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Contact lenses for infant aphakia

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Abstract

We prospectively studied for three years the optical correction by contact lenses of 83 aphakic infants (141 eyes) who generally also had systemic and other ocular anomalies: 85% of the patients tolerated the lens wear for the whole study period. Complications occurred in 46 eyes and led to cessation of lens wear in two cases. Ten patients abandoned the lenses for other reasons. Thirty-four eyes needed subsequent intraocular surgery, mostly minor, and nine patients had strabismus surgery. Contact lenses are a versatile, safe, successful, and cost effective treatment for aphakia in infancy against which, before their widespread introduction for primary optical correction of infant aphakia, other methods of aphakic treatment need to be compared.

In 1959 Sato and Saito[1] presented two children fitted with hard contact lenses, and other early reports using hard lenses[2-4] described difficulties but good visual results. Soft contact lenses were used initially for adult aphakia,[5] but complications occurred, such as the 'tight-fit syndrome', corneal vascularisation, lens deposits, bacterial conjunctivitis, hypersensitivity, and corneal oedema, all partly due to fitting techniques or to the thickness of lenses. Preservatives were introduced to reduce the incidence of conjunctivitis, but hypersensitivity occurred to these agents.[6 7] Hard contact lenses for the correction of infantile aphakia have also been advocated,[8] including the use of silicone rubber lenses.[9]

Although spectacles are inexpensive, easily changed, and generally safe, they may be inappropriate for infants, as they are heavy, ugly and they create a prismatic effect, visual field constriction, and in monocular aphakes they are usually impracticable.[10]

Intraocular lenses have been used since the early 1970s,[11] but the difficulty in obtaining adequate parameters for infants, the subsequent growth of the eye after implantation, and the number of complications[12] make them unacceptable in view of the life-long nature of the treatment and the uncertainty of the lenses' long-term performance. There is little evidence to support the safety of even the newest generation of intraocular lenses in infants in the long term, and the rapid growth of the eye during the first year of life makes a permanent unchangeable power inappropriate.[13]

Epikeratophakia is a promising solution,[14 15] though the undercorrection of the refraction in infants and other problems, including the rapid change in refractive power of the eye in the first year of life,[16] suggest that it should be reserved as an alternative in some older patients who are intolerant to contact lenses.

Infantile aphakia needs an adaptable method of optical correction that allows the parameters to be easily changed, that has a low complication rate, and a high quality of optical correction. The method must also be practical and inexpensive to families and to the providers of medical care.

We present a review of our experience with the use of soft contact lenses, the incidence of complications, tolerance, co-operation from patients and parents, and the costs engendered.

Subjects and methods

From 31 December 1984 we have provided a contact lens service for aphakic infants. Included in our prospective study are all infants made aphakic within the first year of life, until 1 January 1988. Cases where anatomical or functional defects precluded useful vision were not optically corrected postoperatively.

The patients with bilateral cataracts usually had the operations done within three days of each other, with the first eye being patched in between to prevent the second eye from developing amblyopia. Two uniocular cases were traumatic, and one patient with Marfan's syndrome had a dislocated lens; the rest were congenital cataracts. The majority of patients came from outside London; nine patients lived abroad (Table I).

The lenses were fitted during the week following surgery; in bilateral cases both lenses were fitted at the same time. They were re-examined the next week, one month later, and then every three months, unless more frequent visits were required because of complications or lens handling difficulties. Parents were instructed to insert, remove, and clean the lenses daily from the beginning, with special emphasis on vigilance for complications and side effects. Lenses of high water content were used at first, and when the child no longer slept during the day they were changed to lenses of a lower water content.

Initially the lenses were cleaned daily with a surfactant cleaner and then sterilised by boiling in preservative-free saline. Once the parents were more used to the lenses a chlorine-based cleaning regimen (Softab) preceded by surfactant cleaning was used. Protein removal

TABLE I *Patient's travelling distance in miles from central London*

Number of miles	*Number of patients*
Peripheral London (0–15)	16
16–30	15
31–50	10
51–80	6
81–120	7
121–160	3
161–200	7
More than 200	5
From abroad	9
No information	5
Total	83

Note: 1 mile = 1·6 km.

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tablets were rarely used, as the lenses tended to become lost or broken before this became necessary.

After retinoscopy an overcorrection of around 2–3 dioptres was prescribed. The back optic radius (BOR) was selected on a trial basis according to the age of the patient on the known average corneal radius, which in neonates was 7·1 mm, and changes were made as needed. The diameter of the lenses and their fit was determined empirically from the corneal diameter and careful observation on the stability of the lens on the eye, with the size varying between microphthalmic and normal corneas. At each visit an ophthalmic examination was performed, including funduscopy and retinoscopy and, when possible, slit-lamp examination. The child was examined by an orthoptist when signs of a squint were apparent. Spectacles were prescribed as an alternative to contact lenses in case the contact lenses caused problems, and parents were given spare lenses, and extra lenses were mailed when necessary. A detailed verbal description of the risks and difficulties was given to the parents at the outset; more recently they have been given a booklet detailing the treatment.

