorrhages statically significant lower in group "A", P=0.025. Mean postoperative pain score in the group "A" was 1.6± 0.5, and in group "B" 2.725±0.7, P=0.001, as well as, mean time to return to normal diet was 5.4± 0.8 days in group "A", and 8.2±0.4 days in group "B", P=0.012, also tonsillar fossae healing process was clinically faster in group "A". So it concluded, thermal welding tonsillectomy showed better outcomes regarding reduction in both intraoperative blood loss, postoperative hemorrhages, postoperative pain, also shortening in operative time and quicker return to normal diet, as well as, clinically faster tonsillar fossae healing process.

Key words: Tonsillectomy; Cold steel dissection; Thermal welding; Procedures

1. Introduction

Tonsillectomy is one of the most common surgical operations, practiced in otolaryngology field, various techniques have been adopted for many years; being the conventional cold steel dissection tonsillectomy technique was one of the oldest methods applied for removal of tonsils, with its advantages and disadvantages, as well as, there has been a conceptual changes in the indications and surgical techniques in the past 10 years, where, there have been a large number of publications in the literatures. As these publications are a testament to continuous growth, development and controversies engaged with this subject [1].

So recent researchers studied other several procedures, such as, hot dissection techniques as bipolar and monopolar electro cautery, thermal welding, harmonic scalpel, CO2 and KPT-532 laser, also coblation plasma kinetic, as well as, radiofrequency, and argon plasma coagulation tonsillectomies, and often they compared those techniques with cold steel dissection procedure [2].

* Corresponding author: Mohammed Radef Dawood

Since tonsillectomy procedure is associated with several noticeable morbidities, such as intraoperative blood loss, postoperative hemorrhage, post-operative pain with its associated painful swallowing, and limitations in diet, and as, these morbidities compromise patient health and safety, and recovery quality, and also the time to return to a normal daily activity and work, as well as, complication-related visits to otolaryngology department, all, those had negative impact on medical patient workload and hospital cost [3].

Therefore, many studies have been developed several surgical tools in addition to the standard cold steel method, in order to minimized these morbidities, yet, there is no consensus has been accomplish concerning the ideal surgical technique that obtain these objectives [3].

Some studies have introduced thermal welding technique, which is distinctive from other electrosurgical tools as it`s not a bipolar instrument, because it`s effect operates via application of direct heat energy instead of electrical current, at the tip of the instrument denature the tissue protein molecules, therefore, the tissue is squeezed between insulated jaws, so the focused heat is applied to the local region with minimal thermal injury to the surrounding tissues, and this lead to, less postoperative pain, as well as, the denatured protein molecules, forms a tight seal [4].

So thermal welding is a technique, that applied heat and pressure simultaneously to provide coagulation, and thus provides sufficient hemostasis during dissection, and also, it leads to shortening the operative time, and therefore, it proposed to be safe and suitable surgical instrument to be applied for tonsillectomy [4-7].

The aim of this study was to evaluate and compare the clinical data as the operative time duration, intra operative blood loss, postoperative hemorrhage, and postoperative subjective pain threshold sensation, as well as the speed of tonsillar fossa healing process, and return to normal diet among patients whom underwent thermal welding versus those of cold steel dissection tonsillectomy techniques.

2. Material and Methods

In this prospective interventional comparative study, after the approval by Institutional Review Board “Reference number 547 on 6/6/2017”, which were done at Al-Yarmouk teaching hospital, Baghdad, Iraq, in period from June 2017 to August 2018, whom 100 eligible patients for tonsillectomy were recruited and divided evenly "almost identical with age and gender" into two groups; group A: (50 patients) who underwent Thermal Welding (TW) tonsillectomy, and group B: (50 patients) who underwent the Cold Steel (CS) dissection tonsillectomy technique.

All participated patients or their parents were subjected to signed informed consent with description type of the surgical procedure, and its potential complications.

So patient with consistence signs and symptoms of obstructive sleep apnea, and other operation co-existence with tonsillectomy such as adenoidectomy, myringotomy, patient with bleeding disorder, and those who communicating difficulty with their pain threshold sensation, those with psychological problem confirmed by his medical record, as well as, those whom not attended regular the follow-up was excluded from the study.

