The health-related quality of life and anxiety for childhood intermittent exotropia before and after surgical correction

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Abstract

Purposes:

To assess the health-related quality of life (HRQOL) and hospital anxiety and depression scale (HADS) in Chinese children with intermittent exotropia (IXT) before and after strabismus surgery.

Patients and Methods: The records of children with IXT who underwent strabismus surgery at the Zhongshan Ophthalmic Center, of Sun Yat-sen University, China over the period from January 1, 2016 to December 31, 2018 were retrospectively reviewed. All children underwent ophthalmic and orthoptic examinations including the prism and alternate cover test, fusion function by synoptophore, stereoacuity and Newcastle control score. With use of the Intermittent Exotropia Questionnaire (IXTQ), the pre- and post-operative HRQOL and pre-operative HADS were assessed within these children and their parents.

Results: A total of 389 children were eligible for inclusion (47.8% male, 52.2% female, mean + SD age = 8.17 ± 2.81). Pre-operative IXTQ scores in both children and their parents were significantly correlated with near stereoacuity (P = 0.029 and P = 0.015, respectively). The angle of deviation at near vision showed a negative linear relationship with visual function (P = 0.026) and psychological (P = 0.019) scores and opinions regarding surgery(P = 0.024). HADS scores were also related with near stereoacuity (P < 0.05). After surgery, both children's and parents' IXTQs significantly improved (p□0.01). Children' IXTQ scores were related to the angle of deviation at distance and their psychological and visual function scores showed a negative relationship with the angle of deviation at near vision (P < 0.05).

Conclusion: Children and parents HRQOL and HADS were associated with near stereoacuity. Parents usually attend more readily to the angle of deviation at near in their IXT children. HRQOL improved significantly after surgery and can be used as one of the indices for pre-operative evaluation, but is not recommended as a criteria for surgical intervention.

These first two authors contributed equally to this work

Introduction

Intermittent exotropia (IXT) is the most common form of exotropia in children[1]. The incidence in China ranges from 3.3–3.9% in the general population, which is much higher than that observed in Western populations[2–4]. Besides the cosmetic affects and loss of stereoscopic function [5], IXT may negatively impact the psychological well being of the children and their parents[6]. The health-related quality of life (HRQOL) represents an important tool for use in evaluating IXT patients, but rarely used by clinicians. When treating children with IXT, the clinician should not only focus on the physiological parameters such as angle of deviation, Newcastle control score (NCS) and stereoacuity but also the psychological components as assessed with the HRQOL in these children and their parents. There are surveys currently available to perform these evaluations. For example, the Intermittent Exotropia Questionnaire (IXTQ) is a well-accepted, specific tool to assess HRQOL in IXT children and their parents[7]. In addition, the Hospital

Anxiety and Depression Scale (HADS) provides a reliable tool for determining depression and anxiety status for hospital outpatient services and an effective means to measure the severity of emotional disorders [8]. With use of these patient proxy scales it is possible to achieve a more detailed assessment of the impact of IXT on the mental health of these children.

At present, only rarely are the psychological problems of children with IXT considered. In general, the more severe the IXT, the worse the HRQOL. However, Hatt and Lim [9, 10] found that while parents' HRQOL was related to the children's IXT severity, no such relationship was present in the children. In this way, the clinical findings of IXT in these children do not fully correspond with their mental health. Another indication of this difference between the children and their parents were the findings that parents with poorer HRQOL score were more likely to make the decision to perform surgery [11]. Chiu et al. [12] have suggested that the HRQOL should be incorporated into the post-operative evaluation. In support of this proposal are the results of McKenzie et al. who reported that IXT children, especially boys, are three times more likely to suffer from mental illness in the future [13].

As no clear criteria currently exists for surgical intervention in childhood IXT, this raises the issue as to whether the HRQOL should be included as an indication for surgery as well as one of the criteria for evaluating surgical success. Although there are a few papers that have reported on the anxiety and depression in adults with strabismus[14–16], to the best of our knowledge no information regarding these factors are available in children with IXT and their parents. Therefore, the purpose of this study was to assess both the HRQOL and HADS in a large sample of IXT children and their parents as related to the severity of the IXT. In addition, we reexamined the HRQOL after surgery to examine the relationship between the cosmetic/functional recovery and HRQOL.

