



## MICROSURGICAL RECONSTRUCTION WITH VEIN GRAFT FOR CANALICULAR DUCT RUPTURE: A CASE REPORT

Agus Roy Rusly Hariantana Hamid<sup>1,2\*</sup>, I Gusti Putu Hendra Sanjaya<sup>1,2</sup>, Gede Wara Samsarga<sup>1,2</sup>, Shita Diwyani Sudarsa<sup>1,2</sup>, Astrinita Lestari Suyata<sup>1,2</sup>, Chandra Wijaya Setiawan<sup>1,2</sup>

<sup>1</sup>Department of Plastic, Reconstructive, and Aesthetic Surgery, Universitas Udayana, Jl. P.B. Sudirman, Dauh Puri Klod, Denpasar Barat, Denpasar, Bali 80232, Indonesia

<sup>2</sup>RSUD Prof. I.G.N.G. Ngoerah, Jl. Diponegoro No. 45, Dauh Puri Klod, Denpasar Barat, Denpasar, Bali 80113, Indonesia

\*[royruslyhamid@yahoo.com](mailto:royruslyhamid@yahoo.com)

### ABSTRACT

Canalicular rupture is an injury to the lacrimal drainage system, commonly caused by sharp or blunt trauma to the periocular area due to violence, traffic accidents, sports, or falls. Inadequate management can lead to permanent epiphora, canalicular stenosis, and post-traumatic cosmetic disfigurement, necessitating appropriate surgical reconstruction. This study was conducted to evaluate the anatomical and functional outcomes of autologous vein grafting with silicone stent placement in the reconstruction of canalicular rupture. This study aimed to report our experience in canalicular duct rupture repair with silicone tube and dorsal metacarpal vein autograft. This study is a descriptive case series involving patients with canalicular rupture who underwent microsurgical reconstruction using autologous vein grafts. Patient data were collected prospectively from medical records and postoperative follow-up. Outcomes evaluated included anatomical success, functional success, and postoperative complications. After the canalicular repair, the patient showed improvement as indicated by reduced complaints of epiphora significantly. Canalicular duct rupture reconstruction with silicone tube and dorsal metacarpal vein autograft showed a good outcome in this case and successfully reduced epiphora of the patient.

Keywords: canalicular duct rupture; canalicular duct reconstruction; silicone tube; vein graft

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## INTRODUCTION

Canalicular rupture can occur in all age groups with various causes, generally due to penetrating or blunt trauma to the ocular adnexa as a result of violence, sports, traffic accidents, or falls. The canaliculi are often the first structures affected by periorbital trauma or facial trauma. Lacerations in this area can potentially affect the drainage system of the eye, if not treated appropriately can lead to permanent epiphora and post-traumatic cosmetic problems (Peterson et al., 2025). Therefore, an appropriate surgical management are essential to obtain optimal results. Canalicular rupture can be repaired with silicone tubes and or autologous vein graft. Autologous vein graft substitutes the ruptured canaliculi, while stent placement is performed to prevent postoperative canalicular stricture (Jamshidian-Tehrani et al., 2023).

The lacrimal drainage system plays a crucial role in maintaining ocular surface homeostasis by eliminating tears from the ocular surface to the nasal cavity. The lacrimal canaliculus is a major component of the lacrimal drainage system, located on the medial aspect of the eyelid and serving as the initial pathway for tear drainage. Trauma to the periocular and facial areas can cause rupture or laceration of the canaliculus, potentially permanently disrupting tear drainage function if not adequately treated. Lacrimal drainage system lesions are reported to occur in approximately 16% of all eyelid injuries, with the most common causes including traffic accidents, violence, animal bites, sports, and falls. Damage to the canaliculus can lead to stenosis, lacrimal duct obstruction, chronic epiphora, and cosmetic issues that impact the patient's quality of life. (Grace, 2020).

