



## A new method for reconstruction of the lateral wall of the attic after atticotomy

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### Abstract

An original way for reconstruction lateral wall of the attic after separate atticotomy is proposed and demonstrated using a clinical case. Patient P. (33 years old) with chronic left-sided epitympanoantral suppurative otitis media. Left-sided mixed hearing loss of grade 3 (air-bone interval 50-55 dB). Under general anesthesia, a retroauricular approach to the tympanic cavity was performed, separate atticotomy was performed, pathological contents of the middle ear cavities were removed, and autofascia and autcartilage were harvested. According to the original technique, the cartilage plates were placed together and sutured with a 4-0 size absorbable braided polyglactin 910 suture using an atraumatic needle. The needle was first inserted through the center of both cartilage plates from front to back, withdrawn, and re-inserted near the previous needle entry point from back to front. The resulting loop was not tightened. Next, the cartilage was re-inserted from front to back near the previous needle entry point, forming a second loop through which the end of the suture without the needle was threaded. Both loops were then tightened. The suture was passed from the external auditory canal through the attic into the antrum and out into the external auditory canal. The sutured plates were placed in the attic so that their ends were adjacent to the posterior wall of the external auditory canal. The ends of the sutures were tightened with a trial knot

so that the tension of the suture pressed the cartilaginous plates against the posterior wall of the external auditory canal. A mark was made where the knot touched the outer edge of the posterior bony wall of the external auditory canal, the knot was unraveled, a groove was made in the area of the mark, the ends of the suture were retightened, and a knot was tied in the groove. Ossicular chain reconstruction with a 2.25 mm partial prosthesis, tympanoplasty with fascia and cartilage, wound suturing, and packing of the external auditory canal were performed. After one year, the air-bone interval was 10 dB. Computed tomography of the temporal bones showed no recurrence of cholesteatoma, and reconstruction of the lateral wall of the attic was satisfactory.

**Conclusion.** The development and implementation of new reconstructive techniques in chronic suppurative otitis media surgery expands the capabilities and enhances the physician's skills. The proposed technique for forming the lateral attic wall after separate atticotomy effectively restores the anatomical relationship between the middle ear and the external auditory canal and has practical significance.

**Keywords:** attic, cartilaginous plate, chronic suppurative otitis media, attic reconstruction, atticotomy.

**Conflict of interest:** nothing to disclose.

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## Новый способ реконструкции латеральной стенки аттика при отдельной аттикоантроми

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### Аннотация

Предложена оригинальная методика реконструкции латеральной стенки аттика после отдельной аттикоантроми, которая продемонстрирована на клиническом примере. Пациент П. (33 лет), диагноз: хронический левосторонний эпитимпаноантральный гнойный средний отит. Левосторонняя смешанная тугоухость 3 степени (костно-воздушный интервал 50–55 Дб). Под общей анестезией осуществлены ретроаурикулярный доступ в барабанную полость, отдельная аттикоантроми, патологическое содержимое полостей среднего уха удалено, забор аутофасции, аутохряща. Пластинки хряща, согласно оригинальной методике, складывали вместе и прошивали рассасывающейся плетеной нитью из полиглactина 910 размер 4-0 с атравматичной иглой. Сначала прокалывали иглой по центру обе пластинки хряща спереди назад, выводили иглу и снова прокалывали рядом с предыдущим местом входа иглы сзади наперед, при этом сформированную петлю не затягивали, далее

повторно прокалывали хрящ спереди назад рядом с предыдущим местом входа иглы с формированием второй петли, в которую продевали конец нити без иглы, после чего затягивали обе петли. Из наружного слухового прохода нить проводили через аттик в антрум и выводили в наружный слуховой проход. Сшитые пластины помещали в аттик так, чтобы своим торцом они прилежали к задней стенке наружного слухового прохода. Концы нитей затягивали пробным узлом так, чтобы сила натяжения нити прижимала хрящевые пластинки к задней стенке наружного слухового прохода. В месте прилегания узла к наружному краю задней костной стенки наружного слухового прохода делали метку, узел распускали, в области метки делали углубление-паз, концы нити повторно натягивали и завязывали узел в области углубления-паза. Реконструкция цепи слуховых косточек частичным протезом 2,25 мм, тимпанопластика фасцией и хрящом, ушивание раны, тампонада наружного слухового прохода. Через

1 год – костно-воздушный интервал 10 Дб, на компьютерной томографии височных костей рецидива холестеатомы нет, реконструкция латеральной стенки аттика состоятельна.

