

Inferior rectus muscle palsy with constant diplopia following orbito-facial trauma

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Abstract

Aim: To present the management and outcome of a case of severe orbito-facial trauma secondary to an angle grinder injury that resulted in an isolated inferior rectus palsy, orbital soft tissue sequelae and constant diplopia.

Methods and results: A functionally useful field of binocular single vision (BSV score = 45%) centred around the primary position was achieved following three surgical procedures and much interdisciplinary communication during surgical planning and rehabilitation.

Conclusion: The resolution of constant diplopia coupled with a reduced, central field of BSV sufficient to enable daily living activities may be a 'best' outcome and potentially achievable goal in similar trauma-associated strabismus entities.

Key words: Angle grinder injury, Faden operation, Inferior rectus trauma, Inverse Knapp procedure, Orbital fracture

Introduction

Injuries from an angle grinder are common, with 6027 incidents in the UK in 2002 alone. However, traumatic inferior rectus muscle palsy in association with major orbito-facial trauma is rare. The case highlights the complexities of managing injuries spanning three surgical disciplines and outlines a management strategy for diplopia, resolution of which was achieved in this case.

Case report

A 62-year-old man presented following a domestic angle grinder injury to his face that caused full-thickness soft tissue lacerations, bony injuries extending from a breach in the posterior wall of the frontal sinus, without a cerebrospinal fluid leak, to the left medial canthal area, involving the eyelids, canalicular system, medial orbital wall and floor, left maxillary region communicating intra-orally, severed facial artery and parotid duct, and a left comminuted mandibular angle fracture. There was

no globe injury. Primary exploration, debridement and repair were undertaken urgently by maxillo-facial, neurosurgical and ophthalmic oculoplastic surgeons (Fig. 1A). The orbital wall fractures were complex and not repaired as part of the primary procedure as there was no evidence of muscle entrapment.

Following initial repair, the patient had constant diplopia in all positions of gaze; a marked primary position left hypertropia (LHT) that measured 45–50 prism dioptres (Δ) on cover test, and marked soft tissue orbital and eyelid swelling. The right eye movements were normal. He wore a patch over his left eye to avoid constant diplopia.

Seven months after the injury the patient still had constant diplopia, and permanently wore a left occlusive eye patch. His visual acuity was 6/6 and 6/9 in the right and left eyes, respectively.

He had an incomitant strabismus that measured 35 Δ LHT and 10 Δ exotropia in the primary position (Fig. 2A), achieving binocular single vision (BSV) on neutralising the vertical deviation, with a gross (–4) under-action of the left eye on attempted depression and normal pupil responses. The patient achieved BSV in elevation by introducing an 8 Δ base down prism over his left spectacle lens. On extreme elevation the deviation reversed to a minute LHT. There was a minimal restriction of the left eye to elevation (–1) on force duction testing. His deviation increased to >50 Δ LHT in downgaze where a force generation test indicated very slight residual inferior rectus function. There was a minimal under-action of the left eye on abduction with normal force duction testing and full adduction (Fig. 2A; Fig. 1B, C).

The patient underwent a left inverse Knapp procedure^{1–3} augmented with Foster sutures⁴ 7.5 months after the original trauma.

Some 6 months later, he had a residual incomitant deviation with a central field of BSV without prism, measuring at 6 metres in forced primary position 3 Δ of esophoria and 2 Δ of left hyperphoria (Fig. 2B) that extended some 25° into elevation, right and left gaze and some 20° into depression associated with a –3 under-action of the left eye to elevation and depression and –1 to abduction and full to adduction (Fig. 3, Hess chart).

To maximise his BSV field, the patient underwent surgery to the normal right eye, 8 months after the left augmented inverse Knapp procedure: a right medial rectus recession of 3 mm and a Faden suture at 18 mm from the limbus, and a right inferior rectus Faden suture at 18 mm from the limbus. He was aware of a functional

