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Case Report

Anterior Segment Optical Coherence Tomography Signs of Local Dilatation Effect of a Micro-Stent on Schlemm's Canal

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Abstract

Introduction: The iStent inject® (Glaukos Corporation, CA, USA) is a relatively new device designed to be implanted ab-interno through the trabecular meshwork. This is, to the best of our knowledge, the first in-vivo description of a trabecular bypass device visualised with anterior segment optical coherence tomography (AS-OCT), and report of its structural effect on Schlemm's canal. **Case Report:** A 74 year-old female patient suffering from long-standing primary open-angle glaucoma and nuclear sclerosis underwent cataract surgery combined with the implantation of two iStent injects®. Surgery was uncomplicated and achieved intraocular pressure (-1 mmHg) and medication (-2 molecules) reduction at 6 months. Under AS-OCT (Spectralis OCT, Heidelberg Engineering AG, Germany) the stent appears as a 300 µm long hyperreflective hollow device within the trabecular meshwork. Approximately a third of it protruded into the anterior chamber. Profound OCT signal loss was notable within the shadow of the device. A second AS-OCT section 500 µm beside the microstent shows a markedly dilated Schlemm's canal, with a major diameter of 390 µm. **Discussions:** This report confirms that AS-OCT is a suitable technique to assess microstent positioning, and provides a first report on the in-vivo appearance of a functioning stent. It also indicates that iStent injects® could have a tangible effect on adjacent portions of Schlemm's canal with, in this case, a 220% increase in canal diameter compared to the observed average (122 µm). This suggests the IOP-lowering effect of trabecular bypass devices could rely on a dual mechanism involving Schlemm's canal dilatation.

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Introduction

Glaucoma is characterised by an altered circulation of aqueous humour leading to inappropriate levels of intraocular pressure (IOP).[1] With the advent of micro-invasive glaucoma surgery (MIGS), recent years have witnessed significant expansion in the range of surgical devices and treatment options available for glaucoma. Amongst them the iStent inject® (Glaukos Corporation, Laguna Hills, CA, USA) is a relatively new device

that was designed to be implanted ab-interno through the trabecular meshwork. It is thought to facilitate aqueous outflow from the anterior chamber to Schlemm's canal, thus reducing IOP.[2,3] While preliminary studies showed some IOP-lowering effect in mild-to-moderate open-angle glaucoma (OAG), the full extent of the mechanisms through which pressure is reduced remains unconfirmed.[4,5,6]

This report constitutes the first in-vivo description of a trabecular bypass (iStent inject®, Glaukos Corporation, Laguna Hills, CA, USA) device visualised with anterior segment optical coherence tomography (AS-OCT), and its effect on Schlemm's canal.

Case Report

Presentation

A 74 year-old mildly myopic female patient suffering from long-standing primary OAG and symptomatic nuclear sclerosis underwent right cataract surgery combined with the implantation of two iStent injects®. Before surgery, the patient's IOP were stable at 13 mmHg under two anti-hypertensive topical medications, and her visual field mean deviation (VF MD) was 7.8 dBs with no recent evidence of progression. Gonioscopy was unremarkable, and confirmed an open iridocorneal angle. The primary indication for microstent implantation was to achieve reduction in topical therapy and thus improve quality of life.

Combined iStent inject implantation

During surgery, the patient's skin was cleaned and prepared with sterile dressing. Topical anaesthesia was administered and a lid retractor was positioned. Cataract surgery was performed following a standard protocol briefly outlined below. The main incision was performed on the steepest corneal axis and two paracentesis were made in the infero-temporal segment, 1 mm away from the limbus. Phacoemulsification was performed and the intraocular lens was implanted. The viscoelastic device was then left in the anterior chamber and the preloaded injector was inserted through one of the temporal corneal paracenteses. Two iStent injects® were implanted into the pigmented trabecular meshwork, in the superior and inferior nasal quadrants. Viscoelastic material and other potential debris in the AC were thoroughly washed out by irrigation-aspiration. Post-operative treatment consisted of a topical combination of tobramycin and dexamethasone (Tobradex®, Alcon, TX, USA) and nepafenac (Nevanac®, Novartis, Basel, Switzerland), four times a day for one month. All glaucoma medications were stopped at the time of surgery.

