(International Print/Online Journal)

SJIF IMPACT FACTOR: 4.617
GADIF IMPACT FACTOR: 1.49

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume1, Issue 2, Page No: 181-189
July-August 2018

Measurement of Posterosuperior Bony Overhang and Site of Otosclerotic Focus in Patients of Otosclerosis Undergoing Stapedotomy

Dr.Anchal Gupta*[1], Dr. Palak Gupta[2], Dr. Padam Singh Jamwal[3]
[1] Senior Resident, Department of ENT and Head and Neck Surgery,
SMGS Hospital, Government Medical College, Jammu, J&K-180001
[2] Postgraduate, Department of Ophthalmology, Government Medical College,
Jammu, J&K-180001
[3] Professor, Department of ENT and Head and Neck Surgery,
SMGS Hospital, Government Medical College, Jammu, J&K-180001

Corresponding Author:
Dr. Anchal Gupta
Senior Resident, Department of ENT and Head and Neck Surgery, SMGS Hospital
Government Medical College, Jammu, J&K-180001

Type of Publication: Original Research Paper
Conflicts of Interest: Nil

ABSTRACT

Aim: To evaluate the extent of posterosuperior bony overhang required to be removed for proper exposure of incudostapedial complex during stapes surgery and to note the site of otosclerotic focus in patients of otosclerosis undergoing stapedotomy.

Materials and Methods: Forty otosclerotic patients were enrolled for the study. Pure tone audiometry and impedance audiometry was done in patients. All the patients underwent stapedotomy under local anaesthesia. The amount of overhang of the posterosuperior bony canal for the proper exposure of incudostapedial joint was recorded using measured right angled picks. After proper exposure of the incudo-stapedial complex, the stapes superstructure was inspected and palpated to confirm the diagnosis of otosclerosis. The site of otosclerotic focus was noted.

Results: The posterosuperior bony overhang removed for the proper exposure of incudostapedial complex was between 2-2.5 mm in majority of the patients (50%). That means in majority of the patients the incudostapedial complex was not visible and about 2-2.5 mm need to be removed for its proper exposure. The mean posterosuperior bony overhang was 1.87±0.58 mm. The site of otosclerotic focus was anterior focus (60%) in majority of the patients followed by posterior focus (30%).

Conclusions: Proper visualization of incudostapedial joint complex is important in stapes surgery for adequate exposure. most of the patients had anterior focus.

Keywords: posterosuperior bony overhang, otosclerosis, stapedotomy

INTRODUCTION

Otosclerosis is defined as a continuous process of alteration in bone metabolism of otic capsule in the form of bone resorption and redeposition. It is a disease that affects the bony labyrinth capsule, and is characterised by formation of centres of newly constructed bone, which are usually formed in the area of the oval window and annular ligament leading to stapes fixation. It is characterised by destruction of the existing and formation of new, initially spongious, and then compact bone. It is primarily a disease of localized bone remodelling. Otosclerosis is a process occurring in two phases: (1) active phase as characterised by bone resorption (spongiosis) and (2) phase of remission characterised by bone deposition (sclerosis) [1].

Otosclerosis occurs at certain sites of predilection within the temporal bone with the most common site being the area anterior to the oval window (80-95 percent of cases). Other sites of involvement in descending order of frequency are the round window niche (about 30 percent), the apical medial wall of the cochlear labyrinth (about 15 percent), the stapes footplate (about 12 percent) and posterior to the oval window (5-10 percent). The frequency of these

affected sites is similar in both clinical and histologic otosclerosis. Other sites involved less frequently include the walls of the internal auditory canal, around the vestibular and cochlear aqueducts, around the semicircular canals and the malleus and incus. Otosclerosis has not been reported in bones outside the temporal bone.

Examination of both pairs of temporal bones from individuals have shown that otosclerosis is usually bilateral, with involvement of both ears in 70-90 percent of cases. Foci of clinical or histologic otosclerosis can be single or multiple within the temporal bone. It appears that extensive lesions of the otic capsule form by the fusion of separate foci. Expansion of otosclerotic foci can obliterate the oval and round windows. However, invasion of the labyrinthine spaces is rare and occurs only in the most active lesions.

