

The role of CT-DCG in hardware – associated secondary acquired lacrimal duct obstruction: SALDO update study - (SUP) - Paper III

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ARTICLE INFO

Keywords:

Secondary acquired lacrimal duct obstruction
SALDO
Lacrimal duct obstruction
Traumatic lacrimal duct obstruction
Lacrimal

ABSTRACT

Purpose: To study cases of hardware-associated secondary acquired lacrimal duct obstructions (SALDO) and the role of computed tomography dacryocystography (CT-DCG) scans in its diagnosis and management.

Observations: Retrospective, interventional case review of four patients diagnosed as Hardware-associated SALDO, with primary maxillofacial repair performed elsewhere, were analyzed. The mean age was 36.5 years (range: 22–74 years), three of them being males. Left and right lacrimal systems were equally involved. Epiphora, swelling and discharge were the main presenting features. Three lacrimal sacs and nasolacrimal ducts on CT-DCG showed the screws of the orbital fracture plate directly piercing their walls, whereas a single case showed the sac displaced and pierced by the medial side of the orbital floor implant. Two cases underwent dacryocystorhinostomy with intubation, and the remaining two had to undergo dacryocystectomy due to extensive damage. Post-operatively all four cases were doing well at a mean follow-up of 2 months.

Conclusions: The present series highlights the role of CT-DCG in delineating spatial relationship of lacrimal drainage system with the surrounding structures, facilitating planning as well as choice of surgery, and anticipating the intraoperative challenges. It also signifies importance of interdisciplinary coordination between oculoplastic and maxillofacial surgeons to avoid iatrogenic trauma to the lacrimal drainage system.

1. Introduction

Secondary Acquired Lacrimal Duct Obstruction (SALDO) can be classified as traumatic, mechanical, inflammatory, infective, and neoplastic.¹ Traumatic SALDO can result due to primary or iatrogenic trauma following naso-orbital fractures, sinus surgeries, intubation, or maxillofacial repair. Naso-Orbito-Ethmoid (NOE) fracture with or without orbital fractures is the most common cause of traumatic SALDO, which warrants timely intervention.² Intervention involves correction of the fracture by placement of implants in the correct anatomical position. However, trauma to the nasolacrimal system secondary to placement of maxillofacial hardware during primary repair is rare, with only a few studies reported in literature to date.^{3–6} Although Computed Tomography – Dacryocystography (CT-DCG) as an invaluable tool for traumatic SALDO is known, there is a paucity of literature describing its role in maxillofacial hardware – associated SALDO.^{7,8} Herein, the authors highlight the significance of pre-operative CT-DCG and analyze the outcomes of SALDO following maxillofacial hardware mal-placement. Institutional Ethics Committee approval was obtained, and the study

adhered to the tenets of the Declaration of Helsinki.

2. Case 1

A 74-year-old female presented to the clinic with bilateral watering and discharge of 4-years' duration. Symptoms followed maxillofacial surgery, which was performed following a road traffic accident (RTA). On examination, there was bilateral telecanthus, depressed nasal bridge, scarring over the glabellar area, and left-sided swelling in the lacrimal sac area. Regurgitation on pressure over the lacrimal sac (ROPLAS) was positive bilaterally. CT-DCG revealed obstruction at the sac-duct junction with dilated lacrimal sac on both sides. The left lacrimal sac was noted to be superior and posterior in position, along with a breach in the cribriform plate. A metallic plate in the left inferior orbital rim area was seen along the lacrimal sac fossa, with the screw piercing through the lacrimal sac. Additionally, she had unaddressed bilateral medial wall and comminuted nasal bone fractures (Fig. 1, Panel A,B & C). In view of old age with several systemic comorbidities and grossly disturbed lacrimal anatomy, along with a superiorly displaced sac, breach in the

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<https://doi.org/10.1016/j.ajoc.2024.102026>

Received 10 October 2023; Received in revised form 12 December 2023; Accepted 12 January 2024

Available online 21 February 2024

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roof and herniated contents, the plan was to relieve the patient from recurrent infections. Intra-operatively, incision along the left anterior lacrimal crest was made, and on dissection the maxillary plate was found to be adhered to the lacrimal sac, with the screw piercing the sac (Fig. 1, Panel D). The damaged lacrimal sac tissue was carefully dissected, and dacryocystectomy (DCT) was performed (Fig. 1). Right-sided DCT was also completed. At 3-month follow-up, there was no recurrence of any infection, and the patient underwent subsequent cataract surgery.

