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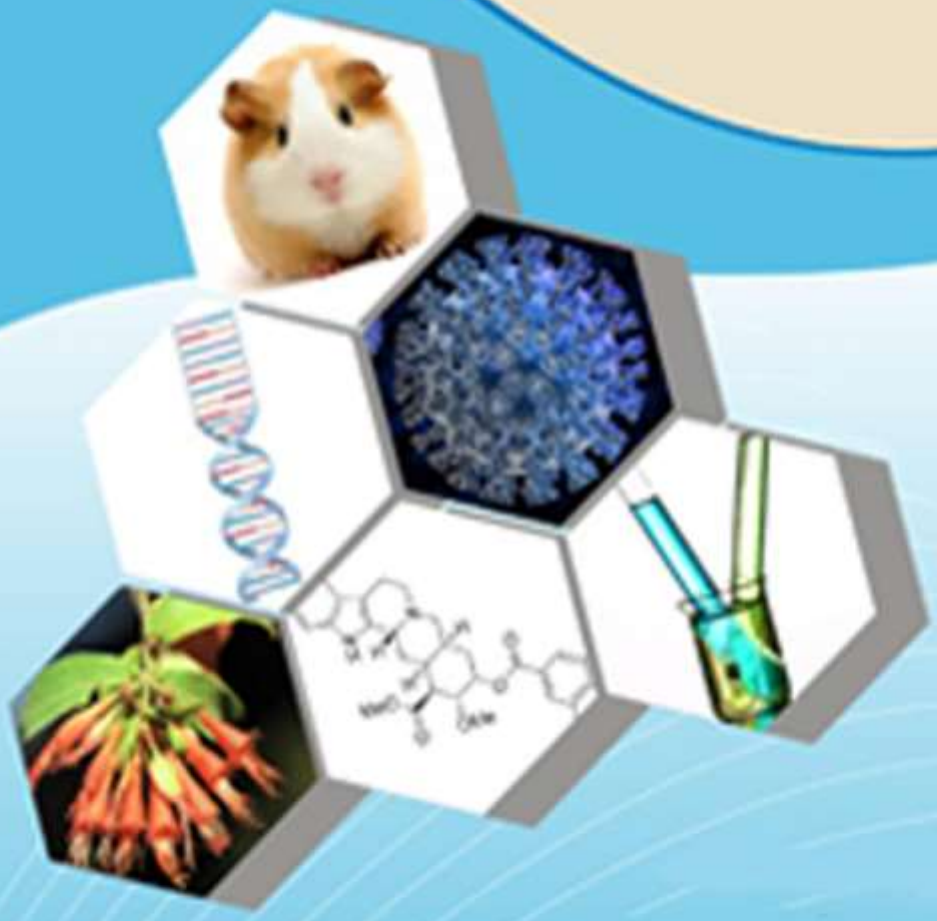

iajpb.editor@gmail.com
editor@iajpb.com

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The effectiveness of a modified version of Park's approach in treating strabismus in youngsters

R.Mounika [1],K.Umadev [2],K.Radhika [3],Bhupathi Madhan [4,]

Abstract

Objective: To study the effectiveness of a modified version of Park's approach in treating strabismus in youngsters. The study's methodology included recruiting 120 patients from the ophthalmology department of the Anhui Provincial Children's Hospital in Anhui, China, from January 2019 through December 2021. Each group of patients consisted of 60 individuals; the research group and the control group were similarly structured. A regular incision was used to modify the rectus muscles in the control group, whereas a modified version of Park's approach including an intermuscular membrane incision and a conjunctiva two-layer suture procedure was used in the experimental group. Patient satisfaction, tear film function, and perioperative signs were among the many characteristics that were evaluated. The results showed that there was a substantial decrease in intraoperative blood loss, operation time, and length of hospital stay in the study group ($p < 0.01$). In addition, there was a marked decrease in corneal staining score ($p < 0.01$), a substantially longer Schirmer's time, and a significantly longer tear film break-up time (TFBUT) time. The study group reported a considerably greater degree of satisfaction than the control group ($p < 0.05$). Also much higher than the control group was clinical effectiveness (91.67% vs. 83.33%). In addition, there was a statistically significant difference in the incidence of complications between the study group (five) and the control group (eleven; $p < 0.05$). Results show that Enhanced Park's approach has a number of positive effects, including an increase in satisfaction, a decrease in problems, and an improvement in perioperative indicators and tear film function. This provides hope that it could one day replace more traditional methods of treating exotropia in youngsters. The effectiveness of this therapeutic approach, however, can only be determined using data collected over an extended period of time. Topics covered include strabismus, the two-layer suture, conjunctiva, intermuscular membrane, and Park's method.

