



APPLICATION OF PLATELET RICH PLASMA AND BONE CARTILAGE FOR RECONSTRUCTION OF THE POSTERIOR EAR CANAL WALL

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ABSTRACT

Introduction: Chronic Suppurative Otitis Media (CSOM) cholesteatoma type with deterioration of the posterior ear canal wall is treated with Canal Wall Down (CWD) mastoidectomy followed by reconstruction of the posterior ear canal wall with Platelet-Rich Plasma (PRP) and bone cartilage. Combining PRP with soft tissue and bone cartilage may stimulate the mineralization of regenerating tissue. **Purpose:** To achieve an effective combination of methods, such as CWD mastoidectomy with posterior ear canal wall reconstruction using PRP, bone cartilage, and soft tissue, to improve wound healing, resulting in a smooth mastoid cavity with no complications. **Case report:** of a 53-year-old man with CSOM suspicious cholesteatoma type at the left ear and devastation of the posterior ear canal wall treated with CWD mastoidectomy and reconstruction of the posterior ear canal wall using PRP, bone cartilage, and soft tissue. **Method:** Literature searching through the Cochrane database, Pubmed, and Google Scholar, using keywords of platelet-rich plasma, posterior ear canal wall reconstruction, mastoid obliteration, and canal wall down mastoidectomy. **Result:** The selection process based on inclusion and exclusion criteria yielded only one pertinent study. The patient underwent mastoid reconstruction using PRP and a cortical bone plate following CWD mastoidectomy. This study included 21 patients, including 9 men and 12 women. Sixteen patients had the disease on the left side. Within ninety to one hundred and thirty-five minutes, all surgical procedures are performed without incident. External canal stenosis and mastoid fistula were not discovered at 12 to 16 months of follow-up. In 18 patients, the tympanic membrane healed properly. There were no radiological indications of recurrence, and the reconstructed mastoid cavity was smooth and well-ventilated. In three patients, residual tympanic membrane perforations were detected. **Conclusion:** When PRP, bone cartilage, and soft tissue are used to rebuild the back wall of the ear canal, the wound heals faster and there are no problems. The result is a smooth surface in the mastoid cavity. Platelet-rich plasma, mastoid obliteration, and posterior ear canal wall reconstruction are the key terms.

Keywords: platelet-rich plasma, mastoid obliteration, posterior ear canal wall reconstruction

INTRODUCTION

Chronic suppurative otitis media (CSOM) is a chronic infection of the middle ear characterized by perforation of the tympanic membrane and secretions leaking continuously or intermittently from the middle ear for more than two months.¹ In general, CSOM is diagnosed when a tympanic perforation continues to generate mucoid secretions for six weeks to three months despite medical treatment.²

The cholesteatoma incidence rate ranged from 3 to 15 per 100,000 person-years.³ According to the World Health Organization, the prevalence of CSOM in Indonesia ranges between 2% and 4%. According to the national survey of vision and auditory health conducted in Indonesia between 1994 and 1996, the prevalence rate was 3.8%.⁴ Progressive cholesteatoma of the type CSOM, the cholesteatoma will destroy the bone, necrosis in the soft tissue through which the cholesteatoma and adjacent tissue, which poses a threat of causing complications.¹

Platelet-rich plasma (PRP) is an autologous product derived from whole blood via gradient density centrifugation. It has been demonstrated that autologous PRP is safe and effective for facilitating natural wound healing, soft tissue reconstruction, bone reconstruction, and augmentation. PRP stimulates the regeneration of mineralized tissues and bone

formation. It would make sense to use it for reconstructing the mastoid cavity.^{5,6}