The primary principle of canalicular rupture management is to perform anatomical reconstruction as early as possible to maintain patency of the lacrimal drainage system. Primary repair within 24–48 hours of injury has been reported to provide better anatomical and functional outcomes than secondary reconstruction. Various reconstructive techniques have been developed, including direct microsurgical anastomosis, monocanicular and bicanicular silicone stent placement, and pericanicular suture techniques. However, the success of reconstruction is still influenced by the degree of tissue damage, loss of canalicular segments, scar tissue formation, and the risk of postoperative restenosis. (Güçlü & Özer, 2024).

In cases of canalicular rupture with extensive tissue loss, direct anastomosis is often difficult due to the tissue defect, which places excessive tension on the reconstruction site. This situation necessitates the use of a substitute material to replace the missing canalicular segment. One reported alternative is the use of an autologous vein graft (Drnovšek Olup et al., 2024). Autologous veins have several advantages, including ease of acquisition, a diameter similar to that of the normal canaliculus, biocompatibility, and minimal risk of immunological reactions. The use of vein grafts as a connecting conduit between the severed lacrimal system and the common canaliculus was first reported to provide satisfactory functional results in the reconstruction of common canaliculus avulsions. Furthermore, the placement of silicone stents in the grafts aims to maintain the lumen open during the healing process and prevent postoperative strictures (Fiorino et al., 2021).

Although microsurgical reconstruction using autologous vein grafts has shown promising potential, scientific evidence regarding the anatomical and functional efficacy of this procedure remains limited, particularly in cases of canalicular rupture with extensive tissue defects. Most available studies are case reports or case series with limited sample sizes. Therefore, research on microsurgical reconstruction using vein grafts for canalicular rupture is needed to evaluate the procedure's success, potential complications, and postoperative anatomical and functional outcomes, thus providing a basis for developing more effective management strategies for patients with lacrimal drainage system injuries (Afriani et al., 2021). This study aimed to report our experience in canalicular duct rupture repair with silicone tube and dorsal metacarpal vein autograft.

## **METHOD**

This study used a descriptive case study design reporting the microsurgical management of canalicular reconstruction using autologous vein graft in patients with canalicular duct rupture. Patient data were collected prospectively from medical records and postoperative follow-up. Clinical data including demographic characteristics, trauma mechanism, clinical findings, surgical technique, and postoperative anatomical and functional outcomes were collected through clinical observation and medical record review. Evaluation of success was based on lacrimal system patency, epiphora complaints, and complications during follow-up.

## **RESULT**

A female patient, 62 years old, came in unconscious, with injuries from the head to the face after a traffic accident fell into a ravine from a height of  $\pm 4$  meters, 1 day ago. From the anamnesis, there was no history of vomiting or seizures. History of bleeding from the nose and ears is unknown. The patient on the motorbike did not wear a helmet. History of systemic disease was denied. From the physical examination, a primary survey was obtained; Airway: stable, Breathing: there is damage to the left hemithorax, Circulation: stable, Disability: GCS E3V5M6, Exposure: according to secondary survey: no cephalic hematoma was found on the head, left hemithorax has damage, cor, pulmo and abdomen within normal limits, on extremities found vulnus excoriation in the right superior extremity region. Local status: Regio Facialis, on inspection it was found that the vulnus appertum measuring 16cm x 15cm formed a flap from medial to lateral (from the frontal temporoparietal sinistra - zygoma sinistra), there was bone exposed, but no active bleeding, debris and clots were found. On palpation there is no step off. Intraoral examination revealed caries on teeth 24, 31, 46 and edentulous teeth 16-18, 27-28, 32, 36-37, 45, 47-48. From the Ophthalmology

examination: Visus ODS, eyeball movement ODS, diplopia, pain, and anel test superior and inferior canaliculi were difficult to evaluate, no subconjunctival bleeding was found.

From the laboratory supporting examination, Hemoglobin was 8.9 gr/dL, and from the Thoracic x-ray showed cardiomegaly with aortosclerosis (ASHD), suspected left hemothorax, left pulmonary contusion or pneumonia, observation of high right diaphragm, complete displaced fracture of costae 3, 6 left posterior and os costae 5 left lateral aspect, and thoracic spondylosis. The results of CT scan concluded that there was a subdural hematoma of the falx cerebri, however, there were no facial bone fractures and retained foreign bodies.

