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Advances in the management of paediatric glaucoma

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Abstract

The paediatric glaucomas present some of the greatest clinical challenges. We review the advances in the management of the paediatric glaucomas, which have improved the outlook for these patients and their families. These advances include improvements in diagnosis, investigations, anaesthetic techniques, medical, surgical, and laser therapies.
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Introduction

Paediatric glaucoma is a relatively rare, potentially blinding condition caused by elevated intraocular pressure (IOP). It is classified into primary, where there is a developmental anomaly of the angle alone, and secondary, where outflow obstruction is due to an ocular or systemic condition.[1] Primary congenital glaucoma (PCG) due to isolated trabeculodysgenesis is the commonest glaucoma seen in infancy.[2,3] Conditions commonly causing secondary glaucoma include Axenfeld–Reiger Anomaly, Peters Anomaly, uveitis, aphakia, aniridia, and Sturge–Weber syndrome.

The management of children with glaucoma presents the ophthalmologist with some of the most anxious but at the same time incredibly rewarding periods in clinical practice. It is so challenging that most cases are managed in tertiary institutions.[4] The goal of preserving a lifetime of vision for these children involves early, prompt control of IOP, correction of ametropia and rigorous amblyopia treatment. The control of IOP in PCG is primarily surgical with medical therapy playing a supportive role, whereas in secondary glaucomas, medical therapy is first line except in congenital cases where surgery is often required to control IOP.

Untreated or suboptimally treated the outcome of paediatric glaucoma is known to be poor.[5,6] However, over the last 60 years, there has been a dramatic improvement in the prognosis of this disease following the introduction of new surgical techniques and the recognition of amblyopia as an important cause of poor vision. The introduction of angle surgery revolutionised the prognosis of PCG. Goniotomy was first reported in children in 1942 by Barkan,[7] followed by trabeculotomy in the 1960s independently described by both Smith[8,9] and Burian[10,11] and popularised by Harms and Dannheim.[12] Subsequently, techniques widely used in adults such as trabeculectomy and drainage implant surgery have increasingly played a role in refractory cases of paediatric glaucoma.

There have been numerous recent advances in the management of paediatric glaucoma. Many have again occurred in the field of surgery, but there also have been significant advances in medical therapy and investigations which will also be briefly discussed.

Investigations

The use of axial length measurement in infants whose eyes are still vulnerable to the effects of IOP was recognised by Sampaolesi,[13] who reported its value in making the diagnosis and by Buschmann and Bluth,[14] who described its significant role in determining progression. Subsequently, the routine use of ultrasound was established for both diagnosis and follow-up of infantile glaucoma.

More recently, the importance of pachymetry in the assessment of children with glaucoma has been highlighted, as evidence has become available regarding the role of central corneal thickness in glaucoma.[15,16] There is evidence that children with aniridia have thickened but healthy corneas, which may have important implications regarding IOP measurements.[17,18] This emphasises the fact that monitoring of

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children with glaucoma should not rely just on IOP, which is subject to many influences such as anaesthesia and corneal properties, but more importantly on regular optic nerve examination. Children can also be examined when sleeping if adequate facilities are available in the clinic (Figure 1).

Figure 1 Examination while sleeping.

Medical therapy

Medical therapy in paediatric glaucoma often plays a supportive role. In PCG cases, preoperatively it may reduce IOP and allow the corneal oedema to clear and so improve visualisation of the angle at the time goniosurgery. Postoperatively, it can be used as an adjunct to maximise IOP lowering. It also plays a role if surgery is very high risk or not possible due to medical problems where anaesthesia poses a serious threat to life. In secondary glaucoma, it is often used as a first line therapy but in congenital or some infantile cases, surgery is often inevitable. Children are usually not included in studies for the approval of glaucoma medication by regulatory agencies, but evidence has become available in the literature regarding their use in children.

