Lacrimo-auriculo-dento-digital syndrome: A case report and literature review

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Abstract:
We report a healthy 18-year-old male Saudi with bilateral agenesis of the lacrimal puncta and canaliculi associated with large dacryocystoceles on the right side without tearing or inflammation, detected in conjunction with other characteristic features of lacrimo-auriculo-dento-digital dysplasia syndrome. Computed tomography scan indicated that dacryocystoceles were bilateral and asymmetrical, with large dimensions at the right side and associated to a right side maxillary sinus mucocele. The right dacryocystocele was surgically removed, and the histology indicated characteristics of the lacrimal sac. The liquid content of the dacryocystocele was negative for microbes. The atypical mucocele in the maxillary sinus disappeared after dacryocystocele removal probably, due to recovery of sinus drainage.

Keywords: Congenital anomalies, lacrimal drainage system, lacrimo-auriculo-dento-digital dysplasia syndrome

Introduction
Lacrimo-auriculo-dento-digital dysplasia (LADD) or Levy-Hollister syndrome is a very rare mesodermal dysplasia first described by Levy in 1967.[1,2] The disorder can present sporadically or as an autosomal dominant trait, displaying variable expressivity of multiple congenital anomalies.[3,4]

There are around 62 cases already reported in the literature [Table 1],[1-29] with variable phenotypic expression, characterized by bilateral or unilateral lacrimal abnormalities (hypoplasia, agenesis or atresia of lacrimal puncta and canaliculi, dacryocystoceles, and nasolacrimal duct obstruction) isolated or combined with lacrimal gland agenesis or hypoplasia (resulting in dry eyes), dental deformities (peg-shaped teeth, microdontia, hypodontia, and enamel dysplasia), major salivary parotid and/or submandibular glands aplasia or hypoplasia (resulting in dry mouth), external ear malformations (low-set and cup-shaped auricles) with or without hearing deficits, skeletal anomalies, especially in the hands, arms, and feet, with preaxial digital abnormalities (hypoplastic thumbs and radii, clinodactyly, and syndactyly).[1-29]

To the best of our knowledge, this syndrome has not yet been reported in the Arabian Peninsula. This particular LADD case was the first to present with a maxillary sinus mucocele with spontaneous resolution after removal of the lacrimal sac mucocele. Hence, the aim of this is to report a case of LADD in a Saudi male with an unusual mucocele affecting the maxillary sinus, the outcomes after treatment, and a literature review.

Case Report
An 18-year-old male Saudi presented to King Khaled Eye Specialist Hospital, Riyadh, Saudi Arabia, in 2016 complaining of a slowly progressing cystic lesion located below the right medial canthal ligament with no infectious symptoms. He is a product of an uncomplicated full-term pregnancy, with vaginal vertex presentation. He has normal birth weight and normal development. He denied any medical illnesses, and there is no other family member with a similar problem.

