

Overlay Versus Underlay Type I Tympanoplasty with Various Graft Material: A Prospective Study



Medical science

KEYWORDS : Chronic suppurative otitis media, Tympanic membrane, Tympanoplasty, Autologous graft.

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ABSTRACT

Objective: To study various graft material properties like their strength, durability, availability and acceptability to the host. Comparison of surgical technique of myringoplasty onlay v/s underlay in relation to hearing improvement and graft take up rate. Material and method: Study was conducted in 90 patients and the demographic and clinical data were collected for success rate of type I Tympanoplasty for various graft material and onlay v/s underlay method. Result: In our study the mean average air-bone conduction gap is 28dB. we found that there is 96.66% graft taken up rate for Temporalis fascia and fascia lata, while for tragal perichondrium it is 93.33% and for vein graft it is only 73.33%. We found that out of 40 patients underwent onlay method in 37 patients graft was taken up which is 92.5% while those who underwent underlay method in 46 patients graft was taken up which is 92 %. Conclusion: Type I Tympanoplasty has a high rate of success in closing tympanic membrane perforations. In case of graft taken up rate and hearing improvement. Temporalis fascia, tragal perichondrium and fascia lata have same success rate. However, the surgeon should do what he/she is most experienced and successful with.

INTRODUCTION:

Hearing is one of the vital sensations and Deafness suspects the tranquility of life. When such a great vital sensation is lost, life naturally loses its charm. About 40% of patients who attend ENT outpatient department suffer from chronic suppurative otitis media. It is the single most common cause of conductive hearing loss in most of patients. There are many causes for tympanic membrane perforation. Majority of these are due to chronic suppurative otitis media and traumatic etiology.

The main stay of treatment for perforation remains surgical. The main goal of surgery includes eradication of the disease, prevention of recurrence and preservation or improvement of hearing. Myringoplasty and tympanoplasty are descriptive terms defining surgical procedures that address pathology of the tympanic membrane (TM) and middle ear. Surgery of the tympanic membrane dates back as far as the 17th century when Banzer (1640) described the first attempt at repair of a Tympanic membrane perforation with a pig's bladder. Since then, myringoplasty has gone through many changes in techniques and materials.

We have made our sincere effort to study which technique of myringoplasty is more beneficial and which graft material is best in their properties, with the available facilities in our institute.

MATERIAL AND METHOD:

A total of 90 patients with chronic otitis media (tubo-tympanic type) disease in inactive stage with TM perforation, between 15yr to 60yr of age, irrespective of their sex, who underwent type 1 tympanoplasty in the Department of ENT, civil hospital, Ahmedabad were studied in the period of two years between June 2010 and November 2012.

Inclusion criteria for study are: The patients with CSOM tubo-tympanic type with conductive hearing loss, Dry ear for at least one week, Age more than 15 yr and less than 60yr. Exclusion criteria are: Patients with mixed & sensorineural hearing loss, discharging ear, suspected ossicular disease and suspected cholesteatoma, marginal perforation, retraction pocket, patients who are not willing for the procedure.

Emphasis was laid on detailed history and through clinical examination, pre-operative finding and post-operative result.

A detailed proforma was filled for each patient with regard to history, clinical examination, investigations, surgical procedures, postoperative period & follow up visits. Audio-logical evaluation (pure tone audiometry) has been done preoperatively, 3months & 6months after surgery and the results are tabulated. After making definite diagnosis, treatment was given in form of type I tympanoplasty. With principles of surgery in mind surgical Procedure is followed.

The patient was premeditated half an hour prior to the procedure with 30mg Pentazocine, 25mg Phenargan and 0.6mg Atropine given intramuscularly if procedure was done in local anesthesia. All patients were placed in the supine position with the head partially rotated to the opposite side with 15°-30° head end elevation. The Postauricular infiltration with 2% Xylocaine with 1: 2, 00,000 adrenaline. The canal wall infiltration was done under microscopic guidance using a 2ml syringe with 26 gauge lever lock needle.

For the closure of Tympanic membrane perforation, following types of Grafts were used: Temporalis fascia, Fascia lata, Tragal perichondrium, Vein graft.