The use of timolol in paediatric glaucoma patients has been extensively studied in comparison with other agents. Plasma timolol levels in children after 0.25% greatly exceed those in adults after 0.5%, especially in infants[19] and are presumed to increase the risk of side effects such as bronchospasm and bradycardia. In light of this, betaxolol (β1 selective antagonist) and timolol gellan 0.25%, as an alternative because of less systemic absorption and the advantage of once a day dosing, have been widely prescribed in children. However, the recent introduction of timolol 0.1% has been useful in neonates and infants due to its superior risk profile. Blotting off of excess drops and punctal occlusion and may also greatly reduce systemic absorption and should be taught to parents.[20]

Topical carbonic anhydrase inhibitors are useful as second-line drugs, or when β-blockers are contraindicated. In a short randomised, controlled, double masked, multicentre trial, dorzolamide was found to be well tolerated and effective for up to 3 months in children less than the age of 6 years.[21] Similarly, topical dorzolamide was found to significantly reduce mean intraocular pressure from baseline, but less so when compared with systemic acetazolamide (27 *vs* 36%) in a paediatric glaucoma population.[22] Furthermore, the use of systemic acetazolamide was limited because of a significant incidence of systemic side effects. Brinzolamide tends to be better tolerated, as it is less irritant. However, care must be taken with topical carbonic anhydrase inhibitors when corneal endothelial function is compromised.

It is possible that latanoprost may be less efficacious in children both as a monotherapy and in combination with other medications.[23] There is evidence to suggest that it is less effective in Sturge–Weber patients[24] and a decline in success over time occurs when used as adjunctive therapy.[25] However, more data are required in children. Parents should be advised about the possibility of longer, thicker hyperpigmented eyelashes and the potential for permanent iris colour change, which has been reported in a 1-year-old child with blue–grey irides following 5.5 months of treatment.[26] Its very long-term side effects are largely unknown.

Surgery

Angle surgery

Angle surgery is the procedure of choice for PCG. The safety of goniotomy depends largely on adequate corneal clarity, but also on maintenance of a deep anterior chamber (AC) to visualise the angle structures and minimise intraocular trauma. The introduction of viscoelastics[27–30] has contributed to the safety of goniotomy by providing a deep and stable AC throughout the procedure, particularly at the extremes of the incision when distortion of the wound can lead to shallowing of the AC. However, they do increase the duration, complexity of the procedure and put the patient at risk of postoperative IOP spikes if they are not thoroughly removed. Large lenses with a wide angle of view considerably improve the view during goniotomy (Figure 2).

In an attempt to avoid invasive intraocular surgery, photodisruptive goniotomy has been performed with Q-switched Nd:YAG laser, which is quick and relies less on corneal clarity. Despite encouraging early results,[31] it has not proven to be a useful tool for goniotomy. In an attempt to improve visualisation of the angle in the presence of a hazy cornea, coaxial endoscopic goniotomy has been described in a case, which resulted in clearing of the cornea sufficiently enough to subsequently perform conventional goniotomy.[32]

Conventional angle surgery incises 90–120° of the angle, but success is known to improve with repeat surgery in the non-operated part of the angle by intorting or extorting the eye. It is in this context that the technique of suture trabeculotomy was described as an alternative to conventional angle surgery. It involves the use of 6/0 polypropylene suture to achieve a 360° trabeculotomy and is claimed to be more successful along with avoiding some of the difficulties encountered with a trabeculotome, such as false passages.[33,34] However, success is not always possible with a single incision and other technical difficulties along with severe hypotony[35] and subretinal positioning of the suture have been reported. The use of a fine illuminated fibre optic probe has been described, which may increase the ease and safety of this procedure.

Filtering surgery

Trabeculectomy is the operation of choice in secondary paediatric glaucomas and in PCG cases in whom angle surgery has failed, or when angle surgery is not possible because of limited experience. It may also be more appropriate when a very low target pressure is required due to advanced disease or where the severity is associated with a poor prognosis, for example, corneal diameter greater than 14 mm.

The main challenges in performing filtering surgery in children relate to the fact that: (i) they are more prone to failure, due to a more aggressive healing response and thicker Tenon's capsule with its large reservoir of fibroblasts and (ii) they are more prone to complications intra- and postoperatively, largely due to the anatomical reasons of a buphthalmic eye with its thin sclera and low scleral rigidity. The former explains why the long-term success rates of an unenhanced trabeculectomy in children are poor.[36,37] Mitomycin-C (MMC) has been used in an attempt to improve surgical success rates, but there is conflicting evidence in the literature as to its usefulness,[38] due to the various definitions of success, age of patients and duration of follow-up. However, what is not disputed is the association of antimetabolite trabeculectomies with thin avascular cystic blebs. These are known to be a major risk factor for chronic complications such as potentially blinding bleb-related infections with a reported incidence as high as 17% in children.[39] Chronic bleb-related complications are particularly significant in children due to their considerable lifetime risk (Figure 3).

