Results of Laser-Assisted Curvature Inversion Technique for Patulous Eustachian Tube: 5-year follow-up study

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Background

The Eustachian tube (ET) is a complex structure, with its lumen and valve surrounded by cartilage, muscles, fat, and fluid-coated mucosa. Normally, the valve remains closed at rest and opens during swallowing or yawning to ventilate and protect the middle ear, with closure aided by the elastic recoil of the tubal cartilage. Symptomatic persistent patency of the valve, known as patulous Eustachian tube dysfunction (PETD), is typically caused by an abnormal concavity in the mucosal valve that prevents proper closure. This condition leads to troublesome autophony of one's own voice and breathing. Patients may also experience hearing changes and, rarely, vestibular symptoms due to abnormal pressure transmission to the middle and inner ear. Diagnosis is based on symptoms and confirmed by observing tympanic membrane excursions during regular or forced nasal breathing under otomicroscopy, as well as by endoscopic visualization of the concavity in the anterolateral wall of the tubal valve. Various techniques have been described,; however, results have been inconsistent.

The laser-assisted curvature inversion technique (CIT) was introduced over a decade ago to address PETD by modifying the curvature of the cartilaginous superstructure of the medial aspect of the ET to favor the tube's resting collapsible forces, thereby achieving more efficient closure of the valve **(Yanez et al)**. Short-term results have been promising, but long-term efficacy has not been established.

Objectives

To assess the 5-year outcomes of the CIT technique in patients with PETD.

Study Design

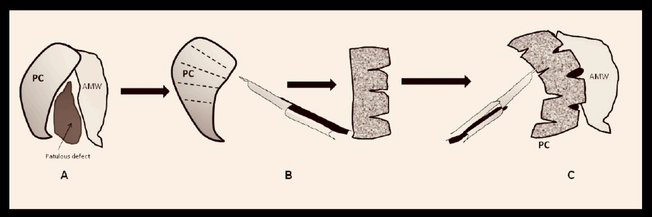
Retrospective case series

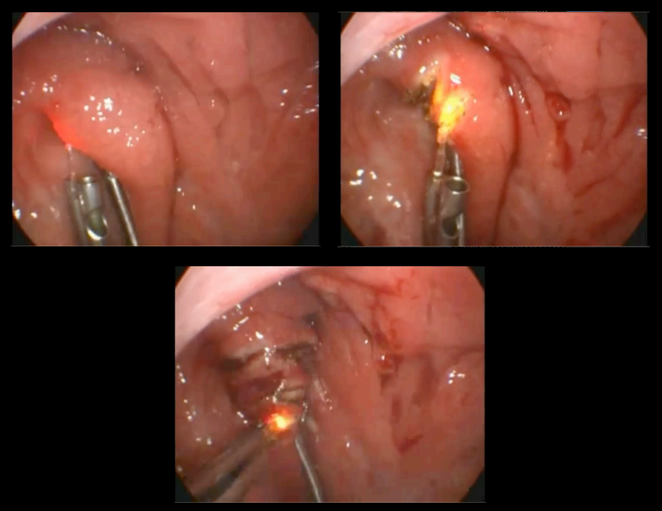
Methods

Fifteen patients with PETD underwent CIT of the ET, as previously described. A KTP laser was used to create non-coalescent full-thickness and medium-thickness incisions along the medial aspect of the posterior cushion, modifying the cartilaginous contour and altering the tube's intrinsic spring mechanism. This adjustment reorients the cartilage to facilitate closure of the patulous gap while preserving normal muscular function. The ET was evaluated pre- and postoperatively using simple and slow-motion endoscopy. Patients were also assessed for pre and post PETD signs and symptoms, including voice and breathing autophony, abnormal tympanic membrane excursions, audiometry and breathing-synchronous tympanometric outcomes. None of the patients had concurrent ear disease or had undergone additional surgical procedures.

Results

Fifteen patients (8 males, 7 females; mean age 42.0 years) who underwent CIT for PETD between January 2019 and February 2024 were studied. All patients had breathing and voice autophony and abnormal tympanic membrane excursions with forced nasal breathing. Following CIT, nasal breathing autophony improved in 13 of 15 patients (86.6%), and voice autophony improved in 11 patients (73.3%). Postoperative evaluation confirmed inversion and medial narrowing of the posterior cushion, with the valve assessed to appear less open on both simple and slow-motion endoscopy. No surgical complications were observed. On otomicroscopy, tympanic membrane excursions with force nasal respiration resolved in 13 of 15 patients (86.6%). Tympanometric measurements under forced respiration showed mean improvements of at least 0.05 mmho in 13 patients (86.6%; P = 0.015). There were no statistical changes between pre- and postoperative audiometry. The follow-up period was 5 years for all patients (mean 5.2 years). No patients were lost to follow-up.





Discussion

The laser-assisted curvature inversion technique (CIT) provides a targeted, minimally invasive approach that directly modifies the curvature of the cartilaginous superstructure of the medial aspect of the ET, enhancing the tube's natural collapsible forces and promoting efficient valve closure. Our study, with a 5-year follow-up, demonstrates significant improvements in both subjective and objective outcomes, including nasal and voice autophony, tympanic membrane excursions, and breathing-synchronous tympanometric measurements. The procedure preserved normal muscular function and resulted in no surgical complications, highlighting its safety and reproducibility.

The observed long-term efficacy suggests that CIT effectively addresses the anatomical dysfunction responsible for PETD, in contrast to prior interventions that often provided only temporary or partial relief. The postoperative inversion of the posterior cushion and reduction in valve patency, confirmed on simple and slow-motion endoscopy, support the mechanistic rationale of the procedure. Furthermore, improvements in tympanometric parameters under forced respiration conditions indicate functional restoration of middle ear pressure regulation.

Despite these results, the study is limited by its small sample size and single-center design. Future multi-center studies with larger cohorts and comparative analyses are warranted to validate these findings, evaluate potential refinements in the technique, and directly compare CIT with alternative surgical approaches, as well as outcomes beyond 5 years.

Conclusions

CIT is a safe, effective, and durable surgical option for the management of PETD. Over a 5-year follow-up period, CIT demonstrated substantial improvements in both subjective and objective measures, including autophony of voice and nasal breathing, tympanic membrane excursions, and forced respiration tympanometry, The procedure effectively modifies the curvature of the cartilaginous superstructure of the medial aspect of the ET, enhancing the tube's natural collapsible forces and promoting efficient valve closure without compromising normal muscular function. Further comparative studies are warranted to validate these findings and to assess longer-term efficacy of CIT beyond the timeline reported here, as well as its performance relative to alternative surgical approaches.

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References

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