**Заключение.** Разработка и внедрение новых способов реконструкции в хирургии хронического гнойного среднего отита расширяет возможности и развивает компетенции врача. Предложенная методика формирования

латеральной стенки аттика после раздельной аттикоантромии позволяет эффективно восстановить анатомическое взаимоотношение среднего уха и наружного слухового прохода и имеет практическую значимость.

**Ключевые слова:** аттик, хрящевая пластинка, хронический гнойный средний отит, реконструкция аттика, аттикоантромия.

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#### Список сокращений

ХГСО – хронический гнойный средний отит; ЛСА – латеральная стенка аттика; НСП – наружный слуховой проход; МСКТ – мультиспиральная компьютерная томография.

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## BACKGROUND

Separate atticoanthrotomy in chronic suppurative otitis media (CSOM) is one of 'closed type' sanitizing operations which, unlike 'open-type' surgeries include not only the stage of removal of the cholesteatoma and the pathological contents, but the stage of reparation of anatomic compatibility of the middle ear structures [1–3]. The sanitizing stage being over, reparation of the access to the antrum and the reconstruction of the later wall of the attic are performed, which is an integral part of formation of the frame and the support of the drum or the neotympanic membrane, especially in the event the hammer is absent [4].

The requirements for a graft used in the reconstruction of the attic lateral wall are rigidity and the ability to be shaped to fit the acquired defect of the attic lateral wall, resistance to inflammation in the setting of CSOM, and the absence of graft tissue resorption over time. Another important factor of successful reconstruction is the possibility of reliable fixation of the graft in the proper position to prevent its displacement to the antrum or the tympanic cavity in the early or remote post-surgery periods, which might necessitate revision surgery [2–6].

We proposed an original method of reconstruction of the lateral wall of the attic after separate atticoanthrotomy [7], which is illustrated on a specific clinical case.

## CASE DESCRIPTION

Patient P. (33 years old). Clinical diagnosis: chronic left-sided epitympanoantral suppurative otitis media. Left-sided mixed hearing loss of grade 3. Admitted to the clinic with complaints of hearing loss and episodes of purulent discharge from the ear up to 2 times per year. CSOM over 12 years.

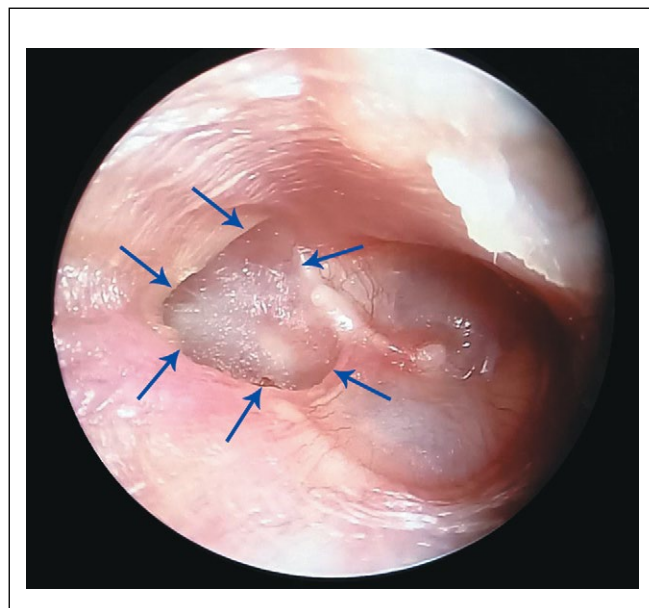
Examination: the left circumaural area is not altered, the ear canal shows traces of mucous discharge, the tympanic membrane is thickened and mildly hyperemic, with a perforation in the pars flaccida. The lateral wall of the attic is partially eroded by the inflammatory process. Hearing: whispered speech is perceived at 0 meters (Fig. 1).

