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CASE REPORT

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Surgical reconstruction technique of medial rectus muscle after endoscopic sinus surgery iatrogenic rupture – report of three cases*

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Abstract

Background: Medial rectus muscle (MRM) injury is an uncommon complication of endoscopic sinus surgery (ESS). The main objective of this study is to report a systematized surgical technique in the reconstruction of the MRM after EES injury.

Case presentation: The present study consists of a retrospective review of three cases of MRM injuries after ESS based on intra-operative observation with clinical and radiologic follow up. Three patients presented with total rupture of MRM after ESS and were surgically treated. To treat the lesion a multidisciplinary team composed by an ENT surgeon and an ophthalmologist used a combined approach that consisted of external and endonasal accesses.

Results: All three patients presented with clinical and radiological satisfactory outcomes in their follow-ups with the resolution of the diplopia and strabismus.

Discussion: In this series of cases, all ruptured MRMs were successfully retrieved by combined approaches. Early intervention, and identification of both stumps allowed a muscle-to-muscle anastomosis. The technique described provided a satisfactory aesthetic result.

Conclusion: Although the present study consists of a small sample supply, we describe a feasible surgical technique in the reconstruction of an MRM total rupture after ESS.

Key words: Medial rectus muscle, medial rectus muscle rupture, endoscopic sinus surgery complications, medial rectus reconstruction

Introduction

Endoscopic sinus surgery (ESS) has become the treatment of choice for surgically treated diseases of the nose and paranasal sinuses, with an expanding role in the management of the orbit and skull base diseases [(1)]. Ophthalmic complications due to ESS are not frequent and range between 0,2 to 0,58% [(2)].

Here we describe three cases of orbital complications after ESS, characterized by the total rupture of a medial rectus muscle (MRM). Additionally, we focused on detailing a feasible surgical technique involving a multi-professional team.

Methodology

Clinical data

The present study consists of a retrospective review of three patients with diplopia due to MRM lesions that were attended at the Felippu Institute of Otorhinolaryngology (FIO), São Paulo, Brazil. Data were collected from clinical charts, operative reports, and computed tomography (CT) exams.

Three patients; two females, aged 40 (patient 1), and 50 (patient 2); and one male, aged 28 (patient 3); presented with immediate post-operative diplopia after ESS due to chronic sinusitis. Con-