Patients And Methods

Patients:

Children (N = 389) with IXT who underwent strabismus surgery at the Zhongshan Ophthalmic Center, of Sun Yat-sen University, China over the period from January 1, 2016 to December 31, 2018 were recruited for this study. The following inclusion criteria were employed: (1) 5–17 years old, (2) angle of distant exodeviation ≥ 15 prism diopters (PD), (3) no "A" or "V" pattern or vertical deviation, (4) best corrected visual acuity of no less than 20/30 and bilateral difference of not greater than two lines and (5) no abnormality in the anterior segment and fundus. The exclusion criteria consisted of: (1) history of ophthalmic and/or strabismus surgery or botulinum injection, (2) previous vision training, (3) nystagmus, paralytic or restrictive exotropia, developmental delay and/or any learning disability and (4) any other neurological and/or psychological disorders. Informed consent was obtained from all patients and their parents. The study was compliant with the Declaration of Helsinki and additional approval was obtained from the Research Ethics Board of the Zhongshan Ophthalmic Center, of Sun Yat-sen University, China.

Clinical evaluation and surgical treatment:

All participants had undergone a comprehensive eye examination, including best corrected visual acuity, intraocular pressure, cycloplegic refraction, anterior segment examination by slit-lamp and fundus color photography. Orthoptic examinations included the prism and alternate cover test (PACT) at distance (6 m) and near fixation (33 cm), fusion function by synoptophore, near stereoacuity (33 cm) by Titmus test, distance stereoacuity (5 m) by Randot test, NCS and the Worth 4 dot test. All patients underwent strabismus surgery under general anesthesia, with 69.9% receiving unilateral lateral rectus recession–medial rectus resection, 10% bilateral lateral rectus recession and 20.1% unilateral lateral rectus recession. After a minimum period of 6-months follow-up, an exotropia of ≤ 10PD and esotropia ≤ 5PD were considered as a surgical success.

HADS:

The 14 items comprising HADS serve to measure anxiety and depression symptoms, with seven items for the anxiety scale (HADS anxiety) and seven for the depression scale (HADS depression)[17]. The scoring method consists of: 0-never, 1-rarely, 2-sometimes, 3-often and 4-almost always. Items from each of the 7-item anxiety and depression subscales were summed to generate a total subscale score. Total subscale scores of 7 or less indicate non-cases, 8–10 as borderline and scores of ≥ 11 as definite cases[18]. It had been reported that the Chinese version of HADS possesses excellent reliability and validity[19]. Parents were asked to read each statement and choose the answer which best describes how they had felt in the preceding week[20]. The HADS was performed one day before the surgery.

IXTQ:

The IXTQ has 3 components, a self-report of the child's own HRQOL completed by the child (5–17 years old), the Proxy IXTQ and a report of the child's HRQOL as completed by the parent[21]. An additional scale for the children's psychological, visual function and surgical opinions was completed by the parents. Each item had 5 response options: 100-Never, 75- Almost never, 50-Sometimes, 25-Often and 0-Almost always. For children aged 5–7 years, only 3 opinions were included: 100-not at all, 50-sometimes and 0-a lot. The final IXTQ score for each child and their parents were calculated as the mean of all items, and ranged from 0 (worst) to 100 (best) HRQOL. During the HRQOL assessment, the children and their parents answered questionnaires separately without any verbal or nonverbal communication. Questionnaires were self-administered with written instructions and were supervised by the same investigator (QL). If the child or his/her parents had some problems in understanding the question, a verbal interview was conducted without any explanation or elaboration[6, 7, 22].The IXTQ was performed one day before the surgery, and then, after surgery, again at the end of follow-up time.

Statistical analysis:

Independent sample t-tests were used to compare the pre- and post-operative differences in HRQOL results between children of different ages, genders and their parents. Children with differences in stereo function and stereoscopic function were compared using one-way analysis of variance. Relationships

among children, proxy HRQOL scores, HADS scores and severity of IXT were evaluated with use of multivariate linear regression analyses and Kendall's tau-b analysis. The SPSS 19.0 software package (SPSS Inc., Chicago, IL,USA) was used to perform these statistical analyses. A P-value of ≤ 0.05 was required for results to be considered statistically significant.

