

EXPERIMENTAL STUDY

## The effects of radiofrequency and incisional myringotomy on the duration of patency

Radyofrekans ve insizyonel miringotominin miringotomi açıklık sürelerine etkileri

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**Objectives:** We investigated whether radiofrequency could prolong the patency of myringotomy.

**Materials and Methods:** Eighteen guinea pigs were enrolled in this study. Myringotomies were created by radiofrequency in the right ears in the study group using the ENTec coblator plasma surgery system, while the left ears had incisional myringotomies as the control group. After the myringotomies, the tympanic membranes were examined with otomicroscopy on the 5th, 7th, 10th, and 14th days. Closure times of the two groups were compared by the Mann-Whitney U-test.

**Results:** All the myringotomies were closed up to the tenth postoperative day. There was no significant difference between the two groups with respect to closure times.

**Conclusion:** Radiofrequency is a safe and minimally destructive method to perform a myringotomy, but it does not provide long-time patency.

**Key Words:** Middle ear ventilation; otitis media.

**Amaç:** Radyofrekansın, miringotomi açıklığını uzatabilme amaçlı kullanılabilirliği araştırıldı.

**Gereç ve Yöntem:** Bu çalışmada 18 guinea pig kullanıldı. Çalışma grubundaki miringotomiler sağ kulaklara radyofrekans ile yapıldı. Kontrol grubu olarak sol kulaklara insizyonel miringotomi yapıldı. Radyofrekans ile yapılan miringotomilerde ENTec koblatör plazma cerrahi sistem cihazı kullanıldı. Timpanik membranlar işlem sonrası 5, 7, 10 ve 14. günlerde otomikroskop ile incelendi. İki gruptaki kapanma süreleri Mann-Whitney U-testi ile karşılaştırıldı.

**Bulgular:** Bütün miringotomiler ameliyat sonrası onuncu güne kadar kapandı. İstatistiksel olarak iki grup arasında kapanma süreleri açısından anlamlı farklılık izlenmedi.

**Sonuç:** Radyofrekans, miringotomi için güvenilir ve minimal destrüktif bir yöntemdir, fakat uzun bir miringotomi açıklığı sağlayamamaktadır.

**Anahtar Sözcükler:** Orta kulak ventilasyonu; otitis media.

Otitis media with effusion (OME) is a pathologic condition of the middle ear in which an effusion is present behind an intact ear drum. The main symptom is a painless conductive hearing loss, varying in degree from mild to moderate. Most cases of middle ear effusion resolve spontaneously. Medical treatment is usually recommended as initial thera-

py. When this fails, ventilation tubes (VT) are placed. VTs are used to provide aeration of the middle ear and this procedure is the most frequent operation carried out during childhood periods.<sup>[1]</sup> VTs are highly effective for children with middle ear effusion, with most remaining free of middle ear disease while the tubes remain patent and function-

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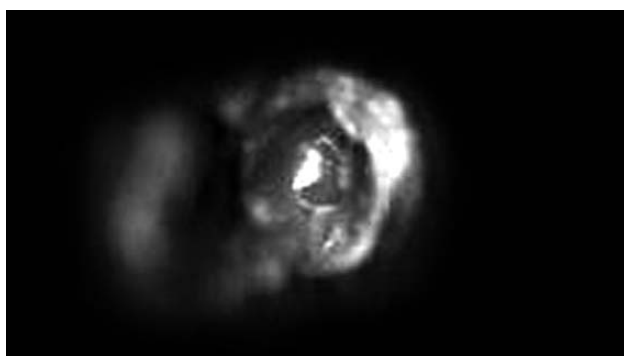
al.<sup>[2-3]</sup> Some conditions often require prolonged or permanent middle ear ventilation. Several different surgical procedures and VTs have been designed to provide prolonged ventilation of the middle ear. Unfortunately, each of these procedures carries with it a finite risk for long term complications including tympanosclerosis, tympanic membrane perforation, granulation tissue formation and associated hearing loss.<sup>[4-6]</sup>

Incisional myringotomy without tube placement is a therapeutic method but it closes within one to two days.<sup>[7]</sup> Long term maintenance of the formed perforations without inserting VT has become an important study subject for the authors, because of the short duration of the patency of the myringotomies and the high complication risk of the VT.<sup>[8]</sup> Due to these disadvantages, thermal and laser myringotomies are referred as alternative procedures to incisional myringotomy and VT insertion.<sup>[9-11]</sup>

The purpose of this study is to examine the duration of patency of the myringotomy created by RF and to determine whether it can be used for an alternative treatment method.

