

The Effect of Balloon Eustachian Dilatation in Patients with Eustachian Tube Dysfunction. A Case-Series from a Tertiary Care Hospital in Greece

Abstract

Background: Eustachian tube dysfunction (ETD) is a common otological condition characterized by impaired ventilation, pressure regulation, and clearance of secretions within the middle ear. There is no gold standard diagnostic tool for this condition; Otoscopy and tympanometry are used to assess ear pressures. Subjective symptom severity is evaluated using the Eustachian tube dysfunction questionnaire-7 (ETDQ7). Objective assessment of Eustachian tube opening is performed using tubomanometry (TMM), which provides a quantitative measure of tube function. Conventional medical management, including decongestants, antihistamines, intranasal corticosteroids, and auto-inflation techniques, often provides only limited or temporary relief, especially in refractory cases. Balloon dilatation has emerged as a minimally invasive intervention for the treatment of obstructive ETD. **Objective:** To evaluate the efficacy of balloon eustachian dilatation in patients with ETD. **Method:** This was a retrospective study of 13 patients with ETD who underwent balloon dilatation and were evaluated pre and post operatively by using TMM and by completing ETDQ7 questionnaires. **Results:** 54% underwent unilateral procedures and 46% bilateral dilatation. An improvement in the ETDQ7 was noticed in our patients post operatively. The R value on TMM had a mean score of 1.39 and post operatively all of our patients R score was normalised. **Conclusion:** In conclusion, our study has shown the subjective and objective effectiveness of balloon dilatation. Balloon dilatation is a promising tool for treating ETD. However, further research needs to be carried out to see the long-term efficacy of dilatation in ETD population.

Keywords: Eustachian Tube, Dysfunction, Balloon Dilatation, Eustachian Tube Dysfunction Questionnaire-7

Review Article

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Introduction

Eustachian Tube Dysfunction (ETD) is a common otological condition characterized by impaired ventilation, pressure regulation, and clearance of secretions within the middle ear [1]. Patients typically present with symptoms such as aural fullness, otalgia, hearing impairment, tinnitus, and, in some cases, recurrent otitis media or persistent middle ear effusion [2]. These symptoms can significantly affect quality of life, particularly in patients with chronic or severe disease [3]. Conventional medical management, including decongestants, antihistamines, intranasal corticosteroids, and auto-inflation techniques, often provides only limited or temporary relief, especially in refractory cases [1,4].

Balloon dilatation has emerged as a minimally invasive intervention for the treatment of obstructive ETD [4,5]. The procedure involves trans nasal insertion of a balloon catheter into the cartilaginous portion of the Eustachian tube, followed by controlled inflation to dilate the lumen [6]. Proposed mechanisms include reduction of mucosal inflammation, disruption of submucosal fibrosis, and improvement of mucociliary clearance [4,7]. Furthermore, balloon dilatation may facilitate structural remodelling of

the Eustachian tube, potentially resulting in sustained functional improvement [5].

Recent studies, including randomized controlled trials and systematic reviews, have reported favourable outcomes following balloon dilatation [5,8]. Improvements have been observed in both subjective symptom scores and objective measures such as tympanometry and audiometry [8]. Patients frequently report relief from pressure-related symptoms and demonstrate improved middle ear ventilation after the procedure [6]. In addition, balloon dilatation has been shown to have a favourable safety profile with a low rate of complications, making it an attractive alternative to more invasive procedures such as tympanostomy tube insertion [9]. Importantly, balloon dilatation targets the underlying pathophysiology of ETD rather than providing symptomatic relief alone, suggesting the potential for longer-term benefit [10].

Despite these promising findings, the available evidence remains heterogeneous, and several questions persist regarding the optimal use of balloon dilatation [5]. Variability in study design, patient selection, and outcome measures limits comparability across studies [9]. The efficacy of balloon dilatation in different subtypes of ETD, including chronic obstructive and baro-challenging induced dysfunction, has not yet been fully established [6]. Additionally, uncertainties remain regarding the long-term durability of treatment outcomes and the potential need for repeat procedures [8].

This case series aims to evaluate the clinical outcomes of balloon dilatation in patients with ETD by assessing both subjective symptom improvement and objective audiological parameters [8]. By contributing further clinical data, this study seeks to clarify the role of balloon dilatation in the management of ETD and support the development of standardized treatment strategies for this challenging condition [10].