Results

Demographic data:

Of the 389 children included in this study, 47.8% were male and 52.2% were female. Ages ranged from 5 to 17 years old (Mean + SD = 8.17 ± 2.81). The best corrected visual acuity was 0.91 ± 0.18 in the right eye and 0.8 ± 0.21 in the left. Spherical equivalent of the right eye was from − 8.5D to + 9.25D (-0.08 ± 2.38D) and from − 10.5D to + 8.25D (-0.03 ± 2.32D) in the left eye (Table 1).

Table 1
Clinical characteristics of childhood intermittent exotropia.

Clinical characteristics			**N = (389)**
Sex (Male/Female)			186/203
Age (years, mean ± SD)			8.17 ± 2.81
VA of eyes (mean ± SD)	Left		0.8 ± 0.21
	Right		0.91 ± 0.18
Deviation (PD, mean ± SD)	Near		31.08 ± 9.92
	Distance		31.43 ± 8.94
Sensory fusion	Normal (III)		82(21%)
	Abnormal (Nil-II)		307(79%)
Stereoacuity (seconds)	Near	Good (≤ 63")	116(29.8%)
		Moderate(≤ 200")	79(20.3%)
		Poor(> 200")	194(49.9%)
	Distance	Good (≤ 63")	25(6.4%)
		Moderate(≤ 200")	41(10.5%)
		Poor(> 200")	323(83.1%)
Near control score (median,range)			9(7–9)
PD: prism diopter; VA: visual acuity.			

Severity Of Ixt And Ixtq:

The mean + SD IXTQ score in children with IXT was 48.21 ± 26.2 and their proxy score was 44.6 ± 25.68. The average score for the psychological, visual function and surgical opinions was 42.04 ± 20.16. The children's IXTQ scores were related to the proxy and comprehensive scales ($p < 0.01$) as well as to near stereoacuity (β=-6.41, P = 0.029). There were no significant differences in HRQOL between children with different fusion functions. In the parent's scale, poor near stereoacuity was associated with lower scores (β=-6.889, P = 0.015). The angle of deviation at near showed negative linear relationships with visual function (β=-1.05, P = 0.026) and psychological scores (β=-1.124, P = 0.019) and opinion regarding surgery(β=-1.146, P = 0.024)(Table 2).

Table 2
Multivariate linear regression of the IXTQ and severity of IXT.

Examination of IXT		Child score	Proxy score	Visual Function subscale	Psychological subscale	Surgery subscale
		48.21 ± 26.2	44.6 ± 25.68	43.15 ± 21.98	41.7 ± 22.32	42.22 ± 23.71
Deviation	Near	P = 0.497 β=-3.86	P = 0.422 β=-0.362	**P = 0.026*** **β=-1.05**	**P = 0.019*** **β=-1.124**	**P = 0.024*** **β=-1.146**
	Distance	P = 0.370 β = 0.53	P = 0.114 β = 0.908	P = 0.967 β = 0.016	P = 0.773 β = 0.112	P = 0.657 β = 0.183
Sensory fusion		P = 0.837 β = 1.558	P = 0.529 β = 1.050	P = 0.388 β=-1.223	P = 0.133 β = 2.165	P = 0.960 β = 0.076
Stereoacuity	Near	**P = 0.029*** **β=-6.41**	**P = 0.015*** **β=-6.889**	P = 0.521 β=-1.530	P = 0.235 β=-2.879	P = 0.274 β = 2.811
	Distance	P = 0.221 β = 3.033	P = 0.412 β = 0.293	P = 0.983 β=-0.042	P = 0.635 β = 0.980	P = 0.655 β=-9.979
Near control score		P = 0.965 β = 0.021	P = 0.061 β=-0.598	P = 0.448 β=-0.205	P = 0.372 β=-0.245	P = 0.940 β=-0.022

Both the child's and proxy scores were related to near stereoacuity. Subscales of visual function, psychological and surgical options were related to the angle of deviation at near. IXTQ: Intermittent Exotropia Questionnaire.

