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EyeSEA Eye South East Asia

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Expanding the horizons of Ophthalmology research in South East Asia

Dear esteemed readers,

Welcome back to our second issue of EyeSEA, published slightly earlier than scheduled for the December 2017 release – in time for the 5th ASEAN Economic Community Ophthalmology Meeting (AECOM) in Hanoi this 24th November 2017 at the Viet Xo Friendship Labour Cultural Palace. Fitting for the occasion, this issue features a prominent collection of studies from throughout Vietnam across various ocular subspecialties.

AECOM, the annual international gathering of Ophthalmologists from over 10 countries is the vital birthplace of EyeSEA, where just 12 months ago many like-minded academic ophthalmologists in the ASEAN region formed the editorial board and set out for what was to become today's regional journal. I cordially invite our readers to attend the 5th AECOM at Hanoi, great opportunities for exchange and collaborations in academic, service and research awaits you.

Credit must be given to the many authors, reviewers and editorial team for the effort required to expedite the review process and publish nearly one month ahead of schedule. Furthermore, our editorial team has elevated the standards of publication practice for the journal by requiring all manuscript submissions to include a declaration of interest form, and statement of approval of their study by an ethics committee – in line with the International Committee for Medical Journal Ethics (ICMJE). These improvements are milestones for EyeSEA's progression from the Thai Citation Index into the ASEAN Citation Index, eventually leading into SCOPUS and PUBMED indices. EyeSEA is also pleased to announce that our online journal system website is getting a major update to improve the presentation and functionality of the website which is integral to our interaction with readers, authors and reviewers alike.

Warmest regards,

Associate Professor Sakchai Vongkittirux, MD
Head of Thammasat Eye Center,
Faculty of Medicine Thammasat University
and Former President of The Royal College of Ophthalmologists Thailand

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Eye South East Asia

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Volume 13 Issue 1 January - June 2018

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Aims and Scope and Publication Policy

Aims and Scope

Eye South East Asia (EyeSEA) strives to promote the dissemination of regionally relevant academic publications and discourse in the field of Ophthalmology. The South East Asian population has a unique spectrum of eye diseases due to pathophysiologic, geographic, socioeconomic and cultural contexts – although often underrepresented in literature. EyeSEA supports the growing number of ophthalmic healthcare professionals in the region seeking to produce and disseminate academic publications, developing robust clinical methodology and quality of original publications in Ophthalmology from South East Asia to the world.

Publication Policy

Dates and Distribution

Publication frequency is twice per year (once every 6 months)

- Issue 1
  - January - June
  - Author Submission Deadline: 31st of March
- Issue 2
  - July - December
  - Author Submission Deadline: 30th of September
- Each issue will contain a minimum of 6 articles, amounting to a minimum of 30 pages
- All printed issues of EyeSEA will be made publically available for free in PDF format on the journal website https://www.tci-thaijo.org/index.php/eyesea/index
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This journal provides immediate open access to its content on the principle that making research freely available to the public supports a greater global exchange of knowledge. Eye South East Asia does not charge a submission fee for authors, nor does it charge a subscription fee for readers.

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Eye South East Asia employs the Double Blinded Peer Review policy.*
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- Articles written by prestigious or renowned authors are considered on the basis of the content of their papers, rather than their reputation.

All manuscripts must have reviews conducted by a minimum of 2 reviewers.
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Submitted manuscript must be an original contribution not previously published (except as an abstract or preliminary report), and must not be under consideration for publication elsewhere.
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Abstract

Abstract Specifications

- Word count: Minimum 150 words - Maximum 250 words including subheadings
- Key Words: minimum 2, maximum 5
- Your abstract must contain content for the following headings:
    1. Title
    2. Background
    3. Methods
    4. Results
    5. Conclusion
    6. Conflicts of Interest
    7. Keywords

Title

Titles should have capital letters only for names of places, institutions, individuals, companies, propietary names, but not diseases, drug formula names. Titles must end with a full stop. '.'

Background

- This section should be the shortest part of the abstract and should very briefly outline the following information:
- What is already known about the subject, related to the paper in question
- What is not known about the subject and hence what the study intended to examine (or what the paper seeks to present)

Methods

- What was the research design?
- e.g. Diagnostic Study, Etiognostic Study, Prognostic Study, Therapeautic / Efficacy Study - in addition to the study method: Case report, Case Control, Cohort, Randomised Controlled Trial.
- What type of patients are recruited?
- What was the clinical setting of the study? (if relevant)
- How were the patients sampled
- What was the sample size of the patients? (whole/and or in different groups)
- What was the duration of the study?
- On what research instruments were the patients rated?
- What was the primary outcome measure and how was it defined?

Results

- The number of patients who completed the study; drop out rates in the different groups and their causes
- The results of the analysis of the primary objectives, mentioning statistical method, expressed in words and numbers along with P values in parenthesis
- The results of the analysis of the more important secondary objectives
- Numerical information about the above analysis such as in terms of means and standard deviations, response and remission rates. Wherever possible: effect sizes, relative risks, numbers needed to treat, and similar statistics should be provided along with confidence intervals for each.
- Important negative findings, if any should also be presented: that is, findings that fail to support the authors' hypothesis
- Data on important adverse events should be included in addition to the data on efficacy

Conclusion

- The primary take-home message
- The additional findings of importance
- The perspective

Our guidelines are based on the following reference:
Andrade C. How to write a good abstract for a scientific paper or conference presentation. Indian Journal of Psychiatry. 2011;53 (2):172.

Abbreviations

Abbreviations should be defined at the first mention in the text and also in each table and figure. For a list of standard abbreviations, please consult the Council of Science Editor Style Guide or other standard sources. Write out the full term for each abbreviation at the first use unless it is a standard unit of measure.

Article category

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- Introduction
- Methods
- Results
- Discussion
- Conclusion
- Acknowledgements and conflict of interest

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- Spacing > After > 5 pt.

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In addition to a hard-copy printout of figures, authors are requested to supply the electronic version of figures in JPEG, TIFF, or Encapsulated PostScript (EPS). Figures should be saved in separated files without their captions, which should be included with the text of the article. Each figure should be numbered and mentioned in the text. The approximate position of figures should be indicated in the text. Figure legends should be grouped and placed on a separate page placed at the end of the manuscript following the Reference section.

Appendices
Supplementary materials should be collected in an Appendix and placed before the Reference section.

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Case Report

Successful management of Duane Retraction Syndrome type III with significant upshoot and concurrent superior rectus contracture

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Abstract

Background: *Duane Retraction Syndrome (DRS) Type III is an uncommon condition, which remains surgically challenging.*

Objective: *To report a rare case of DRS Type III with superior rectus (SR) contracture and its successful surgical management.*

Method: *Case report*

Results: *A 31- year old gentleman presented to our clinic with abnormal head posture and double vision. On examination, he had right face turn. Left exotropia and hypertropia were noted. Adduction of the left eye revealed severe upshoot of the left eye and narrowing of the palpebral aperture. Limitation of left eye adduction, abduction and depression was noted. The patient was diagnosed with DRS type III with SR contracture which is very rare. He later underwent left eye Y-split lateral rectus recession with superior rectus recession for his condition. Post-operatively, there was resolution of head posture and diplopia.*

Conclusion: *The authors has reported a rare occurrence of DRS Type III with SR contracture and their surgical technique adopted for the patient. This surgical procedure improved patient's ocular deviation, cosmetic appearance and functional ability.*

Keywords: *DRS Type III, Duane's retraction syndrome, Lateral rectus Y split, Strabismus, Superior rectus contracture*

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Full text. ***https://www.tci-thaijo.org/index.php/eyesea/index***

Background

Duane Retraction Syndrome (DRS) is an innervational ocular motility disorder characterized by deficient horizontal movements of the affected eye with associated enophthalmos with globe retraction on attempted adduction. The overall prevalence of DRS among patients with strabismus has been reported to be around 1-4%.[1] DRS Type III is an uncommon strabismus representing 15% of all DRS.[2] The occurrence of superior rectus contracture with DRS III is very rare.[3] We report successful surgical management of a case of DRS Type III with significant upshoot and superior rectus contracture.

Case report

A 31-year old gentleman complained of double vision which progressively worsened over the past 10 years. He subsequently developed abnormal head posture, which lead to severe neck pain and the inability to drive. The patient also claimed he had a left eye squint since birth where he was unable to move his left eye outwards. There were no other ocular complaints and he denied any history of trauma. The patient was otherwise well and had no medical illness.

