



AN ESSAY ON CHRONIC SUPPURATIVE OTITIS MEDIA (CSOM - SAFE EAR) SURGERY

Pankaj Srivastava*¹ and Rohit Mehrotra²

¹Pankaj E.N.T. Hospital, 56-C Singar Nagar, Alambagh, Lucknow-226005

²GSVM Medical College, Kanpur

ARTICLE INFO

Article History:

Received 19th June, 2016
Received in revised form 16th
July, 2016 Accepted 18th
August, 2016 Published online 24th
September, 2016

Key words:

Chronic Otitis Media, CSOM,
Tympano mastoidectomy, Ear drum
perforation, ear discharge

ABSTRACT

We all know that there are failures in CSOM (safe ear) surgery up to 10 %. Every step of this surgery has many variations and innovations, but no single method is agreed and gives consistent results. The cause of multiple methods and innovations by each surgeon is persistent failures, which push every surgeon to change over to another method, or innovate to get 100 % result. So there is a need of auditing every step of CSOM surgery with its logic and results so that one method is propagated which gives good and consistent result in everyone's hand. This will satisfy all our patients.

Copyright © 2016 Pankaj Srivastava and Rohit Mehrotra. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Why there are failures in CSOM (safe ear) surgery: We all know that when there is removal of any organ or part of it, like appendisectomy it is successful, but reconstructing an organ may not be that successful, because it depends on patient's condition and its physiology, acceptance & many unknown factor. These may vary from person to person. Tissues, grafts and prosthesis we are keeping in ear as free graft, are on mercy of patient's tissues and its future depends on its acceptance. Graft in ear are not fixed or sutured. Another factor is the anatomy and physiology of ear and its mastoid system. It is complex and ill understood. It plays role in success of surgery, like Eustachian tube and its physiology – can never be assist that whether it is normal or not and how it will affect our reconstructions. CSOM (safe ear) surgery has 15 to 20 steps and each step has its importance, any one of them if wrongly performed may totally fail the surgery and warrant revisions.

Why there are so many methods in each step of CSOM (safe ear) surgery: Starting from incision, canal entry, graft material, wet or dry graft, underlay, interlay or overlay graft. Almost every step in ear surgery right from decision that when to operate, what incision, should Mastoidectomy done or not, etc, have many options, variations and modifications only because results are not cent percent, so every surgeon tries different ways of doing it, and may keep on changing the method. The innovations are due to regular failures. In contrast to stapes surgery or cataract surgery, where we have only one successful method with a little variations gives us satisfactory

and consistent result. The new comers after attending workshops and watching Mentors change their methods every time which may not be suitable in their hands. This becomes the cause of continuous failures. So there should be some agreement about logically best methods which masses should follow for the betterment of patient and our fraternity.

For each step of surgery if there is logical explanation that a particular method is most suitable, adequate and successful, and this will give best and consistent results by most surgeons and new comers, why should other methods be propagated? A particular way of doing a step of any surgery may be good in very experienced particular surgeon, this does not necessarily be in other's hand.

Selection of patient – we have seen that a central perforation heals with conservative treatment with passage of time in younger individuals but this is in rarity, in adults it is rarer. So surgery remains the standard treatment of CSOM (safe type). In children of course the results of surgery is not as good as in adults. The cause being, more patent Eustachian tube, adenoid and tonsillar hypertrophy and catarrhal child. Further the follow up and cleaning etc becomes difficult post operatively, further reducing the outcome. So if we have considered all these factors and given adequate conservative treatment, we should not wait further as it can cause deterioration in hearing and unnecessary long morbidity and overtreatment. In adults nose ailments and allergy should also be considered before ear surgery.

Preoperative management: Except in severely catarrhal child we found no difference in outcome at all whether an antibiotic course was given and we waited the ear to be dry or done in discharging ear. The policy in our setup is if the patient is willing to get operated we do it even in discharging ear and if patient takes time we give oral antibiotics, decongestants and antibiotic ear drops to use this interval, although it is not must.

Routine surgical profile, viral markers, blood pressure is checked. History of anticoagulants taken and stopped seven days prior to surgery. No preparation is needed prior to surgery, no ear cleaning, no shaving on previous day is needed.

