

EXTENDED REPORT

Long term outcome of trichiasis surgery in the Gambia

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Background: Trichiasis surgery is believed to reduce the risk of losing vision from trachoma. There are limited data on the long term outcome of surgery and its effect on vision and corneal opacification. Similarly, the determinants of failure are not well understood.

Methods: A cohort of people in the Gambia who had undergone surgery for trichomatous trichiasis 3-4 years earlier was re-assessed. They were examined clinically and the conjunctiva was sampled for *Chlamydia trachomatis* polymerase chain reaction (PCR) and general bacterial culture.

Results: In total, 141/162 people were re-examined. Recurrent trichiasis was found in 89/214 (41.6%) operated eyes and 52 (24.3%) eyes had five or more lashes touching the globe. Corneal opacification improved in 36 of 78 previously affected eyes. There was a general deterioration in visual acuity between surgery and follow up, which was greater if new corneal opacification developed or trichiasis returned. Recurrent trichiasis was associated with severe conjunctival inflammation and bacterial infection. *C trachomatis* was detected in only one individual.

Conclusions: Recurrent trichiasis following surgery is a common potentially sight threatening problem. Some improvement in the cornea can occur following surgery and the rate of visual loss tended to be less in those without recurrent trichiasis. The role of conjunctival inflammation and bacterial infection needs to be investigated further. Follow up of patients is advised to identify individuals needing additional surgical treatment.

Trachoma is the leading infectious cause of blindness worldwide. Recurrent episodes of *Chlamydia trachomatis* infection promote a chronic follicular conjunctivitis, which can lead to progressive conjunctival scarring, trichiasis, entropion, and ultimately blinding corneal opacification. The World Health Organization (WHO) currently estimates that 1.9 million people are blind from trachoma and a further 7.6 million have trichiasis requiring lid surgery (provisional estimates presented to the IAPB Task Force Meeting, India, 2003). In a collaborative effort to control blinding trachoma by the year 2020 the WHO and its partners are implementing the SAFE strategy: Surgery for trichiasis, Antibiotic to reduce the burden of *C trachomatis* infection, Face washing, and Environmental improvement to interrupt transmission.¹ Of these interventions only trichiasis surgery has been demonstrated to reduce visual loss, largely because of the slowly progressive nature of the disease.²

In many endemic countries minor trichiasis (<5 lashes touching the globe) is often managed by repeated epilation. Major trichiasis (5+ lashes touching the globe) is usually treated surgically. Several alternative procedures are in use. In a formal comparison of a number of these the bilamellar tarsal rotation (BLTR) had the lowest recurrence rate of approximately 20% at 1 year and is therefore recommended by the WHO.^{2,3} In the Gambia and many other endemic countries the posterior lamellar tarsal rotation (PLTR) is used. This is believed to produce results comparable to the BLTR.^{4,5} Despite this reported short term success there is concern that the long term results of surgery are less favourable.^{6,7}

A number of factors may influence whether trichiasis returns following surgery: type of operation, quality of surgery, severity of disease, individual wound healing responses, infection with *C trachomatis* and other bacteria. The progression of corneal opacification (CO) may be promoted by a range of factors in addition to trichiasis such as bacterial infection and ocular dryness. A greater

understanding of these processes could aid the development of interventions, which might limit the recurrence of trichiasis and the loss of sight following surgery.

There is currently limited long term prospective data on recurrent trichiasis and changes in CO and vision following surgery. This is in part because preoperative clinical data are not usually available. In 1998 studies were conducted in the Gambia during which individuals underwent PLTR surgery for trichiasis.^{8,9} Detailed preoperative assessment data and contact information were available. Therefore, this group offered an opportunity to assess the outcome of surgery at 3-4 years and to examine some of the potential determinants of recurrent trichiasis.

METHODS

Ethical permission

This study was approved by the Gambian Government/Medical Research Council joint ethics committee and is in accordance with the tenets of the Declaration of Helsinki.

Clinical assessment

Individuals who had undergone trichiasis surgery in 1998 during the course of previously described studies were revisited at their homes 3-4 years later.^{8,9} Preoperative clinical data were available for these patients including Tumbling-E Snellen visual acuity at 6 metres, severity of trichiasis (major or minor) and the presence or absence of CO overlying the pupil. Trained ophthalmic nurses using the PLTR procedure had performed the surgery.

