

TRABECULOTOMY VERSUS TRABECULECTOMY FOR PRIMARY CONGENITAL GLAUCOMA

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Abstract

The aim of this study was to compare the visual acuity and intraocular pressure (IOP) in children who underwent either trabeculotomy or trabeculectomy as an initial surgical procedure for primary congenital glaucoma. This retrospective study involved 38 eyes (21 patients) with primary congenital glaucoma treated by trabeculotomy and 45 eyes (26 patients) that underwent trabeculectomy. The inclusion criteria were: (i) diagnosis of primary congenital glaucoma and initial surgery before 1 year of age, (ii) no other ocular or systemic diseases, (iii) trabeculotomy or trabeculectomy as the first surgical procedure, and (iv) conditions permitting the assessment of visual acuity. A postoperative vision of 6/18 or better was considered a good outcome. Surgical success was defined as IOP less than 21 mmHg with or without medication and without evidence of glaucoma-associated, progressive optic neuropathy. All children were followed up for 3 to 10 years. IOP was successfully controlled in 89% of the trabeculotomy group eyes and in 54% of the eyes in the trabeculectomy group ($P = 0.007$). In the trabeculotomy group, 74% eyes had a corrected vision of 6/18 or better compared with 51% in the trabeculectomy group ($P = 0.027$). It was concluded that, at long-term follow-up, trabeculotomy appeared to be a more effective procedure than standard trabeculectomy for treatment of primary congenital glaucoma, because it gave better outcomes in terms of IOP control and visual acuity.

Key words

Primary congenital glaucoma, Trabeculotomy, Trabeculectomy, Visual acuity, Intraocular pressure

INTRODUCTION

Advances in microsurgery, the development of goniotomy and trabeculotomy, and means of early diagnosis have improved prognosis in children with primary congenital glaucoma. Several recent studies have reported that approximately 50% of the children with congenital glaucoma who undergo conventional antiglaucoma surgery (goniotomy, trabeculotomy or trabeculectomy), achieve a vision of 6/18 or better (1–7). The prognosis of improved visual acuity seems less favorable for patients with unilateral congenital glaucoma, since fewer than 40% of these patients have achieved the 6/18 or a better value (4, 6). With conventional angle surgery, a small part of the chamber angle is “opened” in each procedure, and more than one procedure is often needed for pressure control (1, 2, 4, 6, 7).

The aim of our investigation was to compare the outcomes of trabeculectomy treatment in the period from 1990 to 1995 with the outcomes of trabeculotomy performed between 1995 and 1999. This retrospective study was based on data obtained from clinical records of children with primary congenital glaucoma treated at the Department of Paediatric Ophthalmology, Paediatric Teaching Hospital, Faculty of Medicine in Brno.

MATERIALS AND METHODS

We reviewed clinical records of children treated for primary congenital glaucoma at our department between 1990 and 1999 and included the children who met the following criteria: (i) diagnosis of glaucoma and subsequent surgery before 1 year of age; (ii) glaucoma was not associated with another ocular or systemic disease (concomitant disease); (iii) trabeculectomy or ab externo trabeculotomy was the first surgical procedure performed; (iv) duration of follow-up sufficient for the determination of visual acuity. The children were allocated to two groups (trabeculectomy or trabeculotomy) according to the surgical procedure used.

Postoperative visual acuity was defined as good (6/18 or better), fair (6/24 to 6/60) or poor (worse than 6/60). The refractive error was measured as the spherical equivalent of a cycloplegic refraction. Surgical success was defined as intraocular pressure (IOP) less than 21 mmHg, with or without glaucoma medication, with no evidence of glaucoma-associated progressive optic neuropathy and no other glaucoma surgery. Two independent measurements on two visits that showed IOP greater than or equal to 22 mmHg were regarded as treatment failure. In addition, the occurrence of one of the following facts was considered treatment failure: (i) IOP more than 22 mmHg or higher at 60 postoperative days, with or without glaucoma medication or (ii) subsequent procedure other than trabeculotomy when additional surgery was required. The duration of IOP control from the initial surgery until either the failure of pressure control or the last IOP measurement was determined for each eye.

