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Cholesteatoma with Labyrinthine Fistula

Introduction

Cholesteatoma disease is the commonest pathology leading to fistula in labyrinth. Erosion of labyrinthine bone by cholesteatoma is produced by pressure from an expanding cholesteatoma sac or by enzymatic activity in its lining membrane. When this erosion includes all three layers of the otic capsule, a bony fistula results. Lateral semicircular canal is the most commonly affected site, due to its proximity to attic, which is the primary site for cholesteatoma. However, structures such as the oval window, promontory, other canals, or the cochlea may be involved alone or in combination with the horizontal canal.

The clinical manifestation is in the form of vertigo and sensorineural hearing loss along with chronically discharging ear. The sensorineural hearing loss is most often, because of the extension of infection and inflammation from semicircular canal to cochlea, rather than invasion.

Causes other than cholesteatoma for labyrinthine fistula can be Koch's mastoiditis, primary malignancy, or secondary metastases in temporal bone. Occasionally the thinning of semicircular canals with or without blue lining is seen in benign lesions involving jugular bulb such as glomus jugulare, lower cranial nerve neuroma, meningioma, and facial nerve neuroma.

Granulation tissue disease associated with Koch's mastoiditis due to its aggressive nature, leads to wider and deeper erosions of semicircular canals or fistulae at multiple sites causing more sensorineural hearing loss and at times dead ear. Occasionally, it may even be associated with cochlear fistula. As far as malignant lesions are concerned, there can be various degrees of erosion of one or multiple semicircular canals or complete erosion of all the canals leading to various degrees of sensorineural hearing impairment.

Various classifications have been proposed over the years. The most basic one is, that bony labyrinthine fistulae can be classified into those involving the vestibular labyrinth and those involving the cochlear wall.

According to Sanna's classification labyrinthine fistulae are classified in 3 groups, according to size:

Small (<1mm), medium (between 1 and 2 mm), and large (>2mm).

According to Dornhoffer and Milewski's classification, which is based on different stages in the bone defect, the fistulae are classified into four types, I, IIa, IIb, and III,

A type I fistula is an erosion of the bony labyrinth with an intact endosteum. Type IIa is accompanied by an opened perilymphatic space with undisturbed perilymph while type IIb has a disturbed perilymph. A Type III fistula is an opened perilymphatic space with a disturbance of the underlying membranous labyrinth. Preoperatively there is not much difference noticed in bone conduction, in different types of fistulae. But chances of postoperative BC becoming worse is more in patients with advanced stage IIb or III fistulae.

Regarding the preoperative sensorineural hearing loss, it is found more in cases of cochlear fistulae than the one in canals.

Similarly, there is no relationship between the size of labyrinthine fistulas and postoperative hearing deterioration, if the fistula has been repaired well. If by accident, membranous labyrinth has been traumatized or opened during surgery, then it involves a major risk of labyrinthine damage because intramembranous fluid can leak out. This then has an adverse effect on the cochlear function, leading to sensorineural hearing loss.

The management of cholesteatoma-induced labyrinthine fistulae consists of the complete removal of the cholesteatoma matrix from the fistula and the prevention of sensorineural hearing loss and dizziness postoperatively due to iatrogenic damage. For that, the fistula needs to be repaired and sealed. The repair depends on depth of destruction of walls of labyrinth and extent of hearing loss. Whenever there is partial thickness erosion or blue lining of canal wall, without exposure of membranous labyrinth, it does not require any repair. Only resurfacing of fistula with bone paste is sufficient to seal that defect. But if the fistula is deeper and wider, it needs to be repaired in multiple layers. In case cholesteatoma sac is sitting on this site, partial thickness drilling of semicircular canal with adequately sized diamond burr may be required to exteriorize the cholesteatoma sac without any significant consequences.

Diagnosis

In patients with chronic ear disease with history of vertigo, fistula test is performed with the pneumatic otoscope. It may not be positive in some of the cases. It is because of cholesteatoma matrix occupying the antrum or sagging of posterior canal wall or polyp in canal wall hampering pressure transmitted to labyrinth through fistula, while performing the test. Significant

number of patients with fistula may not give history of vertigo, reason being, the fistula is completely draped by cholesteatoma sac lining. Thus, the presence of vertigo and/or a positive fistula test, as well as sensorineural hearing loss, should raise the suspicion for a fistula, but their absence does not guarantee an intact bony labyrinth (Dornhoffer and Milewski, 1995).

Most often, the high-resolution computed tomography (HRCT) scan of temporal bone with thinnest possible sections of bone window can demonstrate fistula (Fig. 3.1).

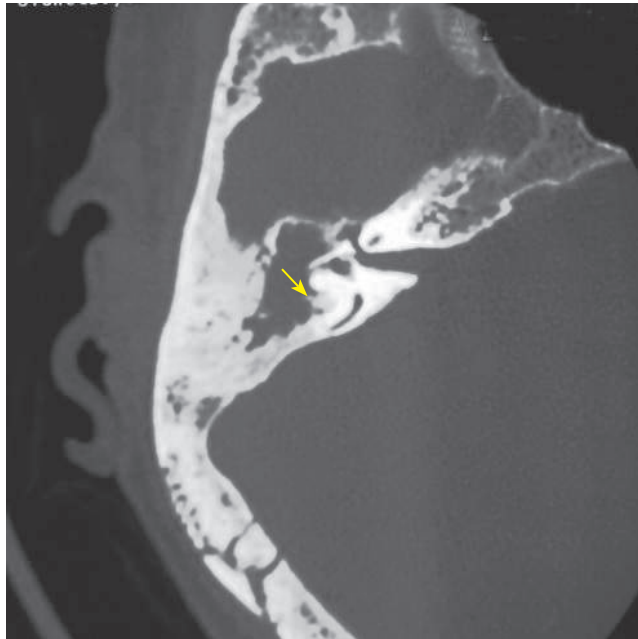


Fig. 3.1 HRCT demonstrating fistula of lateral semicircular canal (arrow).

Although a CT scan is the most reliable preoperative method for detection of labyrinthine fistula, the definitive diagnosis can only be made intra operatively.

Anticipation of Fistula

One should learn to anticipate the presence of fistula even if the patient did not have any vertigo preoperatively and CT scan performed preoperatively does not show fistula. This happens if adequately thin sections are not taken on CT scan.

While performing surgery if loss of convexity or dome of lateral semicircular canal with flattening of bulge of canal is visualized, one must anticipate fistula. Also in case the tympanic membrane (TM) is plastered to horizontal part of fallopian canal and promontory with absence of suprastructure of stapes, the possibility of fistula is higher (Figs. 3.2 and 3.3)

After clearing all loose matrix, occasionally one can visualize fistula under intact sac in case of cholesteatoma. Even, granuloma on lateral semicircular canal could be hiding fistula under it (Fig. 3.3). At the same time, in every case of extensive cholesteatoma or granulation tissue disease that is associated with facial nerve palsy suggesting osteolytic activity, the presence of fistula should be anticipated.

Management of Labyrinthine Fistula

Surgical management depends on the location, size, and depth (bony and/or membranous labyrinth) of the fistula as well as the condition of the other ear. There is always an effort toward complete removal of cholesteatoma with closure of the labyrinthine fistula in single stage.

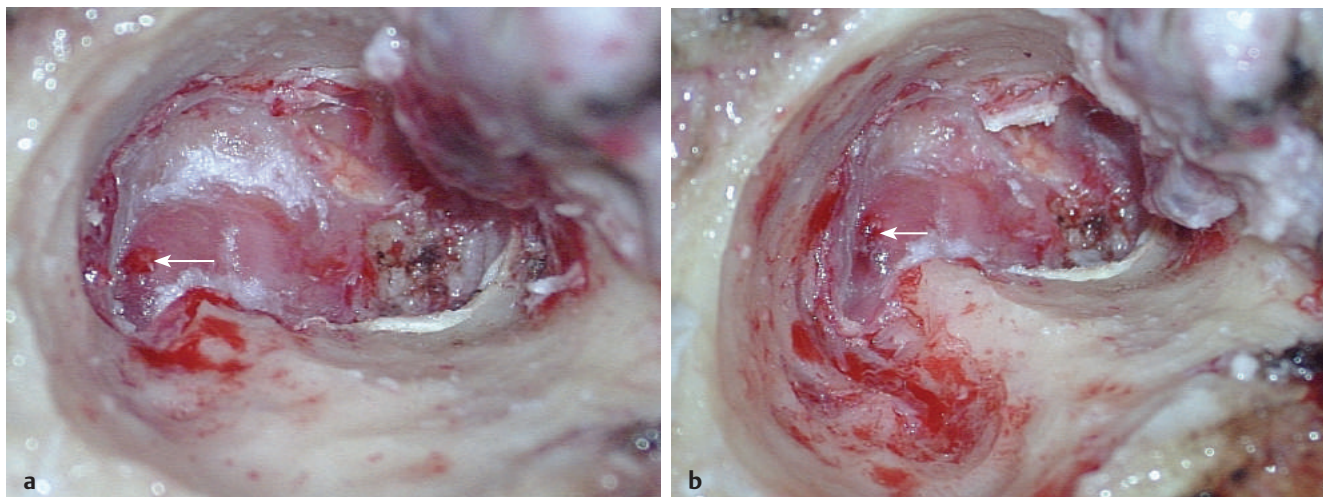


Fig. 3.2 (a, b) Picture showing granulation tissue under the sac in the region of lateral semicircular canal (white arrow). The tympanic membrane is seen plastered to horizontal part of fallopian canal and dome of lateral semicircular canal.

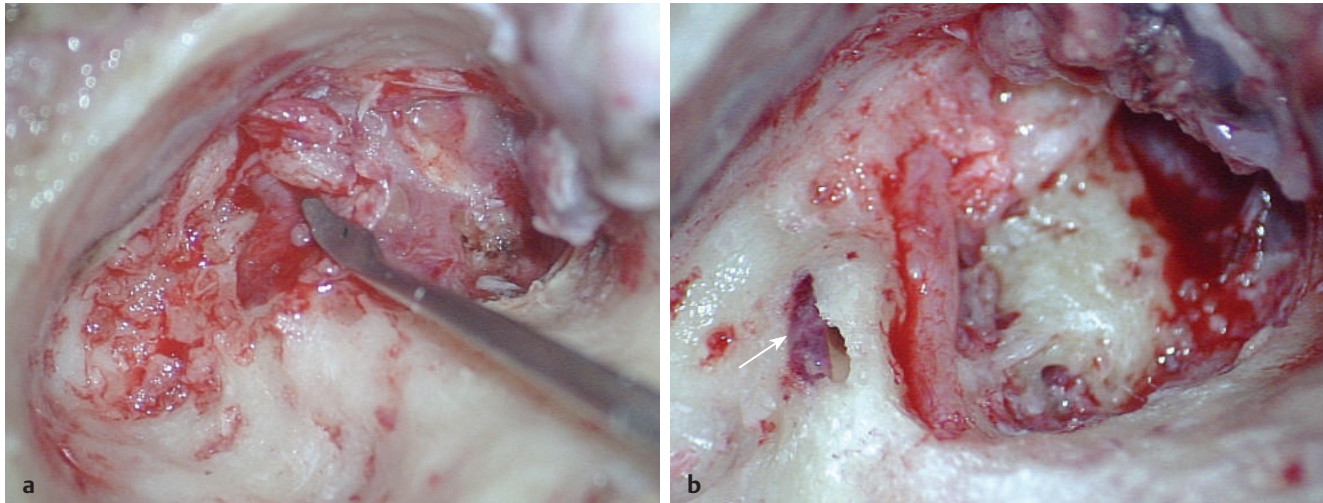


Fig. 3.3 (a) Plastered epithelium being lifted from underlying LSC and fallopian canal. (b) Granulation over fistula in LSC (arrow) with dehiscent facial nerve and absence of supra structure of stapes.

Superficial erosions of bony canal or cochlea should only be repaired with resurfacing technique, whereas plugging is preferred for deeper and larger fistula. One has to be careful, not to put unnecessary pressure or apply force while plugging, as it may lead to damage to membranous labyrinth with a risk of hearing deterioration.

Clearance of Disease from Fistula

After all disease is removed from the mastoid and the middle ear and there is no further need for drilling, cleaning, or irrigation, then the area of the fistula is uncovered, by peeling off the epithelium/granulations covering it. Authors believe in peeling off the sac with gentle microdissection using suction cannula of size 21 for holding the edge of sac and curved pick elevates the sac around and over the fistula. The important thing to remember is that, removal of sac over fistula and its repair is performed at the last stage, after all the drilling work and clearance of complete disease of the mastoid (Figs. 3.4 and 3.5).

In rare situations, where the sac is firmly adherent to the membranous labyrinth, authors believe in leaving the sac behind after removal of disease from rest of the quadrants and performing required ossiculoplasty and tympanoplasty in the first stage. Firmly adherent sac over thinned out, fractured, or partly floating footplate are other places where the firmly adherent sac is left behind to avoid creation of fistula in first stage surgery. Removal of sac during second stage is much easier once infection in mastoid cavity and middle ear is under control.

Repair of Semicircular Canal Fistula

Authors believe in repair of small fistula in three-layers closure. The first layer is with small piece of soft tissue or muscle from postaural area. This piece should be

plugged in the bony defect adequately, though undue force should be avoided during insertion to prevent damage to membranous labyrinth (Fig. 3.6). The second-layer closure involves use of bone dust, which should be secured in place with bone wax, which forms the third layer of closure (Fig. 3.7). Large sized fistula repair involves the four-layer closure, whereas the first-layer closure is similar with soft tissue. The second-layer closure involves use of piece of sliced cartilage with excess perichondrium. Cartilage should be fitting snugly in bony defect and excess perichondrium spreading over the surrounding bone. The third layer involves the use of bone dust secured with the bone wax, which becomes the fourth layer (Fig. 3.8). As fistula is present in extensive cholesteatoma and granulation tissue disease, most of the patients require canal wall down mastoidectomy where the mastoid cavity is obliterated with the use of bone dust, cartilage pieces, and pedicled muscle flap. These materials act as additional layers of support for repaired fistula. These materials are covered with fascia graft.

In cases of extensive cholesteatoma or granulation tissue disease invading the semicircular canal associated with sensorineural hearing loss, the authors widen the margin of fistula with diamond burr and exteriorize the sac or granulation tissue, which is then removed gently. Epithelium is always removed in toto. As size of this fistula is larger it will be repaired with the four-layer closure with cartilage as described earlier.

Rarely, there is extensive erosion of semicircular canal with dead ear. In such cases, drilling around the fistula should be performed with removal of disease along with remnant membranous labyrinth with an adequate four-stage repair.

Very rarely extensive destruction of semicircular canal, dead ear, and intense vertigo may require labyrinthectomy.

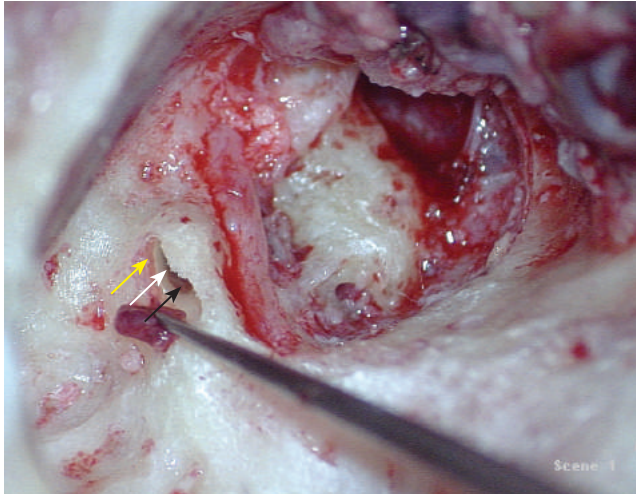


Fig. 3.4 Granulation from fistula being removed. The fistula is up to the depth of endosteum of bony labyrinth sparing membranous labyrinth. Periosteum (yellow arrow), bone (white arrow), and endosteum (black arrow).



Fig. 3.5 Fistula after clearance of granulation.

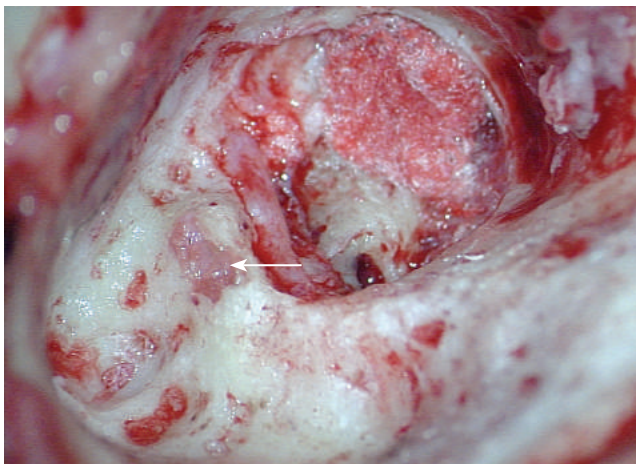


Fig. 3.6 Muscle piece plugged into fistula (arrow).

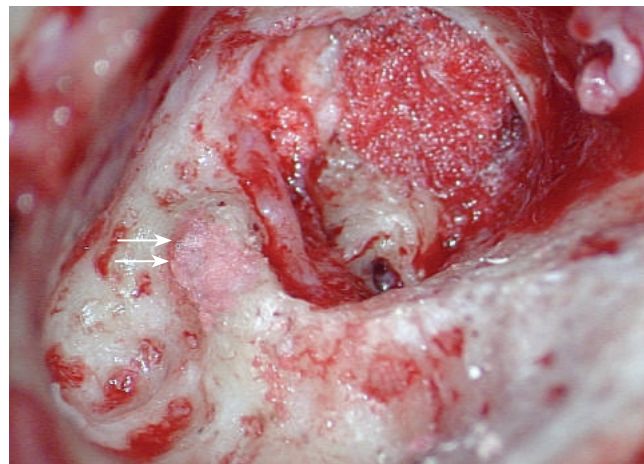


Fig. 3.7 Bone dust placed over fistula (arrows).

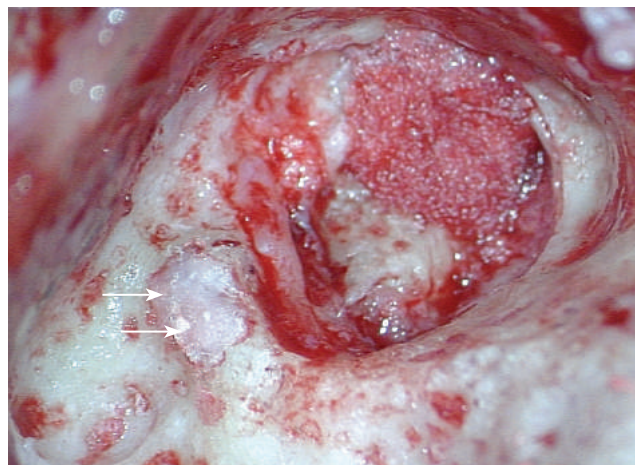


Fig. 3.8 Bone wax placed over bone dust to stabilize (arrows).

Case 1: Cholesteatoma with Labyrinthine Fistula and Facial Nerve Paresis (Right Ear)

Patient presented with complaint of foul smelling discharge from right ear for 2 years with intermittent vertigo for 3 months, and facial nerve paresis for 2 weeks.

Otomicroscopy revealed sagging of posterior canal wall with plastered TM and cholesteatoma flakes.

Pus is sent for culture and sensitivity testing. Patient started with appropriate antibiotics during preoperative period.

Surgical Steps

Postaural incision is given and temporalis fascia graft is harvested. Musculoperiosteal incision is given and posteroinferiorly based musculoperiosteal flap is elevated.

On elevation of canal wall skin, cholesteatoma matrix is visualized eroding the posterosuperior part of bony external auditory canal extending up to annulus (Figs. 3.9 and 3.10). External canal skin is elevated in three-fourth circumference up to annulus and mobilized laterally (Figs. 3.11–3.13). Plastered tympanic membrane is visualised after lifting the EAC skin.

Canaloplasty with inside out atticotomy is performed and collection of bone dust performed intermittently (Figs. 3.14 and 3.15). Cholesteatoma is visualized extending from aditus, antrum up to mastoid air cells (Fig. 3.16). Cholesteatoma sac is followed in an inside out manner along with collection of bone dust from healthy mastoid cortex as described earlier in Volume 1 (Figs. 3.16–3.18).

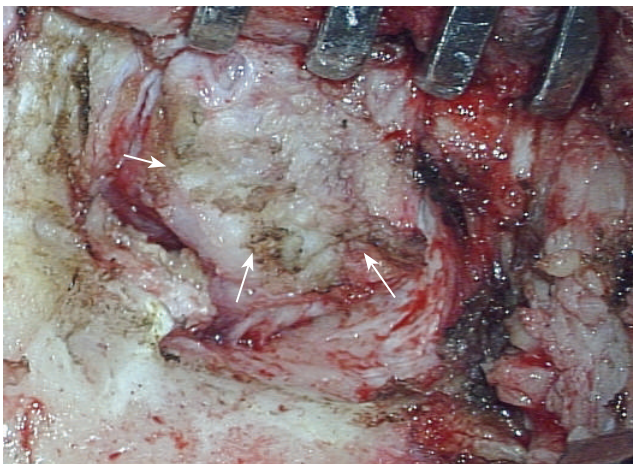


Fig. 3.9 External auditory canal skin being mobilized in three-fourth circumference (arrows).

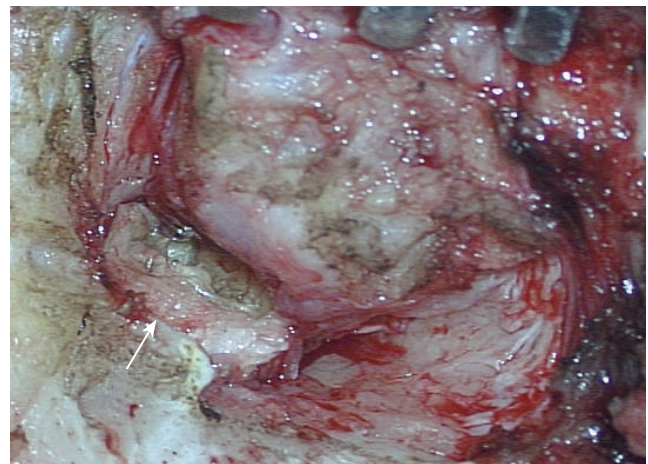


Fig. 3.10 Cholesteatoma flakes visualized eroding posterosuperior bony canal wall (arrow).

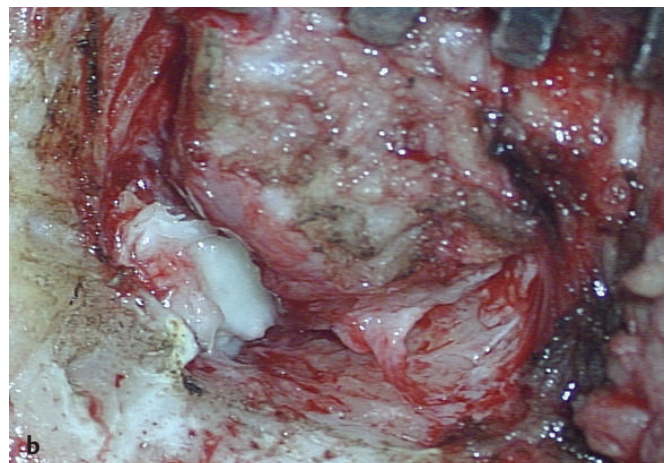
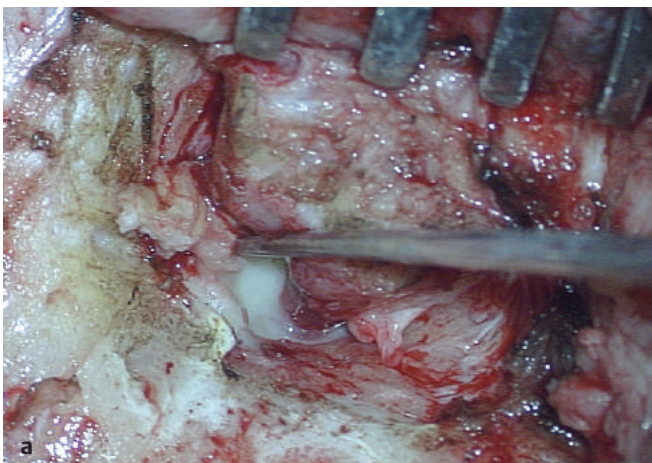


Fig. 3.11 (a) Cholesteatoma extending up to annulus, small amount of mucopus drained. **(b)** External canal skin mobilized further and pus drained.