The working diagnosis of the plastic surgery department is Extensive Open Degloving Wound Hemifacial Sinistra with Bone Exposed (Frontotemporoparietal Sinistra, Rima Orbita Superior et Inferior S, Zygoma S), Rupture of the Canaliculi Superior et Inferior Oculi sinistra, Caries of teeth 24, 31, 46, Edentulous 16-18, 27-28, 32, 36-37, 45, 47-48 and Anemia. Treatment in the Plastic Surgery department is Pro Debridement, Viability Test, Reconstruction of Open Degloving Wound Hemifacial Sinistra + Reconstruction of Repair of Canaliculi Oculi sinistra (Urgent), PRC Transfusion 1 kolf/day until Hemoglobin  $\geq 10$ , Treat the wound with moist gauze, IVFD NaCl 0.9% maintenance, Paracetamol 1 gram every 8 hours intravenously, Ceftriaxone 1 gram every 12 hours intravenously, Consult to the Ophtalmology department to evaluate the eyeball, others according to the relevant department.

During the operation, the patient was in the supine position with GA OTT, the operating field was disinfected with povidone iodine and narrowed with a sterile douche, then a Forced Duction Test was carried out and restrictions were found in the superior, superomedial, superolateral, medial, lateral, inferomedial and inferolateral directions, exploration was carried out and Evaluation of R. Frontotemporoparietal to R. Zygoma S, found Vulnus appertum measuring 16cm x 15cm forming a flap from medial to lateral, Bone exposed (+), muscle exposed (+), medial palpebral ligament exposed (+), Foreign body (+), then debridement was carried out, tissue viability test by excising the distal part of the wound, and refreshing the edges of the wound, then foreign body extraction was carried out, then the wound was washed with NaCL 0.9% 4L, bleeding was controlled, identification of the superior and inferior canaliculus punctum. Left oculi were found: sacs lacrimalis OS (-), inferior lacrimal punctum (+), inferior lacrimal canaliculus Os distal part (+) 1 cm, after that, a drill was carried out on the left nasal os on the inferior part, obtained a gap of 1.5 cm from the inferior lacrimal canaliculus Os with the neocanal on nasal os, a silicone tube is inserted from the lacrimal punctum to the neocanal on the left nasal os. Next, a vein is taken from the dorsal metacarpal vein of the right hand, about 1.5 cm, control bleeding, suture the incision wound with 3.0 nylon thread, then carry out a vein graft with end to end anastomoses on the distal vein with the proximal OS inferior lacrimal canaliculus and suturing the proximal vein with the surrounding tissue. Inferior nasal bone neocanal with 8.0 nylon thread, Medial canthus canthoplasty with 4.0 nylon thread, superior and inferior eyelid borders sutured with 5.0 non-absorbable thread, superior and inferior eyelids sewn deep with 5.0 absorbable thread, Suture the skin with 6.0 non-absorbable thread, Sew the mattress scalp with non-absorbable 5.0 thread. After that, treat the wound with gentamicin eye ointment + tulle + sterile gauze. Operation complete.

#### **Follow-up Observation (4 months Later)**

From the anamnesis, it was found that the left eye sometimes watered but was not accompanied by itching. From the physical examination, the general condition was quite good, hemodynamically stable, Generalist Status: there was injury to the left hemithorax, there was a vulnus excoriation in the right superior extremity region, everything else was within normal limits. Local status: Scalp region found post-operative scars, Regio Facialis found post-op scars in the frontal region, left superior and inferior eyelids to left orbicularis oculi, ptosis of the left superior eyelids and a silicone tube for the left oculi was installed, the impression was good. Intraoral examination revealed caries 24, 31, 46 and edentulous 16-18, 27-28, 32, 36-37, 45, 47-48. Ophthalmology examination revealed

visual acuity OD >2/60, OS 1/300, eye movement OD freely in all directions, OS restriction in the superior, superomedial, superolateral, medial, lateral, inferomedial and inferolateral directions. The working diagnosis of the Plastic Surgery department is severe ptosis OS ec history of superior and inferior eyelid rupture full thickness post eyelid reconstruction, post Debridement + Viability Test + Refreshing wound edges + Soft tissue reconstruction ec Extensive Open Degloving Wound R. Frontotemporoparietal to R. Zygoma S and Post Explore the superior and inferior canaliculi + Neocanalization Reconstruction of the OS inferior lacrimal canaliculus with silicon tube and Vein Graft ec Rupture of the OS Superior et inferior Canaliculi. The treatment for Plastic Surgery is Pro Aff Silicone tube.