The definitive diagnosis of otosclerosis is always made by surgical exploration, which confirms the immobility of the stapes. Clinical symptoms of otosclerosis include progressive hearing loss and tinnitus. In rare cases, dizziness may occur as well. The patient with otosclerotic deafness has a characteristically quiet voice of good tone and the change in speech pattern may be detected by close relatives who often notice the hearing loss before the patient becomes aware of it.

The tympanic membranes in otosclerotic patients are sometimes described as being in 'mint condition' but they may be atrophic, thickened, rigid or immobile due to prior inflammatory disease. The 'flamingo flush', or Schwartze sign, is uncommon (seen in 10% of the patients presenting with otosclerosis). It is said to be a result of vascular bone on the promontory, or blood vessels in the submucosal layer of mucus membrane of the promontory.

A rapid examination of the hearing loss is made by simple speech tests, using conversational and whispered voice, using a Barany noise box to mask the other ear, the effect of trying a hearing aid, and the tuning fork tests.

The audiological signature pattern in fenestral otosclerosis is conductive hearing loss with Carharts' notch at 2 kHz, excellent speech discrimination scores, low compliance on impedance audiometry (less than 0.3cc), normal middle ear pressure and absence or distortion of stapedial reflex.

Carharts' notch is thought to be typical of otosclerosis [2]. It is characterised by depression of bone conduction thresholds of approximately 5dB at 500 Hz, 10dB at 1kHz, 15dB at 2kHz, and 5dB at 4kHz. Surgery improves bone conduction thresholds and Carharts' notch disappears following surgery.

Impedance audiometry is the measurement of the tympanic membrane compliance in response to variations of air pressure in external auditory canal. In otosclerosis the tympanometric peak decreases.

The conductive hearing loss due to otosclerosis is amenable to non-surgical and surgical remedies. However stapes surgery is currently the preferred treatment modality. The aim of stapes surgery is to obtain an air-bone gap within 10dB.

For this operation to perform properly an adequate exposure of the incudo-stapedial complex is mandatory. Inadequate exposure of the stapes footplate area during surgery may lead to post operative hazards and subsequent complications as serious as permanent hearing loss. So if one can assess the amount of the bony meatal overhang clinically, it can guide the surgeon about the extent of bone to be removed during stapes surgery [3].This study was undertaken to diagnose the patients presenting with unilateral or bilateral progressive hearing loss with normal otoscopic findings with otosclerosis, diagnostic evaluation of these patients using pure tone audiometry and impedance audiometry and to offer these patients stapedotomy as primary modality of treatment. A record of the extent of posterosuperior bony overhang in relation to the direction of pars interna and the site of otoscerotic foci in each case was kept.

MATERIALS & METHODS

The present prospective study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery, SMGS Hospital, Jammu w.e.f. November 2015 to October 2016. The study was conducted after taking approval of Institutional Ethics Committee. Forty otosclerotic patients were enrolled for the study. After thorough clinical examination including otoscopy and tuning fork tests, Pure Tone Audiometry and Impedance Audiometry was done in all the patients. After the diagnosis of

Volume 1, Issue 2; July-August 2018; Page No. 181-189

clinical otosclerosis and excluding any contraindication for surgery all the patients underwent stapedotomy. The patients included in the study were in the age group of 15-45 years, both males and females presenting with Progressive hearing loss (unilateral / bilateral), Vertigo, Tinnitus ,On otoscopy- normal tympanic membrane and external auditory canal Tuning fork tests- Rinnie's test negative always, Weber's test-central or lateralized to deafer ear. Pure tone audiometry- Air bone gap ≥25dB with Carharts notch at 2kHz frequency. Impedance audiometry- showing 'As' Type of curve. The patients with infected middle or external ears, perforation of the drum, only hearing ear, disease in the contralateral ear that may threaten hearing in future, Meniere's syndrome, bleeding diathesis, poor air-bone gap on Pure tone Audiometry were excluded from the study.