Table 3
Relationship between the severity of IXT and HADS.

Kendall's tau-b analysis		Anxiety scale score	Depression scale score
		11.2 ± 2.92	10.44 ± 2.9
Deviation	Near	P = 0.483	P = 0.072
	Distance	P = 0.163	P = 0.946
Sensory fusion		P = 0.780	P = 0.756
Stereoacuity	Near	**P = 0.002**	**P = 0.019**
	Distance	P = 0.851	P = 0.359
Near control score		P = 0.293	P = 0.811
HADS scores were negatively correlated with near stereoacuity. HADS: Hospital Anxiety and Depression Scale .			

Severity Of Ixt And Hads:

The mean + SD HADS score of the parents was 11.2 ± 2.92, of which the anxiety scale score of ≥ 8 accounted for 95.87%, while the depression scale score of ≥ 8 accounted for 92.01%. The anxiety (R=-0.215, P = 0.002) and depression scores (R=-0.182 P = 0.009) showed a negative linear relationship with near stereoacuity. There were no statistically significantly differences in other

Surgical outcomes and post-operative HRQOL:

Postoperative orthoptic measurements showed that there were 275 patients(70.6%) got successful surgical results. And 51 patients(13.3%) were overcorrected, 63 patients(16.1%) were undercorrected, respectively.

All HRQOL scores in IXT children were lower after surgery as compared with that of their pre-operative scores children (P < 0.05). The mean + SD IXTQ score in these children was 22.78 ± 14.98 and the proxy IXTQ score was 26.17 ± 15.37. The overall mean + SD score of the children's psychological, visual function and surgical opinions was 25.28 ± 14.1 (Table 4). Even in patients with over- and under-corrections (exotropia > 10 PD, esotropia > 5 PD), post-operative IXTQ scores were significantly improved (p = 0.015). After surgery, the children's IXTQ score showed a negative linear relationship with the angle of deviation at distance (β=-0.599,P = 0.039), while no significant correlations in parental IXTQ scores with any of the clinical features were obtained. Visual function (β=-0.856,P = 0.036) and psychological scores (β=-1.0,P = 0.012) displayed a negative linear relationship with the angle of deviation at near vision (Table 5).

Table 4
Pre- and post-operative IXTQ scores in childhood intermittent exotropia.

IXTQ	Preoperative	Postoperative	P values
Child score	48.21 ± 26.2	22.78 ± 14.98	**0.001**
Proxy score	44.6 ± 25.68	26.17 ± 15.37	**0.032**
Average score	42.04 ± 20.16	25.28 ± 14.1	**0.001**
Differences between pre- and post-operative IXTQ scores were statistically significant.			

Table 5
Multivariate linear regression of surgical outcomes and post-operative IXTQ.

Examination of IXT		Child score	Proxy score	Function subscale	Psychological subscale	Surgery subscale
		22.78 ± 14.98	26.17 ± 15.37	40.81 ± 19.06	35.81 ± 18.58	10.88 ± 21.43
Deviation	Near	P = 0.912 β = 0.036	P = 0.215 β=-0.415	**P = 0.036*** **β=-0.865**	**P = 0.012*** **β=-1.000**	P = 0.360 β=-0.353
	Distance	**P = 0.039*** **β=-0.599**	P = 0.707 β=-0.129	P = 0.406 β=-0.302	P = 0.135 β = 0.608	P = 0.051 β=-0.770
Sensory fusion		P = 0.473 β=-0.580	P = 0.789 β=-0.221	P = 0.701 β = 0.391	P = 0.529 β=-0.618	P = 0.057 β = 2.104
Stereoacuity	Near	P = 0.542 β=-0.800	P = 0.606 β=-0.691	P = 0.265 β = 1.841	P = 0.746 β = 0.516	P = 0.853 β = 0.331
	Distance	P = 0.878 β=-0.278	P = 0.594 β = 0.986	P = 0.508 β=-1.509	P = 0.065 β=-4.062	P = 0.731 β = 0.205
Near control score		P = 0.835 β=-0.091	P = 0.119 β = 0.700	P = 0.144 β = 0.807	P = 0.632 β=-0.165	P = 0.621 β=-0.173
Children' IXTQ scores were related to the angle of deviation at distance. Psychological and visual function scores were negatively related to the angle of deviation at near. No statistically significant correlations were obtained between parental IXTQ scores and any of the clinical features.						