Our recent understanding of the importance of trabeculectomy technique to bleb morphology (Figure 4), has led to a dramatic reduction in chronic bleb-related complications.[40] A number of modifications to the filtering technique have been described in achieving

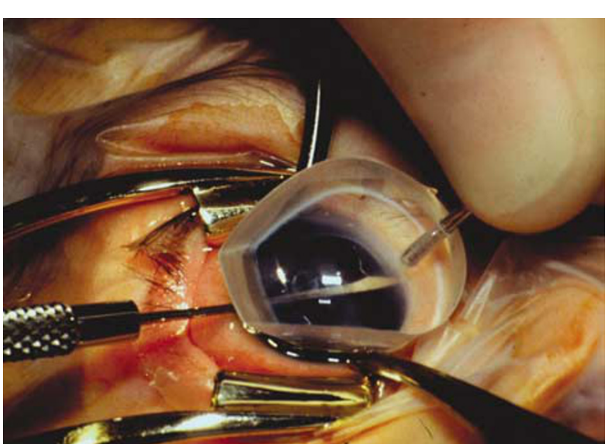

Figure 2 Goniotomy with wide view lens.

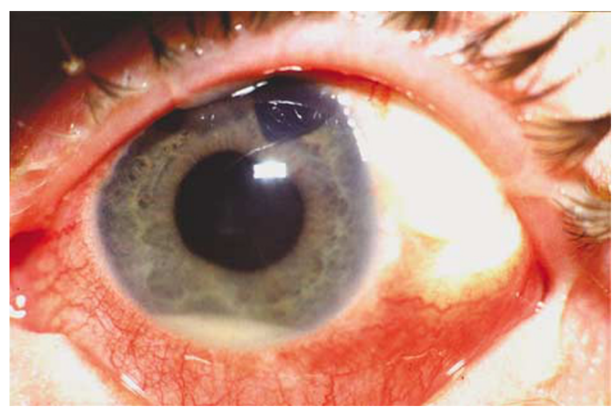

Figure 3 Endophthalmitis in child with a cystic bleb following surgery with small surface area of mitomycin.

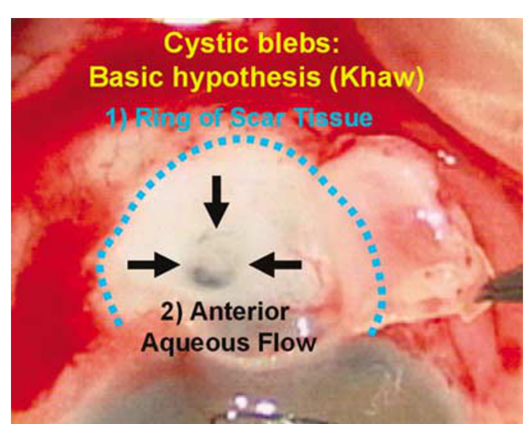

Figure 4 Khaw cystic blebs hypothesis.

favourable bleb morphology.[41] An ideal bleb is one which is elevated and diffuse, without any restricting scar, the so-called 'ring of steel'. A combination of the following three techniques is likely to achieve this: (i) fornix-based conjunctival flap,[40] as it minimises the chance of a posterior scar restricting aqueous diffusion, often seen following the posterior incision of limbal-based conjunctival surgery, (ii) large antimetabolite treatment area,[42] which results in a greater area for diffusion, and (iii) posterior flow encouraged through a large, scleral flap with short side incisions, with thoughtful placement of a combination of fixed, adjustable and releasable sutures to avoid anterior limbal aqueous jets (Figure 5).

Furthermore, the realisation that buphthalmic eyes are more prone to complications due to low scleral rigidity and thin sclera has led to the intraoperative use of an anterior chamber maintainer on a three-way tap to minimise anterior chamber shallowing and the risk of intraoperative choroidal effusions and suprachoroidal haemorrhage to which these eyes are particularly susceptible. It also allows one to judge flow through the scleral flap and place extra sutures for tight closure to reduce the risk of postoperative hypotony (Figures 6, 7, and 8).