#### MATERIALS AND METHODS

The project was approved by the Animal Care and Use Committee of Haydarpasa Numune Education and Research Hospital. We performed the study in 18 healthy guinea pigs in the Kartal Education and Research Hospital between February and April 2004. All animals were kept under standard laboratory conditions and were given pelts and water ad without any vitamin restriction. The weight of the guinea pigs was approximately 750-1000 g. The animals were anaesthetized with ketamine hydrochlorur (50 mg/kg) intraperitoneally and isoflurane. After the



**Fig. 1.** ENTEC Coblator Plasma Surgery System and re-flex 45 probe.

anesthesia, the ENTEC Coblator Plasma Surgery System was used to perform the myringotomy of 1-1.5 mm diameter with 4 power grade to the right ear by using re-flex 45 coblator probe (Fig. 1). With the same probe, an incisional myringotomy was performed on the left ear without using the power unit. The myringotomies were performed on the antero-superior quadrant of the tympanic membranes similarly in both ears (Fig. 2). All myringotomies were performed with the aid of "Zeiss" operating microscope (Zeiss Opmi-pico, USA). After the myringotomies, the tympanic membranes were examined with otomicroscopy on the 5th, 7th, 10th, 14th days under brief isoflurane anesthesia. Myringotomy patency was recorded during each observation. The presence of otorrhea and crusting was also noted. The closure times of myringotomy sites of the study and control groups were evaluated statistically by the Mann-Whitney U-test.

#### RESULTS

Eighteen animals were enrolled in this study. Radiofrequency (RF) myringotomies were performed in the right ears and incisional myringotomies were performed in the left ears.

All of the myringotomies were patent on the fifth postoperative day.

Two tympanic membranes (11.1%) in the study group and three tympanic membranes (16.6%) in the control group were found to be closed on the postoperative seventh day ( $p>0.05$ ).

On the postoperative tenth day, all of the tympanic membranes (100%) in the control group were



**Fig. 2.** The myringotomies were performed on the anterosuperior quadrant of the tympanic membranes.

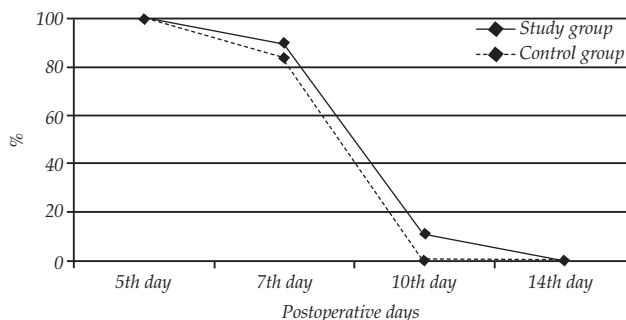


Fig. 3. Duration of patency of RF myringotomies and incisional myringotomies. Note the similarity of the two curves.

closed. In the study group 16 tympanic membranes (88.9%) were closed ( $p>0.05$ ).

The myringotomies that were patent in the study group had closed on the fourteenth postoperative day.

The healing curves for each group are plotted in fig. 3. No statistically significant difference was found between the study and control groups ( $p>0.05$ ) (Table I). On the postoperative fifth and fourteenth days, comparison between the two groups could not be done.

### DISCUSSION

Ventilation tubes have been very useful in the treatment of OME. The complications associated with tube insertion are; tympanosclerosis, tympanic membrane atrophy, chronic otorrhea, permanent perforation.<sup>[3-4]</sup> Many of these complications are not rare. Because of the complications associated with VT, several attempts to find alternative treatments have been made.