One day after surgery, IOP had increased to 15 mmHg. It subsequently decreased to 11 mmHg at one month and remained stable thereafter. Six months post-operatively, IOP was still within the patient's individual target range at 12 mmHg under no medication. Gonioscopy confirmed the presence of two iStent devices, well-positioned within the pigmented trabeculum in the inferior and superior nasal quadrants.

Imaging Appearance

AS-OCT (Spectralis OCT, Heidelberg Engineering AG, Germany) imaging was performed and radial sections were obtained from the inferior iStent inject device (Figure 1A) and from nearby segments of Schlemm's canal, 500 µm beside the microstent (Figure 1B). The section through the stent clearly shows normal angle structures and an approximately 300 µm long hyperreflective hollow device within the trabecular meshwork. About a third (100 µm) of the microstent is protruding from the trabeculum into the anterior chamber. The central lumen and side holes of the stent are clearly identifiable as areas of lesser reflectivity. Profound OCT signal loss is notable within the shadow of the device and impairs visualisation of the posterior side of the iStent inject. The second section beside the device confirms

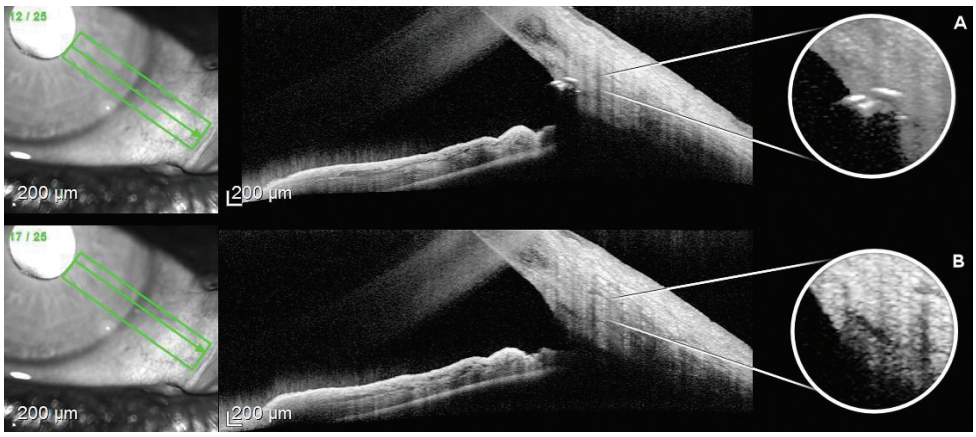

Figure 1: Anterior Segment Optical coherence tomography (AS-OCT) section of an iStent inject device within the anterior trabeculum **(A)** and of a markedly dilated Schlemm's canal 500 µm beside the microstent **(B)** six-month post-operatively.

normal angle anatomy and allows visualisation of Schlemm's canal as an hyporeflective ellipsoid area lying immediately behind the trabecular meshwork, 320 µm anterior to the angle. Schlemm's canal appears markedly dilated, measuring 390 µm along its longest axis (major diameter) by 60 µm at its widest.

Discussions

In this report, we describe a case of successful combined iStent inject® surgery achieving IOP and medication reduction at 6 months, and analyse the in-vivo characteristics of the device and surrounding Schlemm's canal with AS-OCT imaging. This is, to the best of our knowledge, the first report concerning the imaging appearance and structural effect of iStent injects®. The interest of this article is two-fold. Firstly, it confirms that AS-OCT is a suitable technique to assess microstent positioning, and provides a first report on the in-vivo appearance of a functioning stent. Secondly, it suggests that trabecular bypass stents could have a tangible effect on immediately surrounding portions of Schlemm's canal. Indeed, in a prospective study involving ultrasound measurement of Schlemm's canal in 94 patients, Irshad et al. reported an average canal diameter of 122 µm in myopic eyes.[7] In the presently reported case, this would represent a 220% increase in canal diameter compared to observed averages. This suggests the IOP-lowering effect of the iStent inject® could rely on a dual mechanism: not only would it maintain an outflow pathway through the trabecular meshwork but it could also achieve significant dilation of Schlemm's canal similarly to what has been observed in canaloplasty techniques. However, more research will be needed to confirm these anecdotal observations, assess the full extent of the effect of iStent injects® on Schlemm's canal diameter, and explore its impact on IOP control.

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