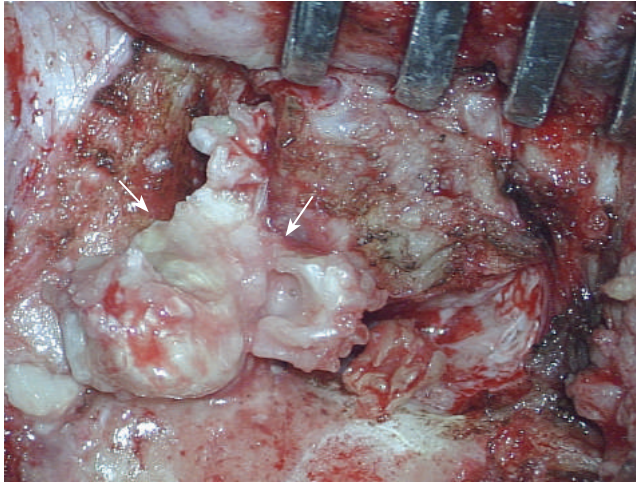


Fig. 3.12 Cholesteatoma matrix debulked (*arrows*).



Fig. 3.13 Plastered tympanic membrane visualized.

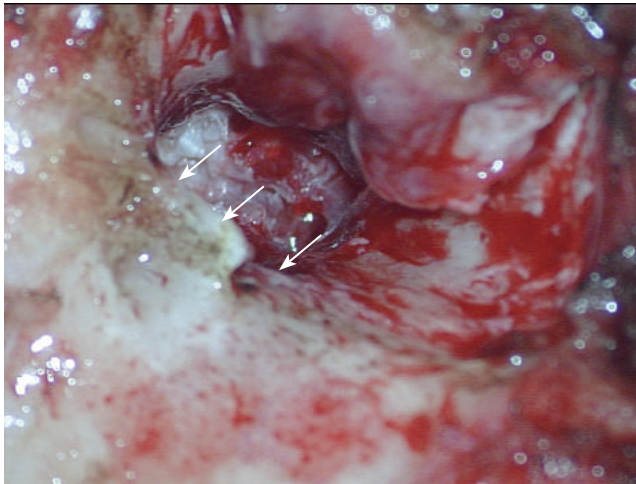


Fig. 3.14 After mobilisation of EAC skin, the posterior canal wall bony overhang (*arrows*) to be drilled for canalplasty.

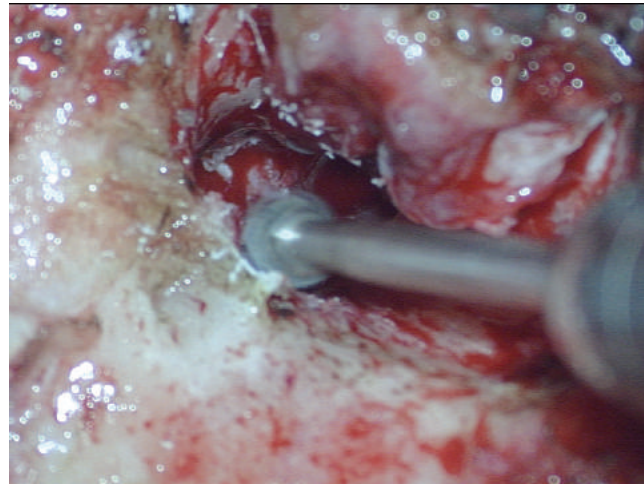


Fig. 3.15 Canalplasty in progress.

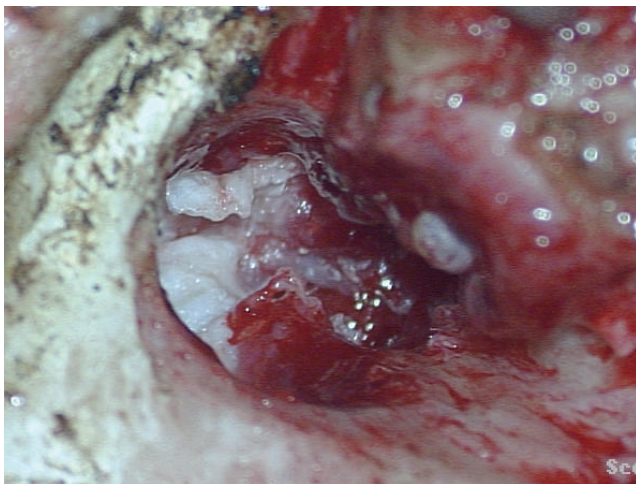


Fig. 3.16 Inside out atticotomy in progress.

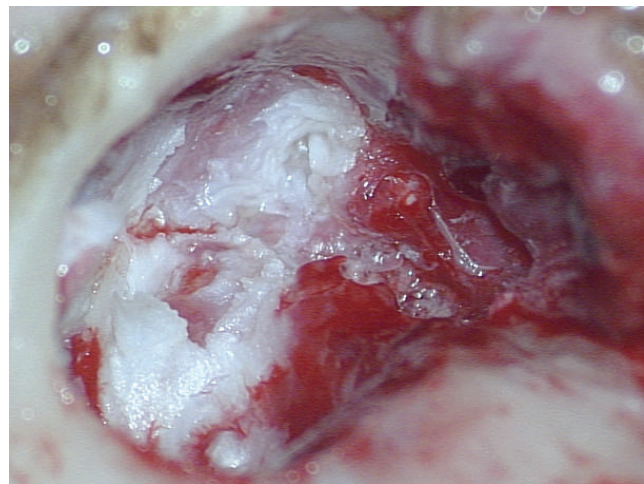


Fig. 3.17 Inside out atticotomy extended to aditus and antrum while following the cholesteatoma sac.

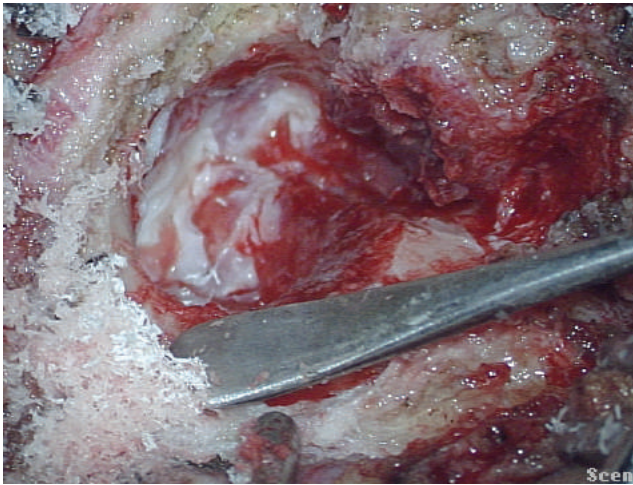


Fig. 3.18 Bone dust from healthy mastoid cortex being collected.

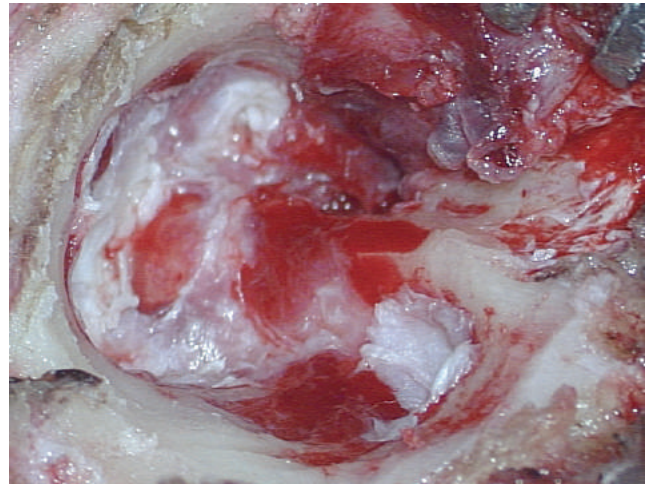


Fig. 3.19 Facial ridge lowered along with inside out mastoidectomy.

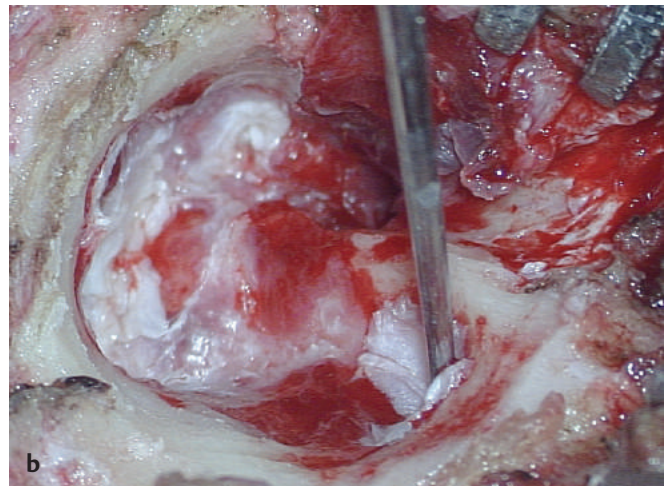
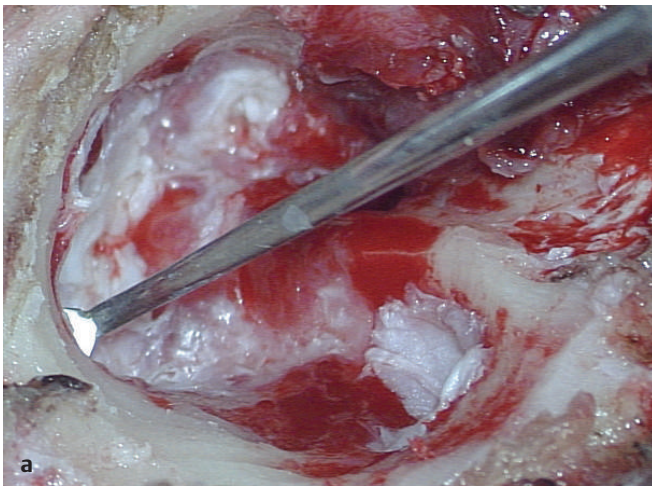


Fig. 3.20 (a) Depth of overhanging bone lateral to cholesteatoma in sinodural angle being demonstrated. (b) Depth of bony overhang lateral to cholesteatoma sac at mastoid tip being demonstrated.

As cholesteatoma extends up to sinodural angle and mastoid tip, the canal wall down mastoidectomy is performed (**Fig. 3.19**). All the bony overhangs are drilled to exteriorize cholesteatoma sac in complete circumference (**Figs. 3.20** and **3.21**). Granulation tissue is visualized lateral to sigmoid sinus and presigmoid area and also in the region of vertical part of fallopian canal inferior to lateral semicircular canal (**Fig. 3.22**).

Cholesteatoma sac is elevated in continuity from mastoid tip area toward labyrinthine block, antrum, aditus, and debulked (**Fig. 3.23**). Granulation tissue is

visualized deeper to sac over lateral semicircular canal (**Fig. 3.24**). Granulation tissue over facial nerve is removed (**Fig. 3.25**).

Lowering and thinning of facial ridge are performed with diamond burr to expose plastered epithelium in the region of sinus tympani (**Fig. 3.26**). Exposed facial nerve is decompressed further for few millimeters in either direction (**Fig. 3.27**). Plastered TM from promontory and attic is elevated and preserved (**Figs. 3.28–3.31**). Polishing of cavity is performed. Granulation tissue over sigmoid sinus and presigmoid dural plate is bipolarized (**Fig. 3.32**).

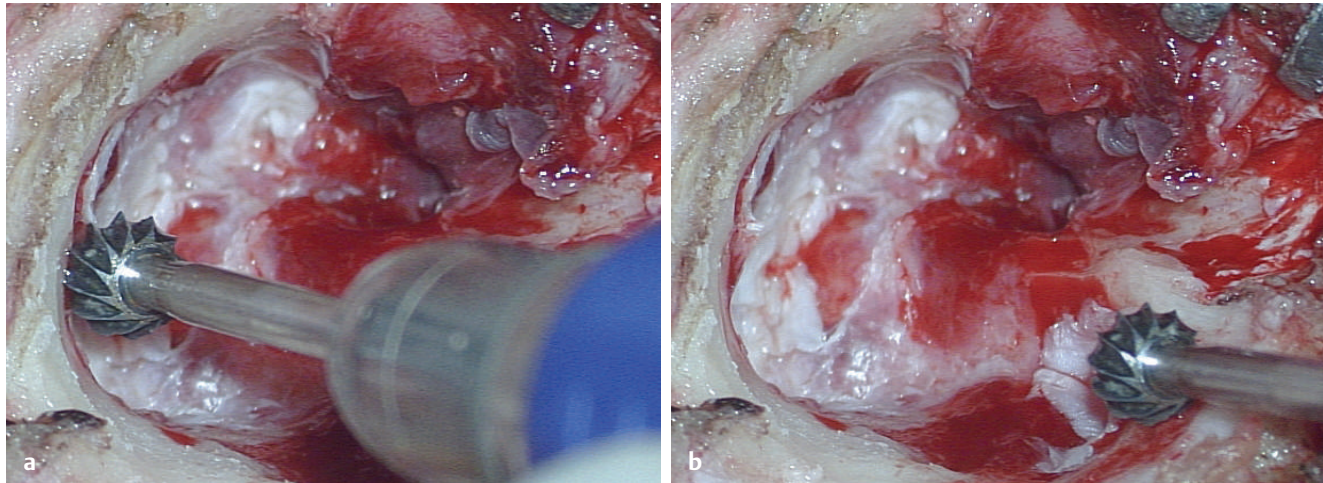


Fig. 3.21 (a) Bony overhang at sinodural angle being drilled. (b) Bony overhang in mastoid tip area being drilled.

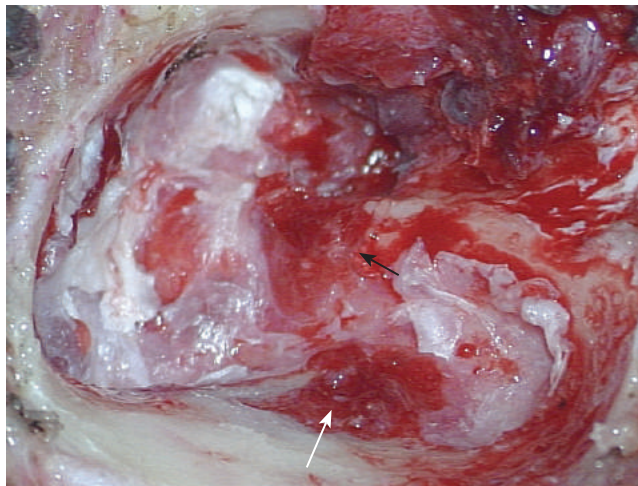


Fig. 3.22 Cholesteatoma sac exteriorized in complete circumference. Granulation tissue visualized in area of sigmoid sinus and presigmoid area (*white arrow*). Granulation tissue in the region of vertical fallopian canal (*black arrow*).

Granulation tissue from lateral semicircular canal fistula is mobilized gently and membranous labyrinth preserved (**Fig. 3.33**). As the fistula involves only the bony labyrinth (**Fig. 3.34**), repair is performed in two layers of bone dust and bone wax (**Fig. 3.35**). Floor and tragal cartilages are harvested. Boomerang shaped cartilage is harvested from tragal cartilage and used for ossiculoplasty extending from footplate to anteroinferior annulus, maintaining the middle ear space as well (**Fig. 3.36**).

Partial obliteration of mastoid cavity is performed with cartilage pieces, bone dust (**Fig. 3.37**). Further obliteration of mastoid cavity is achieved by placing pedicled postaural muscle flap, after splitting it in width to create sufficient length, to fill the inferior portion of mastoid cavity. Large temporalis fascia graft is placed to reconstruct TM and cover bone dust (**Fig. 3.38**), any exposed bone, and pedicled postaural muscle (**Fig. 3.39**). Meatoplasty is performed as usual (**Figs. 3.40** and **3.41**). Postaural wound is sutured and dressed.

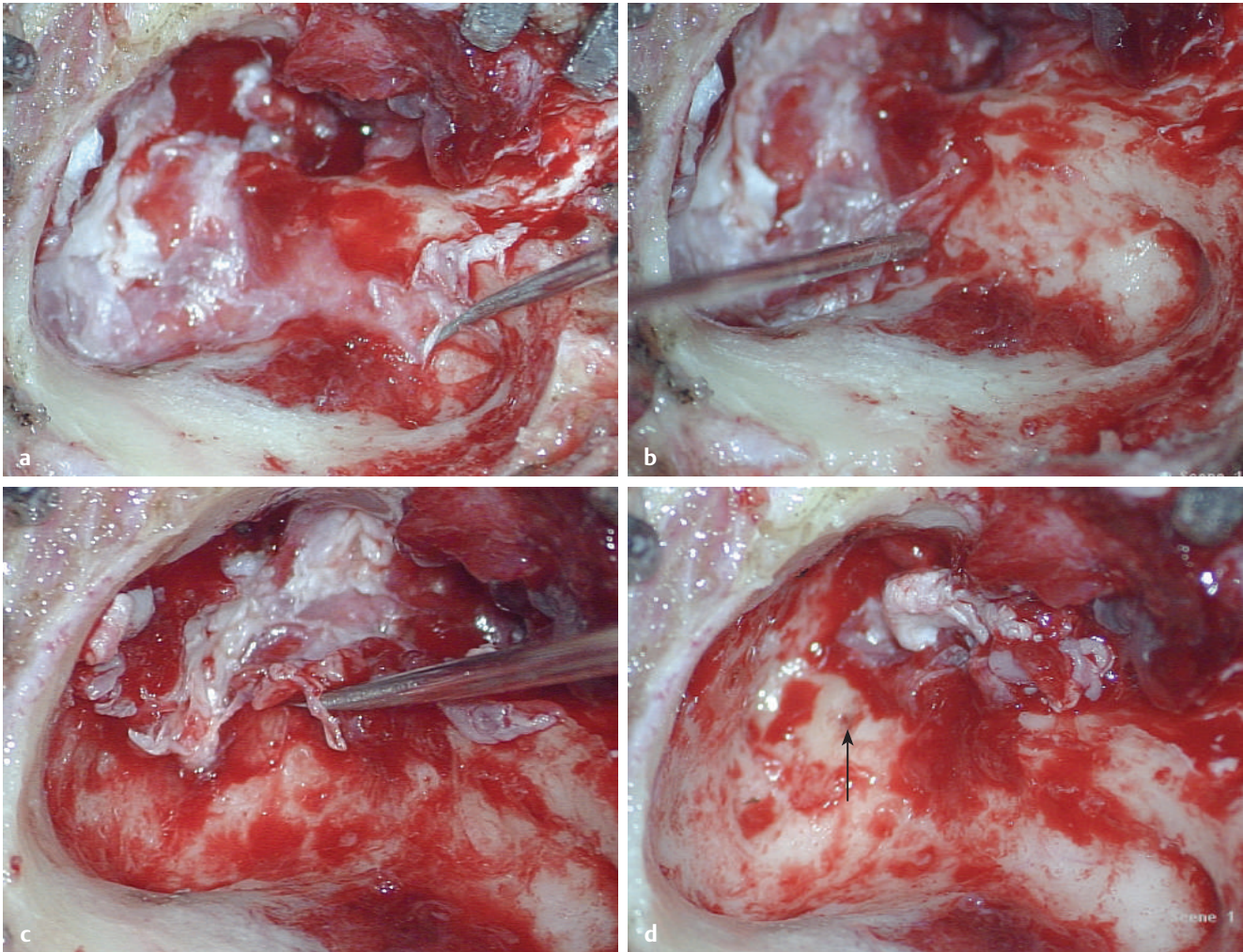


Fig. 3.23 (a) Cholesteatoma sac being elevated from the mastoid tip area with a curved needle. (b) Cholesteatoma sac being elevated from the area of labyrinthine block. (c) Cholesteatoma sac being elevated from the antrum. (d) Cholesteatoma sac elevated up to aditus. Appearance of fistula in the dome of lateral semicircular canal (*arrow*) with flattening of convexity of LSC dome.

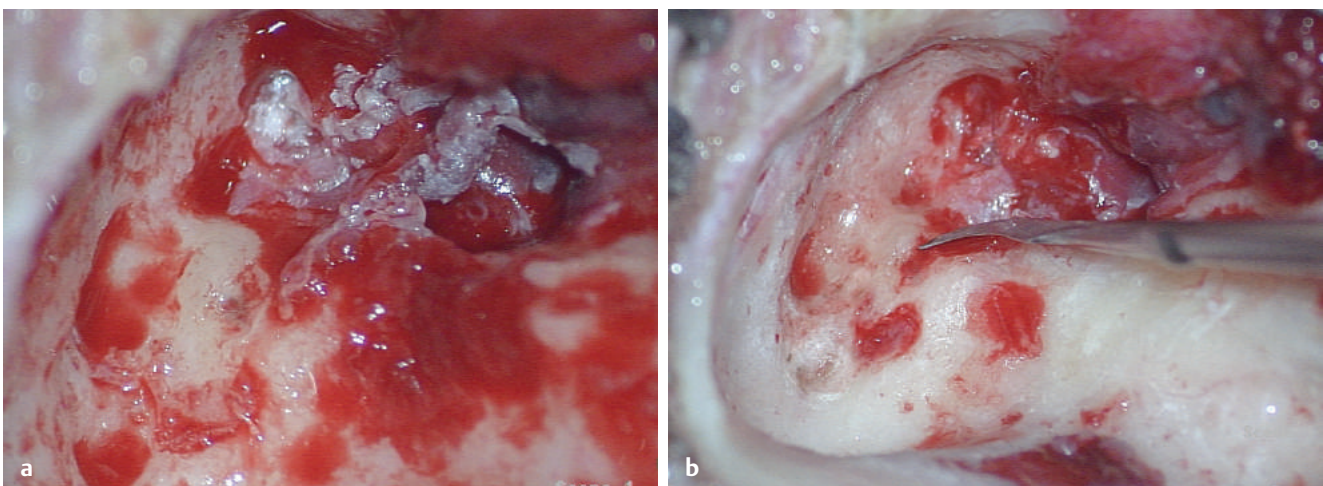


Fig. 3.24 (a) Granulation tissue in the region of fallopian canal visualized better. (b) Granulation in the region of lateral canal being pointed; notice flattening of the dome of lateral semicircular canal.

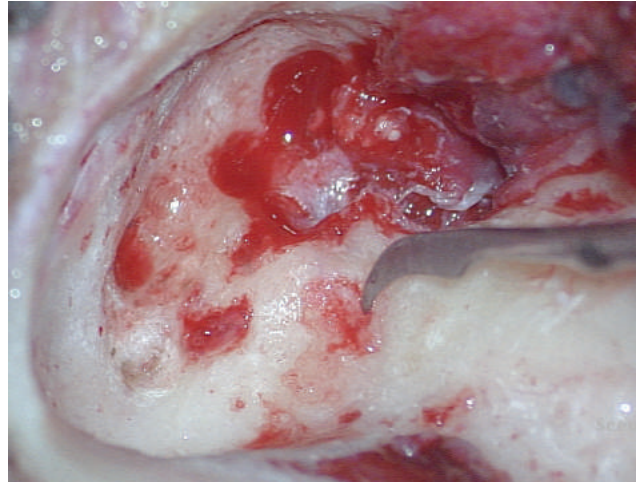


Fig. 3.25 Granulation over vertical facial nerve removed.

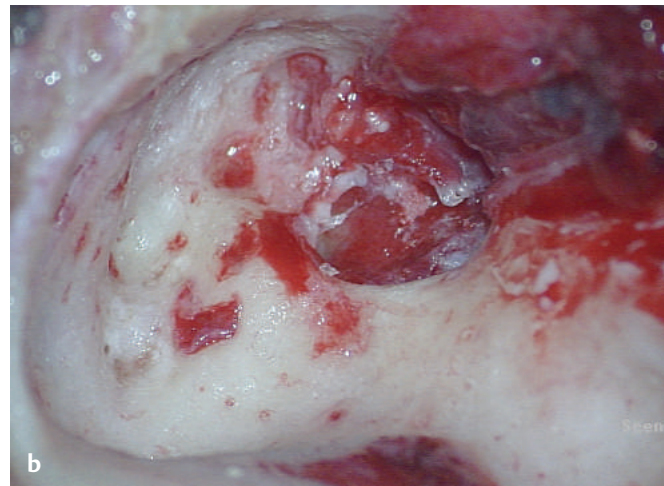
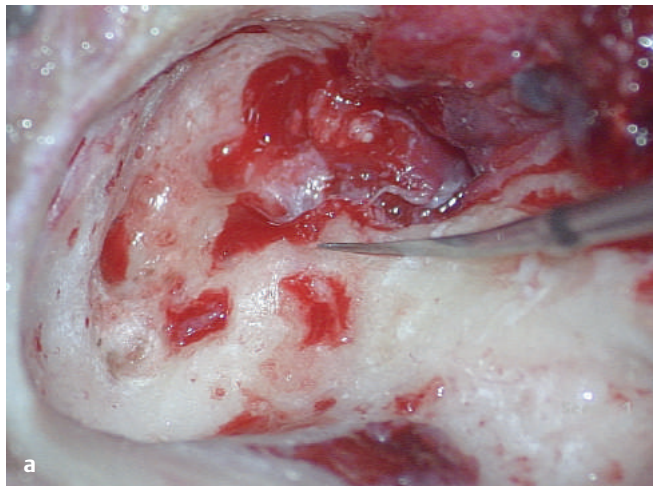


Fig. 3.26 (a) Sufficient lowering of facial ridge achieved. Overhanging facial ridge which needs to be thinned is being pointed out with sickle knife. (b) Thinning of facial ridge performed. Plastered tympanic membrane in sinus tympani visualized better.