During the operation, the patient is in the supine position with GA-IV, then the operating field is disinfected with povidone iodine, then narrowed with a sterile mask. Evaluation was carried out and found post-operative scars, R.Frontal - malar S was good, color matched the surrounding skin, no hypertrophic scars were found, ptosis was found on the superior eyelids, OS (+) inferior lacrimal punctum, intact silicone tube. After that, dilate the inferior lacrimal punctum of the OS with micro tweezers, using Visco Elastic-Canula, and lubricate the silicon tube with Visco gel, then after the silicone tube is soft and free, cut the silicon tube near the lacrimal punctum of the OS then pull the silicone tube from the nasal cavity. S. Next re-evaluate the inferior lacrimal punctum OS and superior palpebral ptosis S. The operation is complete.

## **DISCUSSION**

Canalicular rupture occur in all age groups with a wide range of etiologies. It is important to understand the anatomy when considering the importance of a laceration to this structure. The canaliculi are located at the most medial margins of the four eyelids. The punctum is a superficial opening into the canaliculus functioning to draw tears out of the eye and into the canaliculus. In most people, an upper and lower canaliculus from each eye then drain into a common canaliculus and finally into the lacrimal system. Lacerations to this region affect the drainage system of the eye, can affect the muscles and tendons of the orbit, and potentially even the facial bones (Hwang et al., 2023).

Trauma may be direct or indirect and blunt or penetrating. Direct penetrating traumas may occur by foreign objects, including glass, metal, or some organic materials. Indirect blunt traumas can occur by physical assaults, such as with a fist or bat, a finger poke, or may occur during vehicle accidents, such as an impact against the steering wheel. One of the first studies researching the etiology of canalicular lacerations demonstrated that 84% of this type of injury was caused by indirect trauma without injury to the eyelid (Macri et al., 2024).

In this case, the anamnesis revealed that the patient's trauma mechanism was a motorbike accident, falling from a height of  $\pm 4$  meters without a helmet. From this mechanism, direct or indirect trauma and/or blunt or sharp trauma can occur which can cause canalicular ruptures. Canalicular lacerations may not be obvious on initial physical examination, probing, or other modalities that may be beneficial to help make the diagnosis. To assess it try using loupes, slit lamp, or a surgical microscope. One study has suggested the injection of viscoelastic material to help in the identification of canalicular injury. Topical phenylephrine produces vascular constriction and muscular contraction, both useful to decrease bleeding and improve identification of the injury (Fiorino et al., 2021).

The extraocular movements and visual acuity should be assessed. A good pupillary examination is important, looking specifically at the shape, as a teardrop pupil could indicate a ruptured globe. Fluorescein staining may be beneficial to assess for corneal abrasions and Seidel's sign. The palpation of the facial bones is important in assessing for the presence of facial bone fractures. This is important because these fractures may require surgical repair and should be performed prior to addressing the canalicular injury (Callahan et al., 2022).

On the initial physical examination, ODS vision, ODS eyeball movement, diplopia, pain, and anel test superior and inferior canaliculi were difficult to evaluate, no subconjunctival bleeding was found so immediately consulted to the ophthalmology department for further examination. In addition to physical exam, a Non-contrast CT scan is the imaging modality of choice for facial bone fractures and are also crucial in assessing for retained foreign bodies. Dedicated orbital CTs may be indicated based on clinical suspicion for orbital bone disruption. MRI can be considered but is unlikely to be indicated, after ruling out foreign bodies (Ali & Paulsen, 2020).