Methods

This retrospective study was conducted at the 1st Department of Otolaryngology of AHEPA University Hospital and included 13 adult patients diagnosed with Eustachian tube dysfunction (ETD). The study aimed to evaluate the functional outcomes of Eustachian tube balloon dilatation over a period from 2019 to 2026.

Eligible participants were adults over the age of 18 who presented with symptoms consistent with ETD for a

duration exceeding two months, as assessed using the Eustachian Tube Dysfunction Questionnaire-7 (ETDQ-7). Only patients without a history of previous otologic surgery were included. Exclusion criteria comprised patients with nasal obstruction due to conditions such as adenoid hypertrophy or nasopharyngeal malignancy, presence of cholesteatoma, tympanic membrane perforation, or inability to undergo general anaesthesia. All patients were informed in detail about the purpose and methodology of the study, and written informed consent was obtained prior to inclusion.

Patients were considered for Eustachian tube balloon dilatation after failure of conservative management, defined as persistence of symptoms despite at least one month of treatment with intranasal corticosteroids.

A comprehensive pre-operative assessment was performed in all patients. This included detailed medical history taking and otolaryngological examination, as well as objective and subjective measures of Eustachian tube function. Audiological evaluation consisted of pure-tone audiometry and tympanometry. Additionally, Eustachian tube function was assessed using TMM. Flexible nasal endoscopy was carried out to visualize the nasopharynx and assess the anatomical patency of the Eustachian tube orifice.

Subjective symptom severity was evaluated using the ETDQ-7 questionnaire, a validated tool consisting of seven items that assess symptoms such as ear pressure, pain, hearing loss, and discomfort [11] (Table 1). Each item is scored on a Likert scale, and higher scores indicate more severe dysfunction. A score of more than 2.1 is indicative of eustachian tube dysfunction.

Objective assessment of Eustachian tube opening was performed using TMM, which provides a quantitative measure of tube function. The primary parameter recorded was the R-value, representing the latency of Eustachian tube opening in response to applied pressure. An R-value of less than 1 was considered indicative of normal function, whereas an R-value greater than 1 suggested impaired Eustachian tube opening [12].

All procedures were performed under general anaesthesia as day-case surgeries. Using a zero-degree endoscope that was used intranasally to visualise the opening of eustachian tube and then a balloon catheter measuring 5–7 mm in diameter was introduced trans nasally into the Eustachian tube under endoscopic guidance. The

balloon was inflated to a pressure of 10 atmospheres and maintained for a duration of 2 minutes to achieve mechanical dilatation of the cartilaginous portion of the tube.

Postoperatively, patients were followed up in the otology outpatient clinic with a mean follow up time of 16 months. Follow-up evaluation included repeat TMM to assess changes in Eustachian tube function and re-administration of the ETDQ-7 questionnaire to evaluate subjective symptom improvement.

1. Pressure in the ears
2. Pain in the ears
3. Feelings that ears are under water
4. Ear problems when having cold
5. Poppings sounds ears or crackling
6. Ringing ears
7. Muffled hearing

Table 1. ETDQ-7. (scale 0-7, 0=no issue, 7= severe issue).
Scoring scale (1-2 -mild, 3-5 moderate, 6-7 severe).

The aim of the study was to evaluate the efficacy of patient with ETD after balloon dilatation post operatively.

Results

A total of 13 patients who met the inclusion criteria for Eustachian tube dysfunction (ETD) were enrolled in this study. The age of the study population ranged from 22 to 87 years, with a mean age of 42 years, reflecting a broad adult demographic. Both sexes were represented, with 6 female patients (46%) and 7 male patients (54%), indicating a relatively balanced gender distribution.

In terms of laterality of disease and intervention, 7 patients (54%) underwent unilateral Eustachian tube balloon dilatation, while the remaining 6 patients (46%) underwent bilateral procedures. The procedure was performed successfully in all cases, and notably, no intraoperative or postoperative complications were recorded. There were no reported cases of bleeding, infection, or adverse anaesthetic events, supporting the safety and tolerability of the technique within this cohort. Patient-reported symptom severity was assessed using the Eustachian Tube Dysfunction Questionnaire-7 (ETDQ-7). Preoperatively, the mean ETDQ-7 score across the cohort was 5.25, consistent with moderate to severe symptom burden. Postoperative follow-up

showed that the mean score decreased to 3.4. This represents an approximate 35% reduction in symptom severity, indicating an improvement in patients' subjective perception of their condition.

