

# A Retrospective Study of Treatment Efficacy of 65 Children with Ametroic Amblyopia

Yuxiang Zhang\*, Lihua Huang, Changyang Cao, Yingfang Li  
Shaoguan Hygienic Hospital of Women and Children, Shaoguan 512026, China

## Abstract

**Purpose:** To investigate relationship between treatment efficacy and the severity of ametropic amblyopia, the type of anisometropia and patient age.

**Methods:** A total of 65 children with ametropic amblyopia undergoing clinical treatment in the ophthalmology department of Shaoguan Hygienic Hospital of Women and Children between June 2005 and November 2011 were enrolled in this study. The treatment efficacy for those subjects with different severities of ametropic amblyopia, types of anisometropia and ages was recorded.

**Results:** The near-recovery/recovery rate, improvement rate and ineffectiveness rate were 70.8%, 16.9% and 12.3%, respectively. The recovery rates in mild-, moderate- and severe amblyopia groups were 97.1%, 61.1% and 8.3% respectively ( $P < 0.05$ ). The recovery rate for patients with hyperopic-, astigmatic- and myopic anisometropia were 75.8%, 78.3% and 33.3% respectively. The recovery rates did not differ between hyperopic- and astigmatic- anisometropia children ( $P > 0.05$ ), whereas a statistically significant difference was noted between myopic children compared with their hyperopic and myopic-anisometropia counterparts (all  $P < 0.05$ ). The recovery rate for patients aged 3 to 6 years was 86.8% and 48.1% for those aged between 7 and 10 years ( $P < 0.05$ ).

**Conclusion:** The treatment efficacy in ametropic amblyopia is associated with the severity of amblyopia, type of anisometropia and patient's age. Older patients with more severe amblyopia had poorer treatment efficacy. The efficacy in patients with hyperopic and astigmatic anisometropia was better than that for myopic anisometropia subjects. (*Eye Science* 2012; 27: 85–88)

**Keywords:** amblyopia; anisometropia; treatment; efficacy

Amblyopia is a disorder of the visual system that is characterized by a vision deficiency caused by poor visual stim-

ulation or visual deprivation during critical period of visual development. Previous clinical studies confirmed that early diagnosis and proper treatment of amblyopia, along with comprehensive therapy when necessary, can yield desirable treatment efficacy<sup>1-4</sup>. Anisometropia is one of the common factors leading to amblyopia. Ametroic amblyopia is constantly diagnosed at an older age because its pathogenesis is more complicated than strabismic amblyopia. In clinical settings, it is challenging to treat ametroic amblyopia, and the treatment efficacy is undesirable<sup>5</sup>. To better understand the underlying pathogenesis of ametroic amblyopia and investigate relevant factors affecting treatment efficacy, this study retrospectively analyzed the clinical information from 65 children with ametroic amblyopia undergoing clinical treatment in the ophthalmology department of Shaoguan Hygienic Hospital of Women and Children between June 2005 and November 2011. Additionally, this study also aims at exploring the relationship between treatment efficacy and severity of ametroic amblyopia, type of anisometropia and patient age, and improving the efficacy of ametroic amblyopia in clinical practice.

## Patients and methods

### General information

A total of 65 children (130 eyes) with ametroic amblyopia undergoing clinical treatment in the ophthalmology department of Shaoguan Hygienic Hospital of Women and Children between June 2005 and November 2011 were selected in this study, aged from 3 to 10 years ( $6.5 \pm 3.2$ ), with 35 males (70 eyes) and 30 females (60 eyes). The diagnosis criteria of amblyopia, formulated by Children's amblyopia and strabismus prevention and control group of China in April, 1996, were adopted<sup>6</sup>. Inclusion criteria: the refractive difference between both eyes was  $\geq 1.5$  D, column lens  $\geq 1.0$  D. Exclusion criteria: patients with organic lesions, abnormal eye position, abnormal eyeball movement, or difference of visual acuity between the two eyes of  $< 2$  lines, were excluded from this study. Participants were divided into hyper-

opic anisometropia ( $n=33$ , 50.8%), astigmatic anisometropia ( $n=23$ , 35.4%), and myopic anisometropia ( $n=9$ , 13.8%).