Drainage surgery

Tube drainage surgery remains an important part of the therapeutic repertoire in paediatric glaucoma as it offers the best chance of long-term IOP control in a small proportion of patients whose disease relentlessly progresses despite conventional surgical treatment. Furthermore, it is indicated if future intraocular surgery such as cataract extraction is contemplated, as it is more likely to control IOP postoperatively than filtering surgery (Figure 9). The threshold for drainage surgery in challenging refractory paediatric glaucoma cases has lowered over the years. The reasons being that results are more predictable and definitive than cyclodiode treatment and possibly better than filtering surgery in infants.[43] Furthermore, they allow the use of contact lenses in aphakia and the long-term risk of infection is theoretically lower than that of trabeculectomy. There are no prospective, randomised trials comparing filtering surgery to drainage implants in children, and the retrospective data currently published are contradictory.[43,44] The prevailing current opinion is that tubes are best implanted sooner rather than later in the hope of achieving early, definitive IOP control and in doing so optimising long-term visual prognosis.

With regards success, comparison of the available retrospective case series is difficult because of the varying criteria for success and duration of follow up but certain conclusions can be drawn (i) success

Figure 5 Dramatic change in bleb appearance. Patients left eye using old technique, right eye using new technique.

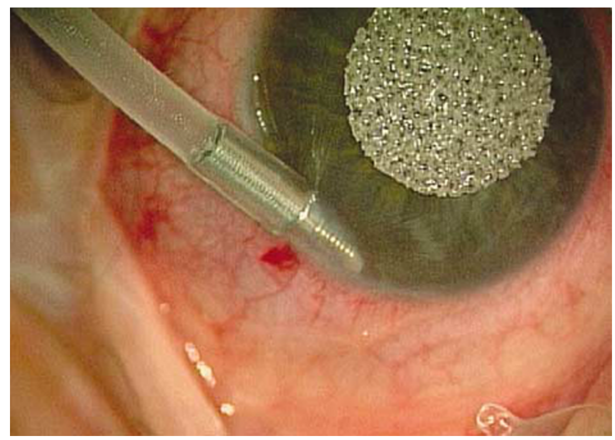

Figure 6 Anterior segment infusion.

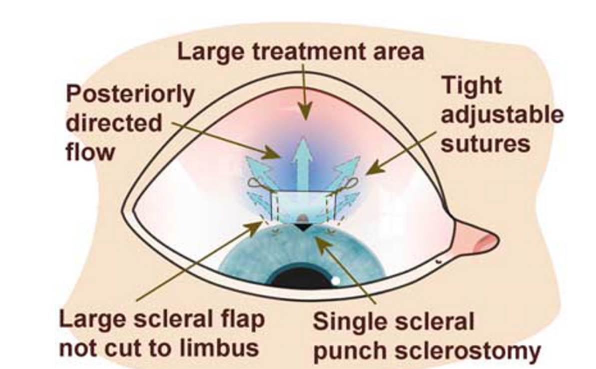

Figure 7 Improved techniques resulting in reduced hypotony and diffuse non-cystic blebs.

Figure 8 Sturge–Weber with secondary glaucoma and myopia. Highrisk of suprachoroidal haemorrhage minimized with anterior chamber maintainer.

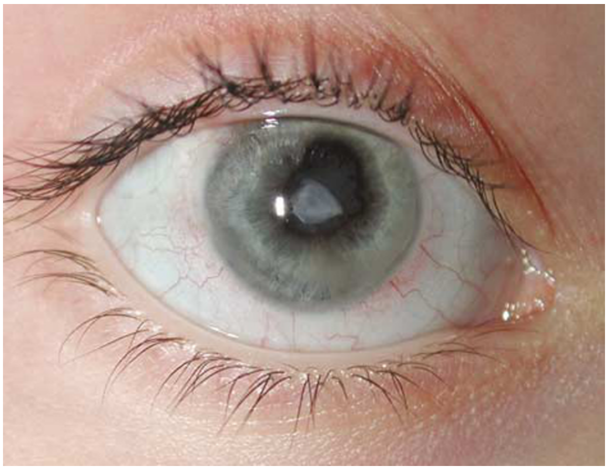

Figure 9 Uveitis with glaucoma, cataract and synechiae. Tube surgery survives better than trabeculectomy following cataract surgery.