Visual acuity was 6/6 in both eyes on presentation. A right face turn of 45 degrees was noted. Upon correction of abnormal head posture, cover test revealed a 40-prism diopter (PD) left exotropia for near and 25PD for distance. The patient also had left hypertropia of 25PD which improved on left gaze and left head tilt. Versions revealed limitation of adduction and abduction of the left eye with severe upshoot and narrowing of palpebral fissure on attempted adduction (Figure 1). The patient had a steroacuity of 55" with abnormal head posture. The rest of the anterior and posterior segment assessment was found to be unremarkable. He was diagnosed with left eye DRS Type III with significant upshoot and possible superior rectus contracture. The patient was scheduled for left eye squint surgery under general anesthesia.

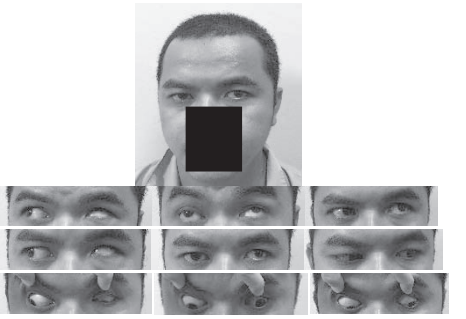

Figure 1. Photograph of patient showing a right face turn in primary position with the 9 preoperative cardinal positions

Intra-operatively, forced duction test of the left eye revealed a tight superior rectus and tight lateral rectus. The patient underwent lateral rectus recession 9mm from insertion with Y-split using the hang-back technique with 6/0 vicryl sutures. The bifurcation of the 2 arms of the Y split was 20mm apart. In addition, he also had left superior rectus recession of 6mm from insertion (direct scleral fixation).

During immediate postoperative period, the right face turn and upshoot improved significantly. Six weeks post-operatively, there was resolution of abnormal head posture and reduction of his left exotropia to 16PD for near and 12 PD for distance and hypertropia reduced to 14PD for near and 9 PD for distance (Figure 2). The patient also reported that his neck pain had resolved and he was able to drive again.

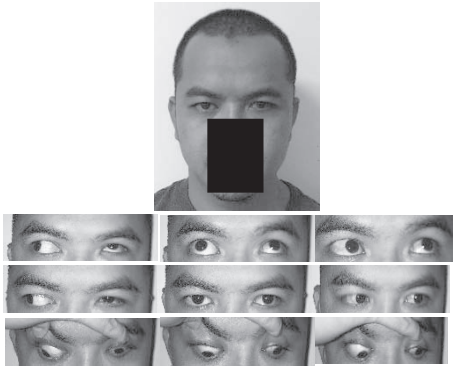

Figure 2. Post-operative photograph showing an improvement of the abnormal head posture and also the 9 cardinal positions

Discussion

Various methods have been suggested for the treatment of upshoot in DRS such as horizontal recti posterior fixation sutures, ipsilateral recession of both horizontal recti and vertical recti recession.[4-6] We chose to Y-split the lateral rectus as this would preserve lateral rectus function while the bifurcated arms would prevent slippage of the eye on adduction.[7] Hang-back technique was chosen due to the large amount of lateral rectus recession.

Clinically our patient did not show classical superior rectus contracture as he did not have an increase in hypertropia of >5PD on version and head tilt to the left side,[8] however, we confirmed superior rectus contracture from forced duction test intraoperatively. The clinical signs of superior rectus contracture may have been masked by abnormal innervation of DRS. We proceeded to recess the superior rectus to relieve this restriction to correct the patients' hypertropia. As the patient had stereopsis with abnormal head posture pre-operatively, we aimed to correct his exotropia and hypertropia to within 10PD to prevent overcorrection and allow for fusion as in our experience, these patients usually have good fusional reserve.

Superior rectus contracture in association with DRS III has only been reported once in literature.[9] To the best of our knowledge, this will be the second reported case of successful management DRS III with superior rectus contracture. Superior rectus contracture in our patient may have existed concurrently with DRS III or could be secondary to longstanding ocular upshoot. Further anatomical studies will be necessary to confirm this theory. We hope that the findings from our case will help contribute to literature to allow for better understanding and management of this very rare condition.

Conclusion

DRS III with significant upshoot and superior rectus contracture is a very rare condition which can be successfully treated with Y-splitting and recession of the lateral rectus combined with simultaneous recession of the superior rectus. This procedure improves ocular deviation, cosmetic appearance and most importantly the functional ability of the patient.

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Case Report

Large conjunctival mass

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[2]Ophthalmology Department, Queen Elizabeth Hospital, Malaysia.
[3]Pathology Department, Queen Elizabeth Hospital, Malaysia.

Abstract

Background: *Conjunctival papilloma is a benign growth of the conjunctival epithelium. It usually presents as a multi-lobular strawberry red lesion with glistening appearance. Recurrence is one of the complications after treatment.*

Objective: *To report a large pigmented, brownish, conjunctival lesion which mimic conjunctival melanoma and its management.*

Methods: *Case report*

Results: *A 60-year-old gentleman presented with a 4-year history of gradually enlarging pigmented growth on the left cornea. It was painless with minimal bleeding. On examination, the visual acuity was 6/48 in the left eye and 6/20 in the right eye. He had a large brownish, lobulated mass arising from the left inferior fornix, covering the medial half of the cornea. The size of the mass was about 16mm X 13mm. The mass was associated with multiple feeder vessels from the nasal bulbar conjunctiva. Incisional biopsy was done and the lesion was reported as benign epithelial melanosis. Subsequently, excisional biopsy with amniotic membrane transplantation was performed. Histopathology of the tumour revealed conjunctival papilloma.*

Conclusion: *Incisional biopsy should be done when malignancy is suspected. Excision biopsy with amniotic membrane transplantation is an alternative option for the treatment of large conjunctival papilloma with cornea invovlment.*

Keywords: *conjunctival papilloma, pigmented conjunctival mass, amniotic membrane transplant, conjunctiva, cornea.*

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Full text. https://www.tci-thaijo.org/index.php/eyesea/index

Introduction

Conjunctival papilloma is a benign, vascularized epithelial tumor.[1,2] Conjunctival papilloma usually presents as a multi- lobular strawberry red lesion with glistening appearance, which can be pedunculated or sessile. It commonly has an exophytic growth pattern.[3] It occurs more in male and the incidence is highest among patients aged 20– 39 years.[4] The most common location of the tumor was caruncle in adults.[3]

Primary treatment include cryotherapy, excisional biopsy and cryotherapy, topical interferon alfa-2b, photodynamic therapy, oral cimetidine, excisional biopsy and cryotherapy with adjuvant topical or injection interferon alfa-2b, and adjuvant oral cimetidine.[3] We report the management of a large conjunctival papilloma which have not shown any recurrence after complete excision for 12 months.

Case Report

A 60-year- old man presented with gradual painless growth over the left eye for the past 4 years. He did not have eye pain, eye discharge, eye swelling or blurring of vision. He had no symptoms of loss of weight or loss of appetite.

On examination, vision in the right eye was 6/20 and in the left eye was 6/48. There was a pigmented, dark brownish, and lobulated growth. The mass covered the limbal area from 4 - 12 O'clock and encroached centrally to cover more than half of the corneal surface. The size of the mass was about 16mm X 13mm. There were multiple feeder vessels arising from the nasal border of the conjunctiva. The remaining part of the anterior segment and posterior segment were normal. [Figure 1]

Initial diagnostic incisional biopsy was done and revealed benign epithelial melanosis. Immunohistochemistry showed the tissue is negative for HMB-45 and Melan-A. Excisional biopsy was performed and hemostasis secured with diathermy. Amniotic membrane transplantation (AMT) with bandage contact lens was done to cover the large epithelium defect. [Figure 2-3] Postoperatively, patient was started on dexamethasone 0.1% 2 hourly, artificial tears 2 hourly and ciprofloxacin 0.3% 4 hourly. Bandage contact lens was removed after the cornea absorbed the AMT. The topical steroid and antibiotic were tapered over 8 weeks. Histo-pathological examination of the excised lesion [Figure 4-5] revealed a papillomatous growth with no malignancy detected. Follow-up examination up to 12 months later showed no recurrence.

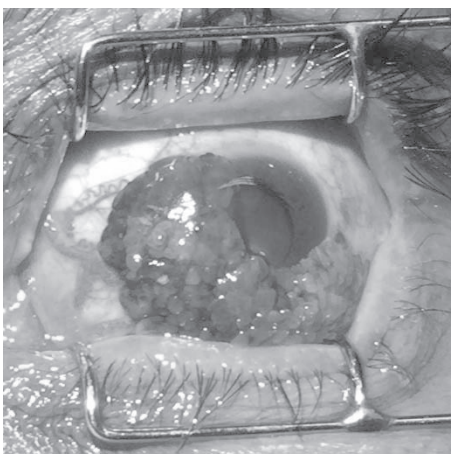

Figure 1. A large brown papillomatous lesion extending from inferior fornix covered more than half of the cornea. Prominent feeder vessels were seen nasally. The size was about 16mm x 13mm.