At follow up the visual acuity was measured using a Tumbling-E reduced logMAR chart at 4 metres or 1 metre.¹⁰ If the subject was unable to read the largest letters at 1 metre the vision was graded as counting fingers, hand movements,

Abbreviations: BLTR, bilamellar tarsal rotation; CO, corneal opacification; PCR, polymerase chain reaction; PLTR, posterior lamellar tarsal rotation

perception of light, or no perception of light. Patients were examined using 2.5× binocular loupes and a bright torch. The clinical signs were graded according to the WHO trachoma grading system.¹¹ The number of eyelashes touching the cornea and other parts of the eye when in primary position were counted and lid closure defects measured. Corneal opacification was considered to be visually significant if it obscured at least part of the pupil margin (CC2/CC3¹¹ or CO¹²). Conjunctival inflammation was considered significant if there were prominent papillae and haziness of the tarsal blood vessel (P2 or P3¹¹).

The conjunctiva was anaesthetised with proxymetacaine 0.5% eye drops (Minims, Chauvin Pharmaceuticals, Romford, UK). A conjunctival swab sample (Dacron polyester tipped swab: Hardwood Products Company, Guilford, ME, USA) was collected from the inferior fornix and immediately placed into a sterile tube containing STGG broth (skimmed milk-tryptone-glycerol-glucose broth) for bacterial culture. A second swab sample for *C trachomatis* PCR was collected from the upper tarsal conjunctiva and placed in a dry tube. Both sets of samples were kept on ice before transfer to -70°C or -20°C freezers, respectively, later the same day. Individuals with trichiasis were offered further surgery under the auspices of the Gambian National Eye Care Programme.

Polymerase chain reaction for *C trachomatis*

Conjunctival samples were tested for *C trachomatis* with a commercial qualitative PCR based assay (Amplicor CT/NG Test; Roche Molecular Systems, Branchburg, NJ, USA) with previously described modifications.¹³

General bacteriology

Conjunctival samples were plated out on a number of media: blood agar (aerobic and anaerobic), McConkey’s agar, gentamicin blood agar, and bacitracin chocolate agar. Plates were incubated at 37°C for 48 hours and any organism isolated was identified using standard bacteriological techniques. The gentamicin blood agar and the bacitracin chocolate agar were incubated in 5% carbon dioxide. The sensitivity of cultured organisms was assessed using antimicrobial susceptibility discs (Oxoid Ltd, Basingstoke, UK). Both *Staphylococcus epidermidis* and *Bacillus* were excluded from the analysis as they were considered to be commensal rather than pathogenic at this site.

Data analysis

Data were analysed in Stata version 7 (Stata Corporation, College Station, TX, USA). The surgery was performed during the months of July to October 1998; however, the exact date was not known for every individual. Therefore, the time to follow up for each individual was calculated relative to 1 September 1998. Univariate odds ratios were calculated for the association between recurrent trichiasis and various risk factors. Multivariable logistic regression models were developed for recurrent trichiasis. Generalised estimating equations were used to adjust for the correlation between eyes in

Table 1 Severity of trichiasis at follow up

Number of lashes touching eye	No of eyes	%
0 (no epilation)	125	58.4
0 (epilating)	15	7.0
1-4	37	17.3
5-9	18	8.4
10-19	15	7.0
20+	4	1.9
Total	214	

Table 2 Changes in clinically significant corneal opacification (CO), before and after trichiasis surgery

		CO before surgery		Total
		+	-	
CO after surgery	+	42	10	52
	-	36	103	139
Total		78	113	191

bilateral cases. Change in the CO status was assessed using McNemar’s χ^2 test. Change in visual acuity before and after surgery was assessed using paired two sided *t* tests. The preoperative Snellen visual acuity was converted to a logMAR score.¹⁰ In order to include individuals whose visual acuity was counting fingers or less in the analysis, logMAR values were attributed as follows: counting fingers 2.0, hand movements 2.5, and perception of light 3.0.