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| Author                       | Gender | Age (years) | Tearing | Secretion | Puncta | NLDO | Ears* | Hearing loss | Dental | Dry mouth | Digital | Renal               |
|------------------------------|--------|-------------|---------|-----------|--------|------|-------|-------------|--------|-----------|---------|---------------------|
| Alhamadi, et al., 1995[12]   | Male   | 12          | Yes     | No        | Normal | No    | Yes   | No          | Yes    | Yes       | Yes     | Normal              |
| Hollister et al., 1973[2]    | Female | 15 month    | No      | Yes       | Absent | Yes   | Yes   | Yes         | Yes    | No        | Yes     | Normal              |
| Male                         | 4      | Yes         | Yes     | Yes       | Absent (2) | Yes   | Yes   | Yes         | Yes    | ?         | Yes     | Abnormal            |
| Female                       | 6      | Yes         | Yes     | Absent    | Absent (1) | Yes   | Yes   | Yes         | Yes    | Yes       | Yes     | Normal              |
| Female                       | 11     | No          | No      | No        | Normal | No    | Yes   | Yes         | No     | Yes       | Yes     | Normal              |
| Female                       | 17     | No          | No      | No        | Absent | No    | Yes   | Unilateral  | ?      | Yes       | Yes     | ?                   |
| Male (father)                | 43     | Yes         | Yes     | Normal    | Hypoplastic | Yes  | Yes   | Yes         | Yes    | Yes       | Yes     | ?                   |
| Shiang and Holmes, 1977[3]   | Male   | 21          | No      | Yes       | Absent | Yes   | Yes   | No          | Yes    | Yes       | Yes     | Abnormal + hypopadia |
| Female (mother)              | ?      | No          | ?       | Absent    | Yes    | No    | Yes   | Yes         | Yes    | No        | Yes     | Normal              |
| Thompson et al., 1985[4] (first to describe dry mouth) | Male   | 5          | No      | Yes       | Normal | Yes   | Yes   | Yes         | Yes    | No        | Yes     | Normal              |
| Female (mother)              | 32     | No          | Yes     | Yes       | Normal | Yes   | Yes   | Yes         | Yes    | No        | Yes     | Normal              |
| Hennekam, 1987[5]           | Male (+3 family members) | 20 month | No     | Yes       | Normal | ?     | Yes   | No          | Yes    | No        | Yes     | Normal              |
| Kreutz and Hoyme, 1988[6]    | Female | 9           | Yes     | Yes       | Fistula | Yes   | Yes   | No          | Yes    | ?         | Yes     | ?                   |
| Female                       | ? (mother) | No   | No     | Normal    | No     | Yes   | ?     | Yes         | ?      | ?         | Yes     | Normal              |
| Female                       | Stillborn | ? | ?     | ?        | ?     | ?     | Yes   | ?          | ?      | ?         | Yes     | Normal              |
| Wiedemann and Drescher, 1986[7] | Female (mother) (+grandmother) | 30 month | Dryness | ?       | Absent (1) | Yes  | Yes  | ?          | Yes    | Yes       | Yes     | Normal              |
| Female                       | 29     | No          | Yes     | ?         | ?      | Yes   | Bilateral | Yes    | Yes       | Yes     | Normal              |
| Calabro et al., 1987[8]      | Female | 17 month    | ?       | ?         | ?      | ?     | Yes   | ?          | Yes    | ?         | Yes     | ?                   |
| Female                       | 26 (mother) | ? | ?     | ?        | ?     | ?     | Yes   | ?          | Yes    | ?         | Yes     | ?                   |
| Roodhooft et al., 1990[9]    | Male   | 10 month    | Yes OS  | Yes       | Absent (2) | ?     | Yes   | No          | Yes    | ?         | Yes     | Abnormal            |
| Bamfort and Kaurah, 1992[10] | Female (grandmother) | 64     | No      | No        | Normal | No    | No    | Bilateral  | Yes    | No        | Yes     | Normal              |
| Female (mother)              | 30     | No          | No      | No        | Normal | No    | No    | No          | No     | No        | No      | Normal              |
| Male                         | Stillborn | ? | ?     | ?        | ?     | ?     | ?     | ?          | ?      | ?         | ?       | Abnormal            |
| Female                       | 12     | Yes         | ?       | Absent    | Yes    | No    | No    | Yes         | No     | No        | No      | Normal              |
| Female                       | Stillborn | ? | ?     | ?        | ?     | ?     | ?     | ?          | ?      | ?         | Yes     | Abnormal            |
| Female                       | ?      | Yes         | ?       | Normal    | Yes    | No    | No    | No          | Yes    | ?         | Yes     | ?                   |
| Male                         | 18 month | Yes      | ?       | Normal    | Yes    | Yes   | No    | No          | ?      | Yes       | ?       | Yes                  |
| Female                       | 22 months | No    | Yes     | Absent   | Yes    | Yes   | Yes   | Bilateral  | Yes    | ?         | Yes     | ?                   |
| Female (mother)              | 25     | No          | No      | ?         | No     | No    | No    | No          | Yes    | ?         | Yes     | ?                   |
| Heinz et al., 1993[11]       | Female | 8 month     | Dryness | Yes       | Absent (2) | Yes   | Yes   | Bilateral  | Yes    | No        | Yes     | Abnormal            |
| Female (mother)              | 28     | Dryness     | Yes     | Absent    | Absent (1) | No    | No    | Bilateral  | Yes    | Yes       | Yes     | Normal              |
| Female                       | 24     | Dryness     | ?       | ?         | ?      | Yes   | No    | Yes         | Yes    | Yes       | Yes     | Normal              |
| Ostuni et al., 1995[12] (ptosis + telecanthus + corneal perforation) | Female | 9          | Dryness | No       | ?      | ?     | Yes   | No          | Yes    | No        | Yes     | ?                   |
| Toumba and Gutteridge, 1995[13] | Female | 20         | Dryness | Yes       | ?      | ?     | Yes   | No          | Yes    | No        | Yes     | ?                   |
| Female                       | 13     | Dryness     | Yes     | ?         | ?      | Yes   | Yes   | Yes         | Yes    | Yes       | Yes     | ?                   |
| Male                         | 3      | Dryness     | No       | ?         | ?      | Yes   | Yes   | Yes         | Yes    | No        | Normal             |
| Female                       | ?      | No          | No       | ?         | ?      | No    | Yes   | No          | No     | No        | No      | ?                   |
| Female                       | ?      | Dryness     | Yes     | ?         | ?      | Yes   | No    | Yes         | Yes    | Yes       | Yes     | ?                   |