All stapedotomies were performed under local anaesthetic blockage of ear with 2% xylocaine and 1:60,000 adrenaline. A transcanal approach with Rosen's incision was used in majority of the cases. Other approaches used were postaural and endaural.[Figure 1]

The tympanomeatal flap was elevated from the sulcus tympanicus through permeatal incision and placed forwards.

The chorda tympani nerve was freed from mucosal attachments and displaced anteroinferiorly to view the oval window complex. After elevation of the tympanomeatal flap, the visibility of the long or lenticular process of incus was noted and the distance between the posterior margin of the lenticular process of the incus and the sulcus tympanicus was noted with help of measured picks of different sizes 0.5mm, 1mm, 1.5mm, 2mm, 2.5mm, 3mm [Figure 2]. Then the bony overhang of the posterior meatal wall from the level of the sulcus tympanicus was removed either using micro curette. The bone was removed till the summit of the pyramid was visualized. The distance between the posterior border of the lenticular process of incus and the posterosuperior bony canal wall at the level of the base of the pyramid was noted using measured using right-angled picks of different lengths. The measurements were noted down in the prescribed performa. The difference between these two measurements denotes the actual extent of bony overhang removed in millimeters in each case. After proper exposure of the incudo-stapedial complex [Figure 3], the stapes superstructure was inspected and palpated to confirm the diagnosis of otosclerosis. The site of otosclerotic focus was noted. The mobility of the ossicular chain was confirmed and the distance between the footplate of stapes and the inner surface of long process of the incus was determined. The incudostapedial joint was disarticulated, the stapedial tendon was cut and the crura of stapes fractured [Figure 4]. The footplate was perforated using a perforator. Titanium-teflon prosthesis with a diameter of 0.5 mm was used in all the cases and crimped to the long process of incus, the oval widow was left unplugged. Subsequently, after confirming the position of the prosthesis and subjective hearing improvement on the operating table, the tympanomeatal flap was replaced and secured with gelfoam and an antibiotic soaked pack.

RESULTS

A total of forty patients were enrolled in the present study. The patients were in the age group of 16-44 years with the mean age of 28.5 ± 8.5 years. Maximum patients were in the age group of 20-40 years (70%). 55% patients were females and 45% were males and the F: M ratio was 1.2:1.Out of 22 females 10 (45%) were in the age group of 21-30 years whereas out of 18 males 8 (44%) were in the age group of 31-40 years. There was a history of progressive hearing loss in all the patients whereas hearing loss was associated with tinnitus in 10 (25%) patients**.** The mean age of onset of disease was 25.05±7.73 years. In females the mean age was 22.90±7.48 years whereas in males it was 27.66±7.61 years. The mean age of onset of disease was lower in females as compared to males. Based on symptoms and audiometric data, 8(20%) patients had unilateral disease whereas 32(80%) patients had bilateral disease at the time of presentation**.** The mean duration of symptoms was 3.45±1.50 years.

All the patients were operated under local anaesthesia. The approach used was transcanal in 26 (65%) patients, postaural in 10 (25%) patients and endaural in 4 (10%) patients. The postaural approach was used when external auditory was narrow and the exposure was limited.

The posterosuperior bony overhang was measured for proper exposure of incudostapedial complex with the help of measured right angled picks. The mean

Volume 1, Issue 2; July-August 2018; Page No. 181-189

posterosuperior bony overhang measured was 1.87±0.58 mm. 20 (50%) patients had Type B (2-2.5mm), 12 (30%) patients had Type A (0-2mm), 6(15%) patients had Type C (2.5-3mm) and only 2(5%) patient had Type D (>3mm) bony overhang. After measuring this bony overhang the bone was curetted using microcurette. [Figure 5] [Table 1]

Intraoperatively the site of otosclerotic focus was seen and noted. 24(60%) patients had involvement of anterior part of footplate, 12(30%) had posterior focus whereas biscuit type and circumferential footplate was present in 5% each. [Figure 6][Table 2]