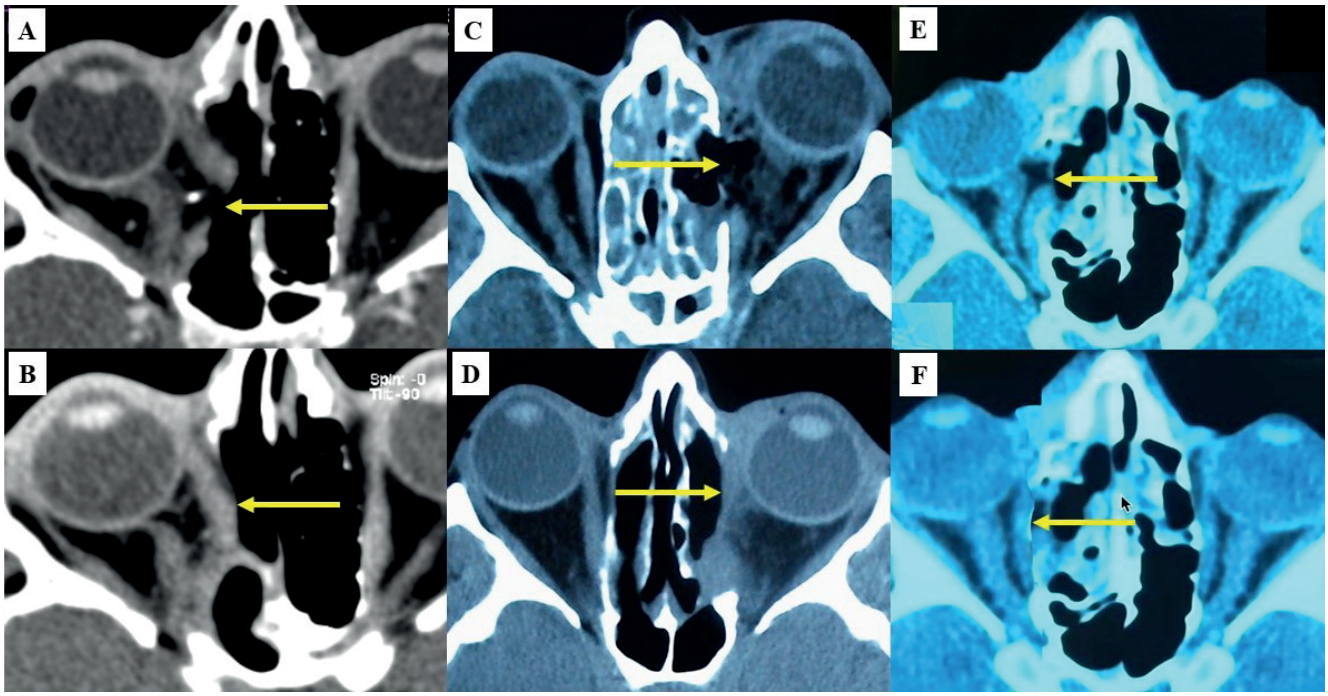

Figure 1. Pre and postoperative axial orbital CT scans. A. Patient 1 pre operative: ruptured right MRM (arrow); B. Patient 1 post operative: sutured right MRM (arrow); C. Patient 2 pre operative: ruptured left MRM (arrow); D. Patient 2 post operative: sutured left MRM (arrow); E. Patient 3 pre operative: ruptured right MRM (arrow); F. Patient 3 post operative: sutured right MRM (arrow).

ventional instrumentation was used in all previous ESS surgeries. Physical examination revealed right eye strabismus in patients 1 and 3; and left eye strabismus in patient 2. Sinuses CT exams showed a lesion of the MRM in the correspondent exotropia (Figure 1 A, C, E). Concern was raised towards the integrity of the optic nerve in patient 2, since the CT exam suggested a possible optic nerve lesion of the left eye. However, magnetic resonance imaging (MRI) scans evidenced optic nerve integrity (Additional Figure 1).

The therapy of choice was MRM reconstruction, and all injuries were approached by the same surgical technique. Early treatment of the lesions was preconized and was initialized in two to seven days after the complication. In one patient a weakening procedure on the antagonist lateral rectus muscle (LRM) was necessary due to an overcorrection of the eye caused by excessive fibrosis on the MRM.

Surgical technique

The technique consisted in an external approach performed by the ophthalmologist and progressed with the ENT surgeon finishing with an endonasal approach (Video 1). The ophthalmologist performed a medial transconjunctival incision followed by blunt dissection of the subconjunctival space and tenon´s capsule (Figure 2 A), exposed the MRM with a muscle hook (Figure 2 B), completely dissected the distal MRM stump and trimmed its posterior border to make it even. A single suture (3-0 Vicryl) on the posterior border of the distal stump was performed, preserving the suture line and needle (Figure 2 C). The distal stump was then introduced with the suture line and needle within the medial periorbital space so it could gain access to the nasal cavity (Figure 2 D). At this moment, the endonasal approach began. The ENT surgeon then performed a complete ethmoidectomy with exposure of the medial wall of the orbit and the ethmoid roof followed by identification of the orbital lesion. Then, the remaining papyraceous lamina was removed with exposure of the periorbita and its incision (Figure 3 A, B). These procedures allowed access and dissection of the proximal MRM stump (Figure 3 C) in the orbital apex after identifying the posterior part of the superior oblique muscle. The anterior border of the proximal stump was trimmed to even out the extremity. After that, to approximate the distal stump towards the proximal stump in the periorbital space the ophthalmologist medialized the eye with the use of forceps (Figure 3 D). The stump ends were anastomosed with a single "U" suture using the suture line and needle previously prepared and introduced in the nasal cavity (Figure 3 E, F). The eye was kept in the anatomical position during the anastomotic suture to control the position and tension of the suture (Figure 4 A, B). In one case, we had to weaken the LRM by incising some muscle fibers so we could adjust the overcorrection of the eye.