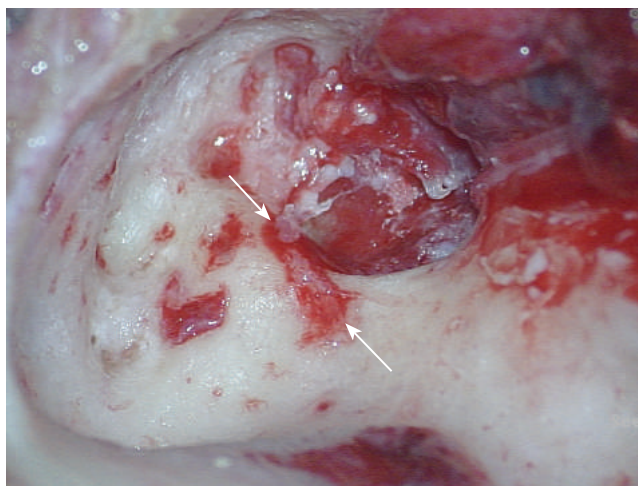


Fig. 3.27 Facial nerve decompressed in either direction (arrows).

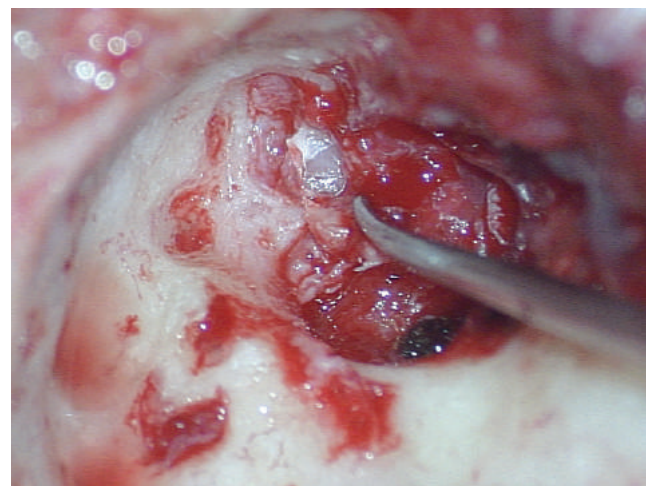


Fig. 3.28 Epithelium in sinus tympani and supratubal area being mobilized to clear anterior ventilation pathway.

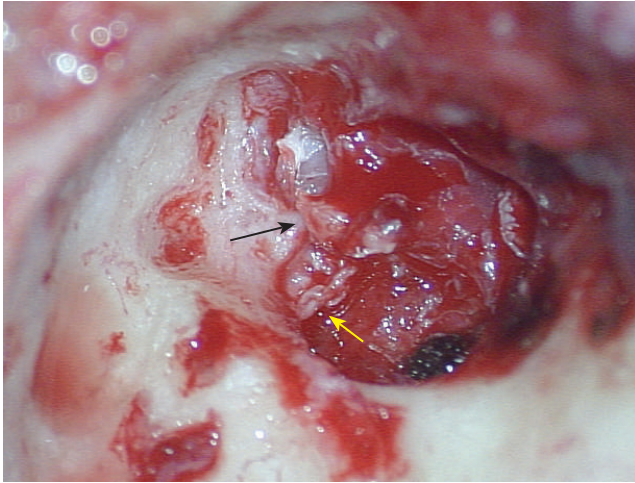


Fig. 3.29 Processus cochleariform (black arrow) and plastered tympanic membrane over footplate area (yellow arrow) visualized.

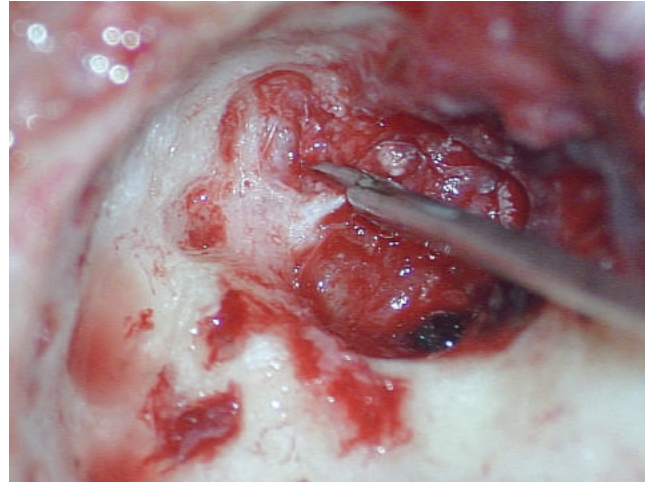


Fig. 3.30 Tensor tympani tendon being cut.

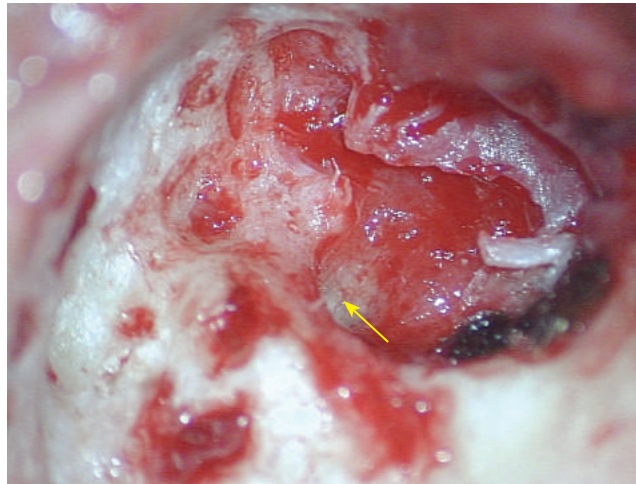


Fig. 3.31 Plastered tympanic membrane mobilized and preserved. Footplate visualized (arrow).

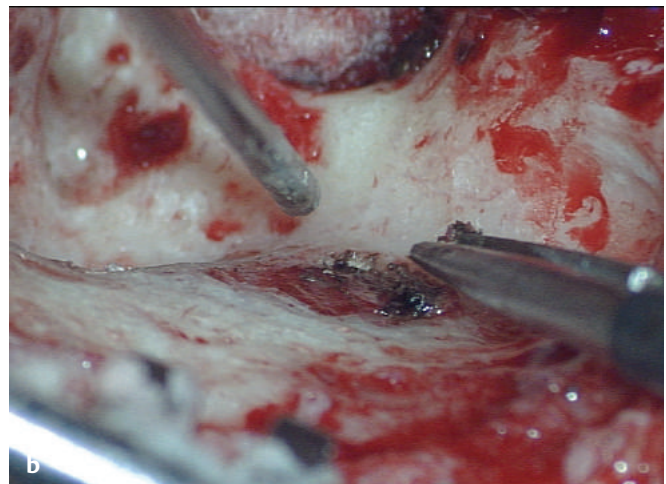
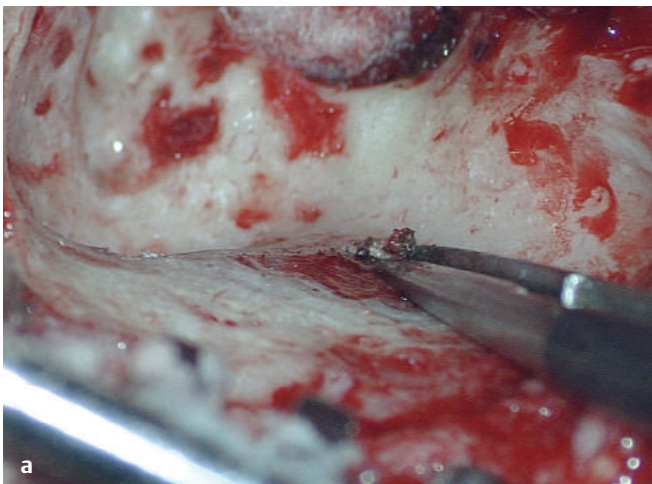


Fig. 3.32 (a, b) Granulation over sigmoid sinus being bipolarized and cleared.

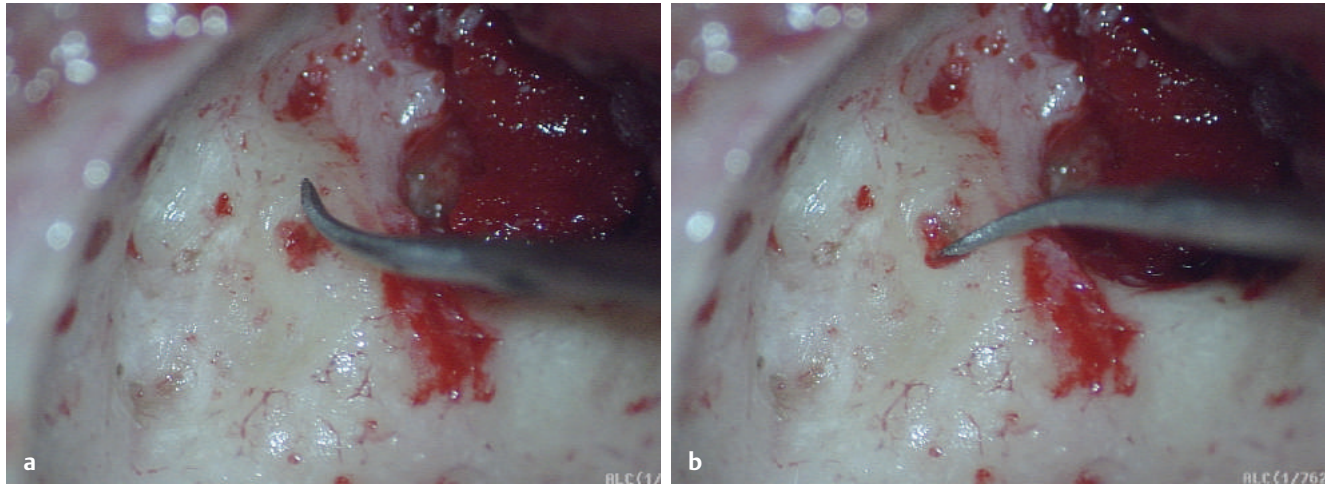


Fig. 3.33 (a) Lateral semicircular canal being puncted out. (b) Granulation tissue from fistula being removed.

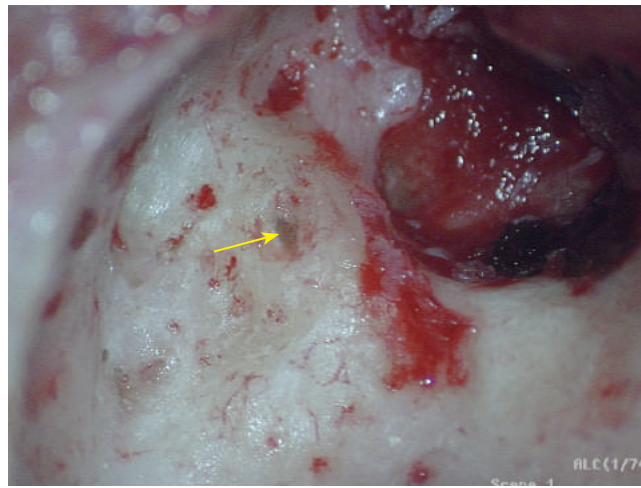


Fig. 3.34 Fistula with intact endosteum covering the membranous labyrinth (*arrow*).



Fig. 3.35 (a) Bone dust placed over fistula (*arrow*). (b) Bone dust covering the fistula (*arrow*).

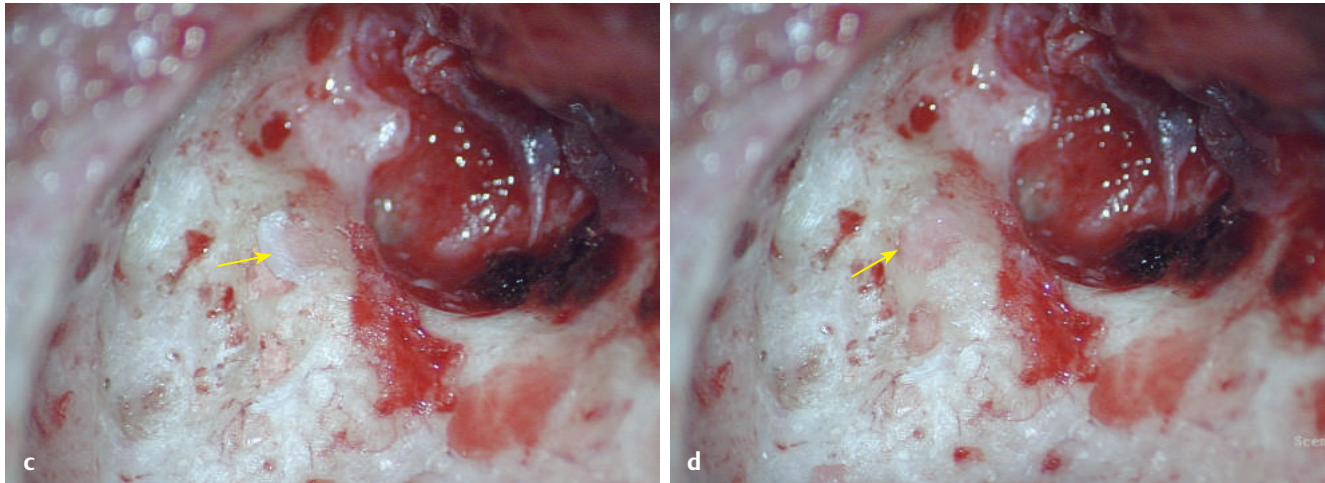


Fig. 3.35 (Continued) (c) Bone wax placed over bone dust (arrow). (d) View after repair of fistula (arrow).

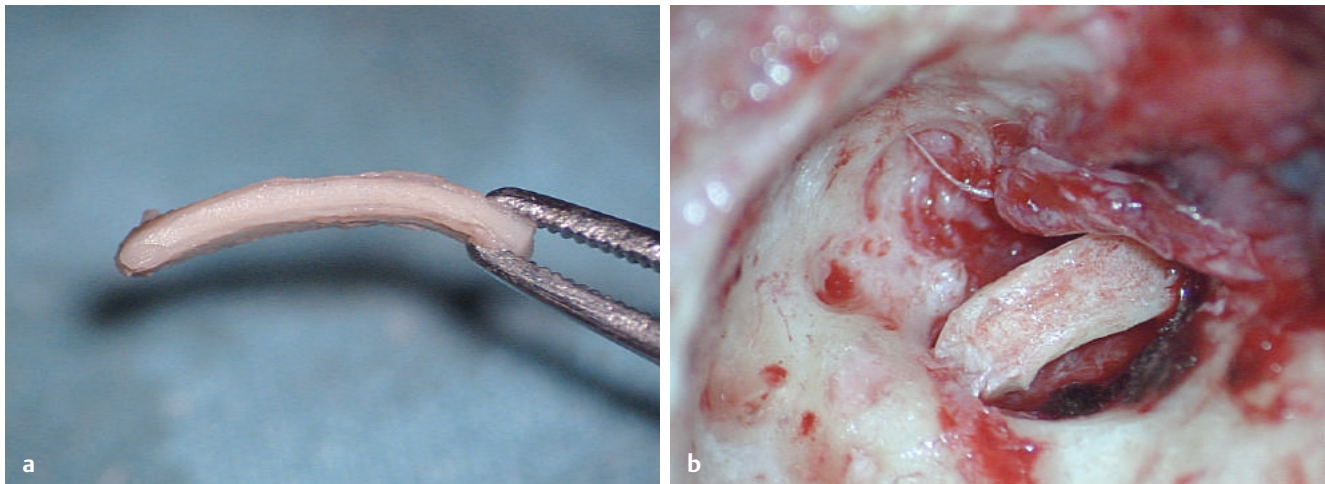


Fig. 3.36 (a) Boomerang shape cartilage. (b) Boomerang shape cartilage placed from footplate to anteroinferior annulus.

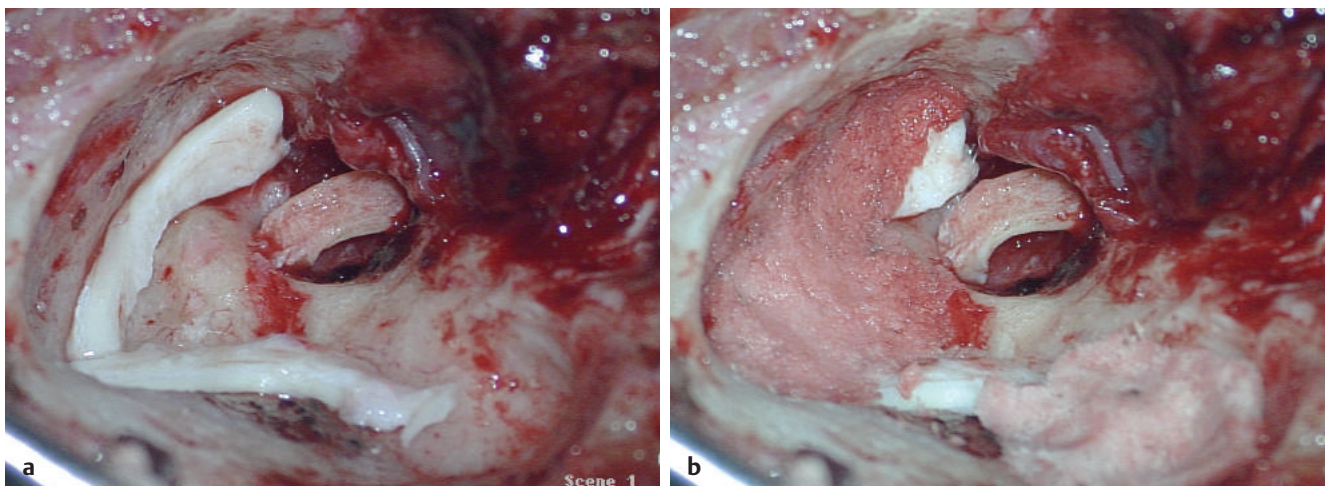


Fig. 3.37 (a) Cartilage pieces placed for reducing depth of cavity. (b) Bone dust placed over cartilage.

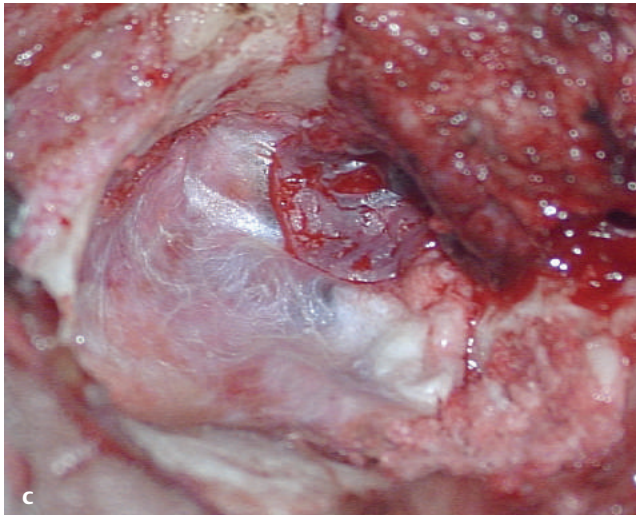
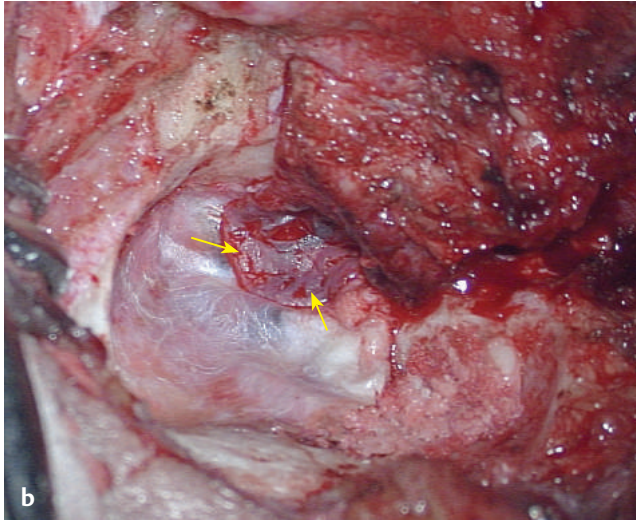
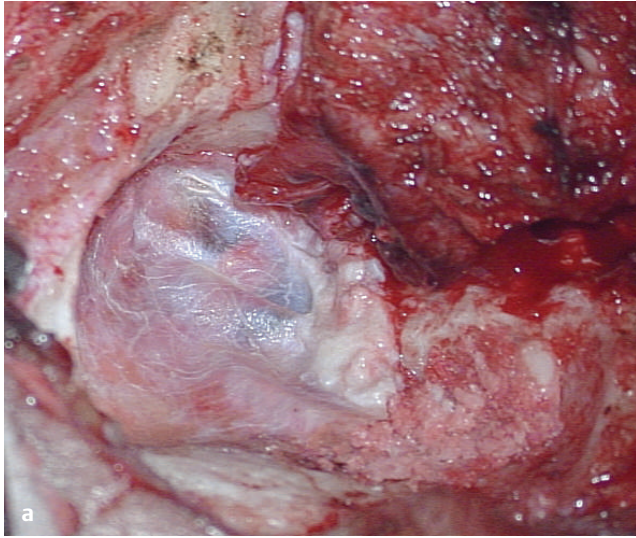


Fig. 3.38 (a) Temporalis fascia graft placed to reconstruct tympanic membrane and over bone dust. (b, c) Residual tympanic membrane repositioned over fascia graft. Notice the dimension of preserved plastered tympanic membrane (*arrows*).

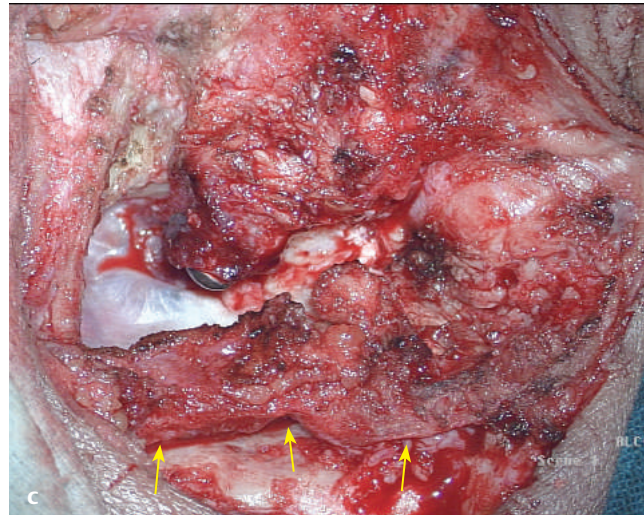
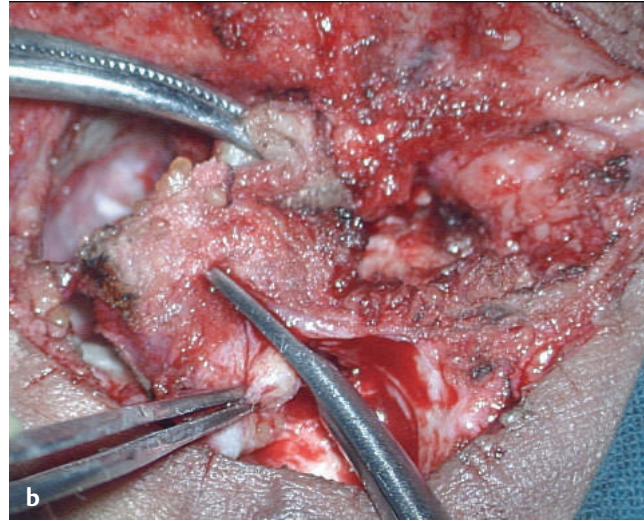
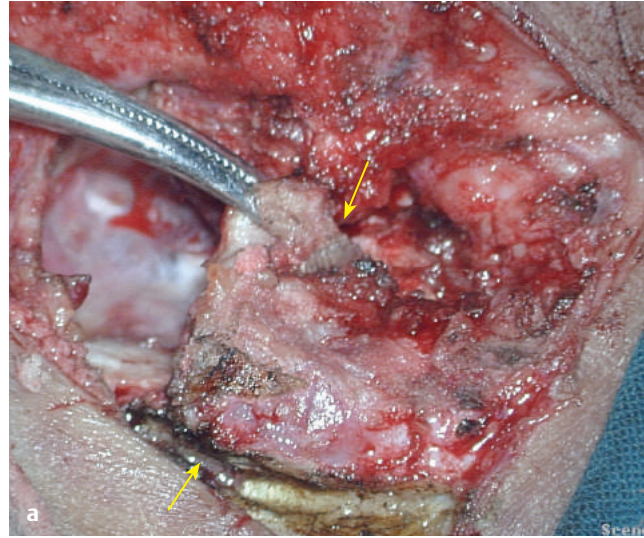


Fig. 3.39 (a) Notice width of postaural muscle flap (*arrows*). (b) Postaural muscle flap being split in width. (c) Notice length of postaural muscle flap (*arrows*).