### Vision correction

The participants were required to wear eyeglasses for vision correction. The patients aged between 3 and 6 years received cycloplegia using 1% atropine eye ointment once daily for three consecutive days, and prolonged up to 7 days when ciliary muscle still performed vision accommodation. The children aged between 7 and 10 years were administered with 0.5% atropine for cycloplegia and replaced by 1% atropine if necessary. Retinoscopy was conducted following cycloplegia. Spherical amounts of diopter minus 2.50 D equaled hyperopic spherical lens. Astigmatism was fully corrected. The cooperative children were told to wear glasses after atropine lost its efficacy (3 weeks later). The uncooperative children were told to wear glasses according to the optometry results. The international standard visual chart was used for visual acuity test throughout the study.

### Amblyopia treatment

Comprehensive therapy was given according to individual conditions; 1. Eyeglass prescription was performed as described above; 2. Occlusion therapy was given for the eyes with poor visual acuity for 4 h

daily; 3. Eyesight exercise was conducted for 30 min every day; 4. Red flash stimulation was conducted twice daily, 10 min each time. The visual acuity was reexamined at 3 months of wearing eyeglasses, and then at 6 months, according to individual conditions.

### Diagnosis, classification and efficacy evaluation of amblyopia

The diagnosis, classification and efficacy evaluation criteria referred to the standard proposed by Children's Amblyopia and Strabismus Prevention and control Group of China in April, 1996<sup>6</sup>. The patients were divided into different groups according to the severity of amblyopia: 1. Mild amblyopia, corrected visual acuity ranging from 0.8 and 0.6; 2. Moderate amblyopia, corrected visual acuity ranging from 0.5 and 0.2; 3. Severe amblyopia, corrected visual acuity  $\leq 0.1$ . Evaluation criteria for amblyopia treatment: 1. Ineffectiveness: visual acuity decreased, remained unchanged or improved by 1 line; 2. Improvement: visual acuity increased by 2 lines or above; 3. Near recovery: corrected visual acuity reached 0.9 or above; 4. Recovery: visual acuity remained normal after 3-year follow-up.

### Statistical analysis

SPSS 13.0 software was used for statistical analysis.  $P < 0.05$  was considered as statistically significant.

**Table 1** Relationship between the severity of amblyopia and treatment efficacy ( $n=65$ )

Groups	Number of cases	Near recovery or recovery	Improvement	Ineffectiveness
Mild degree of amblyopia	35	34(97.1%)	1(2.9%)	0(0%)
Moderate degree of amblyopia	18	11(61.1%)	6(33.3%)	1(5.6%)
Severe degree of amblyopia	12	1(8.3%)	4(33.3%)	7(58.3%)
Total	65	46(70.8%)	11(16.9%)	8(12.3%)

**Table 2** Comparison on the treatment efficacy of the three types of anisometropia ( $n=65$ )

Groups	Number of cases	Near recovery or recovery	Improvement	No response
Hyperopic anisometropia	33	25(75.8%)	5(15.2%)	3(9.1%)
Astigmatic anisometropia	23	18(78.3%)	4(17.4%)	1(4.3%)
Myopic anisometropia	9	3(33.3%)	2(22.2%)	4(44.4%)
Total	65	46(70.8%)	11(16.9%)	8(12.3%)

**Table 3** Relationship between patients' age and treatment efficacy ( $n=65$ )

Groups	Number of cases	Near recovery or recovery	Improvement	No response
3~6 years	38	33(86.8%)	2(5.3%)	3(7.9%)
7~10 years	27	13(48.1%)	9(33.3%)	5(18.5%)
Total	65	46(70.8%)	11(16.9%)	8(12.3%)

## Results

### Relationship between the severity of amblyopia and treatment efficacy

As shown in Table 1, near-recovery/recovery rate, improvement rate, and ineffectiveness rate were 70.8%, 16.9%, and 12.3%, respectively. The recovery rate in mild-, moderate-, and severe-degree of amblyopia groups were 97.1%, 61.1%, and 8.3% ( $P < 0.05$ ).

### Comparison of treatment efficacy of three types of amblyopia

As shown in Table 2, hyperopic and astigmatic ametroic amblyopia patients showed similar efficacy and did not differ in terms of near recovery rate and recovery rate ( $P > 0.05$ ). However, myopic ametroic amblyopia children yielded poorer treatment efficacy and significantly lower near recovery/recovery rates than patients with hyperopic and astigmatic ametroic amblyopia did (all  $P < 0.05$ ).

### Relationship between patients' age and treatment efficacy

The near recovery/recovery rates in children aged 3 to 6 years were significantly higher compared with those aged 7 to 10 years ( $P < 0.05$ ), as illustrated in Table 3.