TABLE I  
THE NUMBER AND THE RATE OF THE HEALED MYRINGOTOMIES

Examination days	Study group		Control group	
	n	%	n	%
5th day	0	0	0	0
7th day	2	11.1	3	16.6
10th day	16	88.9	18	100
14th day	18	100	18	100

The comparison could not be done on the 5th and 14th postoperative days. On the 7th and 10th postoperative days; the difference of closure rates were not statistically significant between two groups ( $p>0.05$ ). (Mann Whitney U-test was used).

Lasers were advocated as an alternative procedure to VT insertion. In 1978, Lyons et al. experimented with CO<sub>2</sub> lasers in guinea pig ears.<sup>[10]</sup> Wilpizeski et al.<sup>[11]</sup> first used the CO<sub>2</sub> laser to perform myringotomies in squirrel monkeys. The perforations healed quickly in all experimental animals. Soderberg et al. made myringotomies with laser in rat tympanic membranes and found that the myringotomies were closed within two to three weeks.<sup>[7]</sup> DeRowe et al.<sup>[12]</sup> performed CO<sub>2</sub> laser myringotomies in guinea pig ears, varying the exposure energies and times. He noted dose dependent relationship between the total energy used and the duration of the patent myringotomy.

In 1982, Goode reported the first laser myringotomies in humans and described prolonged middle ear ventilation when compared with incisional myringotomy.<sup>[13]</sup> Silverstein reported that myringotomies of 1 to 3 mm in diameter created by laser in human tympanic membranes were closed within 3 weeks.<sup>[8]</sup>

Thermal myringotomy was used as another alternative procedure to VT. Lau et al. performed thermal myringotomy of 1 to 2 mm and they have seen that the myringotomies closed within one to three weeks.<sup>[9]</sup> Kent and Evans<sup>[14]</sup> performed thermal myringotomy in guinea pigs and they found that the myringotomies healed within six weeks.

The complication rate of thermal and laser myringotomies is lower than VT. But the prolonged patency duration of the myringotomies created by these methods is a question mark for the healing of the pathology in the middle ear.

The optimal duration of middle ear aeration for adequately treating chronic OME remains unknown, although Armstrong reported that two to three weeks of ventilation may suffice.<sup>[15]</sup>

Silverstein et al.<sup>[8]</sup> reported that the OME healed in 78% of their patients on whom they performed laser myringotomy. Lau et al.<sup>[9]</sup> reported that the patients treated by thermal myringotomy had a high recurrence rate of OME.

These data encouraged us to make an experimental study related with an alternative method to VT. Thus we performed the myringotomies with RF in guinea pig ears. When we searched the literature we only found one study in which the myringotomies were performed by RF.

ENTec Coblator Plasma Surgery System is an electro-surgical instrument with a voltage range of 96

to 312 voltage root-mean-square value at 100 Khz.<sup>[16]</sup> The instrument produces RF energy and makes minimal tissue destruction. It also produces a clean cut and decreased amount of bleeding because of its small coagulative effect.

In the previous study by Cakir et al. myringotomies were performed with RF in 30 guinea pigs and they found that perforations were closed within the time period of one week.<sup>[17]</sup> In our study we performed the RF myringotomies in 18 ears and we found that they were closed within seven to 10 days (10.33±2.27). Only two ears were closed at the fourteenth day and it was not significant statistically.

Clawson and Litton reported that incisional myringotomies closed within five to seven days in guinea pigs.<sup>[18]</sup> In our study the closure time of the incisional myringotomies was within seven to 10 days (9.5±1.15).

We found that there was no statistically significant difference between RF myringotomies and incisional myringotomies in the duration of the patency (p>0.05).

Cakir et al.<sup>[17]</sup> thought the reason of the faster closure time by RF than thermal and laser myringotomies was that RF does not cause carbonization and tissue destruction around the surgical site.

### CONCLUSION

Otitis media with effusion is the leading cause of conductive hearing loss in childhood. The goals of any surgical treatment for this disorder should include reversing conductive hearing loss, reestablishing normal middle ear ventilation and drainage, minimizing complications and reducing future recurrences.

For maintaining long time patency of the myringotomy, new methods should be searched. Radiofrequency can not be an alternative method to conventional incisional myringotomy for solving the problem in the middle ear although it provides a bloodless surgery area, gives minimal damage to the tissues and can be performed easily.

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