2.1. Surgical techniques

All operations were performed by the same surgical team under general anesthesia with orotracheal intubation, and tonsillectomy was based on the sort of the surgical technique applied, as following:

In group A: It’s done by using thermal welding system "Starion instruments Corp., Sunnyvale, CA, USA)", see figure 1.

The surgical technique was applied, and dependent upon dissection of the tonsil using the Bayonet ultra slim machine forceps, via power supply foot switch–activated unit.

Thermal welding technique was done through extra-capsular tonsillectomy with thermal welding device, using a probe with a power setting, after placing the mouth gag, then, the tonsil was retracted medially using clamp, dissection was performed via tonsil probe at the upper pole of the tonsil by clamping the anterior pillar tonsillar mucosa. Then, the tissue was activated with the foot switch and clamped between the ends of the tonsil probe and coagulation was done, after that, cutting procedure was performed by activating with foot switch. Dissection was extended from the upper pole to the lower pole by exposing the tonsil capsule. Tonsil tissue was coagulated for finally at its lower pole and then, whole tonsil was removed, this procedure was done for both tonsils.

Figure 1 Thermal welding device

In group B: It`s done by conventional cold steel dissection technique.

Cold steel dissection Tonsillectomy was performed by the following steps: each tonsil was hold and retracted medially using the standard Denis Brown tonsil holding forceps, then the anterior pillar tonsillar mucosa was incised with the scissor to expose its capsule, and then by Gwynne Evans tonsil dissector the tonsillar dissection continued toward its lower pole were it clamped with a Negus forceps and divided by scissor and ligated by silk, and hereby the tonsil was now fully excised, and then full hemostasis of the tonsiilar fossa was carried out by wet gauze swabs and silk ligatures, this procedure was done for both tonsils.

All operated patients prescribed on discharge on the same Antibiotics, as "Amocillin/Clavulanic acid", for 10 days, "625 mg capsule three time daily for adult and 40 mg/day PO divided q8hr for children", as well as, "Acetophenamine" tablet 500mg three times daily for adult and 20mg/kg for children.

So the following study`s parameters were analyzed and compared between both groups; the operative time, intraoperative blood loss, postoperative hemorrhage, the postoperative pain, as well as, the tonsillar fossae healing process, and time to return to normal diet.

The operative time was estimated from the time of first anterior mucosal tonsillar pillar incision till full hemostasis of both tonsils was secured.

The intraoperative blood loss was calculated by estimating blood loss by measuring all the blood lost collected in the suction bottle, plus those in all soiled cotton balls/gauzes; as following:

All the soiled cotton balls/gauzes together with unused cotton balls/gauzes were placed on the physical balance and weighed, and then the difference in weights was the weight of blood lost in cotton/ gauze was converted into milliliters by dividing the weight by specific gravity of the blood (1.055) using the following formula [8]:

"Weight of the cotton balls before use=yg, and the weight of the cotton balls soaked with blood=xg, Weight of the blood lost=xg-yg, while the specific gravity of blood=1.055. So the quantity of blood lost=xg-yg/1.055 g.

As well as, the amount of fluid (blood + known quantity of saline) collected in suction bottle=z ml, and the amount of saline sucked in the bottle=150 ml, so quantity of blood in suction bottle=z-150 ml, therefore the total quantity of blood lost=x-y/1.055 g+z-150 ml". So the total amount of intraoperative blood loss was "the suction bottle blood, plus those in all soiled cotton balls/gauzes".

The postoperative bleeding was classified and measured according, to Flinders Modification of the Stamberger criteria for grades of bleeding [9], as following: hemorrhage was classified as " P" Primary; bleeding within 24 hours following operation, and "S "Secondary bleeding; as occur after 24 hours, while, its severity as follows: grade "A" reported as a minor bleeding, but either nor active bleeding, or a clot present, grade "B" reported as bleeding actively under examination, with no shock, and grade "C" Surgical treatment needed under general anesthesia, but also, no shock,

while grade "D" Dramatic hemorrhage causing shock, or blood transfusion required, and grade "E" Death due to hemorrhage or hemorrhage related complications.