Instrument trolley and draping: The threads of trolley sheet and drapings go to the operating area and deposit there causing granulations and failure. So the trolley should be draped with plastic sheet and patient should also be draped with plastic sheet or Lenin free drapes. The glove powder may also cause foreign body reaction and may granulate, so powder free gloves should be used for ear procedures. Cotton should not be used during the procedure.

Microscope and surgeon stool: The surgeon stool must be most comfortable, it should have a back rest. The microscope should have eye piece tilting facility. Lateral tilt of the operating table should be used. The height of the operating table, lateral tilt of table, height of surgeon stool and eye piece angle should be adjusted so that there is no forward bending of surgeon. The back rest should touch the back of surgeon. If the surgeon is tired the outcome may be affected.

Anesthesia: We prefer local anesthesia with dexmedetomidine in presence of anesthetist. If need arises anesthesia can be deepened or converted to General anesthesia, whatever anesthetist decides but for sure we need hypotensive and co-operative patient. Premade Xylocain with adrenaline is used for infiltration. Canal skin is infiltrated with insulin syringe very slowly to avoid bleb formation. After infiltration patient draping is done to get enough time to Adrenaline to act.

Ear wash: Thorough Saline wash is needed before we start the surgery. There is infection or pus in canal and at TM and its margin. The canal is lined with exfoliated skin and sometimes live skin peels off. If any of this skin is left and deposited in middle ear cleft, it will cause failure. As we know only with water jet we cannot clean our hands and utensils, we need to scrub these. A simple water or betadine wash is not enough, unless we scrub the lining. We take a large wet gel foam piece in Alligator forceps in the mid of the block to protect its tip as shown in Fig: 3 and scrub the canal and TM with continuous irrigation till we are satisfied. It should be atraumatic.

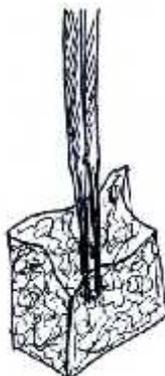


Figure-3 Gel foam held by crocodile forceps so that its tip is protected all around.

Incision : We did CSOM surgery also with endaural route for many years but post aural route has edge over it . However small and clean, the endaural scar is visible but post aural is not. If at all there is hypertrophy of scar or Keloid it may cause embarrassing situation. Graft harvesting is a bit difficult and large size graft if needed is difficult. The biggest problem is incision line and Mastoidectomy fall in same line. So there is possibility of Antrocutaneous fistula. We give small post aural incision exactly at the post aural crease thus giving almost invisible scar. This provides good exposure, limitless graft size harvesting and no fear of antro-cutaneous fistula. (Fig: 1)



Figure-1 Post aural incision exactly at the crease

Elevation of flaps: No electro-cautry is used at skin and subcutaneous tissue as in our experience this can cause post operative long term pain and parasthesia. Temporalis muscle is not traumatized, cut and electro-cautry is also avoided on muscle as this also can cause post operative pain. Periosteum is cut in 'T' shape so that while closing this is approximated firmly to prevent forward displacement of pinna. Horizontal marking at incision line is always given so that vertical displacement of pinna is avoided while closing.

Mastoidectomy: In all CSOM (safe ear) surgeries we do Cortical mastoidectomy except non healing, non discharging traumatic perforation. We call it Tympanomastoidectomy. No Myringoplasty or Tympanoplasty is performed. People who are doing Tympanoplasty or Myringoplasty alone may be missing disease, granulations or blocked aditus at least in some cases and this may cause failure of surgery whatever small their number may be and warrant revisions. There is no way we can know that a particular mastoid is having granulations, mass or blocked aditus or not unless we open it. So the best policy would be to open the mastoid and do water patency test to get cent percent result. Tubercular ear involvement is more common than thought in our country, if mastoid is not opened and biopsy tissue is not collected, we can never know the diagnosis and surgery will definitely fail. If at all someone wants to avoid complete cortical Mastoidectomy he can open some cells and if Betadine which is filled in ear canal comes through mastoid cells further drilling can be avoided.

Freshening of margin of perforation: The epithelium in long persisting perforation turns and joins the endothelium, so if only a thin margin is freshened we may leave epithelium on under surface. A good thick rim of membrane including all three layers of TM should be removed but the health of the membrane as a whole should be seen, not only the perforation. If granulations or myringitis is seen we never hesitate to remove whole of membrane and even a part of canal skin if

involved. Because a part of unhealthy skin or membrane can cause total failure while increasing the size of perforation has no ill effects on the result of surgery.