Discussion

Attempts at establishing a relationship between the child's HRQOL and clinical severity of their IXT have proved inconsistent as based on previous literature. A multi-ethnic pediatric eye disease study (MEPEDS) [23] surveyed children with strabismus at 25 to 72 months of age and found that strabismus reduced the HRQOL in these pre-school children. However, in that study a wide variety of strabismus types were included in their analysis. In the Wang et al's study, the deviation angle at distance and exotropia control at home were associated with the child's HRQOL[22], while Lim et al believed that the child's HRQOL and clinical severity were not related[10]. Our current results were mixed, that is, the child's IXTQ was related to near stereoacuity, but not to the deviation angle, NSC and distant stereoacuity. The clinical findings partially correspond with the child's HRQOL responses. Children's perception of strabismus differ from that of adults [24], in part due to the limited attention that children direct to their visual problems [25]. Especially, younger children, who have not yet to form a clear aesthetic concept and an established awareness of their eye disease. Essentially, strabismus is their norm and has little effect on their daily life[26]. Moreover, exotropia in children with IXT appears intermittently, which may also make it difficult for them to consistently respond to this condition and would thus not always affect their quality of life. In contrast, stereoscopic function is more critical for daily events, and, if disturbed may lead to the children's inability to perform delicate operations[27, 28] and affect their social activities[29]. Patients with IXT experience an initial decline in distance stereoacuity followed by a decline in near stereoacuity. Our findings that children in the later stages of IXT show the affects on their HRQOL may be related to the disturbance of the stereoscopic function.

For parents, their proxy scale scores were also related to near stereoacuity, and the subscale scores of psychological, visual function and surgery opinion had a negative relationship with the deviation angle at near. These results indicate that not only do the later stages of IXT affect the parents' HRQOL, but also that deviations at near represent their greatest concern. As near deviation can be readily detected by parents, it seems understandable that they would worry that this IXT affects their children's physical and mental health. These parents would observe the frequency and severity of their children's near deviation, and therefore be more inclined to take their children to see a doctor as well as being more concerned about the surgical risk and surgical prognosis. Wang et al [22] found that both the child and their parents' HRQOL showed a trend toward correlating with clinical severity, with large deviation, poor control and poor stereo function being significantly associated with higher IXTQ scores. In our experience we have found that some patients with a more serious IXT may show a lower HRQOL score, which then predisposes them to ignore the severity of IXT and thereby delay the time for surgery. In fact, the relationship between the angle of deviation, stereoacuity and fusion function are not yet clearly defined [30], but the larger the angle of deviation the more likely it will be to disrupt the binocular balance[31]. A loss of stereoacuity in children may result in abnormal daily activity that is readily apparent. Overall, the objective clinical findings of IXT do not provide a good representation for the subjective understanding of the disease to these children. The pre-operative HRQOL is related to the later stages of impaired stereoacuity in children with IXT, and may provide a litter bit guide for clinicians to judge the severity of

IXT and the time for surgical intervention. However, these HRQOL scores are not in full accord with the severity of IXT. Therefore, it is important for the clinicians to inform parents about all aspects of IXT, including the various clinical features and surgical versus non-surgical interventions, that may help them to make the appropriate decision.

