Saudi Journal of Ophthalmology (2015) 29, 95–102

Original Article

Incidence, efficacy and safety of YAG laser goniopuncture following nonpenetrating deep sclerectomy at a university hospital in Riyadh, Saudi Arabia

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Abstract

Purpose: Assessing the frequency and evaluating the efficacy and safety of Neodymium:Yttrium Aluminum Garnet (Nd:YAG) Laser goniopuncture (LGP) following nonpenetrating deep sclerectomy (NPDS).
Design: Retrospective cohort study.
Patients and methods: We retrospectively reviewed the outcome of 197 eyes of 153 patients with open angle glaucoma who underwent either NPDS or NPDS combined with cataract extraction between January 2005 and September 2010 at King Abdulaziz University Hospital (KAUH). Both demographic and clinical data were retrieved and analysed.
Results: Goniopuncture (GP) was needed in 48 (24.4%) of the eyes which had NPDS or NPDS with cataract extraction after a mean post operative interval of 9.78 (±11.16) months. The mean IOP had significantly decreased from 23.3 (±5.9) mmHg prior to Nd:YAG LGP procedure to 14.6 (±4.4) mmHg at the last post-procedure assessment. At the last follow-up; Nd:YAG LGP was successful in controlling IOP in 27 eyes (56.3%). Mean Nd:YAG LGP failure time was 6.04 (±5.80) months. Young age (<50 years) ($p = 0.001$); type of glaucoma (secondary versus primary open angle, $p = 0.0258$) and the use of drainage implant ($p = 0.038$) were the identified predicting factors for the need of Nd:YAG LGP. Complications following Nd:YAG LGP occurred in 5 eyes (iris touch to TDM (4.2%), Hyphema (2.1%), hypotony maculopathy (2.1%) and choroidal detachment (2.1%).
Conclusions: LGP is an efficient IOP lowering procedure after NPDS, when it is indicated. It is a simple and noninvasive procedure. However, certain precautions should be taken to avoid complications.

Keywords: Goniopuncture, Nd:YAG, Deep Sclerectomy, Glaucoma

http://dx.doi.org/10.1016/j.sjopt.2014.09.015

Introduction

Trabeculectomy is a penetrating filtration surgery widely used for the surgical treatment of medically uncontrolled glaucoma. The penetrating nature of this procedure may result in several operative and postoperative complications.[1] In an attempt to lower the incidence of such complications, non-penetrating glaucoma surgery (NPGS) was developed. This procedure is designed to avoid full thickness penetration into the anterior chamber and consequently, minimize the risk of complications commonly encountered with the standard trabeculectomy. The NPGS was described by Krasnov in the late 1960s.[2] He suggested deroofing Schlemm's canal (SC) aiming to lower the intraocular pressure (IOP). However, the effect of such procedure was relatively short, and required a long learning curve. In addition, classic trabeculectomy was introduced in the same era and it was easier to perform, had higher efficacy and longer longevity. As a result, the popularity of NPGS was quite limited. In the

Received 1 April 2014; received in revised form 9 June 2014; accepted 25 September 2014; available online 7 October 2014.

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Peer review under responsibility of Saudi Ophthalmological Society, King Saud University

Production and hosting by Elsevier

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1980s, NPGS started to gain popularity again, and different techniques with several modifications were described.[3–10]