3. Case 2

A 25-year-old male presented with watering in the left eye following maxillofacial repair two months ago. A history of RTA four days prior to the surgical intervention was elicited. At presentation, left-sided enophthalmos, traumatic telecanthus with epicanthal fold, depressed nasal bridge, and multiple facial scars were noted (Fig. 2, Panel A). Left ROPLAS test was positive. CT-DCG revealed a small, inferiorly displaced, fibrotic left lacrimal sac with an abrupt obstruction at the sac-duct junction and associated comminuted NOE fracture. The intervening screw was seen directly lacerating the fibrosed lacrimal sac. Callus was noted in the lacrimal fossa area. Metallic plates were visualized along the ipsilateral zygomaticomaxillary complex, frontozygomatic, and inferior orbital rim fracture. Additionally, unaddressed medial and floor fractures of the left orbit were also noted (Fig. 2, Panel B). In view of the extremely fibrosed, small lacrimal sac with extensive damage due to the sac wall and mucosa with the screw in situ, the lacrimal sac could not be salvaged, and a dacryocystectomy was performed (Fig. 2, Panel C). At 3-month follow-up, epiphora was tolerable, without any discharge, and the patient was given options of lacrimal gland needling or botulinum toxin injection to reduce the amount of epiphora.

4. Case 3

A 25-year-old male presented to the Dacryology clinic with post-traumatic enophthalmos and constant epiphora following maxillofacial repair performed two months ago. The maxillofacial repair was done following a RTA four days prior. At presentation, he had significant right – sided enophthalmos of 5 mm and traumatic telecanthus with an acquired epicanthal fold (Fig. 3, Panel A). Lacrimal irrigation findings were suggestive of right lacrimal duct obstruction. CT- DCG revealed the misplaced maxillofacial implant extending onto the lacrimal fossa area, causing sac displacement with the screw piercing the sac and projecting into the nostril. It also showed misaligned bilateral zygomaticomaxillary complex, right NOE and orbital floor as well as medial wall fractures (Fig. 3, Panel B,C & D). A pre-operative nasal endoscopy showed the screw piercing the nasal mucosa anterior to the middle turbinate (Fig. 3, Panel E). Intra-operatively, a careful dissection was carried out, with partial implant removal along with retrieval of the screw under endoscopic visualization (Fig. 3, Panel F & G). A successful external dacryocystorhinostomy with silicone intubation and mitomycin-C was performed. At 1-month follow-up, the lacrimal irrigation was patent, and the patient was subsequently planned for orbital fracture revision and repair with volume augmentation through fat transfer.

5. Case 4

A 22-year-old male presented with watering in the right eye of one month duration. The patient had RTA one year ago, after which he underwent zygoma, orbital floor fracture, and NOE repair twice elsewhere. At presentation, he had enophthalmos, traumatic ptosis, and traumatic telecanthus (Fig. 4, Panel A). Irrigation showed mucoid discharge regurgitation from the opposite punctum. CT-DCG revealed dilated right lacrimal sac with an obstruction at the sac-duct junction. The 3D-metallic implant placed in the orbit was seen piercing the