approximates 80% in the first year regardless of implant type, similar to adults (ii) success declines with duration of follow up, again as in adults, and (iii) the definition of success invariably includes medical treatment as most patients require these to control IOP after surgery.[38] Currently there are no data available regarding the adjunctive use of MMC in paediatric implants, although smaller plates without antimetabolite, such as the single-plate Molteno, are much more likely to encapsulate with poor pressure control (Figures 10 and 11).

Although it may be argued that drainage devices offer the most effective long-term treatment for IOP control in refractory cases, they are associated with significant complication rates. The problems usually relate to hypotony or to the tube itself (eg occlusion, retraction, corneal, or iris touch) and can result in visual loss. Buphthalmic eyes are especially prone to hypotony-related complications because reduced scleral rigidity allows leakage around the tube at its entry site, making subsequent problems such as choroidal effusions and suprachoroidal haemorrhage more likely, even with the use of valved implants. There are a number of modifications that can minimise intra- and postoperative hypotony: an anterior chamber maintainer (Lewicky cannula); a relatively long and 'snug' limbal tunnel incision with a 25 gauge needle; the use of an intraluminal suture (3/0 Supramid); an external ligating suture (6/0 vicryl) with a venting 'Sherwood' slit[45] and viscoelastic or intraocular gases such as 20% C_3F_8 in the anterior chamber if required. To minimise the complications related to the tube itself, care should be taken to avoid: exposure by constructing a scleral tunnel 1–2 mm from the limbus; corneal-tube touch by directing the 25G needle away from the cornea, close and parallel to iris once the AC is entered; tube occlusion from iris by

Figure 10 Encapsulated bleb in child with single-plate Molteno.

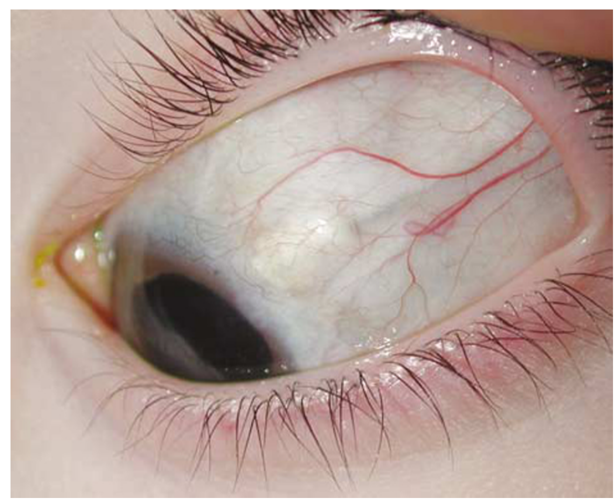

Figure 11 Single plat Molteno tube with antimetabolite-diffuse quiet bleb.

beveling the tube and having the bevel face the cornea and tube retraction by leaving at least a 2 mm length of tube in the AC. Vitreous occlusion in aphakes is prevented by performing a thorough anterior vitrectomy in all cases. If viscoelastics are used and left in the eye, sterile air is a useful adjunct to reduce postoperative pressure spikes (Figure 12).

Cyclodestruction

A number of cyclodestructive procedures have been described for use in: blind painful eyes; eyes with poor visual potential, or in whom surgery either has a poor prognosis, or is technically impossible (eg severely scarred conjunctiva). Contact trans-scleral semi-conductor diode laser (810 nm) has become increasingly more popular than Nd:YAG laser and cyclocryotherapy as a method of ciliary body ablation.