Canal incision: About 360 degrees sandwiching of graft would be definitely better than just keeping the graft under tympanic membrane anteriorly. Thus we need elevation of canal skin from 1 o'clock to 11 o'clock. The posterior horizontal incision is 1 cm lateral to annulus and this turns vertically medial at 7 o'clock and then runs horizontally anteriorly 5 mm lateral to annulus till 1 o'clock. This elevated skin gives good chance of almost 360 degree sandwiching of fascia and has good blood supply to carry to graft because it is just not attached 11 – 1 o'clock it has a wide base vertically. (Fig: 2A,B)

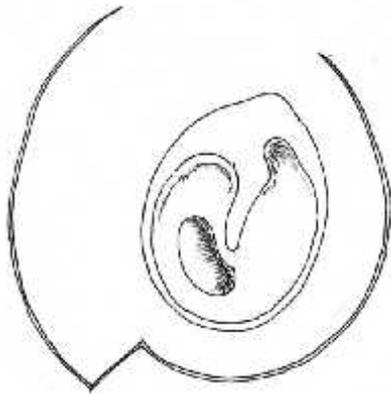


Figure 2 (a) Canal Incision

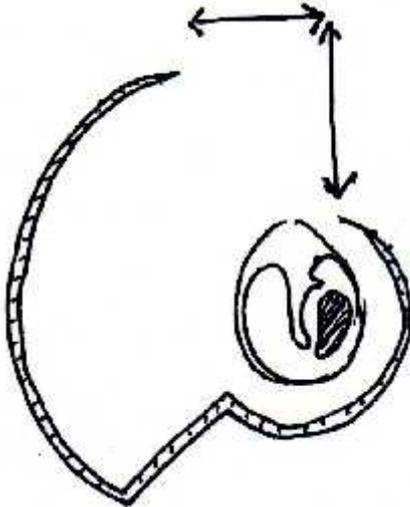


Figure 2 (b) Canal Incision

The graft which is sandwiched approx 360 degrees would have more blood supply and better chances of survival than those tugged by a tunnel. So canal skin elevation almost 360 degrees is done elevating skin of the canal and peeling skin layer of the membrane leaving annulus and bed of mucosa to receive and feed the graft.

Each and every tissue taken during CSOM (safe ear) surgery including margin of tympanic membrane should be subjected to biopsy and if tuberculosis is all the test like AFB, gene expert bectac culture and histopathology should be done. Disproportionate hearing loss, disproportionate pain in safe discharging ear, short history of fast progressive CSOM, facial palsy in safe CSOM. Osteitis, Canal wall sagging, canal granulations in central perforation, more bleeding, fragile granulations, weak bone while drilling are features we identified in tubercular ear involvement.

Concept of Load and nutrition (demand and supply): We put fascia, cartilage etc in middle ear as a free graft which ultimately needs nutrition to be live. So the more free graft we put is the more need of nutrition is and so less chances of graft and tissue becoming live. Such grafts and tissues slough and become source of secondary infection, failure and discharging cavity. So we should put thinnest possible fascia and smallest possible cartilage if needed and minimum possible or no other tissue. Foreign body like sialastic sheet, gel foam etc should be avoided to prevent failures.

Concept of Horizontal and vertical free grafts : A large thin fascia kept will not slough as it gets supply from underlying bone (large area) so called horizontal graft, but thick fascia or multiple layers of free grafts may slough as it will get supply from a smaller area, so called vertical graft. Obviously horizontally large grafts are acceptable but vertically put large mass may slough.

Never detach skin from Maleus. As it helps in hearing preservation and helps in early epithelisation of graft. Only the undersurface should be denuded as epithelium may have grown under Maleus, and to make it raw for fascial attachment. Maleus with it's epithelium goes upto centre of the graft. If healthy and attached it gives blood supply to the graft right upto centre. Epithelium also starts growing from centre. It also prevents lateralization. So the Maleus should never be shortened or removed or stripped. If there is gross medialisation of maleus and there is difficulty in graft slipping the anterior Malleolar fold should be drilled with small diamond burr which frees the Maleus. Medialisation is due to ossification of anterior Maleolar fold. Graft must be kept under Maleus.