RESULTS

Patient characteristics

In total, 141/162 (87.0%) individuals who had undergone trichiasis surgery in 1998 were re-assessed. Of the 21 who were not seen 14 had died, two refused, and five were untraceable. They came from the Western, North Bank and Lower River Divisions of the Gambia. The patients were predominantly female (74.5%), had a median age of 60 years (interquartile range 50-70 years), and were mostly of the Mandinka ethnic group (80.1%). The median time from surgery to re-assessment was 3.5 years (interquartile range: 3.2-4.4 years; total range 2.9-4.5 years). In all, 214 eyes had been operated on; 38 right only, 30 left only, 73 bilateral. The surgery had been conducted in a number of different settings: hospitals (39.2%), village health posts (48.6%), and patients’ homes (12.2%).

Recurrent trichiasis

At follow up 89/214 (41.6%) previously operated eyes had some degree of trichiasis and 52/214 (24.3%) had five or more lashes touching the eye, including those with extensive epilation. The severity of trichiasis at follow up is presented in table 1. The recurrence rate was the same for both left and right eyes (right 41.4%, left 41.8%). Of the 73 individuals who had undergone bilateral surgery 20 had unilateral recurrence and another 20 had bilateral recurrence.

Corneal opacification

Preoperative and postoperative corneal grading data was available on 191 eyes (table 2). Before surgery, 78/191 (40.8%) eyes had clinically significant CO, while at follow up 52/191 (27.2%) had CO. This represents a significant reduction in the amount of CO following surgery: OR: 0.28, 95% CI: 0.12 to 0.57, $p < 0.001$ (McNemar’s χ^2 test). New opacification developed in 10 eyes, of which six had recurrent trichiasis. CO resolved in 36/78 eyes (46.2%). Of these 36 eyes, 17 had recurrent trichiasis. Of the 42 eyes that had CO on both occasions, 20 had recurrent trichiasis. The post-operative trichiasis tended to be less severe in eyes that had resolved CO compared with those with CO on both occasions (mean: three lashes *v* eight lashes, respectively). Corneal opacification at follow up was more commonly found in eyes with lashes touching the cornea (23/63; 36.5%) compared to eyes with lashes only touching bulbar conjunctiva (2/16; 12.5%), however, this did not reach statistical significance. Corneal opacification in eyes with recurrent trichiasis was less common if extensive epilation was practised (2/14;

Table 3 Pathological conjunctival bacterial isolates

Organism	All eyes		No trichiasis		Trichiasis	
	No	%	No	%	No	%
<i>S pneumoniae</i>	18	42.9	3	20.0	15	55.6
<i>Streptococcus</i> group C	6	14.3	1	6.7	5	18.5
<i>Streptococcus</i> spp	3	7.1	1	6.7	2	7.4
<i>S viridans</i>	1	2.4	1	6.7	0	–
<i>Staphylococcus aureus</i>	13	30.9	8	53.2	5	18.5
<i>Coliform</i> spp	1	2.4	1	6.7	0	–
Number of isolates	42		15		27	
Number of eyes sampled	155		87		68	

14.3%) compared to eyes that were not epilated (25/73; 34.3%), again this difference was not significant.

Visual acuity

Visual acuity data were available for 199 eyes before and after surgery. Excluding eyes that had a visual acuity of counting fingers or less on either occasion, there was a mean deterioration in vision of 0.16 logMAR units, which was statistically significant ($p < 0.0001$, paired, two sided t test). The reduction in visual acuity tended to be less among those without recurrent trichiasis (0.13 logMAR) compared to those with recurrent trichiasis (0.22 logMAR); however, these groups were not statistically different ($p = 0.124$). When eyes with a visual acuity of counting fingers or less are included the mean deterioration was 0.21 logMAR units ($p < 0.0001$, paired, two sided t test). There was no difference in the reduction of vision between those with or without trichiasis at follow up. Visual acuity deteriorated more rapidly in eyes that developed new CO compared with those that did not (0.54 v 0.06 logMAR, respectively. $p = 0.003$, paired, two sided t test). There was a non-significant trend towards less rapid visual loss in eyes in which the CO resolved compared with those in which it persisted (0.15 v 0.46 logMAR, respectively. $p = 0.18$, paired, two sided t test).