Results

The surgical technique in 121 eyes was lensectomy with anterior vitrectomy. A lens aspiration without vitrectomy was performed in 19 cases. One eye had an intraocular lens implant, in a patient who lived far from London, and had a life span likely to be limited to three years.

The known age of onset of the visual deprivation from the cataracts was at birth in 109 of the eyes (77·3%). In six eyes the age of onset was unknown (Table II). 12·2% of the bilateral cases were operated on by 2 months and by 4 months of age, and 53·8% of the unilateral cases had surgery by 2 months and 85% by 4 months.

Twenty-six had associated systemic abnormalities (Table III), and 39 patients had other eye anomalies apart from the cataracts (Table IV). As regards postoperative complications, 11 eyes required pupilloplasties (Table V), mainly to maintain a clear visual axis when this became inadequate. Six eyes developed glaucoma, of which two improved on medical therapy. Four eyes required anterior vitrectomy, three of them to reduce increased intraocular pressure secondary to pupil block. Two of these improved with surgery; the other developed uncontrolled glaucoma with a blind, buphthalmic eye. One eye developed glaucoma of unknown cause, controlled with a trabeculectomy. The eyes with non-pupil-block glaucoma had anomalies additional to the cataracts.

Removal of residual lens matter with posterior capsulotomy was required in both eyes of one patient. Of the 19 patients who had lens aspiration without vitrectomy 14 required posterior capsulotomy. Nine patients underwent squint surgery. Five patients needed removal of sutures under general anaesthetic, and nine patients had examinations under general anaesthetic for various reasons. 141 eyes of 83 patients were fitted with soft contact lenses. Of these patients 67 were under 1 year of age, 58 were binocular aphakes, and 25 were uniocular.

Forty-three eyes had complications due to the use of contact lenses (Table VI). Twelve developed red eye, with no evidence of bacterial or viral infection; loose sutures were responsible for this in five cases. In those cases not due to loose sutures the eyes settled within a few days once the lenses were removed. In bilateral cases if one lens was removed the other was also, to equate the optical state of the two eyes. Eighteen patients had bacterial conjunctivitis which always improved with antibiotic treatment. Three patients had recurrent infections, probably due to improper cleaning of the lenses. Three patients who had hypoxic ulceration due to improper handling and inadequate removal of the lenses improved after regular and daily removal of lenses, but two of these were changed to spectacle wear.

Three patients developed intolerance, with red eye, discomfort, and watery discharge when the lenses were in, but they were completely asymptomatic when the lenses were out. None of these were related to giant papillary conjunctivitis, but when changed to HEMA (38% water content) soft contact lenses or silicone rubber

TABLE II *Age of onset of visual deprivation from cataract*

Onset (months)	*Bilateral*	*Unilateral*
0	48	13
1·5	1	1
2	2	–
3	1	–
5	–	2
6	1	2
8	2	1
9 or more	–	6
Unknown	3	–

TABLE III *Systemic abnormalities (83 patients)*

	Without other abnormalities	57
	With other abnormalities	26
a.	Down's syndrome	7
b.	Congenital rubella	7
c.	Marfan's syndrome	1
d.	Cerebro-oculo-facial-skeletal syndrome (Pena Shokeir)	2
e.	Cardiomyopathy; lactic acidosis	1
f.	Severe neonatal asphyxia	1
g.	Cerebral palsy	1
h.	Persistent fetal circulation; sepsis	1
i.	Ectopic anus	2
j.	Hearing problems	2

TABLE IV *Other ocular abnormalities (83 eyes)*

Persistent hyperplastic primary vitreous	4 eyes
Posterior lenticonus	4 eyes
Microphthalmos	2 eyes
Ant segment dysgenesis	21 eyes
Ectropion uveae	2 eyes
Dislocated lenses	2 eyes
Rubella retinopathy	1 patient
Heterochromia	1 patient
Blepharospasm	1 patient
Iridopupillary membrane	1 patient

TABLE V *Postoperative surgical complications (n=141 eyes)*

Pupilloplasty	11
Anterior vitrectomy	4
Glaucoma	6
(*a*) Improved medically	2
(*b*) Anterior vitrectomy	3
(*c*) Trabeculectomy	1
Residual lens matter extraction	2
Posterior capsulotomies	14
Squint surgery	9
Removal of sutures under GA	5
Examination under anaesthetic for other reasons	9
Total	60