Canal plasty is done only if there is bony overhang immediate 4-5 mm above the annulus. So that our graft rests like a saucer and there are no chances of potential space due to overhang and there is collection of blood or serum thus causing failure to graft uptake. Too much canal plasty to see all the annulus in one view can cause straightening of canal which is neither natural and nor really needed. (Fig: 5)

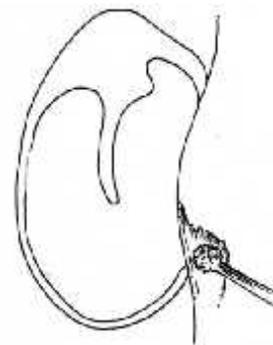


Figure-5 Removal of immediate bony hang

Overlay / underlay/ interlay grafting : When a free fascia graft is put and we expect it to be live, this can only happen when it gets early and good nutritional supply . This prevents graft from being sloughed. So we need vascularity all around the graft.

In underlay technique fascia is kept between bone and mucosa posteriorly and it is under mucosa anteriorly or tugged in a tunnel. So there is no firm contact anteriorly and graft get vascularity from one side i.e. mucosal layer, so vascularity may be compromised.

In interlay – the canal skin, membrane skin and annulus with its fibrous layer is elevated from bed and graft is put between bone, annulus with fibrous layer and mucosa of tympanic membrane below and skin above. There is good sandwich contact all around but it is inferior to overlay as annulus is thick and relatively a vascular tissue which has been elevated from its bed and between this and its bed fascia has been kept. So nutrition to annulus may be compromised and may cause graft failure.

In overlay grafting, skin of canal and membrane is elevated leaving bed of Membrane mucosa, annulus with its fibrous layer, so the graft is in good sandwich contact between bone and annulus, fibrous layer and mucosa and Skin superiorly, under Maleus, thus almost 360 degree sandwiching, ensuring early and maximal nutrition and chances of sure uptake. Here the annulus and fibrous layer is live. Logically this seems to be the best method of grafting so why should still other ways of grafting be followed. (Fig: 6)

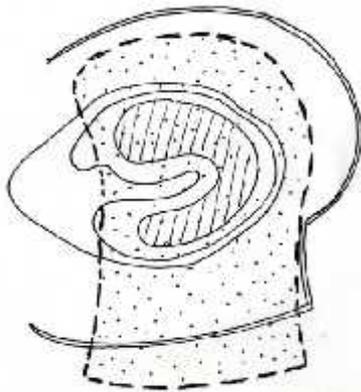


Figure-6 Placement of tongue shaped graft

Concept of secondary infection: In post operative discharging ear infection is not the primary cause, it is secondary to sloughing of tissues or granulations, mucosa coming over epithelium or epithelium growing inside mucosa or sometimes chronic infections like Tuberculosis. We have to remove slough, treat granulation. Only Antibiotics, aural toilet, culture sensitivity etc will not work most of the time.

Firm contact of graft with bone, skin and mucosa: If all the three layers namely skin, graft and mucosa are kept loosely or graft is wrinkled, there will be potential space for blood or serum to be collected and thus nutrition to graft will compromise. Most displacement and dislodgement of graft occurs while we are closing the ear. While we disengage the retractors at times oozing starts, it can collect in ear canal or mastoid which may push graft, while removing the ribbon gauge, cleaning the blood etc may disturb the graft. When we have closed the post aural flaps, any collection in the mastoid will push the graft from below. so tightly kept cotton ball protects our graft from these. And we keep a tube drain in mastoid to further drain out the collection if any to save the graft. Drain prevents any suction effect or push by blood or serum collection on graft. Further if blood is collected in mastoid cavity and with time it organizes, it shrinks and causes negative pressure in middle ear cleft causing graft displacement or pouching.

Although we do not advice or keep any foreign material in middle ear one gel foam is kept at Eustachian opening to temporarily avoid the push or suction from nasal side which may disturb the graft.

Eustachian tube function: For some time we did pre operative Eustachian tube function tests and in which ear it was blocked we performed surgery with special consent. But to our surprise there were no difference in outcome in these cases. We also performed per operative Eustachian tube function tests by instilling saline and asking patient whether he could feel same in mouth, and if it was blocked we did Eustachian tube catheterization. We could not make any advantage of this. The conclusion being Eustachian tube function assessment makes no difference in outcome of CSOM (safe ear) surgery.

