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Bilateral, mixed hearing loss with a predominant sensorineural component in Larsen's syndrome

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Abstract

Background: Larsen's syndrome is primarily known as an orthopaedic disease. However, it has been found to be associated with conductive hearing loss caused by ossicular malformation. The possibility of a sensorineural hearing impairment as an additional part of this syndrome has been rather neglected in the past.

Method: Case report and literature review.

Patient and results: We present a teenage boy suffering from typical Larsen's syndrome. Despite no history of recurrent middle-ear infections, he showed a bilaterally symmetrical, mixed hearing loss dominated by an extensive sensorineural component. In order to review the corresponding literature, a Medline search was performed using the criteria 'Larsen's syndrome' and 'hearing loss/deficit'.

Conclusion: The literature review showed the presented case to be the first sufficiently documented report describing a predominant sensorineural hearing loss in a Larsen's syndrome patient. Although a specific association of Larsen's syndrome with sensorineural hearing loss is still speculative, this case might give grounds for further examinations of this rare finding.

Key words: Larsen's Syndrome; Hearing Loss, Sensorineural; Ossicular Malformation

Introduction

In 1950, Larsen *et al.* first described the characteristic combination of facial stigmata with flattened mid-face, prominent forehead, hypertelorism, and multiple joint dislocations of the knees, hips and elbows.[1] This congenital disease – presumed to be a generalised mesenchymal disorder[2] – occurs sporadically in many cases; however, apparent autosomal dominant and recessive patterns of transmission have been observed.[1,3] Larsen's syndrome has been found to be associated with further anomalies such as cleft palate,[4] orofacial malformations,[5] tracheomalacia,[6] hydrocephalus,[7] atlanto-axial subluxation[8] and cardiovascular defects.[9,10]

Due to the variable palatal cleft deformity, middle-ear effusions seemed to represent the natural pathogenesis of concomitant conductive hearing loss in such patients. However, ossicular abnormalities have also been suggested and observed in Larsen's syndrome patients.

Data suggesting an association of Larsen's syndrome with sensorineural hearing loss are very rare. The possibility of sensorineural hearing loss as an exclusive, typical feature of this syndrome has not been studied in detail thus far.[11–13] We present the case of a child with classical Larsen's syndrome who suffered from profound, bilaterally symmetrical, sensorineural hearing loss with only a mild conductive component. In addition, we review the literature on the association of Larsen's syndrome with variable types of hearing loss.

Case report

A 13-year-old boy was referred for evaluation and treatment of bilateral hearing loss of unknown origin. The patient's Larsen's syndrome had been diagnosed at birth. There was no family history of the disease.

The patient showed the typical stigmata of the disease, as initially described by Larsen *et al.*[1] (Figures 1 and 2). Significantly, no palatal cleft deformity was found, and there was no history of previous compromised tubal ventilation. The patient had suffered no perinatal complications. There was no known genetic predisposition to inner-ear disease.

The patient's congenital luxation of both knees and hips had already been corrected orthopaedically at the ages of three, five and seven months by open surgical hip replacement and repositioning of both knees after surgical elongation of the quadriceps tendon. The malformation of the upper limbs with displacement of both elbows had been asymmetrical since an olecranal fracture of the right arm (Figure 2). Therefore, the disease-related complaints in the patient's childhood years had been dominated by motor disability. The deficits had persisted, although intensive physiotherapy had enabled good compensation.

The patient's mental and social development had been completely normal, and there had been no indication of any hearing deficit, especially in light of the boy's excellent progress at school. Therefore, the rather coincidental finding of an extensive hearing deficit, revealed by a hearing test at the age of 12 years, was more than a little unexpected.

Physical examination revealed a completely normal otomicroscopic appearance.

Audiometry revealed a bilateral, mixed hearing loss characterised by an almost linear, middle- and high-pitched sensorineural decline between 1 and 6 kHz, with a

