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Dean van der Westhuizen*, Anthony Murray, Hamzah Mustak and Nagib du Toit

Groote Schuur Hospital, University of Cape Town, South Africa

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***Corresponding author:** Dean van der Westhuizen, Division of Ophthalmology, Faculty of Health Sciences, University of Cape Town, 7935 Observatory, Cape Town, South Africa, Tel: 905309302205; E-mail: deanandrevdw@gmail.com; vwsdea001@myuct.ac.za

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Case report

Isolated Rupture of the Superior Rectus Muscle following Blunt Trauma – A Case Report

Abstract

We report the rare case of a left isolated superior rectus muscle (SRM) rupture due to a bizarre mechanism of injury, where a universal serial bus (USB) flash drive entered the orbit during a motor vehicle accident leading to rupture of the SRM 7mm from the limbus. The proximal stump was relocated and reattached using a non-absorbable hangback suture. Post-operatively the patient had a residual 5 prism diopter left hypotropia (LHoT), which allowed for fusion in primary, with a slight chin up position, as well as downgaze. The globe, eyelids and orbit were spared of injury and orbital fractures were absent. We discuss our experience and surgical management of the case, which included locating the lost muscle and repairing it primarily in preference to a transposition.

Introduction

Isolated traumatic injury to an extraocular muscle is rare [1]. Even rarer is an isolated rupture of a SRM in the absence of a globe injury or orbital fractures [2-4]. We report a case of a muscle belly rupture/laceration as a result of a combination of blunt/sharp trauma from the bizarre mechanism of injury where a USB drive entered the orbit during a motor vehicle accident. We will also briefly discuss our approach to surgical management of the resulting “lost” superior rectus where we were able to find a reattach to the globe which was preferred to a transposition procedure.

Case Report

A healthy 36-year-old female, with no relevant past ophthalmological, medical or surgical history presented to Groote Schuur Hospital casualty a day after being involved in a motor vehicle accident as a passenger. She was unrestrained and seated behind the driver of a mini-bus taxi which collided, head on, with another vehicle. The patient went over the drivers’ shoulder and hit a USB flash disc that was protruding from the radio in the Taxi’s dashboard.

On initial presentation her vision wash 6/6 vision in each eye, with no relative afferent pupil defects and normal fundal examination. She had periorbital swelling and mild ecchymosis but no eyelid lacerations. There were no signs of a scleral laceration or occult globe rupture. Her Glasgow coma score

(GCS) was never compromised and no other cranial nerves or neurological signs were elicited. The conjunctiva was diffusely injected and chemotic. She had a 9mm conjunctival laceration resulting in a superior conjunctival flap that was draped over the cornea.

On examination of her eye movements she had a marked left elevation and abduction deficit. Her LHoT was coupled with an inability to initiate any saccadic movement in upgaze. Forced duction test showed no restriction to supraduction and force generation testing indicated a negligible restriction to inferior movement when the patient was requested to supraduct the eye [4]. Versions can be noted in figure 1.



Figure 1: Preoperative versions showing an elevation and abduction deficit on the left.

The patient had a CT brain and orbits done which indicated a disruption of the SRM posterior to the equator of the globe. No orbital fractures, muscle entrapment, intra-ocular foreign bodies were noted.

Four days post injury the patient had an examination under anesthesia, a 9mm superior conjunctival laceration was noted and the superior rectus was found to be completely transected and bunched up at the insertion. The distal stump of superior rectus was approximately 7mm long as can be noted in figure 2. A failed attempt was made to try and find the proximal stump at this time, and the conjunctival laceration was sutured. The lateral rectus muscle (LRM) was isolated and found to be intact.

The patient was referred to the strabismology service and a second procedure was carried out on day 8 post injury, to retrieve the proximal stump. An operating microscope was used, allowing both the primary surgeon and assistant the same view of the surgical field. The proximal muscle stump was found using a direct anterior conjunctival approach. The SRM sheath was identified by tracing the intermuscular septum from the LRM and medial rectus muscle (MRM). Once identified, the sheath was held open, the proximal SRM stump was found within the sheath [4-6]. The proximal end reattached using a non-absorbable (5/0 ethibond, Ethicon) hangback suture [1]. The tension of the suture was adjusted until the eye remained in the primary position guided by the springback tests [5].