DISCUSSION

Complete removal of the stapes ankylosed by otosclerosis with subsequent sealing of the open oval window with a transposed vein graft and reconstruction of the transmitting mechanism with a beveled polyethylene tube was described in a seminal publication by [4] in 1958. Since that time, stapes surgery for clinical otosclerosis has evolved from total stapedectomy to partial platinectomy [5] and then to calibrated stapedotomy [6] in which a small fenestra is created in the fixed stapes footplate to allow insertion of one of a variety of solid piston prostheses. The aim of all stapes surgery is to correct the conductive component of a patient's hearing impairment so as to achieve a long-lasting hearing improvement. Ideally, the first operation on the ear should also be the last. The stapes operation certainly offers predictable improvement of hearing in the short term with a low prevalence of complications. The practical trend of reducing the area of the fenestra in the fixed stapedial footplate was induced by considerations that a small-fenestra technique was less traumatic to the inner ear [7][8], had a lower incidence of immediate or delayed sensorineural hearing loss [9] had fewer complications such as perilymph fistulas at the oval window or vestibular disturbance, and gave better high-frequency hearing gains that were more stable over time and had a slower rate of decline than those of total stapedectomy. Small-fenestra techniques were also found to be more appropriate in the management of severe otosclerotic obliteration of the oval window niche.

In our study we measured posterosuperior bony overhang and curetted it out for proper exposure of incudostapedial complex and classified the patients to Type A (0-2mm), Type B (2-2.5mm), Type C (2.5-3mm) and Type D (> 3mm). The average overhang measured was 1.8±0.58 mm and maximum patients (50%) showed measurements between 2-2.5 mm and 30% showed Type A. This finding was strongly associated with the similar study conducted by Roy chaudhuri *et al*. [3] who found posterosuperior bony overhang between 2-2.5 mm in 55% of patients followed by 0-2 mm in 25% patients. A strong support to our study is given by Glasscock and Shambaugh [10],who stated that the amount of bony overhang was found out by to be between 2 and 4mm usually.

In our study 60% patients showed anterior focus, 30% patients showed posterior focus and circumferential and biscuit type of footplate was seen in 5% each that closely correlates with the study conducted by Schuknecht and Barber [11] on stating that anatomical site for otosclerosis foci both clinical and histologic in order of frequency are:1) anterior to oval window, 2) in the margins of round window, 3) in the apical medial wall of cochlear bony labyrinth. Our study is also comparable with the finding by Wycherly *et al*. [12] who in their study concluded that the sites affected included the ante fenestram , round window niche , cochlear promontory , cochlear apex, and posterior fenestram in that order. Similarly our study is in accordance with Guild [13] who stated that the disease process may begin in almost any portion of the otic capsule more than half of all otosclerotic areas arise in the region immediately in front of the oval window, and in more than three fourths of all ears with histologically demonstrable otosclerosis this region is involved. Obviously, there is good reason to call it the "area of pre¬dilection" for otosclerosis.

CONCLUSIONS

Stapedotomy is the method of choice for the surgical treatment of otosclerosis. Proper exposure of incudostapedial joint complex can help the surgeon to perform the surgery efficiently and hence reduce intraoperative and postoperative complications.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