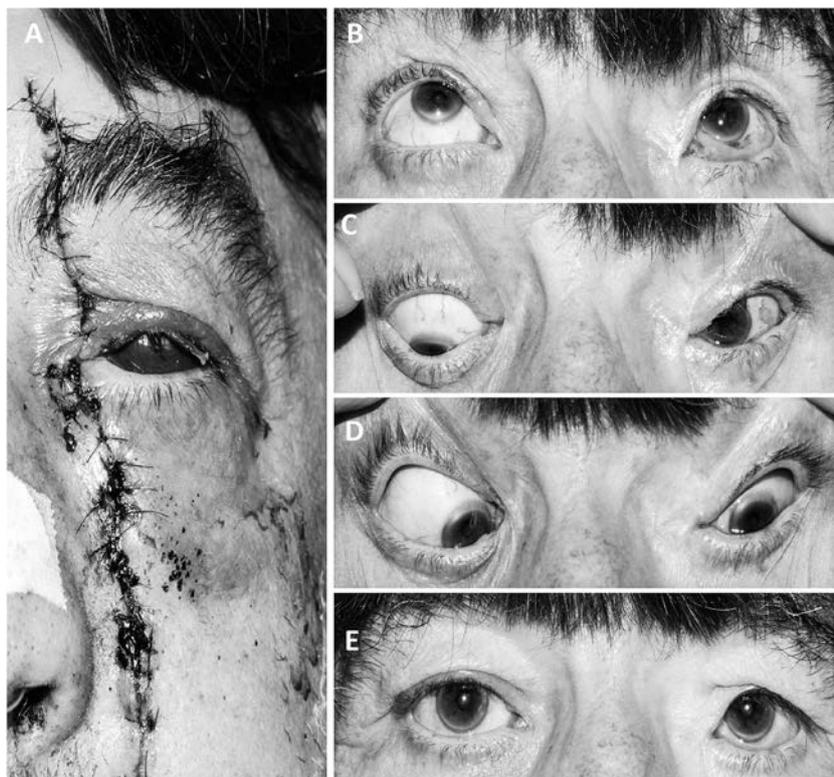


Fig. 1. (A) The patient's face following primary exploration, debridement and repair. (B) Mild impaired elevation of the left eye pre-operatively. (C) Inability of left eye depression pre-operatively. (D) Mild impaired left eye depression post-operatively. (E) The post-operative primary gaze position.



Fig. 2. Alternate prism cover test measurements in the five cardinal positions of gaze. (A) Before the inverse Knapp procedure. (B) Before the Faden procedure. (C) After the Faden procedure. E, esophoria; ET, esotropia; LH, left hyperphoria; LHoT, left hypotropia; LHT, left hypertropia; XT, exotropia.

improvement/expansion primarily horizontally and this was associated with a minor under-action of the right eye on adduction (Fig. 2 C; Fig. 1D, E). His field of BSV extended 25° into elevation, 20° into depression, 30° into right gaze and 40° into left gaze (Fig. 3; BSV score = 45%).

Comment

This case highlights an unusual presentation of traumatic inferior rectus weakness where interdisciplinary communication was essential for surgical planning and rehabilitation. The patient's strabismus was successfully but incompletely corrected with a primary augmented inverse Knapp procedure,^{1,2} following careful evaluation of the underlying muscle dysfunction and of the severity of any underlying orbital tissue restriction.

His strabismus was mainly secondary to a near-total isolated traumatic left inferior rectus palsy, where the

residual function, albeit minimal, was beneficial in optimising his field of BSV in depression. Globe elevation was reduced following the transposition procedure due to pre-existing mild (-1) restriction to elevation coupled with the innate effect of the transposition procedure.² The result was a balanced, limited but functional field of diplopia-free vision centred on the primary position. The inverse Knapp procedure can correct 15–25^Δ of hyper-deviation in the primary position and as much as 30–35^Δ in downgaze.² The extent to which Foster sutures enhance the procedure is unclear from the literature, but up to 35^Δ of forced primary position vertical was corrected in our patient (Fig. 2A, B).

A Faden operation in the normal eye was utilised to reduce the incomitant downgaze, vertical and left gaze esodeviation, where the primary position alignment was one of orthophoria. This operation tends to be more effective when the contralateral yoke muscle(s) have