Right ear: the tympanic membrane is gray and mobile. Hearing: whispered speech is perceived at 6 meters. No vestibular disorders.

According to the multi-spiral computed tomography (MSCT) of the temporal bones, the cells of the left mastoid

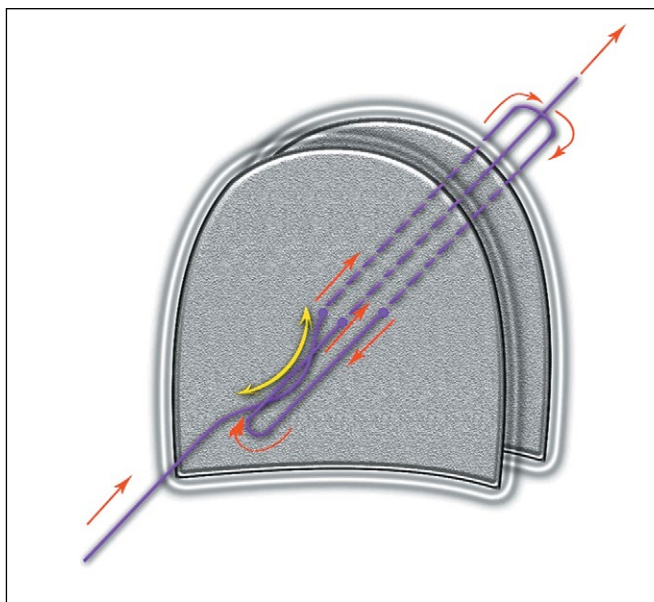
process are well developed, pneumatization is impaired; the antrum and attic are filled with pathological content. The lateral wall of the attic is partially eroded. The head of the malleus and the body of the incus show carious changes; the long process of the incus is destroyed by the inflammatory process. The stapes is preserved. The audiometry shows mixed loss of hearing of the left ear, the air-bone interval was 35–40 dB.

The surgical treatment was performed under combined general anesthesia. Under the control of an operating microscope, a postauricular approach to the tympanic cavity was performed. A disruption of the ossicular chain was identified, caused by resorption of the long process of the incus. The stapes was preserved and mobile. The cholesteatoma developed to the attic and the additus. The bore was used to incise the cells of the mastoid process, to perform the anthrotomy with preservation of the posterior wall of the external auditory tract (EAT). The pathological contents of the



**Figure 1.** View of the tympanic membrane and bone defect in the area of the lateral wall of the attic (the boundaries of the defect are indicated by arrows).

**Рисунок 1.** Вид барабанной перепонки и костного дефекта в области латеральной стенки аттика (границы дефекта указаны стрелками).



**Figure 2.** Schematic diagram of suture placement on two cartilaginous plates. Red arrows indicate the direction of needle and thread movement; the yellow arrow with two ends indicates insertion of the end of the thread without the needle into the second loop.