The results of the patient's CT scan concluded that there was a subdural hematoma of the falx cerebri, however, there were no facial bone fractures and retained foreign bodies. Treatment for ruptured canaliculi includes surgical repair. Surgical repair is always indicated for lacerations involving both the superior and inferior canaliculi. The use of stents when repairing the canaliculi is likely to improve the cosmetic results and the overall prognosis.<sup>6</sup> There are multiple trademarked brands of stents for both monocanicular and bicanicular injuries. The location of the laceration (proximal, mid, or distal) does not seem to influence the success of the repair (Fiorino et al., 2021).

For monocanicular lacerations, a punctual dilator should be passed to enlarge the punctum. A stent may then be passed into the punctum and through the canaliculus. The stent should then be pulled flush with the punctum, and the distal portion pulled into the second portion of the canaliculus (Marshak, 2020). For bicanicular lacerations, a bicanicular intubation set should be introduced into the punctum, advanced 2mm, then make a 90-degree turn, following the canaliculus for about 8mm. A guidewire is then passed through the nasal end of the lacerated canaliculus and passed into the lacrimal sac fossa. A stent is then placed along the guidewire - this step may require a rotation of the stent itself. This is then repeated for the opposite canaliculus. The stents are tied with a square knot. The remaining steps are a common pathway for both mono- and bicanicular lacerations.<sup>7</sup> Suturing of the stent into place should occur with 5-0 (or 7-0) polyglactin suture on a P-2 needle, utilizing a buried horizontal mattress suture. The eyelid margin, and skin-layer, should be closed using a 6-0 fast-absorbing gut. Antibiotic ointment should be applied to the wound. Monocanicular stents are left in place for six weeks, while bicanicular stents should be left in for up to 3 months. Depending on the mechanism of injury, antibiotic prophylaxis with 3 to 5 days of amoxicillin-clavulanate may be of benefit. The patient should be provided with an eye shield to wear at night. Patients should also be instructed to avoid rubbing the eye for at least two weeks after repair (Hwang et al., 2023).

In this case, a drill was carried out on the left nasal os on the inferior part, obtained a gap of 1.5 cm from the inferior lacrimal canaliculus Os with the neocanal on nasal os, a silicone tube is inserted from the lacrimal punctum to the neocanal on the left nasal os. Next, a vein is taken from the dorsal metacarpal vein of the right hand, about 1.5 cm, control bleeding, suture the incision wound with 3.0 nylon thread, then carry out a vein graft with end to end anastomoses on the distal vein with the proximal OS inferior lacrimal canaliculus and suturing the proximal vein with the surrounding tissue. Inferior nasal bone neocanal with 8.0 nylon thread, Medial canthus canthoplasty with 4.0 nylon thread, superior and inferior eyelid borders sutured with 5.0 non-absorbable thread, superior and inferior eyelids sewn deep with 5.0 absorbable thread, Suture the skin with 6.0 non-absorbable thread, Sew the mattress scalp with non-absorbable 5.0 thread. After that, treat the wound with gentamicin eye ointment + tulle + sterile gauze. The postoperative treatment consisted of Gentamicin eye ointment, Tobramycin eye drop and artificial tear eye drop (Sharma et al., 2024).

Autologous vein grafting has been an accepted and successful method of treatment for peripheral and central vascular repair for many years. Although vein grafts have been used almost exclusively for vascular anastomosis, recent reports have shown that they are suitable for anastomosing nonvascular structures as well. Vein graft is usually chosen because of its size, location, and ease of procurement it is a satisfactory autologous material for replacement of canalicular tissue.<sup>8</sup> In this

patient we use dorsal metacarpal vein instead, and shows excellent result after the surgery. Most canalicular lacerations do not involve tissue loss, and vein grafting is not necessary in such cases. Vein grafts should be considered in acute lacerations with proximal canalicular tissue loss. They may be useful in delayed repair of injuries with 5 mm or ore of intact distal canaliculus and a salvageable lacrimal sac. Unanswered questions remain about the long-term survival of the graft and its capacity to drain tears.

## CONCLUSION

Canalicular duct rupture reconstruction with silicone tube and dorsal metacarpal vein autograft showed a good outcome in this case and successfully reduced epiphora of the patient.

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