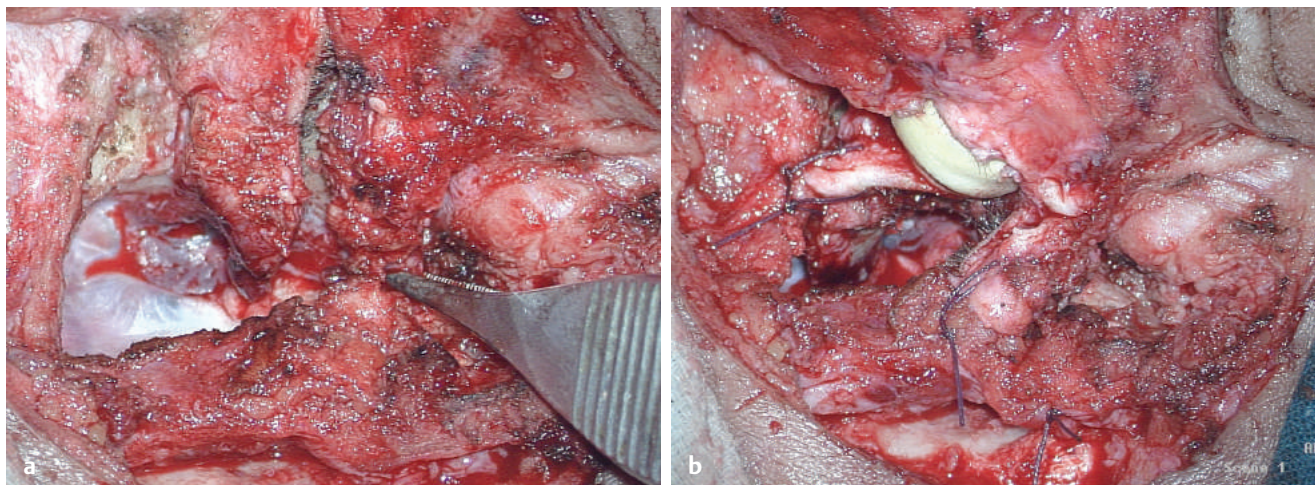


Fig. 3.40 (a) Meatoplasty in progress. External canal skin incised at the 9 o'clock position up to conchal cartilage. (b) Superior and inferior meatoplasty flaps are sutured after giving horizontal incisions in EAC skin at the level of conchal cartilage. Dimensions of meatoplasty being demonstrated.

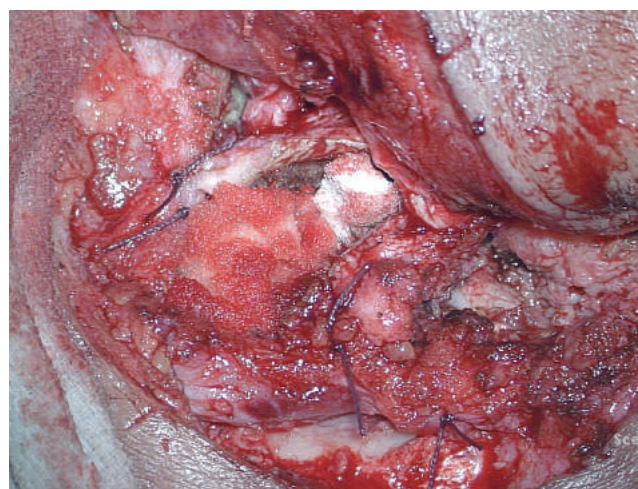


Fig. 3.41 Canal and cavity packed with Gelfoam.

Case 2: Extensive Cholesteatoma with Subperiosteal Fistula of Mastoid Cortex and Erosion of Posterosuperior Canal Wall with Fistula in Lateral Semicircular Canal (Left Ear)

This is a case of discharging ear (foul ear smelling discharge) with hearing loss, puffiness in the postaural area, and sagging of the posterosuperior canal left ear is taken up for inside out mastoidectomy (**Fig. 3.42**).

Pure tone audiometry shows moderate conductive hearing loss.

Postaural incision given, temporalis fascia graft harvested, postaural musculoperiosteal flap elevated posteroinferiorly, and mastoid fistula visualized. External auditory canal (EAC) skin is elevated in three-fourth circumference and mobilized anterolaterally.

Cholesteatoma matrix is visualized under the canal skin flap secondary to the bony erosion.

As there is fistula in mastoid cortex and erosion of posterosuperior canal wall, exteriorization of cholesteatoma sac is performed following the cholesteatoma from mastoid cortex and posterosuperior canal wall. After drilling of all overhanging bone lateral to the matrix and cholesteatoma sac in all dimensions, matrix is cleared and sac is removed in continuity except over fistula in lateral semicircular canal (**Fig. 3.43**). All the cells deeper to cholesteatoma sac are polished along with tegmen plate,

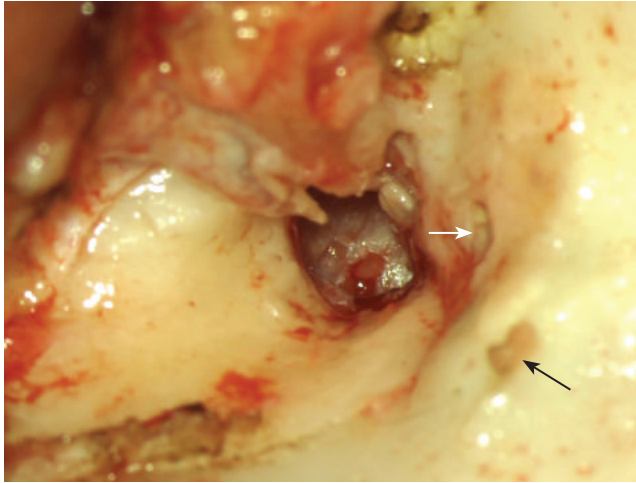


Fig. 3.42 Fistula of mastoid cortex (*black arrow*), erosion of posterosuperior canal wall (*white arrow*), plastered TM noted in the depth.

sinus plate, and presigmoid area (**Fig. 3.44**). Bone dust is collected from healthy noncholesteatoma bearing area of mastoid cortex.

Floor cartilage is excised as part of soft tissue meato-plasty as well as for partial obliteration of mastoid cavity. Residual epithelium and underlying minimal granulation over lateral semi-circular canal fistula are cleared with due precautions and repair of fistula in multiple layer performed as described earlier (**Figs. 3.45** and **3.46**).

Ossiculoplasty

As stapes is intact and mobile, reshaped head of malleus is placed over head of stapes to give adequate depth to middle ear (**Fig. 3.47**). Bony sockets are obliterated with multiple pieces of cartilage (**Fig. 3.48**). Inferiorly based postaural muscle flap mobilized and used to reduce depth and dimensions of the cavity, mainly to

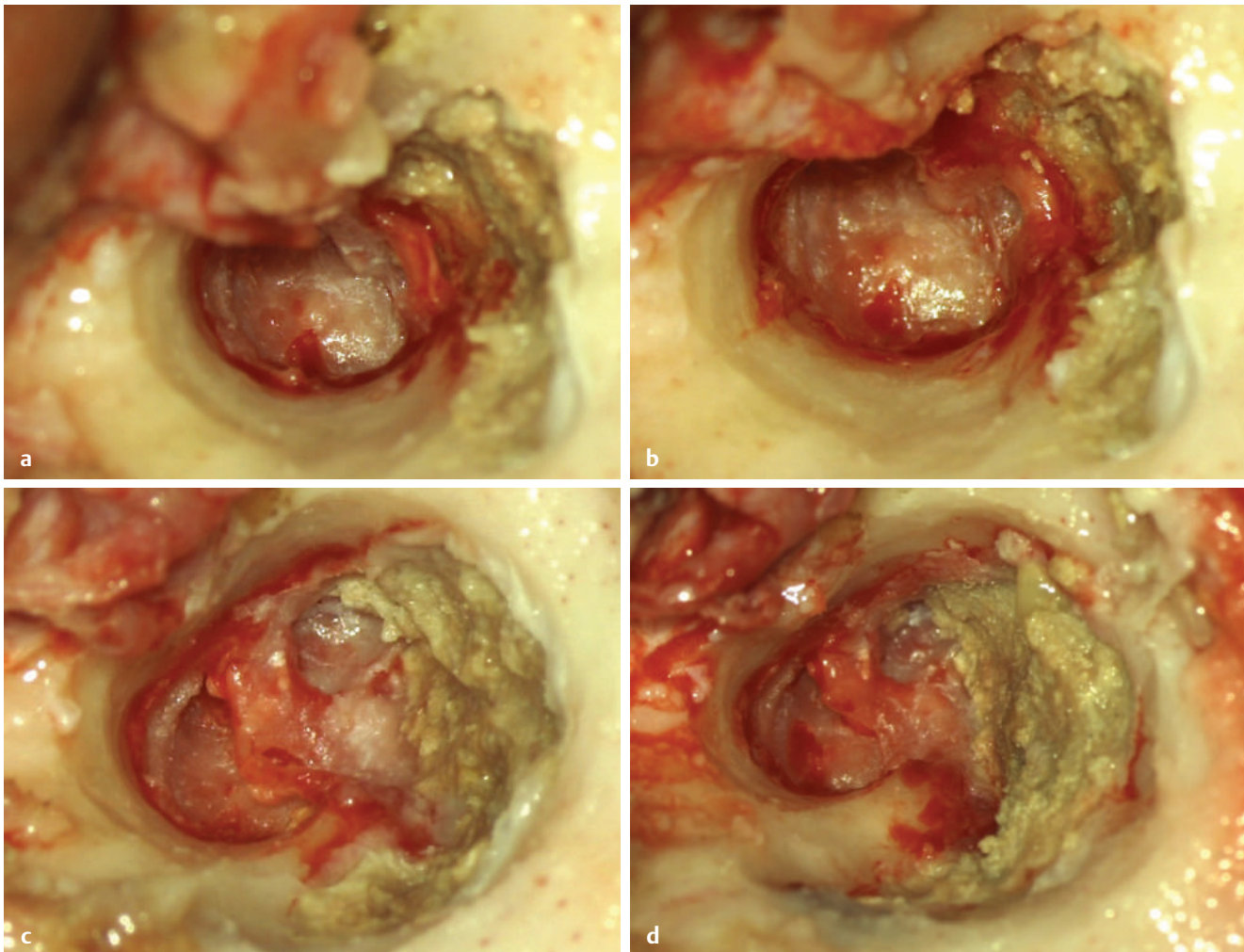


Fig. 3.43 (a) Drilling of mastoid cortex along the margins of erosion of external canal and mastoid fistula in an inside out manner. (b) Further drilling of mastoid cortex lateral to margin of sac toward tegmen plate. (c) Further drilling of cortex toward sinodural angle and mastoid tip. (d) Further drilling of mastoid cortex with partial debulking of matrix and lowering of facial ridge.

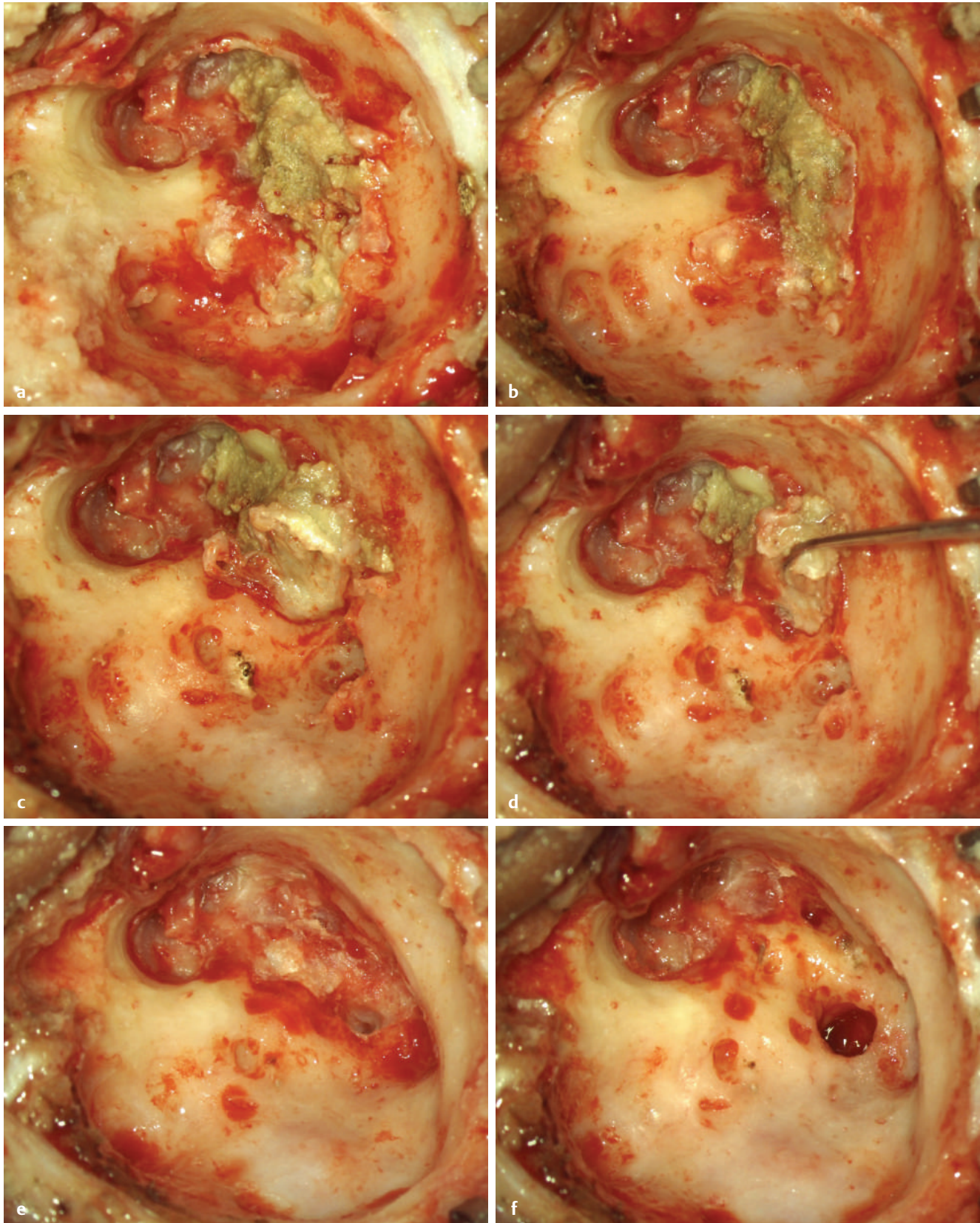


Fig. 3.44 (a) Tegmen plate up to sinodural angle lateral to cholesteatoma matrix polished out. (b) Facial ridge lowered and thinned, floor of EAC drilled to align with the floor of the cavity. Cholesteatoma matrix partly debulked. (c) Mastoid cavity polished from tegmen to sinodural angle, sinus plate, and floor of the cavity, residual cholesteatoma sac lifted toward antrum and attic. (d) Cholesteatoma sac being mobilized from the antrum. (e) Debulking of cholesteatoma sac up to aditus performed. (f) Further polishing of cavity, drilling of floor of canal, lowering, and thinning of facial ridge performed.

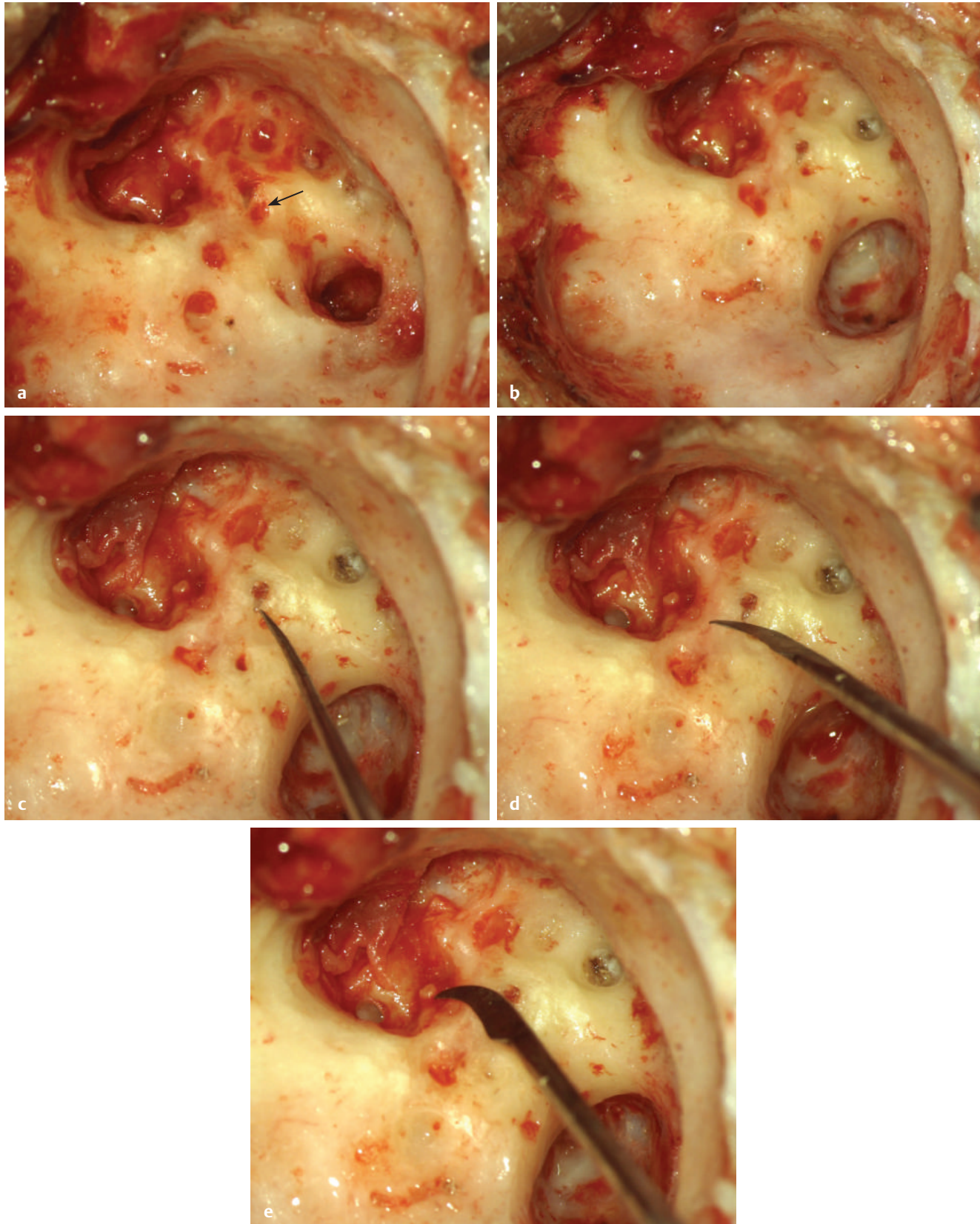


Fig. 3.45 (a) The sac mobilized from the attic and the plastered TM elevated in continuity with the sac. The plastered TM also elevated from suprastructure of stapes and promontory. Granulation tissue (*arrow*) seen over flattened LSC (convexity of LSC eroded). (b) Floor of attic polished, notice bony socket created to eradicate air cells posterior to semicircular canals. (c) Fistula of LSC after removal of granulation around it. (d) Second genu of facial nerve. (e) Stapes being pointed out with sickle knife.

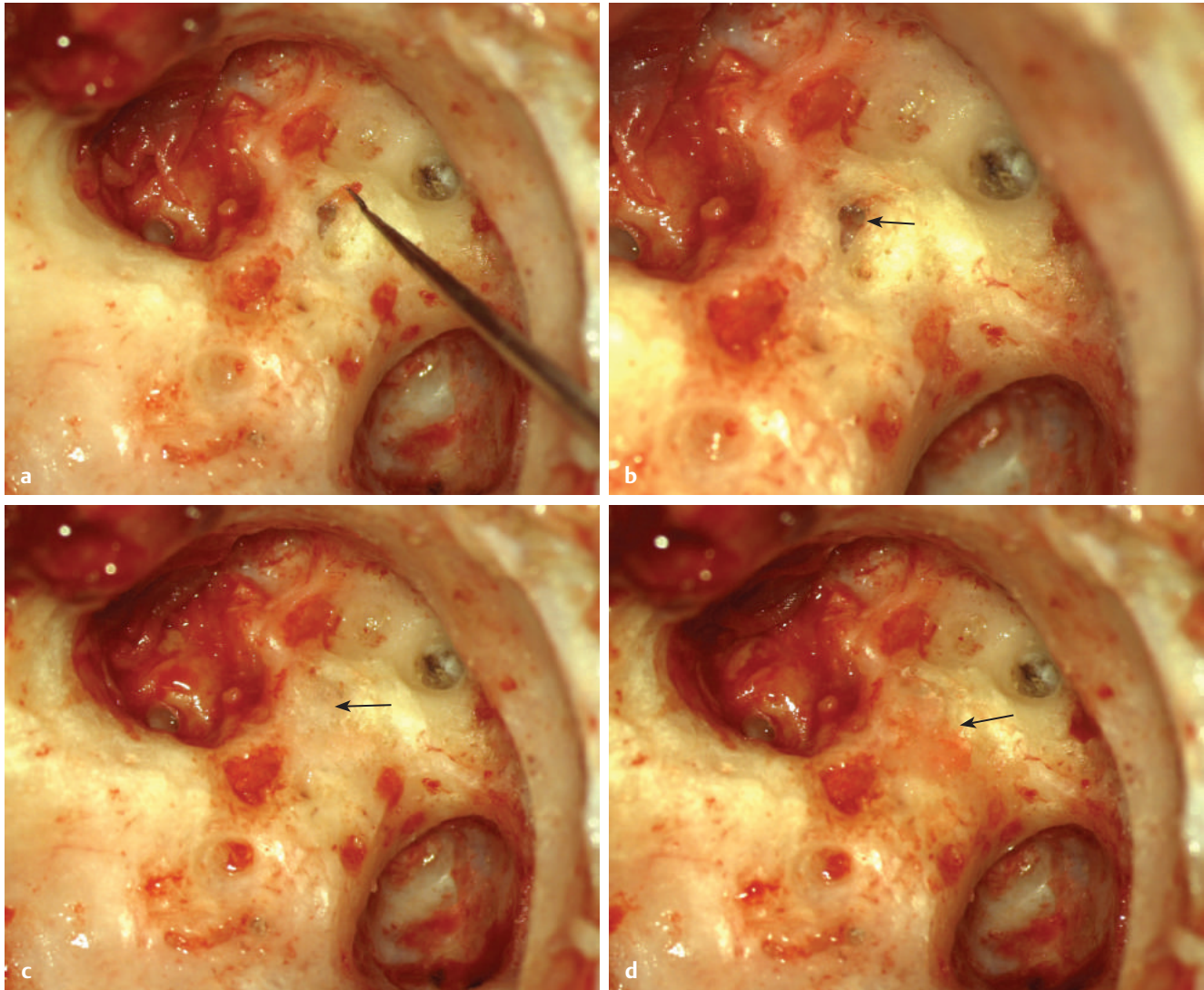


Fig. 3.46 (a) Removal of granulation from fistula. (b) Fistula with intact membranous labyrinth (*arrow*). (c) Fistula repaired with soft tissue and bone dust (*arrow*). (d) Bone wax placed over bone dust to anchor it (*arrow*).



Fig. 3.47 Reshaped malleus head placed over head of stapes (*arrow*).

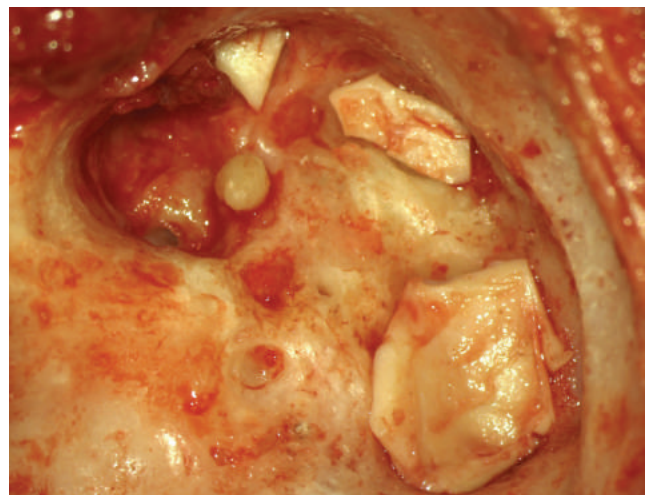


Fig. 3.48 Multiple pieces of cartilage placed to obliterate sockets in attic and mastoid cavity.