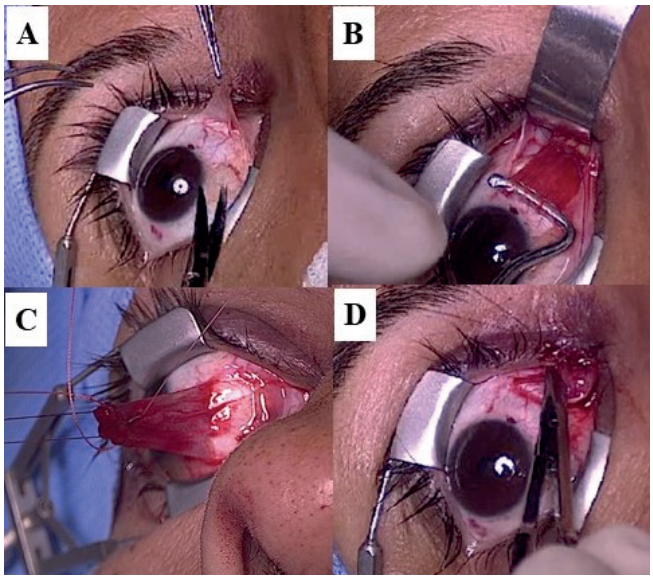

Figure 2. Ophthalmologic approach of the right eye. A. Transconjunctival incision; B. Isolation of the MRM with a muscle hook; C. Placement of a single suture on the posterior end of the distal stump. D. Introduction of the distal stump with the suture line and needle in the nasal cavity through the periorbital space.

Results

Patients follow-ups consisted of static (Figure 5 A, B, C, D) and dynamic clinical evaluation of the eye. Each patient presented with progressive clinical improvement of the strabismus. The follow-up times were eight years for patient 1, thirteen years for patient 2, and five years for patient 3. Postoperative control sinuses CT exams showed the reconstructed MRMs (Figure 1 B, D, F). It was noted that patient 2 postoperative CT scan (Figure 1 D) showed an inferior result of the MRM reconstruction when compared to the other patient´s postoperative CT scans (Figure 1 B, F); we attribute this to the fact that more muscle mass was lost in the previous ESS procedure when compared to the other patients. Nevertheless, this did not prevent surgical reconstruction from being executed; and since the patient presented with a satisfactory postoperative outcome, no extra imaging was necessary. Indeed, all patients presented with satisfactory esthetic results with some degree of functional improvement after surgery.

Discussion

Recent studies verify that the most common injured extraocular muscle after ESS surgery is the MRM [1-16]. Nonetheless, the overall incidence of MRM lesions is difficult to determine due to its