Post auricular Wilde's incision was used in our entire study. After elevating skin, subcu. and periosteum, post canal wall skin cut. Freshening of the perforation margins was done using a curved pick. The middle ear findings were noted. In overlay technique, the graft is placed lateral to tympanic annulus, and in underlay technique, the graft is placed medial to tympanic annulus.

The flap is repositioned to its original position and closure is done. Every patient must follow up on 7th day for suture removal, after 6 week, 3month and 6month.

Condition of graft on otoscopy and tuning fork test were noted. Pure tone audiometry was done at 3month and 6month. All results were collected, tabulated and analyzed.

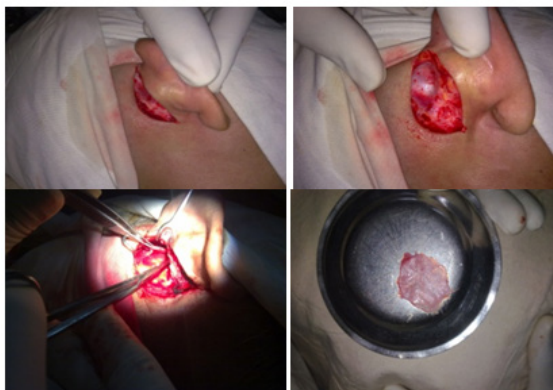


Fig 1.Steps for getting Temporalis fascia graft

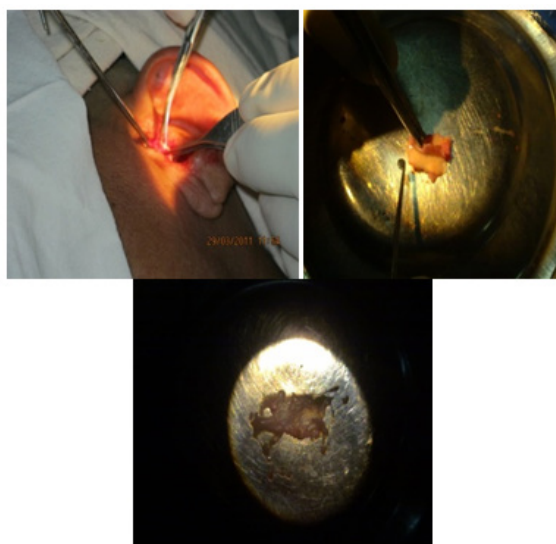


Fig.2 Steps for getting Tragal perichondrium graft.

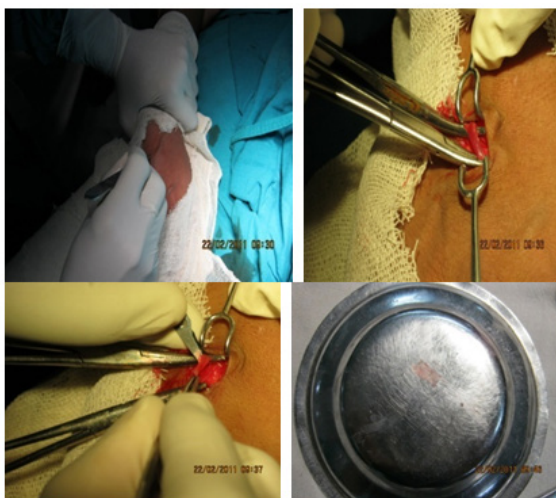


Fig.3 Steps for getting Vein graft.



Fig.4 Steps for getting Fascia lata graft.

RESULT:

This is about a series of ninety patients having chief complain of ear discharge and decreased hearing who had undergone type I tympanoplasty. The main observation in this study is documented as follows:

In our study most common age affected was 21-30yrs. The mean age of presentation was 33.33yrs.with infective etiology was the most common cause.

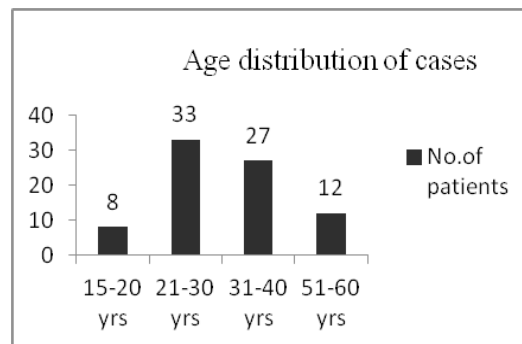


Fig.5 Age distribution of cases

In our study male predominance 63.33% was observed. Same observation detected by Okafor in which there was male predominance of 60%. However there is no such reference to predominance for any sex reported in standered text-book. This could be a statistical artifact due to small sample size.