Contd...
Table 1: Contd...

| Author                | Gender | Age (years) | Tearing | Secretion | Puncta | NLDO | Ears* | Hearing loss | Dental | Dry mouth† | Digital | Renal |
|-----------------------|--------|-------------|---------|-----------|--------|------|-------|--------------|--------|------------|---------|-------|
| Lehotay et al., 2004  | Female | 13          | Dryness | ?         | Normal | ?    | No    | No           | Yes    | Yes        | Yes     | Normal |
| Haktanir et al., 2005 | Male   | 14          | Dryness | Yes       | Normal | Yes  | ?     | Yes          | Bilateral | Yes        | Yes     | ?      |
| Ong et al., 2005      | Female | 15          | Dryness | ?         | Absent | Yes  | ?     | ?            | ?      | ?          | ?       | ?      |
| Milinsky et al.,      | Female | 3           | No      | No        | No     | Yes  | No    | No           | Yes    | Yes        | Yes     | Normal |
| Inan et al., 2006     | Male   | 13          | Dryness | Yes       | ?      | Yes  | Yes   | Yes          | Yes    | Yes        | Yes     | ?      |
| Caluff et al., 2009   | Male   | 13          | Dryness | No        | Normal | No   | Yes   | Bilateral    | Yes    | Yes        | Yes     | ?      |
| Mathrawala and Hegde, | Male   | 7           | Dryness | ?         | Yes    | Yes  | Yes   | Yes          | Yes    | Yes        | Yes     | Normal |
| 2011                  |        |             |         |           |        |      |       |              |        |            |         |        |
| Lim et al., 2012      | Female | 5           | Dryness | ?         | ?      | Yes  | ?     | Yes          | Yes    | Yes        | Yes     | ?      |
| Santo et al., 2013    | Female | 13          | Dryness | Yes       | Absent | Yes  | ?     | ?            | Yes    | Yes        | Yes     | ?      |
| Pathivada et al., 2016| Male   | 7           | Dryness | ?         | Yes    | Yes  | Yes   | Yes          | Yes    | Yes        | ?       | ?      |
| Alhamadi et al., 2020 | Male   | 17          | Dryness | Yes       | Absent | Yes  | Yes   | Yes          | Yes    | Yes        | Yes     | ?      |

* Cup shaped/low set, **Present case, † In parentheses the number of absent puncta, ‡ Dry mouth or salivary glands abnormalities. ?: Information not available, NLDO: Nasolacrimal duct obstruction
A very large dilated round nontender cystic mass measuring around 20 mm × 20 mm was located below the right medial canthal ligament and in the lacrimal fossa area, with no regurgitation of secretion on pressure. In the left side, there was no palpable mass in the medial canthus. Bilaterally, the upper and lower puncta and canaliculi were absent and lacrimal lid portion was short. Intercanthal distance was 35 mm and interpupillary distance was 63 mm. The periorbital skin was hyperpigmented bilaterally. The eyelid margins were hyperemic with wet lashes and mucous yellowish sticky discharge in both sides. Schirmer test was 15 mm OD and 13 mm OS. Bilateral instability of the tear film and superficial diffuse punctate keratopathy were noted. Otherwise, the conjunctiva was quiet. Ocular examination indicated bilateral myopia with corrected visual acuity of 20/20 in both eyes, and otherwise, the eyes were normal.

The patient presented with other features including low-set and cup-shaped auricles with normal hearing, small, pointed, and widely spaced teeth, dry mouth, and long phalanges in the hands with hypoplasia of the thumbs. A foot X-ray indicated supernumerary distal left phalanx attached to the base of the deformed big toe and to the head of the fourth metatarsal bone as an abnormal syndactyly fusion [Figure 1].

