

## Original Article

# Role of Trichloroacetic Acid and Gelfoam in Closure of Tympanic Membrane Perforations

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### ABSTRACT

**Objective:** The aim of the study was to study the closure of dry central type of tympanic membrane perforations by chemical cautery and improvement of hearing, to analyse the effect of Gelfoam on nonhealing small tympanic membrane perforations, and to examine the relevance of conservative means of closure of tympanic membrane perforations as an office procedure. **Materials and Methods:** In this study, 100 patients attending the outpatient department were enrolled. Cautery of perforation margin was carried out with 50% trichloroacetic acid (TCA). After cautery, in small perforations less than 4 mm, a small piece of Gelfoam larger than the size of perforation was cut, impregnated with corticosteroid ointment, and carefully placed over the cauterized area under endoscopic visualization. In slightly larger perforations, that is, between 4 and 5 mm, after applying TCA to the margins of the perforation, a piece of Gelfoam larger than the size of perforation was soaked with corticosteroid ointment and placed in the middle ear cavity. **Results:** Patients had relief from various symptoms, such as tinnitus, heaviness, and so on. There was some amount of auditory improvement in almost all the cases. It ranged from 5 to 23 dB. **Conclusions:** Cautery and patching of tympanic membrane perforation may be considered as the first-line management in the small- to medium-sized perforations before attempting the surgical closure.

**KEYWORDS:** Cautery, Gelfoam, patching, trichloroacetic acid, tympanic membrane perforation

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## INTRODUCTION

Hippocrates (460-377 BC)<sup>[1]</sup> was the first to regard the tympanic membrane as a part of organ of hearing and described it as a dry, thin spun web. The tympanic membrane got its name from Gabriel Fallopius of Padua (1523-1562), who was the first to use the term “tympanum.” The tympanic membrane is frequently injured and the relative incidence of myringal lesions has been reported to range from 0.4% to 2.3% of all disorders of the ear.<sup>[2]</sup> Persistence of tympanic membrane perforation has long been a challenge to medical science. The central perforation can be divided into two groups on the basis of the causes: (1) traumatic and (2) inflammatory [Table 1].

A perforation in the tympanic membrane makes it very difficult for the sufferer to take part in

water sports. A person may be unfit for some skilled jobs such as air pilot or scuba diving if he or she is having a perforated drum.<sup>[3]</sup> For the closure of tympanic membrane perforation, a number of methods have been used.<sup>[4,5,6]</sup>

Surgical repair of the tympanic membrane using various types of tissue grafts<sup>[7]</sup> (e.g., skin, temporal fascia, and perichondrium) by various researchers by using various techniques is generally accepted. Cauterization helps in establishing the natural pattern of migration of epithelium of perforated tympanic membrane, hence helping to achieve healing.<sup>[8,9,11,12]</sup>

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Repeated cauterization<sup>[13]</sup> is required at the rim of the perforation to close it, which often results in a very thin atrophic scar due to thinning of the lamina propria from its normal thickness of 100  $\mu\text{m}$  to approximately 2-3  $\mu\text{m}$ .<sup>[14]</sup>

Different patching materials<sup>[7]</sup> have also been used for promoting healing of tympanic membrane perforation, for example, absorbable gelatin sponge was introduced.

Gelfoam is a denaturated porous gelatin sponge that is nontoxic and nonallergic.<sup>[6]</sup> The study of the closure of tympanic membrane perforation by repeated cautery with trichloroacetic acid (TCA) and Gelfoam (which is easily available) was carried out in our department.

## MATERIALS AND METHODS

This study was conducted among 100 patients attending the Outpatient Department of Otorhinolaryngology and Head and Neck Surgery, Government Medical College, Rajindra Hospital, Patiala, India. These patients had small- and medium-sized (up to 5 mm) dry central tympanic membrane perforations. A detailed history was noted and a functional examination was carried out. An approximate method was used to determine the size of the tympanic membrane perforation. A thorough cleaning of the external auditory meatus was performed, and a tiny scab or wax was carefully picked up from the meatus as well as tympanic membranes. For anesthesia, a cotton ball soaked in 4% xylocaine was applied in the external auditory canal and over the tympanic membrane.

### Cautery of perforation margin

Cautery of perforation margin was carried out using a 0° endoscope with 50% TCA. A small bead of cotton was tightly wound to the end of a fine metal applicator and moistened with TCA. The excess acid was removed from the applicator by touching it to an absorbent tissue paper or cotton. This acid application was carried out over the epithelial lining to retard epithelial progression and extend out upon epithelial meatal surface for a distance of 0.5-1 mm, producing a solid white eschar. The applicator tip was stroked over the edge of perforation in an inward to outward direction.

### Patching

After cautery, in small perforations less than 4 mm, a small piece of Gelfoam larger than the size of perforation was cut, impregnated with corticosteroid drops, and carefully placed over the cauterized area under endoscopic visualization. In slightly larger perforations, that is, between 4 and 5 mm, after applying TCA to the margins of the perforation, a piece of Gelfoam larger than the size of perforation was soaked

with corticosteroid ointment and placed in the middle ear cavity. Another Gelfoam pack was placed over the cauterized tympanic membrane in the ear canal, thus “sandwiching” the tympanic membrane.

