



Ab-interno trabeculotomy with Kahook dual blade in secondary traumatic glaucoma in a child

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ABSTRACT

Purpose: To report a successful ab-interno trabeculotomy with Kahook Dual Blade (KDB) in secondary traumatic angle recession glaucoma in a child and discuss the possible mechanisms of action.

Observations: A 7 years-old boy presented, after a blunt trauma in the left eye, with angular recess surroundings 110° and concomitant intra-ocular pressure (IOP) elevation around 35 mmHg, despite the maximum topical and systemic ocular hypotensive therapy. As there was no glaucomatous neuropathy yet, a KDB ab-interno trabeculotomy was performed. After KDB's surgery, oral and topical hypotensive medications were gradually withdrawn until complete suspension with IOP levels around 11 mmHg, which has remained the same in the last 2 years. Both functional and structural assessment of glaucoma have maintained stable throughout the follow-up until the present moment.

Conclusion and Importance: The KDB has demonstrating a favorable safety profile and a useful surgical technique that should be considered mainly in trabecular glaucomas, as well as those secondary to trauma. Studies are still needed to define which patient and glaucoma profile are the most suitable for the procedure and for how long it is effective.

1. Introduction

Eye trauma in children is a significant cause of morbidity and one of the main causes of unilateral non-congenital visual impairment in children.^{1,2} This is due to several causes for instance secondary glaucoma, which may represent up to 30% of those in the pediatric group.³ Another important issue is that Post-traumatic sustained intraocular pressure (IOP) elevation is more common when the injury occurs in a closed globe (CGI).²⁻⁴ About 2/3 of post-traumatic glaucoma occur after CGI, while the remaining third occurs in open globe injuries.⁴ In general, topical treatment is necessary in 2/3 of the eyes and 1/3 may require surgery.³

Blunt trauma can cause direct or indirect damage in some ocular structures as iris, ciliary body and trabecular meshwork (TM) or also cause TM mechanical obstruction by hyphema or pigment.¹⁻³ Structural damage in TM usually leads to a breakdown of the TM lamellae leading

to an internal homeostasis breakdown of the eye and IOP rise in 7–9% of the cases.^{2,4} The IOP elevation can be transient or prolonged, predisposing the development of glaucomatous neuropathy.⁴ When this increase lasts short period of time or does not reach pressure levels that compromise the ganglion cells, this phenomenon is not considered glaucoma but a transient IOP increase event.²

The main treatments reported in the literature for IOP control after eye trauma in children are use of topical ocular hypotensive medications, surgical intervention for hyphema drainage, trabeculectomy with mitomycin-C, traumatic cataract surgery combined or not with trabeculectomy and implantation of the Ahmed's glaucoma valve (AGV).³ Cyclodestructive procedures are usually reserved for patients with limited visual potential.² Considering the surgical approach, minimally invasive glaucoma surgeries (MIGS) have been expanding their field of action in the surgical treatment of glaucoma in recent years and new technologies have been developed and improved.⁵ One of them is the

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Kahook Double Blade (KDB, New World Medical, Rancho Cucamonga, CA), which consists of a single-use ophthalmic knife that has two parallel blades designed to remove more efficiently a tissue strip of TM and the inner wall the underlying Schlemm Canal, which allows a sustained reduction in IOP.⁵ Pre-clinical studies have shown that the removal of the TM is performed without damaging the surrounding tissues, in contrast to goniotomy with a microvitrectomy blade or trabectome®.⁵ The procedure can be performed alone or in combination with other ophthalmic procedures through a clear incision in the cornea and the use of a direct gonioscopy lens.⁵ Although KDB ab-interno trabeculectomy has been reported for treatment of childhood glaucoma and has been associated with IOP control,⁶ there are no reports in the literature regarding the KDB procedure for pediatric traumatic glaucoma treatment.

The present study aims to describe the first case, in the revised literature, of a child with elevated IOP due to blunt eye trauma that did not respond to maximum clinical treatment, in which the surgical therapeutic option adopted was surgery by KDB, instead of fistulizing the surgery or implanting a device drainage, which are the main options for surgical treatment in these cases.

