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A comparison of pre-school versus school-age orthoptic screening programmes in the North-East of England

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Abstract

Aim: **Following changes to the age at which our primary vision screening programmes are delivered we aimed to assess the impact of this change of practice on final vision outcomes.**
Methods: **This is a retrospective notes review of visual outcomes of children failing from two primary vision screening programmes: group A who were screened at pre-school age (3.5 years old) and group B who were screened at school entry age (4–5 years old).**
Results: **Group A: coverage at screening 2742/4567 (60%), start visual acuity (VA) 0.516 logMAR (range 0.175–1.500), end VA 0.195 logMAR (range 0.00–0.800). Group B: coverage at screening 5842/6082 (96%), start VA 0.514 logMAR (range 0.225–1.500), end VA 0.209 logMAR (range 0.00–1.200).**
Conclusion: **Children in group B achieved the same visual outcome as group A in a shorter episode length and with a larger proportion of the target group screened.**

Key words: Amblyopia, Pre-school, School, Vision screening, Visual outcomes

Introduction

Amblyopia is defective visual acuity in one or both eyes which persists after correction of the refractive error and removal of any pathological obstacle to vision.[1] A widely accepted clinical definition of amblyopia is based on 2 or more Snellen or logMAR lines difference between eyes in best-corrected visual acuity.[2] The *Health for All Children* report describes screening as 'a non-diagnostic procedure applied to a population who has no manifestations of a disorder to separate out those at higher risk from those at lower risk', following which the former then proceed to have a definitive diagnostic test.[3] It remains unclear whether screening for amblyopia reduces the prevalence in the adult population and what the long-term effects of treatment are. However, vision screening for amblyopia is current practice within the NHS and so the debate becomes one of timing.

It is common practice to treat amblyopia before 7 years of age as it appears to be the upper limit at which treatment is successful,[4–6] but the age at which the plasticity of the visual system is lost is widely debated. There are published studies that report the effectiveness of treatment is no different if commenced any time between 3 and 7 years of age[7–9] and that deferring treatment until the age of 5 years does not appear to limit potential for improvement.[10] There are also suggestions in the literature that the window for treating amblyopia may be wider than current practice would suggest;[11,12] some even suggest a response to treatment at up to 17 years of age, though recognise compliance may become more difficult with increasing age.[13]

The *Health for All Children* report recommended an examination involving orthoptists of all children between 4 and 5 years of age, using a crowded logMAR test as the gold standard for vision screening children.[3] In 2006 the Orthoptic Department in the Newcastle Eye Centre in the UK reviewed current practice and amended screening service provision in line with these recommendations to implement primary orthoptic screening in reception class at school in place of the existing programme which screened at 3.5 years in community clinics.

The aim of this retrospective case notes review was to compare the results of the two screening services following this change in practice and to determine whether delaying screening has a detrimental effect on final visual outcomes. Coverage and treatment duration will also be compared; both are highly important factors in a screening programme.

Methods

This is a retrospective case notes review of visual outcomes of children failing primary vision screening in the geographical area covered by the Newcastle upon Tyne NHS Hospitals Trust. Group A were screened at pre-school age between 2005 and 2006, and group B were screened at school entry age between 2009 and 2010.

Group A

Screening was offered to all pre-school children (3.5 years old), either via an appointment at a local clinic or at nursery schools in some localities. Screening tests included assessment of uniocular vision (Keeler uncrowded logMAR with a pass level of 0.150, or single Kay Pictures with a pass level of 0.100).

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Group B

Screening was undertaken of all children at school entry (4–5 years old) enrolled in reception class at any school (state, independent and special). Consent for screening was via an opt-out method. Parents were notified in writing when screening would take place, and a tear-off slip was provided to be returned if screening was declined. Screening tests performed included assessment of uniocular vision (Keeler crowded logMAR with a pass level of 0.200, or crowded Kay Pictures with a pass level of 0.100).

Referral pathways

There were two referral pathways for children who failed screening in both groups. The first was to a community optometrist pathway and the other to the hospital eye service (HES). For both groups, the community optometrist pathway included local opticians working towards an agreed protocol to treat and manage children failing screening. The optometrist pathway referral criteria were:

- group A: 0.175–0.475 uncrowded logMAR or 0.125–0.375 single Kay Pictures, with the absence of a manifest deviation;
- group B: 0.225–0.475 crowded logMAR, with the absence of manifest deviation.