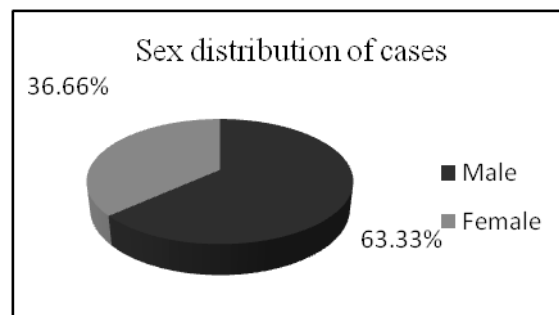


Fig.6 sex distribution of cases

In our study commonest symptoms was Otorrhea seen in 96.66% of patients. There was an 83.33% incidence of associated hearing impairment.

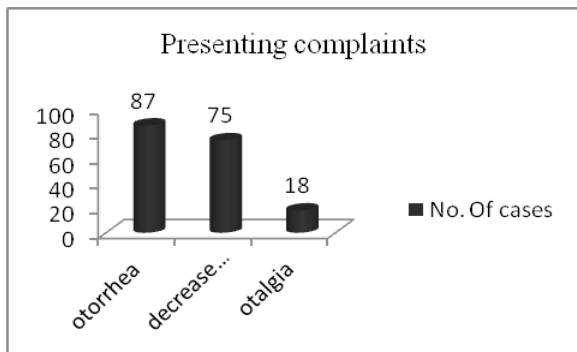


Fig.7 presenting complaints

Majority of patients having duration of otorrhea of about 1-5yrs. There is also a group of patients having duration of more than 10yrs (18.88%). Major reason behind this is lack of awareness, patients attending govt. hospital coming from low socio-economic class.

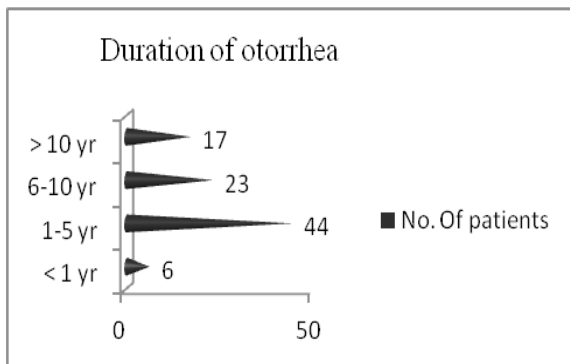


Fig.8. duration of otorrhea.

In our study most of the patients had unilateral disease. About 37.77 % of patients had both ear involvements simultaneously.

Table no.1 Ear involvement

Ear	No. of cases	Percentage (%)
Unilateral	56	62.22
Bilateral	34	37.77

On otoscopic examination majority of patients (48.88 %) have large central perforation and associated average hearing loss for them is 36dB. The mean average air- bone conduction gap is 28dB. All patients have conductive hearing loss. Above finding suggest that due to tympanic membrane perforation there is loss of area ratio, decreased ossicular lever effect and cancellation of phase effect leading to loss of hearing which is directly proportional to size of perforation.

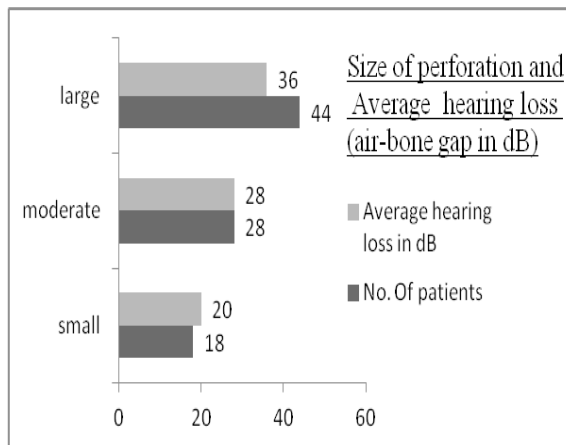


Fig.9.relation between size of perforation and average hearing loss.

An intact graft with closure of perforation and air-bone conduction gap less than 20dB on post operative pure tone audiometry was considered a success.