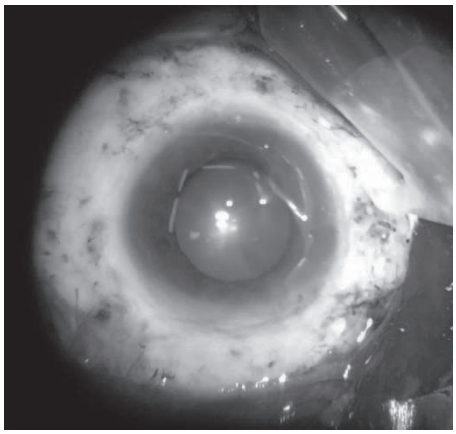

Figure 2. Intra-operatively, the mass was removed and cornea epithelium was debrided.

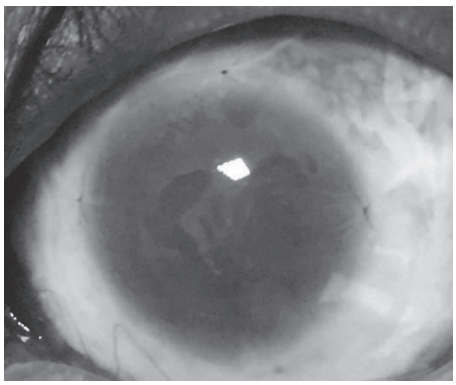

Figure 3. Post amniotic membrane transplantation and bandage contact lens.

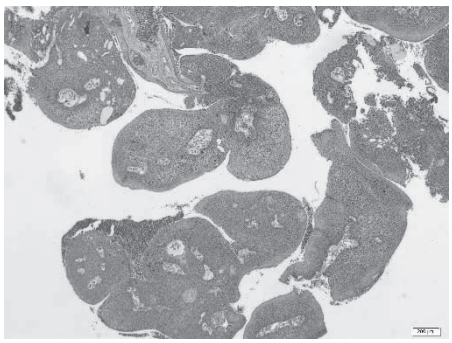

Figure 4. (X4 magnification) HPE with hematoxylin and eosin stain. Papillomatous lesion composed of proliferation of basaloid and squamous cells with the presence of few small horn cysts

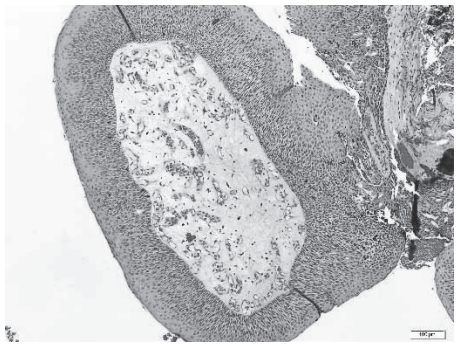

Figure 5. (X10 magnification) with hematoxylin and eosin stain. Few pigmented melanocytes are seen at the basal layer of the lesion. The sub-epidermal layer is oedematous with presence of few dilated vessels. No malignancy was seen. No cytopathic effect was seen

Discussion

Fifty two percent of conjunctival tumors are benign.[4] Malignant tumors tend to occur in older patients and demonstrate greater basal diameter and thickness, compared with benign counterparts.[4] For this patient, incisional biopsy was initially done to rule out malignancy as the mass was large with the presence of feeder vessels. The first histo-pathological examination (HPE) was reported as benign epithelial melanosis. Benign epithelial melanosis is pigmentation restricted to the basal layer of the epithelium and is absent of nest formation.[5] Thus clinically, they usually presented with flat, not inflamed, non-vascularised brown pigmented lesion.

Excision biopsy was offered for this patient as conjunctival melanoma could not be ruled out and the mass was huge and disfiguring. In order to accelerate cornea healing, amniotic membrane transplantation was also planned. Topical dexamethasone 0.1% was given 2 hourly to reduce the inflammation. Topical artificial tears preservative free 2 hourly and ciprofloxacin 0.3% 4 hourly were given. Bandage contact lens was removed after AMT had been absorbed. Topical

steroid and antibiotic were tapered over 8 weeks.

Amniotic membrane is a translucent biological product, which originate from the innermost layer of fetal membranes of the placenta. It acts as a biological bandage having properties like anti-inflammatory, antimicrobial, anti-fibrotic, anti-angiogenic and source of growth factors.[6]

HPE post excision biopsy revealed conjunctival papilloma with melanocytes, which explained the dark brown colour of the conjunctival mass. Pigmented conjunctival papilloma present in darkly pigmented individuals was reported.[7,8] This holds true in this case. Both pigmented conjunctival papilloma involved inferior fornix only and were treated with excision. Conjunctival papilloma has a low risk of malignant transformation.[9] No further investigation was done. There was no recurrence after excision 1 year so far.

Management of conjunctival papilloma can be difficult and it may be complicated with multiple recurrences. The recurrence rate in conjunctival papilloma is 3% to 27%.[3,10,11] No-touch surgical excision and adjunctive double freeze-thaw cryotherapy are the preferred methods of treatment.[2]

Table 1 summarizes the management of squamous conjunctival papiloma reported to date. There was only 1 case with quarter of cornea involvement which was treated with cryotherapy. Most of the cases had no cornea involvement. Only 2 cases used AMT in the treatment of conjunctival papilloma. Kaliki S et al[3] suggested oral cimetidine (300-400 mg 3 times a day) and/or topical interferon alfa-2b (1 MU 3 times a day) for 3 months after excisional biopsy to prevent recurrence in multiple and/or large tumours. In this case, the tumour was large with involvement more than half of the cornea, thus, applying AMT would be the better option.

Table 1. Summary of published article regarding primary treatment of squamous conjunctival papilloma

Reference	Method	Location	Cornea involvement	Primary treatment	Follow up
Omohundro JM, Elliott JH[12], 1970	Case report	Bulbar conjunctiva	¼ cornea	Cryo	No recurrence in 7months
Barry A Schechter et all[13], 2002	Case report	Tarsal conjunctiva	No	Topical IFN (1 million unit/ml)	No recurrence in 18 months
Laura A. Falco et al[14], 2007	Case report	Limbus and bulbar conjunctiva	No	Topical IFN (1 million unit/ml)	Not reported
Kalantzis G et al[7], 2010	Case report	Fornix	No	Exc	No recurrence in 12 months
Rimvydas S. Asoklis et al[15], 2011	Retro-spective study	Limbus, Bulbar conjunctiv, Fornix,	No	Exc, Cryo and AMT (2 tumours)	no recurrence in 3 years.

		Palpabral conjunctiva			
Kaliki S et al[3] , 2013	Retro-spective study	Limbus, Bulbar conjunctive Fornix, Tarsal conjunctiva Eyelid margin, Punctum, Plica semilunaris Caruncle	No	Cyro (3 tumours)	No recurrence in 36 months
				Exc and Cryo (61 tumours)	60 cases no recurrenc in 36 months
				Topical IFN (1 tumour)	No recurrence in 36 months
				PDT (1 tumour)	No recurrence in 36 months
				Oral cimetidine (6 tumours)	No recurrence in 36 months
				Exc, Cryo, and topical or inj IFN (18 tumours)	17 cases no recurrence in 36 months
				Exc, Cryo, and oral cimetidine (9 tumours)	8 cases no recurrence in 36 months
Dawodu OA and Okeigbemen V[16] , 2016	Case report	Palpabral conjunctiva	No	Exc, introp MMC 0.3mg/ml and oral cimetidine	No recurrence for 10 months

Cryotherapy (Cryo), Excision biospsy (Exc) Interferon α_2b (IFN), Photodynamic therapy (PDT), Mitomycin C (MMC), Injection (Inj) , intraoperative (intraop).

Conclusion

No clinical trial was done to provide the best treatment option. Incisional biopsy is necessary to rule out malignancy and large excision may require amniotic membrane graft. Clinician should be aware of the risk of recurrence in management of conjunctival papilloma. Regular follow up is important.

Conflict of interest statement

We declare that we have no conflict of interest.

