OPEN

PRS GLOBAL OPEN

CASE REPORT

Pediatric/Craniofacial

Optic Canal Decompression with a Lateral Approach for Optic Nerve Injury Associated with Traumatic Optic Canal Fracture

Yu Hokazono, MD
Hiroki Umezawa, MD, PhD
Yuta Kurokawa, MD
Rei Ogawa, MD, PhD, FACS

Summary: Optic canal fracture (OCF) is a traumatic injury that requires urgent intervention because it can induce optic nerve damage and visual impairment. Despite the severity of OCF, a standard treatment method has not been established. In this article, we report a case of OCF and traumatic optic nerve injury in which visual acuity was recovered by releasing the optic canal using an unconventional lateral approach. A 43-year-old man presented with right lateral ethmoid fracture, right orbit blowout fracture, and OCF. The visual acuity was "hand motion" before surgery. Decompression was performed 10 hours after injury by approaching the right optic canal laterally from a coronal incision in front of the right ear, cutting along the border of the sphenoid bone, and scraping away some of the sphenoid wing and zygomatic bone. Steroid pulse therapy was added. Eventually, the visual acuity improved to 0.2 and the intraocular pressure decreased to 16.0 mm Hg. Compared with conventional methods, this method associates with better safety because (1) it causes relatively little bleeding and cerebrospinal fluid leak; (2) once the sphenozygomatic suture is identified, the distance to the optic canal is relatively short; and (3) if the fracture point is on the outer optic canal, the fracture line can be observed directly. Steroid pulse therapy may also have contributed to the good visual outcome. This is the first report of a novel lateral approach to OCF that is safe, effective, and only requires plastic surgery skills. *(Plast Reconstr Surg Glob Open 2019;7:e2489; doi: 10.1097/GOX.0000000000002489; Published online 30 October 2019.)*

BACKGROUND

Optic canal fracture (OCF) is a traumatic injury that requires urgent intervention because it can induce optic nerve damage and concomitant visual impairment. Currently, the main treatment strategies for OCF are decompression via the trans-optic sinus method or craniotomy.[1]

The trans-optic sinus methods include those of Fujitani[2] (an intranasal transethmoidal approach), Kawaguchi et al.[3] (an extranasal transethmoidal approach), and Rigante et al.[4] (a supraorbital approach). The craniotomy methods can be divided into the intradural approaches favored by neurosurgeons and the epidural approaches described by Yang et al.[5] (anterior clinoid process resection) and Wada et al.[6] (cavernous sinus peeling).

From the Department of Plastic, Reconstructive, and Aesthetic Surgery, Nippon Medical School, Japan.

Received for publication June 20, 2019; accepted August 14, 2019.

DOI: 10.1097/GOX.0000000000002489

All methods have limitations, particularly for plastic surgeons: the intranasal transethmoidal method requires transnasal endoscopy techniques, the intracranial methods require extensive neurosurgical skills, and most methods associate with high risks of bleeding and cerebrospinal fluid (CSF) leak. Plastic surgeons require a safe approach that does not involve special devices or neurosurgical skills. In this article, we report an OCF case in which recovery of visual acuity was achieved by opening the optic canal with a novel lateral approach.

CASE REPRESENTATION

The patient was a 43-year-old man who fell 1.5 m from a train station platform onto a track and sustained a wound to his right upper eyelid. Four hours post injury, the patient's right light reflex was noted to start disappearing gradually. Right eye visual acuity was initially 50 cm with 1 M print (0.5 in decimal notation; minimal impairment) but it started to decline. Just before surgery, the visual acuity had deteriorated to hand motion. The right eye exhibited hyperemia, conjunctival edema, a Marcus Gunn pupil, diplopia, and an ocular motility disorder that affected upward movements. Right eye pressure was 26.0 mm Hg.

Disclosure: *The authors have no financial interest to declare in relation to the content of this article.*

Computed tomography revealed a right lateral ethmoid fracture, a right orbital blowout fracture, and OCF (Fig. 1).

Decompression was performed 10 hours post injury by opening the right optic canal. The optic canal was approached by performing a coronal dissection in front of the right ear (Fig. 2), cutting along the border of the sphenoid bone, and partially scraping away the sphenoid wing and zygomatic bone (Fig. 3). The optic nerve had some hematoma-like purpura when the bone fragments were removed. Lateral canthotomy was performed to obtain intraorbital decompression.

After surgery, the patient underwent steroid pulse therapy with 1,000-mg methylprednisolone/d/3 d. Thereafter, 30 mg/d/4 d prednisolone was given. Mannitol was also administered. On postoperative day 4, central scotoma was still observed but right visual acuity was 0.01. Sixty-four days after surgery, right visual acuity improved further to 0.2. Intraocular pressure was 16.0 mm Hg. Now 6 months after surgery, right visual acuity keeps 0.2.