TABLE VI *Number of eyes with contact lens induced complications (n=141)*

Red eye	12
Infection	18
Hypoxic ulceration	3
Fine vascularisation	3
Intolerance	3
Oedema	2
Punctate keratitis	2
Total	43

TABLE VII *Number of patients in whom contact lenses were discontinued (n=83)*

Hypoxic ulceration	2
High turnover	3
Parent's difficulties in handling contact lens	4
Others (preferred glasses)	3
Total	12

lenses they were symptom-free. Two patients had corneal oedema which subsided after removal of the contact lenses and change of parameters. 1 mm or more of corneal pannus developed in three patients. Two of them were changed to Polycon gas-permeable hard lenses, with reduction in the pannus; the other was changed to spectacle wear. Punctate keratitis necessitating temporary lens removal was diagnosed in two patients, and three patients had such a high incidence of loss or renewal of lenses (turnover) that their use was abandoned.

Twelve (14·5%) of the patients abandoned the lens wear (Table VII), two with hypoxic ulceration, three with a high lens turnover, and four with visually handicapped parents; three older children had no major problems but preferred to use spectacles. Five other patients stopped the use of contact lenses for more than one month but started them again.

81·1% of the eyes in the bilateral aphakes and 66·8% of the unilaterals had less than one lens replaced per month (Figs 1, 2). In the first six months of treatment there was a higher incidence than in later months of lens replacement either for changes in parameters or because the lenses were lost, broken, or rubbed out (Fig 3). 76·6% of the bilateral cases and 80·76% of the unilateral required less than one change of lens for reasons of change in parameters. Seven eyes were excluded from this figure because they had been treated for less than three months.

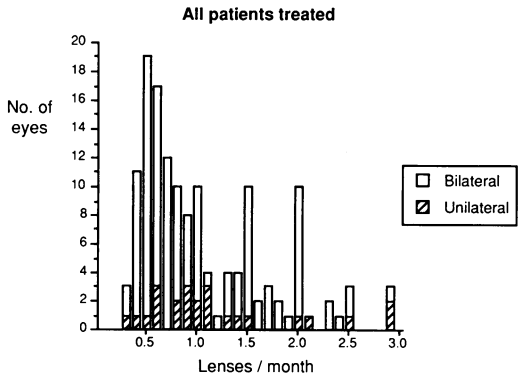

Figure 1: Total number of lenses per month per eye.

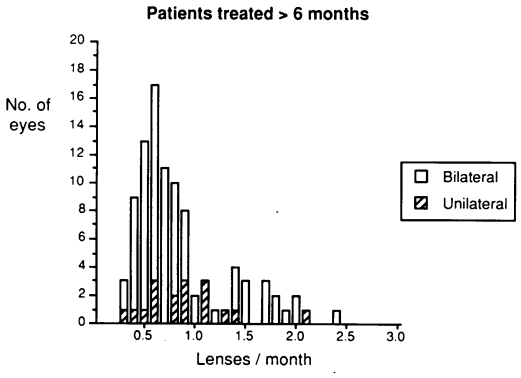

Figure 2: Number of lenses per month per eye in patients treated for more than six months.

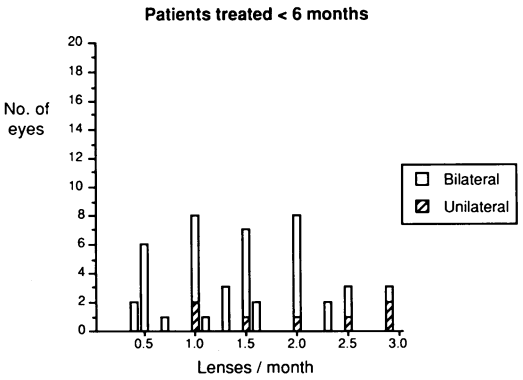

Figure 3: Number of lenses per month per eye in patients treated for less than six months. There is a higher turnover in the first six months.

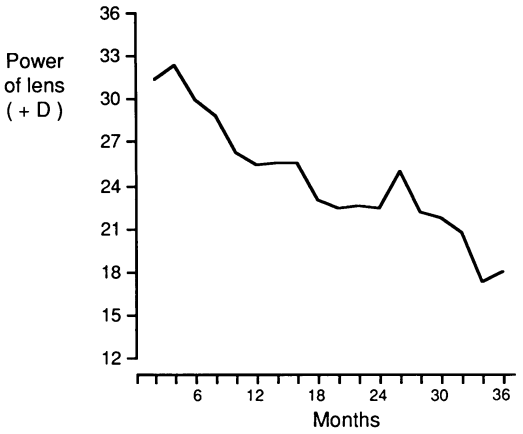

Figure 4: Power of the contact lenses compared with the age of the patients. As the age increases there is a steady decrease in the power of the contact lenses.