The pain-assessment visual analogue scale (VAS) was handed out to them, or their parents to record their pain reception scores on daily basis, by using the numeric pain rating scale for adult, and Wong Baker faces scale for children, both score from 0-10, and was scheduled regularly on (1st, 3rd, 5th, 7th, 10th and 14th days) postoperatively, as shown on figure 2.

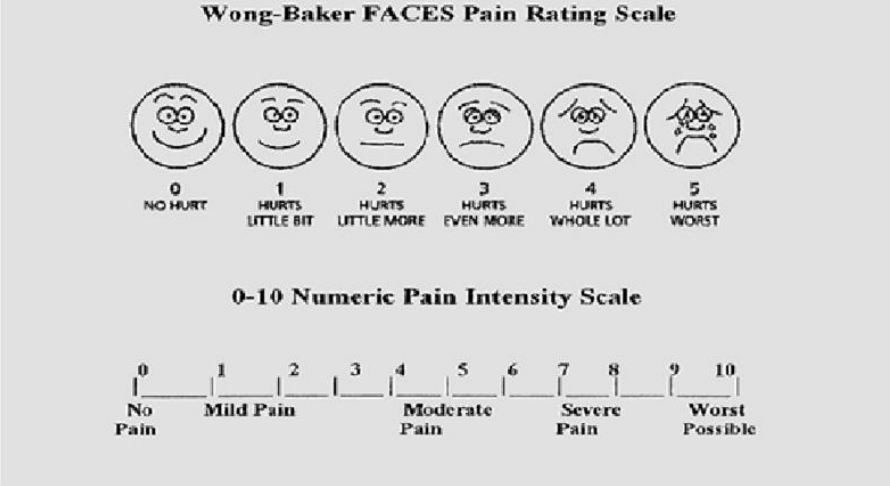


Figure 2 Wong – baker pain rating scale, 0-10 numeric pain intensity scale

While the tonsillar fossae healing process was assessed through careful inspection of the tonsillar fossae on the 14th postoperative day, as well as, the time was recorded in which the patient return to normal diet.

2.2. Statistical analysis

Using SPSS-20 Data were presented in simple measures of percentage, mean, frequency, standard deviation, and range (minimum-maximum) values, by using Students-t-test for difference between two independent means to test the significance of difference of different means (quantitative data), while using Pearson Chi-square to test the significance of difference of different percentages (qualitative data). Statistical significance was considered whenever; the P value was ≤ 0.05.

3. Results

The age was ranged from 5 to 30 years, with the mean age was (14.3±7.2) years for CS group and (15.1±6.5) for TW group, and it was non-significant as P=0.214, also there were 27 males (54%) and 23 females (46%) for CS group, and 26 were males (52%) and 24 were females (48%) for TW group, and it was non-significant with P=0.823, as table 1 highlighted the distribution of different age groups studied.

Table 1 Distribution of different age groups studied

		CS group		TW group		P value
		No.	%	No.	%	
Age (years)	<10y	13	26%	12	24%	0.745
	10-19y	19	38%	18	36%	0.823
	=>20y	18	36%	20	40%	0.678
	Mean±SD (Range)	14.3.1±7.1 (5-30)		15.1±6.5 (5-30)		0.214

*Significant difference between proportions using Pearson Chi-square test at 0.05 levels.; CS= cold steel, TW= thermal welding

The operative time was (29.6±12.4) min in CS group and (11.0±1.4) min in TW group, with P=0.001, and the mean amount of intraoperative blood loss was (53.2±18.8) ml in CS group and (17.4±1.3) ml in TW group with P=0.001, as in table 2 which shows the distribution of various operative times and intraoperative blood loss among the studied groups "according to the age".