Results of the HADS from parents indicates that they exhibit an obvious tendency for anxiety and depression regarding their children's IXT. It is clear that the parents are really concerned about their children with IXT, as more than 90% of parents show a decline in mental health. We found that the decline in near stereoacuity can result in a significant amount of anxiety and depression in them, although there is no correlation with other factors such as deviation angle, NSC, and distance stereoacuity. It has been reported that the visual impairment and loss of binocular function are related to symptoms of anxiety and depression[32]. With the decline in binocular function in the later stages of IXT, the resultant abnormal activities in these children may cause anxiety or depression within the parents. Results from a prospective study by Chai et al.[33] reveal that the children, adolescents or adults with strabismus may experience symptoms of anxiety and depression, and that children are more affected and less likely to recover their emotional and mental state. Mcbain [16] and Snaith [34] have emphasized that it was society's and patient's awareness of the disease that affected the quality of life, not the severity of disease itself. Our results also confirm this. Almost all parents show signs of psychological stress in response to the various degrees of IXT severity in their children, which can explain their anxiety and likelihood to take their children to hospital for treatment.

The post-operative HRQOL in both children and their parents significantly improves, likely due to the changes in the child's appearance after surgery[35]. In fact, all subscales of IXTQ scores show improvements after surgery. It is generally believed that both the cosmetic and functional recovery of binocular vision following surgery result in a positive impact on the social skills, emotions and mental state of these children. These post-operative HRQOL scores show a significant relationship to the eye position, and even in patients with under- or over-corrections resulting from the strabismus surgery, their post-operative HRQOL scores were substantially improved. Interestingly, these changes in psychological state may not parallel the surgical outcome. For example, Mruthyunjaya et al.[36] noted that subjective satisfaction can be obtained when the eye position is within 10 PD after surgery, even if it is objectively considered as unsuccessful by the surgeon. Archer et al. [37] also reported that although strabismus surgery in children can improve their HRQOL, there was no statistically significant difference between the successful and unsuccessful surgical outcomes in patients. Another explanation was that as a parent they would evaluate the quality of life of their own child as significant higher after the low risk strabismus surgery regardless of any functional outcome. This is similar to the findings of our study. Strabismus surgery can produce a similar degree of comfort and reduce the patient's concern about their disease as that in response to a placebo. After surgery, children's HRQOL scores are consistent with that of their parents. Perhaps, the surgery enables both the children and their parents to attend similarly to the IXT.

There are certain limitations in this study. Currently, no unified criteria exist for the judging of IXT severity. Different methods used for measuring stereoacuity and fusion function may reveal quite different results.

In addition, there were a few children in this study with a history of amblyopia treatment and some wore glasses, which may affect their HRQOL. Finally, we did not have a healthy control group, the fact that all patients in our study underwent strabismus surgery, may introduce some bias with regard to the whole population of children with IXT.

In summary, both children' s and parents' HRQOL and HADS scores were associated with near stereoacuity. The improvements in HRQOL scores in both the children and parents following surgery indicate that a timely surgery is important for enhancing the quality of life for these children. However, HRQOL scores failed to reflect the seriousness of childhood IXT, nor could these scores be used as an indication for surgical intervention. It is important to note that HRQOL scores vary widely between people as well as in the same illness within an individual over time, as these scores are based on personal assessments and are influenced by physical, psychological and social factors[38]. Nonetheless, these HRQOL scores should be considered by the clinician when evaluating children with IXT to understand the anxiety of these children and their parents and attend to their psychological state.

Abbreviations

HRQOL:health-related quality of life; HADS:hospital anxiety and depression scale; IXT:intermittent exotropia; IXTQ:Intermittent Exotropia Questionnaire

Declarations

Ethical Approval and Consent to participate:

Ethical approval was obtained from the human ethics committee of the the Zhongshan Ophthalmic Center, of Sun Yat-sen University, ChinaConsent for publicationThe authors declare that they have no competing interests.

Availability of supporting data

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request

Competing interests:

The authors declare that they have no competing interests.

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Author Contributions:

Conceptualization, J.H.Y.; Methodology, J.H.Y., D.Y.M., J.L., L.N.C., and J.Y.L.;; Validation, J.H.Y.; Formal analysis, D.Y.M.; Resources, J.H.Y., L.J., L.N.C., and J.Y.L.; Data curation, J.H.Y., D.Y.M., L.J.; L.N.C., and J.Y.L.; Writing-original draft preparation, D.Y.M and L.J.; Writing-review and editing, J.H.Y.; Visualization, D.Y.M. and L.J.; Supervision, J.H.Y.; project administration, J.H.Y.; Funding acquisition, J.H.Y.

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