Which graft material -Fascia / cartilage / perichondrium: The thickness of the Temporalis fascia is unmatched. The thinner the graft, less nutrition it requires and more chances of uptake. Fascia harvesting is easy, we can harvest as much size as we want. Perichondrium is thick, so the nutritional load is more. It has its shape memory, so it cannot be laid freely and we cannot have a large size if needed. Cartilage is equally good in uptake but it will never give natural membrane with elasticity. So beyond doubt thin Temporalis fascia is best material for membrane graft.

We take large tongue shaped thinnest possible fascia and lay it anteriorly and inferiorly just below the anterior canal incision line, under the Maleus and posteriorly it overshoots the post canal skin flap because posteriorly the skin falls short due to canal drilling and thus long fascia is needed to cover the exposed bone so that it does not granulate. The size should be just adequate so that there are no wrinkles and it does not fall short as tense graft can cause perforation. Fascia should also not pop out of skin incision line otherwise it granulates. Special attention is given to anterosuperior area where there are more chances of graft falling off. So there should be adequate graft sandwiching between skin and bone and if there is more room and fear of graft sucking in a piece of gel foam can be put to support it. The skin then is pressed all around to squeeze off collection of fluid. Then gel foam bed is created to further receive a large cotton ball.

Always Wet Graft: There are many logical explanation that a immediate harvested wet Fascia graft will be live, fibroblasts which are responsible for healing would be live and active. The stickyness of wet graft is many times more than dry graft. Such a graft will have more chances of taking up rather than dried parchment like dead graft which can slough and discharge. Finally in most cases epithelium grows over it but this is not primary healing and till then ear would be discharging. This discharging episode may cause middle ear scarring and can disturb ossicular reconstruction whatever it may be. The only advantage of dry graft is ease of laying it, but for an ear surgeon with good exposure there is no difficulty at all for wet graft. If needed there are two alternates to immediate harvesting of fascia before grafting. First we can dissect out the fascia but leave just a bit attached and left in situ, to be separated just before grafting and other if fascia has been taken out and grafting is delayed we should keep graft in chilled saline as hair follicles are kept in hair transplant to arrest the metabolism so that graft remains live longer.

If canal skin falls short of length due to drilling or canal flap is detached: If the canal skin is short and bone is exposed. This should be covered with Fascia or free skin graft from Tragal skin or post aural skin. If canal skin is avulsed, it should be saved, thinned out and regrafted as free graft. If due to excessive widening canal skin do not fall on bony canal wall ,

it should be cut at 6 o'clock so that both the ends have sufficient blood supply but the skin must fall on bony wall firmly.

Concept of primary and secondary healing: Skin is friend, granulation is enemy. If there is skin to skin closure it will heal by primary intention which is early and no inflammation or granulation is there. But if skin is not approximated exposed bone granulate. Skin should be mobilized to cover all canal wall. In necessity a free skin graft can be put from Tragal area or post aural area. Or at least should be covered with Temporalis fascia. If mucosa, fascia graft or skin are not properly placed at there position the margins may granulate and will heal by secondary healing, causing secondary infection, discharge and ultimately scarring or tissue loss.

Incus and postero superior area: Unnecessary drilling at postero superior area should be avoided because this is the area where postoperative pouching starts and ultimately may give way. At the time of closure postero superior and superior skin looks very thick and healthy giving an impression that this area needs no support but in long term this thins out and retracts. If drilling has been done, it must be supported with thin cartilage. Incus if eroded and even if it is of no use should not be removed because this also promotes postero superior retraction and pouching. Preserved bony canal acts like live bed for graft, by unnecessary drilling we may increase the size of unsupported part of graft.

Mastoid and middle ear wash and Eustachian tube area: When both mastoid and middle ear has been exposed these need a thorough wash. Wash should be started from mastoid side first because middle ear and canal side may contain detached epithelial tissue which may deposit in aditus area. A good wash of all the area of middle ear with special attention to Eustachian tube area should be done as this is most roomy area and may contain debris or even foreign body. Thorough wash to expect removal of all the exfoliated cells and infection from middle ear and Mastoid at all as we say five minute wash of our hands with tap water makes infection free.