Platelets have the potential to stimulate the mitogenic activity of human trabecular bone cells and to enhance the proliferation rate of human osteoblast-like cells and stromal stem cells, thereby contributing to the regeneration of mineralized tissues. Platelet-derived growth factors signal local mesenchymal and epithelial cells to migrate, proliferate, and increase collagen and matrix synthesis, thereby providing a scaffold that promotes osteoblast migration. In addition to stimulating chemotaxis, metabolism, and proliferation in osteoblasts and bone marrow osteoprogenitor cells, PRP growth factors also stimulate chemotaxis. PRP is a straightforward laboratory technique for obtaining large concentrations of one's own growth factors. Platelet-rich plasma could accelerate tissue regeneration and promote soft tissue healing, so PRP is used with success in soft tissue otological procedures.^{5,6}

Recent advances in the surgical treatment of cholesteatoma include reconstruction of the posterior ear canal wall.^{7,8} The objective of reconstructing the posterior ear canal wall is to provide a safe, dry mastoid and restore hearing to near-normal levels. Autologous grafts (muscle, periosteum, fascia, and bone cartilage) and synthetic materials are the two primary types of materials used for posterior canal wall

reconstruction. Combining PRP with soft tissue and bone cartilage may promote tissue regeneration.^{5,7}

The purpose of this case report is to determine the optimal combination of actions for the application of platelet-rich plasma, bone cartilage, and soft tissue on canal wall down mastoidectomy with posterior ear canal wall reconstruction in CSOM cholesteatoma-type patients with devastation of the posterior ear canal.

CASE REPORT

On December 23, 2021, a 53-year-old male patient presented to the ORL-HNS outpatient clinic of RSUP Dr. M. Djamil Padang with a discharge from the left ear that had been worsening for three months. The patient's left ear has discharge intermittently since five years ago, particularly when he has fever, cough, and runny nostrils. The discharge is yellow in color, has a foul odor, and has a three-month history of being intermingled with blood. Since five years ago, hearing in the left ear has diminished. Since 5 months ago, intermittent left ear pain has been present. There were no severe headaches, crooked faces, decreased levels of consciousness, humming ears, or vertigo.

On otoscopy, the right ear and right retroauricular examination were within the normal range. On the left ear, the ear canal was constricted, the tympanic membrane was completely perforated, there was granulation tissue, and there was yellow mucopurulent discharge with an offensive odor. Left retroauricular examination revealed no edema, hyperemias, or cicatric lesions (Figure 1).



Figure 1. Otoendoscopy left ear before surgery, there was granulation tissue (black arrow)

Examinations of the nose and pharynx were within normal parameters. The 23rd of December, 2021, testing with a tuning fork revealed bilateral sensorineural hearing loss (Table 1). Balance and facial nerve examinations revealed no abnormalities.

The laboratory results were within the parameters of normality. The pure tone audiometry examination performed on the 23rd of December 2021 revealed that the right ear's hearing threshold was 40 dB with mild sensorineural hearing loss, while the left ear was profound (Figure 2).

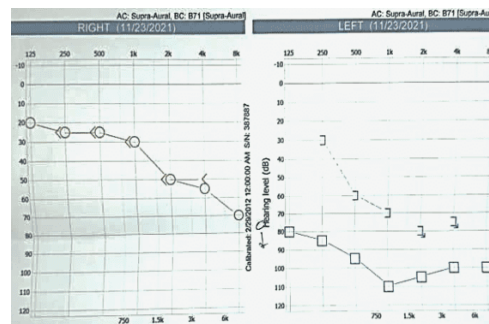


Figure 2. Audiogram before surgery

Table 1. Tuning fork examination before surgery

F	Rinne		Weber	Schwabach	
	Right	Left		Right	Left
128	Positive	Positive		shorten	Shorten
256	Positive	Positive		shorten	Shorten
512	Positive	Positive	Lateralization to the left	shorten	Shorten
1024	Positive	Positive		shorten	Shorten
2048	Positive	Positive			Shorten

The 15th of November, 2021, computed tomography of the left mastoid revealed the external acoustic canal, tympanic cavity, mastoid air cell, and destruction of the posterior ear canal. Also destroyed were the tympanic tegmen, scutum, and auditory ossicles. Less distinct was the boundary between the lateral walls of the horizontal semicircular canal

(SCC) and the VII par tympanic nerve. Cochlea was in good health. (Figure 3).