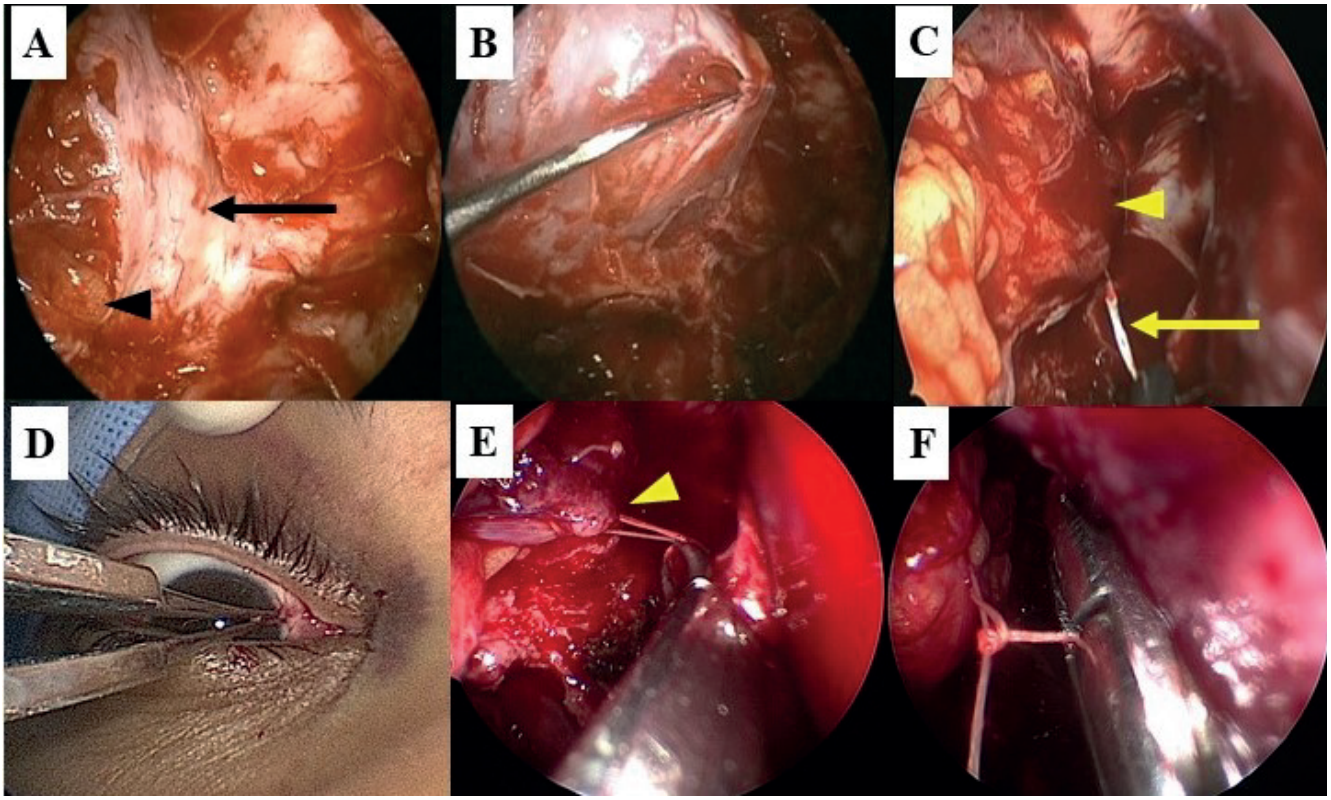

Figure 3. Endonasal approach on the right nasal cavity. A. Periorbita (black arrow) and periorbital fat (black arrowhead) evidencing perirbital injury from previous ESS surgery; B. Incision and dissection of the residual periorbita; C. Exposure and insertion of a single suture in the anterior end of the proximal MRM stump (yellow arrowhead) and suture needle (yellow arrow); D. Medialization of the orbit to facilitate approximation of distal and proximal stumps; E. Approximation of the distal MRM stump (yellow arrowhead) in the nasal cavity; F. Both ends of the ruptured MRM were sutured.