REFERENCES

Volume 1, Issue 2; July-August 2018; Page No. 181-189

1. Yazdi AK, Sazgar AA, Motiee M, Ashtiani MK. Improvement of bone conduction after stapes surgery in otosclerosis patients with mixed hearing loss depending from surgical technique. Eur Arch Otorhinolaryngol 2009; 266: 1225–1228.
2. Carhart R. Clinical application of bone conduction audiometry. Arch Otolaryngol 1950; 51: 798-808.
3. Roychaudhuri BK, Roychaudhuri A, Ghosh S, Nandy S. Study on the Anatomical Variations of the Posterosuperior Bony Overhang of the External Auditory Canal. Indian J Otolaryngol Head Neck Surg 2011; 63(2): 136-140.
4. Shea JJ Jr. Fenestration of the oval window. Ann Otol Rhinol Laryngol 1958; 67: 932-951.
5. Shea JJ, Sanabria F, Smyth GD. Teflon piston operation for otosclerosis. Arch Otolaryngol 1962; 76: 516-521.
6. Bailey HA Jr, Pappas JJ, Graham SS. Small fenestra stapedectomy. A preliminary report. Laryngoscope 1981; 91: 1308-1321
7. Schuknecht HF, Applebaum EL. Surgery for hearing loss. N Engl J Med 1969; 280:1154-60.
8. Fisch U. Stapedotomy versus stapedectomy. Am J Otol 1982; 4: 112-117.
9. Smyth GDL, Hassard TH. Eighteen years experience in stapedectomy. The case for the small fenestra operation. Ann Otol Rhinol Laryngol Suppl 1978; 87(49): 3-36
10. Glasscock ME, Shambaugh GE Jr Surgery of the ear, 2nd edn. Saunders, Philadelphia (1990), p 393.
11. Schuknecht HF, Barber W. Histologic variants in otosclerosis. Laryngoscope 1985; 95: 1307-1317Guild SR. Incidence, Location And Extent Of Otosclerotic Lesions. Arch Otolaryngol 1950; 52: 263-269.
12. Wycherly BJ, Berkowitz F, Noone AM, Kim HJ. Computed Tomography and Otosclerosis: A Practical Method to Correlate the Sites Affected to Hearing Loss. Annals of Otology, Rhinology & Laryngology 2010 119 (12): 789-794.
13. Guild SR. Incidence, Location And Extent Of Otosclerotic Lesions. *Arch Otolaryngol* 1950; 52: 263-269.
14. Nandi S, Palit S, Ray A, Mukherjee P, Tapadar A, Dutta N. A Review of Otosclerosis With Special Reference to Measurements of External Auditory Canal for Corrective Surgery. J Anat Soc India 2007; 56(1): 48-52.
15. Smyth GD. Otosclerosis. In: Kerr AG, Booth JB, editors. Scott‐Brown's Otolaryngology. 6th ed., vol. 3. Oxford: Butterworth‐Heinemann; (1997): p 1

Volume 1, Issue 2; July-August 2018; Page No. 181-189

POSTEROSUPERIOR BONY OVERHANG (IN mm)	NO. OF PATIENTS	PERCENTAGE
0-2 (TYPE A)	12	30
2-2.5 (TYPE B)	20	50
2.5-3 (TYPE C)	6	15
3-3.5 (TYPE D)	2	5
TOTAL	40	100

Table 1: Measurement of posterosuperior bony overhang.

SITE OF FOCUS	NO OF PATIENTS	PERCENTAGE
Anterior	24	60
Posterior	12	30
Biscuit Type	2	5
Circumferential	2	5

Volume 1, Issue 2; July-August 2018; Page No. 181-189

TOTAL	40	100

Table 2: Site of otosclerotic focus

Figure 1: Instruments used for Stapedotomy

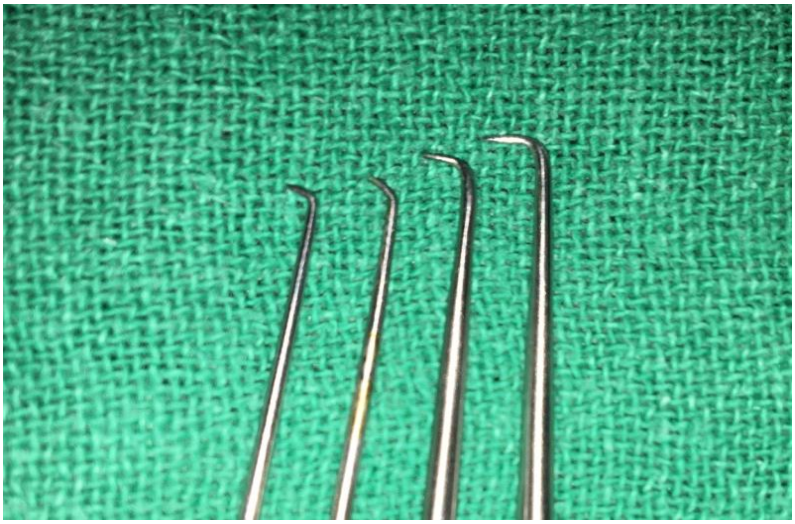

Figure 2: Measured right angled picks for the measurement of posterosuperior bony overhang

Volume 1, Issue 2; July-August 2018; Page No. 181-189

Figure 3: After measuring the posterosuperior bony overhang the bone is curreted with microcurette for proper visualisation of stapes area.