The culture result and sensitivity examination of ear discharge revealed the bacteria to be *Pseudomonas aeruginosa*, which was sensitive to Cefotaxime, Gentamicin, Cefpirom, and

Meropenem.



Figure 3. Mastoid computer tomography before surgery shown destruction of the posterior ear canal (black arrow)

The patient was diagnosed with a cholesteatoma-suspicious CSOM of the left ear based on the history, physical examination, and supporting examination. Under general anesthesia, the patient was scheduled to undergo a CWD mastoidectomy and reconstruction of the posterior ear canal wall by an otolaryngologist consultant.

The operation on December 28, 2021. Before surgery, 14ml of blood was extracted from patients with cubital intermedial vein, placed in seven PRP tubes, and sent to a tissue bank. The blood in the PRP tube was centrifuged for 10 minutes, first at 1,300 rpm and then at 2,000 rpm. The PRP results are placed in a new, unfilled tube and transported to the operating room (figure 4).



Figure 4. Patient's PRP before surgery.

The surgical procedure commenced with aseptic and antiseptic measures. An incision was marked 2 mm from the left retroauricular sulcus, followed by an epinephrine infiltration

anesthetic of 1:200,000 and a horizontal skin incision that was tangential to the ear canal. A graft was removed from the temporalis muscle's deep fascia. Mastoid exposure was performed using McEwen's triangle as a landmark, followed by mastoid drilling; yellowish white tissue resembling cholesteatoma was observed in the mastoid cavity; tissue was removed. Drilling was continued until the mastoid antrum was located. Tissue resembling a cholesteatoma was observed in the antrum and was removed. The sigmoid sinus was not exposed, the tegmen was not compromised, and the facial canal and nerve were not exposed to the mastoid and tympanic segments. The semicircular canals are concealed from view. Damage to the auditory canal's posterior wall was observed (figure 5).



Figure 5. There was destruction of the posterior ear canal (red arrow)

Malleus, incus, stapes, and tissue (cholesteatoma) were not visible. Cholesteatoma tissue was removed and cleansed. The conchae cartilage was extracted and as much as possible preserved. The conchae cartilage was then formed into a rectangle that was adjusted to the size and shape of the previously removed posterior wall of the auditory canal, positioned in the area, and fixed with a sponge containing PRP. The temporalis muscle deep fascia transplant was then placed underlay and secured with a PRP-infused sponge. The procedure continued by obliterating the perforation site and inserting sofratul gauze into the ear canal (figure 6). The surgical laceration was sutured layer by layer with Prolene 4.0 interrupted suture, gauze, and an elastic bandage were applied. The operation has been completed. Tissue obtained from a cholesteatoma during surgery was sent for histopathological analysis.

The patient was admitted to the ORL-HNS ward postoperatively with IVFD RL 20 drops/minute, Cefotaxime injection 2x1 g, Dexamethasone injection 3x5 mg, and Paracetamol tablets 3x500 mg (orally). On the second day following surgery, on December 29, 2021, the patient's general condition was moderate, and composmentis cooperative experienced modest pain in the left ear. There were no headaches, nausea, vomiting, noise in the ear, or vertigo. On left ear examination, a bandage was applied, and there was no evidence of bleeding. There was no face deformity. Examination of the facial nerve's periphery House-Brackmann I.