INTRODUCTION

Strabismus, characterized by misaligned extraocular muscles, can result in a deviation in eye position. It is a relatively common condition among adolescents, with a prevalence of around 4 %. Treatment of strabismus is time-consuming and often leads to psychological stress for both patients and their families [1,2]. Surgical correction is currently the main approach, but it carries the risk of complications such as corneal exposure and surface damage, which may affect tear film function and impact surgical outcomes and patient satisfaction [3,4]. As a result, safeguarding the cornea during surgery and reducing postoperative complications have become key priorities in clinical practice.

In recent years, rectus recession has emerged as a preferred surgical option for strabismus treatment. It offers advantages such as shorter operation time, improved visual field during surgery, and fewer postoperative side effects [5]. However, this technique is not without issues, including eyelid scarring and conjunctival wounds [6]. In comparison, modified Park's technique has gained popularity in strabismus surgery due to its smaller conjunctival incisions, reduced postoperative discomfort, and minimal aesthetic impact [7].

Assistant professor [1,2,3,4],
Department of Pharmacy,
Samskruti College of Pharmacy,
Kondapur (V), Ghatkesar (M) Medchal Dist, Telangana, India.

In traditional Chinese medicine (TCM), strabismus in children is classified as ophthalmoplegia or visual divergence, often attributed to blocked meridians caused by *wind*, *phlegm*, and *stasis*. This obstructs the flow of *qi* and blood while depriving tendons and muscles of nourishment and relaxation, resulting in oblique eyes. Intermittent external strabismus is mostly associated with *qi* deficiency, resulting from lack of positive *q*i, weakened external guard consolidation, and deficiency in veins and ligaments. Hence, this study incorporates the use of *Buzhong Yiqi* decoction as a treatment approach. This study investigated the efficacy of modified Park's technique in the treatment of strabismus in children.

METHODS

General patient data

This research was conducted at Anhui Provincial Children's Hospital in Hefei, Anhui Province, China, comprising 120 children diagnosed with strabismus. Patients were randomly assigned using an online web-based tool (http://www.randomizer.org/) to two groups namely; study and control groups. An independent research assistant, not involved in participant screening or evaluation, managed the randomization process. The original calculation for sample size determined that 60 patients in each group would be sufficient to detect a 3-point difference between two groups in a two-sided significance test, with a statistical power of 0.8 and an alpha error level of 0.05.

All patients and their guardians received comprehensive information and provided informed consent by signing respective documentation before participating in the study which adhered to the ethical standards outlined in the Declaration of Helsinki [8]. The study received approval from the Ethics Committee of Anhui Provincial Children's Hospital, China (approval no. CHA18239474).

Inclusion criterion

Patients who met diagnostic criteria for strabismus as specified in the 9th edition of ophthalmology [9].

Exclusion criteria

Patients with abnormal eye movements or A-V signs, nystagmus, vertical strabismus, a history of eye surgery or trauma, or any other ocular diseases, surgical intolerance, abnormal immune function, refractive interstitial opacity, or neurological diseases were excluded from this study.

Interventions

Patients were in the supine position and received general anesthesia. In preparation for surgery, the conjunctival sac was rinsed with 0.3 % povidone-iodine. Compound epinephrine was applied to the conjunctival surface to constrict capillaries and minimize intraoperative blood loss.

For medial rectus surgery, an arcuate incision was made 5 mm away from the cornea in the nasal region. For lateral rectus surgery, an arcuate incision was made 7 mm away from the cornea in the temporal region. The bulbar conjunctiva was cut open, and the rectus muscle was secured in place using a strabismus hook. Thereafter, bulbar conjunctiva and fascia were dissected to fully expose the rectus muscle. A double-loop suture was performed using a 6 - 0 absorbable suture, approximately 2 mm from the endpoint of rectus muscle. The medial or lateral rectus muscle was then cut about 1 mm posterior to its end to allow for recession. Suture was advanced obliquely at the posterior edge of the insertion point of rectus muscle, emerging from the anterior edge. Needle was passed through the superficial sclera at the end of the rectus muscle. Configuration of the suture resembled a "V", with its tip facing the cornea, and the amount of muscle recession was measured. The suture was tightened without ligating according to the preoperative suspension muscle design. The conjunctiva was secured with a silk thread. Following operation, tobramycin and dexamethasone ophthalmic ointment were applied to the conjunctival sac. If necessary, the suture was adjusted 1-2 days after surgery based on eye position.

In control group, rectus muscle adjustment suture was performed using the conventional incision method. A 5 – 10 mm bulbar conjunctival fornix incision was made, and the medial or lateral rectus muscle was secured using a strabismus hook. Intermuscular membrane and ligamentum temperatum were dissected. After performing a double-loop suture using 6 - 0 absorbable sutures, extraocular muscles were shortened according to preoperative design, and conjunctival incision was sutured.