One month post operatively her elevation deficit was reduced to -2 with no diplopia in the primary position. She was found to have a 5 prism diopter (PD) LHoT in primary, 20 PD LHoT in upgaze and 4 PD LHoT in down gaze (Figure 3). Her left abduction deficit was still present but continued to improve. The abduction deficit was thought to be due to neuropraxia or myopraxia as the muscle was found to be intact intraoperatively.

Discussion

This case was of particular interest firstly due to the bizarre nature of the mechanism of injury (USB stick) but also because rupture/laceration of the SRM occurs very rarely [7]. When it does occur, it is usually associated with injury to the globe, and orbital fractures [8,9]. The globe and bony orbit were

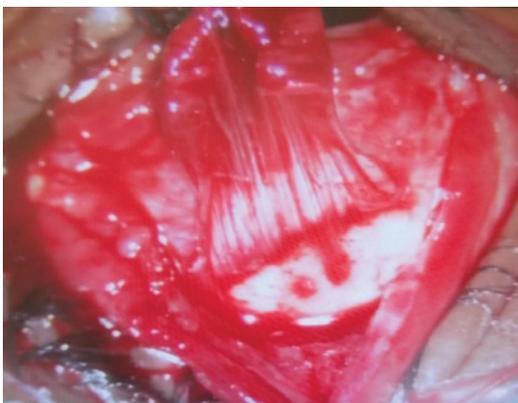


Figure 2: Intraoperative picture showing superior rectus tendon and insertion intact with ruptured muscle belly.



Figure 3: Versions observed one month post operatively. Elevation deficit improved but still present. Left abduction deficit improved.

spared in this case. The most common causes for traumatic rectus muscle rupture are due penetrating trauma with a metal hook or iatrogenic during endoscopic sinus surgery [7]. The inferior and medial rectus muscles are by far the most commonly traumatized muscles [5,7]. This may be due to the Bell's phenomenon that would occur peri trauma, directing the eye upwards and outward, thereby exposing the inferior and medial rectus muscles. It may also be related to these muscles inserting closest to the corneoscleral limbus [2]. The medial rectus is also one of the more commonly operated on rectus muscles in strabismus surgery, putting it at higher risk of being lost [6].

Diplopia and strabismus are common occurrences post trauma but usually result from direct muscle injury, orbital fractures with entrapment, neuropraxia or cranial nerve palsies. It is important to exclude all of the above before considering the much rarer cause of a lacerated or ruptured muscle [3]. Correction of a post traumatic strabismus is often delayed to allow any recovery to occur and then plan surgery accordingly. This would be an inappropriate approach in the case of a lacerated or ruptured muscle [3]. In the case of a ruptured muscle one should attempt to repair the muscle at the earliest convenience, as waiting months would cause the antagonist to contract, further retraction of the lost muscle and scar formation would also occur, which may make finding the muscle difficult and therefore treating diplopia more challenging. This highlights the importance of the CT scan in evaluating the patient with post traumatic diplopia and to keep a high index of suspicion. That being said, consideration must still be made regarding the ideal timing of surgery as edema and bleeding can make surgery challenging in the acute setting. One could consider the use of steroids and delaying surgery.

Parks originally described the difference between lost and slipped muscles, "lost" muscles being those in which the muscle and capsule are completely detached from the sclera, while a slipped muscle is one that retracts within its sheath, while the capsule remains attached to the sclera [6,10]. Rectus muscles that are traumatically injured are usually easier to find than those that are "lost" or have "slipped" following elective muscle surgery [4-6,8] as the injured muscle often retains some fascial attachments and not all muscle fibers

may be ruptured. As noted in figure 2, in our case the SRM had no remaining intact muscle fibers and has been completely transected.

Finding the “lost” muscle required identifying the adjacent lateral and medial rectus muscles and tracing the intermuscular membrane toward the “lost” superior rectus, then identifying the capsule / sheath which was held open and explored to identify the proximal end of the muscle within [3–5].