Computed tomography (CT) scan indicated bilateral dacryocystocele extending inferiorly into the nasolacrimal duct with bilateral enlarged intraosseous portion ending abruptly in a bony obstruction and without entry into the inferior meatus. The right dacryocystocele was very large, and a smaller dacryocystocele was present in the left side. The right maxillary sinus was presented with an expansive, cystic lesion with fluid (30 Hounsfield units). The patient had a significantly deviated nasal septum with a large bony spur toward the right side and bilateral agger nasi cells. The lacrimal gland was hypoplastic bilaterally but significantly more hypoplastic in the right side [Figure 2]. In the temporal bone, the middle ear ossicles were normal on both sides.

Magnetic resonance imaging confirmed bilateral distended lacrimal sacs and nasolacrimal duct atresia associated with the bilateral aplasia of the parotid and the submandibular salivary glands and hypertrophied minor salivary glands along the oropharyngeal wall.

Nasal endoscopy confirmed a nasal septal deviation and narrow space in the medial meatus with no intranasal mucocele extension.

The large right dacryocystocele was surgically removed in toto and was identified as a large cyst with a smooth wall, containing crystalline secretion, nonadherent to the proximal structures. A swab was taken from the cyst content, and Gomori methenamine silver and acid-fast bacilli were negative for any organisms.

The histologic examination indicated that the cyst wall was composed of pseudostratified columnar epithelium showing mucin-secreting goblet cells, and the submucosal tissue was focally infiltrated with mixed-type chronic inflammatory cells including lymphocytes, plasma cells, and scattered eosinophils. The conclusion was consistent with a normal lacrimal sac and part of the nasolacrimal duct.

In the postoperative period, the patient continued with wet and sticky secretion linked to the lashes. Another CT scan 6 months after right dacryocystocele removal indicated spontaneous regression of the right maxillary sinus abnormalities.

**Comments**

We report a very rare case of dacryocystocele in a Saudi adult associated with bilateral congenital agenesis of the puncta and canaliculi in the upper and lower lids and other features as ear, dental, and digital abnormalities, compatible with LADD. Despite the fact that most of reported cases had autosomal dominant inheritance, our patient had no previous family history of this condition, likely to be the result of a new mutation in the gene.

Details of the 62 previous reported cases and the percentage of the LADD features are presented in Tables 1 and 2.

Our patient was a male. However, 64% of the reported cases of LADD are female. Our patient presented and was diagnosed for the first time as an adult, but many findings of LADD can be recognizable at birth.

Despite bilateral congenital puncta and canalicular agenesis, our patient did not complain about epiphora. Epiphora is present only in 19.6% of LADD carriers. The reason for that can probably be attributed to the fact that this syndrome can be associated to lacrimal gland aplasia or dysfunction and acinar hypoplasia as we observed also in our patient.

Aplasia or hypoplasia of the lacrimal gland can result in dry eyes, with abnormal lacrimal tear and limbal stem cell deficiency, predisposing to corneal epithelial erosions, neovascularization, and hypoesthesia.
The chronic sticky secretion in the eyes or the lashes as observed in our patient was detected in many LADD cases. It can be related to chronic dacryocystitis or reflecting the instability of the tear film secondary to lacrimal gland dysfunction.

Our patient had agenesis of the four lacrimal puncta and canaliculus. Underdeveloped or absent lacrimal puncta can be unilateral or bilateral in 45.2% of the LADD cases.

Nasolacrimal duct obstruction was detected bilaterally in our patient. Obstruction of the lacrimal ducts can occur in 71.4% of LADD carriers. Even with nasolacrimal duct obstruction, acute dacryocystitis never occurred in the present case because the upper lacrimal system was absent and bacteria could not access the cyst. However, chronic dacryocystitis has been reported in LADD cases with patent upper lacrimal excretory system.

Other less common features of LADD as telecanthus, ptosis, epiblepharon, entropion, lacrimal fistula, antimongoloid slant, and ophthalmoplegia were not detected in our patient.

The chief complaint of our patient was a large cystic lesion that was slowly progressive with no episodes of infection. Dacryocystocele in adolescents or adults are extremely rare. LADD dacryocystocele is distinct from congenital dacryocystocele that is noted in general at or within a few days after birth, characterized by the appearance of a cystic blue mass over the region of the lacrimal sac with the possibility of spontaneous resolution and risk of complications due to intranasal mucocele.