In our study we found that there is 96.66% graft taken up rate for Temporalis fascia and fascia lata, while for tragal perichondrium it is 93.33% and for vein graft it is only 73.33%. In our study we found that out of 40 patients underwent onlay method in 37 patients graft was taken up which is 92.5% while those who underwent underlay method in 46 patients graft was taken up which is 92 %.

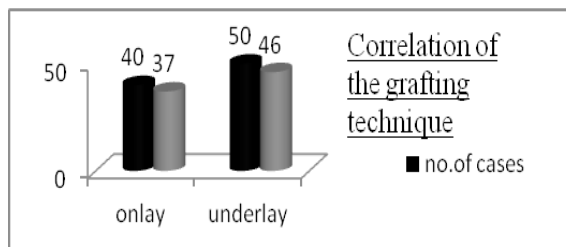
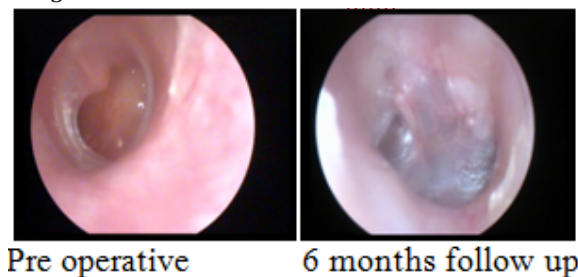
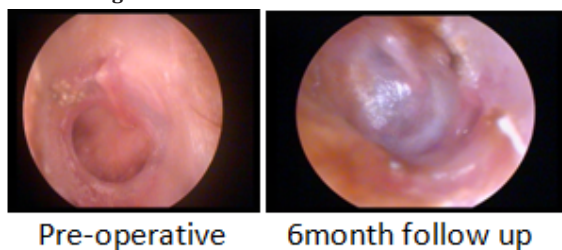
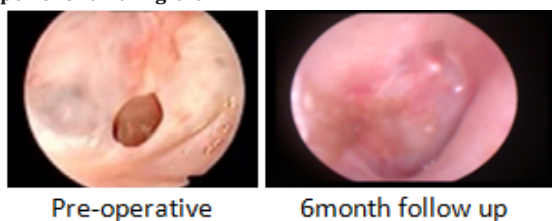


Fig.10. Grafting technique and graft taken up rate.

Out of 37 patients in whom graft was taken up who underwent onlay technique 34 patients (91.89 %) showed post operative average air-bone gap <20 dB. Out of 6 patients in 3 graft was not taken up while in 3 patient there was lateralization of graft. While out of 46 patients in whom graft was taken up who underwent underlay technique 46 patients (100%) showed post-operative air-bone gap <20dB at 6 month follow-up. In 4 patient graft was not taken up.

For Temporalis fascia out of 30 patient, 28 patients shows post-operative average air-bone gap <20dB. Out of 2 patient in one graft was not taken up while in other there was lateralization of graft. For fascia lata out of 30 patient 27 patients showed hearing improvement, post-operatively at 6 month follow-up. Out of 3 patient in one graft was not taken up while in other two there was lateralization of graft occur. For vein graft in 4 patient there was not taken up and hearing improvement occur in rest of the 11 patient. For tragal perichondrium in 1 patient graft was not taken up and hearing improvement occurs in rest of the 14 patient.

Fig. 11. Pre & post operative otoscopic finding for fascia lata graft.**Fig. 12. Pre & post operative otoscopic finding for Temporalis fascia graft.****Fig. 13. Pre & post operative otoscopic finding for Tragal perichondrium graft.****DISCUSSION:**

Chronic suppurative otitis media is still a major problem in our country. Tympanic membrane(TM) perforations lead to recurrent ear infections and hearing loss.

In this study with 90 patients who underwent type I tympanoplasty for COM, tubotympanic disease, the age distribution included maximum patients in the age group 21-30 yrs with 36.66% followed by (30%) 31-40yrs. The mean age was 33.33 yrs. Observation detected by other investigator is tabulated below which was comparable with our study, suggested that COM is present in majority of young and adult patients.

Table no.2 mean age in years.