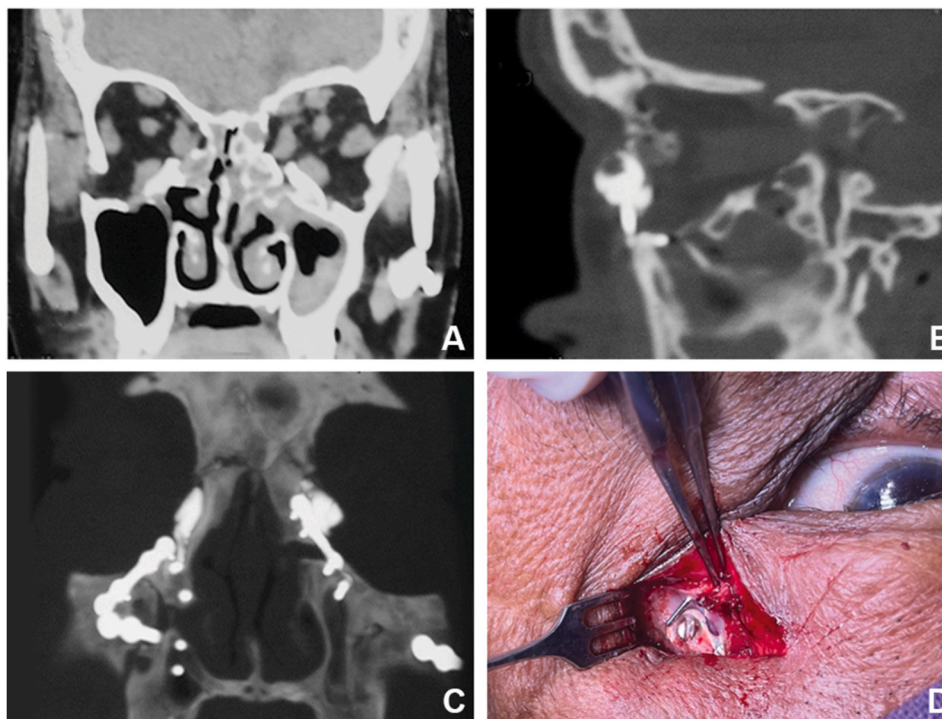


Fig. 1. Computed tomography (CT) scan images, coronal view, showing bilateral, multiple comminuted fractures involving the zygoma, floor, and medial wall, along with naso-orbito-ethmoid fracture and breached cribriform plate on left side (Panel A). Pre-operative Computed tomography – dacryocystography (CT-DCG) scans, parasagittal, and coronal cuts, highlighting the defect in dye filling in the area of left sac impinged upon by the screw (Panel B & C). Intra-operative image showing screw with the implant piercing the lacrimal sac with Bowman's lacrimal probe exiting through the common canaliculus (Panel D).

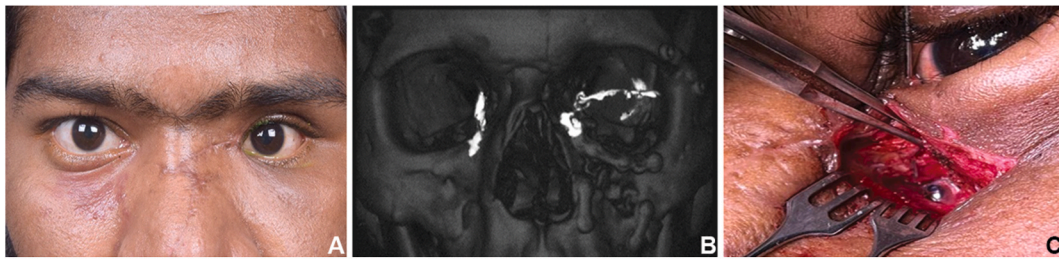


Fig. 2. Clinical photograph showing left-sided telecanthus and enophthalmos with associated scarring, post-trauma (**Panel A**). Pre-operative CT-DCG scan images showing defect in dye filling in the fibrosed lacrimal sac area impinged upon by the screw with NOE fracture and repaired zygoma and floor on the left side (**Panel B**). Intra-operative photograph showing screw piercing the torn, shrunken and fibrosed lacrimal sac (**Panel C**).