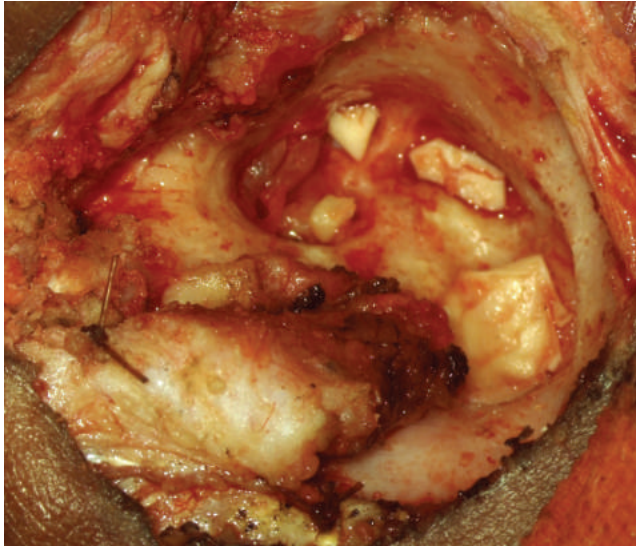


Fig. 3.49 Postaural pedicle muscle flap harvested to augment inferior part of cavity and to align it with floor of EAC. Note the muscle flap sutured to anteroinferior margin of mastoid cavity.

augment inferior part of cavity to align it with floor of EAC (**Fig. 3.49**). Adequate meatoplasty is performed with creation of superior and inferior flaps, which are sutured to the margin of temporalis muscle and postaural muscle, respectively (**Fig. 3.50**). Fascia graft is used to reconstruct TM and to cover pieces of cartilage and mastoid cavity (**Fig. 3.51**). Residual TM is repositioned over fascia graft. Gelfoam is placed in EAC. Postaural wound sutured in layer.

In this case, authors had performed wider conchotomy by excising part of conchal cartilage as cavity was not obliterated adequately.

Management of Cochlear Fistula

It is an uncommon complication of chronic suppurative otitis media as otic capsule is one of the toughest bones in the body. Generally, the osteolytic activity is seen more often with granulation tissue disease rather than cholesteatoma, and granulation tissue disease is seen most commonly with Koch's mastoiditis.

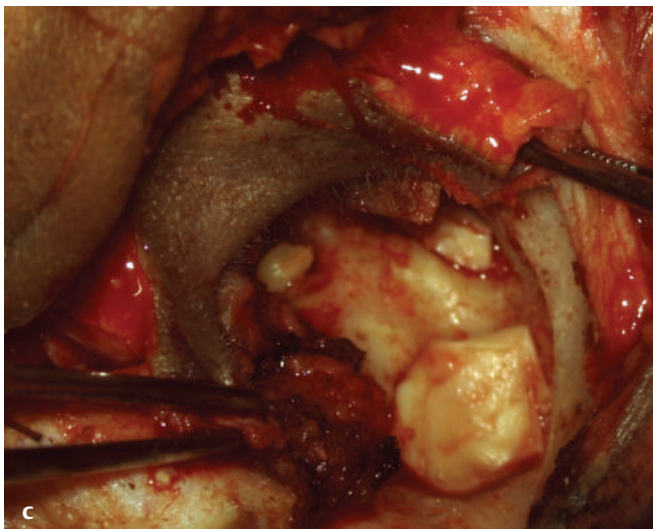
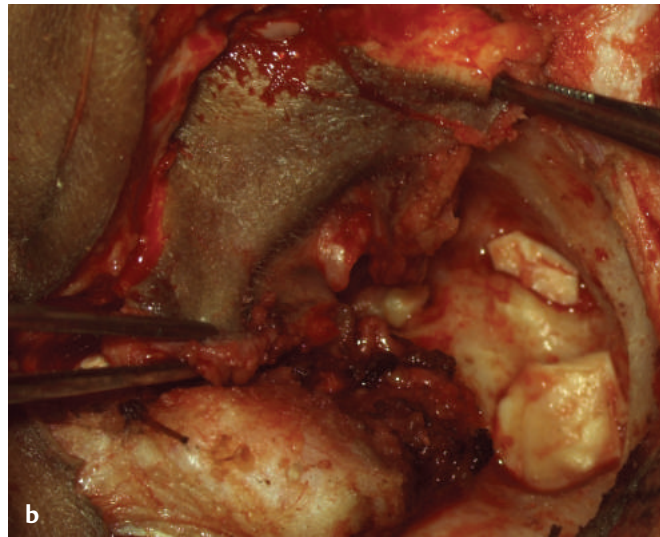
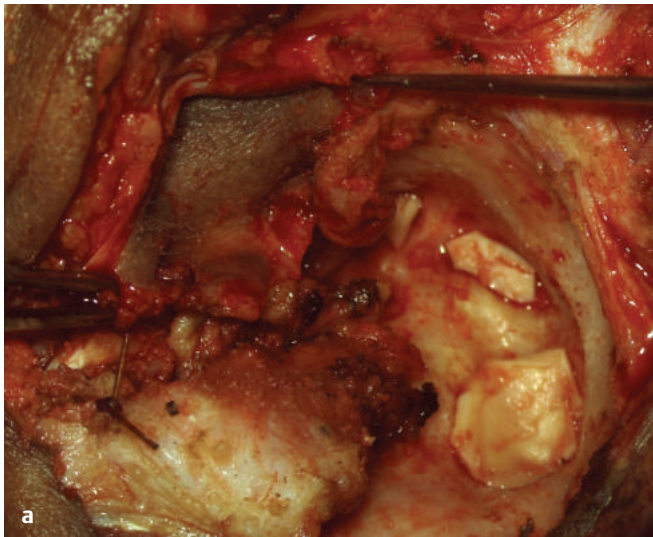


Fig. 3.50 (a) Meatoplasty—vertical incision at the 3 o'clock position up to conchal cartilage. (b) Meatoplasty—horizontal incisions given to create superior and inferior flaps. (c) Meatoplasty—superior and inferior flap mobilized and sutured to temporalis muscle and postaural muscle, respectively.

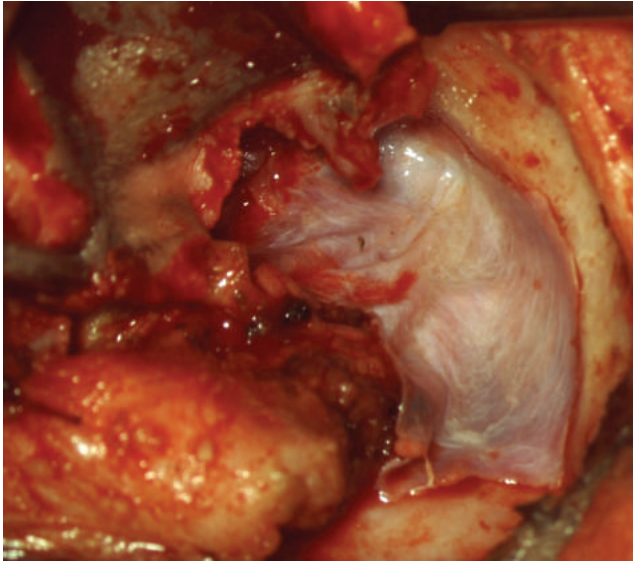


Fig. 3.51 Temporalis fascia graft placed to reconstruct tympanic membrane and to cover mastoid cavity, residual TM repositioned.

Acquired cholesteatoma is an attic disease that extends most often from attic to aditus, antrum, and mastoid air cell system and less often to middle ear. Because of the nature of spread, fistulas are more commonly seen in lateral semicircular canal than any other semicircular canals, and least often seen involving the cochlea.

In every case of granulation tissue disease, it is mandatory to send the granulation tissue for histopathology and more often when there is fistula of cochlea. This is done to exclude Koch's mastoiditis or malignancy.

Patient with a fistula in cochlea presents with profound sensorineural hearing impairment and occasionally it

may be associated with episodes of vertigo. Usually, along with fistula of cochlea one does find fistula of lateral semicircular canal as well.

Patient presenting with profound sensorineural hearing loss with vertigo must have HRCT scan temporal bone with bone window, performed preoperatively.

In patient presenting with profound or total deafness with fistula, one must repair the fistula with snugly fitting cartilage piece and bone dust with or without surgical glue as this fistulous tract can be responsible for intracranial spread of infection.

In such cases, besides repairing the fistula, one must also obliterate the Eustachian tube (ET) to minimize the risk of spread of infection through the ET.

To reduce the risk of infection from external auditory canal, one of these two techniques must be used:

1. Rarely along with the fistula there could be osteolytic activity leading to destruction of tegmen bone, sinus plate, or presigmoid dural plate. In such situations it is better to obliterate the cavity completely with the muscle flaps—extended temporalis or postaural muscle flaps with cul-de-sac closure.
2. In situation where osteolytic activity is limited to fistula of cochlea, obliteration of fistula along with the ET suffices. Reconstruction of TM is performed with full thickness tragal cartilage with the fascia graft extending for couple of millimeters over the residual bony canal to minimize incidence of failure of TM repair. Partial obliteration of cavity with bone dust, cartilage along with use of postaural pedicle muscle flap depending upon dimensions of the cavity should be performed.

Authors are presenting a case of cochlear fistula with the second technique, with partial obliteration of cavity.

Case 3: Osteoma of External Auditory Canal with Cholesteatoma and Cochlear Fistula (Right Ear)

Patient presented with history of foul-smelling ear discharge from the right ear for 8 years and developed mastoid abscess around 9 months back which ruptured with discharging fistula. Patient also complained of total deafness on the right side.

Pure tone audiometry showed profound hearing loss in the right ear.

HRCT temporal bone is performed which suggested osteoma of external auditory canal right side with soft tissue extending from attic, aditus to antrum with haziness of mastoid air cells (**Fig. 3.52**) and cochlear fistula (**Fig. 3.53**).

Pus is sent for culture and sensitivity testing, and patient is taken up for surgery under cover of appropriate antibiotics.

Otomicroscopy revealed bulging of external canal in posterior part along with plastered TM and postero-superior retraction pocket (**Fig. 3.54**).

Surgical Steps

Fistulous tract visualized in posteroinferior part of postaural region. Elliptical incision given around opening of fistula, scar tissue along with fistulous tract,

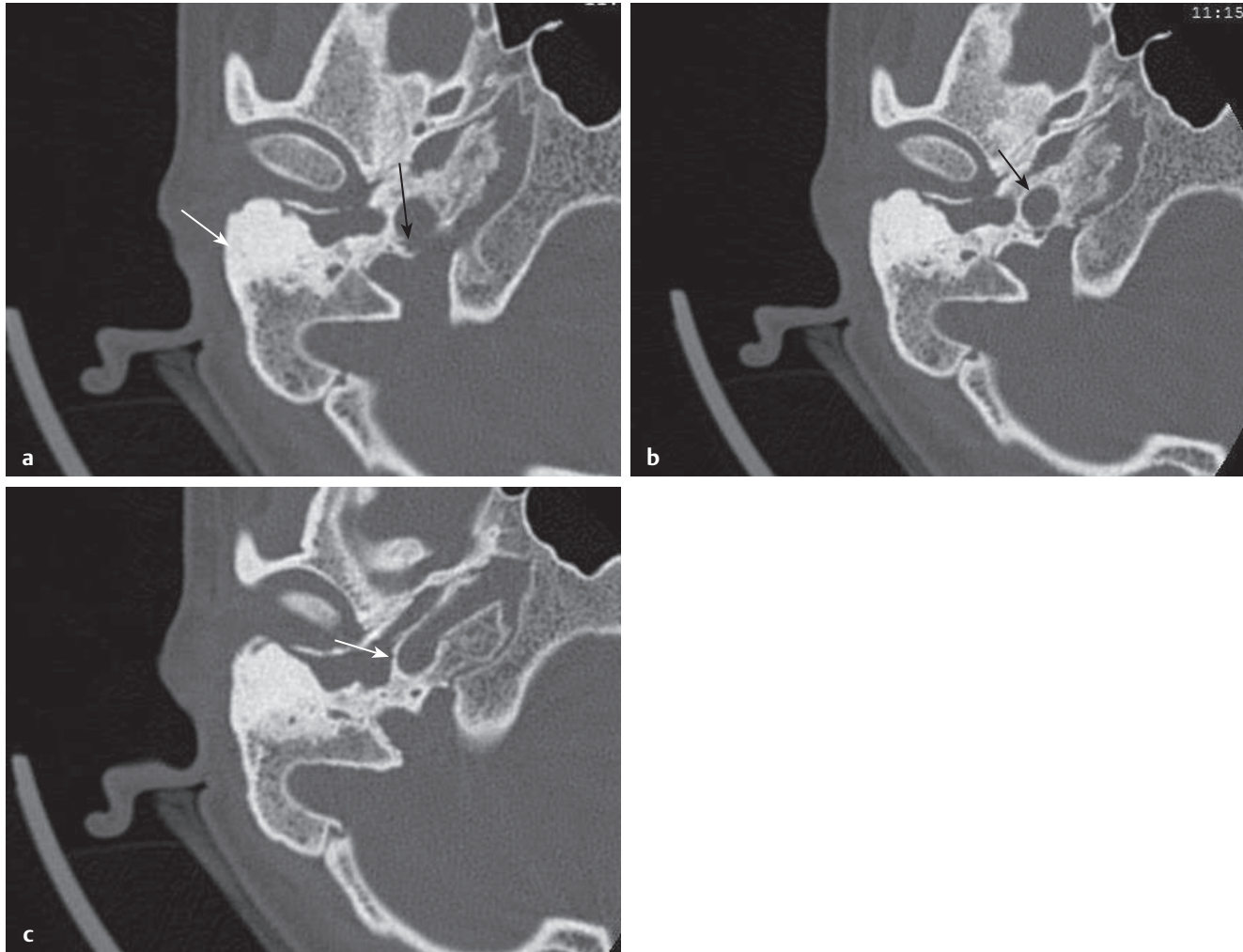


Fig. 3.52 (a) HRCT suggestive of osteoma (*white arrow*) in lateral part of EAC at the level of carotid foramen (*black arrow*). (b) HRCT suggestive of osteoma at the level of carotid canal (*arrow*). (c) Osteoma at the level of horizontal carotid canal (*arrow*).

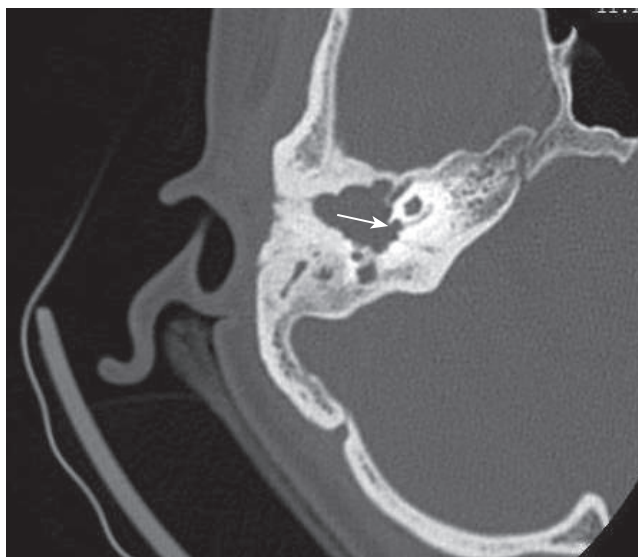


Fig. 3.53 Erosion in cochlea (*arrow*).

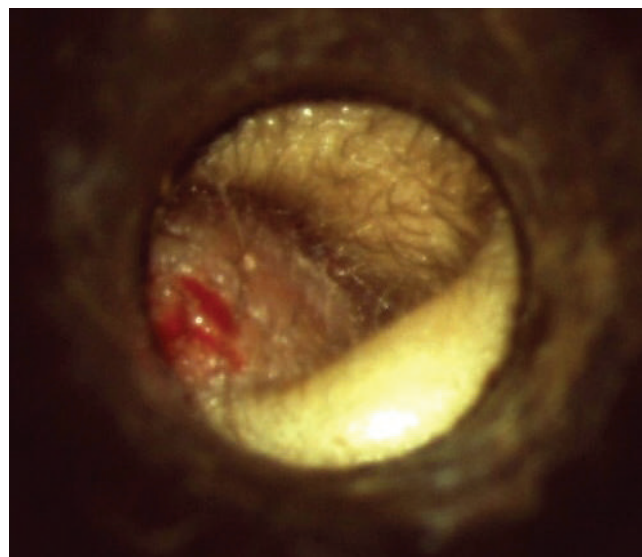


Fig. 3.54 Posteroinferior bulge with plastered TM.

and granulation tissue excised (**Fig. 3.55**). Postaural incision given, extending from upper end of elliptical incision. Temporalis fascia graft is harvested (**Fig. 3.56**). Musculoperiosteal incision is given and flap elevated posteroinferiorly.

Osteoma is visualized in posterior part of bony external auditory canal (**Fig. 3.57**). With the help of osteotome, osteoma is separated and excised (**Fig. 3.58**).

Cholesteatoma flakes are visualized along with posterosuperior retraction of TM (**Fig. 3.59**). Canalplasty and atticotomy are performed and bone dust collected from healthy canal bone (**Fig. 3.60**). Cholesteatoma traced from attic via aditus toward antrum (**Fig. 3.61**). Bony overhang of external canal drilled to visualize extension of cholesteatoma in to tympanic recess (**Figs. 3.62 and 3.63**).

Canal wall down mastoidectomy in progress with lowering of facial ridge, aligning of floor of canal with floor of cavity, drilling of sinodural angle, drilling of tegmen overhang to exteriorize the cells performed (**Fig. 3.64**).

Cholesteatoma sac is elevated from aditus, attic, and horizontal fallopian canal (**Fig. 3.65**). Polishing of residual cells of mastoid cavity, antrum, and attic is performed (**Fig. 3.66**).

Further lowering and thinning of facial ridge are performed to exteriorize cholesteatoma extending to sinus tympani (**Fig. 3.67**). Cholesteatoma with plastered TM is elevated from sinus tympani, promontory, infra-cochlear area, and ET (**Fig. 3.68**).

Fistula tract is visualized anterior to mastoid tip and passing through the posteroinferior part of external canal which is unusual finding as most of fistulas are through



Fig. 3.55 (a) Post aurial fistula. (b) Elliptical incision given around fistulous tract. (c) Fistulous tract along with scar tissue being excised.

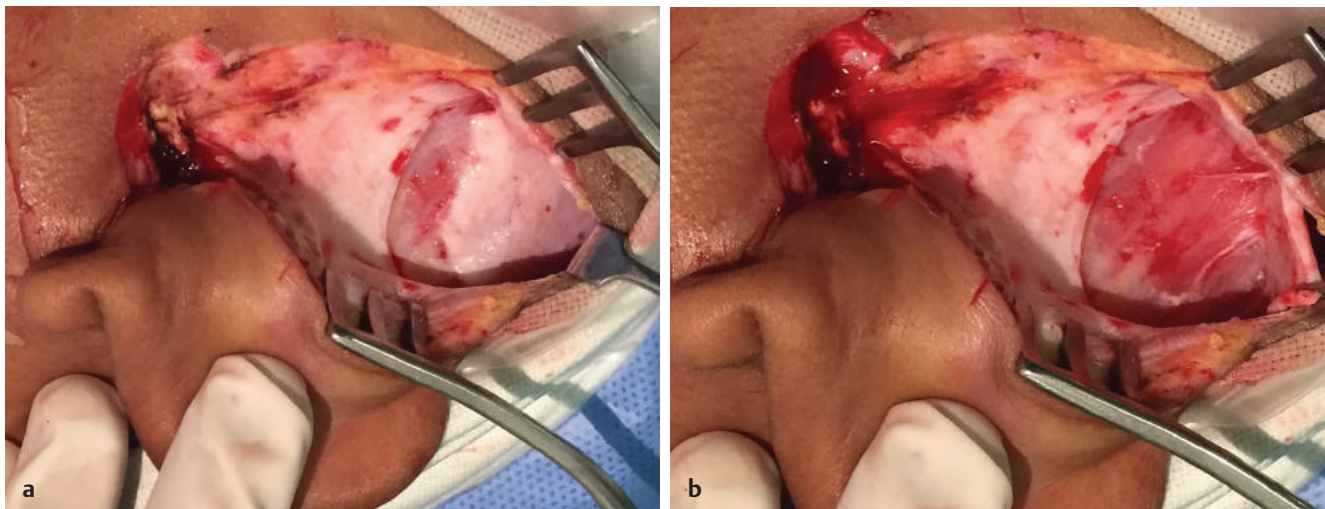


Fig. 3.56 (a, b) Temporalis fascia graft being harvested.

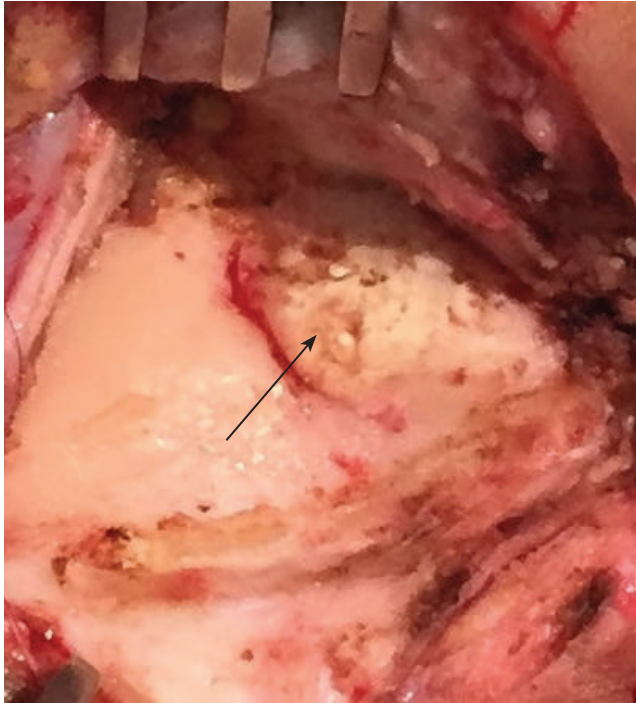


Fig. 3.57 Osteoma in posterior part of bony external auditory canal (arrow).

mastoid cortex (**Fig. 3.69**). Fistula tract is excised along with surrounding normal tissue.

Granuloma is visualized over promontory between round window niche and footplate, indicating some disease process deep to it. Facial ridge is thinned further to exteriorize promontory fistula under granulation tissue (**Fig. 3.70**). Granulation tissue is excised and fistula is repaired in three layers. Bony defect is plugged with snugly fitting cartilage, which is covered with bone dust and to hold bone dust bone wax applied over it (**Fig. 3.71**). Similarly, ET is also plugged with piece of cartilage that is further reinforced with bone dust and bone wax (**Fig. 3.72**).

TM is reconstructed with full thickness cartilage to avoid chances of recurrent perforation as patient has promontory fistula (**Fig. 3.73**). This is reinforced with fascia graft after partial obliteration of cavity with bone dust (**Fig. 3.74**).

In view of large cavity and inadequate skin of canal, split thickness skin graft is harvested from postaural area. Part of skin graft which has subcutaneous tissue is scrapped before placing (**Fig. 3.75**). Meatoplasty is performed and sutured as usual (**Fig. 3.76**). Skin graft is placed to cover exposed bone. Postaural pedicled muscle flap is used to obliterate cavity further (**Fig. 3.77**).