This case notes review analyses the visual outcomes of children failing to the HES pathway.

Inclusion criteria

The inclusion criteria were:

- children referred with vision of 0.500 logMAR or worse;
- children with vision 0.225 or worse with strabismus;
- follow-up appointments at HES.

Exclusion criteria

The exclusion criteria were:

- orthophoric children with vision of 0.225–0.475 logMAR (these children were referred to an optometrist and excluded from the study due to lack of final visual acuity (VA) data);
- children with normal VA (0.200 or better) but who were referred for another reason (e.g. strabismus);
- children already under the care of the HES.

Primary outcome measure

The primary outcome measure was VA at discharge or when lost-to follow-up.

Secondary outcome measures

The secondary outcome measures were mean length of hospital episode and screened population coverage for each group. The length of hospital episode was time the patient spent under the care of the HES and included observation as well as active treatment.

Statistical analysis

A paired *t*-test was used within groups to compare the change in VA over time. The mean, standard deviation (SD) and range were also calculated. For the purposes of analysis, where there was no numerical value recorded for vision a value of 1.500 logMAR was assigned.

Results

A total of 785 notes of children referred into the HES were reviewed; 74/785 (9%) were in group A and 711/785 (91%) were in group B.

Group A

Coverage and episode length

2742/4567 (60%) of the eligible cohort were screened, of whom 168/2742 (6%) failed the screening test and 74/168 (44%) were referred to the HES. The mean HES episode length was 25.24 months.

Vision outcomes

Complete VA data were available for 40/74 (54%). Three of 40 with pass-level vision failed with other conditions (e.g. strabismus) and were therefore excluded. Twenty-three of 37 (62%) children failed due to reduced bilateral vision (most of these were presumed to be purely refractive), 14/37 (38%) due to unilateral reduced vision. Sixty eyes were therefore included in the analysis. It was not possible to extract data to allow us to distinguish between purely refractive reductions in vision and true amblyopia.

Mean vision at baseline was 0.516 logMAR (SD 0.310); range 0.175–1.500. At outcome there was a clinically and statistically ($p < 0.0001$) significant change in vision. Mean vision at discharge was 0.195 logMAR (SD 0.137); range 0.000–0.800. Thirty-nine of 60 (65%) of the eyes analysed achieved 0.200 logMAR or better.

Seventeen of 23 (74%) children who failed with reduced vision in both eyes achieved $\leqslant$ 0.200 logMAR in at least one eye. Three children had no numerical value for vision recorded and were therefore assigned vision of 1.500; removing these from the analysis had no clinically significant impact (start VA 0.466 to 0.516, end VA 0.181 compared with 0.195).

Table 1 gives a summary of start and end VA for both groups.

Group B

Coverage and episode length

5842/6082 (96%) of the eligible cohort were screened, of whom 711/5842 (12%) failed the screening test and 374/711 (53%) were referred to the HES. The mean HES episode length was 9.01 months.

Vision outcomes

Complete VA data were available for 130/374 (35%) children; 20/130 (15%) with pass-level failed with other conditions (e.g. strabismus) and were therefore excluded. Sixty-eight of 110 (62%) children failed due to reduced bilateral vision (most of these were presumed to be

Table 1. Comparison of start and end VA of group A versus group B

	Group A ($n = 37$)[a]			Group B ($n = 110$)[b]		
	Start vision (logMAR)	End vision (logMAR)	*p*-value	Start vision (logMAR)	End vision (logMAR)	*p*-value
Mean (SD)	0.516 (0.310)	0.195 (0.137)	$p < 0.0001$	0.514 (0.225)	0.209 (0.157)	$p < 0.0001$
Range	0.175–1.500	0.000–0.800		0.225–1.500	0.000–1.200	

[a]A total of 60 eyes were analysed 14 from uniocular fails, 46 from binocular fails.
[b]A total of 178 eyes were analysed 42 from uniocular fails, 136 from binocular fails.

purely refractive), 42/110 (38%) due to unilateral reduced vision. A total of 178 eyes were therefore included in the analysis. It was not possible to extract data to allow us to distinguish between purely refractive reductions in vision and true amblyopia.