Investigator	Mean age in years
Sirena E. et al ^[4]	33.33
Okafor et al ^[5]	27
Sapci T.et al ^[6]	30
In our study	33.33

The sex distribution was males 63.33% (n=57) and females 36.66% (n=33). The common symptoms in patients who presented with COM, tubotympanic disease as seen in this study were Otorrhea (96.66%) and hearing loss (83.33%). Other less common symptoms were tinnitus, earache (22.5%) and giddiness or vertigo (2%).

Costa SS and colleagues' and other observer mention in table; in their study found that the major symptom in Non chole-

steatomatous COM patients is intermittent otorrhea, usually associated to upper airway infections or a past history of extrinsic contamination, painless, without giving off foul smell, together with hearing loss.

Table no.3 major presenting complain

Investigator	Major presenting complain
Sirena E. et al ^[4]	Otorrhoea
Okafor et al ^[5]	Otorrhoea
Costa ss and colleagues ^[7]	Otorrhoea
In our study	Otorrhoea

In our study 62.22% (n=56) of patients have unilateral diseases while in 37.77% (n=34) of patients have bilateral disease, observation of other investigator were tabulated below which show that around 30-35% of patients have bilateral diseases suggested upper airway infections plays major role apart from other etiology of tympanic membrane perforation like traumatic and iatrogenic.

Table no.4 ear involvement

Investigator	Ear involvement	
	Unilateral	bilateral
Okafor et al ^[5]	55.7%	44.3 %
In our study	62.22 %	37.77 %

Traumatic causes of TM perforations include blunt and penetrating trauma, barotraumas, acoustic injury, blast injury, and thermal injury. Iatrogenic causes of TM perforations include myringotomy and myringotomy with tube placement, cerumen removal. Nichols et al. found that 40% of patients with retained tubes longer than 36 months had persistent TM perforations versus 19% of patients with tubes less than 36 months. The overall rate of spontaneous healing of traumatic TM perforations is approximately 80% (Kristensen, 1992).

The middle ear couples sound signals from the ear canal to the cochlea primarily through the action of the tympanic membrane and the ossicular chain. The major transformer mechanism within the middle ear is the ratio of the tympanic membrane area to the stapes footplate area (the areal ratio).

Perforations of the tympanic membrane cause a conductive hearing loss that can range from negligible to 50dB. Perforations cause a loss that depends on frequency, perforation size, and middle ear air space volume^[1,2]. Perforation-induced losses are greatest at the lowest frequencies and generally decrease as frequency increases. Perforation size is an important determinant of the loss; larger perforations result in larger hearing losses as shown below in table.

Table no.5 Mean hearing loss and size of perforation

investigator	Mean hearing loss and size of perforation		
Okafor ^[5]	Small	21.85 %	11.5 dB
	Moderate	11.47 %	19.2 dB
	large	66.66 %	25.3 dB
In our study	Small	20 %	20 dB
	Moderate	31.11 %	28 dB
	large	48.88 %	36 dB

Table no.6 Mean hearing loss (air-bone gap)

Investigator	Mean hearing loss (air-bone gap) in dB
Mawson ^[8]	<50 dB
Beales ^[9]	25-40 dB
Payne MC and githler FJ ^[10]	25dB
Glasscock and shambaugh ^[11]	20-45dB
In our study	28dB

The volume of the middle ear air space combined tympanic cavity and mastoid air volume is also an important parameter that determines the amount of hearing loss caused by a perforation; small middle ear air space volume result in larger air-bone gaps. Hence, the trans -tympanic membrane sound pressure difference will be smaller (and the conductive loss correspondingly greater) with smaller middle ear volumes. Identical perforations in two different ears can have conductive losses that differ by up to 20to 30 dB if the middle ear air space volumes differ substantially.

When large portions of the tympanic membrane are lost or when chronic or recurrent infections occur, the perforation may become permanent. In these cases, the tympanic membrane must be repaired.

In 1965, the American Academy of Ophthalmology and Otolaryngology Subcommittee on conservation of Hearing set forth a standard classification for surgery of chronic ear infection and defined tympanoplasty as "A procedure to eradicate disease in the middle ear and to reconstruct the hearing mechanism, with or without tympanic membrane grafting"^[3]. Myringoplasty is defined as "An operation in which constructive procedure is limited to repair of a tympanic membrane perforation".