Conjunctival infection

C trachomatis PCR testing was conducted on conjunctival swab samples from 135 of the 141 study participants. Only one gave a positive test result. Bacterial culture samples were collected from 155/214 operated eyes. Pathological isolates were grown from 42/155 (27.1%) samples. The isolation rate was higher in eyes with recurrent trichiasis (27/68; 39.7%) compared to those without recurrent trichiasis (15/87; 17.2%). *Streptococcus pneumoniae* and *Staphylococcus aureus* were the most frequently cultured organisms (table 3). Eyes with trichiasis were more frequently infected with *S pneumoniae*

than those without trichiasis (22.1% v 3.4%, respectively. OR: 7.92, 95% CI: 2.19 to 28.7, $p = 0.002$).

Risk factors for recurrent trichiasis

Univariate associations between various risk factors and any trichiasis at follow up are presented in table 4. There was a tendency to more frequent recurrence in older age groups. Bacterial infection and conjunctival inflammation (grade P2 or P3) were both associated with recurrent trichiasis. Multivariable logistic regression models for recurrent trichiasis were developed, which was adjusted for the correlation between eyes in the case of bilateral surgery by generalised estimating equations (table 5). These indicated significant associations between recurrent trichiasis and conjunctival inflammation and bacterial infection.

DISCUSSION

Surgery for trachomatous trichiasis is believed to reduce the risk of blindness. There is, however, limited information on the long term outcome of this intervention, the determinants of recurrent trichiasis, its effect on vision and CO. In this study a group of subjects, in whom preoperative clinical data were available, was re-examined 3.5 years after trichiasis surgery.

Recurrent trichiasis was common (41.6%). The finding that 24.3% of operated eyes had major trichiasis at 3.5 years is of particular concern, as such eyes are probably at high risk of progressive corneal damage. These trichiasis recurrence rates are comparable to previously reported 3 year outcomes from trachoma control programmes, which have ranged up to 62%.^{6,7} Recurrence rates reported by more formal prospective clinical studies have tended to be lower at around 20% after 2 years.^{2,4} In one of these only 3.5% of eyes had three or more lashes touching the eye at 3 years.⁴ These studies have tended to use one or just a few highly trained individuals to perform the surgery, and therefore may not reflect the usual situation in trachoma control programmes.

Table 4 Univariate associations between recurrent trichiasis and various factors

Variable	OR	95% CI	p Value
Age (years)			
<50	1	–	–
50–59	1.64	0.69 to 3.91	0.263
60–69	1.23	0.56 to 2.72	0.609
70+	2.33	1.08 to 5.02	0.031
Sex (female)	0.67	0.36 to 1.27	0.219
Ethnic group (non-Mandinka)	0.59	0.29 to 1.22	0.156
Surgery in hospital	1.01	0.58 to 1.75	0.985
Eye (right)	1.01	0.59 to 1.74	0.964
<i>C trachomatis</i> infection	0.82	0.42 to 1.61	0.575
Bacterial infection	3.16	1.51 to 6.62	0.002
Conjunctival inflammation	4.01	1.49 to 10.8	0.006

Table 5 Multivariable logistic regression models for associations between recurrent trichiasis and various factors, adjusting for the correlation between eyes in bilateral cases by generalised estimating equations

Variable	1+ Lashes			5+ Lashes		
	OR	95% CI	p Value	OR	95% CI	p Value
Age (years)						
<50	1	—	—	1	—	—
50–59	1.19	0.42 to 3.41	0.736	1.37	0.41 to 4.50	0.607
60–69	1.00	0.35 to 2.84	0.997	1.48	0.45 to 4.88	0.521
70+	1.44	0.57 to 3.64	0.434	2.14	0.74 to 6.18	0.128
Sex (female)	0.63	0.28 to 1.43	0.267	0.45	0.19 to 1.04	0.064
Conjunctival inflammation	2.06	1.03 to 4.12	0.040	2.85	1.33 to 6.14	0.007
Bacterial infection	2.51	1.04 to 6.07	0.041	2.42	1.08 to 5.42	0.032