Table 2 Distribution of various operative times and intraoperative blood loss among the studied groups according to the age

Parameter		**CS group**		**TW group**		**P value**
		No	%	No	%	
Operative time	<10min	0	0%	44 14<12years 30>12years	88% 32% 68%	-
	10---19mins	1 1>12years	2% 100%	6 2<12years 4>12years	12% 33.3% 66.6%	
	20-29min	32 12<12 years 20>12years	64% 37.5% 62.5%	0	0%	
	=>30min	17 5<12 years 12>12 years	34% 29.4% 70.6%	0	0%	
	Mean ±SD (Range)	29.6±12.4 (20-100)min.		11.0±1.4 (5-10)min.		0.001*
*Significant difference between two independent means using Students-t-test at 0.05 levels.						

CS= cold steel, TW= thermal welding

While Figure 3, highlighted the distribution of operative times and intraoperative blood loss in studied groups "in general".

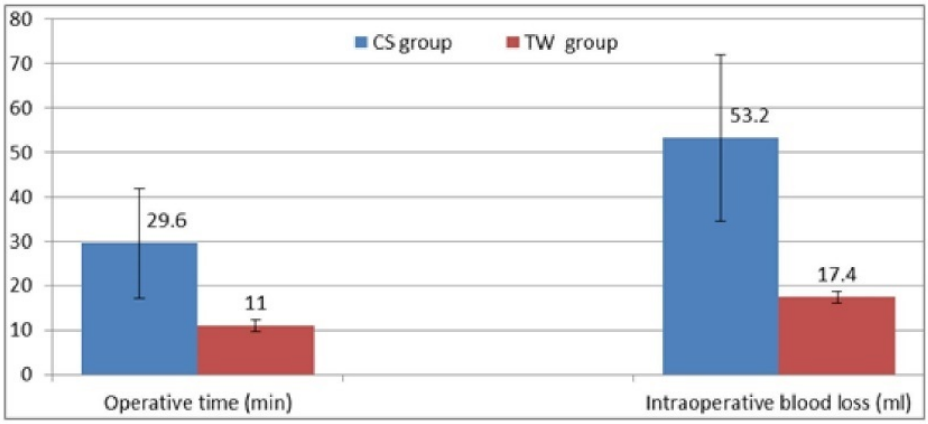


Figure 3 Mean operative time and intraoperative blood loss in studied groups

The postoperative hemorrhage was recorded as following:

One patient aged >12years from the CS group was developed primary hemorrhage; grade "B", with no patient from the TW group, while, 3 patients aged >12years from the CS group were developed secondary hemorrhage; as 2 patients were "grade B", and 1 patient was grade "A", while 1 patient aged >12years from the TW group was developed secondary hemorrhage; grade "A", so the primary and secondary postoperative hemorrhages in TW group were shown significant statically results, as P=0.025. As table 3 showed the distribution of post-operative bleeding, among the both groups.

Table 3 Distribution of post-operative bleeding among the studied groups

Parameters		**CS group**		**TW group**		**P value**
		No	%	No	%	
Postoperative hemorrhage	Primary	1 1>12years	0.02% 100%	0	0%	
	Secondary	3 3>12years	0.06% 100%	1 1>12years	0.02% 100%	
	Mean ±SD (Range)	46.3±12.5 (31-50)		31.2±17.4 (29-50)		0.025*
*Significant difference between two independent means using Students-t-test at 0.05 levels.						