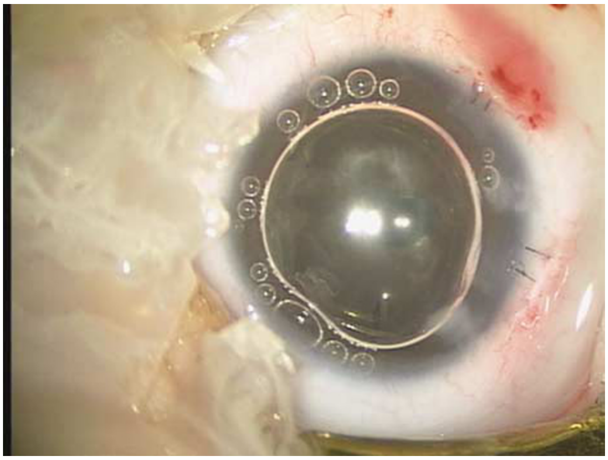

Figure 12 Use of air to prevent postoperative IOP spike.

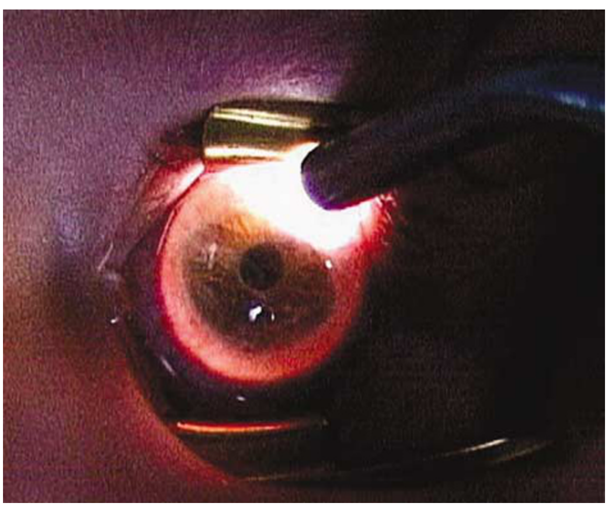

Figure 13 Transillumination in buphthalmic eye.

Apart from being compact and portable, diode laser has the advantageous properties of improved penetration and transmission with conjunctival and scleral compression, and more selective absorption by the ciliary body, leading to coagulative necrosis. As a result, it is better tolerated and less complications have been reported than with Nd:YAG laser and cyclocryotherapy.[46–49] It has a satisfactory pressure lowering effect in the short term with an apparently low risk of serious complications (including phthisis) and a rapid rehabilitation.[48,49] However, the disadvantages include the need to be repeated to achieve and maintain IOP control, which probably increases the likelihood of phthisis, and also the requirement of ongoing medical treatment post laser. It is important to use transillumination in buphthalmic eyes to avoid inadvertent treatment of the iris base as the normal anatomical landmarks are unreliable (Figure 13).

The use of endoscopic diode laser cyclophotocoagulation has been reported in a series of 36 eyes, with a cumulative success rate of 43% similar to that of diode and Nd:YAG laser but with a lower retreatment rate.[50] The biggest drawback of this technique is the intraocular approach, which may increase the risk of infection, cataract formation and other significant surgical complications such as retinal detachment in aphakic patients.

Other considerations with cyclodestructive procedures are predisposing the eye to hypotony from chronic aqueous hyposecretion if future implant surgery is required,[49] and possibly to long-term fibrotic failure from the destruction of the blood aqueous barrier and subsequent release of inflammatory mediators bathing the drainage site.

Conclusion

There have been many advances in the management of the paediatric glaucomas particularly in the field of surgery, which have significantly improved the management of these often difficult and challenging cases.

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References

1 Papadopoulos M, Khaw PT. Childhood glaucoma. In: Taylor D, Hoyt CS (eds) *Pediatric Ophthalmology Strabismus*. Elsevier Saunders: Philadelphia, 2005, pp 458–471.
2 Taylor RH, Ainsworth JR, Evans AR, Levin AV. The epidemiology of pediatric glaucoma: the Toronto experience. *J AAPOS* 1999; **3**: 308–315.
3 Shaffer RN, Weiss DI. Infantile glaucoma: diagnosis and differential diagnosis. *Congenital and Pediatric Glaucomas*. CV Mosby: St Louis, 1970, pp 37–59.
4 Papadopoulos M, Cable N, Rahi J, Khaw PT, The BIG Eye Study Investigators. The British Infantile/Childhood Glaucoma (BIG) Eye Study. *Invest Ophthalmol Vis Sci* 2007, (in press).