## Discussion

Anisometropia stems from the difference in refraction degree between the two eyes of various degrees and characters. Severe anisometropia may affect binocular visual function and is considered as one of the most common factors causing children's amblyopia. The underlying mechanism of ametroic amblyopia is probably that anisometropia causes unequal clarity of the same object between the two eyes, which leads to overlapping of one clear image and another blurred image and image perception conflict of macular fovea, thus inducing amblyopia<sup>5</sup>. It has been reported that anisometropia in children might cause serious damages to visual acuity and visual function<sup>7</sup>. The percentage of abnormal stereopsis was 43%, 29%, and 36% when hyperopic anisometropia  $> 1.00D$ , astigmatic anisometropia  $> 1.00D$ , and myopic anisometropia  $> 2.00D$ , respectively. The incidence of abnormal stereopsis tended to significantly

increase over the increasing severity of anisometropia. The proportion of abnormal stereopsis reached 100% when anisometropia  $> 3.00D$ . Besides, anisometropia may also affect the fusion function of the two eyes. Griebel et al<sup>8</sup> analyzed the relationship between vertical anisometropia and vertical fusional amplitudes, and observed that vertical fusional amplitudes increased by approximately  $1.1^\Delta$  when vertical anisometropia was elevated by 1D, suggesting that the patients necessarily presented with compensation changes after long-term endurance of anisometropia. If these occurred in the critical and sensitive stages of children's visual development, amblyopia is likely to be induced.

Previous findings demonstrated that the treatment efficacy of amblyopia is closely associated with the severity of amblyopia. More serious amblyopia is likely to yield poorer treatment efficacy. Li et al<sup>9</sup> drew a consistent conclusion in patients with ametroic amblyopia. The results showed that the patients with mild amblyopia had the highest treatment efficacy (recovery rate: 93.51%, effective rate: 95.67%), followed by those with moderate amblyopia (recovery rate: 62.76%, effective rate: 90.79%) and severe amblyopia (recovery rate: 38.46%, effective rate: 84.62%). In the current study, the overall recovery rate reached 70.8%, and effective rate reached 87.7%. Similarly, the patients with mild amblyopia presented with the highest treatment efficacy (recovery rate: 97.1%, effective rate: 100%), significantly higher compared with those in moderate (recovery rate: 61.1%, effective rate: 94.4%) or severe amblyopia groups (recovery rate: 8.3%, effective rate: 41.6%).

The critical period for human vision development remains elusive. Some investigations using mammals and primate animals postulated that the critical period for human vision development started from date of birth to 3 years old. The sensitive period ranged from date of birth to 12 years of age. During these periods, children's vision is subject to the influence of various factors, and amblyopia might be caused<sup>10-11</sup>. Previous studies suggested that amblyopia is a vision development disorder. The patients' visual acuity may be restored if they received proper training and therapy during critical- and sensitive-periods for vision development, but it is extremely dif-

difficult to treat amblyopia after these critical times<sup>10-12</sup>. Some scholars conducted group comparison among amblyopia children aged between 3 and 12 years in terms of treatment efficacy and noted that better treatment efficacy can be obtained if the patients undergo therapy at an earlier age<sup>13</sup>. In the present study, the treatment efficacy between 3 to 6 years group (recovery rate: 86.8%) and 7 to 10 years group differed significantly (recovery rate: 48.1%). Hence, early detection and prevention of amblyopia are of great significance in clinical practice.

It is generally considered that clinical treatment of amblyopia is correlated with types of amblyopia. In addition, relevant studies found that the types of anisometropia also closely correlate with the treatment efficacy of amblyopia<sup>9,14</sup>. In general, the treatment efficacy of hyperopic and astigmatic amblyopia was better than that of myopic amblyopia. Ye's<sup>14</sup> findings indicated that the recovery rate for patients with hyperopic and astigmatic amblyopia achieved above 98%, whereas it was only 81.03% for those with myopic amblyopia. Additionally, Li<sup>9</sup> yielded consistent outcomes that the recovery rates for patients with hyperopic, astigmatic, and myopic amblyopia were 80%, 90%, and 62%, respectively. The results in the current investigation revealed that the treatment efficacy between patients with hyperopic and astigmatic amblyopia was similar, while the treatment efficacy for those with myopic amblyopia was relatively poor.

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