CS= cold steel, TW= thermal welding

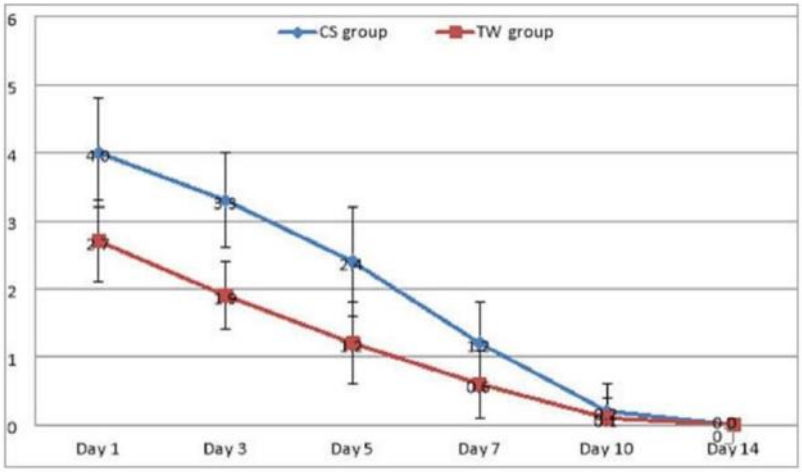
The postoperative pain revealed, that, the pain score was significantly lower in the TW group (1.6± 0.5), than in the CS group (2.725±0.7) on the 1st, 3rd 5th and 7th days of surgery, mean score was with P=0.0001, however it was non-significant on 10th postoperative day with P=0.107, and also on 14th day postoperatively, the statistical analysis was not applicable to be formed, as shown in table 4.

Table 4 Distribution of postoperative pain score among the studied groups

Pain score at	**CS group**	**TW group**	**P value**
Day 1	4.0±0.8 (3-5)	2.7±0.6 (2-4)	0.0001*
Day 3	3.3±0.7 (2-5)	1.9±0.5 (1-3)	0.0001*
Day 5	2.4±0.8 (1-4)	1.2±0.6 (0-3)	0.0001*
Day 7	1.2±0.6 (0-3)	0.6±0.5 (0-1)	0.0001*
Day 10	0.2±0.4 (0-1)	0.1±0.3 (0-1)	0.107
Day 14	0	0	-
Data were presented as Mean ±SD (Range)			
*Significant difference between two independent means using Students-t-test at 0.05 levels.			

CS= cold steel, TW= thermal welding

Also, figure 4 shows postoperative-pain-score-among-the-studied-groups



CS= cold steel, TW= thermal welding

Figure 4 Postoperative-pain-score-among-the-studied-groups

Regarding the healing process of the tonsillar fossae; in all aged patents, as follows; on 14th day postoperatively, it revealed that, in 19 patients (38%) in TW group, and 17 patients (34%) in CS group the tonsillar fossae bed were totally healed (no slough), so the tonsillar fossae healing process was clinically faster in TW group than in CS group, although, was no statistically significant between the two groups as P = 0.357.

While, the mean time to return to the normal diet in all aged patients was 5.4± 0.8 in TW group, and 8.2±0.4 in CS group, which was statistically significant as the P=0.012.

4. Discussion

Tonsillectomy is one among the oldest Otolaryngological operations performed in the whole world. At the beginning of the 20th century, forceps and scalpels were introduced with reduction in intraoperative hemorrhage. In 1909, tonsillectomy became a safe procedure with the use of ligatures by Cohen to control hemorrhage [10].

Variety of surgical techniques such as cold dissection, snare technique, guillotine tonsillectomy, cryosurgery electro cautery, harmonic scalpel, laser removal, coblation, radiofrequency, bipolar electro cautery, thermal welding tonsillectomy, the choice of the technique depends on surgeon's preference and which procedure have positive impacts on patient's quality of life [11].

It is done with different of procedures and techniques, in spite these different techniques, there is no consensus and conclusive evidence in the studies till now on the optimum or the best method, and none of the techniques has been accepted as the best one universally. Each of these procedures has advantages and disadvantages. However, these techniques have usually been compared with each other by different authors across the world [12].

In the current study the mean operative time was significantly lower in TW tonsillectomy with P=0.001 and this observation were agreed with many other studies [7,13-15]. Shortening in operative time was mainly attributed to decrease in time of surgical hemostasis, as thermal welding induces cutting and coagulation of vessel at same time, and this in turn will improves visualization of surgical field.

While a study performed by Yilmaz M, et al [16], and Karatzanis A, et al [17], encountered there was no significant difference in the operative time encountered between the two techniques, however, Yasar H, et al [18] observed in their study, the duration of the operative time was significantly shorter in CS surgical technique.