Atraumatic procedures in middle ear: We have to keep the canal flap intact till the end of procedure because complete and healthy canal skin is the key to success for graft uptake. Also we have to save Middle ear mucosa from damage. Two instrument, Suction and drill cause most of the trauma to middle ear. If the mucosa is torn, stripped or made raw it will invite granulation, scarring and adhesions. Eustachian tube area damage may cause tubal blockage, Suction and drill both may avulse the canal flap. We have designed the suction tip with one side perforation above the tip. So it securely retracts the flap while drilling as well as keeps doing suction, without damaging the flap. Piezoelectric drill can solve this problem. Suction tip in no case should touch mucosa carelessly as the suction power damages the mucosa which may not be visible immediately. Drilling in the middle ear should be done if really necessary.

Special suction Tips: We have designed suction tip for middle ear drilling. This has a hole above the tip so that it holds the flap while suction is on. Otherwise normal tips suck the flap and close the suction. (Fig: 4)

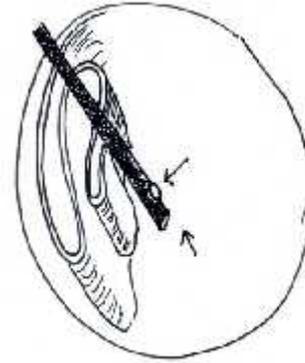


Figure-4 Suction tip with extra opening at side which acts as refractor as well as suction

Cartilage is best material to be used if needed in Middle ear. It may be for ossiculoplasty or augmentation or reinforcing the canal wall. Perichondrium, periosteum etc are not preferred. Because cartilage survives very well in middle ear even in absence of direct vascularity. It behaves like material not as tissue with less nutritional requirements. Cartilage behaves like Cornea it does not need blood supply but can survive on body fluids so its survival is sure in middle ear. It is also not recognized by body immune system so a preserved cartilage can also survive in other patient like cornea does.

Closure in two layer: Both vertical and horizontal displacement (lop ear)of pinna is common after ear surgery and looks very bad, and is easily noticeable. So closure should be done in two layers. Periosteum being very important as it is tough and when approximated nicely it prevents lop ear. A horizontal incision mark while giving incision should be approximated carefully to prevent vertical displacement.

Canal skin is approximated and gel foam with firm ointment pack is done. Mastoid dressing is done and patient is discharged as day care procedure.

Dressing removal and gel foam and drain: Dressing is removed after three to seven days with drain. Stiches are removed on seventh day. Gel foams are removed with suction tip under vision. Cotton ball is removed carefully. Last layer of gel foams are left in situ, as this is soaked in body fluid and may help in survival of graft and help in epithelisation, to be removed in next visit after two weeks or shreds off by itself. Some surgeons say once done adequately ear surgery needs no care. But this is not true. We have seen small problems occurring post operatively which if tackled then and there improves result otherwise can cause total failure.

Follow up: It is very necessary initially monthly then three monthly. Any granulation should be cauterized immediately and steroid and antibiotic pack should be given till granulations subside. Post op sloughing of graft if any should be excised, as this tissue is of no use and will invite secondary infection. For soft granulations antibiotic and steroid packs are best.

Failures: Even after taking all precautions the result may not be upto our satisfaction or it fails. The graft may slough partially or fully. It depends on the condition of ear, its physiology or unknown factors. So we should be realistic in approach.

Pinhead perforation: Dry ear with small perforation may be kept under watch or fat myringoplasty can be done.

Large Perforation and total graft failure: As we have done Mastoidectomy and removed disease from middle ear cleft, there are chances that self healing may occur. So early revision is not advisable. Both patient and surgeon should have patience and decide accordingly.

Myringitis: Can be cauterised with Trichloroacetic acid or Laser and antibiotic and steroid drops are given.

Perichondritis: Perichondritis can be prevented by least touching the cartilage, no tooth forceps should be used on cartilage. For cartilage incision and cutting only with new blade every time. Because serrated edges and margins and used blades may harbor infection which may get deposited in cartilage and as cartilage is a vascular structure, infection may flair up. Nowhere cartilage should be exposed to exterior.

Canal opening and meatoplasty: For Tympanic membrane and ear canal to be healthy it needs to be well exteriorized and ventilated, means the canal opening should be adequately wide. A wide canal opening is necessary for post operative examinations, care and early healing. It should be decided pre operatively that a canal plasty or meatoplasty is needed or not. Sometimes only cartilagenous opening is narrow and can be widened by pulling the pinna posteriorly. This needs meatoplasty only by removing meatal cartilage with canal wall cartilage as shown in (fig: 7), with no skin work, this will open the canal opening with the time. If canal is narrow bony canal plasty is needed.

