

Review Article

Transmastoid Repair of Superior Semicircular Canal Dehiscence - A Review

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doi: <https://dx.doi.org/10.47739/Otolaryngology.1243>**OPEN ACCESS****Abstract**

Objective: To perform a literature review of the technique of transmastoid repair of superior semicircular canal dehiscence.

Data Sources: PubMed, MD consult and Ovid-SP databases.

Results: Transmastoid repair of superior semicircular canal dehiscence (SSCD) is now gaining popularity and is being performed with various modifications, with or without dural elevation. Various studies have reported successful outcomes with effective symptom resolution and hearing preservation. A variety of materials have been used to seal the defect. Plugging of the dehiscence has proven to be more effective than capping or resurfacing techniques. Transmastoid endoscopic underwater repair has also been performed more recently, with successful outcomes.

Conclusion: Transmastoid repair of SSCD is an effective and reliable technique that can be performed under local anesthesia; with lesser morbidity and should be considered as an alternative to the middle cranial fossa approach.

Keywords

- Superior semicircular canal dehiscence
- Transmastoid
- Repair

ABBREVIATIONS

SSC: Superior Semicircular Canal; SSCD: Superior Semicircular Canal Dehiscence; SSCDS: Superior Semicircular Canal Dehiscence Syndrome

INTRODUCTION

Superior semicircular canal dehiscence syndrome (SSCDS) was first described by Minor in 1998 [1]. Patients with SSCD can present with vertigo, oscillopsia, nystagmus, hearing loss (which may be conductive due to the third window effect), pulsatile tinnitus or, autophonia triggered by Valsalva or loud noise. Patients with mild symptoms can be managed conservatively with salt restriction, diuretics, vestibular suppressants, vestibular rehabilitation, and avoiding the offending stimulus. Tympanostomy tube placement may help in patients with pressure-induced symptoms.

However, patients with debilitating symptoms may require surgical repair, which involves plugging, capping, or resurfacing of the superior semicircular canal dehiscence.

Various surgical techniques such as the middle cranial fossa approach, transmastoid approach, as well as a transcanal approach (for oval and round window reinforcement) have been described [2,3].

In this article we have carried out a literature review of the technique of transmastoid repair of SSCD.

OBJECTIVE

To perform a literature review of the technique of transmastoid repair of superior semicircular canal dehiscence.

DATA SOURCES

PubMed, MD consult and Ovid-SP databases.

REVIEW OF LITERATURE

Traditionally, SSCD repair was carried out by resurfacing the dehiscence via a middle cranial fossa, extradural approach. This approach, however, involves a craniotomy and temporal lobe retraction. As a result, transmastoid repair of SSCD has now gained popularity.

SURGICAL TECHNIQUES

The transmastoid approach for SSCD repair was first described by Brantberg et al., (2001) [4]. SSC occlusion was performed in two patients via a transmastoid approach, using four separate fenestrations. Both patients had relief from pressure induced vertigo. Sensorineural hearing loss was however observed in one of the two patients following surgery [4,5]. Agrawal and Parnes modified this technique by occluding the superior semicircular

canal with bone pate and fibrin sealant, using two fenestrations, one placed on either side of the dehiscence [6]. They reported preservation or improvement of hearing, and successful control of vestibular function postoperatively. Kirtane et al performed transmastoid repair of SSCD under local anesthesia by elevating the dura [7]. The dehiscence was identified, the bone over the dome of the superior semicircular canal drilled out, and bone pate' packed into the fistula and down both the limbs to block the lumen completely. Bone wax, connective tissue, and cartilage were used to reinforce the repair. Resolution of sound and pressure induced vertigo, and oscillopsia was reported in the immediate post-operative period. Unsteadiness lasted for a few days, which resolved subsequently. Transient sensorineural hearing loss, which was reported post-operatively, improved over time. Complete resolution of all symptoms of oscillopsia, autophony and imbalance was observed one year after surgery. Afif et al encountered intraoperative cerebrospinal fluid (CSF) leak, during dural elevation, seen in four of 12 ears (33%) [8]. Fiorino et al. [9], and Rodgers et al. [10], have reported successful outcomes by performing transmastoid repair of SSCD with dural elevation. Fiorino et al plugged the dehiscence with bone dust, fibrin glue and bone wax, and further resurfaced it using cortical bone in 6 patients, with no intra or post-operative complications and immediate relief of symptoms [9]. Rodgers et al., performed cartilage capping with tragal cartilage, with the narrower portion of the cartilage covering the dehiscence and the wider portion placed within the mastoid cavity in 15 ears. This was secured in place with bone cement [10]. Failure was encountered in 2 cases. 80% of patients experienced complete (40%) or moderate (40%) relief with this technique, versus 71% in the group that underwent repair via the middle fossa approach. Of the patients who underwent transmastoid repair in the study by Rodgers et al, residual auditory symptoms were observed in 27%, vestibular in 13% and 20% had mixed auditory and vestibular symptoms. 43% of the patients who underwent middle fossa repair had residual vestibular symptoms. They, however, did not encounter any intra or post-operative complications associated with dural elevation [9,10].

Zhao et al performed transmastoid repair by skeletonizing the labyrinth and blue lining the superior semicircular canal without dural elevation [5]. The SSC was effectively plugged via a single fenestra in 3 cases and 2 fenestrations in 7 cases, with hearing preservation and no significant complications [5].