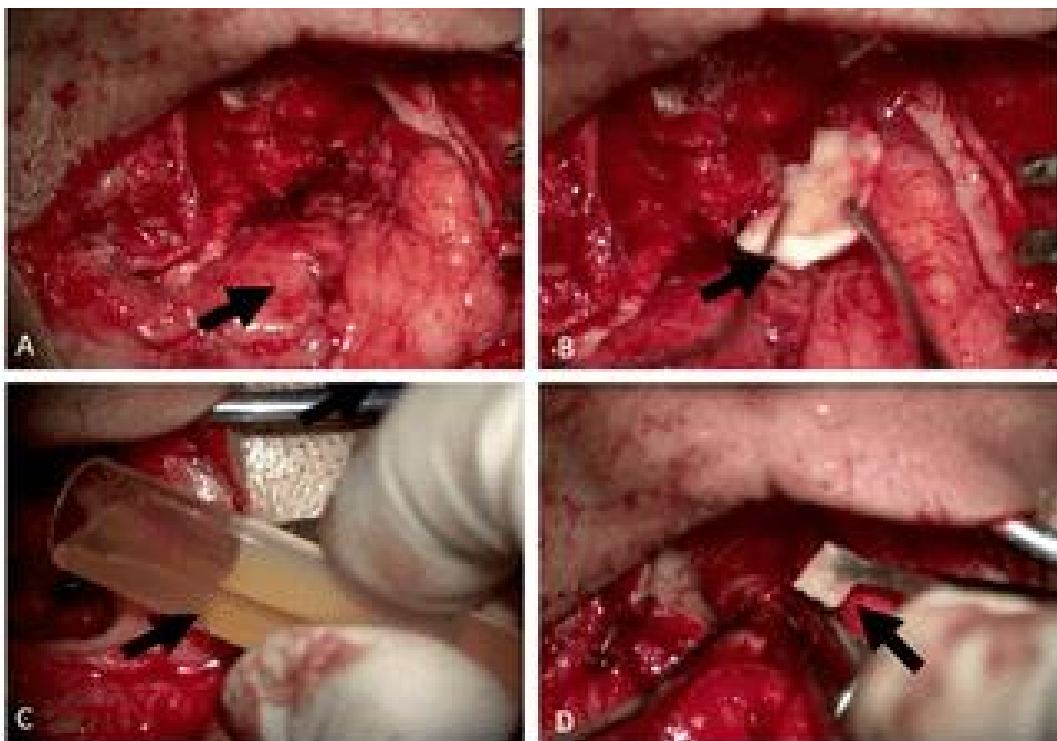


Figure 6. (A) Obliteration with soft tissue (arrow). (B) Conchae cartilage for posterior ear canal reconstruction (arrow). (C) The PPP poured to ear canal (arrow). (D) The P-PRP with spongostan apply to help in fixating the bone cartilage (arrow).

On December 31, 2021, the third day after surgery, the bandage was removed and the suture incision behind the ear was redressed. There were no indicators of infection or inflammation at the suture wound, which was dry. The patient was permitted to return home and continue treatment at the ambulatory clinic of ORL-HNS. The patient was sent home with Cefixime tablets 2x200 mg, Paracetamol tablets 3x500 mg, and Ofloxacin ear drops 2x5 drops for the left ear. Four days later, the patient was requested to return for follow-up.

On January 4, 2022, the patient visited the ORL-HNS outpatient clinic for observation. The patient's general condition was fine; there was no bleeding from the bandage, no headache, dizziness, or crooked face. The surgical incision has healed well, so the sutures are removed. Cefixime tablet 2x200 mg (orally) and Ofloxacin 2x5 drops in the left ear were continued as treatment.

The results of a histopathological examination conducted on January 4, 2022 revealed the macroscopic appearance of two sections of brownish-white, densely chewy tissue measuring 35x10x10mm. On a microscopic scale, the tissue fragments resemble stratified squamous epithelium containing a keratin mass. In conclusion, the physical characteristics were consistent with cholesteatoma.

On January 17, 2022, the patient returned to the ORL-HNS outpatient clinic for a second follow-up. There was no blood leaking from the bandage, no headache, dizziness, or crooked face, and the surgical incision was healthy. The sofratul gauze is then removed from the ear canal, and the ear canal is

thoroughly cleansed. There was no discharge or blood in the ear canal. Cefixime tablet 2x200 mg (orally) and Ofloxacin ear drops 2x5 drops in the left ear were continued as treatment.

The general condition was good, the surgical wound was excellent, the ear canal was wide, and there was no discharge or blood in the ear canal one month after surgery. No perforation exists in the auditory canal. The graft was positioned properly.