5 Duke-Elder S. *System of Ophthalmology*. CV Mosby: St Louis, 1969, pp 548–565.
6 Richardson KT, Ferguson Jr WJ, Shaffer RN. Long-term functional results in infantile glaucoma. *Trans Am Acad Ophthamol* 1967; **71**: 833–836.
7 Barkan O. Operation for congenital glaucoma. *Am J Ophthalmol* 1942; **25**: 552–568.
8 Smith R. A new technique for opening the canal of Schlemm. Preliminary report. *Br J Ophthalmol* 1960; **44**: 370–373.
9 Smith R. Nylon filament trabeculotomy in glaucoma. *Trans Am Ophthalmol Soc UK* 1962; **82**: 439–454.
10 Burian HM. A case of Marfan's syndrome with bilateral glaucoma: with description of a new type of operation for developmental glaucoma (trabeculotomy *ab externo*). *Am J Ophthalmol* 1960; **50**: 1187–1192.
11 Allen L, Burian HM. Trabeculotomy *ab externo*. A new glaucoma operation: technique and results of experimental surgery. *Am J Ophthalmol* 1962; **53**: 19–26.
12 Dannheim R, Harms H. Technic, success and mode of action of trabeculotomy. *Klin Monatsbl Augenheilkd* 1969; **155**: 630–637.
13 Sampaolesi R, Caruso R. Ocular echometry in diagnosis of congenital glaucoma. *Arch Ophthalmol* 1982; **100**: 574–577.
14 Buschmann W, Bluth K. Eine echographische methode zur verlaufskontrolle angeborener glaukome. *Graefe's Arch Clin Exp Ophthalmol* 1974; **192**: 313–329.
15 Henriques MJ, Vessani RM, Reis FA, de Almeida GV, Betinjane AJ, Susanna Jr R. Corneal thickness in congenital glaucoma. *J Glaucoma* 2004; **13**: 185–188.
16 Muir KW, Jin J, Freedman SF. Central corneal thickness and its relationship to intraocular pressure in children. *Ophthalmol* 2004; **111**: 2220–2223.
17 Brandt JD, Casuso LA, Budenz DL. Markedly increased central corneal thickness: an unrecognised finding in congenital aniridia. *Am J Ophthalmol* 2004; **137**: 348–350.
18 Whitson JT, Liang C, Godfrey DG, Petroll WM, Cavanagh HD, Patel D *et al*. Central corneal thickness in patients with congenital aniridia. *Eye Contact Lens* 2005; **31**: 221–224.
19 Passo MS, Palmer EA, Van Buskirk EM. Plasma timolol in glaucoma patients. *Ophthalmol* 1984; **91**: 1361–1363.
20 International Glaucoma Association. www.iga.org.uk.
21 Ott EZ, Mills MD, Arango S, Getson AJ, Assaid CA, Adamsons IA. A randomized trial assessing dorzolamide in patients with glaucoma who are younger than 6 years. *Arch Ophthalmol* 2005; **123**: 1177–1186.
22 Portellos M, Buckley EG, Freedman SF. Topical *vs* oral carbonic anhydrase inhibitor therapy for pediatric glaucoma. *J AAPOS* 1998; **2**: 43–47.
23 Enyedi LB, Freedman SF. Latanoprost for the treatment of pediatric glaucoma. *Surv Ophthalmol* 2002; **47**(Suppl 1): S129–S132.
24 Yang CB, Freedman SF, Myers JS, Buckley EG, Herndon LW, Allingham RR. Use of latanoprost in the treatment of glaucoma associated with Sturge–Weber syndrome. *Am J Ophthalmol* 1998; **126**: 600–602.
25 Ong T, Chia A, Nischal KK. Latanoprost for the treatment of paediatric glaucoma. *Br J Ophthalmol* 2003; **87**: 1091–1093.
26 Brown SM. Increased iris pigment in a child due to latanoprost. *Arch Ophthalmol* 1998; **116**: 1683–1684.
27 Winter R. Technical modification in goniotomy using high viscous hyaluronic acid. *Dev Ophthalmol* 1985; **11**: 136–138.
28 Hodapp E, Heuer DK. A simple technique for goniotomy. *Am J Ophthalmol* 1986; **102**: 537.