Yamauchi et al. [11], and Creighton et al. [12], have reported transmastoid endoscopic underwater repair of SSCD in one patient each. The dehiscence was identified after blue lining the SSC, plugged with muscle fascia and bone wax, and reinforced with bone paste and temporal muscle fascia (Yamauchi et al.,) [11]. Creighton et al., filled the mastoid cavity with balanced salt solution. A 0-degree endoscope with endoscrub was used to see the SCC underwater. The SCC was opened at the ampullated end with a burr and plugged with strips of wet and dried fascia and bone dust. The non-ampullated end was similarly plugged. The openings were capped with bone chips under the microscope after suctioning the balanced salt solution from the mastoid [12]. No complications were encountered in both cases [11,12].

PLUGGING, CAPPING, RESURFACING

SSCD may be repaired by plugging, resurfacing, or capping the dehiscence, or, by a combination of these techniques. Amoodi et al., reported effective symptom resolution with transmastoid resurfacing in 4 patients [13]. In a study by Powell et al., revision surgery with plugging of the dehiscence was required in 3 out of 18 patients who underwent transmastoid repair of SSCD with resurfacing [14]. Rodgers et al., encountered 2 failures in a series of 15 ears repaired by capping with tragal cartilage [9]. One of these patients required extensive physical and occupational therapy for vestibular symptoms, while the other patient had a recurrence following head injury and requires a revision transmastoid plugging. 80% of patients experienced complete (40%) or moderate (40%) relief with transmastoid capping. Of the patients who underwent transmastoid repair in the study by Rodgers et al, residual auditory symptoms were observed in 27%, vestibular in 13% and 20% had mixed auditory and vestibular symptoms.[9] Afif et al reported a revision rate of 33% in 10 patients (12 ears) undergoing cartilage overlay transmastoid resurfacing technique for SSCD, with deterioration in hearing through air and bone conduction at frequencies greater than 2500 Hz [8]. In a meta-analysis by Vlastarakos et al, success rates with plugging and capping techniques were found to be higher than resurfacing [15]. Most studies have reported good outcomes with plugging of the dehiscence with respect to symptom resolution and hearing preservation irrespective of the material used for plugging [5-7,9-12,14,15].

MATERIAL FOR REPAIR

Various materials such as bone pate, bone chips, fascia, connective tissue, muscle, bone cement, cartilage and fibrin glue have been used to repair SSCD [4-15]. Cartilage and bone have been used when performing capping and resurfacing [8,9].

HEARING PRESERVATION

Afif et al reported deterioration in hearing through air and bone conduction at frequencies greater than 2500 Hz [8]. Wilms et al., reported a bone conduction change of 5.9 dB in a retrospective study of 31 patients who underwent transmastoid plugging of SSCD [16]. Brantberg et al., encountered a sensorineural hearing loss in one out of two patients [5]. Kirtane et al., reported a deterioration in bone conduction in the immediate post-operative period, which improved over 6 weeks with steroids [7]. Similarly, most other studies have reported good auditory outcomes, with reduction in air-bone gap and hearing preservation following transmastoid repair of SSCD, irrespective of the materials used for sealing the dehiscence [9-21].

DISCUSSION

Surgical repair of SSCD is carried out when patients have debilitating symptoms not responding to conservative measures. Transmastoid repair of SSCD is now gaining popularity over the traditional middle cranial fossa approach on account of the lower morbidity and lower risk of complications. Brantberg et al first described transmastoid repair of SSCD with dural elevation and creating fenestrations in the superior semicircular canal [4]. Agrawal and Parnes [6] performed a modification by using 2 fenestrae, while Kirtane et al. [7], performed a transmastoid

SSCD repair with dural elevation, identification of the defect, and plugging it without creation of additional fenestrae.

The degree of temporal bone pneumatization, and dural angulation need to be considered while performing transmastoid repair. The amount of dural manipulation depends on the slope of the tegmen and the dural overhang. Excessive dural manipulation during identification and plugging of the dehiscence could result in complications such as CSF leaks. The membranous labyrinth could be disrupted during elevation of the dura medially. Excessive manipulation could result in sensorineural hearing loss, which may be temporary, as reported by Kirtane et al. [7], or could be permanent. A pre-operative high resolution computed tomographic scan of the temporal may provide a better understanding of the tegmen angulation.

Repairing the dehiscence by skeletonizing the labyrinth and blue lining the superior semicircular canal without dural elevation can help prevent the complications associated with dural manipulation. Endoscopic visualization and repair of SSCD can further help in minimizing such complications. Creighton et al., hypothesized that loss of perilymph would be minimized by performing the procedure 'underwater' using a balanced salt solution [12]. Other authors have proposed that underwater endoscopic technique can help preserve of inner ear function, provides better visualization, and can reduce the thermal effect of the endoscope [11]. Successful repair of SSCD has been reported via transmastoid endoscopic underwater technique in the case reports that have been published with no complications.

A variety of materials have been effectively used to repair SSCD. Bone dust, fascia and cartilage have been effectively used in most studies, as described earlier. Lateral semicircular canal plugging in animal experiments has also shown better periosteal osteogenesis and perilymphatic fibrosis with bone dust, as compared to bone wax [22].

Plugging and capping have been found to have lesser failure and recurrence rates as compared to resurfacing of the dehiscence. Resurfacing alone, may not completely seal the dehiscence effectively, and should therefore be used as reinforcement along with plugging.

CONCLUSION

Transmastoid repair of SSCD is an effective and reliable technique that can be performed under local anesthesia; with lesser morbidity; and avoids the need for a craniotomy. Plugging of the dehiscence has been demonstrated to be more effective than other techniques of repair; and should be considered as the technique of choice for SSCD repair. Successful symptom control and hearing preservation with the transmastoid approach have been demonstrated across the years. It is a safe and effective alternative to the traditional middle fossa approach. Transmastoid endoscopic underwater repair appears to be a promising technique; however, we require larger data demonstrating its effectiveness.

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