The reduction in ETDQ-7 scores was observed consistently across most patients, suggesting a uniform benefit of the intervention in alleviating common ETD-related symptoms such as aural fullness, pressure, discomfort, and hearing impairment. Although individual variability in response was noted, the overall trend demonstrated a clear shift toward symptomatic relief following balloon dilatation. However, 5 of our patients did not show any improvement in the ETDQ7 scores post operatively. One of them had tinnitus postoperatively in her right ear; that was due to her reduction of hearing (70db) that was unchanged postoperatively at 8 kHz. Another patient had same ETDQ7 score pre and post operatively as he also had nasal polyps' recurrence and his eustachian tube symptoms were unchanged after his balloon dilatation. One of the patients felt that her symptoms resolved in the first month post operatively and then relapsed afterwards; and one of the patients had autophony postoperatively and bilaterally had pre and post operatively mild presbycusis. These findings are illustrated in Figure 1.

Objective assessment of Eustachian tube function was performed using Tubo manometry, with the R-value serving as the primary quantitative parameter. Preoperatively, the mean R-value was 1.39, which is indicative of delayed or impaired Eustachian tube opening. Following balloon dilatation, the mean R-value decreased to 0.73 representing a 47% improvement in Eustachian tube function.

Importantly, postoperative R-values were below the threshold of 1 in all evaluated cases, indicating normalization of Eustachian tube opening function across the entire cohort. This suggests that balloon dilatation not only improved function but restored physiological opening dynamics in most treated eustachian tubes.

The improvement in objective measurements correlated well with the observed subjective symptom relief, supporting the clinical effectiveness of the intervention. The combined findings from ETDQ-7 and TMM demonstrate both functional and symptomatic benefits of Eustachian tube balloon dilatation in patients with persistent ETD.

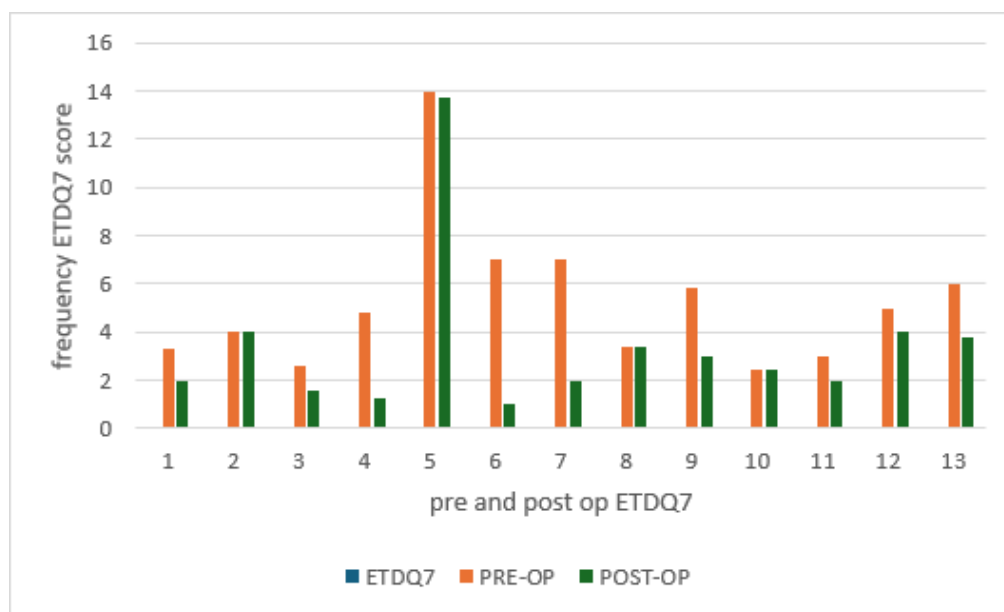


Figure 1. Outcome of ETDQ7 scores pre and post operatively showing improvement of patient's symptoms.