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Original Article

Characteristics and prognostic indicators of final visual acuity in pediatric open globe injury

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Abstract

Background: *Pediatric open globe injury is a common disease which not only brings about severe visual impairment in children but also results in huge economic burden for the society.*

Objective: *To evaluate the characteristics as well as prognostic factors associated with unfavorable postoperative visual acuity in pediatric open globe injury.*

Methods: *This was a prospective non – comparative case series recruiting 93 children aged from 3 to 15, and were admitted to The Pediatric Department of Ho Chi Minh City Eye Hospital with open globe injuries from November of 2013 to April of 2014. Duration of follow up was 6 months since the last operation. All the epidemiological and clinical characteristics as well as treatment outcomes were assessed. The association between prognostic indicators and unfavorable final visual acuity (< 20/200) was determined via multivariable logistic regression analysis.*

Results: *The mean age of the studied population was 9.04 ± 3.05. Injuries occurred more commonly in boys than in girls (the male to female ratio was 2.20). There were 63.44% of patients injured at home. 80.44% of children received open globe injuries while playing. Sharp objects made up the largest percentage of all causes (65.59%). Corneal laceration, accounted for 68.82%, was the commonest type of trauma. 71.95% of children had initial visual acuity lower than 20/200. 82 children were followed up until 6 months postoperatively and 75.61% of them had final best-corrected visual acuity ≥ 20/200. Incidence of complications was relatively low (< 10%). Prognostic factors associated with poor final visual acuity (< 20/200) were: central cornea-related injury, wound length ≥ 6 mm, vitreous hemorrhage, endophthalmitis and retinal detachment.*

Conclusion*: Our study results can be beneficial for health educational programs of open globe injuries prevention in children. Unfavourable prognostic indicators are likely to help pediatric ophthalmologists predict their patients' final visual acuity.*

Keywords*: pediatric open globe injury, prognostic indicators of final visual acuity.*

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Full text. ***https://www.tci-thaijo.org/index.php/eyesea/index***

Introduction

Ocular trauma is a common condition which accounts for 10 to 15 % of all eye diseases.[1, 2] According to World Health Organization (WHO), it is estimated that there are approximately 55 million cases of eye trauma occurring annually.[3] Among them, 8 – 21% are children.[4, 5] Open globe injury can result in severe visual impairment, even blindness, to children.[6,7] Many studies point out that penetrating ocular trauma is one of the leading causes of unilateral non-congenital visual impairment in children.[8,9] According to blindness prevention programs of WHO, it is estimated that ocular trauma may bring about 1.6 million cases of blindness, 2.3 million cases of bilateral visual impairment and 19 million cases of unilateral visual impairment each year.[10] This condition not only leads to immediate low vision, but also causes children who are younger than 10 years old to have higher risk of developing amblyopia as a result of long-term sequelae after an eye trauma.[11] In addition, ocular trauma can bring about considerable economic burden, for instance, the total cost caused by ocular trauma in the United States in 1988 was estimated to reach 710 million dollars.[10, 12] This extremely high expense is obviously a severe burden for developing countries.[6]

Due to its popularity and severe consequence to health and economy, many studies of open globe injuries in children have been undertaken worldwide. However, In Vietnam, particularly in Ho Chi Minh City, there were no studies about the issue in the last 10 years. Therefore, we decided to carry out this research with the aims of evaluating the epidemiological and clinical characteristics, treatment outcomes as well as prognostic indicators of unfavourable best-corrected visual acuity (BCVA) in pediatric open globe injury.

Methods

This was a non-comparative prospective case series recruiting 93 children who were 3 to 15 years of age and diagnosed with open globe injury at Pediatric Department of Ho Chi Minh City Eye Hospital in Vietnam from November of 2013 to April of 2014. Duration of follow-up was 6 months after the final operation. Approval from the institutional research ethics board was obtained for the study.

Convenience sampling was our chosen method. We included children whose parents' consent for participating in the research could be given. Children with mental problems or eye disorders in which best-corrected visual acuity could not reach 20/20, for instance, amblyopia, cataract, retinoblastoma, etc. were excluded.

Epidemiologic variables evaluated were: age, gender, circumstances, causes of injury, places where the eye injury occurred. Clinical variables assessed were: types, locations, wound size, accompanied wounds and complications of eye trauma, initial visual acuity, final best-corrected visual acuity.

Types of injury was categorized according to the Ocular Trauma Classification Group: penetrating, perforating, intraocular foreign body, and rupture. Penetrating injury was defined as a single laceration of the eye wall, usually created by a sharp object. Perforating trauma referred to a 2 full-thickness laceration (entrance and exit) of the eye wall by the same entity, usually caused by sharp objects or projectiles. Rupture was defined as a full-thickness wound of the eye wall, often generated by a blunt object. The location of the open globe injury was classified as the following: zone I, wound involvement limited to the cornea; zone II, wound involving the sclera and no more posterior than 5 mm from the corneoscleral limbus; and zone III, wound involvement posterior to the anterior 5 mm of the sclera.[3] Wound

size was divided into 2 categories: ≥ 6 mm (half of the mean horizontal corneal diameter) and < 6 mm. Corneal lacerations were classified as central laceration (affecting the optical zone) and peripheral laceration. In our research, unfavourable final BCVA was defined as lower than 20/200 at which the patient's general abilities are restricted even with visual aids, according to a report published by the International Council of Ophthalmology in Sydney in 2002.[13] Other studies also classified final BCVA < 20/200 as a poor BCVA.[14, 15]

Categorical data were analysed with the Chi-squared test or Fisher's exact test. A logistic regression analysis was performed for risk factors predictive of a final unfavourable best-corrected visual acuity (< 20/200). Univariate analysis of all independent variables was initially performed and area under receiver operating characteristics curve was also calculated for statistically significant variables. Subsequently, those variables were entered into multivariate logistic regression model for further analysis. *P* value of < 0.05 was considered statistically significant. The statistical analysis was carried out using the R 3.3.1 software.

Results

Initially, our study recruited 93 children diagnosed with open globe injury. However, via the period of follow-up, 11 of them went missing. Ultimately, we had 82 children completing the research.

The mean age of our research population was 9.04 ± 3,50. Boys received open globe injury 2.20 times more frequently than girls ($p < 0.001$) (table 1).

Zone I wounds accounted for 68.82% of cases, followed by zone II (22.58%) and zone III (8.60%). Among cornea-related wounds which contained zone I and zone II injuries, central cornea-related lacerations made up 43.53 % cases while peripheral ones accounted for 56.47%. In addition, there were 40.86% of cases who had wound size ≥ 6mm and 59.14% of those having wounds size < 6 mm.

Types of open globe injuries respectively decreased in descending order of penetration (82.80%), rupture (10.75%), intraocular foreign body (5.38%) and perforation (1.08%) (table2). Intraocular foreign bodies were caused more commonly by missiles (27.27%) than by other causes (2.44%) (figure1). Retinal detachment were statistically more prevalent in sclera-related wounds (zone II and zone III) than in corneal laceration (zone I) (figure 2).

The most frequent accompanied wounds were those located in the anterior segment of the eye, such as iris prolapse (45.16%), cataract (38.70%) and hyphaema (20.43%). Posteriorly accompanied wounds were quite rare: vitreous prolapse (15.05%), vitreous hemorrhage (8.60%), vitreous foreign body (3.23%) and retinal detachment (2.15%) (table 3).

There were 71.95% of cases having initial visual acuity lower than 20/200. At 6 months after the last operation, 75.61% of patients had final BCVA ≥ 20/200 (figure 3).

Via the multivariate logistic regression analysis model, there were 5 traumatic features showing a statistically significant association with unfavourable final BCVA (< 20/200): central cornea-related laceration, wounds size ≥ 6mm, endophthalmitis, vitreous hemorrhage and retinal detachment (table 6).