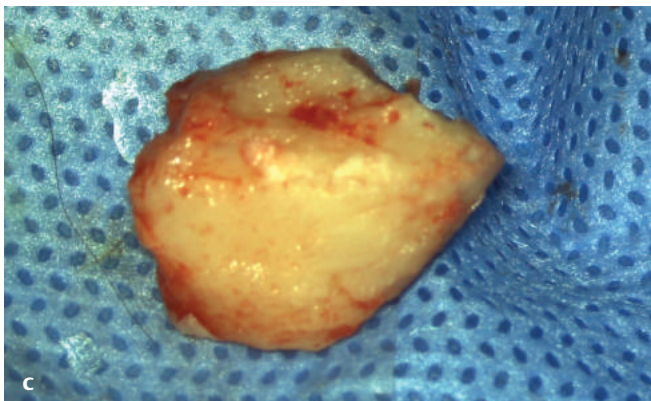
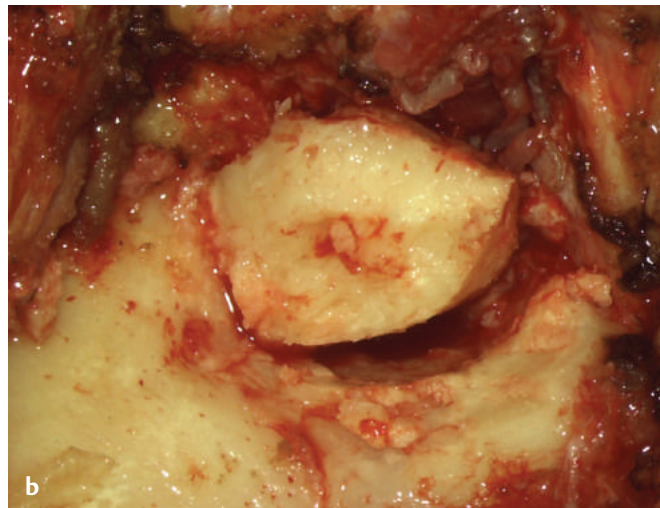
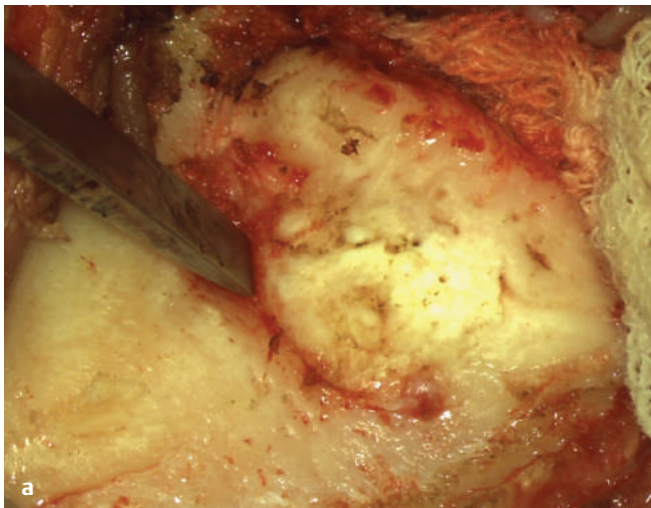


Fig. 3.58 (a) Osteotome being used to separate osteoma. (b) Osteoma separated from all sides. (c) Excised osteoma piece.

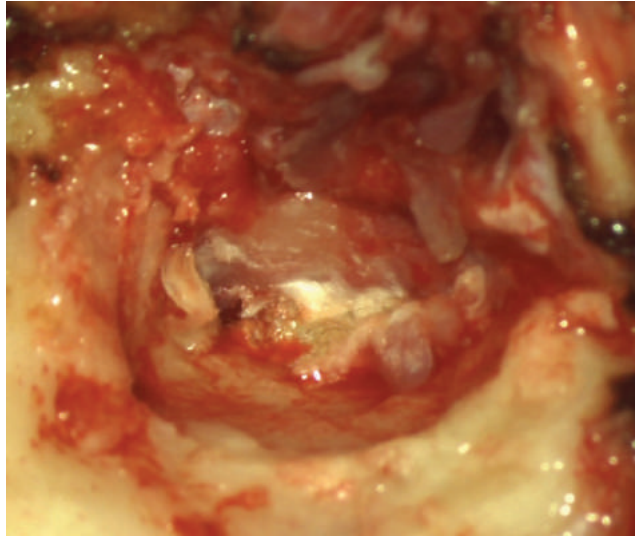


Fig. 3.59 Cholesteatoma with posterosuperior retraction.

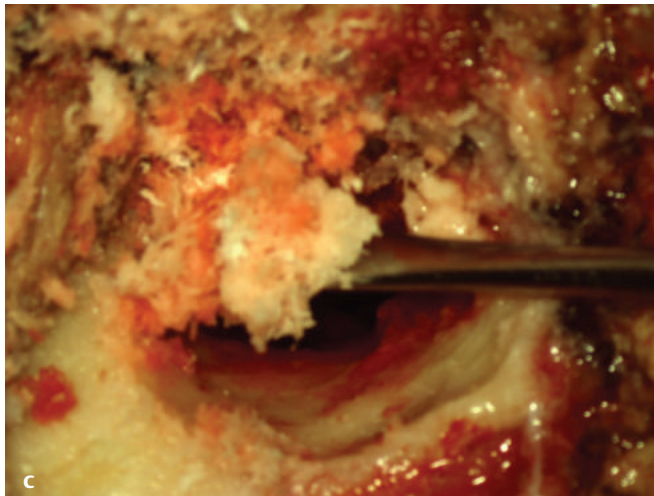
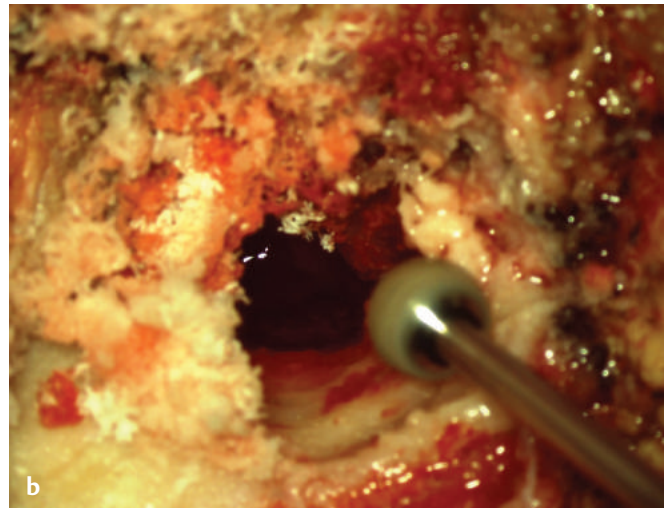
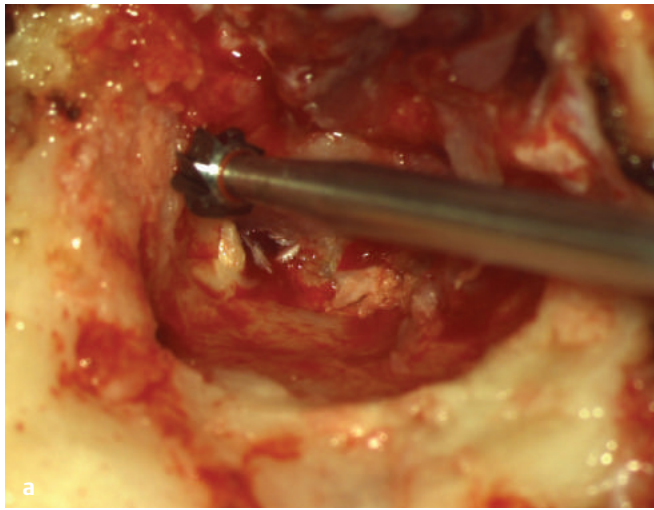


Fig. 3.60 (a) Canalplasty and inside out atticotomy in progress. (b, c) Canalplasty in progress with collection of bone dust from healthy mastoid cortex.

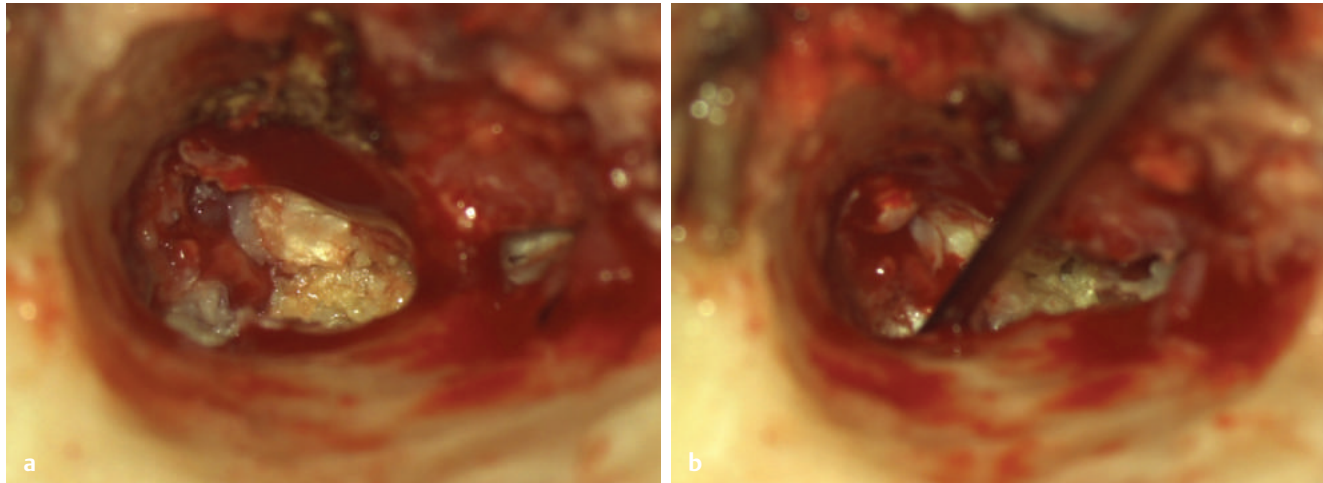


Fig. 3.61 (a) After canalplasty, cholesteatoma visualized in mesotympanum and attic. (b) Extension of cholesteatoma to antrum being demonstrated.

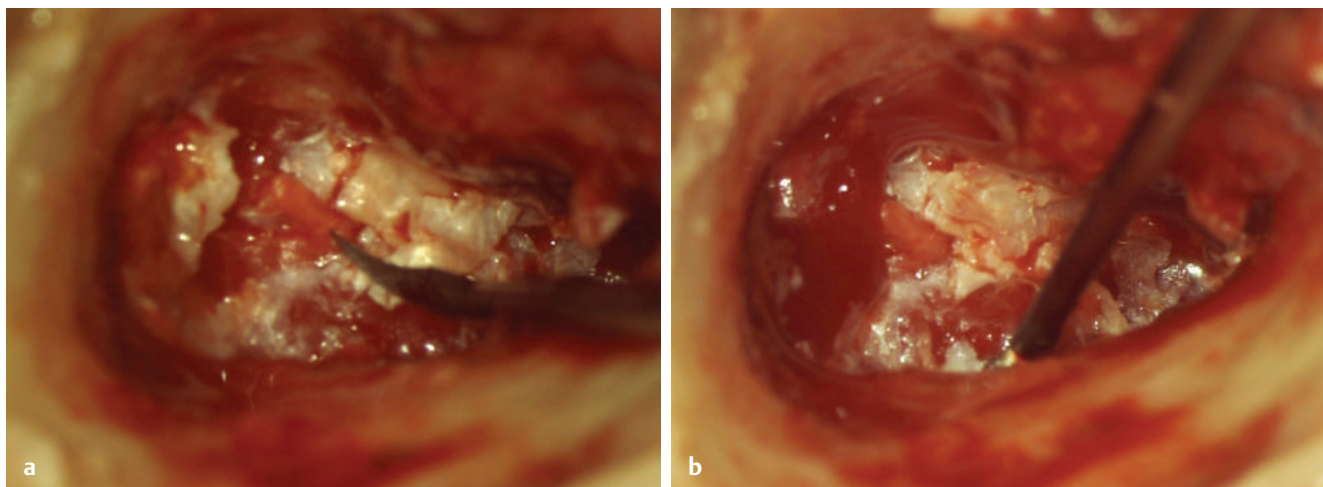


Fig. 3.62 (a) Residual handle of malleus being pointed. Cholesteatoma visualized deeper to it. (b) Bony overhang lateral to tympanic recess being demonstrated.

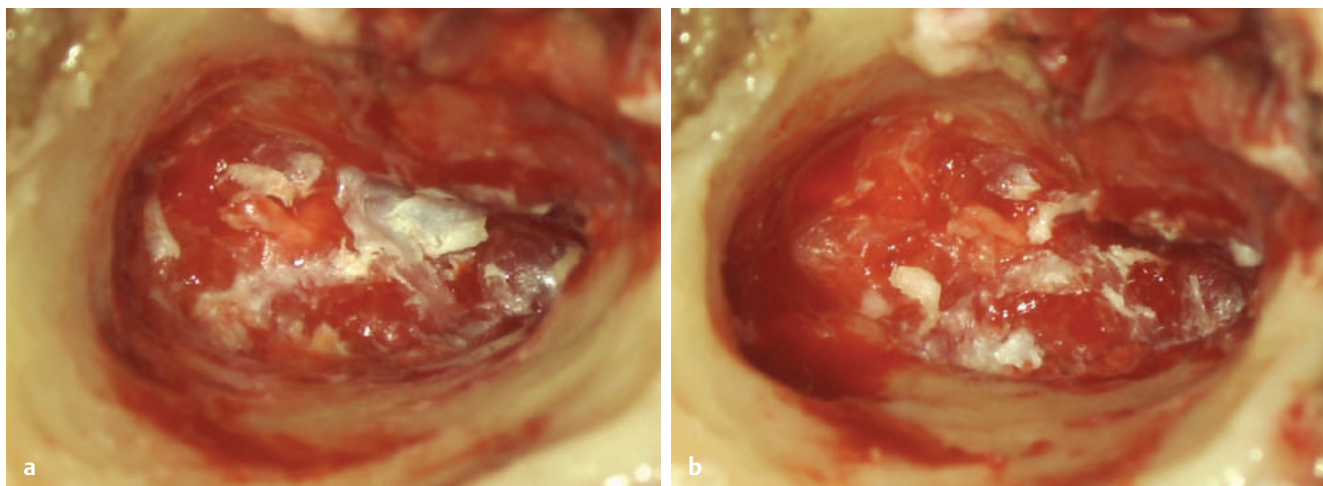


Fig. 3.63 (a) Drilling of facial recess and thinning of facial ridge performed. (b) Cholesteatoma extending to antrum and part of the mastoid cleared.

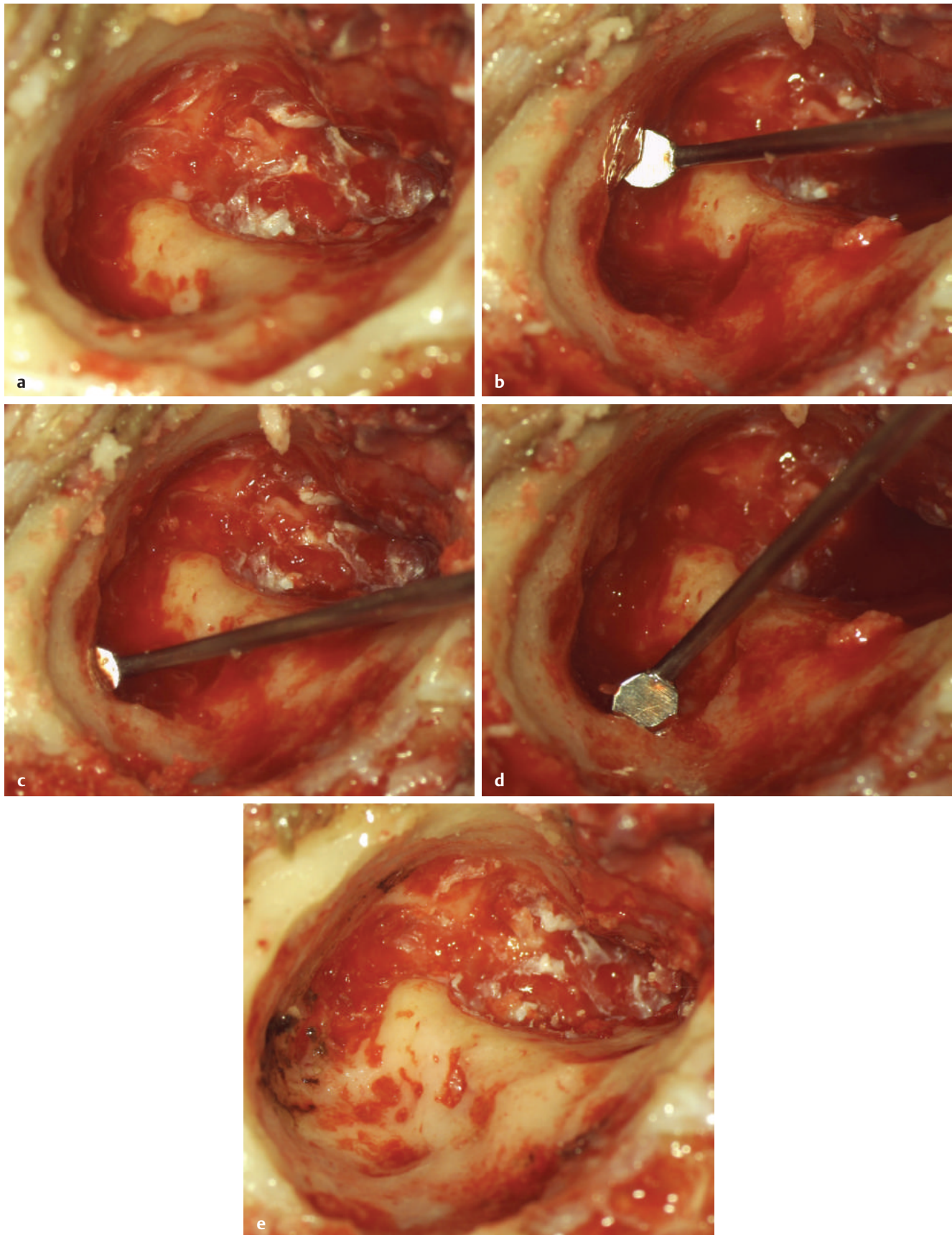


Fig. 3.64 (a) Complete exteriorisation of cholesteatoma sac performed with lowering of facial ridge. (b, c) Bony overhang in the region of tegmen and sigmoid sinus being demonstrated. (d) Bony overhang in the region of sigmoid sinus being demonstrated. (e) Drilling of bony overhangs performed. Floor of canal aligned with that of mastoid cavity.

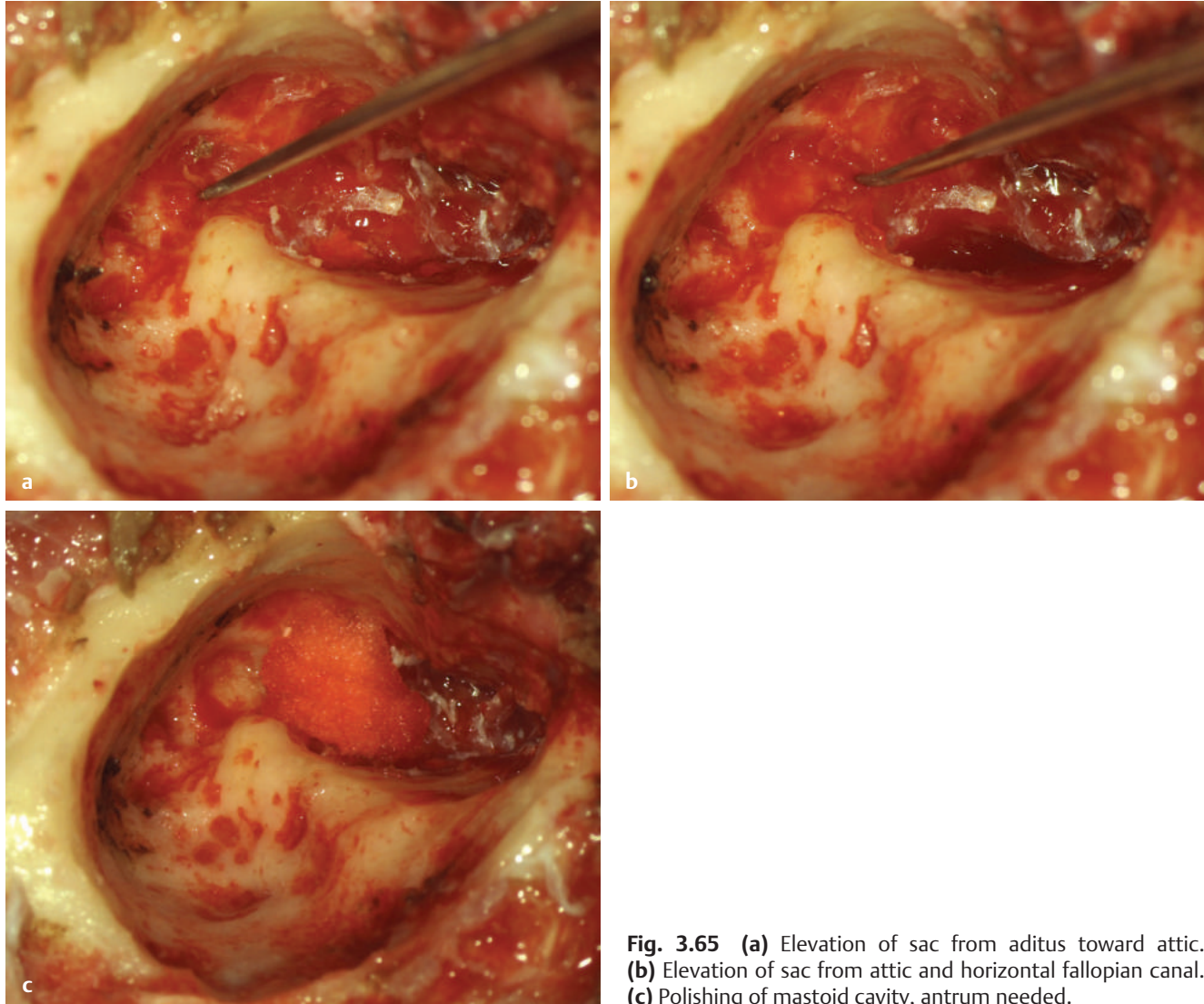


Fig. 3.65 (a) Elevation of sac from aditus toward attic. (b) Elevation of sac from attic and horizontal fallopian canal. (c) Polishing of mastoid cavity, antrum needed.

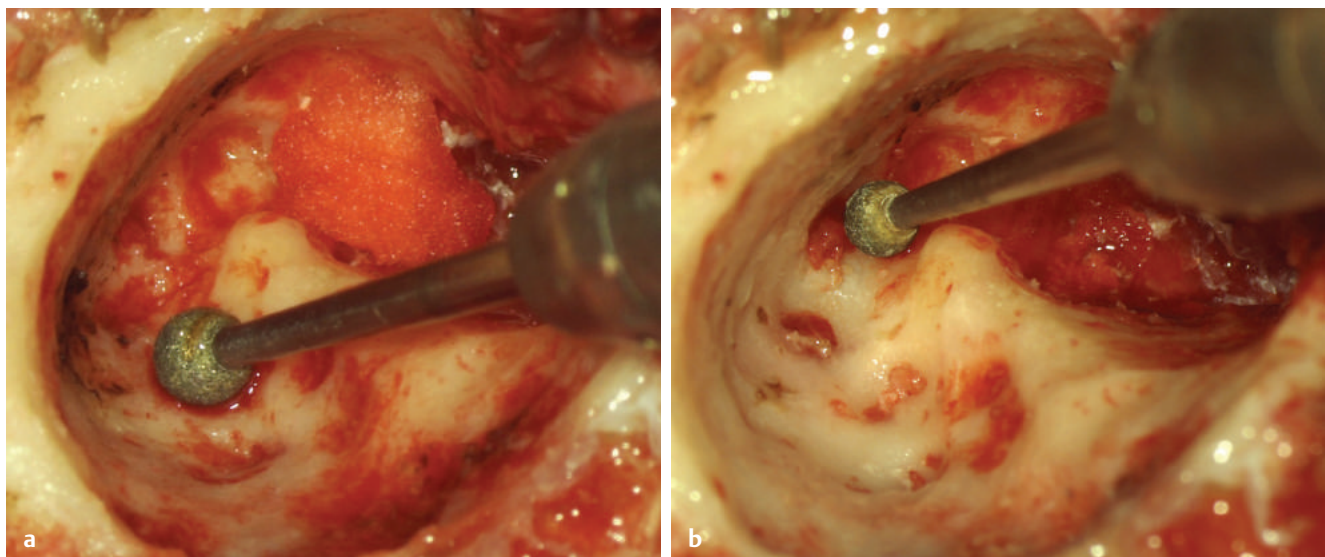


Fig. 3.66 (a) Polishing of cells of mastoid cavity in progress. (b) Residual cells in floor of antrum being polished.