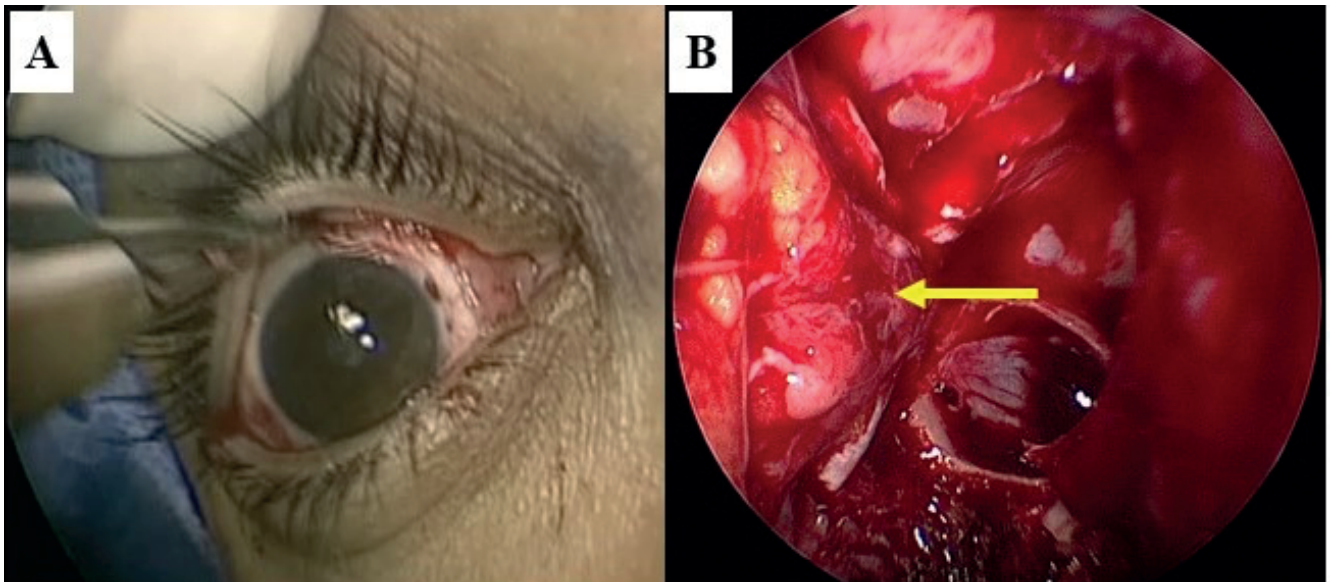

Figure 4. Final result after the MRM anastomoses. A. Eye in anatomical position so that correct tension should be given to anastomosis suture; B. The result of suturing (arrow).

uncommon occurrence and because they could be underreported. Most of these studies consist of case reports or small series with limited patient follow-up or treatment details, especially regarding a surgical technique [4-13,15-19]. Therefore, the present study focused on describing a systematized surgical technique for the reconstruction of a total ruptured MRM after ESS.

Orbital imaging is essential for discerning the extent and nature of the orbital injury, including extraocular muscles, optic nerve, orbital wall defect, and hemorrhage [6,12]. In the present study, CT scans efficiently diagnosed the bony defect on the medial orbital wall and the discontinuity of the injured MRM on all patients. MRI scans were essentially important in patient 2 since it allowed a more detailed evaluation of the optic nerve's integrity.

MRM injury can cause great patient morbidity, such as diplopia and disorders of the eyeball movement [7,10,14,15]. The largest study to date in ESS MRM related injuries [11] reported 30 cases where they identified four common patterns of muscle injury: pattern I, complete MRM transection; pattern II, partial MRM transection; pattern III, intact and mildly contused MRM with entrapment; and pattern IV, intact and mildly contused MRM without entrapment. Pattern I and II injuries did not result in improved ocular alignment or motility when patients were submitted to clinical treatment alone, reinforcing the importance of surgical treatment in complete transection MRM lesions.

Although, some studies advocate for initial clinical management of extraocular injuries after ESS [12,13], in the present study, management of the injured MRM was essentially surgical. Surgical management of MRM injury seeks to not only restore the adduction function of the muscle itself, but also to limit the fibrosis and contractile forces experienced by the antagonizing extraocular musculature. Transection of the MRM warrants immediate or early orbital exploration in hopes of identifying and retrieving the distal and proximal muscle stumps. In this scenario, a variety of approaches exist to recover the transected MRM, such as, transconjunctival or transcaruncular access, anterior and medial orbitotomy or a trans nasal endoscopic approach; and to restore muscle function, such as, muscle transposition, muscle-to-muscle anastomosis using an interposition graft or hang-back adjustable sutures. It is worth mentioning that traditional surgical methods, including vertical muscle transposition, commonly result in complete recurrence of exotropia and increase risk of anterior ocular ischemia [1]. Furthermore, medial orbitotomy approaches may result in a non-aesthetic scar to the patient's face.