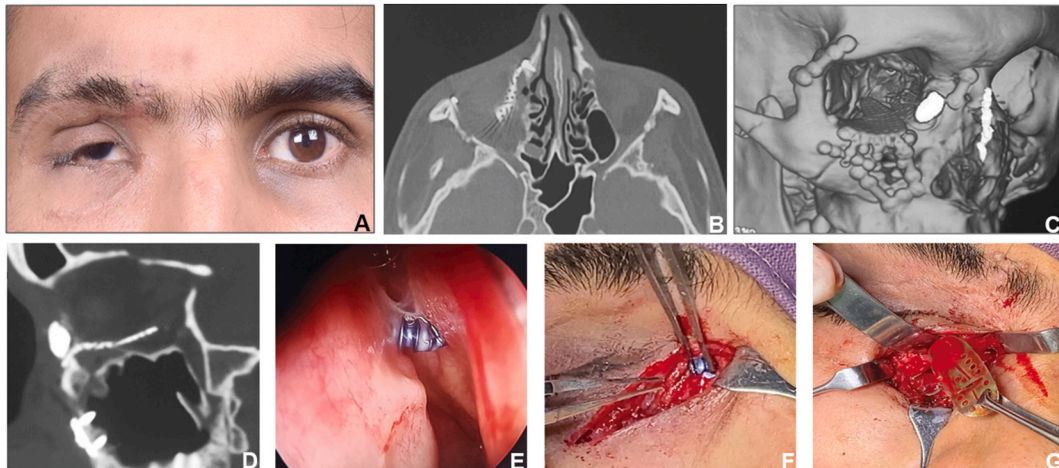


Fig. 3. Clinical photograph showing right-sided telecanthus, enophthalmos, traumatic ptosis, and acquired epicanthal fold with associated periocular scarring, post-trauma (**Panel A**). CT-DCG scan images, axial view, revealing fixation screw protruding into the nasal cavity (**Panel B**), 3D CT-DCG scans showing screw piercing the sac (**Panel C**) and parasagittal section images, highlighting the superiorly displaced sac with the plate in the fossa region (**Panel D**). Pre-operative nasal endoscopy showing the screw in the nasal cavity anterior to the middle turbinate, displaced towards the roof (**Panel E**). Intra-operative photograph showing retrieval of offending screw and partial plate during external dacryocystorhinostomy (**Panel F & G**).

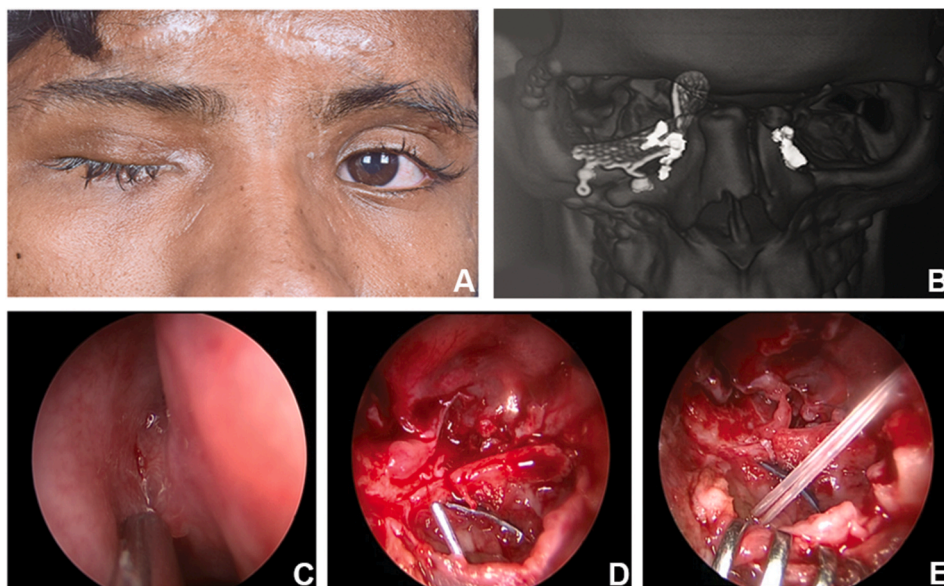


Fig. 4. Clinical color photograph showing right-sided traumatic ptosis, telecanthus, and enophthalmos, post-trauma (**Panel A**). 3D CT-DCG revealing dilated lacrimal sac with 3D metallic orbital implant piercing the sac (**Panel B**). Pre-operative nasal endoscopy revealing extensive turbinate-septal synechiae and scarring with inferior displacement of middle turbinate (**Panel C**). Intra-operative view showing marsupialized lacrimal sac flaps with implant seen inferior to the common canalicular opening, pre- and post-silicone intubation (**Panel D & E**).

lacrimal sac and extending into the ethmoid sinus (Fig. 4, Panel B). A preoperative nasal endoscopy revealed inferiorly displaced middle turbinate and roof with signs of an extensive trauma (Fig. 4, Panel C). Intraoperatively, the lacrimal sac was isolated and marsupialized in the H-fashion. The orbital implant was seen just piercing thru the lacrimal sac inferior to the common canalicular opening (Fig. 4, Panel D). The implant was left in place, and external dacryocystorhinostomy with bicanalicular intubation and mitomycin-C was completed (Fig. 4, Panel E). At one month follow-up, stent extubation was performed, and endoscopically the internal common opening was dynamic, with a positive fluorescein endoscopic dye test. However, no implant was visible in the ostium, nor was any granulation tissue seen.

