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Superior semicircular canal dehiscence: A new perspective

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ABSTRACT

Objective: To determine the use of multi-detector computed tomography (MDCT) in the diagnostic interpretation of superior semicircular canal dehiscence (SSCD) or thinning and its association with ear pathologies and to find whether it is an acquired condition and its association with increase in age.

Materials and methods: study was performed in a tertiary care institute present in a village, following approval of the institutional ethical committee. Retrospective review of temporal bone CT examinations performed between September 2016 and March 2017 was done. 1 mm interval axial images with sagittal and coronal reformatted images were reviewed for the presence of canal dehiscence and thinning by investigators. We characterised the Superior semicircular canal status as normal, frank dehiscence or thinning. Frank dehiscence was further classified anatomically as anterior limb, apex and posterior limb dehiscence.The patient list was then subcategorized into 5 age groups, and the prevalence of SSCD was calculated for each group.

Results: Retrospective review yielded 80 positive cases which included SSC dehiscence (N = 39) and thinning (N = 41). 80 normal scans were selected as control group retrospectively. Statistical analysis was performed to assess for differences between the groups studied. Pearson chi-square test applied. there was a significant association of SSC pathologies prevalence with increasing age (p = < 0.001). No significant relationship was found between SSCD and presence of either CSOM or Cholesteatoma (p = 0.285). Vertigo rather than Tullio phenomenon was the statistically significant complaint (p = < 0.001). which brought the patient to the hospital.

Conclusions: The SSCD and thinning belong to the same spectrum and are acquired conditions. Increasing prevalence in old age suggests it to be an acquired condition rather than a congenital one. No significant association of these condition was seen with CSOM and cholesteatoma. Vertigo is the predominat symptom bringing the patient to hospital along with Tullio phenomenon.

1. Introduction

SSCD was initially described by Minor et al. Superior semicircular canal dehiscence syndrome (SCDS) is a recently described inner ear abnormality, consisting of clinical disequilibrium phenomenon and associated absence of the bony covering of the superior semicircular canal (SSC). This CT finding has also been described in approximately 10% of individuals without these clinical symptoms [1,2]. As the age increases, incidence of semicircular canal dehiscence increases. Patients may experience vestibular and visual symptoms which can be precipitated by Valsalva manoeuvre and exposure to loud noises. In few patients, there is a history of longstanding disequilibrium and unsteadiness [3]. It can also present with a conductive hearing loss that mimics otosclerosis and could explain some cases of persistent conductive hearing loss after stapedectomy [4,5]. A defect in the osseous semicircular canal can also cause apparent conductive hearing loss, hyperaccusis for bone conducted sounds and autophony. The auditory as well as vestibular manifestations of superior canal dehiscence is due to creation of a third mobile window by the dehiscence into the inner ear, exposing the membranous semicircular canal to the middle cranial fossa [4–6]. This creates abnormal sound pathways and allows abnormal pressures resulting in vestibular and visual symptoms. The purpose of this study was, therefore, to find the prevalence of SSCD on imaging among different age groups and find out its association with increases with age and pathologies like CSOM or cholesteatoma [8–10].

Abbreviations: SSC, superior semicircular canal; SSCD, superior semicircular canal dehiscence; SCDS, superior semicircular canal dehiscence syndrome; CSOM, chronic suppurative otitis media; CT, computed tomography; MDCT, multi-detector computed Tomography; HRCT, high resolution computed tomography

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Table 1
Prevalence of SSCD[a] and thinning of SSC[b] according to age distribution.

Group	Age group (Age in years)					Total
	0–20	20–40	40–60	60–80	> 80	
SSCD	2 (8.3)	15 (31.2)	30 (60)	27 (84.4)	6 (100)	80
Non SSCD	22	33	20	5	0	80
Total	24	48	50	32	6	160

[a] SSCD – superior semi-circular canal dehiscence.
[b] SSC – superior semi-circular canal.