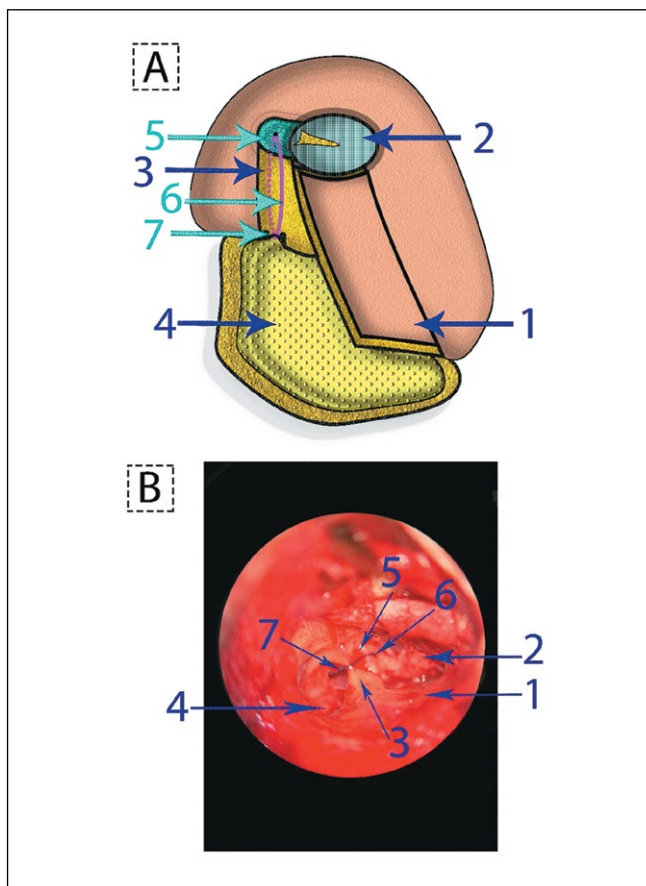
**Рисунок 2.** Схема наложения шва на две хрящевые пластины. Красные стрелки – направление движения иглы с нитью, желтая стрелка с двумя концами – вправление конца нити без иглы во вторую петлю.

antrum was removed until the body of the anvil was visualized from the side of the antrum, the remaining part of the anvil was removed. Atticotomy was performed using a drill. The head of the malleus was removed. Under endoscopic control (30°, 45°, and 70° scopes), sanitization of the tympanic cavity, attic, and antrum was carried out. Perichondrium, temporal fascia, and conchal cartilage were harvested from the left postauricular region for reconstruction of the lateral epitympanic wall and the access area to the antrum.

According to the original method, the cartilage plates were placed together and sutured with a 4-0 size absorbable braided polyglactin 910 suture using an atraumatic needle. The needle was first inserted through the center of both cartilage plates from front to back, withdrawn, and re-inserted near the previous needle entry point from back to front. The resulting loop was not tightened. Next, the cartilage was re-inserted from front to back near the previous needle entry point, forming a second loop through which the end of the suture without the needle was threaded. Both loops were then tightened (Fig. 2).

The suture was passed from the external auditory canal through the attic into the antrum and out into the external auditory canal. The sutured plates were placed in the attic so that their ends were adjacent to the posterior wall of the external auditory canal. The ends of the sutures were tightened with a trial knot so that the tension of the suture pressed the cartilaginous plates against the posterior wall of the external auditory canal. A mark was made where the knot touched the outer edge of the posterior bony wall of the external auditory canal, the knot was unraveled, a groove was made in the area of the mark, the ends of the suture were retightened, and a knot was tied in the groove (Fig. 3).

Ossicular chain reconstruction with a 2.25 mm partial titanium prosthesis. He access to the antrum was closed



**Figure 3.** A - diagram showing the middle ear cavities and the walls of the external auditory canal after reconstruction of the lateral wall of the attic with a cartilaginous graft. B - intraoperative photograph of a similar stage of the operation; 1 - external auditory canal, 2 - projection of the neotympanic membrane, 3 - posterior wall of the external auditory canal, 4 - antromastoid cavity, 5 - cartilaginous graft, 6 - thread, 7 - knot in the depression-groove at the end of the posterior wall of the external auditory canal.