6. Discussion

Maxillofacial trauma is the most commonly sustained injury following RTA, warranting early surgical intervention.⁹ Open reduction and internal fixation with a combination of rigid miniplates and fixation screws remains the first line of management.¹⁰ The common complications following maxillofacial repair include infection, extrusion, or exposure of the implant, all of which require removal.¹¹ Although inadvertent injury to the nasolacrimal system during maxillofacial surgery is well known,¹² maxillofacial hardware as the source of SALDO is underreported.^{13–15} Hardware – associated SALDO can be broadly attributed to variable etiological factors such as implant migration or misdirection, implant-related inflammation exerting compressive effects, and fixation screws which can either impinge along the lacrimal drainage system or directly traumatize the lacrimal sac.^{3,4,16} Fixation screws as the principal cause of SALDO following maxillofacial repair was first studied by Kong et al. recently.¹⁵ They described cases wherein the screw went through the maxillary bone into the lacrimal fossa area or into the NLD. However, the sac remained intact in both the cases. In our series, fixation screws and the plate were seen directly piercing the lacrimal sac, a CT-DCG based clue which corroborated with the intra-operative finding. This was the predominant cause of epiphora in all four cases.

The choice of lacrimal surgery in these cases depends on the status of the lacrimal drainage system (LDS), the damage incurred to the LDS, and the position of the hardware on the LDS. This is considered along with the surrounding structural anatomy like the nasal, ethmoidal, and orbital fractures associated with the trauma. Extensive damage to the lacrimal drainage system or surrounding structures warrants dacryocystectomy to relieve the excessive discharge and dampen the chances of having a lacrimal infection, as seen in first two cases of the present series. In cases where the lacrimal sac anatomy is preserved, a dacryocystorhinostomy to relieve the epiphora and discharge is the preferred choice, as in the latter two cases of the present series.

CT – DCG is an invaluable diagnostic tool for complex lacrimal situations such as lacrimal diverticula, neoplastic SALDO, nasomaxillary and facial fractures, and lacrimal duct obstruction following paranasal sinus surgeries.^{17–19} It was found that not only does CT DCG better delineate the anatomic relationship between the lacrimal sac and the maxillofacial hardware, but it also accurately depicts the area where the screw is piercing the sac as a filling defect or irregularity in the dye uptake. The displacement of the lacrimal drainage structures secondary to the implant placement and its relationship with the underlying bony anatomy is also clearly delineated. Damage to the lacrimal sac is indicated by shrinkage and fibrosis of the sac, which helps to formulate an accurate pre-operative plan and partly prognosticate the outcomes.

Although the present study was limited by its retrospective nature and the small sample size, this report highlights exclusive CT-DCG features in Hardware-associated SALDO. CT-DCG demonstrates the spatial relationship of lacrimal drainage system with the surrounding structures, facilitates surgical planning, and is instrumental in anticipating the intra-operative challenges. This report also provides a detailed description of hardware-related SALDO attributable to direct injury of

the lacrimal sac by the fixation screws or the maxillofacial implants. It also emphasizes the potential deficiencies in the primary surgical care and thus, a thorough applied knowledge of the lacrimal anatomy should be a part of every maxillofacial surgeon's armamentarium to avoid inadvertent lacrimal trauma during repair.

Patient consent

Consent to publish this case report has been obtained from the patient(s) in writing. This report does not contain any personal identifying information.

Funding

Hyderabad Eye Research Foundation.

Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

Declaration of competing interest

The following authors have no financial disclosures: AA, MN,NB.

MJA receives royalties from Springer for his treatise 'Principles and Practice of Lacrimal Surgery', and 'Atlas of Lacrimal Drainage Disorders', and 'Video Atlas of Lacrimal Drainage Surgery'.

Acknowledgements

None.

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