Mean vision baseline was 0.514 logMAR (SD 0.228); range 0.225–1.500. At outcome there was a clinically and statistically ($p < 0.0001$) significant change in vision. Mean vision in the worse eye at discharge was 0.209 logMAR (SD 0.157); range 0.000–1.200.

One hundered and forty-eight of 178 (83%) of the eyes analysed achieved 0.200 logMAR or better. Sixty-three of 68 (93%) children who failed with reduced vision in both eyes achieved $\leqslant$ 0.200 logMAR in at least one eye. There were no outliers in group B.

Discussion

There is still much debate as to whether vision screening and amblyopia treatment is worthwhile.[14–16] It remains unclear whether vision screening during childhood reduces the prevalence of amblyopia in the adult population[17] and the impact of living with untreated amblyopia has yet to be fully quantified. Studies have found no difference in occupational class, educational attainment, employment or general and mental health between those with amblyopia and those without it.[18,19] Nevertheless vision screening programmes are commonplace and it is therefore important to evaluate the existing service.

Following recommendations from the *Health for All Children* report,[3] the primary vision screening service offered by the Newcastle upon Tyne Hospitals NHS Foundation Trust was amended to meet national screening committee (NSC) recommendations:[20] screening children within schools in reception class at 4–5 years old rather than screening at 3.5 years in community clinics. This retrospective case notes review was therefore undertaken to review and compare the updated screening programme to evaluate the effect of screening at a later age on final vision outcomes, length of treatment and coverage.

Predictably, coverage of children screened in school was significantly higher than pre-school (96% versus 60%), which is consistent with other published reports on vision screening.[21] The length of time that patients were under the care of the HES was also significantly lower for school screening compared with pre-school screening (9.01 months versus 25.24 months). Children under review for vision treatment are typically followed up every 6–12 weeks. At a tariff of £57 per visit, the significantly lower episode length of patients from school screening highlights the substantial cost savings to the service when screening is delayed until children are 4–5 years of age. Fewer hospital appointments also minimises inconvenience and cost to the child and family and allows a more effective use of appointments and a reduction of pressures on resources.[22] Most importantly, by delaying screening from 3.5 years old to 4–5 years there was no clinically significant difference in the final visual outcomes between pre-school screening (0.195) and school screening (0.209); removing the 3 children from pre-school screening who had really poor vision (e.g. perception of light, hand movements only) and who were therefore allocated an arbitrary value for acuity did not make a clinically or statistically significant difference to the final VA outcomes.

It is unclear why the referral rate in school screening was double that of pre-school screening (12% and 6% respectively). Possible explanations include the reduced sensitivity and specificity of the vision test used in pre-school screening; the school-age children were tested using a more sensitive crowded vision test than the uncrowded test used for pre-school children. Certainly another study comparing vision outcomes from pre-school and school screening had higher and equal referral rates from each group (22% and 22%).[23] This higher referral rate might be due to the more stringent pass criteria used in this particular study (0.000 crowded logMAR) and referral rates equal due to a larger cohort. It remains unknown as to whether we would have found similar results with larger, more equal cohorts.

Limitations

Complete data were only available for 54% of children from pre-school screening and 35% from school screening. Incomplete data was primarily due to the large proportion of patients being followed up in community clinics, as it was difficult to obtain these notes. Vision tests used for each group were age appropriate and thus different, which limits the ability to directly compare the visual outcomes of each group. The dissimilar group sizes ($n = 37$ from pre-school screening, $n = 110$ from school screening) meant that a direct statistical analysis between the two groups, although possible, was unlikely to be meaningful when drawing conclusions from this review.

It is possible that delaying treatment might result in an increased burden of treatment. We were unable to analyse length of treatment time due to difficulty accessing notes, and therefore had to report on the episode length, which refers to the amount of time the patient was kept under the HES and is not specific to active treatment.

Conclusion

Delaying screening to school entry at 4–5 years of age has enabled a more cost-effective service, capturing a larger proportion of the target group and reducing hospital episode length. This has been achieved without detriment to the vision outcome.

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The authors declare they have no competing interests.

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