Table 1. Epidemiological features of the study population

Features	Number of cases (n = 93)	Percentage %
Gender		
Male	64	68.82
Female	29	31.18
Mean age	9.04 ± 3.50	
Circumstances of injury		
Playing	75	80.66
Fighting	11	11.83
Work accidents	4	4.30
Traffic accidents	3	3.23
Causes of injury		
Sharp objects	61	65.59
Blunt objects	10	10.75
Missiles	11	11.83
Stork attack	6	6.45
Other	5	5.38
Places of injury		
Home	59	63.44
Street	19	20.43
School	11	11.83
Work place	4	4.30

Table 2. Clinical features of the study population

Features	Number of cases (n = 93)	Percentage %
Locations of injury		
Zone I	64	68.82
Zone II	21	22.58
Zone III	8	8.60
Wound size		
≥ 6 mm	38	40.86
< 6 mm	55	59.14
Types of injury		
Penetrating	77	82.80
Rupture	10	10.75
Intraocular foreign body	5	5.38
Perforationng	1	1.08

Table 3. Accompanied wounds

Accompanied wounds	Number of cases (n = 93)	Percentage %
Anterior chamber		
Hyphaema	19	20.43
Pus	6	6.45
Foreign body	2	2.15
Iris		
Iris prolapse	42	45.16
Iris laceration	6	6.45
Iris dialysis	4	4.30
Lens		
Opacification	36	38.70
Luxation	1	1.08
Vitreous		
Vitreous prolapse	14	15.05
Vitreous hemorrhage	8	8.60
Vitreous foreign body	3	3.23
Retinal detachment	2	2.15

Table 4. Complications of open globe injury

Complications	Number of cases (n=82)	Percentage %
Early		
Endophthalmitis	5	6.10
Elevated IOP	3	3.66
Hyphaema	2	2.44
Late		
Uveitis	3	3.66
Retinal detachment	2	2.44
Phthisis bulbi	2	2.44
Cataract	3	3.66
Pupillary membrane	2	2.44

Figure 1. Causes of intraocular foreign body (n=93)

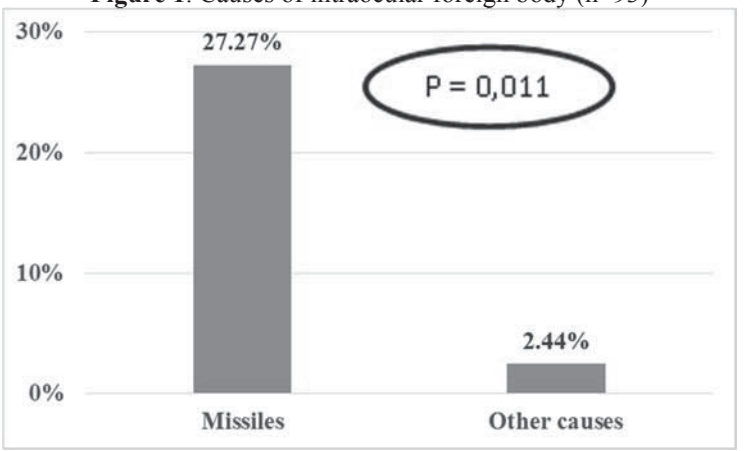

Figure 2. Retinal detachment caused by corneal laceration and sclera-related laceration (n = 82)

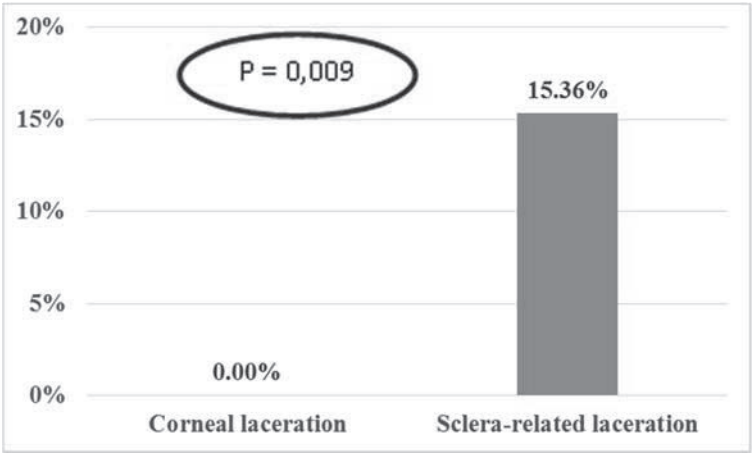

Figure 3. Initial visual acuity and final BCVA (n = 82)

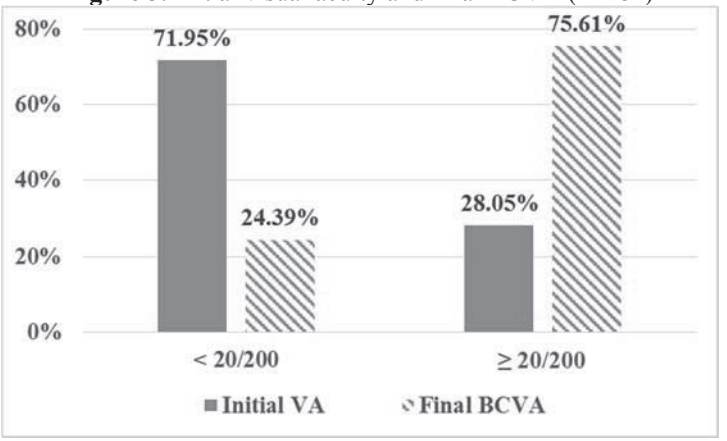

Table 5. Risk factors predictive of a final BCVA < 20/200 by univariate analysis

Features	Final BCVA		OR (CI 95%)	*p*	Area under ROC (CI 95%)
	< 20/200	≥ 20/200			
Age					
≤ 5	3	11	0.82 (0.17 - 3.00)	0.777	-
> 5	17	51	-		
Initial visual acuity					
< 20/200	19	40	10.45 (1.96 - 194.01)	**0.027**	0.652
≥ 20/200	1	22	-		(0.575 - 0.730)
Cornea-related laceration					
Central	12	19	3.89 (1.30 - 12.75)	**0.018**	0.664
Peripheral	6	37	-		(0.535 - 0.792)
Wound size					
> 6 mm	15	19	6.79 (2.28 - 23.42)	**0.001**	0.722
< 6 mm	5	43	-		(0.609 - 0.835)
Types of injury					
Rupture	4	5	2.85 (0.64 - 12.04)	0.150	-
Other	16	57	-		
Hyphaema					
Yes	7	11	2.50 (0.79 - 7.70)	0.111	-
No	13	51	-		
Iris prolapse					
Yes	7	28	0.65 (0.22 - 1.82)	0.426	-
No	13	34	-		
Cataract					
Yes	11	24	1.94 (0.70 - 5.48)	0.204	-
No	9	38	-		
Vitreous hemorrhage					
Yes	6	2	12.86 (2.65 - 94.44)	**0.003**	0.634
No	14	60	-		(0.529 - 0.739)
Vitreous foreign body					
Yes	2	1	6.78 (0.62 - 150.89)	0.127	-
No	18	61	-		
Retinal detachment					
Yes	3	1	10.76 (1.29 - 225.44)	**0.045**	0.567
No	17	61	-		(0.485 - 0.649)
Endophthalmitis					
Yes	4	1	15.25 (2.08 - 309.67)	**0.018**	0.592
No	16	61	-		(0.501 - 0.683)

Table 6. Risk factors predictive of a final BCVA < 20/200 by multvariate logistic analysis

Features	β	OR (CI 95%)	*p*
Initial visual acuity < 20/200	2.694	14.78 (0.89 - 987.17)	0.117
Central cornea-related laceration	3.182	24.10 (2.31 - 1090.93)	**0.030**
Wound size > 6 mm	2.900	18.17 (2.98 - 206.17)	**0.005**
Vitreous hemorrhage	4.606	100.09 (4.51 - 9677.88)	**0.014**
Retinal detachment	6.175	480.71 (9.46 - 926850.10)	**0.033**
Endopthalmitis	3.340	28.21 (1.86 - 1015.30)	**0.025**

Discussion

Characteristics of pediatric open globe injuries

Epidemiological features

Our study showed that boys were 2.20 times more likely to have open globe injury than girls with $p < 0.001$ (table 1). Other studies in the world revealed similar results in which the male to female ratio ranged from 1.42 to 5.52.[16, 17, 15] This is probably because boys tend to be more active than girls.

The mean age of our research population was 9.04 ± 3.50, which was quite the same as other studies' results (mean age ranges from 5 to 11.57).[14, 15, 18, 19]

In our research, children mostly received penetrating injuries from sharp objects while playing at home (table 1). This finding was fairly identical to previous studies in Vietnam (2001)[18], Nigeria (2015)[20], Turkey (2011)[16] and Canada (2013).[17] As a result, we recommend that parents should pay more attention to children's activities while they are playing at home. Also, sharp objects in children's surroundings should be hidden or removed to avoid potential open globe injuries to children.