2. Case report

A 7 years-old boy reported a blunt trauma in the left eye (OS), evolving with angular recess close to 110° (Fig. 1) and concomitant IOP elevation. Approximately 45 days was the time between trauma and patient care at our service. He was referred for a fistulizing glaucoma surgery after failure in IOP control with topical and systemic ocular hypotensive medications. In the referral letter it was reported that the patient had attended the doctor's appointment one day after the trauma complaining of visual blurring, photophobia and pain in the affected eye. At that time, on examination, he presented an anterior chamber formed, a 4+ reaction of the anterior chamber, with the presence of blood cells and pigments in the aqueous humor, in addition to an inferior laminar hyphema. The IOP was 12/08 mmHg. Gonioscopy showed blood in the lower sinus, both nasal and temporal, and light pigmentation in the other quadrants. He started topical steroids (0,1% topical fluormetholone) at weaning, which was used for 25 days, and 1% tropicamide until symptoms persisted. After 5 days, the patient returns with a complaint of visual haze and ocular pain. There was 1+ stromal and epithelial corneal edema with an IOP of 50 mmhg in the left eye, the right eye remained unchanged. Maximum topical medication was started, 0.5% timolol maleate, 0.2% brimonidine tartrate, 0.04 mg/ml travoprost, without satisfactory response, it was decided to introduce a quarter of 250 mg acetazolamide 4 times a day. There was a partial response with improvement in corneal edema, but IOP was still high,

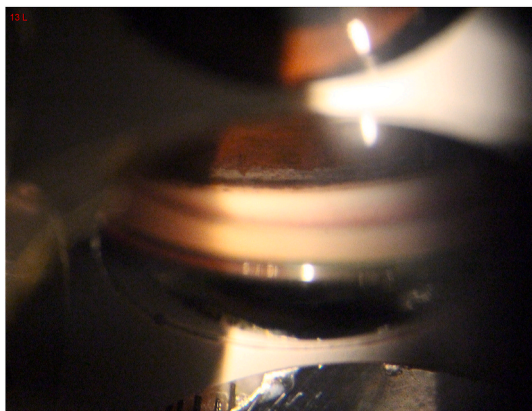


Fig. 1. Gonioscopy photo showing part of the angular recess with widening of the ciliary body band in the lower nasal quadrant. It is also possible to observe the great pigmentation of the trabecular meshwork (TM).

around 30 mmHg. At this point, a new gonioscopy was performed, which showed an increase in pigment, especially in the lower quadrants, of approximately 3+/4+, and the presence of an angular recess in the lower nasal quadrant had already been described. As the patient no longer had an anterior chamber reaction or blood cells, it was decided to suspend the topical corticosteroid, which was being administered twice a day, after 25 days of use. After 40 days of follow-up, the IOP remained high, using only ocular hypotensive agents and acetazolamide, when they chose to refer the patient to our service. He kept using topical and oral hypotensive. At biomicroscopy, no hyphema or significant alteration of the ocular anatomy were observed and funduscopy demonstrated physiological optic disc excavations in both eyes (OU) (Fig. 2). Visual acuity was 20/20 (Snellen chart) OU with normal standard automated perimetry. Despite the maximum topical and systemic ocular hypotensive therapy, the IOP maintained around 35 mmHg. As there was no glaucomatous neuropathy yet, it was considered performing a KDB ab-interno trabeculectomy instead of a fistulizing surgery. His parents were well informed about the innovative indication of this procedure and their agreement was obtained. All options were discussed and presented to the child's parents who agreed to conduct the case according to our guidelines. Approximately 55 days after the trauma the patient was operated. In the KDB's surgery immediate post-operative phase (Fig. 3), oral and topical hypotensive medications were gradually withdrawn until complete suspension at the end of the third week of the post-operative period with IOP levels around 11 mmHg, which has remained the same in the last 2 years. Both the functional and the structural assessment of glaucoma have remained stable throughout the follow-up until the present moment. Fig. 4, which was documented 6 months after surgery, shows the place where the KDB was performed and, even 2 years after the procedure, its final appearance is very similar.

3. Procedure

The surgery was performed under sedation using a mask induction with sevoflurane and the hypnotics propofol with fentanyl. Besides that, under a peribulbar anesthesia with a medial canthus injection of 1.5 ml (2% lidocaine and 0.5% bupivacaine at a 1:1 ratio) was applied. The caruncle injection was performed with a 26-gauge insulin needle.