Usually, strabismus surgical approaches alone are recommended for the treatment of MRM injuries [1]. In fact, only 4 patients in the various studies reviewed were treated with a combined ophthalmological and endonasal approach [14,18,19].

The present study highlights the benefits of using the combined approach. While the ophthalmologist isolates the distal stump, which is usually not accessible by an endonasal approach, the ENT surgeon isolates the proximal stump through the orbit's medial wall [20], which is usually not accessible by conventional strabismus surgical approaches [17-19]. This is possible because the proximal stump is usually more preserved than the distal stump in this type of injury. We believe this occurs because of how the nasal sinus tissues are handled during the ethmoidectomy. When performing ethmoidectomies, there is a tendency to execute traction movements with a posterior to anterior orientation, causing tearing in the anterior portion of the MRM. In contrast, the posterior portion remains in place. Additionally, the ophthalmologist performs a crucial step in the surgery, reversing the strabismus with a partial and controlled rupture

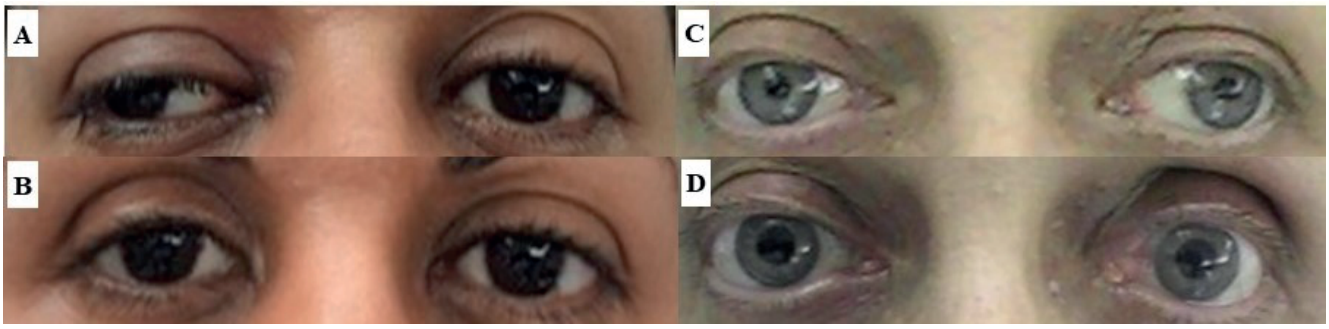

Figure 5. Clinical evaluation. A. Patient 1 pre operative: extropia of the right eye caused by a total rupture of the right MRM; B. Patient 1 post operative: correction of the right eye extropia after MRM reconstruction; C. Patient 2 pre operative: extropia of the left eye caused by a total rupture of the left MRM; D. Patient 2 post operative: correction of the left eye extropia after MRM reconstruction.

of the antagonist's muscle. In this series of cases, all ruptured MRMs were successfully retrieved by combined approaches. Early intervention, and identification of both stumps allowed a muscle-to-muscle anastomosis. The technique described provided a satisfactory aesthetic result, since a medial orbitotomy incision was not necessary.

It is worth notice that the reconstruction of the MRM could be done intraoperatively. In such a situation, the presence of an ophthalmologist specialized in strabismus surgery would be necessary, as he is responsible for isolating the distal stump and exposing it into the nasal cavity while forcefully medializing the orbit. This allows the ENT surgeon to perform the muscle anastomosis with the least tension possible.