Three months after surgery, the ear canal was wide, there was no discharge or blood in the ear canal, there was no perforation in the ear canal, the graft had begun to grow, and there were no symptoms of infection (figure 7).

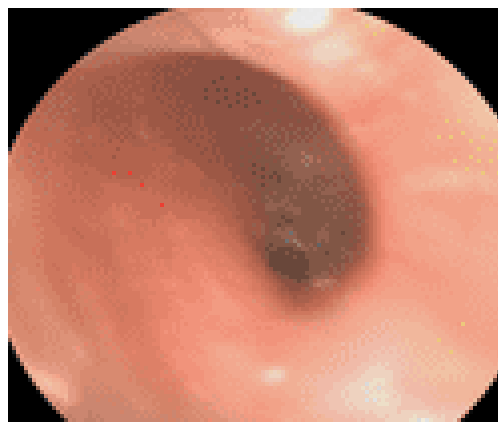


Figure 7. Otoendoscopic feature of the left ear 3rd months postoperative

Audiometry showed an hearing threshold on the right ear was 40 dB with mild sensorineural hearing loss, and the left ear was profound (figure 8).

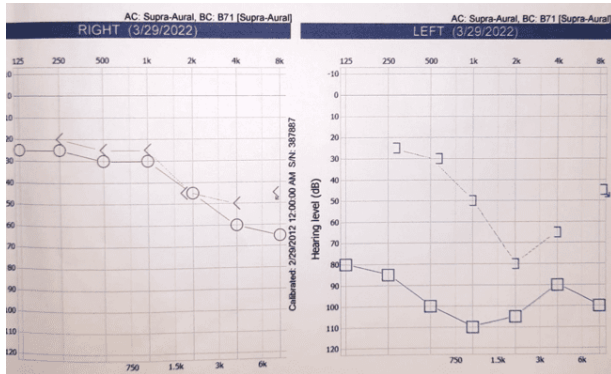


Figure 8. The audiogram 3rd month postoperative

In patient with CSOM cholesteatoma type with destruction of posterior ear canal wall, is platelet rich plasma effective on reconstruction posterior ear canal wall with bone cartilage and soft tissue ?

- **P** : Patient with CSOM cholesteatoma type with destruction of posterior ear canal wall
- **I** : CWD mastoidectomy and reconstruction of posterior ear canal wall with application of platelet rich plasma, bone cartilage and soft tissue
- **C** : There is no comparison in this paper
- **O** : To improve wound healing, give a smooth appearance to the mastoid cavity, and no complications

METHOD

The authors conducted a comprehensive literature search using the terms platelet-rich plasma, posterior ear canal wall reconstruction, mastoid obliteration, and canal wall-down mastoidectomy (figure 9).

The search was restricted to manuscripts published in the last 10 years. 1) Application of autologous bone cartilage and soft tissue with platelet-rich plasma for reconstruction of the

posterior wall of the ear canal; and 2) Mastoid obliteration with platelet-rich plasma; exclusion criteria: 1) Patients without posterior ear canal destruction, 2) Chronic Suppurative Otitis Media without cholesteatoma type, and 3) posterior ear canal wall reconstruction without application of platelet-rich plasma.