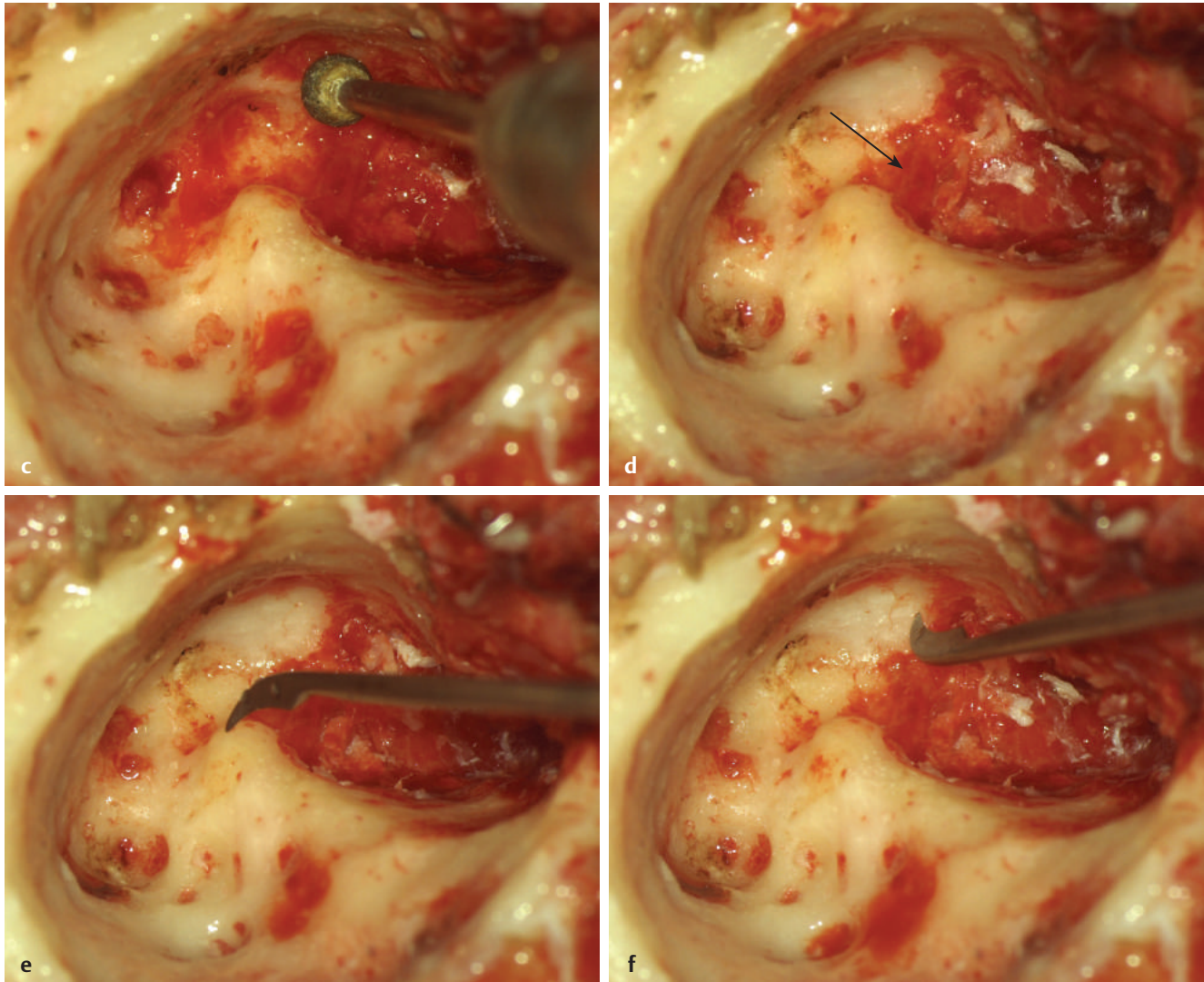


Fig. 3.66 (Continued) (c) Anterior buttress being polished. (d) All cells facing mastoid cavity antrum, posterior and anterior attic are cleared with their mucosa. Horizontal portion of facial nerve being pointed out (*arrow*) due to absence of fallopian canal bone. (e) Lateral semicircular canal being pointed. (f) Anterior attic wall aligned with anterior canal wall.

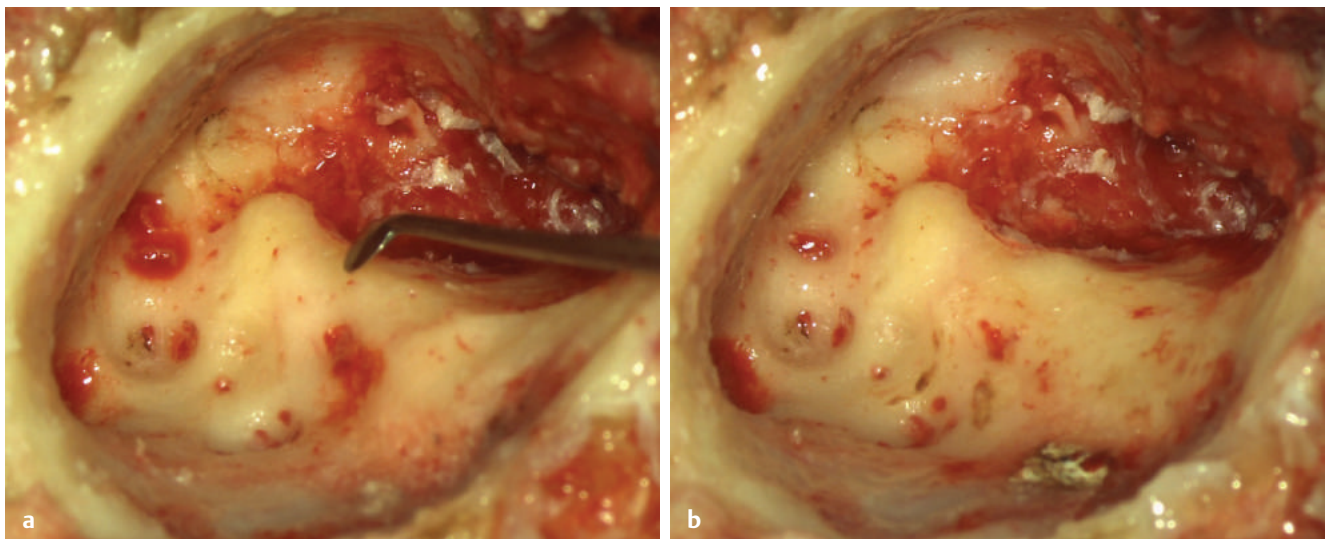


Fig. 3.67 (a) Lowered facial ridge being pointed. (b) Further lowering of facial ridge performed.

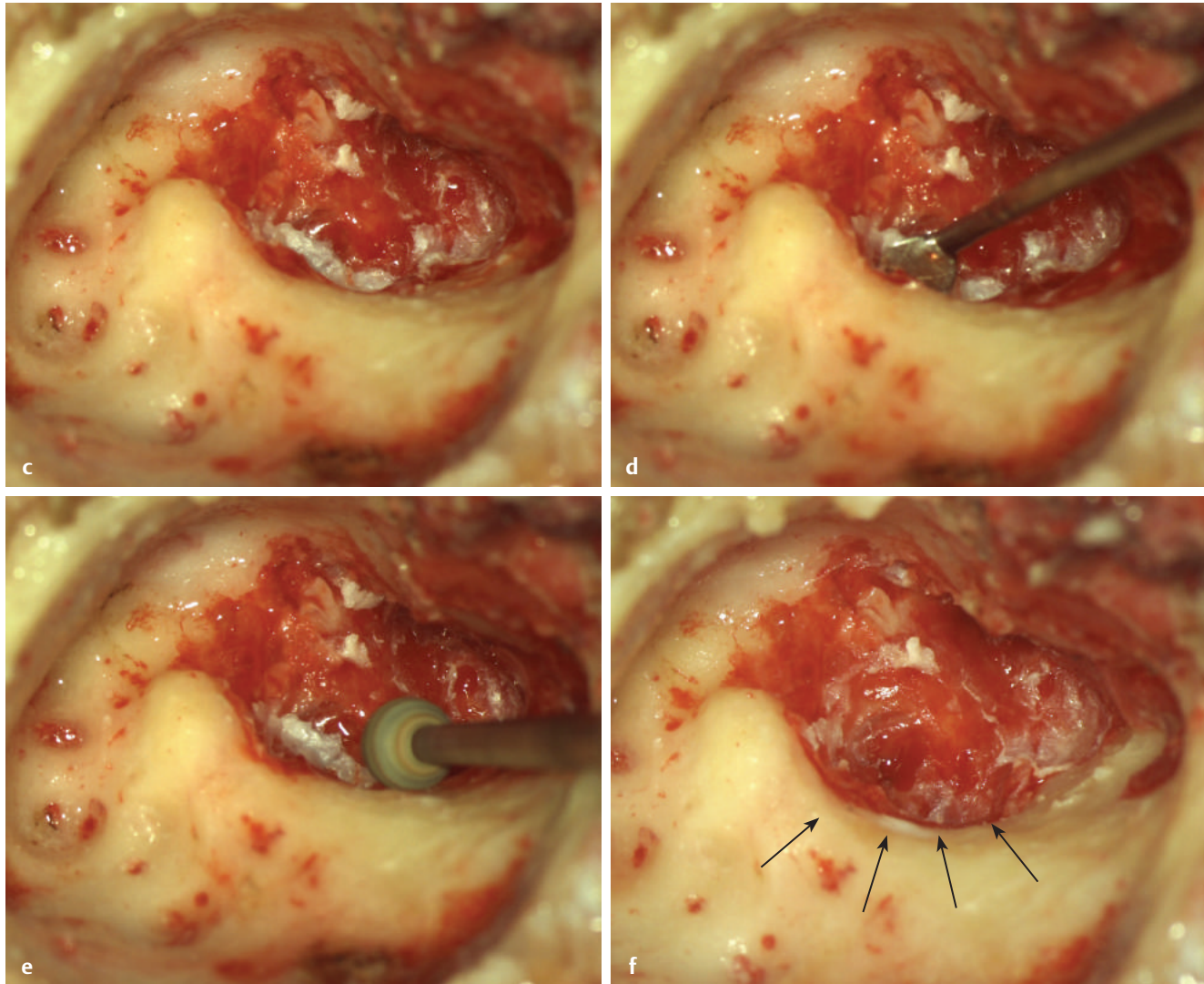


Fig. 3.67 (Continued) **(c)** Thinning of facial ridge is required to open up the sinus tympani. Depth of sinus tympani being demonstrated. **(d)** Depth of sinus tympani to be opened. **(e)** Thinning of facial ridge in progress with diamond burr. **(f)** Exteriorized sac being demonstrated after thinning of facial ridge (arrows).

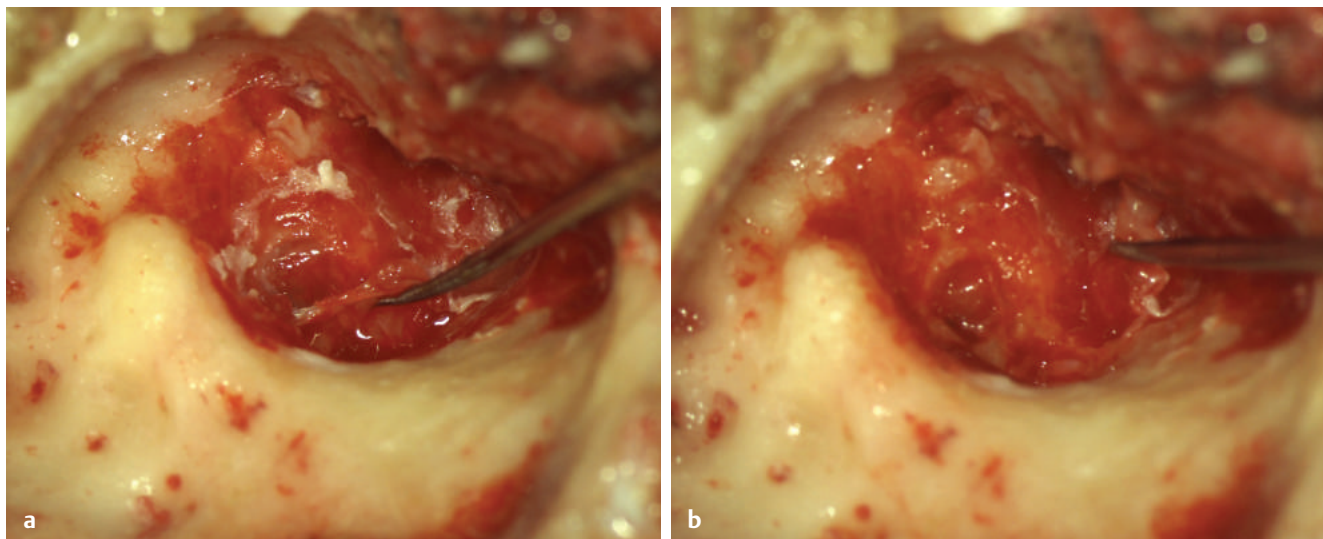


Fig. 3.68 **(a)** Plastered tympanic membrane being elevated from sinus tympani. **(b)** Plastered tympanic membrane elevated from promontory.

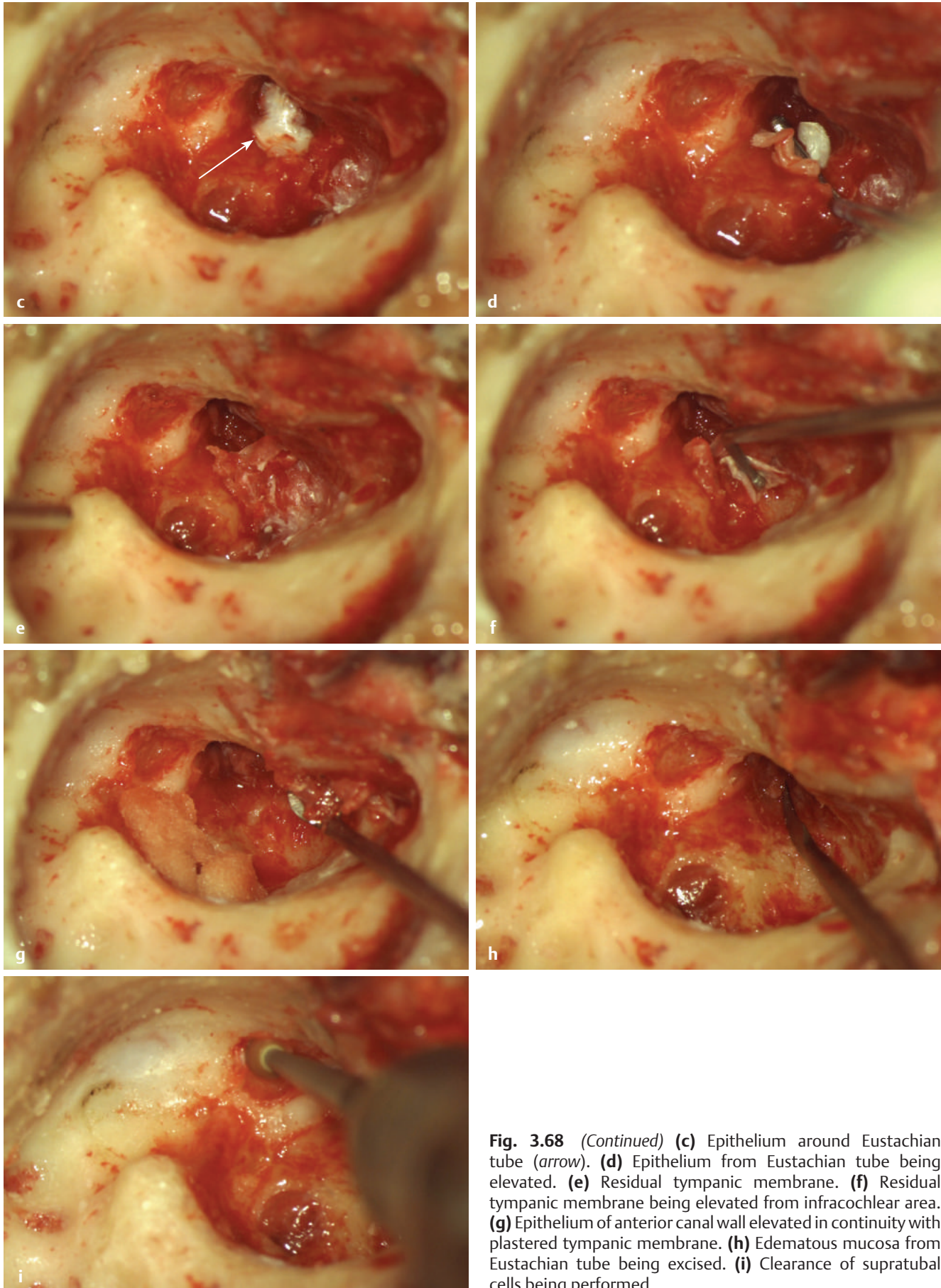


Fig. 3.68 (Continued) **(c)** Epithelium around Eustachian tube (*arrow*). **(d)** Epithelium from Eustachian tube being elevated. **(e)** Residual tympanic membrane. **(f)** Residual tympanic membrane being elevated from infracochlear area. **(g)** Epithelium of anterior canal wall elevated in continuity with plastered tympanic membrane. **(h)** Edematous mucosa from Eustachian tube being excised. **(i)** Clearance of supratubal cells being performed.

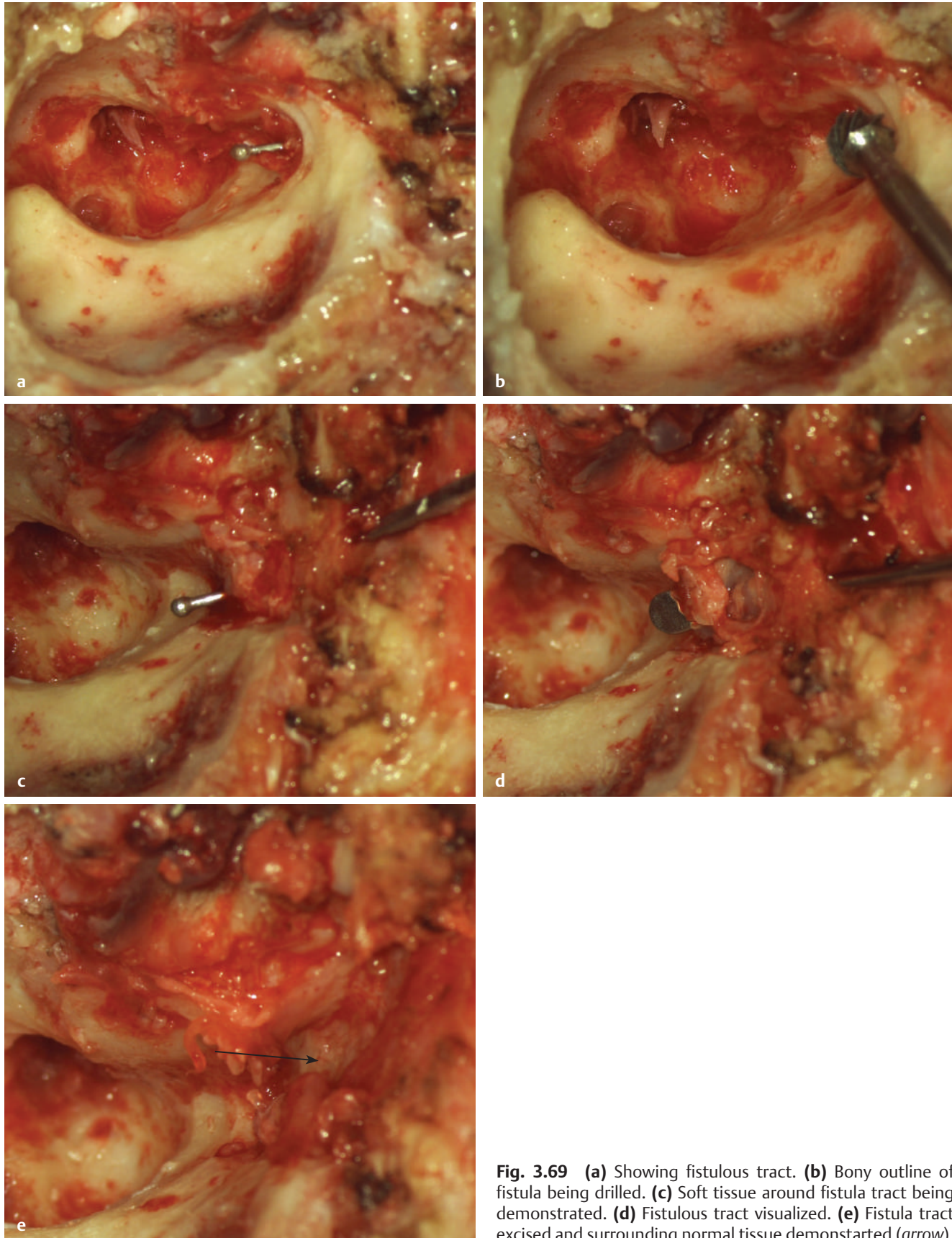


Fig. 3.69 (a) Showing fistulous tract. (b) Bony outline of fistula being drilled. (c) Soft tissue around fistula tract being demonstrated. (d) Fistulous tract visualized. (e) Fistula tract excised and surrounding normal tissue demonstrated (arrow).

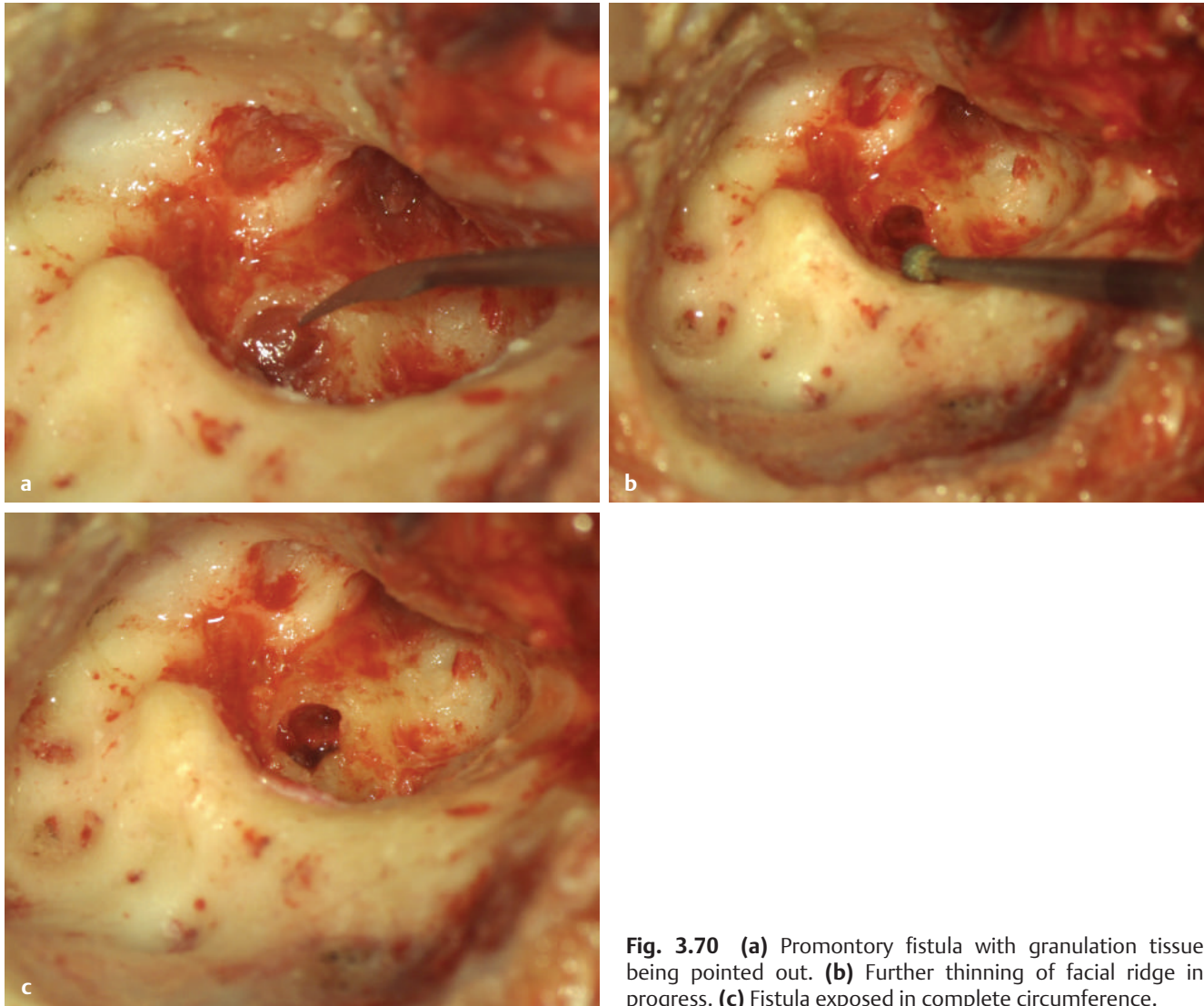


Fig. 3.70 (a) Promontory fistula with granulation tissue being pointed out. (b) Further thinning of facial ridge in progress. (c) Fistula exposed in complete circumference.