Clinical features

As can be seen from table 2, zone I was the most common location of open globe injury, (accounting for 68.82% of cases), followed by zone II (22.58%) and lastly zone III (8.60%). This result was quite similar to studies in Taiwan (2009)[14], Vietnam (2001)[18] and Nigeria (2015).[20]

Types of open globe injury respectively decreased in descending order of penetration (82.80%), rupture (10.75%), intraocular foreign body (5.38%) and perforation (1.08%) (table 2). This finding was similar to studies in Germany (2000)[21] and Taiwan (2009).[14]

Via Fisher's exact test, it was shown that intraocular foreign body was caused more commonly by missiles (27.27%) than by other causes (2.44%) (figure 1) ($p = 0.011$). Therefore, pediatric ophthalmologists should suspect an intraocular foreign body when examining eye wounds caused by projectiles such as bullets, sling and so on until proved otherwise.

Besides, our study also pointed out that retinal detachments were statistically more prevalent in sclera-related wounds (zone II and zone III) than in corneal laceration (zone I) (figure 2). Hence, it is better to have a prudent plan of tight follow-up to early recognise retinal detachment in open globe injury associated with sclera (zone II and zone III).

Treatment outcomes

In our study, 71.95% of cases had initial visual acuity lower than 20/200 (figure 3). This finding was quite identical to studies in Turkey (2011)[16, 22] At the time of 6 months after the last operation, only 24.39% of children had final best-corrected visual acuity lower than 20/200 while 75.61% of them had final BCVA greater than 20/200 (figure 3). Studies in Turkey (2011),[16] Germany (2000),[21] and Taiwan (2009)[14] presented the same results as percentage of final BCVA ≥ 20/200 ranged from 70.37% to 72.58%.

Both early and late complications of penetrating ocular trauma in our research

were fairly low (under 10%) (table 4). This result was identical to previous studies of Huong Bui (2001)[18] and Lan Le (2002)[23] in Vietnam.

Prognostic indicators of unfavourable final best-corrected visual acuity

Via multivariate logistic regression analysis model, we found that there were 5 traumatic features showing a statistically significant association with unfavourable final BCVA (< 20/200): central cornea-related laceration, wounds size ≥ 6mm, endophthalmitis, vitreous hemorrhage and retinal detachment (table 6). These elements can bring about visual impairment as they affect either the media of the visual axis or the perceiving retina. Studies in Taiwan (2009),[14] Canada (2013),[17] Austria (2014)[24] also revealed similar results to our study. These unfavourable prognostic indicators are very helpful and clinically relevant as they can be feasibly and practically attained during patients' examination with little dependence on children's subjective feelings. In addition, it does not cost patients extra money nor risk their health in collecting these clinical data.

Apart from that, our research also pointed out that there was no statistically significant correlation between poor final BCVA and other characteristics, such as initial visual acuity lower than 20/200, age < 5, rupture, iris prolapse, hyphaema, cataract etc. (table 5)

Through univariate logistic regression analysis, initial visual acuity lower than 20/200 was significantly associated to unfavourable final BCVA (p = 0.027) (table 5). However, when having further analysis with multivariate logistic regression model, this relationship disappeared (p = 0.117) (table 6). Other research throughout the world presented controversial results: studies in Canada (2013)[17] and the United States (1998)[19] did not show a significant association between the two factors while those in China (2014)[15], Austria (2014)[24] and Turkey (2011)[22] did. This difference of results in studies may be explained by inaccuracy of recording initial visual acuity. Acar[16] supposed that it was almost impossible to have children's initial visual acuity correctly measured as they tended to be uncooperative due to pain. Hence, we recommend the conduction of further studies with elaborate measurement of initial visual acuity to clarify this association.

Conclusion

Open globe injury in children is a common condition which can be very dangerous. A profound understanding of this disease's characteristics is likely to be helpful in establishing a better treatment attitude as well as building up educational programs of penetrating ocular trauma prevention. Furthermore, unfavourable prognostic indicators including central cornea-related injury, wound length ≥ 6 mm, vitreous hemorrhage, endophthalmitis and retinal detachment can be useful for pediatric ophthalmologists to partially prognose patients' final BCVA. Last but not least, it is necessary to perform further studies to elucidate the association between other features of open globe injury and the final BCVA.

Conflicts of interest

The authors declare no conflicts of interest.

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Original Article

Comparison of accuracy of Cirrus HD and Spectralis in analyzing optic nerve head

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Abstract

Background: *Nowadays, in large eye centers, two Fourier-domain optical coherence tomography (OCT) devices are often used in parallel to obtain optical coherence tomograph images of patients, especially retinal nerve fiber layer (RNFL) thickness analysis and central retinal image. Determining system stability and accuracy, as well as finding a correlation and a formula to unify measurement values of these 2 systems are essential to finding consensus in clinical practice.*

Objectives: *To evaluate measurement errors of Cirrus HD and Spectralis OCT system in analyzing optic nerve head and the correlation of the results from these two systems.*

Methods: *Cross-sectional study. Seventy-one eyes from 38 patients underwent RNFL thickness analysis by Cirrus HD system 3 times consecutively, which was repeated after 5 minutes rest. The whole procedure was then repeated using Spectralis system, after another period of 30 minutes rest. Measurement errors of each quadrant (superior, inferior, nasal and temporal) and the overall errors were analyzed. The correlation between measurement values of Cirrus HD and Spectralis system, as well as a formula to convert Spectralis measurement values into Cirrus HD values, was conducted.*

Results: *The overall measurement error of Spectralis system was significantly higher than that of Cirrus HD system ($p=0.015$). The measurement errors of Spectralis system were also significantly higher than those of HD system in inferior, nasal and temporal zone ($p<0.05$). In both systems, the measurement errors before and after 5 minutes rest did not differ significantly ($p>0.05$). There was a strong linear correlation between Spectralis and Cirrus HD measurement values ($R=0.91$, $p<0.001$).*

Conclusion: *Spectralis system has statistically higher measurement errors than Cirrus HD system, however the difference is less likely to have clinical meaning. Both systems could be used in parallel in clinical practice with acceptable consensus.*

Keywords: *Cirrus, correlation, optical coherence tomography, reliability, retinal nerve fiber layer thickness, spectral-domain, Spectralis, stability.*

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Introduction

For ophthalmologists to manage chronic glaucoma, retinal nerve fiber layer (RNFL) thickness taken by optical coherence tomography (OCT) has been an irreplaceable mean for objectively and quantitatively monitoring glaucomatous damage.[1,2] As visual field defect is often not detected until 40% of RNFL is lost, OCT provides earlier detection of glaucomatous damage.[3] Former time-domain OCT (TD-OCT) has been demonstrated to be a reliable device to assist the clinical diagnosis and management of glaucoma.[4-6] With the development of technology, the recent spectral-domain OCT (SD-OCT) has brought out a big advantage in image resolution and software capabilities. SD-OCT improves image acquisition speed, which allows multiple parallel B-scans to be acquired and summed into 3 - dimensional (3 D) volume data sets. Depending on device used, scanning speed can vary from 29000 to 55000 A-scans/second.[7,8] This fast scanning speed results in in-tissue axial resolution from 5-7 μm, even up to 2 μm in most recent models, which is comparable to histopathological sample.[7] Various models have been available on the market: Spectralis (Heidelberg Engineering, Heidelberg, Germany), Cirrus (Carl Zeiss Meditec, Dublin, California, USA), RTVue (Optovue, Inc, Fremont, California USA).

In large eye centers, equipment of various OCT systems has become more commonly available. Moreover, a disagreement in device equipment between private clinics and large eye centers is common. In our country, as a result of organizational scale, private clinics are usually equipped with multimodal image obtaining devices (such as Spectralis), while large devices like Cirrus are often present in large eye centers. Knowledge about the reliability and stability of these OCT systems, in addition to communicating the results from these systems is essential to preventing patients from taking various unnecessary images. The aim of this study is to compare the measurement errors of Cirrus HD and Spectralis system (which are available at the same time in our eye center), as well as evaluating the correlation between measurement values of these 2 systems.

Methods

Our study was a cross-sectional study which has taken place at Ho Chi Minh city Eye Hospital. The institutional review board approved this study, and all participants gave informed consent. Male or female patients who were 18 years old or above, having eye checks at Ho Chi Minh city Eye Hospital and willing to participate were recruited in our study. Exclusion criteria were opacities of cornea, aqueous humor, lens or vitreous humor, inappropriate OCT signal strength (<6/10 on Cirrus HD and <16 dB on Spectralis) and patient's health problem which cannot spend enough time taking all OCT images.

After recording patient's age, sex, and thorough explanation, each patient underwent complete ophthalmic examination, including history, best-corrected visual acuity testing, intraocular pressure check with Goldmann applanation tonometer and slit-lamp biomicroscopy check. All the patients were dilated with Tropicamide 0.5% (Mydrins-P®, Santen®) to prepare for fundus examinations and to ensure obtained images were the best quality possible. The patients also had OCT images taken by a single experienced operator, with both OCT systems, on the same day.