The intraoperative blood loss, as well as, primary and secondary postoperative hemorrhages were shown significantly lower in TW group than in CS group, as P=0.001, and 0.025 respectively, these observations were agreed with several other studies [13,14,16,19,20].

The explanation for that was probably attributed to the mechanism of the thermal welding, that induces cutting and coagulation of blood vessels at the simultaneously, as the closing the forceps jaws compresses the thermal element

toward a silicone “boot”, so it eases the generation of a graded thermal profile, as narrow high-temperature (300 C to 400 C) cutting area, enclosed by a lower–temperature coagulating area (60 C to 100 C), that is considered the perfect temperature scope to coagulate and seal tissues, by way of protein denaturation [6].

Furthermore, the silicone “boot” make on pressure or crumples the blood vessel walls altogether in a lower – temperature coagulation area, manufacturing a strong seal on the ends of the cut blood vessel [4].

In a study performed by Ozkiris M, et al [21] whom compared cold technique with thermal welding regarding the intraoperative bleeding, their result was the amount of intraoperative bleeding in the cold technique was found to be more than those in thermal welding group, but, regarding the postoperative early or late bleeding, there was no significant difference found between them.

Pain reduction is not simply for the patient`s symptom relief, but, also, it may subsidence the swallowing with associated hazard of dehydration, that in turn lead to infection and secondary hemorrhage, so the subjective postoperative pain score was statistically significant lower in TW group, on the first 7 days' postoperative days, with P=0.0001, and this finding, was agreed with many other studies [7,11,14-16,19].

The reason behind the postoperative pain looks to be minimal in TW technique was probably, related to the minimal thermal spread, to the adjacent tissues, as well as, it induces cutting and coagulation of the blood vessels simultaneously, also, minimal muscle fibers of the tonsillar bed stretching and injury.

On the other hand, a study performed by Yasar H, et al [18] found that, there was no statistically significant difference in early post-operative pain encountered between the both groups.

The healing process of the tonsillar fossae was shown clinically faster in TW group, than CS group, the same observation was reported by Weinstock BI [20] study who reported, that the tonsillar fossae healing time after TW group was rather faster than in CS group, however, a study performed by Yasar H, et al [18] found there was no statistically significant difference encountered between the both groups.

Regarding, the mean time for patients to return to normal diet, this study detects that in TW technique was shortened in the time to regain to the normal diet than in CS technique, and this observation was agreed with other studies [4,19,20].

Lastly it worth mention, that the use of disposable tool in TW technology is very beneficial, as a protective method against transmitting variant form of Creutzfeld-Jacob disease, however, TW forceps technology is much cost-effective than those of CS [22].

5. Conclusions

Thermal welding tonsillectomy shown better outcomes than cold steel tonsillectomy technique, regarding a reduction in postoperative pain, intraoperative blood loss, postoperative hemorrhages, also shortening both the operative time and return to the normal diet, as well as, there were clinically faster in tonsillar fossae healing process.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors (Mohammed Radef Dawood, Ehsan Abdullah Othman) declare no conflict of interest /Competing Interests.

Statement of informed consent

All necessary information provided and voluntarily signed consent form.

References

[1] Verma R, Verma RR, Verma RR. Tonsillectomy-Comparative Study of Various Techniques and Changing Trend. Indian J Otolaryngol Head Neck Surg. 2017; 69(4):549-58.

[2] Sayin, I., Cingi, C. Recent medical devices for tonsillectomy. Hippokratia 2012; 16(1):11–6.

[3] Altun H, Hanci D. Postoperative outcome of thermal welding tonsillectomy versus monopolar electrocautery tonsillectomy: a randomized control study. J Otolaryngol ENT Res 2018; 10(6):400–40.

[4] Karatzias GT, Lachanas VA, Papouliakos SM, Sandris VG. Tonsillectomy using the thermal welding system. ORL J Otorhinolaryngol Relat Spec 2005; 67:225-9.

[5] Treat MR. a new thermal device for sealing and dividing blood vessels. Available from: http://www. starioninstruments.com/PDFs/Treat.pdf. April 3. 2019.