The results were statistically evaluated. The Kaplan-Meier method was used to estimate the probability of IOP control in relation to time after surgery in each group. The differences in IOP values between the trabeculectomy and trabeculotomy groups were compared using a log-ranked test (Wilcoxon test). The χ^2 test was used to compare the following results between the two groups: (i) proportions of eyes with continued pressure control on the last visit, (ii) proportions of eyes with a visual acuity of 6/18 or better on the last measurement and (iii) proportions of eyes with both good visual acuity and continued pressure control on the last visit. The Wilcoxon nonparametric test was used to compare the magnitude of refractive errors, found on the last examination, between the two groups. The $P < 0.05$ values were considered statistically significant.

RESULTS

A total of 47 patients met the criteria of the study. All children who underwent antiglaucoma surgery were in the care of a paediatric ophthalmologist for amblyopia management when present. Between 1990 and 1995, 26 patients (45 eyes) were treated by trabeculectomy; between 1995 and 1999, 21 patients (32 eyes) had trabeculotomy (*Table 1*).

Of 38 eyes in the trabeculotomy group, 34 (89.1%) had controlled IOP on the last visit. All eyes were treated by a single procedure and 17 eyes required antiglaucoma medication to maintain pressure control. Of 45 eyes in the trabeculectomy group, 24 (54.2%) had controlled IOP on the last visit and 16 eyes

Table 1

Data characterising the patient groups

Characteristics	Trabeculectomy group	Trabeculotomy group
No. of patients	26	21
No. of eyes	45	38
Unilateral/bilateral cases	7/19	4/17
Boys/girls (%)	76/24	68/32
Mean age at surgery (range)	5.1 mo (1.3–10.4 mo)	3.8 mo (1.1–8.9 mo)
Mean follow-up (range)	8.2 yr (5.6–11.3 yr)	4.3 yr (2.9–6.3 yr)

Table 2

Visual acuity outcome on the last visit

Visual acuity assessment	Trabeculectomy group (45 eyes)	Trabeculotomy group (38 eyes)
Good (6/6 to 6/18)	23 (51.2%)	28 (74%)
Fair (6/20 to 6/60)	15 (33.3%)	7 (18%)
Poor (<6/60)	7 (15.5%)	3 (8%)

received antiglaucoma medication. The success rate was significantly higher in the trabeculotomy group ($P = 0.007$).

The analysis involving only the eyes treated as first in bilateral cases showed that 31 of 34 eyes (91%) in the trabeculotomy group and 21 of 38 eyes (55%) in the trabeculectomy group achieved successful pressure control. The difference between the two groups was statistically significant ($P = 0.013$).

Successful IOP control was achieved by one operation in 21 (47%) of 45 eyes and 29 (76 %) of 38 eyes in the trabeculectomy and trabeculotomy groups, respectively, when recorded at 2 years postoperatively. The trabeculotomy group, therefore, showed significantly better long-time results than the trabeculectomy group ($P = 0.021$). The proportion of eyes with good vision was higher in the trabeculotomy than the trabeculectomy group (28/38 vs. 23/45, i.e., 74 % vs 51 %; $P = 0.027$) (Table 2).

The causes of failure in both the trabeculotomy and trabeculectomy groups (10 and 22 eyes, respectively) are shown in *Table 3*. Poor outcomes in most of the patients were associated with patients' poor compliance with the postoperative regimen prescribed, including amblyopia therapy.

Of 38 eyes in the trabeculotomy group, 29 (76%) had both successful pressure control and good vision. Of 45 eyes in the trabeculectomy group, 19 (42%) had both successful pressure control and good vision. The overall success rate was significantly higher in the trabeculotomy group ($P = 0.014$). The results in relation to the magnitude of refractive errors are shown in *Table 4*.

Most of the eyes in both groups were emmetropic or slightly hyperopic. High myopia was more prevalent in the trabeculectomy group. However, the magnitudes of refractive errors did not differ significantly between the two groups ($P = 0.23$).