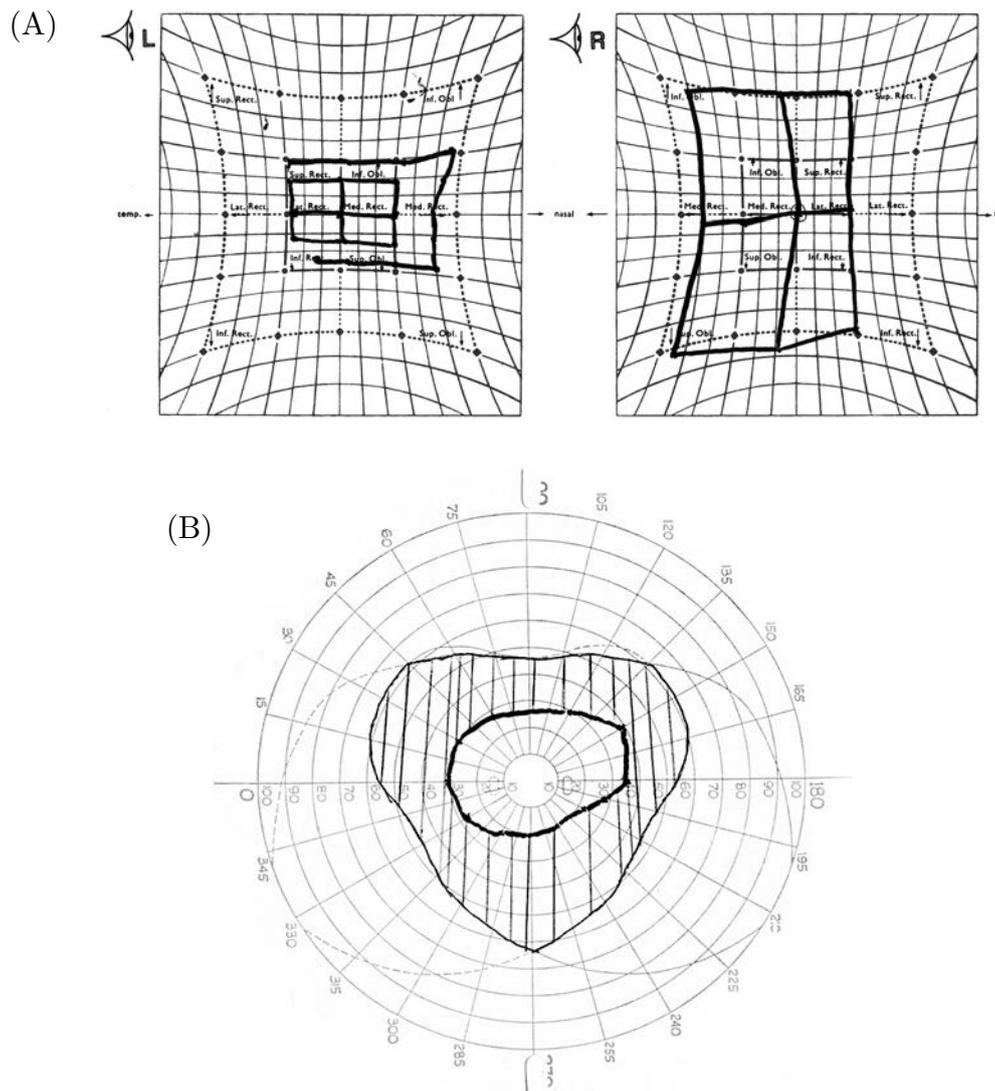


Fig. 3. (A) Hess chart after the inverse Knapp procedure. (B) BSV (central area) and diplopia (hatched area) after the Faden procedure.

some function and are not mechanically limited.⁶ In our case, it led to a functional expansion of the BSV field in left gaze and to a lesser extent in depression where the left inferior rectus had little residual active contractility.⁶

The precise aetiology of the inferior rectus muscle weakness is speculative, but the inferior division of the oculomotor nerve branches just inside the orbital apex into three separate roots that travel medially to the medial rectus muscle, laterally to the inferior oblique muscle and ciliary ganglion, and inferiorly to the inferior rectus. The findings at the patient's initial orbital surgery, integrity of the inferior rectus and the subsequent pattern of extra-ocular muscle weakness implicate isolated direct trauma to the nerve to the inferior rectus muscle as a possible mechanism.⁵ The inverse Knapp procedure with or without augmentation can correct up to 35^A of distance primary position hypertropia^{1-3,7} in isolated traumatic near-total inferior rectus palsy with mild mechanical restriction to globe elevation. Faden procedures on contralateral healthy yoke muscles, as in our patient, can offer an enhanced

but variable functional effect that is dependent on the degree of under-action of the weakened agonists and represent an important supplementary procedure when managing complex post-traumatic parietic strabismus.

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