DISCUSSION

The optic canal is 3.5 mm in diameter and 10 mm long. OCF arises when an external concussive force impacts the bone near the outer edge of the eye. This often leads to OCF because the optic nerve enters the orbit at approximately 45°. Consequently, OCF should be suspected if there is a wound on the outer side of the eyebrow. It can affect the optic nerve and cause visual impairment by either directly damaging the optic nerve, inducing hemorrhage in the narrow optic canal, or producing edema that compresses the optic nerve.

The craniotomy methods of optic canal release can be divided according to whether an intradural or epidural approach is used. Neurosurgeons usually release the optic canal from inside the dura after craniotomy. However, there are also 2 safe epidural methods: the Yang et al.[5] method involves anterior clinoid process resection with craniotomy whereas the Wada et al.[6] method involves peeling the cavernous sinus (the anterior clinoid process does not have to be removed). Our lateral approach is also an epidural method. The cavernous sinus remains intact after the sphenozygomatic suture is exposed if the bone is cut along the border of the sphenoid bone.[7] The anterior clinoid process at the inner end of the sphenoid lesser wing serves as an important surgical landmark because the anterior part of the anterior clinoid process usually lies about 5 mm out from the outer lateral optic canal wall. In our case, the bone fragments were located 8 mm out from the distal end of the anterior clinoid process. This made it easy to open the outer optic canal wall without having to remove the anterior clinoid process. By contrast, the other, more proximal, epidural methods require scraping away the sphenoid wing and anterior clinoid process to secure the operative field. This increases the risk of hemorrhage and postoperative CSF leak.

Our lateral method has several advantages over other methods: It involves less bleeding and CSF leak, the distance to the optic canal is relatively short once the sphenozygomatic suture is identified, and the fracture line can be confirmed directly if it lies on the outer optic canal wall. Thus, our method decompresses the optic canal as effectively as other methods but is safer.

In our case, surgery started 10 hours after injury. This may have promoted the good outcome because Emanuelli et al.[8] showed that short times between injury and surgery associate with better visual acuity recovery. Moreover, Mine et al.[9] showed that time to surgery correlated negatively with visual acuity improvement if the patients could still see hand movements preoperatively. Yang et al.[5] and Wada et al.[6] also recommend early surgical treatment.

Our patient was treated with steroid pulse therapy after surgery. This is common in traumatic optic neuropathy because steroids can reduce trauma-induced inflammation

Fig. 1. The computed tomography image taken shortly after injury. The red arrow indicates the bone fragments that were compressing the optic nerve.

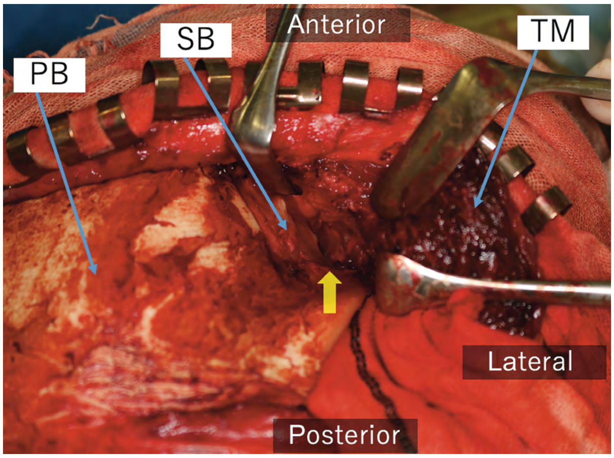

Fig. 2. The surgical method used to decompress the right optic nerve started with a coronal skin incision in front of the right ear. The yellow arrow indicates the bone fragments that were compressing the optic nerve. PB, parietal bone; SB, sphenoid bone; TM, temporal muscle.