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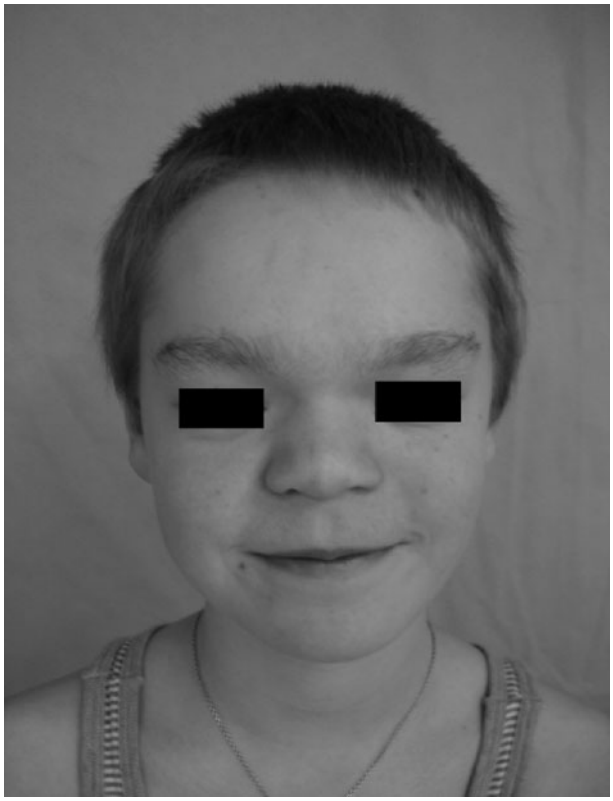

FIG. 1

The patient, showing typical stigmata of Larsen's syndrome: hypertelorism, a rather prominent forehead, and a flattened mid-face resulting from naso-maxillary hypoplasia.

maximum of 50 dB HL, together with a simultaneous, mild, conductive component of up to 15 dB HL on average (Figure 3). Follow-up audiometric examinations one and three months later reproduced these audiometrical results.

The patient's speech perception was significantly diminished; bilateral, monosyllabic speech understanding was approximately 50 per cent at 65 dB HL (Figure 4).

Tympanometry showed the compliance of the tympanic membrane and the ossicular chain to be slightly diminished. Bilaterally, no stapedial reflexes could be evoked (Figure 5).

Clinical follow-up assessment with regular audiometric testing was recommended, in order to intervene as early as possible in case of progression. The predominant sensorineural component of the patient's hearing impairment made bilateral hearing aids necessary; these were well tolerated and used constantly.

Literature review and discussion

In order to enable discussion and comparison of the presented case with similar reports in the literature, a Medline search was performed using the main criteria 'Larsen's syndrome' and 'hearing loss/deficit'. The outcome of this search was quite poor (Table I). In all, we found only eight articles reporting an association between Larsen's syndrome and hearing loss due to pathogenic reasons other than mere tympanic effusion. (The latter frequently evolves due to cranio-facial dysplasia compromising tubal ventilation; approximately 30 per cent of Larsen's syndrome cases have an associated cleft palate.)[14]

The possibility of ossicular abnormalities as an alternative aetiological factor for conductive hearing loss has

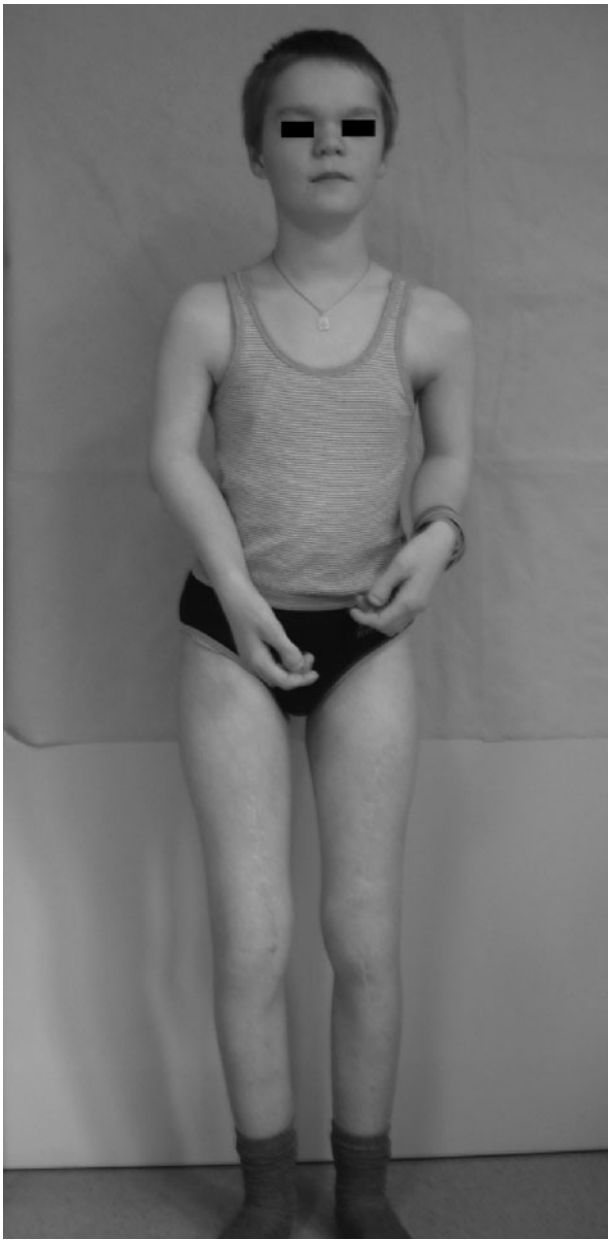

FIG. 2

The patient's main limb deformities are clearly visible, despite orthopaedic intervention at an early age.

