Glaucoma is a leading cause of preventable and irreversible blindness. Glaucoma is a chronic and progressive neurodegenerative disorder causing loss of retinal ganglion cells and their axons. Characteristic ‘cupping’ of the optic disc is seen with corresponding loss of visual field. Elevated intraocular pressure (IOP) is a causative risk factor for the development and progression of glaucoma, and lowering IOP is the mainstay of treatment. Besides IOP, other risk factors are well-known, e.g. age, family history, and race (e.g. African descent). The balance of aqueous humor production (inflow) and drainage (outflow) determines the IOP. The pathophysiology of elevated IOP in primary open-angle glaucoma (POAG) is dysfunctional drainage, specifically through the trabecular meshwork (TM). The exact mechanisms that control drainage through the TM are not fully understood, but changes in the extracellular matrix (ECM) are one of the reasons. Furthermore, pathological accumulations of certain ECM structures within the TM have been described as causative in eyes with POAG.

In managing glaucoma patients, lowering the IOP is the only available treatment with a significant body of supporting evidence. Medical reduction of IOP is the first line of therapy in most cases. If medical treatment fails, there are several well-established surgical procedures to reduce IOP.

Trabeculectomy (TE) as it is performed today was introduced in 1968 by Cairns and at the same time by Linner. It is still the gold standard in glaucoma surgery. The aqueous flows via a scleral flap from the anterior chamber into the subconjunctival space. TE is very effective in long-term IOP reduction. The use of antimetabolites during surgery provides an even better long-term success.

The greatest outflow resistance is at the location of the juxtacanalicular TM (JCT) and inner wall of Schlemm’s canal. Schlemm’s canal communicates with the episcleral veins. The drainage of aqueous outflow through the TM into Schlemm’s canal and later on into the episcleral veins is called the trabecular outflow (83–96 %, ‘conventional’ pathway), the remaining 5–15 % of the aqueous humor is drained via the uveoscleral pathway (‘alternative’ pathway). The JCT region, which includes the inner wall of Schlemm’s canal and the underlying TM, is thought to be the region where regulation of aqueous humor outflow takes place. The JCT region has the highest resistance to outflow, especially under conditions of elevated IOP.

Although TE remains the mainstay of surgical glaucoma treatment, it remains feasible to enhance aqueous outflow through the conventional pathway. Several surgical approaches have been tried, e.g. ab interno TE with the Trabectome™, goniotomy, and gonipuncture, which can be performed with or without endoscopy.

This paper focuses on another technique, excimer laser trabeculotomy (ELT, also known as excimer laser trabeculostomy). First, goniotomy and gonipuncture are discussed briefly.
Goniotomy

Goniotomy is used to enhance the route for aqueous humor outflow into Schlemm’s canal. For this purpose, the tissue of the chamber angle is incised under direct visualization with an operating microscope and a surgical gonioscopy lens or with a fiber optic probe. Instead of a surgical knife, a photoablative laser device can be used. In 1997, Medow and Sauer reported the first use of endoscopic goniotomy in human subjects. Goniotomy is known as the gold standard for the treatment of primary congenital (infantile) glaucoma. A successful goniotomy improves the aqueous outflow and IOP control can be maintained for extended periods of time. For the procedure, an incision just below the Schwalbe line is made to open Schlemm’s canal. Early treatment is important, as the success rate of goniotomy is dependent on the patient’s age. From those patients who had glaucomatous anomalies at birth or older than two years and who underwent one or two goniotomies, about 26% were controlled. However, in patients between one and 24 months of age the success rate is 90–94%. Table 1: Technical Data for the AIDA Excimer Laser

<table>
<thead>
<tr>
<th>Laser type</th>
<th>XeCl excimer laser, laser class 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>308 nm</td>
</tr>
<tr>
<td>Cooling</td>
<td>Air</td>
</tr>
<tr>
<td>Pulse energy</td>
<td>1.2 mJ at fiber tip</td>
</tr>
<tr>
<td>Pulse duration</td>
<td>60 ns</td>
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<tr>
<td>Repetition rate</td>
<td>20 Hz</td>
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<tr>
<td>Laser spot size</td>
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<tr>
<td>Cannula diameter</td>
<td>500 μm</td>
</tr>
<tr>
<td>Cannula material</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Length of fiber</td>
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</tr>
</tbody>
</table>