Deterioration/facial palsy: If after surgery condition deteriorates badly, there is disproportionate pain, granulations which do not respond to conservative treatment, canal wall sagging occurs or delayed facial paresis occurs. These may be the signs of tubercular involvement. The biopsy should be reviewed in this regard.



Figure- 7 Meatoplasty

CONCLUSION

The factors influencing the result of CSOM Surgery are multiple. So to compare any one step of the surgery is difficult. Here we have tried to come to a set of steps which provide satisfactory results even in average surgical skilled hands.

Reference

1. D.M. Fliss, R. Dagan, Z. Houry, A. Leiberman, Medical management of chronic suppurative otitis media without cholesteatoma in children, *J. Pediatr.* 116 (6) (1990) 991—996.

2. P.S. Roland, Chronic suppurative otitis media: a clinical overview, *Ear Nose Throat J.* 81 (8 Suppl. 1) (2002) 8—10.
3. M.A. Kenna, B.A. Rosane, C.D. Bluestone, Medical management of chronic suppurative otitis media without cholesteatoma in children—update 1992, *Am. J. Otol.* 14 (5) (1993) 469—473.
4. Arguedas, C. Loaiza, J.F. Herrera, E. Mohs, Antimicrobial therapy for children with chronic suppurative otitis media without cholesteatoma, *Pediatr. Infect. Dis. J.* 13 (10) (1994) 878—882.
5. P.S. Morris, Management of otitis media in a high risk population, *Aust. Fam. Physician* 27 (11) (1998) 1021—1029.
6. C.D. Bluestone, S.E. Stool, M.A. Kenna (Eds.), *Pediatric Otolaryngology*, third ed., W.B. Saunders Company, Philadelphia, United States of America, 1996
7. Tympanomastoidectomy has been advocated as the surgical treatment of choice in CSOM since the 1970s [, ,].
8. C.D. Bluestone, S.E. Stool, M.A. Kenna (Eds.), *Pediatric Otolaryngology*, third ed., W.B. Saunders Company, Philadelphia, United States of America, 199
9. E. Vartiainen, Results of surgical treatment for chronic non cholesteatomatous otitis media in the pediatric population, *Int. J. Pediatr. Otorhinolaryngol.* 24 (1992) 209—216
10. E. Vartiainen, M. Kansanen, Tympanomastoidectomy for chronic otitis media without cholesteatoma, *Otolaryngol. Head Neck Surg.* 106 (3) (1992) 230—234 a higher incidence of surgical failures in younger children [107,108].
11. D. Dawes, Myringoplasty, *J. Laryngol. Otol.* 86 (2) (1972) 141—146
12. C.H. Raine, S.D. Singh, Tympanoplasty in children. A review of 114 cases, *J. Laryngol. Otol.* 97 (3) (1983) 217—221.
13. Aggarwal R, Saeed SR, Green KJ. Myringoplasty. *J Laryngol Otol.* 2006 Jun. 120(6):429-32.
14. Cavaliere M, Mottola G, Rondinelli M, Iemma M. Tragal cartilage in tympanoplasty: anatomic and functional results in 306 cases. *Acta Otorhinolaryngol Ital* 2009; 29(1):27-32.
15. Sheehy JL, Glasscock ME. Tympanic membrane grafting with temporalis fascia. *Arch Otolaryngol* 1967; 86(4):391-402.
16. Mishiro Y, Sakagami M, Takahashi Y, Kitahara T, Kajikawa H, Kubo T. Tympanoplasty with and without mastoidectomy for non-cholesteatomatous chronic otitis media. *Eur Arch Otorhinolaryngol.*, 2001, 258 (1): 13-15
17. Tos M, Stangerup SE, Orntoft S. Reasons for reperforation after tympanoplasty in children. *Acta Otolaryngol Suppl.*, 2000, 543: 143-146
18. Vrabec JT, Deskin RW, Grady JJ. Meta-analysis of pediatric tympanoplasty. *Arch Otolaryngol Head Neck Surg.*, 1999, 125 (5): 530-534.
19. Tos M, Orntoft S, Stangerup SE. Results of tympanoplasty in children after 15 to 27 years. *Ann Otol Rhinol Laryngol.*, 2000, 109 (1): 17-23.