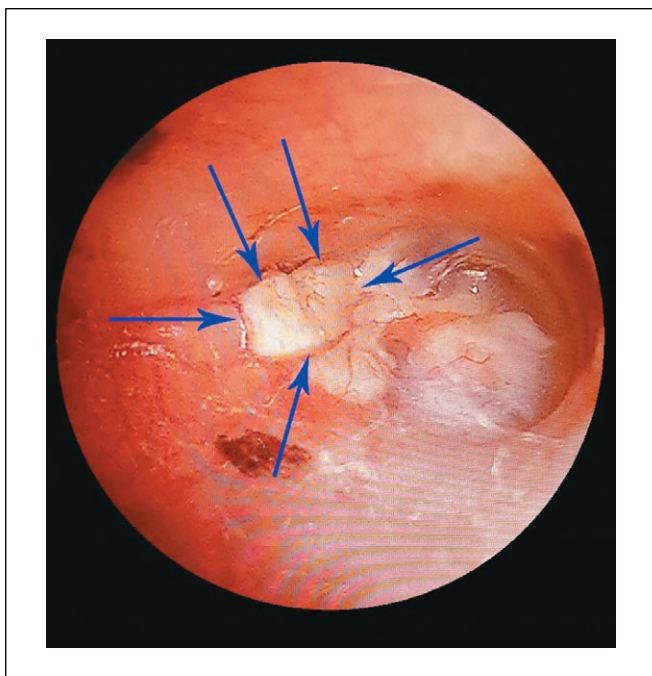
**Рисунок 3.** А – схема, на которой изображены полости среднего уха и стенки наружного слухового прохода после реконструкции латеральной стенки аттика хрящевым трансплантатом. В – интраоперационная фотография аналогичного этапа операции; 1 – наружный слуховой проход, 2 – проекция неотимпанальной мембраны, 3 – задняя стенка наружного слухового прохода, 4 – антромастoidalная полость, 5 – хрящевой трансплантат, 6 – нить, 7 – узел в углублении-пазу в торце задней стенки наружного слухового прохода.

with cartilage. Tympanoplasty was performed with temporal fascia. The meatal-tympanic flap was repositioned to its original position, the wound was sutured by layers, and the external auditory canal was packed with a hemostatic sponge.

Three weeks after removal of tampons from the external auditory tract, the examination revealed integrity of the neotympanic membrane, the repair area had no visible defects, the hearing improved, the bone-air interval was 15–20 dB. One year after the operation, the bone-air interval was 10 dB, and the MSCT of the temporal bones and the MRI showed no signs of recurrence of the cholesteatoma; the reconstruction was secure (Fig. 4).

**DISCUSSION**

Numerous methods of reconstruction of the lateral wall of the attic using transplants are reported in literature; all of them having their proper advantages and disadvantages.



**Figure 4.** View of the tympanic membrane and reconstruction of the lateral wall of the attic 1 year after surgery (the boundaries of the cartilage transplant are indicated by arrows).

**Рисунок 4.** Вид барабанной перепонки и реконструкции латеральной стенки аттика через 1 год после операции (границы хрящевого трансплантата указаны стрелками).

Thus, the use of free bone grafts from the cortical layer of the temporal bone [8], on the one hand, enables anatomical reconstruction. On the other hand, it is technically challenging to first drill out and then shape the graft to the exact size of the defect using a bur. The absence of tight contact with the bony walls of the attic may compromise graft osteointegration, leading to sequestrum formation.

Reconstruction of the lateral wall of the attic is most commonly performed using a fragment of conchal or tragal cartilage. This preference is due to the graft's accessibility in sufficient quantity, ease of shaping to fit the acquired defect of the lateral wall of the attic, resistance to inflammation in the setting of CSOM, and lack of postoperative resorption. However, simply placing the cartilage plate over the defect without additional fixation can easily lead to graft displacement during healing [4].

In the event of use of allogeneic [9] or autogenous [10] cartilage plates, where fixation relies on the elastic properties of the cartilage plate itself, instability of the formed construct can lead to changes in its position and shape.

The use of a reconstruction technique for the lateral wall of the attic involving a chondroperichondrial graft offers a clear advantage. In this graft, the cartilage size matches the defect of the lateral wall of the attic, while the perichondrium exceeds it [11]. This provides excellent “primary” fixation of the graft to the walls of the external auditory canal, even in the absence of tight contact between the cartilage and the bony walls of the attic. The downsides of this method, in our opinion, are the displacement of the graft in the healing process due to scarring, tightening or, conversely, thinning and partial lysis of the perichondrium; the impossibility of changing the shape and increasing the thickness of the graft and, if necessary, reconstructing large defects of the lateral wall of the attic: the graft is attached to the perichondrium, and its thickness and shape depend on the cartilage of the donor area. Besides, an error on part of the surgeon in the selection of the size and form of the graft in this method of fixation would require harvesting a second graft, the source whereof is limited.