Repeated cauterization, as described earlier, was carried out at weekly intervals for 7 weeks. After completion of the period, observations were made in regard to status of the tympanic membrane, any local complication and state of hearing.<sup>[10]</sup>

## RESULTS

Patients had varying degree of relief from various symptoms, such as tinnitus, heaviness, and so on. There was some amount of auditory improvement in almost all the cases. It ranged from 5 to 23 dB. The closure of a larger perforation led to a higher gain in hearing than that of a smaller perforation. Of 100 cauterized perforations, 76% were closed with an average of 4.1 applications (range was 1-7 applications) [Table 2].

1. Status of the tympanic membrane perforation, that is, whether there was
  - a) complete closure of perforation.
  - b) reduction in size of perforation.
  - c) persistence of perforation.

**Table 1: Comparison of etiology factors**

Name of the author	Total cases	Inflammatory		Traumatic	
		No.	%	No.	%
Derlacki (1953)	143	129	90.20	14	9.70
Sellars (1969)	23	21	93.30	2	8.60
Stenfors (1989)	15	7	46.66	8	53.33
Uppal (1997)	50	33	66	17	34
Santhi (2012)	38	30	78.9	8	21
Present study	100	72	72	28	28

**Table 2: Number of treatments (range and average) taken to close perforations**

Name of the author (year)	No. of treatment (range)	Average
Derlacki (1953)	2-64	14.6
Mitchell (1958)	-	4.25
Juers (1958)	-	4.2
Juers (1963)	2-20	3.7
Sellars (1969)	2-11	6.0
Uppal (1997)	1-6	2.8
Santhi (2012)	1-5	3.2
Parmar (2015)	1-23	4.8
Present study	1-7	4.1

**Table 3: Comparison of healing of present study with previous studies**

Name of author (year)	Method	Total cases	Healed	Percentage
Wright (1956)	50% Trichloroacetic acid, cotton patch, neomycin drops	65	57	88.0
Mitchell (1958)	50% Trichloroacetic acid, gelatin sponge soaked in autogenous blood	50	36	72.0
Juers (1958)	Marginal eversion. Cotton patch Boric acid in urea	15	10	66.0
Dragovich (1962)	50% of trichloroacetic acid Neosporin powder and cotton patch 5% urea and boric acid in isotonic saline	25	21	84.0
Juers (1963)	100% Trichloroacetic acid. Paper disk, urea–borofax ointment	33	29	88.0
Sellers (1969)	100% Trichloroacetic acid No patching	23	16	69.5
Stenfors (1989)	Hyaluronic acid	15	14	93.0
Uppal (1997)	100% Trichloroacetic acid. Surgical patching	50	39	78
Santhi (2012)	50% Silver nitrate. Thin sterile aluminum foil as patch	49	36	73.75
Parmar (2015)	20% Trichloroacetic acid Gelfoam piece moistened by antibiotic solution	144	102	70
Present study	50% Trichloroacetic acid with Gelfoam patching	100	76	76

d) recurrence of perforation after complete closure, if any.

- Any local complication(s) of the cauterizing agent was recorded.
- A repeat audiogram was conducted in cases with complete closure of perforation to compare the pre- and post-closure state of hearing.

## DISCUSSION

Although surgical closure is an extensively tried method of closing a central tympanic membrane perforation, yet hospitalization and expense and fear of operation make the closure by cauterization of perforation margins a favored method in the developing countries like India.

In the present series, the following prerequisites were a must for the cases to be selected for application:

- Central small- to medium-sized perforation (approximate size of less than 5 mm) of pars tensa with dry ear in which patch test showed improvement of level more than 10 dB
- Normal Eustachian tube function
- Normal cochlear function
- No active predisposing disease foci in nose and throat
- Age more than 15 years.

In the present study, 50% of TCA was applied to the entire margin of perforation using the 0 endoscope. In the series published by Dunlap and Schuknecht,<sup>[5]</sup> in the average case it took 6 months to 1 year for closure. Of 100 cases studied here, 28 cases were of traumatic origin and 72 cases of inflammatory origin.

## SUMMARY AND CONCLUSIONS

A total of 100 cases of varying age groups and both sexes presenting with small- to medium-sized (up to 5 mm) dry central tympanic membrane perforations were

enrolled for the study. Of 100 cauterized perforations, 76% were closed with an average of 4.1 applications (range was 1-7 applications). With the increase in the size of perforation, the average number of applications required was also higher. Healing was better observed in the younger age group of second and third decades (80% and 81.5%, respectively). The study concluded with a success rate of 76%.

Reviewing the various studies [Table 3], cauterization and patching of tympanic membrane perforation may be considered as the first-line management in the small- to medium-sized perforations before attempting the surgical closure. This study has led to the following conclusions:

- The smaller the perforation, the better the closure rate.
- Larger perforation may be reduced to a smaller one, thereby making surgical intervention easier.
- The healing rate was better in patients with traumatic perforation.
- Correction of primary etiological factors helps in achieving a better closure rate.
- Surgical complication of the middle ear can be avoided.
- It may be safely tried among patients who are under control and in whom surgical intervention is contraindicated.

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## Conflicts of interest

There are no conflicts of interest.

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