Marcus Benzer(1640) the first known documented account of covering ear drum perforation by use of a piece of pig's bladder. After that many graft material were used for covering perforation. We use fascia lata, Temporalis fascia, tragal perichondrium and vein graft for covering perforation and success rate for graft taken up of our study was compare with other study as below,

Table no.7

STUDY	Temporalis fascia %	Tragal perichondrium %	Vein graft %	Fascia lata %
Vartiainen E et al ^[12]	88	-	-	-
Sheehy et al ^[13]	97	-	-	-
Dornhoffer J ^[14]		97.6	-	-
Goodhill et al ^[15]		88	-	-
Shee JJ & Tabb HG ^[16]	-	-	70	-
In our study	96.66	96.66	73.33	93.33

Above table show that for Temporalis fascia, tragal perichondrium and fascia lata have almost same success rate while for vein graft; graft taken up rate was quite low. Major advantage and disadvantage of various graft material we use cited below:

Table no.8

Autologous Graft material	
Temporalis fascia	• Ease of harvest from the same incision • Availability of a large amount • Low basal metabolic rate • Same tensile strength as tympanic membrane • Ease of handling, • Subject to shrinkage
Fascia lata	• Available in larger quantity • Post operative contraction less • Available for revision surgery • Separate incision • Post-operative pain and wound gaping • Difficult to obtain in fatty people
Tragal perichondrium	• From cosmetic aspect it is good • Less post operative pain • Easy to manipulate • Good survival capacity • Not available in large quantity • Not available for revision cases
Vein graft	• Non keratinizing property of the epithelium. No chance of iatrogenic cholesteatoma. • Separate incision, Difficult to handle, • Not available in larger area • Disadvantage of curling and prolapsed into middle ear

Two basic grafting techniques have emerged, referred to as the overlay and underlay techniques. In our study graft taken up rate for onlay method was 92.5% while for underlay method it was 92% which is almost same, but we found that in Overlay Technique pros: good exposure of anterior meatal recess, , no reduction of ME space and applicable to all cases cons: more demanding, lateralization and blunting of TM, longer healing time. While for Underlay Technique pros: ideal for small, easily visualized perforations, faster, easier, avoids lateralization and blunting. Cons: poorer visualization of anterior meatal recess, reduction in ME space, increased failure when graft bed side reduced (in large anterior perforation). Our finding was comparable with other investigator;

Table no.9

Investigator	Grafting technique and taken up rate (%)	
	Onlay	Underlay
Sheehy and Anderson ^[17]	97	-
Packer et al ^[18]	88	87.5
Gibb and chang ^[19]	76	87.5
Rizer ^[20]	95.6	88.8
Singh ^[21]	93.3	93.3
In our study	92..5	92

Regarding success in hearing improvement for both types of technique and with various graft materials we use suggested that any of technique use and with various graft material, all have good acceptable result (PTA average <20db after 6 month) provided that graft must be taken up and not perforated and lateralized. This finding suggested that neither graft material nor technique affect in hearing improvement success. Observation detected by other investigator as shown in below table also support above findings.

Table no.10

Author	Technique	Graft take up rate %	Post operative PTA-ABG
Vartiainen et al ^[12]	Onlay & underlay	88	<25 dB in 87 %
Our study	Onlay & underlay	92.25	< 20 dB in 94.5 %

CONCLUSION:

Myringoplasty as a treatment procedure for perforation of tympanic membrane is an established surgery. Type I Tympanoplasty has a high rate of success in closing tympanic membrane perforations and improving hearing without any complication. Patients should be chosen carefully based on the indications discussed and attempts at attaining a dry ear prior to surgery should be made. Patients should be thoroughly counseled preoperatively about the expectations and goals of the surgery. Overlay techniques for grafting is effective in form of graft taken up rate while for underlay technique, post operative healing rate and hearing improvement better than onlay technique. however, the surgeon should do what he/she is most experienced and successful with. Autologous graft material are most commonly used. Among them Temporalis fascia is most commonly use. Fascia lata and tragal perichondrium are next most commonly used graft material. In case of graft taken up rate and hearing improvement: Temporalis fascia, tragal perichondrium and fascia lata have same successes rate, while autologous vein graft has poor success rate particularly for graft taken up rate. . So at the end selection criteria of graft material should include patient factor (gender, history of previous operation),characteristic of perforation and surgeon preference.

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