After the patient's eyes were fully dilated, they had OCT images taken 3 consecutive times with Cirrus HD. After that, the patients had 5 minutes rest, and 3 consecutive images of RNFL thickness with Cirrus HD were taken again. After another period of 30 minutes rest to prevent the patients from over fatigue, the above procedure was repeated using

Spectralis system. Thickness values of 4 quadrants (superior, inferior, nasal and temporal) from all 6 images of both Cirrus HD and Spectralis were recorded.

Cirrus HD images were obtained using Optic Disc Cube 200 x 200 protocol. Under this protocol, a 3D cube of data is generated over a 6-mm-square grid of 200 horizontal scan lines, each composed of 200 A-scans. Cirrus software automatically detects the center of the optic disc and places a 3.46-mm-diameter circle over this center. From the 256 A-scans along this circle, the border of the RNFL is identified and RNFL thickness was calculated at each point along the circle. All scans are reviewed to ensure signal strength > 6.

Spectralis OCT system uses confocal scanning laser ophthalmoscope which enables real-time 3 D tracking of eye movements, basing on a previously generated retinal map (TruTrack Active Eye Tracking system). This tracking feature also allows the utilization of AutoRescan feature, which helps obtain images at the exact location as previous visit(s). Spectralis system allows multiple B-scans to be acquired at an identical location on the retina, thus reducing speckle noise. The operator manually centers a 3.4-mm-diameter circle on the optic disc. TruTrack and AutoRescan feature were activated in every scan to ensure the scan circle to be fixed on the exact location. The images were obtained at the scan circle under high-resolution settings (1536 A-scans) and averaged automatically by the software. RNFL boundaries were also delineated and calculated automatically underneath the scan circle. All images were reviewed to ensure signal strength >16 dB.

Mean overall measurement error, as well as mean measurement error of each quadrant (superior, inferior, nasal and temporal) from Cirrus HD and Spectralis system were calculated to compare the accuracy of these 2 systems. Mean overall measurement error, as well as mean measurement error of each quadrant before and after 30 minutes rest of each OCT system, was calculated to rule out system stability. A regression model was then constructed to discover the correlation between measurement values of the 2 systems and to convert Spectralis measurement values into Cirrus HD measurement values, if such correlation is available.

Paired-sample t-test was used to compare measurement errors and Spearman's correlation test was used to construct a regression model. All the tests were performed by SPSS 16.0 for Windows. For all statistical tests, $p > 0.05$ was considered statistically significant.

Results

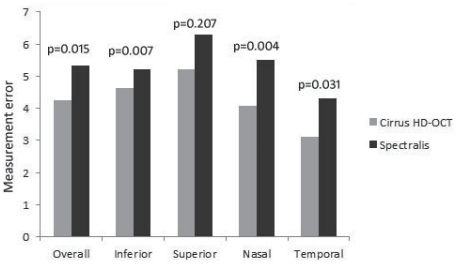
From April 2016 to October 2016, Seventy-one eyes from 38 patients were enrolled in this study. Among the patients, 33 have OCT images of both eyes taken, the other 5 have OCT images taken in only one eye due to severe cataract in the remaining eye. The baseline characteristics of our sample were shown in Table 1, and there were no statistically significant differences between sub-groups, except that most of patients are from 41 to 60 years old.

Table 1. Baseline characteristics

Variable	N	Percentage
Age (mean±SD)	46.9±12.7	
Age group		
18-40	10	26.3
41-60	23	60.5
>60	5	13.2
Gender		
Male	18	47.4
Female	20	52.6
Eye		
OD	37	52.1
OS	34	47.9

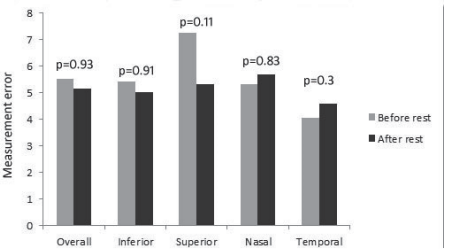
Comparison between Cirrus HD and Spectralis measurement errors was demonstrated in Figure 1. Mean overall measurement error was 4. 26±3. 38µm with Cirrus HD and 5.33±5.25µm with Spectralis, this difference was statistically significant (p=0. 015) . Mean inferior quadrant measurement error was 4.62±3.64µm with Cirrus HD and 5.22±6.71µm with Spectralis, this difference was statistically significant (p=0. 007). Mean superior measurement error was 5. 21±5. 77µm with Cirrus HD and 6.29±8.42µm with Spectralis, this difference was not statistically significant (p=0.207). Mean nasal quadrant measurement error was 4. 07±4. 41µm with Cirrus HD and 5. 51±6. 21µm with Spectralis, this difference was statistically significant (p=0. 004). Mean temporal quadrant measurement error was 3. 12±4. 58µm with Cirrus HD and 4.32±4.69µm with Spectralis, this difference was statistically significant (p=0.031).

Figure 1. Measurement error comparison between Cirrus HD and Spectralis



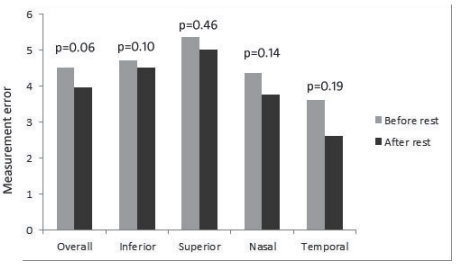
Comparison between measurement errors of Spectralis system before and after 5 minutes rest was shown in Figure 2. Measurement errors before and after 5 minutes rest were, in order, 5.52±5µm and 5.15±5.52µm overall (p=0.93), 5.42±6.68µm and 5.02±6.78µm in inferior quadrant (p=0.91), 7.25±9.92µm and 5.33±6.52µm in superior quadrant (p=0.11), 5.34±5.85µm and 5.68±6.59µm in nasal quadrant (p=0.83) and finally, 4.05±3.94µm and 4.59±5.36µm in temporal quadrant (p=0.30). Except the nasal quadrant, all the differences were not statistically significant.

Figure 2. Spectralis measurement errors before and after 5 minutes rest



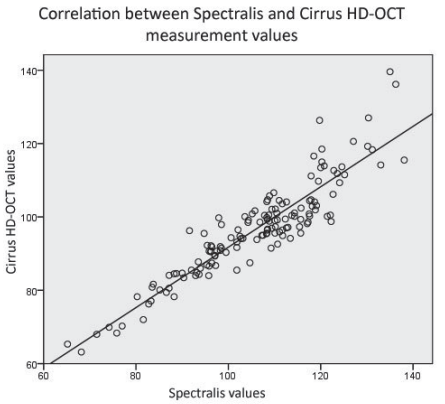
Comparison between measurement errors of Cirrus HD system before and after 5 minutes rest was shown in Figure 3. Measurement errors before and after 5 minutes rest were, in order, 4.53±4.21µm and 3.98±2.25µm overall (p=0.06), 4.73±4.29µm and 4.51±2.88µm in inferior quadrant (p=0.10), 5.38±6.63µm and 5.03±4.79µm in superior quadrant (p=0.46), 4.38±5.04µm and 3.77±3.69µm in nasal quadrant (p=0.14) and finally, 3.62±5.96µm and 2.62±2.49µm in temporal quadrant (p=0.19). All the differences were not statistically significant.

Figure 3. Cirrus HD measurement errors before and after 5 minutes rest



As demonstrated in Figure 4, Spectralis measurement values were found to be tightly correlated with Cirrus HD measurement values in linear manner (Spearman's correlation coefficient=0.91, p<0.001). Using the following formula, Spectralis measurement values (S-value) can be converted into Cirrus HD measurement values (C-value): *C-value = 0.82 x S-value + 9.4*

Figure 4. Correlation between Spectralis and Cirrus HD measurement values



Discussion

Since its emergence, SD- OCT has demonstrated its advantage when compared to TD- OCT with higher image resolution and has been used more frequently both in clinical practice and in studies, whether they are ongoing, planned or longitudinal in nature.[9- 12] Various commercial SD-OCT systems are available on the market. However, in private clinic, multimodal imaging system like Spectralis is preferred as it is compact and versatile, which can take near- infrared, fundus autofluorescence, red free, fluorescein angiography and indocyanine green angiography image using just one platform. While in large eye centers, a larger system like Cirrus is often used. On the other hand, various SD- OCT systems may be used conjunctively in large eye centers. A communication between the results of different systems – Spectralis and Cirrus in our case – is essential. Hence, we compare two systems of SD-OCT in a head- to- head study of normal patients. In our knowledge, this is the only study comparing directly measurement errors of two SD-OCT systems, as well as the only one finding a direct correlation between two SD-OCT systems. As there is a difference between actual histopathological thickness and image scan thickness of RNFL[13], we did not mention RNFL thickness and only focused on absolute measurement errors, instead of relative errors.