Table 3

Causes of fair and poor visual acuity outcomes

Cause	Trabeculectomy group (n=22)	Trabeculotomy group (n=10)
Failed surgery	13 (59%)	3 (30%)
Poor compliance	7 (32%)	6 (60%)
Undetermined	2 (9%)	1 (10%)

Table 4

Proportions of eyes with refractive errors (in %)

Refractory status (in dioptres)	Trabeculectomy group (n = 45)	Trabeculotomy group (n = 38)
> +1.0 D	22%	35%
-1.0 to +1.0 D	31%	41%
-3.0 to -1.0 D	19%	10%
< -3.0 D	28%	14%

DISCUSSION

Both conventional trabeculectomy and trabeculotomy result in successful IOP control in up to 90% of patients with primary congenital glaucoma. (1, 2, 4, 7, 9, 10). Many of these patients require more than one trabeculectomy procedure to have a good outcome whereas, in other patients, only a single trabeculotomy procedure is sufficient to achieve equally successful results (8). Several studies have shown that, after trabeculectomy and goniotomy, only 50% of the eyes have a visual acuity of 20/50 or better (1-7).

The present study recorded the visual acuity outcome and refractive status in eyes after trabeculectomy and compared these data with the results after ab externo trabeculotomy. The results indicate that better outcomes can be achieved by a single trabeculotomy than by one or multiple trabeculectomies. The fact that, in some cases, IOP control improves with additional goniotomies suggests that the extent to which the angle is opened is important for the outcome.

In trabeculotomy ab externo, the procedure follows a more standard course than in goniotomy. Once the external wall of Schlemm's canal is identified and cannulated, the remainder of the procedure (i.e., "opening" of the angle) is uniform in each eye. In goniotomy, on the other hand, the position of a goniotomy knife and depth of incision may vary with each surgeon and even within the angle tissue of the same eye. It is also possible that a better surgical outcome of trabeculotomy is related not to the surgical procedure itself but to some other aspects of management. For instance, with trabeculotomy, the standard practice is to use topical pilocarpine for several weeks after the operation while the eye heals. It is possible that the prolonged exposure to a miotic agent during the healing phase helps the angle region to remodel in a way that is physiologically more efficient.

In our study, trabeculectomy gave good outcomes in terms of visual acuity in only 51.2% of the eyes treated whereas, after trabeculotomy, good outcomes were found in 74% of the eyes. *Barsoun-Homasy* (11) reported a vision of 20/50 or better in 77% of the children with congenital glaucoma who underwent treatment by different surgical procedures. The authors attributed the good visual acuity outcomes to early IOP normalisation (80% of eyes were surgically controlled within the first year), prompt optical correction of ametropia and sufficient amblyopia therapy.

The mean age at the time of antiglaucoma surgery was slightly lower in the trabeculotomy (3.8 months) than the trabeculectomy group (5.1 months). The reason may be that the trabeculectomy group included more refractory cases. Our success rate of 54.2% for trabeculectomy might be considered low compared with other reports in the literature, which may be explained by the fact that the follow-up period in our study was long, i.e., from 3 to 11 years. Some studies report a decrease in long-term effects after transient good outcomes in the early

postoperative period. For example, *Barsoum-Homsy* reported that 19 of 24 eyes (77%) with a standard angle procedure had good IOP control in the first year after surgery; this, however, dropped to 58% by 5 years after surgery (11). Similarly, *Broughton* (2) reported a 74% chance of success in the early postoperative period after goniotomy. However, this rate dropped to 59.7% at 4 years after surgery. *Richardson et al.* (4) reported a 92% success rate in pressure control many years after goniotomy in 54 patients. However, they included only those patients who came for regular check-ups; the authors state that their high success rate may be optimistic in that "patients with good results may be more likely to return for consistent follow-up." In contrast, our study identified all the children who had antiglaucoma surgery in the defined period (1990 to 1999) with continuing follow-up. *Gramer et al.* reported a 100% success in pressure control for 60 patients who had goniotomy and were followed up for over 18 years (1). However, these patients represented only 31% of the total goniotomies performed during that period, since 53% of the children were lost to follow-up. In contrast, we identified 47 patients who had antiglaucoma surgery during the period of 10 years and none was lost to follow-up. It is possible that, with an even longer duration of follow-up, more eyes in the trabeculotomy group may fail to maintain IOP control. A further long-term study would be needed to give an answer. However, most of the failures in the trabeculectomy group did occur within the first 2 years of surgery. We would expect that if the eyes in the trabeculotomy group had followed the same course, some of them would have begun to fail within the period of our study.

It can be concluded that, for the treatment of primary congenital glaucoma, trabeculotomy ab externo is a highly effective procedure that has better outcomes, in terms of IOP control and visual acuity, than conventional trabeculectomy.