29 Arnoult JB, Vila-Coro AA, Mazow ML. Goniotomy with sodium hyaluronate. *J Ped Ophthalmol Strabismus* 1988; **25**: 18–22.
30 Tamçelik N, Õzkiri° A. A comparison of viscogoniotomy with classical goniotomy in Turkish patients. *Jpn J Ophthalmol* 2004; **48**: 404–407.
31 Senft SH, Tomey KF, Traverso CE. Neodymium-YAG laser goniotomy *vs* surgical goniotomy. *Arch Ophthalmol* 1989; **107**: 1773–1776.
32 Joos KM, Shen JH. An ocular endoscope enables a goniotomy despite a cloudy cornea. *Arch Ophthalmol* 2001; **119**: 134–135.
33 Beck AD, Lynch MG. 360° trabeculotomy for primary congenital glaucoma. *Arch Ophthalmol* 1995; **113**: 1200–1202.
34 Mendicino ME, Lynch MG, Drack A, Beck AD, Harbin T, Pollard Z *et al*. Long-term surgical and visual outcomes in primary congenital glaucoma: 360° trabeculotomy *vs* goniotomy. *J AAPOS* 2000; **4**: 205–210.
35 Gloor BRP. Risks of 360 degree suture trabeculotomy. *Ophthalmologe* 1998; **95**: 100–103.
36 Beauchamp GR, Parks MM. Filtering surgery in children: barriers to success. *Ophthalmol* 1979; **86**: 170–180.
37 Gressel MG, Heuer DK, Parrish RK. Trabeculectomy in young patients. *Ophthalmol* 1984; **91**: 1242–1246.
38 Tanimoto SA, Brandt JD. Options in pediatric glaucoma after angle surgery has failed. *Curr Opin Ophthalmol* 2006; **17**: 132–137.
39 Sidoti PA, Belmonte SJ, Liebmann JM, Ritch R. Trabeculectomy with mitomycin-C in the treatment of pediatric glaucomas. *Ophthalmol* 2000; **107**: 422–429.
40 Wells AP, Cordeiro MF, Bunce CV, Khaw PT. Cystic bleb formation and related complications in limbus *vs* fornix based conjunctival flaps in pediatric and young adult trabeculectomy with mitomycin C. *Ophthalmol* 2003; **110**: 2192–2197.
41 Jones E, Clarke J, Khaw PT. Recent advances in trabeculectomy technique. *Curr Opin Ophthalmol* 2005; **16**: 107–113.
42 Khaw PT, Sarodia U. Achieving the perfect post operative conjunctiva. *Glaucoma Today* 2007; **5**: 32–34.
43 Beck AD, Freedman S, Kammer J, Jin J. Aqueous shunt devices compared with trabeculectomy with mitomycin C for children in the first two years of life. *Am J Ophthalmol* 2003; **136**: 994–1000.
44 Hill R, Orhanesian R, Voskanyan L, Malayan A. The Armenian Eye Care Project: surgical outcomes of complicated paediatric glaucoma. *Br J Ophthalmol* 2003; **87**: 673–676.
45 Sherwood MB, Smith MF. Prevention of early hypotony associated with Molteno implants by a new occluding stent technique. *Ophthalmol* 1993; **100**: 85–90.
46 Phelan MJ, Higginbotham EJ. Contact transcleral Nd:YAG laser cyclophotocoagulation for the treatment of refractory pediatric glaucoma. *Ophthalmic Surg Lasers* 1995; **26**: 401–403.
47 Wagle NS, Freedman SF, Buckley EG, Davis JS, Biglan AW. Long term outcome of cyclocryotherapy for refractory pediatric glaucoma. *Ophthalmol* 1998; **105**: 1921–1927.
48 Bock CJ, Freedman SF, Buckley EG, Shields MB. Transscleral diode laser cyclophotocoagulation for refractory pediatric glaucomas. *J Ped Ophthalmol Strabismus* 1997; **34**: 235–239.
49 Kirwan JF, Shah P, Khaw PT. Diode laser cyclophotocoagulation: role in the management of refractory pediatric glaucomas. *Ophthalmol* 2002; **109**: 316–323.
50 Neely DE, Plager DA. Endocyclophotocoagulation for management of difficult pediatric glaucomas. *J AAPOS* 2001; **5**: 221–229.