repeatedly been suggested.[13,14,18] This theory has been proven by exploratory tympanotomy in hearing-disabled Larsen's syndrome patients, which revealed an incudostapedial joint abnormality as well as a fixed stapes footplate.[15,16] Kaga *et al.* supplied further proof in this respect, from temporal bone studies of two infants with Larsen's syndrome; they found dislocations of the malleus and incus, an abnormal footplate and an abnormal stapes.[17] In the same publication, the authors also reported poor development of the labyrinth; this may also contribute to the explanation of sensorineural hearing deficit in Larsen's syndrome patients.

Some clinical reports certainly observed a mixed-type hearing loss, but concentrated on the conductive part of the hearing impairment in order to consolidate the probability of ossicular dysplasia.[13,18] Only Ventruto *et al.*[11] and Renault *et al.*[12] explicitly described a total of four Larsen's syndrome patients with bilateral, purely sensorineural

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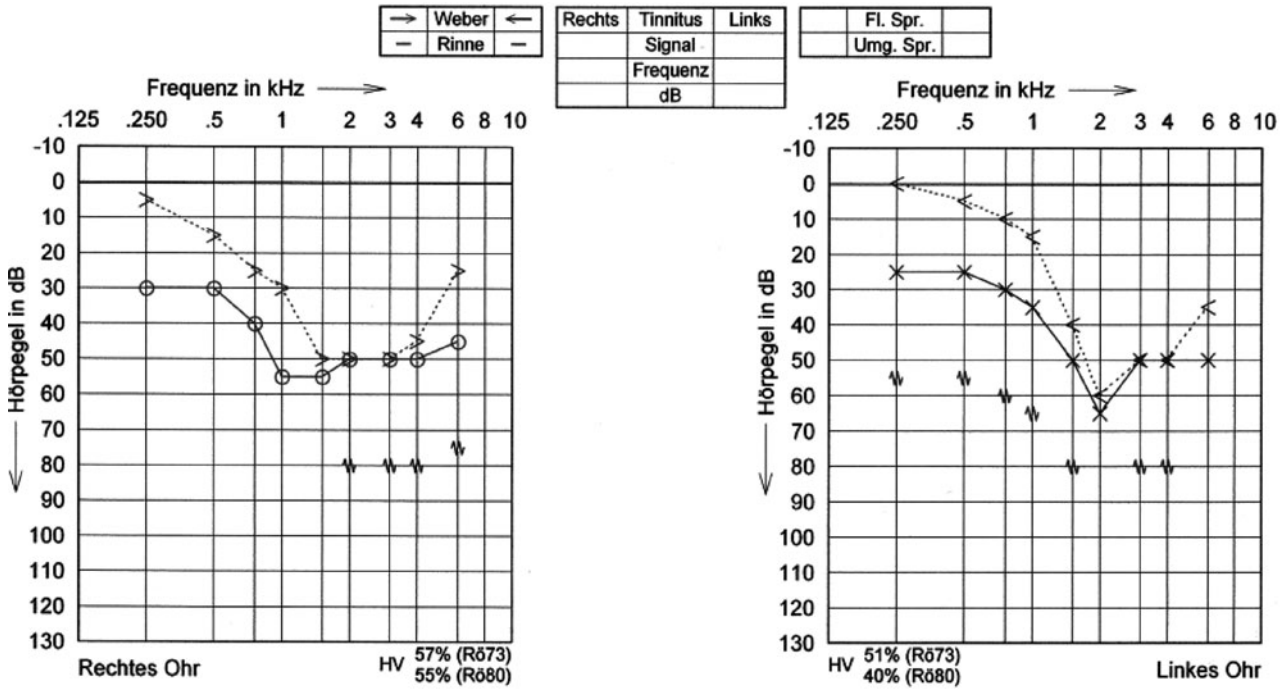

FIG. 3
Pure tone audiometry results (identically reproduced after 1 and 3 months).