Discussion

Eustachian tube dysfunction (ETD) is a condition due to failure of ventilation and pressure equalisation function that comprises of several symptoms such as aural fullness, ear discomfort, reduced hearing, popping noises and has a prevalence in the adult population of 1% [13]. ETD is difficult to diagnose as well as challenging to treat. There is no gold standard investigation to make a diagnosis of ETD. Traditional clinical assessment involves taking a history, physical examination such as otoscopy, Valsalva manoeuvre. However, a study has shown that clinical assessment alone is insufficient to make a diagnosis of ETD [14].

Tympanometry remains the cornerstone of ETD diagnosis. However, it only provides a snapshot of middle ear status and may miss fluctuating dysfunction of eustachian tube [15,16].

TMM was first described in 2001 which is another diagnostic test for ETD. This is a non-invasive objective test that records the pressure changes that occur through a nasal applicator during swallowing with the help of a probe that is inserted into external auditory canal. The main purpose of this test is to measure the delay between the delivery of the pressure in the nose and the opening of eustachian tube [17].

From a diagnostic point of view, TMM in comparison to

tympanometry has a greater accuracy in the diagnosis of ETD with high sensitivity of 91.7% even with patients who present with a normal tympanogram [18].

In 2012, the ETDQ7 was introduced for quantitative assessment of ETD [19]. It is a reliable method by which symptoms severity can be assessed and improvement post treatment can be quantified [19]. Throughout the years, this questionnaire has been translated into various languages including Greek [20].

The main contribution of our study has shown that the combination of ETDQ-7 questionnaire and TMM is the establishment of a diagnostic approach in eustachian tube dysfunction.

Our current data set demonstrates an improvement of ETDQ7 scores in 67% of our patients post operatively. Similar results were evident from a recent publication in 2026 where ETDQ7 scores improved significantly 6 weeks post balloon dilatation of eustachian tube [21]. Another study in Australia showed that the mean ETDQ7 score post balloon dilatation 6 months afterwards was 3 (in our study was 3.4) [22]. In addition, a randomised control trial study showed a significant improvement in ETDQ7 scores post balloon dilatation with a mean score of 2.9 six weeks post treatment. The only difference to our study was that the dilatation of ET was carried out in the office under local anaesthetic in most of their cases [8].

In our study there were five patients that did not show any changes in their ETDQ7 scores. Similar studies such as Cheng et al showed 2 of their cases that had an unchanged ETDQ7 scores and 9 cases had worsening of their symptoms [23]. In addition, a recent study showed unchanged ETDQ7 scores in 16% of their cases and 4% showed worsening of their symptoms post dilatation [24]. Therefore, not every patient with ETD is symptom free post procedure.

In our study, TMM R values improved in all our cases post operatively. This signifies the effectiveness that balloon dilatation had in our patients. Similar results were shown in another study by Holm et al where R values improved post treatment with balloon dilatation with 58.8% patients satisfaction [25]. A study has also shown that after balloon dilatation there was an improved function on TMM in 81% of cases and the procedure was well tolerated [26]. In addition, a study in 2020 also showed a significant reduction of ET opening pressure 4 weeks after intervention [27].

The management for eustachian tube dysfunction has many controversies and there is no gold standard treatment for that. A recent meta-analysis found that intranasal corticosteroids are ineffective for chronic management of ETD [28]. Grommet insertion on the other hand may be offered; however, the grommet insertion tends to be less effective than in children [29]. Balloon dilatation that involves the cartilaginous portion

of eustachian tube has demonstrated that it is a safe and efficacious procedure but its potential for its management strategy remains sceptical. Reported complications of this procedure include surgical emphysema, patulous eustachian tube, minor bleeding, and transient tinnitus [30].

Balloon dilatation has shown good results in many studies in managing patients with ETD [3,5,6,22,26,31]. Balloon dilatation may lead to clinically meaningful improvement in ETD compared to non-surgical or no treatment up to 3 months. The effects of balloon dilatation treatment beyond 3 months are questionable [32].

The limitation of this study is that it included a small sample size and the lack of control study group. The pre-operative and post-operative results were not statistically validated. Finally, the study was carried out in a single-centred setting.

Conclusion

In conclusion, our study has shown the subjective and objective effectiveness of balloon dilatation. Balloon dilatation is a promising tool for treating ETD across Europe and other countries. Future research needs to be carried out, such as randomised control trial with a larger group to be collected, to observe the effects of balloon dilatation in practice so to address the controversies of balloon dilatation and the efficacy of diagnostic tools for eustachian tube dysfunction.

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