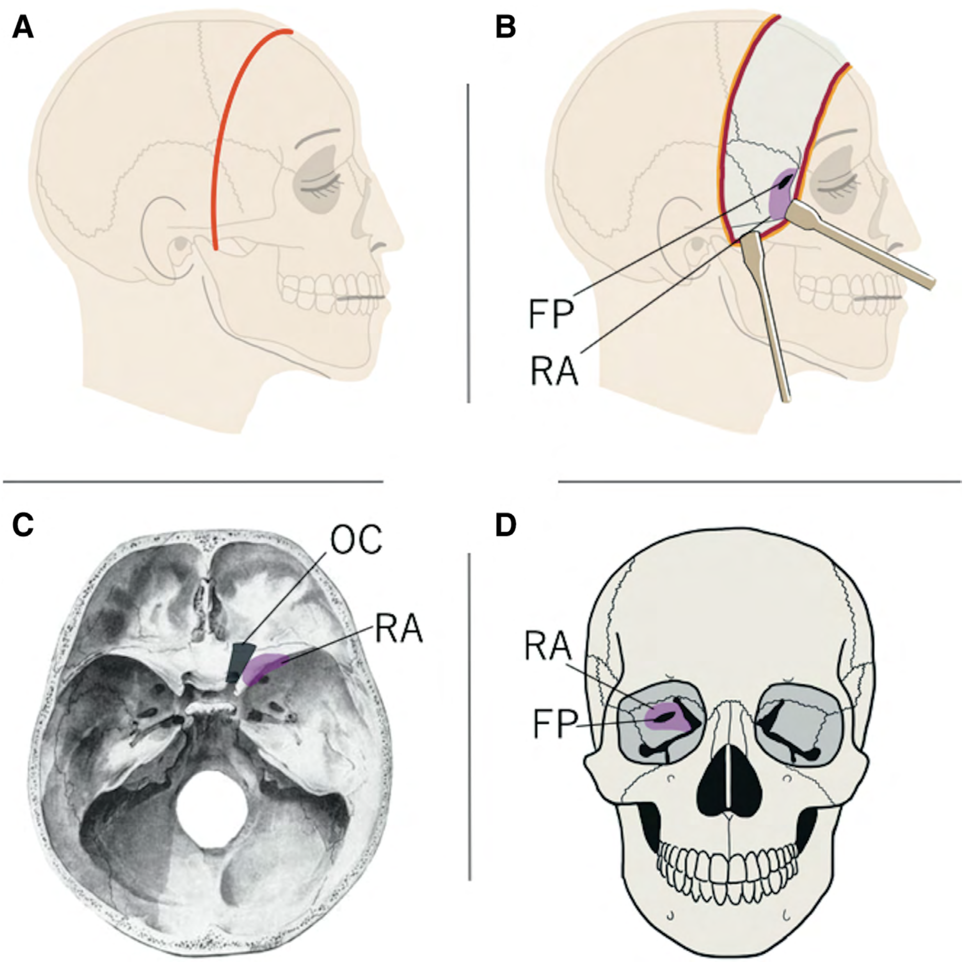

Fig. 3. A, Frontotemporal skin incision (lateral approach). B, The schema of partial sphenoidectomy. C, Positional relationships among the optic canal, the fracture point, and the resection area of sphenoid. FP, fracture point; RA, resection area; OC, optic canal.

and swelling and thus may prevent secondary injury to the optic nerve. This is supported by studies that suggest steroid treatment may improve visual outcomes in traumatic optic neuropathy. However, the evidence level for this intervention is weak.[10] Further studies are warranted.

SUMMARY

We describe an OCF case that was treated with a novel surgical decompression method and steroid pulse therapy. Visual acuity improved after surgery. The surgery was performed by plastic surgeons and involved a lateral epidural approach to the optic canal. Further studies on this method for OCF are warranted.

Yu Hokazono, MD
Department of Plastic, Reconstructive, and Aesthetic Surgery
Nippon Medical School
1-1-5 Sendagi, Bunkyo-ku
Tokyo 113-8602, Japan
E-mail: yuu-hokazono@nms.ac.jp

REFERENCES

1. Yanagi K. Optic nerve decompression. *Oto-Rhino-Laryngology, Tokyo* 2010;53:160–165.
2. Fujitani T. Intranasal optic canal decompression technique for traumatic visual disturbance. *Practica Otologica Pract Otol.* 1972;18:300–307.
3. Kawaguchi H, Makishima K, Kimitsuki T, et al. Diagnosis and management of optic canal fracture. *Otologia Fukuoka* 1988;34:1125–1128.
4. Rigante L, Evins AI, Berra LV, et al. Optic nerve decompression through a supraorbital approach. *J Neurol Surg B.* 2015;76:239–247.
5. Yang Y, Wang H, Shao Y, et al. Extradural anterior clinoidectomy as an alternative approach for optic nerve decompression: anatomic study and clinical experience. *Neurosurgery.* 2006;59(4 Suppl 2):ONS253–ONS262; discussion ONS262.
6. Wada K, Toyooka T, Otani N, et al. Two cases of traumatic optic neuropathy treated with modified extradural optic canal decompression surgery. *Neurosurg Emerg* 2015;20:215–219.
7. Abe H, lnoue T. Microsurgical anatomy of the cavernous sinus. *Jpn J Neurosurg (Tokyo)* 2008;17:656–665.
8. Emanuelli E, Bignami M, Digilio E, et al. Post-traumatic optic neuropathy: our surgical and medical protocol. *Eur Arch Otorhinolaryngol.* 2015;272:3301–3309.
9. Mine S, Yamakami I, Yamaura A, et al. Outcome of traumatic optic neuropathy. Comparison between surgical and nonsurgical treatment. *Acta Neurochir (Wien).* 1999;141:27–30.
10. Stunkel L, Van Stavern GP. Steroid treatment of optic neuropathies *Asia-Pac J Ophthalmol* 2018;7:218–228.