Figure 4:Stapes superstructure removed.

Volume 1, Issue 2; July-August 2018; Page No. 181-189

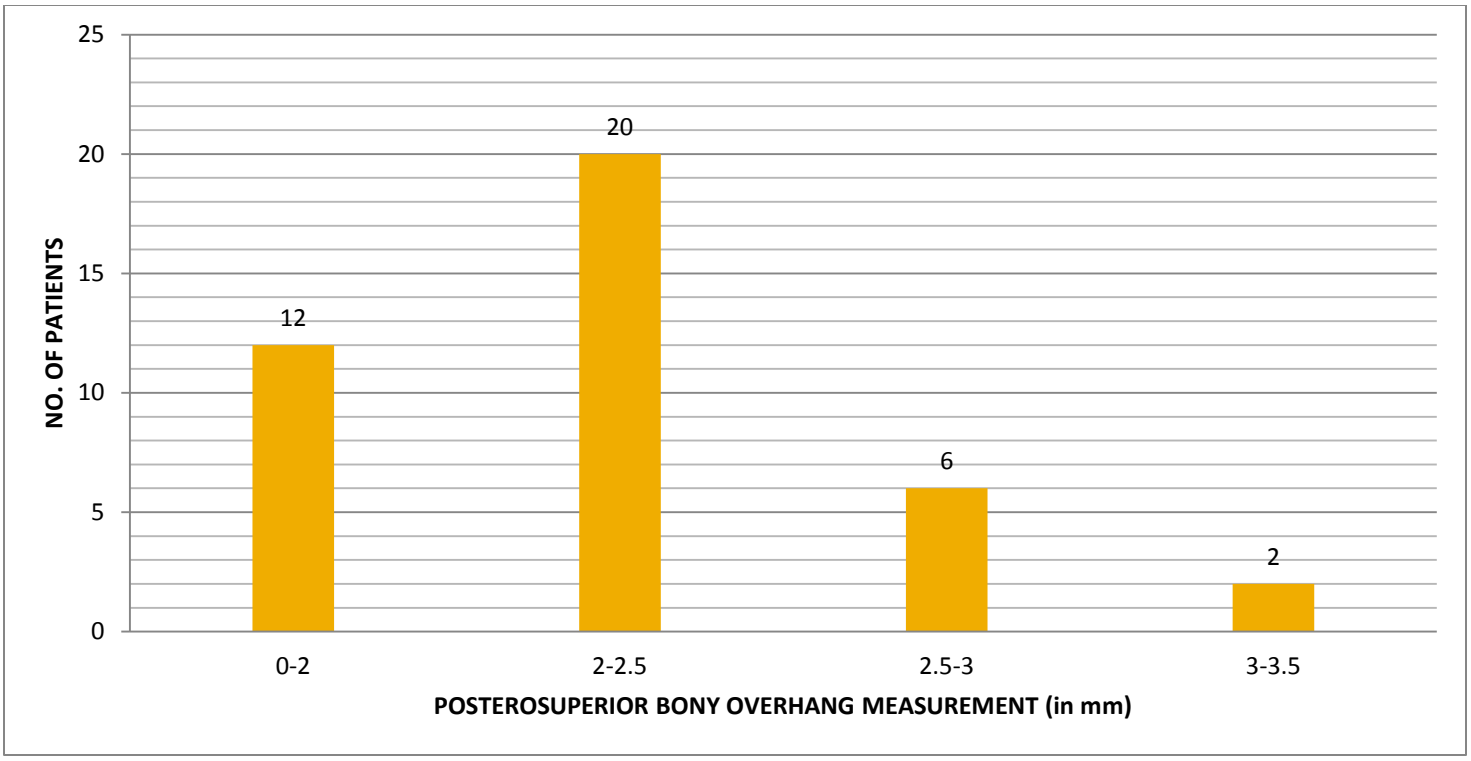

Figure 5: Measurement of posterosuperior bony overhang.