Initially a corneal incision was made in the upper temporal region with a 1.2 mm corneal incision, followed by the injection of ophthalmic viscoelastic devices (OVDs) in the anterior chamber to keep it formed. The microscope was maintained in its traditional position, while the patient's head was rotated to the right about 45°. Then, a Volk Transcend Vold Gonio (TVG) surgical lens was used to visualize the nasal aspect of the angle. The KDB was then inserted through the corneal incision and advanced towards the nasal angle for KDB-assisted goniotomy, in which the pointed tip of the KDB was advanced to wrap and remove about 110° of the TM band in the same region of the angular recess.

The patient's head was rotated to its original position and the viscoelastic and blood reflux of the Schlemm canal was removed from the eye using the irrigation/aspiration handpiece. The entire surgical procedure was uneventful.

Postoperative care included 1% topical prednisolone acetate (gradual reduction over 4 weeks) and fourth generation topical fluoroquinolone (moxifloxacin) 4 times a day for one week.

4. Discussion

The use of MIGS for the surgical treatment of chronic glaucoma is performed effectively and safely to reduce IOP and/or the number of hypotensive drugs in patients with mild and moderate primary and secondary open angle glaucoma.⁵ This surgical modality has become an increasing option, especially in those cases when glaucoma is stable and there is an phacoemulsification indication, taking advantage of the

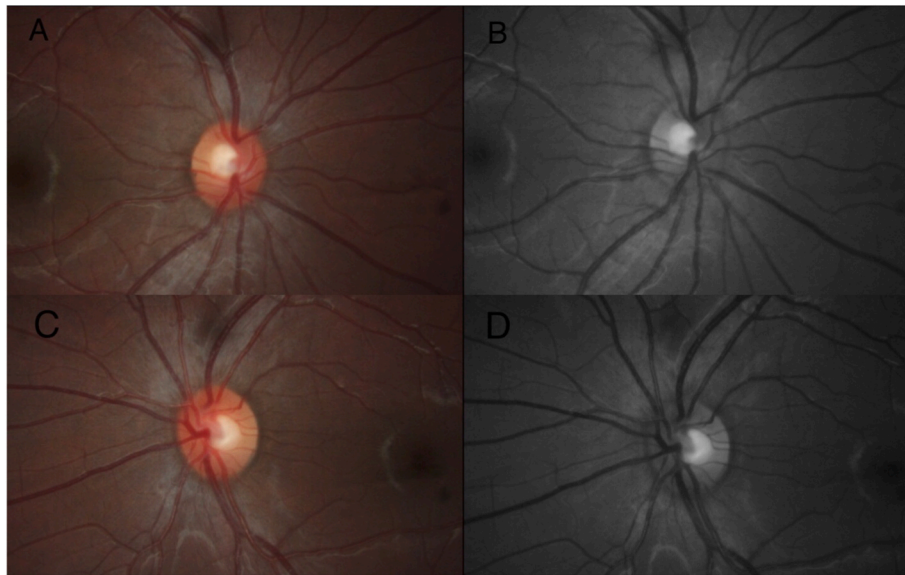


Fig. 2. Retinography before the surgery:
A – Right eye; B – Right eye Redfree; C – Left eye; D – Left eye Redfree.

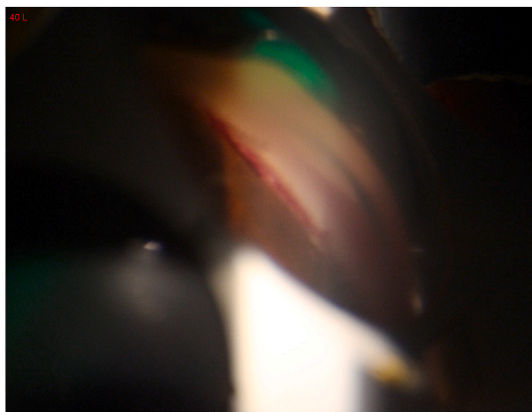


Fig. 3. Gonioscopy of KDB's surgery immediate postoperative.