To our knowledge this is the first study to evaluate the impact of trichiasis surgery on CO. Encouragingly, surgical correction of trichiasis was followed by a reduction in the prevalence of CO, even if some trichiasis returned. This suggests that by reducing the burden of trichiasis a degree of corneal recovery can occur. The majority of eyes developing new opacification had recurrent trichiasis; however, a few developed CO in the absence of recurrent trichiasis. This suggests that other factors contribute to corneal damage such as ocular infection or dryness, and warrant detailed investigation. It is possible that some of the changes in the grade of CO could be due to misclassification. Different observers performed baseline and follow up examinations. Corneal opacification is considered to be significant when it overlies any portion of the pupil; however, this could be a bit variable depending on ambient light levels.

There was a general deterioration in visual acuity between surgery and follow up. This may in part be due to other age related change such as cataract. There was a non-significant trend towards a greater deterioration in vision if the trichiasis returned. In the absence of a randomly assigned non-operated control group it is not known how much deterioration would have occurred without surgery. There was, however, a significantly greater deterioration in vision in those who developed new corneal opacification. Short term improvements in vision have previously been reported following trichiasis surgery.²⁻⁹

Recurrent trichiasis was associated with conjunctival inflammation. This clinical appearance is relatively common in individuals with trichiasis. It may reflect an ongoing pathological inflammatory process, which could contribute to progressive scarring and recurrent trichiasis.⁹ The grading of conjunctival inflammation in a heavily scarred individual can sometimes be difficult as there is limited epithelium to develop a papillary response and the scarring may obscure the tarsal vessels. A study of conjunctival biopsies collected during trichiasis surgery found that a proportion had an inflammatory cell infiltrate, which corresponded to clinical inflammation.¹⁴ A number of factors could provoke the inflammation including mechanical irritation from inturned lashes, chlamydial or bacterial infection, or a primary immune mediated process. Although conjunctival inflammation in people living in a trachoma endemic region might be expected to be due to infection with *C trachomatis*, in this group of patients this is unlikely as only one individual had detectable chlamydial DNA by PCR. This is in contrast with a small study from Nepal, which found an association between recurrent trichiasis and chlamydial detection by PCR.¹⁵

Bacterial infection was independently associated with recurrent trichiasis following surgery. This is to our knowledge the first time this has been observed. Previously, an association was found in a subgroup of this cohort between bacterial infection and progression of CO before surgery.⁹ A

similar spectrum of organisms was isolated. It is likely that eyes with trichiasis are more vulnerable to bacterial infection. Conversely, although a role for bacteria in the pathogenesis of blinding trachoma has been suggested for many years, it still remains poorly defined.¹⁶ It is biologically plausible that persistent bacterial conjunctivitis could contribute to progressive cicatricial changes through chronic inflammation.

Our study has a number of potential limitations, which should be borne in mind. Firstly, the preoperative assessment was by a different observer from the follow up and it was not possible to assess potential interobserver variability. However, the principal clinical outcome measures used in this study, presence of trichiasis and corneal opacification, are relatively objective, clearly defined, and have been shown to have good interobserver reliability.¹⁷ Secondly, a Snellen visual acuity was measured before surgery and converted to a logMAR equivalent for comparison with the follow up measurement. This may have introduced some systematic bias in the comparison. Finally, it is not known exactly when the trichiasis returned in this group of patients. Recurrence in the early postoperative period may arise for different reasons than late recurrence, such as limitations of the surgical method, inter-surgeon variability, and differences in wound healing responses.

This study indicates that recurrent trichiasis is a common problem, which represents a significant threat to the sight of many. It needs to be considered by trachoma control programmes as they plan surgical services. Wherever possible trichiasis patients should be re-examined on an ongoing basis following surgery to identify those in need of additional treatment. On a more encouraging note this study has demonstrated that some restoration of the cornea can occur after surgery and that this is associated with a slowing of the rate of visual loss. There is a pressing need to find ways to improve the long term outcome of surgery. This may involve further randomised controlled trials to optimise the surgical technique, clinical audit to monitor surgeon specific outcomes, and interventions to control infection. In addition, the part of other factors besides trichiasis in the pathogenesis of CO needs to be examined as correcting trichiasis alone may not be sufficient to prevent trachoma related blindness in all cases.

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