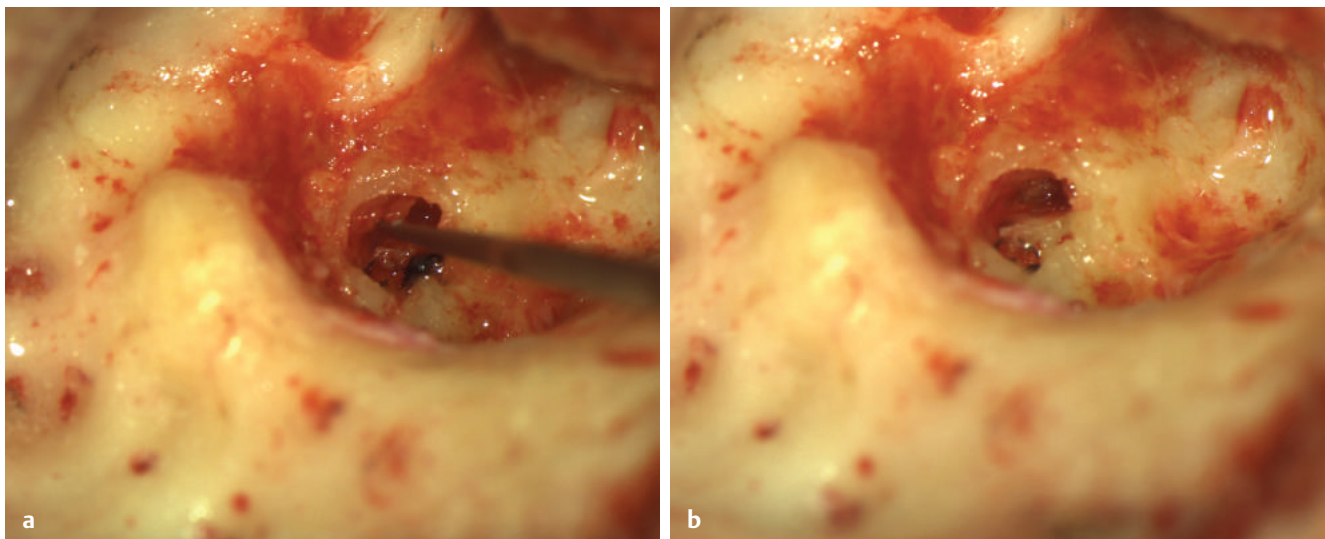


Fig. 3.71 (a) Granulation tissue being mobilized and removed. (b) Granulation tissue cleared from fistula.

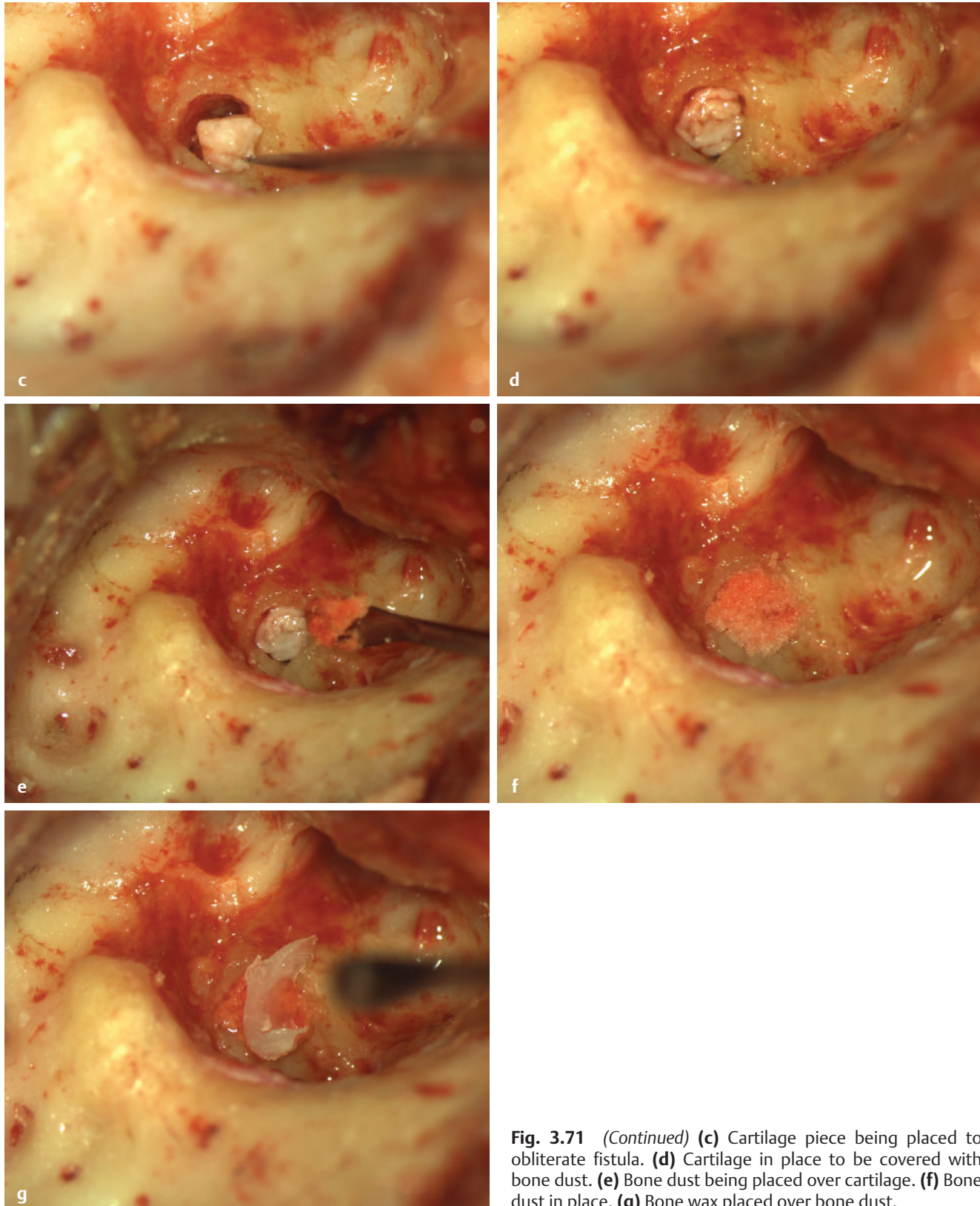


Fig. 3.71 (Continued) **(c)** Cartilage piece being placed to obliterate fistula. **(d)** Cartilage in place to be covered with bone dust. **(e)** Bone dust being placed over cartilage. **(f)** Bone dust in place. **(g)** Bone wax placed over bone dust.

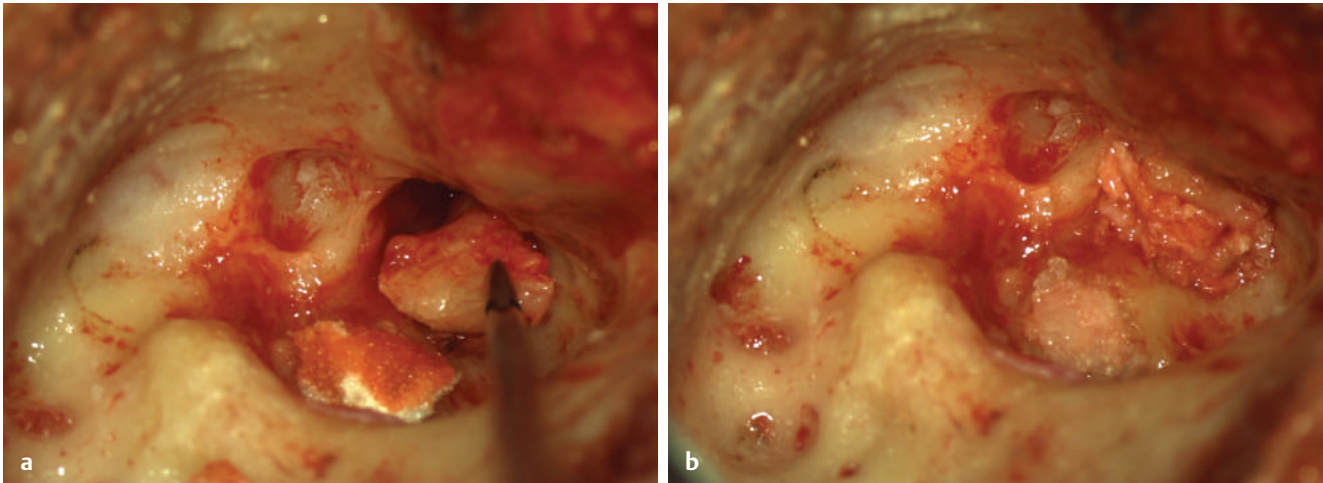


Fig. 3.72 (a) Cartilage piece being placed to obliterate Eustachian tube. (b) Cartilage covered with bone dust and bone wax.

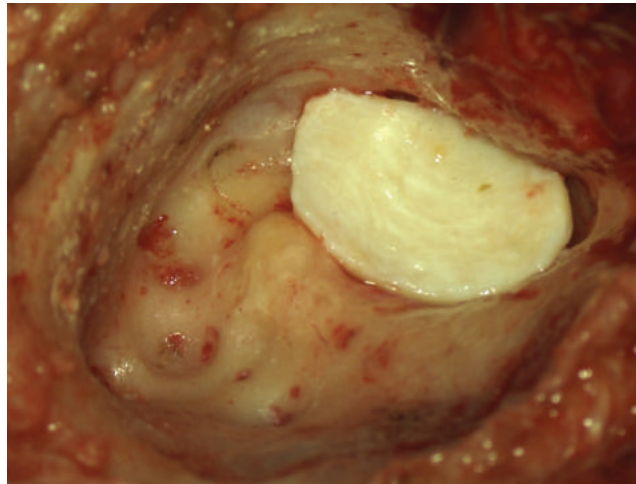


Fig. 3.73 Full thickness cartilage to reconstruct tympanic membrane.

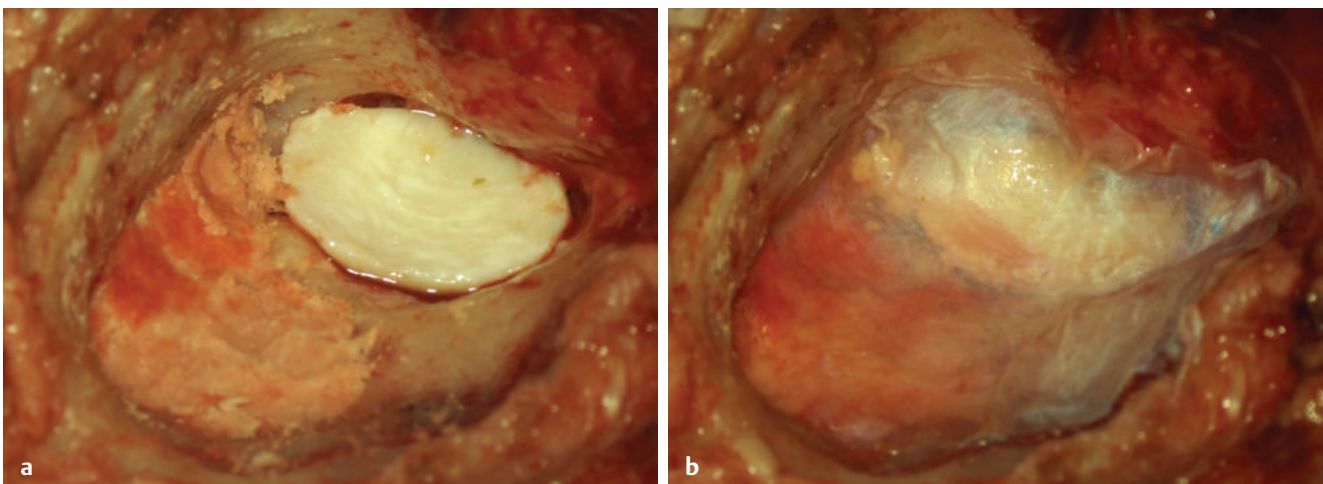


Fig. 3.74 (a) Partial obliteration of cavity with bone dust. (b) Temporalis fascia graft placed from anteroinferior canal wall to cover bone dust.

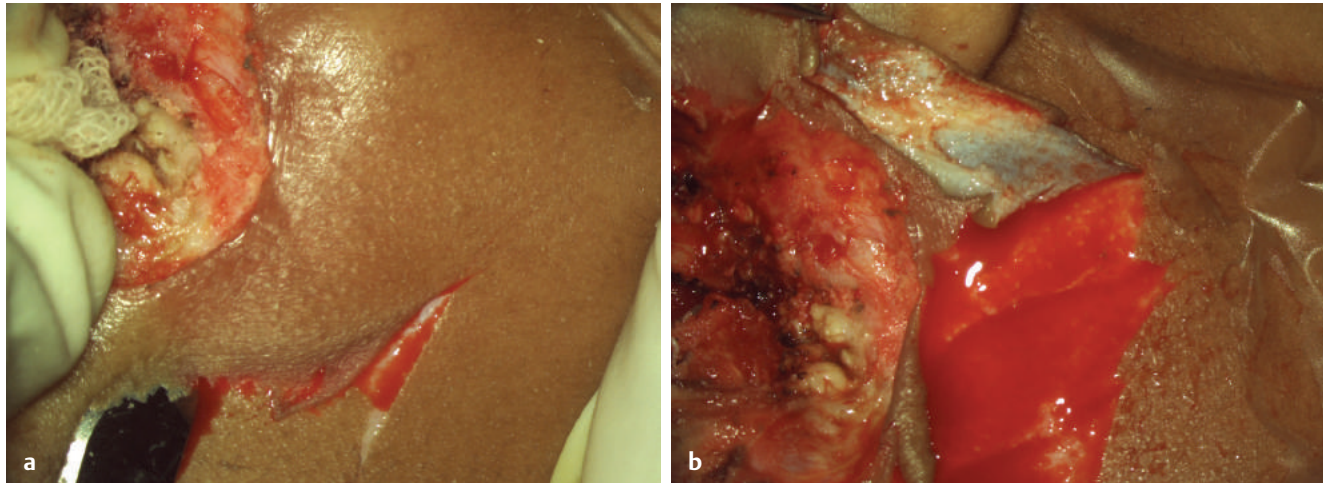


Fig. 3.75 (a) Split thickness skin graft being harvested. (b) Harvested piece of skin graft with excessive subcutaneous tissue which will be scrapped off.

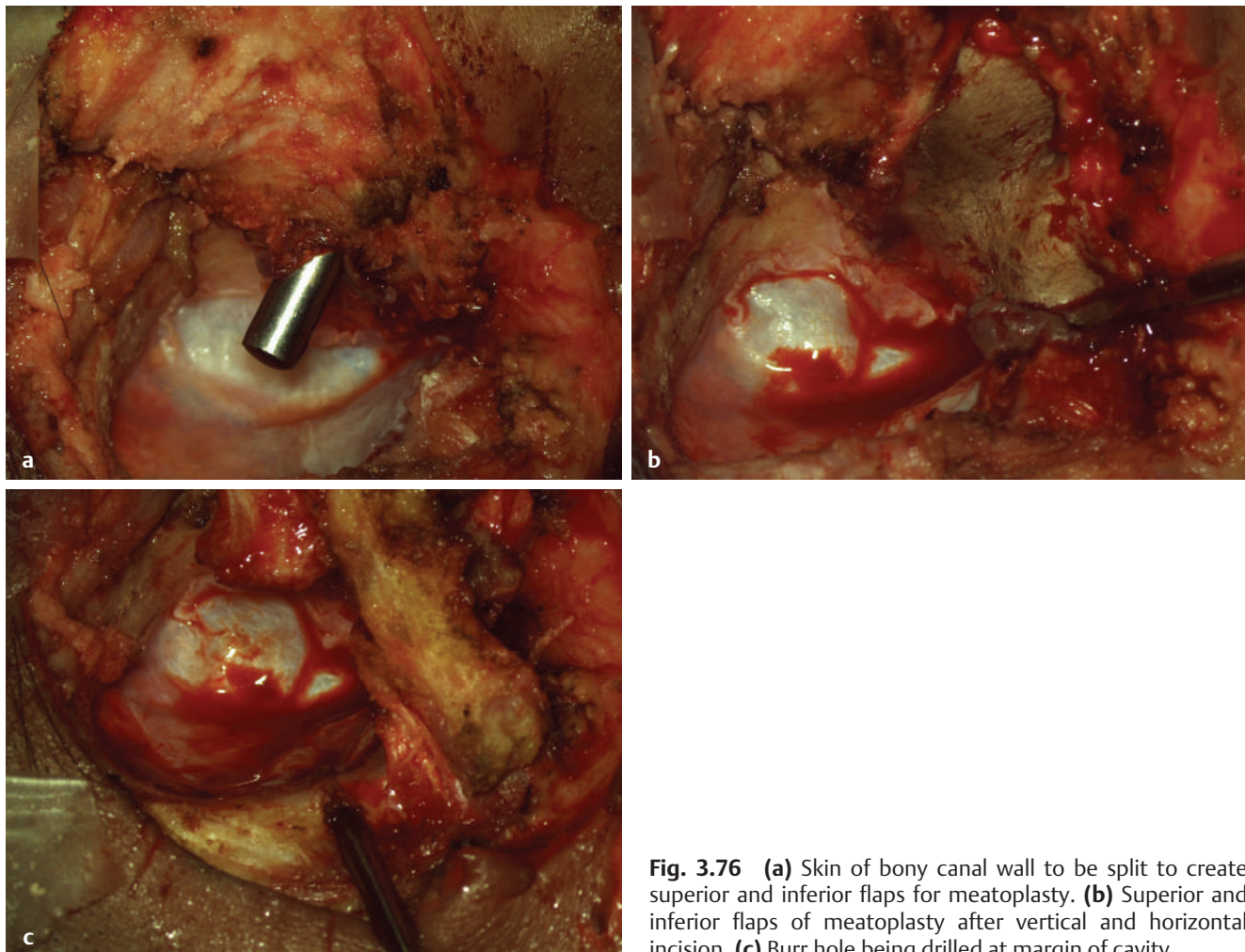


Fig. 3.76 (a) Skin of bony canal wall to be split to create superior and inferior flaps for meatoplasty. (b) Superior and inferior flaps of meatoplasty after vertical and horizontal incision. (c) Burr hole being drilled at margin of cavity.

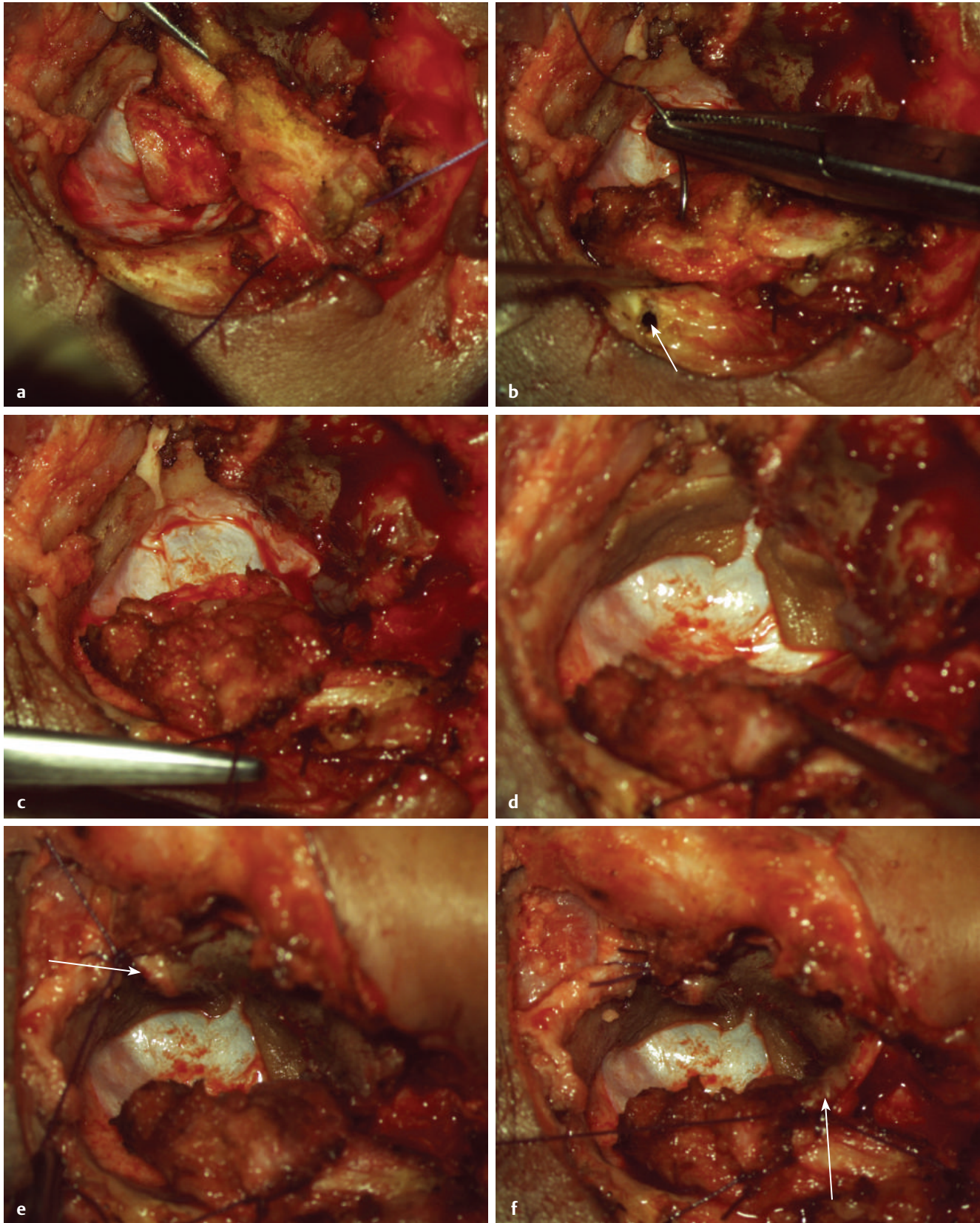


Fig. 3.77 (a) Flap anchored to bony margin of cavity, through burr hole, inferior to flap. (b) Anchoring suture superiorly between flap and burr hole (*arrow*). (c) Notice dimension of cavity obliterated by muscle flap. (d) Split thickness graft placed over exposed bone. (e) Superior flap of skin after meatoplasty being sutured to temporalis muscle (*arrow*). (f) Inferior flap of skin being sutured to post auricular muscle (*arrow*).

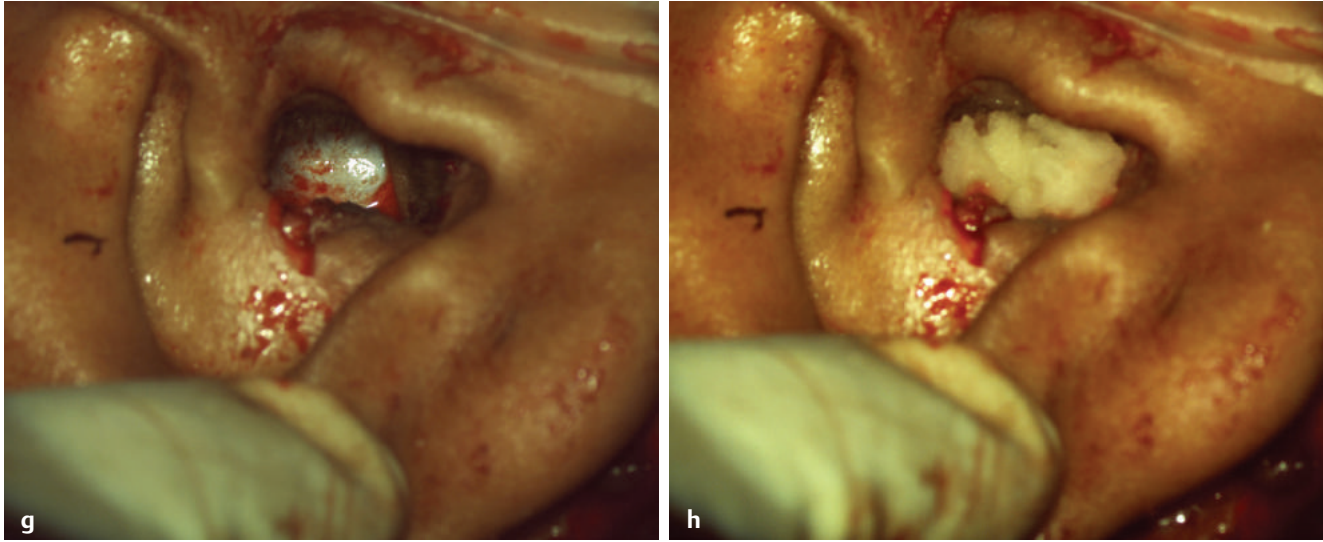


Fig. 3.77 (Continued) **(g)** View of neotympanum. **(h)** External canal packed with Gelfoam.