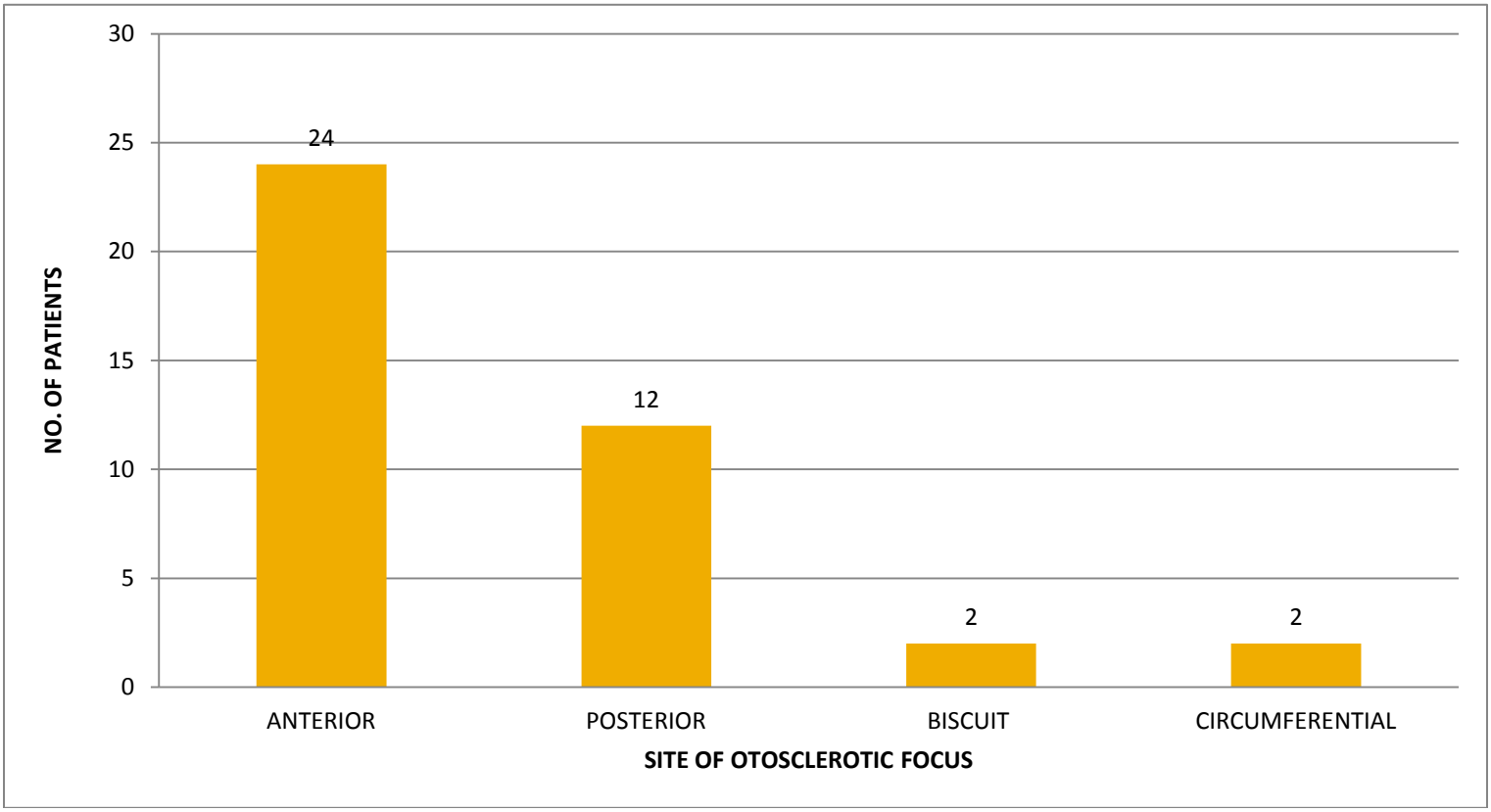

FIGURE 6: Site of otosclerotic focus.

Volume 1, Issue 2; July-August 2018; Page No. 181-189