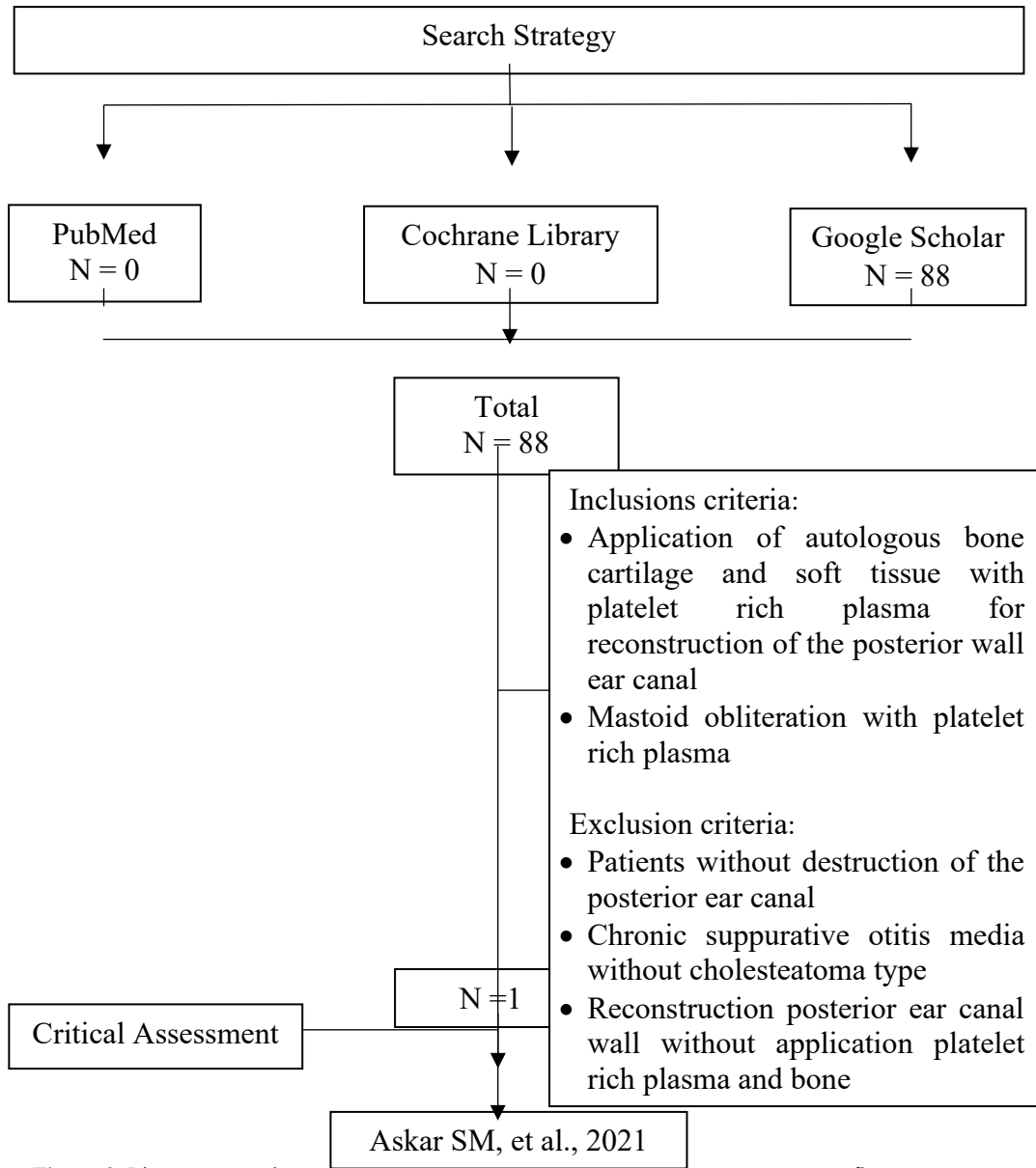


Figure 9. Literature search

flow

RESULT

After searching the Cochrane database, Pubmed, and Google Scholar, 88 articles published within the last decade were located. Selection based on inclusion and exclusion criteria revealed only one pertinent study (Table 2).

According to Askar et al's case series, the study design was a case series. Patients underwent mastoid reconstruction using PRP and cortical bone pate following canal wall down mastoidectomy. This study included 21 patients, including 9 men and 12 women.