The cystic lesion was located below the right medial canthal ligament. CT scan documented bilateral dacryocystocele smaller in the left side and bilateral nasolacrimal ducts not developed with a dilated intraosseous portion of the obstructed nasolacrimal duct, which can represent an arrested development in the initial embryonal stages, when only the lacrimal sac was canalized.

The nature of the entrapped fluid inside a dacryocystocele is questionable. The agenesis of the upper lacrimal system makes it unlikely that the external fluid extended into the cyst. The crystalline secretion filling the large dacryocystocele verified during the surgery for cyst removal was likely due to cyst wall production, confirmed by biochemical and histological examination showing lacrimal sac epithelium with goblet cells.

The chronic cystic enlargement of the inferior portion of the right lacrimal system resulted in obstruction of the normal drainage of the maxillary sinus, leading to the development of a mucocele and chronic sinusitis. Notably, the pathology spontaneously resolved after removal of the lacrimal dacryocystocele.

Other phenotypic characteristics of LADD were present in our patient including the low-set and cup-shaped auricles, which occur in 78.2% of LADD patients. The malformations of the auricular pavilion can be quite variable, ranging from slight changes to the nonformation of the ear.

Although we did not perform an audiometric assessment to rule out a possible hearing deficit, our patient had no hearing complaints. Auricular pavilion alterations are often accompanied by unilateral or bilateral hearing loss, which can occur in 59.1% of LADD carriers. The changes can be in the inner ear (sensorineural deafness), in the middle ear (conductive hearing loss), or both (mixed hearing loss), and CT scan images can show abnormalities in the temporal ear ossicles, which was not found in our case.

Other features of LADD in our patient included dental anomalies as peg-shaped incisors, microdontia, hypodontia, and enamel dysplasia. Dental anomalies are very common characteristic in LADD disease, present in 91.1% of the cases.

### Table 2: Number and percentage of lacrimo-auriculo-dento-digital dysplasia characteristics presented in the previously reported cases in the literature

| Variable             | Yes (%) | No (%)* | Unknown** |
|----------------------|---------|---------|-----------|
| Tearing              | 11 (19.6) | 45 (80.3) | 6         |
| Secretion            | 24 (66.7) | 12 (33.3) | 26        |
| Puncta agenesis      | 14 (45.2) | 17 (54.8) | 31        |
| NLDO                 | 25 (71.4) | 10 (28.6) | 27        |
| Ears                 | 43 (78.2) | 12 (21.8) | 7         |
| Hearing loss         | 26 (59.1) | 18 (40.9) | 18        |
| Dental alterations   | 51 (91.1) | 5 (8.9)   | 6         |
| Dry mouth            | 23 (65.7) | 12 (34.3) | 27        |
| Digital alterations  | 53 (91.4) | 5 (8.6)   | 4         |
| Renal                | 23 (69.7) | 10 (30.3) | 29        |

*Absent or dryness, **Unknown or not reported. NLDO: Nasolacrimal duct obstruction

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**Figure 2:** Axial computed tomography scan showing right cystic lesion, fluid-filled structure (black arrows). Bilateral dilated nasolacrimal duct ending in bone obstruction. Lacrimal gland marked hypoplastic on the right side and hypoplastic on the left side. In the temporal bone, the middle ear ossicles were normal on both sides. Coronal and 3-D coronal surface shaded display fluid containing destructive expansible lesion originating from the alveolar process of the right maxilla (white arrow). Expansive lesion seen involving from the right maxilla is no longer seen after lacrimal cyst removal.
detected in the clinical or in the imaging examinations impairs saliva production, which occur in 65.7% of LADD cases. A decrease in saliva leads to xerostomia and persistent dry mouth with swallowing problems and a greater susceptibility to serious dental erosion, periodontal disease, increasing risk of dental caries, and precocious loss of teeth.

The feature most strongly related to LADD is abnormal hands, feet, and limbs, present in 91.4% of the LADD carriers.[1-5,7-15,17-22,24-28] There are several distinct anomalies of distal limb and digit abnormalities, such as long phalanges, hypoplastic thumbs and radii, extra or missing fingers, curved pinky fingers, lateral or medial bending of the digits (clinodactyly), and webbing or fusion of the digits (syndactyly). Sometimes, it is possible to find shorter forearm with abnormal wrist and elbow joint development that limits movement.