2. Materials and methods

This study was carried out after the approval of ethical committee, for the period of six months. The Department's database was searched retrospectively, to identify 80 patients (160 ears) undergoing High-Resolution Computed Tomography (HRCT) of the temporal bone and NCCT head over a 6 months period beginning September 1, 2016. All scans were performed with 1 mm collimation.All the patients had undergone HRCT temporal bones and NCCT Head using MDCT scanner (BRILLIANCE 16 SLICE PHILIPS). The CT images were acquired by using a 120-kV and 500-mAs technique. Images were reconstructed into a contiguous 5-mm axial dataset by using a standard algorithm. The inclusion criteria were scans of patients having conductive, sensorineural, and mixed hearing loss; tinnitus; and vestibular symptoms. Exclusion criteria were scans of trauma, extensive surgery, or a unique medical condition which limited the ability to assess the structures in question like fibrous dysplasia and post surgical for ear pathology patients. Images were reviewed by two blinded experienced radiologists. All standard HRCT views, including coronal, axial, sagittal, Stenver, and Poschl views were done. The Stenver view is an oblique coronal reconstruction parallel to the petrous portion of the temporal bone. Poschl view is an oblique coronal reconstruction perpendicular to the petrous portion of the temporal bone [7].

All consecutive scans were reviewed bilaterally for the presence or absence of SSCD, the right and left superior semicircular canal was characterised as "normal," "thin," or "dehiscent" in each case. The location of canal dehiscence was characterised as ascending limb, apex, descending limb, or involvement of two or more contiguous regions was documented when dehiscence was seen.

All consecutive scans were reviewed bilaterally for the presence or absence of Cholesteatoma and chronic otomastoiditis, and for the presence of other temporal bone abnormalities Table 3 and 4.

Table 2
Pearson Chi-square test showing correlation between age and prevalence of SSCD.

	Value	df	p-value
Pearson Chi-Square	46.542[a]	4	< 0.001

Table 3
Prevalence of CSOM[a] and cholesteatoma in our study.

Group	CSOM	Cholesteatoma	None	
SSCD[b]	4	0	76	80
Non SSCD	6	2	72	80
Total	10	2	148	160

[a] CSOM – chronic suppurative otitis media.
[b] SSCD – superior semi-circular dehiscence.

Table 4
Pearson Chi-square test showing insignificant association between SSCD and presence of CSOM and cholesteatoma.

	Value	df	p-value
Pearson Chi-Square	2.508[a]	2	0.285

Table 5
Frequency of SSC dehiscence and thinning according to anatomical location on SSC[a].

SSC dehiscence		
Frequency		Percent
Ant Limb	7	9.0
Apex	3	4.0
Post Limb	8	10.2
Thinning	41	51.2
1 & 2	9	11.4
2 & 3	11	14.0
Total	80	100.0

[a] SSC – superior semi-circular canal.

Cholesteatoma and chronic otomastoiditis were assessed separately and were not considered mutually exclusive.

After including 80 positive cases (160 ears), 80 normal cases (160 ears) were added retrospectively as statistical controls.

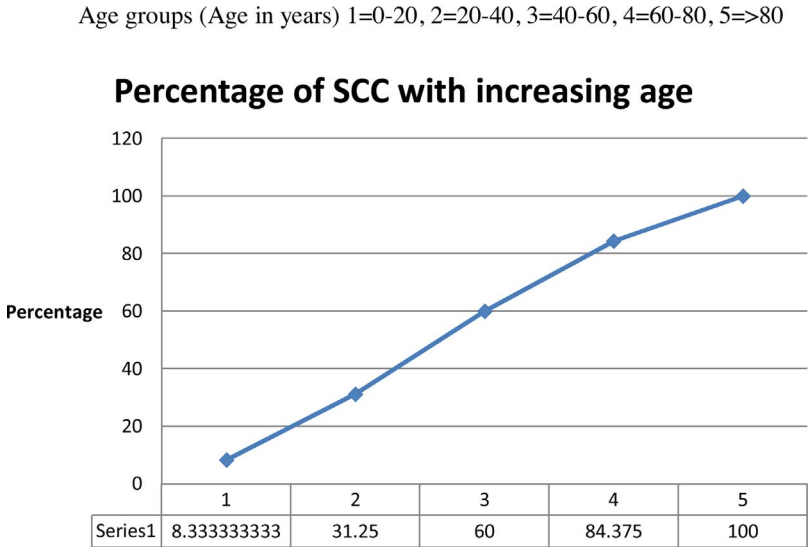

Fig. 1. Line graph showing increase in prevalence of SSCD (Y-axis) with increasing age (X-axis).