Both groups of patients received oral dexamethasone tablets (5 mg/day) for three consecutive days. Levofloxacin and praprofen eye drops were administered four times daily for two consecutive weeks.

Additionally, both groups received treatment with *Buzhong Yiqi* decoction, which included 12 g each of *Codonopsis radix* and *Astragali radix*, 9 g each of

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Atractylodis macrocephalae rhizoma, *Rehmanniae radix*, *Angelicae sinensis* radix, *Bupleuri radix*, *Scrophulariae radix*, and *Cimicifugae rhizoma*, and 6g each of tangerine peel, *Ophiopogonis radix*, and liquorice root. The herbs were decocted with water and administered every other day for six months.

Evaluation of parameters/indices

Postoperative indicators

Amount of blood loss during surgery, duration of surgical procedure, and length of hospital stay was recorded.

Efficacy

Efficacy was classified as cured (following treatment, symptoms vanished, and eye position was restored, with degree of strabismus decreasing to less than 5△), effective (a noticeable improvement in symptoms, and degree of strabismus dropped to between 5△ and 10△ after treatment), and ineffective (despite treatment, there was no significant improvement in symptoms) [10].

Tear film function

Schirmer's test procedure involved placing a sterile test paper below the patient's eye in the conjunctival sac. Patient was instructed to look straight ahead for a few seconds and then keep their eyes closed. After 5 mins, the paper strip was collected, and the length of moistened area was measured. In the tear film break-up time (TFBUT) test, sodium fluorescein was applied to the conjunctival surface, and eye was examined using a slit lamp. Lamp was switched to a cobalt blue filter, and patient was instructed to blink once and keep their eyes open. A dark spot indicating a dry area appeared after the patient blinked. Tear film break-up time (TFBUT) was calculated as the time interval between the last blink and appearance of the first dark spot. For corneal fluorescein staining score, a solution of sodium fluorescein was placed on patient's cornea, and eye was observed under cobalt blue light to determine staining pattern. Cornea was divided into quadrants, and each quadrant was assigned a score from 0 to 3. Total score across all quadrants ranges from 0 to 12 with lower scores indicating better tear film function.

Satisfaction with surgery

After a 28-day post-surgery period, a survey was administered to evaluate patient satisfaction. The survey included questions regarding the efficacy of surgery and any discomfort experienced. Each question was assigned a score of 1 to 5. A score of 80 – 100 indicated a very high level of satisfaction, 60 – 80 indicated satisfaction while < 60 indicated dissatisfaction.

Complications

Occurrences of complications, which included conjunctivitis, corneal edema, diplopia and scar adhesion were recorded.

Statistical analysis

Data processing was conducted using Statistical Packages for Social Sciences (SPSS 23.0). Enumeration data were presented as N (%) and analyzed using Chi-square test. Normally distributed measurement data were represented as mean ± standard deviation (SD). Comparison of means between two groups was carried out using chi-square F-test. Data showing chi-square differences were tested using independent samples t-test, while data with non-chi-square differences were analyzed using independent samples t-test. Intra-group pre- and post-comparisons were performed using paired samples t-test. $P < 0.05$ was considered statistically significant.

RESULTS

Patient data

There was no statistical difference in clinical data between study and control groups ($p > 0.05$; Table 1).

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Table 1: Comparison of general data (mean ± SD, N = 60)

Characteristic	Study group	Control group	t/χ^2	*P*-value
Sex (M/F)	43/37	42/38	1.667	0.197
Age (years)	6.75±1.22	6.34±1.45	0.049	0.961
Duration of disease (months)	2.42±0.79	2.14±1.17	2.064	0.356
Left eye	36	41	0. 054	0. 816
Right eye	44	39		
Degree of strabismus	46. 01±10. 22	45. 82±9. 65	0. 123	0. 902

Perioperative indicators

Perioperative indices in study group showed significant improvement compared to control group. ($p < 0.05$; Table 2).

Tear film function

Following intervention, the use of modified Park's technique led to significantly improved tear film function, when compared to rectus muscle adjustment suture.

Data was significantly reduced in both groups after intervention, and tear film function was significantly better in study group compared to control group ($p < 0.05$; Table 3).

Satisfaction level

Satisfaction level in study group was significantly higher compared to control group ($p < 0.05$; Table 4).

Clinical efficacy

Patients in study group exhibited higher treatment efficacy rate compared to control group ($p < 0.05$) (Table 5).

Incidence of complications

Study group had lower incidence rate of complications compared to control group ($p < 0.05$) (Table 6).