Our patient did not have renal abnormalities. However, many different kinds of renal anomalies as nephrosclerosis, hydronephrosis, recurrent urinary tract infections, and other genitourinary system abnormalities were described in 69.7% of LADD cases.[2,5,6,10-12,17,20]

All the LADD alterations detected in the lacrimal and salivary glands, ears, skeleton, and many other organs can be the result of abnormal genes as FGFR2, FGFR3, and FGFR10, which can stimulate cells to form structures for these affected organs. Mutations in these genes can result in impairment in cell maturation and development of many tissues, leading to the signs and symptoms of LADD syndrome.[24]

There are no standard guidelines for managing LADD. Treatment approach needs to be customized to the patient complaints. We removed the large dacryocystocele, and no further procedures were warranted since epiphora was not present. If epiphora is present, external/endonasal dacryocystorhinostomy associated to opening of the upper lacrimal excretory lacrimal system or Jones tube can be useful. If the dacryocystocele is not too large, it is not necessary to remove[21] as we did in the left side.

**Conclusion**

We present an adult patient with bilateral agenesis of the lacrimal puncta and canaliculi and large right lacrimal sac dacryocystocele. These features were detected in conjunction with auricular, dental and digital abnormalities, confirming the diagnosis of LADD syndrome. Our patient had an atypical mucocele in the maxillary sinus, which disappeared after dacryocystocele removal probably due to recovery of sinus drainage.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initial s will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Levy WJ. Mesoectodermal dysplasia. A new combination of anomalies. Am J Ophthalmol 1967;63:978-82.
2. Hollister DW, Klein SH, De Jager HJ, Lachman RS, Rimoin DL. The lacrimo-auriculo-dento-digital syndrome. J Pediatr 1983;83:438-44.
3. Wiedemann HR, Drescher J. LADD syndrome: Report of new cases and review of the clinical spectrum. Eur J Pediatr 1986;144:579-82.
4. Inan UU, Yilmaz MD, Demir Y, Degirmenci B, Ermiş SS, Oztürk F. Characteristics of lacrimo-auriculo-dento-digital (LADD) syndrome: Case report of a family and literature review. Int J Pediatr Otorhinolaryngol 2006;70:1307-14.
5. Shiang EL, Holmes LB. The lacrimo-auriculo-dento-digital syndrome. Pediatrics 1977;59:927-30.
6. Thompson E, Pembrey M, Graham JM. Phenotypic variation in LADD syndrome. J Med Genet 1985;22:382-5.
7. Hennekam RC. LADD syndrome: A distinct entity? Eur J Pediatr 1987;146:94-5.
8. Kreutz JM, Hoyme HE. Levy – Hollister syndrome. Pediatrics 1988;82:96-9.
9. Calabro A, Lungarotti MS, Mastroiacovo P. Lacrimo-auriculo-dento-digital (LADD) syndrome. Eur J Pediatr 1987;146:536-7.
10. Roodhooft AM, Brussaard CC, Elst E, van Acker KJ. Lacrimo-auriculo-dento-digital (LADD) syndrome with renal and foot anomalies. Clin Genet 1990;38:228-32.
11. Bamforth JS, Kaurah P. Lacrimo-auriculo-dento-digital syndrome: Evidence for lower limb involvement and severe congenital renal anomalies. Am J Med Genet 1992;43:932-7.
12. Lacombe D, Serville F, Marchand D, Battin J. Split hand/split foot deformity and LADD syndrome in a family: Overlap between the EEC and LADD syndromes. J Med Genet 1993;30:700-3.
13. Heinz GW, Bateman JB, Barrett DJ, Thangavel M, Crandall BF. Ocular manifestations of the lacrimo-auriculo-dento-digital syndrome. Am J Ophthalmol 1993;115:243-8.