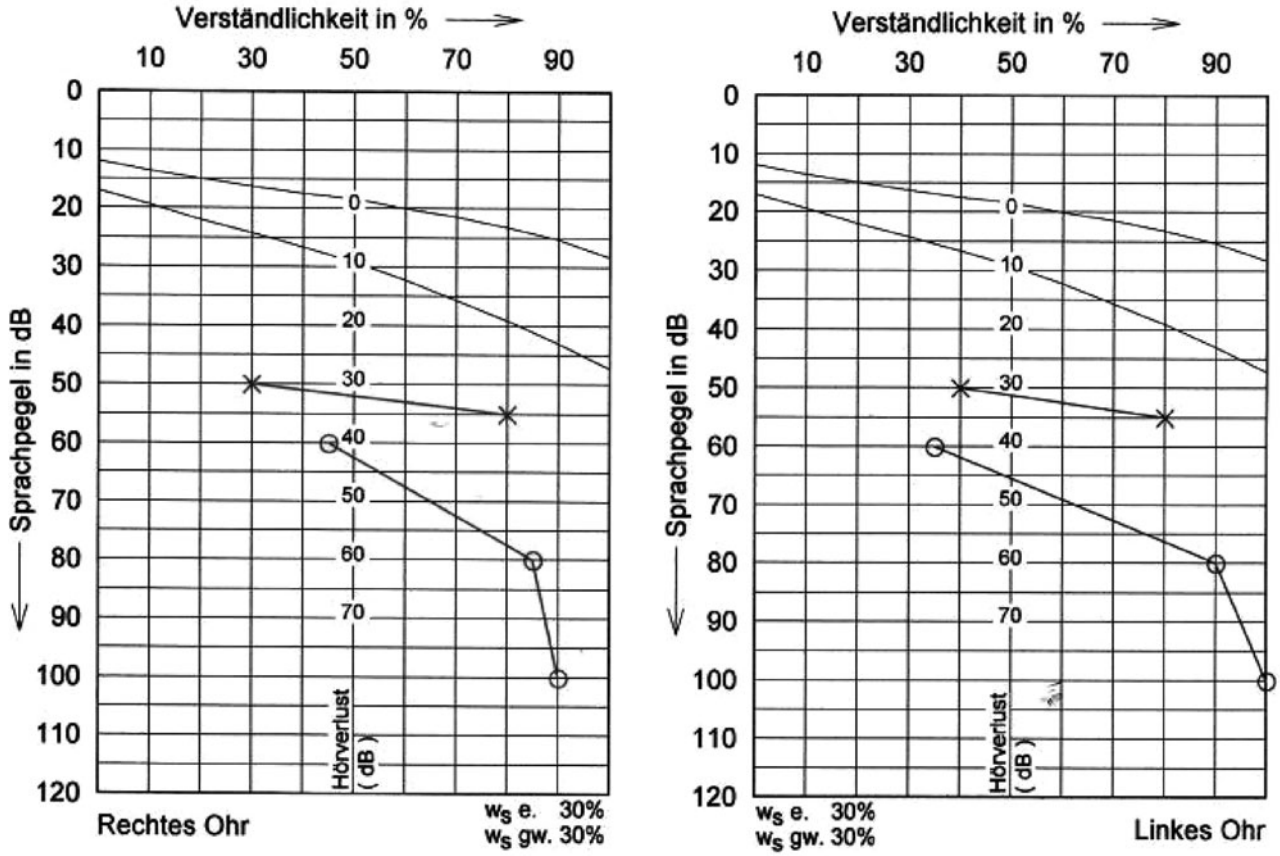

FIG. 4
Speech audiometry results (Freiburger Sprachtest). X = understanding of numbers; O = understanding of monosyllabic words

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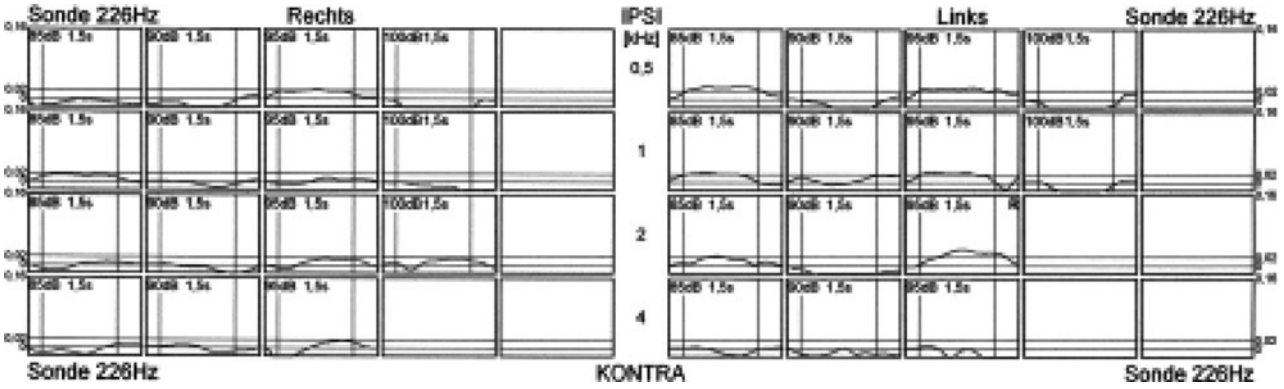