Figure 4 shows the average power of the lenses up to 3 years of age (the dioptric value range from 12 to 34 dioptres), clearly demonstrating how the required power of the lenses decreased as the infants grew. Microphthalmic eyes remained small, requiring high power lenses, even with age.

The number of lenses issued during this period was 1483. At a cost of £18 per lens, this totalled £26 694. The total cost of solutions was £3978. On average, the cost of lenses per month per patient was £28.50. In addition to this the costs of running the clinic must be taken into account, including the services of an optometrist, an ophthalmologist, an orthoptist, and nurses.

Discussion

Microsurgical techniques have considerably improved the outcome of infantile cataract surgery, and our results show that the number of reoperations is small, the majority of them being pupilloplasties, often to recentre the pupil when it has been decentred, usually by vitreous strands. Nine patients at risk for glaucoma required repeated examinations under anaesthetic, but the incidence of glaucoma was low, unless the eye was otherwise anomalous or microphthalmic.[13] We do not routinely remove the corneal sutures, but when these are loose, especially when contact lenses are used, they can cause irritation until removed.

With our contact-lens fitting protocol there is a

low incidence of side effects attributable to the use of the lenses. We have seen no cases of giant papillary conjunctivitis.[17-19] The low incidence of bacterial conjunctivitis, hypoxic ulceration, and corneal oedema is probably due to the daily lens removal and sterilisation regimen.

Although it may be thought that daily handling of the lenses increases the risks of infection, our experience suggests the opposite, and this may be due to the careful handling by well trained and dedicated parents. Electron microscopy[20] has shown that bacteria attach to the surface of soft contact lenses and 'proliferate' unless the lenses are removed, cleaned, and sterilised frequently.[21] Solutions with preservatives such as thiomersal or chlorhexidine may cause allergic reactions, but our handling scheme avoids this problem. The lens deposits associated with this method were usually avoided because of the high lens turnover.

The daily removal of lenses may appear daunting for parents, but most of them were willing and co-operative and learned within the first weeks. Four families could not get used to handling the lenses: in two cases, the mothers were blind, and in another the patient had very microphthalmic, sunken eyes.

The parents were impressed with the need to remove the lenses if there were any signs of infection, red eye, or discomfort. General practitioners cannot be expected to be experienced with the use of lenses and cannot usually advise on handling them or on the treatment of complications, so removal by the parents, especially if they live far from ophthalmological care, is especially important as a first step. When the child was older, or where corneal damage was evident, they were changed to more durable low-water-content lenses.

Three patients, two of whom had worn soft lenses for three years, developed superficial corneal vessels of less than 1 mm. The low incidence in this study was presumably due to the short period of follow up and the daily wear regimen.

Only 12 (14·5%) of the 83 patients discontinued use of their contact lenses. Three of these did not have a clinical reason to do so. They found it more convenient to use the spectacles, or they had an excessively high turnover rate. This rate is remarkably similar to the recently reported failure rate of Levin *et al*,[21] and there are sufficient other reports of successful contact lens wear in aphakic infants[22-25] to suggest that it is a technique that can be adopted by many departments already experienced with adult contact lenses provided some differences in management are used. Most parents were reluctant to change their child to spectacle wear even if the wearing of lenses had been difficult.

The loss of contact lenses in adults is relatively low.[26] Lens loss in infants is necessarily higher owing to the frequent change in parameters, the high rate of loss and breakage of lenses, and the ocular complications. Because of the necessary changes in contact lens parameters it is not practical to fit many children in the United Kingdom with silicone rubber lenses, which are slow and expensive to obtain and which have inherent surface problems. This material was therefore only occasionally used. Figures 4 and 5 show the change in power during the first year of life, and the frequent need to change parameter. This is in contrast to the study by Pratt-Johnson and Tillson,[8] who did not change hard lens parameters during the first five years of life. 81·1% of the eyes required fewer than one lens per month; many of these lenses can be reused once sterilised. The optical correction of infantile aphakia during the first three years of life costs £440 in contact lenses and £112 in solutions (aerosol saline and cleaning solution), making a total of £562. These costs do not include the services of an ophthalmologist and an optometrist, nor the considerable travel costs for parents (Table I).

The optical correction of infantile aphakia with daily wear soft contact lenses is an effective and economical method. It has the adaptability to respond to changes in the parameters, and the parents can easily insert and remove the lenses. It gives a high quality optical correction with a low incidence of complications. It is cost effective, though there are many hidden costs for the parents. With a contact lens tolerance rate of 85·5% it is difficult to see a need for alternative, relatively untried optical correction, such as intraocular lenses, for the primary correction of infantile aphakia.

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