Our method utilizing two sutured cartilages allows for stabilization of the graft in the area of the defect of the lateral wall of the attic supported by the posterior wall of the external auditory tract and to prevent formation of retraction pockets thanks to an increased thickness of the graft. Suturing with single-thread absorbable 910 polyglactin through the cartilages involving the posterior osseous wall of the external auditory tract and fixation of the knot in the groove area prevents the thread from displacement relatively to the posterior wall of the external auditory tract and secures the graft in place in the early postoperative period.

**CONCLUSION**

Development and implementation of new reconstruction techniques in CSOM surgery broadens capabilities and enhances physician competencies. The proposed method for reconstructing the lateral wall of the attic after separate atticoantrotomy effectively restores the anatomical relationship between the middle ear and the external auditory canal and is of practical significance. ■

ADDITIONAL INFORMATION	ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ
<p><b>Ethics approval.</b> Compliance with ethical principles: the conducted study complies with the standards of the Declaration of Helsinki as amended in 2024. The compliance of the study protocol with ethical principles was confirmed by the Local Ethics Committee of the Federal State Budgetary Educational Institution of Higher Education “ROSBIOTECH” (Protocol No. 7/2 dated February 25, 2025).</p>	<p><b>Этическая экспертиза.</b> Соответствие принципам этики: проведенное исследование соответствует стандартам Хельсинкской декларации (Declaration Helsinki) в редакции 2024 г., соответствие протокола исследования этическим принципам было подтверждено локальным этическим комитетом ФГБОУ ВО «РОСБИОТЕХ» (протокол №7/2 от 25 февраля 2025 г.).</p>
<p><b>Consent for publication.</b> Written consent was obtained from the patient for the depersonalized publication of relevant medical information and all of accompanying images in the journal.</p>	<p><b>Согласие на публикацию.</b> Авторы получили письменное согласие пациента на публикацию в журнале медицинских данных и фотографий в обезличенной форме.</p>
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<p><b>Conflict of interest.</b> The authors declare that there are no obvious or potential conflicts of interest associated with the content of this article.</p>	<p><b>Конфликт интересов.</b> Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с содержанием настоящей статьи.</p>
<p><b>Contribution of individual authors.</b> Morozov I.I., Gorbunova N.V.: study concept and design, manuscript editing. Bulanov K.V., Abdullaev A.G.: material collection, statistical data processing, writing of the text.                      Authors gave their final approval of the manuscript for submission, and agreed to be accountable for all aspects of the work, implying proper study and resolution of issues related to the accuracy or integrity of any part of the work.</p>	<p><b>Участие авторов.</b> Морозов И.И., Горбунова Н.В. – концепция и дизайн исследования, редактирование рукописи. Буланов К.В., Абдуллаев А.Г. – сбор материала, статистическая обработка данных, написание текста.                      Авторы одобрили финальную версию статьи перед публикацией, выразили согласие нести ответственность за все аспекты работы, подразумевающего надлежащее изучение и решение вопросов, связанных с точностью или добросовестностью любой части работы.</p>

<p><b>Statement of originality.</b> No previously published material (text, images, or data) was used in this work.</p>	<p><b>Оригинальность.</b> При создании настоящей работы авторы не использовали ранее опубликованные сведения (текст, иллюстрации, данные).</p>
<p><b>Data availability statement.</b> The editorial policy regarding data sharing does not apply to this work.</p>	<p><b>Доступ к данным.</b> Редакционная политика в отношении совместного использования данных к настоящей работе не применима.</p>
<p><b>Generative AI.</b> No generative artificial intelligence technologies were used to prepare this article.</p>	<p><b>Генеративный искусственный интеллект.</b> При создании настоящей статьи технологии генеративного искусственного интеллекта не использовали.</p>
<p><b>Provenance and peer review.</b> This paper was submitted unsolicited and reviewed following the standard procedure. The peer review process involved 2 external reviewers.</p>	<p><b>Рассмотрение и рецензирование.</b> Настоящая работа подана в журнал в инициативном порядке и рассмотрена по обычной процедуре. В рецензировании участвовали 2 внешних рецензента.</p>

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