[6] Karatzanis AD, Bourolias CA, Prokopakis EP, Panagiotaki IE, Velegrakis GA. Tonsillectomy with thermal welding technology using the TLS (2) thermal ligating shear. Int J Pediatr Otorhinolaryngol 2007; 71:999-02.

[7] Stavroulaki P, Skoulakis C, Theos E, Kokalis N, Valagianis D. Thermal welding versus cold dissection tonsillectomy: A prospective, randomized single-blind study in adult patients. Annals of otology, rhinology and laryngology 2007; 116 (8):565-70.

[8] Prasad KC, Prasad SC. Assessment of operative blood loss and factors affecting it in tonsillectomy and adenotonsillectomy. Indian J Otolaryngol Head Neck Surg. 2011; 63(4): 343–48.

[9] Samy S, Ossmitiz G, HebermannW, Stammberger H. hemorrhage following tonsil surgery: a multicenter prospective study. Laryngoscope 2011; 121:2553-60.

[10] Adoga AA. Cold versus hot dissection tonsillectomies: The Nigerian experience. East and Central African Journal of Surgery. 2011; 16(3): 64-8.

[11] Anoop M, Kumar VM, Naseeruddin M, Zameer KN, Hamdani N. Adult Tonsillectomy as a Day care Procedure-our experience. Ann. Int. Med. Den. Res. 2017; 3:6-9.

[12] Mohammad MR, Forod SH. Mehran HT. Mahsa S. Gholamreza HT. Mohammad M. Comparison of postoperative morbidity between conventional cold dissection and bipolar electrocautery tonsillectomy: which technique is better? Braz J Otorhinolaryng. 2020; 86 (84):427-33

[13] Chimona T, Proimos E, Mamoulakis C, Tzanakakis M, Skoulakis M, Papadakis CE. Multiparametric comparison of cold knife tonsillectomy, radiofrequency excision and thermal welding tonsillectomy in children. Int J Pediatr Otorhinolaryngol 2008; 72: 1431-6.

[14] Sezen OS, Kaytanci Hì, Kubilay U, Coskuner Tì, Unver S. Comparison between tonsillectomy with thermal welding and the conventional 'cold' tonsillectomy technique ANZ J Surg 2008 ;78(11):1014-8.

[15] Hanci D, Altun H. Comparison of cold knife tonsillectomy versus thermal welding tonsillectomy in adults: a prospective trial. ENT Updates 2015;5(2):63–7.

[16] Yilmaz M, Duzlu M, Catli T, Ustun S, Ceylan A. Thermal welding versus cold knife tonsillectomy: a prospective randomized study. Kaohsiung J Med Sci 2012; 28 (5); 270-2.

[17] Karatzanis A, Bourolias C, Prokopakis E, Panagiotaki E, Velegrakis G. Thermal welding technology vs ligature tonsillectomy: a comparative study. Am J Otolaryngol 2008; 29: 238-41.

[18] Yasar H, Ozkul H, Verim A. Comparison of the thermal welding technique and cold dissection for pediatric tonsillectomy. Trakya Univ Tip Fak Derg 2009; 26(4): 326-30.

[19] Arif Sanlı, Gazi Yildiz, Banu Atalay Erdogan, Comparison of Cold Technique Tonsillectomy and Thermal Welding Tonsillectomy at Different Age Groups. Prague Medical Report / (2017) Vol. 118 No. 1, p. 26–36.

[20] Weinstock BI. An improved method for tonsillectomy using thermal welding technology. Available from: http//www.starioninstruments.com/PDFs/Tonsil.pdf.

[21] Ozkiris M, Kapusuz,ZL Saydam. Comparison of three techniques in adult tonsillectomy. Eur. Arch. Otorhinolaryngol. 2013; 270, 1143–7.

[22] Raut VV, Bhat N, Sinnathuray AR, Kinsella JB, Stevenson M, Toner JG. Bipolar scissors versus cold dissection for pediatric tonsillectomy--a prospective, randomized pilot study. Int J Pediatr Otorhinolaryngol 2002; 64:9-15.