An adjustable suture is preferred to reattach a “lost” muscle for a few reasons [5]. Firstly if there is a delay between injury and repair the ipsilateral antagonist may become contracted, exacerbating the duction deficit [3,4]. In this case the muscle was found at the second procedure so some inferior rectus contraction may have occurred already. A ruptured muscle may rupture some distance from its insertion as in this case, which means one would essentially be advancing the shortened stump, and inadvertently strengthen the muscle if reattached at the insertion, which is why an adjustable suture is advocated. Alternatively, the eye can be adjusted to orthophoria in the primary position using the springback test to guide appropriate position [5,11]

Fortunately, we were able to find the proximal muscle using an anterior conjunctival approach. The superior rectus had ruptured 7mm from the insertion which generally makes locating the proximal stump difficult. Other approaches; Medial wall sub periosteal approach; Orbital wall internal periosteal surface approach; Trans nasal endoscopic retrieval [4,12], are alternative options if unable to locate a “lost” muscle using an anterior conjunctival approach although we considered these options, they have limited use when working on the SRM. In a series of 34 cases in China the ruptured muscle was found using a routine anterior conjunctival approach in 19 patients, 4 patients required a transcutaneous superior orbitotomy [7].

Transposition rather than attempting to find a lost muscle is an option, as it is technically easier and more predictable, but transpositions are usually guarded as less effective which may result in a smaller field of binocular single vision [12]. Both options normally establish orthophoria in the primary position. If one is unable to retrieve the muscle by any of the above approaches then a transposition is a feasible although inferior alternative [3,5]. In this case one would could consider weakening the antagonist (IRM) and doing a transposition of medial and lateral rectus muscles [2,7] (Jensen; modified Jensen), keeping in mind that one may induce anterior segment syndrome if 3 muscles are removed from their insertions. In our case there was also an abduction deficit, which excluded a transposition as an option, which further increased our preference for finding the muscle.

There are circumstances where a transposition may potentially be a preferred option. If the proximal stump is no longer functional then finding and reattaching the muscle would have no benefit. Determining this clinically is impossible and dynamic CT and MRI imaging can be very helpful in assisting with this decision [4,5]. Imaging the muscle during different sustained positions of gaze may determine if the

proximal stump is functional. The nerve supply to the superior rectus enters at the junction between the middle and posterior third of the muscle [13], injury at this point, or posterior to this point, would lead to a neuropraxia. If there is paralysis of the proximal stump retrieving it may provide a superior anchor allowing for orthophoria, but a transposition may give a better functional effect.

When attempting to locate a lost muscle it is important to stress the value of using an operating microscope, and having 1 or 2 assistants who have the same view as the primary surgeon [4,5]. This ensures adequate retraction which aids in identification and manipulation of the lost muscle. An important tool in assisting with identification of a lost muscle is the oculocardiac reflex [6,7,12,14]. When pulling on the proximal stump of muscle one should illicit the oculocardiac reflex causing a parasympathetic response and hence a bradycardia. It is important that atropine is withheld from the patient pre or intra-operatively as this would dampen this response. Although this is not a fool proof method it is a very useful finding if elicited.

The primary goal of surgery is to provide diplopia free vision in primary and when possible, downgaze. We were successful in this endeavor although the patient still has a residual but resolving horizontal deficit. If there is no further recovery to abduction then further surgery may be required. Prisms, chemodenervation with botox, and further surgeries may be required for a residual or consecutive tropia, so close follow up is essential. It is suggested that a reattachment procedure should be done at about 7–10 days after the injury for best results [14], in this case the repair was done on day 8 post injury, which lead to an outcome that the patient was happy with.

Conclusion

Lost muscles are a rare occurrence post trauma and a high index of suspicion coupled with a good clinical examination which includes; forced ductions and force generation testing, supplemented by a CT scan will ensure the diagnoses is made. Surgery may be challenging but the proximal stump is often found using a standard anterior conjunctival approach, by following the intermuscular septum which is often intact post trauma. Using an operating microscope with one or more assistants is valuable in finding the lost muscle which should be prioritized over doing a transposition procedure which has inferior outcomes. Adjustable sutures are preferred, and using the springback test intraoperatively aids in determining the correct placement of the injured muscle.

Patient consent

The patient has consented to the publication of the above case and images relating to the it.

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