Nonpenetrating deep sclerectomy (NPDS) is one of the NPGS procedures, commonly used for surgical management of open angle glaucoma. In NPDS, removal of a deep scleral flap leads to the formation of an empty scleral space known as '*the decompression space*', where the aqueous humour gets collected before its drainage.[11] The literature reports that the aqueous outflow resistance is mainly located in the Trabecular Meshwork (TM), with approximately 75% of this resistance both in normal and abnormal glaucomatous eyes occurring in the juxtacanalicular TM and the inner wall of SC.[12] Therefore, NPDS was developed to address this resistance through deroofing SC and peeling its floor, together with the juxtacanalicular TM and part of the corneoscleral layers of TM. As a consequence, aqueous drainage occurs at the level of the posterior trabeculum through the remaining corneoscleral TM and the intact uveal part of the TM (Trabeculo-Descemet's Membrane, TDM).[3,13,14] Physiologically, the TDM acts as an outflow resistance site, allowing gradual decrease of IOP which in turn precludes the sudden hypotony that usually occurs after trabeculectomy.[15,16] Several routes have been suggested for the aqueous drainage from the decompression space. One of the potential routes is the subconjunctival space as demonstrated by the presence of a filtering bleb in the majority of successful cases.[13,17] Other suggested routes are drainage through the suprachoroidal space and through a transcleral pathway. Furthermore, aqueous may enter the SC to be drained by the episcleral venous plexus.[13] To facilitate IOP lowering efficacy, space-maintaining devices in NPDS were introduced. These devices are used to reduce scar formation and to keep the decompression space open during the time of maximal healing, which consequently enhances the drainage process. Nowadays, different absorbable and nonabsorbable; expensive and low cost; animal-, chemical-based and synthetic space-maintaining devices are being used.[13] Examples of the commonly used devices are: collagen implants (STAAR® Surgical Company, California, USA), reticulated hyaluronic acid implant (SKGel™, Corneal Laboratories, Paris, France), nonabsorbable hydrophilic acrylic implant (T-flux®, Ioltech, La Rochelle, France), and viscoelastic implant (e.g. Healaflow, Anteis S.A., Geneva, Switzerland).

In some patients, the TDM may demonstrate an increased resistance to aqueous outflow either in the early or late post operative period causing elevation of IOP.[14] The insufficient passage of aqueous humour through the TDM is usually due to fibrosis developed as a part of the TDM healing process or due to excessive deposition of debris and or pigments (Fig. 1). Goniopuncture is effective when underfiltration is due to poor TDM functionality and not due to other causes such as poor dissection plane, excessive bleb fibrosis or other more serious causes.[13] Additionally, it is considered as a minor follow up procedure equivalent to postoperative scleral flap suture lysis after trabeculectomy.

Laser goniopuncture (LGP) converts deep sclerectomy from being a nonpenetrating procedure to a penetrating one, but with fewer complications compared to penetrating glaucoma surgery.

In the present study, we assessed the frequency, efficacy and safety of Nd:YAG LGP following NPDS performed at glaucoma service unit, King Abdul-Aziz University Hospital (KAUH), King Saud University, Riyadh, Kingdom of Saudi Arabia.

Figure 1. Gonioscopic view of the trabeculo-Descemet's membrane with clear deposition of pigments and debris indicating the area of filtration.

Materials and methods

In the current retrospective cohort study, 153 charts of patients who underwent a NPDS or NPDS with cataract extraction for medically uncontrolled primary or secondary open-angle glaucoma between January 2005 and September 2010 were reviewed. Our exclusion criteria included congenital glaucoma cases. However, cases with previous ocular surgery such as filtering procedure or cataract extraction were not excluded. Indications for surgery were uncontrolled glaucoma, which was defined as an intraocular pressure (>21 mmHg) with maximum tolerated anti-glaucoma medication, progressive glaucomatous visual field loss and/or progressive optic disk cupping. Mitomycin C was used in all the cases. Steps of our NPDS technique were as follows: after a fixation suture (a 4–0 silk suture to the superior rectus muscle or a 6–0 vicryl suture to the superior cornea) had been placed, a fornix-based conjunctival flap was fashioned, and a 5 × 5 mm one-third sclera thickness superficial flap was created, which extended 1.5 mm into the clear cornea. A sponge soaked in Mitomycin C solution 0.2 mg/ml was placed under the superficial scleral flap and Tenon's capsule for 2 min, then thorough irrigation with 20 cm^3 balanced salt solution was performed to wash the surgical site. A 4 × 4 deep scleral flap was created leaving only a very thin layer (50–70 μm) of scleral tissue over the uvea. Dissection was carried out from the posterior part of the flap and extended anteriorly to deroof SC spontaneously. Dissection continued anteriorly to create the TDM. The floor of SC was peeled off with fine-toothed forceps (Fig. 2) and the deep flap was excised.

If an implant was used, it was then placed in the floor of the excised deep flap (Fig. 3). The superficial scleral flap was then secured with 10–0 nylon sutures at the posterior corners. The conjunctival flap was closed in a watertight fashion. An Implant drainage device, such as T-flux® (Ioltech, La Rochelle, France), SKGel™ (Corneal Laboratories, Paris, France) or Healaflow was used in the majority of cases. Post operatively, all patients received topical steroid in a tapering dose and topical antibiotic eye drop.