14. Ostuni PA, Modolo M, Revelli P, Secchi A, Battista C, Tregnaghi A, et al. Lacrimo-auriculo-dento-digital syndrome mimicking primary juvenile Sjögren’s syndrome. Scand J Rheumatol 1995;24:55-7.
15. Toumba KJ, Gutteridge DL. Lacrimo-auriculo-dento-digital syndrome: A literature review and case reports. Quintessence Int 1995;26:829-39.
16. Lemmerling MM, Vanzeleghem BD, Dhooge IJ, Van Cauwenberge PB, Kannen MF. The Lacrimo-Auriculo-Dento-Digital (LADD) syndrome: A literature review. Cent Eur J Pediatr 2006;70:1307-14.
17. Azar T, Scott JA, Arnold JE, Robin NH. Ewingzell hypoplasia associated with lacrimo-auriculo-dento-digital syndrome. Ann Otol Rhinol Laryngol 2000;109:779-81.
18. Meusel-Wehner S, Klingebiel R, Werbs M. Inner ear dysplasia in sporadic lacrimo-auriculo-dento-digital syndrome. A case report and review of the literature. ORL J Otorhinolaryngol Relat Spec 2002;64:352-4.
19. Fierke O, Laskawi R, Bönnewann C, Hanefeld F. The Levy-Hollister syndrome: A syndrome of dysplasias with ENT-manifestations. HNO 2003;51:654-7.
20. Ramirez D, Lammer EJ. Lacrimoauriculodentodigital syndrome with cleft lip/palate and renal manifestations. Clef Palate Craniofac J 2004;41:501-5.
21. Lehotay M, Kunkel M, Wehrbein H. Lacrimo-auriculo-dento-digital syndrome. Case report, review of the literature, and clinical spectrum. J Orofac Orthop 2004;65:425-32.
22. Haktanir A, Degirmenci B, Acar M, Albayrak R, Yücel A. CT findings
of head and neck anomalies in lacrimo-auriculo-dento-digital (LADD) syndrome. Dentomaxillofac Radiol 2005;34:102-5.
23. Ong CA, Prepageran N, Sharad G, Luna D. Bilateral lacrimal sac mucocele with punctal and canicular atresia. Med J Malaysia 2005;60:660-2.
24. Milunsky JM, Zhao G, Maher TA, Colby R, Everman DB. LADD syndrome is caused by FGF10 mutations. Clin Genet 2006;69:349-54.
25. Caluff PR, Silva AL, Mascaro VL, Neustein I. The lacrимo-auriculo-dento-digital syndrome (LADD): Case report and literature review. Arq Bras Oftalmol 2009;72:715-8.
26. Mathrawala NR, Hegde RJ. Lacrимo-auriculo-dento-digital syndrome. J Indian Soc Pedod Prev Dent 2011;29:168-70.
27. Lim LT, Blum R, Chia SN, Ting DS, Lavy TE, Dutton GN. Lacrimal-auricular-dental-digital (LADD) syndrome with diffuse ophthalmoplegia – A new finding. Semin Ophthalmol 2012;27:59-60.
28. Santo RO, Golbert MB, Akaishi PM, Cruz AA, Cintra MB. Giant dacryocystocele and congenital alacrimia in lacrimo-auriculo-dento-digital syndrome. Ophthalmic Plast Reconstr Surg 2013;29:e67-8.
29. Pathivada L, Krishna MK, Rallan M. A case of lacrimo-auriculo-dento-digital syndrome with multiple congenitally missing teeth. Case Rep Dent 2016;2016:8563961.
30. Simpson A, Avdic A, Roos BR, DeLuca A, Miller K, Schnieders MJ, et al. LADD syndrome with glaucoma is caused by a novel gene. Mol Vis 2017;23:179-84.
31. Gupta H, Kane S, Balasubramaniam V. Bilateral dacryoceles associated with bilateral alacrimia with punctal and canicular agenesis. Saudi J Ophthalmol 2014;28:72-5.
32. Shekunov J, Griepentrog GJ, Diehl NN, Mohney BG. Prevalence and clinical characteristics of congenital dacrocystocele. J AAPOS 2010;14:417-20.
33. Lueder GT. The association of neonatal dacryocystoceles and infantile dacrocystitis with nasolacrimal duct cysts (an American Ophthalmological Society thesis). Trans Am Ophthalmol Soc 2012;110:74-93.
34. Schloegel L, Sindwani R. Massive enlargement of the nasolacrimal canal causing epiphora and chronic maxillary sinusitis. Laryngoscope 2006;116:1517-9.
35. Plaza G, Nogueira A, González R, Ferrando J, Toledano N. Surgical treatment of familial dacryocystocele and lacrimal puncta agenesis. Ophthalmic Plast Reconstr Surg 2009;25:52-3.