Sixteen patients had left side disease. No distressing occurrences were reported during the 90 to 135 minute duration of each surgical procedure. External canal stenosis and mastoid fistulas were not observed between 12 and 16 months of follow-up. In 18 patients, the tympanic membrane healed properly. There were no radiological indications of recurrence, and the reconstructed mastoid cavity was smooth and well-ventilated. In 3 patients, residual tympanic membrane perforations were detected (Table 3).⁵

Table 2. Search strategy

Literature	Result	Keywords
PubMed	0	'platelet rich plasma AND 'posterior ear canal wall reconstruction' AND 'mastoid obliteration' AND 'canal wall down mastoidectomy'
Cochrane Library	0	
Google Scholar	88	

Table 3. Literature review

No	Writer - journal	Patients/ Problem	Intervention	Comparison	Outcome
1	Askar SM, et al. <i>Ear, Nose & Throat</i> 2021.	Adult patients with chronic suppurative otitis media who needed CWD mastoidectomy	mastoid reconstruction after canal wall down mastoidectomy using PRP and cortical bone pate	-	Good healing of the tympanic membrane. Reconstructed mastoid cavity was smooth and well aerated.

DISCUSSION

A case of cholesteatoma-type CSOM was reported on the left ear of a 53-year-old male. Due to complications, CSOM cholesteatoma type on the left ear is a hazardous infection and inflammation of the middle ear. The CSOM mortality rate owing to complications reaches 76.4 percent. According to some sources, complications of CSOM with cholesteatoma range from 58% to 78.5 %. Alam M. and Chandra K. reported that the presence of cholesteatoma causes a locally invasive and detrimental process by eroding adjacent bone via the pressure effect of the expanding keratin mass and osteoclast-mediated collagenase enzyme activity.⁷

The diagnosis was based on the patient's medical history, physical examination, and additional tests. CSOM is characterized by persistent ear discharge for more than two months and the presence of a perforated tympanic membrane.⁹ In this instance, CSOM was diagnosed based on anamnesis findings of continuous discharge for the past 5 months and a history of intermittent discharge for the past 6 years. On physical examination, mucopurulent discharge was discovered in the left ear canal and the tympanic membrane was completely perforated. Cholesteatoma-type CSOM is typically treated through surgery. According to Alam M. and Chandra, CWD mastoidectomy is more appropriate for cholesteatoma. It is associated with a reduced risk of recurrence than CWU mastoidectomy, in which the preferable preservation of the middle ear fissure and mastoid may maintain favorable conditions for the re-formation of cholesteatoma.⁷

In addition to the benefits of CWU mastoidectomy, CWD mastoidectomy followed by concurrent reconstruction of the Posterior canal wall achieves a low cholesteatoma recurrence rate, according to Elbary. This provides structural support, which plays a crucial role in preventing the postoperative formation of a retraction pocket and subsequent development of cholesteatoma. Platelet-rich plasma (PRP) is an autologous product obtained by gradient density centrifugation from whole blood. Autologous PRP has been shown to be safe and effective in facilitating wound healing, soft tissue regeneration, bone reconstruction, and augmentation.⁶

Follow-up Three months after surgery, there was no discharge from the ear, the graft was growing well, and the ear canal was intact. According to Yaor et al., surgery plays a significant role in the management of CSOM. The success rate is measured by closing the tympanic membrane perforation, removing all pathological tissues, attaining a sterile and secure ear, and, in some cases, hearing improvement. The epithelialization of the tympanic membrane and ear canal improved one month postoperatively and was complete three months after surgery, as determined by Ito et al. During six-month postoperative observation, the reconstructed posterior ear canal wall did not retract.¹⁰

In conclusion, the treatment of preference for CSOM cholesteatoma type with devastation of the posterior ear canal wall is Canal Wall Down (CWD) mastoidectomy with reconstruction of the posterior ear canal wall using Platelet-Rich Plasma (PRP) and bone cartilage. The application of platelet-rich plasma, bone cartilage, and soft tissue for posterior wall reconstruction of the ear canal has the advantage of expediting wound healing and giving the mastoid cavity a seamless appearance, with no complications.

The suggestions are as follows: 1) Further research is required to compare the administration without PRP, and 2) PRP should be utilized more in the reconstruction of the posterior ear canal wall.

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