FIG. 5
Stapedial reflexes (not evokable bilaterally).

hearing loss. However, in both of these reports an exclusive association of the prevailing sensorineural hearing impairment with Larsen's syndrome was questionable, due either to multiple other congenital abnormalities which seemed to indicate a more complex syndrome,[12] or to an apparent disposition for early, progressive, inner-ear hearing loss within one family.[11]

In the light of these data, the finding of a bilateral, mixed hearing loss in a teenage patient suffering from typical Larsen's syndrome correlates with the known association of this syndrome with middle-ear malformations. Unfortunately, diagnostic tympanotomy to confirm ossicular dysplasia was refused by the patient's parents. High resolution computed tomography scanning of the petrous bones was also declined, because of the significantly elevated levels of radiation needed for precise imaging of the ossicular structures. However, such interventions would have been of a diagnostic rather than therapeutic value, as the minor conductive component of the patient's hearing loss could hardly have been improved to any relevant extent. Therefore, the parents' cautious attitude was quite understandable at this stage. Even though ossicular malformation could not be conclusively proven, it certainly has to be assumed in this case, referring to the available literature.

The predominant sensorineural component of this young patient's hearing loss may be considered an additional feature of Larsen's syndrome. Taking into account the poor results of our Medline search (Table I), the current patient represents the first well documented case

TABLE I
PREVALENCE OF CONDUCTIVE* AND SENSORINEURAL HEARING LOSS IN REPORTED CASES OF LARSEN'S SYNDROME

Reference	Cases (*n*) (age)	Ossicular abnormality	SNHL	Remarks
Ventruto *et al.*[11]	3†	Not documented	Progressive	Family Hx of early, progressive SNHL
Herrmann *et al.*[14]	1 (5 yr)	Assumed	None	General review of 45 Larsen's syndrome patients with cleft palate
Renault *et al.*[12]	1 (15 yr)	Not documented	Bilaterally symmetrical (up to 70 dB)	Case report of 3 patients Multiple other congenital malformations not typical of Larsen's syndrome
Stanley *et al.*[13]	1 (28 mth)	Assumed	10–35 dB (ABR, left ear)	No data for sensorineural deficit of R ear
Horn *et al.*[15]	1 (12 yr)	Proven (deformed and thick long process of incus + fixed stapes footplate)	Bilaterally symmetrical (low/middle frequencies up to 20 dB, high pitch decline of max 50 dB)	Case report of unilaterally performed stapedotomy Sensorineural loss only documented by audiogram, no further discussion
Maack *et al.*[16]	1 (6 yr)	Proven (incudostapedial joint dysplasia + fixed stapes footplate)	None	Case report of unilateral 'tympanoplasty'
Kaga *et al.*[17]	2 (20 mth & 3.5 yr)	Proven (dislocation of malleus/incus + abnormal footplate; dislocation of malleus/incus + abnormal stapes)	In 1 case (poor labyrinthine development)	Macro-pathological study of temporal bone specimens
Percin *et al.*[18]	1 (13 yr)	Assumed	Bilaterally symmetrical (up to 15 dB)	Consanguineous parents‡

*Due to ossicular dysfunction. †A father and his 2 daughters. ‡First cousins. SNHL = sensorineural hearing loss; yr = years; mth = months; ABR = auditory brainstem response; max = maximum

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of Larsen's syndrome with a simultaneous and predominantly sensorineural hearing impairment of (as yet) unknown origin. A syndrome-specific association of these symptoms is certainly speculative, as coincidental appearance of such symptoms, representing different genetic inheritance, is also conceivable. Nevertheless, such an association must still be considered, especially as there have already been observations of poor labyrinthine development in Larsen's syndrome patients, making syndromal inner-ear hearing loss quite likely.[17] Therefore, future studies are required to confirm or refute this assertion.

In general, early and appropriate audiological evaluation, with regular follow-up examination, should be performed as an essential diagnostic standard for all patients diagnosed with Larsen's syndrome, in order to manage individual patients's pathology in a timely manner.

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