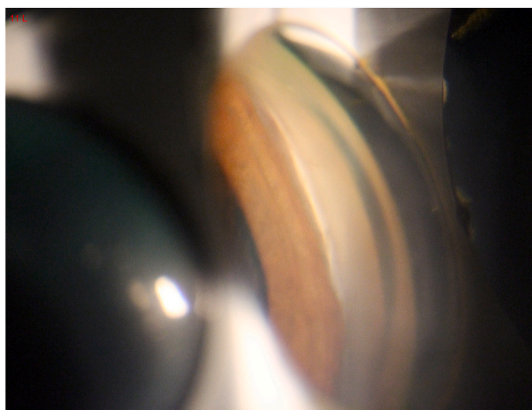


Fig. 4. Gonioscopy showing excision area of the TM.

surgical time to access the TM.⁷⁻⁹ The most studied surgical modality among MIGS is the iStent®,⁷ however it was not our option because, in addition to being a high-cost procedure, there is a lack of long-term studies that assess the impact on endothelial loss during life and the fact of the patient reported being a child was considered. As KDB

demonstrates, it has a favorable safety profile, alone or in combination with cataract extraction, and a similar pressure reduction.^{5,7-10} According to the experiences of these authors, KDB is a low cost procedure when compared to the others MIGS, for that reason it was chosen. The case described can contribute not only to help spreading this anti-glaucoma technique, but also to increase the range of options in which KDB can be safely indicated.

In glaucoma refractory as clinical treatment and/or with very high pressures, KDB in general would not be the technique of choice, since pressure reduction is limited, around 10–20%. Generally these eyes present the traditional resistance in TM and a sclerosis in the downstream drainage pathways, where the KDB would have no direct action.^{5,7,8,10} However, there is a study showing reduction in both pressure and IOP-lowering medications, 24% and 36%, respectively, in patients with advanced glaucoma and refractory to clinical treatment.¹⁰ Considering the high risks of a bleb in a child regarding possible traumas, blebitis and other complications,¹¹ we opted for the KDB procedure that the main mechanism for IOP rise was the breakdown of the trabecular lamellae. Further, if the procedure failed, it would be possible to perform a trabeculectomy afterwards. Based on this reasoning, the reported case behaved with a pressure reduction above that described in the literature, around 70%, because the TM removal reestablished an adequate aqueous drainage. The studies that evaluated the KDB effectiveness in reducing IOP were carried out in the eyes of patients with previous glaucoma and older ages, which are risk factors for increased resistance to outflow of the aqueous not only in TM but also on collector channels.¹² Thus, in these eyes, when removing TM, only part of the resistance factors is removed, which would impact on a lower IOP reduction. In addition, since it is a child and a relatively short period of low flow time through the aqueous humor drainage pathways, post-trabecular structures would probably not have undergone a sclerosis process.

There are other causes that should also be considered as contributors or reasons for the reduction of the patient's IOP. As this is not a study in which cause-effect can be attributed, there may have been a temporal coincidence: the IOP of the patient in question would be regularized after a certain period of trauma and this may have occurred precisely at the postoperative moment, making it seems like it was the effect of surgery. In addition, because of the trauma, an extensive release of pigment into the eye could clog the TM as well as trabecular endothelial cells that phagocytize the pigment particles could also block the

meshwork, directly and through changes induced at the meshwork.¹³ Thus, the surgical procedure itself may have washed the pigment dispersed in the trabeculate, facilitating the flow of the aqueous and consequently pressure reduction.⁵

5. Conclusion

KDB is a useful surgical technique that should be considered by the glaucoma surgeon in traumatic glaucoma, if the patient is informed that in case of failure, a fistulizing procedure may be necessary afterwards, as there are still not enough cases to infer its effectiveness. In this case, because it is an ocular hypertension mechanism whose main site of resistance to drainage of the aqueous is probably TM, the KDB had a performance above the expected by the literature data. Studies are still needed to define which patient and glaucoma profile are the most suitable for the procedure, in addition to a better understanding of how the aqueous outflow behaves after the procedure and for how long its effectiveness in pressure reduction is maintained.

Patient consent

Consent to publish the case report was obtained. Moreover, this report does not contain any personal information that could lead to the identification of the patient. This study complied with the tenets of the Declaration of Helsinki. Approval by the IRB was exempted as this is a single case report.

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Authorship

All authors attest that they meet the current ICMJE criteria for authorship.

Declaration of competing interest

None of the authors have financial disclosures or conflicts of interest

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