Table 2: Perioperative indices (mean ± SD, N = 60 in each group)

Group	Intraoperative blood loss (mL)	Duration of surgery (min)	Length of hospital stay (days)
Study	8.11±2.12	22.14±5.02	5.87±1.53
Control	13.21±3.07	35.23±6.41	7.86±2.35
χ^2/t	9.326	10.632	5.476
P-value	<0.01	<0.01	<0.01

Table 3: Comparison of tear film function (mean ± SD, N = 60 in each group)

Group	Schirmer's test (mm.5min)		TFBUT (s)		Corneal staining score (points)	
	Before intervention	*After intervention*	*Before intervention*	*After intervention*	*Before intervention*	*After intervention*
Study	5.62±1.21	10.42±1.54*	5.58±1.23	8.12±1.39*	8.27±1.32	4.25±1.27*
Control	3.67±1.05	11.33±1.35*	3.64±1.07	9.13±1.41*	8.22±1.31	6.16±1.24*
T	0.042	7.322	0.042	7.632	0.058	7.322
P-value	0.974	<0.01	0.954	<0.01	0.942	<0.01

*$P < 0.05$ vs. before intervention

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Table 4: Comparison of satisfaction (N = 60 in each group)

Group	Very satisfied	Satisfied	Dissatisfied	Overall satisfaction
Study	32	17	1	59
Control	14	26	10	50

Table 5: Efficacy of treatment (N = 60 in each group)

Group	Cure	Effective	Ineffective	Total efficacy (%)
Study	26	29	5	91.67
Control	18	32	10	83.33

Table 6: Incidence of complications (N= 60 in each group)

Group	Conjunctivitis	Corneal edema	Diplopia	Scar adhesions	Total
Study	1	2	1	1	5
Control	4	3	2	2	11
χ^2					4.234
P-value					0.035

DISCUSSION

Strabismus is commonly associated with craniocerebral injury and neurological diseases [11,12]. It typically manifests before age 5, causing alignment issues and vision loss as children struggle to align their eyes correctly [13]. Vision training, along with appropriate eye surgery, aids in the recovery of eyesight, with corrective surgery being the primary management method for strabismus in current practice [13-15].

For children with external strabismus, the root cause often lies in an internal deficiency of *middle-qi* and lack of glory of *Ying* and blood. This leads to deficiency of *yin* and blood and excessive *yang* activity, resulting in intermittent and sudden eye strabismus. Main clinical symptoms include *qi* deficiency, with strabismus occurring after physical exhaustion or loss of mental focus. *Buzhong Yiqi* decoction, containing Astragali radix benefits *qi*, Codonopsis radix and *Atractylodis macrocephalae* rhizoma strengthen and nourishes spleen and *middle-qi*, tangerine Peel regulates *qi*, *Angelicae sinensis* radix tonifies blood, Cimicifugae rhizoma and Bupleuri radix elevate and strengthens *middle-qi*, Ophiopogonis radix nourishes *Yin* and blood, are used as a combination treatment option.
The modified technique of Park's incision, combined with two layers of intermuscular and conjunctival sutures, contributes to the restoration of tertiary visual function in both eyes of children with external strabismus. It also promotes the attainment of functional eye position after surgery.

Compared to control group, study group showed lower perioperative scores, which is attributed to accurate lesion localization and smaller conjunctival incision using modified Park's technique. These factors significantly reduced intraoperative bleeding, operative time, and postoperative complications. The less invasive nature accelerated healing, shortened hospital stays reduced pain and treatment costs. Additionally, study group exhibited improved tear film function when compared to control group. Thus, modified Park's technique was less damaging to aqueous and mucus layers of tear film. Furthermore, this procedure minimizes conjunctival scarring, nerve damage and irritation in postoperative period, leading to enhanced tear film stability and recovery [16-18].

Study group surpassed control group in terms of treatment efficacy, complication rate and satisfaction with surgery primarily due to smaller conjunctival incision and reduced postoperative pain. Park's technique, originally developed by Dr Marshall Parks, an American ophthalmologist in 1968, eliminates the need for tissue dissection anterior to muscle insertion, thereby reducing nerve damage. This may be considered as a therapeutic option in future.

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Limitations of this study

This current study has some limitations. Firstly, the sample size used was relatively small, which may limit the generalizability of findings. Secondly, lack of long-term follow-up data did not establish durability of treatment outcomes over an extended period.

CONCLUSION

Modified Park's technique is highly efficacious for the treatment of strabismus in children. This technique minimizes surgical wounds and reduces the length of surgical procedures and hospital stays. As a result, patients undergoing this technique experience a lower incidence of complications and a higher level of satisfaction. Thus, modified Park's technique may be considered a preferred surgical option for treating strabismus in children following collection of long-term follow-up data to establish durability of treatment in the future.

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