In our observations, muscle rupture was diagnosed post operatively when patients presented with diplopia. In this case, we believe that the perfect timing for surgical reconstruction of the ruptured MRM is in the following 72 hours after the injury. Early intervention of MRM injuries seems to be the best approach since over time there is a retraction of the proximal stump and the presence of more fibrous and scar tissue involving the MRM making it difficult to isolate and suture the muscle ends [6,7,11,14,17,19]. Also, the lack of surgical landmarks and the protrusion of orbital fat into the field of view of the surgeon contributes to hampering access to the proximal MRM stump when a standard strabismus approach alone is used [18,19]. In fact, we observed that the delay in muscle reconstruction leads to greater surgical demands since the stumps progressively distant from each other. We believe that early reconstruction could lead to better results since muscle function will probably not be regained once it has suffered full separation and a gap is created between the proximal and distal stumps.

With the use of powered cutting instruments, the risk of severe injuries is even more concerning. As the microdebrider offers minimal tactile feedback, many minor orbital injuries, which would ultimately prove to be trivial when using conventional instruments, turn into significant complications when using powered dissection [3,4]. We believe that, when evaluating treatment choices for patients who underwent MRM injuries using a microdebrider, the main concern is to correctly diagnose whether there is a partial or a total rupture of the MRM. In total rupture injuries, we recommend the combined approach described in the present study. In cases of partial ruptures, alternative approaches could be considered. Even though powered cutting instruments were not the underlying cause of MRM injuries in the present study, the microdebrider was responsible for a partial lesion of the left MRM after ESS surgery in another patient attended at FIO. In this case, diplopia was treated with an injection of botulinic toxin in the left LRM by the ophthalmologist with satisfactory patient outcomes.

Furthermore, it is important to emphasize that a multidisciplinary approach, with an ophthalmologist specialized in strabismus surgery and an ENT surgeon with rhinology expertise, is necessary.

Conclusions

It is not well established in the current literature the surgical approaches to MRM reconstruction after a total rupture due to ESS complication. We conclude that although the present study consists of a small sample supply, we achieved satisfactory esthetic results with some degree of functional improvement. The surgical technique described in this study proved to be feasible. Nevertheless, future studies and research aimed at this type of injury and surgery are necessary.

List of abbreviations

EES: endoscopic sinus surgery; MRM: medial rectus muscle; CT: computed tomography; LRM: lateral rectus muscle; ENT: ear nose and throat.

Acknowledgments

Not applicable.

Ethics approval and consent to participate

Not applicable.

Authorship contribution

AF: operating ENT surgeon, collected, analyzed, interpreted patient data, and manuscript preparation; MG: operating ophthalmologist; EBF, BBO, DSRJ, AWDF, AWDF, FC: collected patient data and manuscript preparation. All authors read and approved the final manuscript.

Conflict of interest

The authors declare that they have no conflicting interests.

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Not applicable.

Consent for publication

Written informed consent for publication of their clinical details and images was obtained from the patients.

Availability of data and materials

Not applicable.

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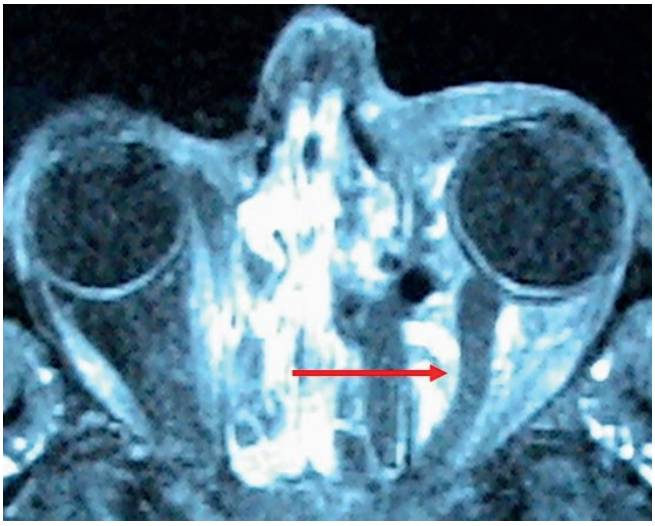
ADDITIONAL FIGURE



Additional Figure 1. MRI demonstrating the intact optic nerve (arrow) in the left eye in patient 2.