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SROVNÁNÍ TRABEKULOTOMIE A TRABEKULEKTOMIE V LÉČBĚ PRIMÁRNÍHO VROZENÉHO GLAUKOMU

Souhrn

Záměrem práce je srovnání výsledků zrakových funkcí a stavu refrakce u dětí s primárním vrozeným glaukomem léčených trabekulotomií nebo trabekulektomií jako prvním chirurgickým zákrokem. Retrospektivní klinická studie hodnotí 38 očí u 21 dětí s primárním vrozeným glaukomem, u kterých bylo provedena trabekulotomie; a 45 očí u 26 dětí, u kterých byla provedena trabekulektomie jako první operace. Všechny děti splnily tyto podmínky: diagnóza primárního vrozeného glaukomu a první operace do věku 1 roku dítěte, žádné jiné oční nebo systémové onemocnění, trabekulotomie nebo trabekulektomie jako první operace, spolupráce dítěte při vyšetření zrakové ostrosti. Pooperační vizus 6/18 byl hodnocen jako dobrý. Chirurgický zákrok byl hodnocen jako úspěšný, pokud nitrooční tlak byl kompenzován pod hodnotou 21 mmHg bez nebo s dodatečnou lokální antiglaukomatozní medikací a nebyla přítomna progresivní glaukomová neuropatie. Všichni pacienti byli sledováni 3 až 10 let. Nitrooční tlak byl úspěšně kompenzován

u 89% očí po trabekulotomii a u 54% očí po trabekulektomii ($P = 0.007$). Ve skupině dětí po trabekulotomii mělo 74% očí vizus 6/18 a lepší, ve skupině dětí po trabekulektomii mělo tento vizus jen 51% očí ($P=0.027$). Vysoká myopie byla častější po trabekulektomii, ale rozdíl není statisticky významný ($P=0.19$). Horší výsledný vizus byl spojen se selháním chirurgického zákroku nebo s horší spoluprací při následné pooperační péči a léčbě amblyopie. V léčbě primárního vrozeného glaukomu je efektivnější trabekulotomie než trabekulektomie jako první operace. Srovnávací studie prokázala, že po trabekulotomii je lepší kompenzace nitroočního tlaku a lepší výsledný vizus než po trabekulektomii u těchto dvou skupin dlouhodobě sledovaných dětí s diagnózou primárního vrozeného glaukomu.

REFERENCES

1. *Gramer E, Tausch M, Kraemer C.* Time of diagnosis, reoperations and long-term visual results of goniotomy in the treatment of primary congenital glaucoma: a clinical study. *Int Ophthalmol* 1997; 20: 117–123.
2. *Broughton WL, Parks MM.* An analysis of treatment of congenital glaucoma by goniotomy. *Am J Ophthalmol* 1981;91:566–572.
3. *Robin AL, Quigley HA, Pollack IP, Maumenee AE, Maumenee IH.* An analysis of visual acuity, visual fields, and disc cupping in childhood glaucoma. *Am J Ophthalmol* 1979;88:847–858.1.
4. *Richardson KT, Ferguson WJ, Shaffer RN.* Long-term functional results in infantile glaucoma. *Tr Am Acad Ophthalmol Oto* 1967;71:833–837.
5. *Haas J.* Principles and problems of therapy in congenital glaucoma. *Invest Ophthalmol* 1968;7:140–146.
6. *Biglan AW, Hiles DA.* The visual results following infantile glaucoma surgery. *J Pediatr Ophthalmol Strabismus* 1979; 16: 377–381.
7. *Morgan KS, Black B, Ellis FD, Helveston EM.* Treatment of congenital glaucoma. *Am J Ophthalmol* 1981;92:799–803.
8. *Beck AD, Lynch MG.* Trabeculotomy for primary congenital glaucoma. *Arch Ophthalmol* 1995;113:1200–1202.
9. *Luntz MH, Livingston DG.* Trabeculotomy ab externo and trabeculectomy in congenital and adult-onset glaucoma. *Am J Ophthalmol* 1977; 83:174–179.
10. *McPherson SD, McFarland D.* External trabeculotomy for developmental glaucoma. *Ophthalmology* 1980; 87:302–305.
11. *Barsoum-Homsy M, Chevrette L.* Incidence and prognosis of childhood glaucoma. *Ophthalmology* 1986; 93:1323–1327.