Roof of the superior semicircular canal, was distinguished four different types, depending on their thickness. Normal pattern in with a thickness of between 0.6 and 1.7 mm, fine thickness ≤0.5 mm, thick pattern ≥1.8 mm and a dehiscent pattern [22].

Data was analyzed using the IBM SPSS statistical system 23(2015).

Age was categorized into 5 groups: 0–20 years, 21–40 years, 41–60 years, 61–80 years, and 81–100 years. The radiologic prevalence of SSCD and thinning was calculated for each age group (Table 1 Fig. 1). Pearson Chi-square test and Log-linear regression models were used to estimate a trend in prevalence ratios by age category and relationship with CSOM or cholesteatoma was studied, *p*-values ≤ 0.05 were treated as statistically significant.

3. Results

82 patients initially met positive eligibility criteria. A total of 82 HRCT temporal bone and NCCT brain scans were selected reviewed. Two patients were excluded due to previous operative history. 80 patient cohort of normal patient was prepared for comparison. Out of 80 patients 41(51%) were having SSC thinning and 39(49%) were having SSCD. The anterior limb was dehiscent in 7 (9%),apex in 3(4%), posterior limb in 8(10.2%), anterior limb plus apex in 9(11.4%) and apex plus posterior limb in 11(14%) patients(Table 5).

There was little interobserver variability with high (90%) concordance of classifications.

Pearson Chi square test (Table 2) was carried out to find the relationship of prevalence of SSC dehiscence and thinning with increasing age and analysis showed that its percentage increases with increase in the age which was statistically significant (p = < 0.001). The congenital basis of the SSCD and thinning is ruled which is again agreement with previous studies.

Pearson Chi-square test was done to find out the statistically significant symptom in the patients having SSCD and thinning. It was found to be vertigo (p = < 0.001). Any association between CSOM or Cholesteatoma and SSC pathologies was analyzed. Only 4 patients (.5%) with SSCD and thinning had CSOM and none had cholesteatoma, which proved this association to be statistically insignificant (p = 0.285). Tullio phenomenon was found only in 18 patients(22%).

4. Discussion

Superior semicircular canal dehiscence (SSCD) is a condition caused by the absence of bone over one or both of the superior semicircular canals that leads to dysfunction of the vestibular end as result of formation of third window besides round and oval window resulting in altered fluid dynamics [1,2].

The radiological prevalence of SSCD in our study is 7.8% which is in agreement with previous studies which documents the same to be between 3 and 12% and Our observations also provide information about the location of SSCD whether it is ascending limb, apex, descending, ascending plus apex or descending plus apex as done by Gartrell et al. [12].

We observed a statistically significant increase in the prevalence of radiographic SSCD with age which is agreement with literature but thinning of SCC which we analyzed to be in statistically significant relationship with inceasing age was in disagreement R.N.Nadgir et al. [2]. The possible cause for the increased prevalence of dehiscence as well as thinning was difficult to suggest as not much is given in the literature. However it may be result of osteoporosis resulting from systemic demineralisation with increasing age which is an established phenomenon [13,14].

We also observed that there was no statistically significant relationship between the radiological prevelance of SSCD or SCC thinning and concomitant presence of either CSOM or cholesteatoma. We are not in agreement with Gartrell et al. [11,12]. Who established a significant relationship of SSCD with both CSOM as well as Cholesteatoma. The characteristic Tullio phenomenon which was found in majority of the patient of SSCD as described in the literature was seen 78% of our patients with SSCD and SSC thinning [16–18].

Lack of assessment and follow up of the patients studied by us remain the drawback of this study. Another study with better design of long term clinical outcome analysis is required.

5. Conclusion

The prevalence of SSCD as well as SSC thinning, being in same etiological spectrum and acquired conditions, increases with age which is now a well established relationship. The association with CSOM and cholesteatoma was not found which is again important for the operating surgeon.

Conflict of interests

No conflict of interests in this study. The study was approved by institutional ethics committee.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.ejro.2017.10.003.

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