Excimer Laser Trabeculotomy

ELT ab interno is a minimally invasive surgical technique to reduce IOP in patients with glaucoma or ocular hypertension by creating pores from the anterior chamber into Schlemm’s canal. There are almost no thermal side effects or damage to the outer wall of Schlemm’s canal. ELT could easily be performed at the end of a clear cornea phacoemulsification or as a stand-alone procedure. It can reduce IOP for an extended period of time and is associated with a low rate of complications. The duration of cataract surgery is only prolonged by 2–3 minutes for the ELT. The same corneal incision as for phacoemulsification is used. In our procedure, at the end of the cataract surgery or at the beginning of a stand-alone procedure, a medical miosis is performed with acetylcholine chloride and the anterior chamber deepened with viscoelastics. An endoscopically guided photoablative laser (see Figure 1) operating at a wavelength of 308 nm (excimer laser, AIDA, TU-Laser, Munich, Germany) is used to create ten microperforations into the TM spread over an area of 90°. Each microperforation is about 0.5 mm in diameter (diameter of the laser fiber). Further details of the device are given in Table 1. To transmit the complete energy of the laser to the TM,
and at least moderate cataract, the combined procedure of ELT and of glaucoma patients, in particular those with an IOP over 21 mmHg with a phacoemulsification in minimally invasive endoscopic surgery, Excimer laser trabeculotomy could become more popular in combination with endoscopic surgical methods. Goniotomy is mostly used in infantile glaucoma, and goniopuncture is an option following deep sclerectomy.

However, it may also be possible to achieve a sufficient reduction in IOP post-operative complications demands minimally invasive procedures. Antimetabolites is still the gold standard. The goal of minimizing therapy and no further glaucoma surgery within the follow-up period).78

A larger study is ongoing. In this study, eyes with IOP less than 22 mmHg are also included. The preliminary results of 73 eyes of 64 patients with a mean age of 76.51 ± 9.36 years after a follow-up period of 12 months are also included. The preliminary results of 73 eyes of 64 patients with IOP of over 21 mmHg (mean 25.33 ± 2.85 mmHg). We conducted a preliminary study that included 28 eyes of 28 patients with a pre-operative IOP of over 21 mmHg (mean 25.33 ± 2.85 mmHg). One year after combined phaco-ELT we found a mean IOP reduction of 8.79 ± 5.28 mmHg (-37.70 %, p<0.001). During the same period, the number of antiglaucoma medications could be reduced by an average of 0.79 ± 1.50 per patient (-62.70 %, p=0.017). The complication rate was similar to that of normal cataract surgery and no serious complications occurred. The success rate was 64.3 % (as defined by post-operative IOP < 21 mmHg in addition to IOP reduction of ≥20 % with or without medical therapy and no further glaucoma surgery within the follow-up period).79

A larger study is ongoing. In this study, eyes with IOP less than 22 mmHg are also included. The preliminary results of 73 eyes of 64 patients with a mean age of 76.51 ± 9.36 years after a follow-up period of 12 months post-surgery are shown in Table 2.

**Conclusion**

A range of surgical options to lower IOP is available. TE with phacoemulsification appears to be a promising approach to avoid (or at least to delay for some years) the onset of TE.
35. Bill A, Phillips CI, Uveoscleral drainage of aqueous humour in
21. Feiner L, Piltz-Seymour JR, Collaborative Initial Glaucoma
36. Pederson JE, Gaasterland DE, MacLellan HM, Uveoscleral
34. Yoon PS, Singh K, Update on antifibrotic use in glaucoma
30. Lama PJ, Fechtner RD, Antifibrics and wound healing in


investigators TAGIS, The Advanced Glaucoma Intervention

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