Transmastoid Approach to the Superior Semicircular Canal

Toshiaki Yamanaka, G Mark Pyle*, Hiroshi Hosoi, Charles N Ford*

Department of Otolaryngology-Head and Neck Surgery, University of Wisconsin Medical School, Madison WI 53792-7375

Background
Superior semicircular canal dehiscence syndrome (SSCD) which is characterized by specific vestibular symptoms such as loud sound- and pressure-induced vertigo and eye movement (nystagmus) due to an absence of bone overlying superior semicircular canal (SSC) has recently been focused on since reported initially by Minor et al in 1998. Surgical management is generally considered for the treatment of this syndrome when patients have debilitating symptoms and signs. Since two kinds of procedures for repair of the dehiscence, canal plugging and resurfacing of the bony were reported, these surgical interventions are performed through a middle cranial fossa (MCF) approach. However some reports suggest a transmastoid approach (TMA) as a less invasive alternative (Fig.1). We examined the variability and utility of anatomic features between the SSC and other surgical landmarks in the transmastoid approach to see if it is a feasible alternative to craniotomy.

Methods
Thirty formalin-fixed human cadaveric temporal bones with normal ear drum were used for an anatomic study. Each temporal bone was positioned as for mastoid surgery under an operating microscope and dissected with a high-speed electric drill to expose the sigmoid sinus, middle fossa dura and semicircular canals by the transmastoid approach in a standard fashion of simple mastoectomy. The sino-dural angle (SDA), point in the surface of cortical bone perpendicular to SSC top(b), subarcuate artery(SA) (c), fossa incudis(FI) (d), top of the horizontal semicircular canal(HSC) (e), and MCF tegmen(f) were chosen as landmarks for identification of the SSC as shown in Fig. 2. The distances from these various landmarks to the top of SSC within the temporal bone were measured with a fine caliper to further evaluate the accessibility of the top of SSC where the bone defect exists in the SSCD.

Results
Fig.3 shows measurements of distances from SDA (a), Point in the surface of cortical bone perpendicular to SSC top (b), FI (c), HSC top (d), SA (e) and MCF tegmen (f) to top of the SSC. These respective average distances were 31.3, 22.4, 10.1, 7.91, 3.99 and 0.54 mm. The calculated standard deviations were less than 10 % for a, b, d, and e, but not for c and f. The temporal bones examined were classified as 4 types according to the features of the MCF tegmen and the supralabyrinthine cells around SSC top. Briefly, Type A and B showed a low MCF with and without a development of the supralabyrinthine cells, respectively, while Type C and D exhibited no lowering of tegmen with and without supralabyrinthine cells as indicated in Fig. 4. Based on this classification, 9 (30.0 %), 11(36.7 %), 5 (20.0 %) and 5 (20.0 %) out of 30 temporal bones were found as Type A, B, C and D, respectively (Fig.4). A MCF low tegmen was identified in 10 (33.3 %) of all examined bones, while no supralabyrinthine cells tract was seen in 16 (53.3 %) bones. The distance between SSC top and tegmen ranged 0-1 mm, 1-2 mm and 2-3 mm was respectively observed in 5 (20.0 %), 5 (20.0 %) and 2 (6.7 %) of 30 bones (Fig.5). There is no bone showing the distance more than the temporal bone.

Discussion
The measurement obtained from a, b, d and e to SSC were similar among individual bones except from c and f with the standard deviations less than 10 % of the average value suggesting little variability in these distances. These results suggest that these structures are useful as a surgical landmark for the access to the SSC top in the mastoid. On the basis of the classification proposed in this study, it was definitely feasible to access the SSC top under direct visualization in type A, while other types needed an elevation of dura to visualize. Furthermore, Type D showing low MCF tegmen without supralabyrinthine cell development limited access to the top of SSC. However it seems to make an access of the SSC top possible to the supralabyrinthine cells by the transmastoid approach. This classification also could be helpful to determine an indication of a transmastoid surgery, since it can be evaluated from findings in CT examination for surgical cases.

Conclusion
The cadaver results suggest that a transmastoid approach is a possible alternative for treatment of SSCD. These measurements may facilitate identification on the SSC during this approach.