As demonstrated in Figure 1, Spectralis between-scan measurement errors seem to be significantly larger than those of Cirrus HD, except the superior quadrant. Both Spectralis and Cirrus HD had between-scan measurement errors >3 μm. Compared to proposed measurement errors manufacturers, the high measurement errors in our study is reasonable as we set the study environment close to clinical practice as much as possible, and this is a keen proof that clinical practice is always far more complicated than research environment. In the author's opinion, there are several reasons to explain the measurement errors the difference between the two systems. First, the software algorithms of Spectralis and Cirrus HD are different; one of which is that the scan circle diameter is 3.46 mm in Cirrus HD and 3.4mm in Spectralis. The smaller circle results in thicker RNFL, and hence higher measurement errors. However, we cannot explain more clearly as we do not have much information about how the different software was coded. Second, the operator's knowledge, skill and experience takes an important role, especially when the operator has to manually place the scan circle on the optic disc center with Spectralis system. The operator may be more used to Cirrus HD than the newly available Spectralis in our eye center. Third, the patient's cooperation can contribute to measurement errors; therefore, patient's explanation and mental preparation are essential. Finally, many other factors may affect the concentration of both the patients and the operator, such as room temperature, light exposure and noise exposure. The authors believe that insignificant difference in measurement error of superior quadrant is just a coincidence.

Figure 2 and 3 demonstrated that the differences in between- visit measurement errors of Spectralis and Cirrus HD are insignificant,

comparing to each other. These results proved that the stability of Spectralis and Cirrus HD in obtaining images of the patients on follow-up visits is comparable. However, both Cirrus HD and Spectralis had between-visit measurement errors >3 µm. The possible reasons had been mentioned before, and these measurement errors may affect the ophthalmologist's decision on clinical practice.

We also found a tight linear correlation between Spectralis and Cirrus HD measurement values, as demonstrated in the scatter plot (Figure 4). This is a proof that Spectralis and Cirrus HD measurement values are interchangeable. Using the formula above, Spectralis measurement values can be converted into Cirrus HD value with acceptable reliability, and vice versa. This finding is useful in clinical practice when the patients obtained Cirrus HD scans in one visit and then Spectralis in another visit. Therefore, it helps gain the consensus between SD-OCT systems, save the patient's time and economy burden taking unnecessary scans.

Many authors compared measurement values and announced the correlation between SD-OCT and TD-OCT before.[14-17] In a recent study, Ha, Lee and Kim compared SD-OCT and swept source OCT and concluded that the correlation between the two systems are stable.[18] Hence, the heritability of SD-OCT from past models and to future model is relatively reliable. No author has directly compared the two SD-OCT systems yet.

Our study has its limitations. First, our sample size is relatively small and does not include glaucoma patients, a study with large sample size is necessary to aid our results. The reliability and correlation of SD-OCT systems may be altered with lower RNFL thickness[19]. The study on normal eyes may help building baseline data on reliability and agreement between SD-OCT systems, which can assist in future study involving glaucoma eyes. Second, ethnical characteristics that may alter measurement results were not modified in our study.[20,21] Third, signal strength, the factor affecting directly RNFL thickness result, was not modified in our study also, as we do not have baseline data[22]. Moreover, as we focused on find measurement errors and correlation between SD-OCT systems, sensitivity and specificity of the results in management of glaucoma was not mentioned in this study. More large-scale studies with appropriate sample size, confounders modified and looking forward to find sensitivity and specificity of SD-OCT in diagnosis and monitoring of glaucoma are therefore necessary.

Conclusion

As we have discussed above, it was shown that in RNFL thickness analysis, measurement errors of Spectralis system are statistically higher than those of Cirrus HD system. However, the absolute difference is within 2 µm, which is less likely to have clinical value. The performance of both Cirrus HD and Spectralis through different visits is quite stable, which makes the previous results reliable references for the present results. It was demonstrated that there is a tight linear correlation between measurement values of Cirrus HD system and Spectralis system, which was expressed in the formula above. As different results taken by different systems after visits can be converted into unified values, the authors believe that this discovery will bring out more consensuses between ophthalmologists of different centers, as well as ophthalmologists in big eye centers that utilize both Cirrus HD and Spectralis. Patient's effort and economy can be saved, as a consequence.

Acknowledgements

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Conflict of interest

No potential conflict of interest relevant to this article was reported

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Original Article

Acquired color vision deficiency in Vietnamese patients with primary open angle glaucoma

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Abstract

Aim: *To study acquired color vision deficiency (ACVD) in Vietnamese patients with primary open angle glaucoma (POAG).*

Methods: *Cross-sectional descriptive study on 51 eyes of 27 patients with POAG presenting to the Vietnam National Institute of Ophthalmology. Color vision defects were assessed using Farnsworth-Munsell 100 Hue Test. Data were matched to visual field defects on the Humphrey Visual Analyzer (HVFA) and optic nerve analysis on optical coherence tomography (OCT).*

Results: *48/51 eyes had color vision defects, with average total error score (TES) of 128.78 ± 117.93. Of these44 of 48 eyes manifested a tritan color vision defect. We found an inverse correlation between TES and mean deviation (MD) on the HVFA (Spearman's Rho Testing, $r = -0.238$, $p < 0.05$). The severity of color vision deficiency was correlated to average retinal nerve fiber layer (RNFL) thickness on OCT. There was a high degree of interocular correlation in TES at the FM100Hue; however, asymmetry was noted in patients having different clinical stages of glaucoma between eyes. (Wilcoxon signed-rank test, $z = -2.667$, $p < 0.01$). 19.6% of eyes had ACVD without manifest visual field defect on the HVFA and 7.6% eyes had ACVD without decreased RNFL thickness on OCT.*

Conclusion: *We found a high prevalence of acquired color vision deficiency in our cohort of patients with POAG, suggesting ACVD may be an important finding in POAG.*

Keywords*: Acquired color vision deficiency (ACVD), primary open angle glaucoma (POAG).*

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Introduction

Human color vision is trichromatic: every perceivable color can be matched using three judiciously chosen primary color, provided that color subtraction is permitted. Individuals with normal color vision have three types of specialized cells, known as cones, in retina to perceive red, green and blue colors.[1] The first steps of chromatic discrimination occur in the retina: the three classes of cone possess different but overlapping spectral sensitivities. The neural apparatus of vision compares the rates of quantal catches between the classes of cone to derive color vision.[2] Color vision deficiency is one of the commonest disorders of vision and can be divided into congenital and acquired forms.[3] The primary difference between congenital and acquired CVDs is that genetic deficiencies present bilaterally at birth with congenital CVD, whereas acquired CVD can be unilateral, asymmetric or even transient.[4] Traditionally, acquired color vision deficiency is considered a separate entity from congenital color vision deficiency, although emerging clinical and molecular genetic data would suggest a degree of overlap. Acquired color vision deficiency (ACVD) may be classified by the site of pathology or by its clinical characteristics.[5] ACVD can occur at any step in the process of visual formation: photoreceptors, optic nerve, optic tract, lateral geniculate nucleus of thalamus, optic radiation and visual cortex or systemic disease.[6] Acquired CVD due to ocular disease, neurological disease or drug toxicity.[7] Bull (1883) provided one of the earliest descriptions of ACVD in patients with glaucoma[8] and more recent studies suggest that ACVD may occur in early glaucoma.[8-11] This study aims to access acquired color vision deficiency in Vietnamese patients with POAG, which may contribute to be an inexpensive test for national glaucoma control program.

Methods

Twenty-seven (27) patients were randomly selected amongst those with treated POAG and controlled intraocular pressure (IOP) at Glaucoma Department, Vietnam National Institute of Ophthalmology (VNIO) from 2/2016 to 9/2016.

Inclusion criteria

- Visual Acuity (VA) > 20/200.
- Approve the consent form.

Exclusion criteria

- Normal tension glaucoma (NTG)
- Any opacification of ocular media e.g. cataract, corneal disease, vitreo-retinal diseases.
- Optic nerve disorders and cortical visual impairment.
- History of using tuberculosis drugs or any other medication known to be associated with ACVD.
- Patients with congenital color vision deficiency were excluded by Seohan Computerized 85-Hue Test.[12-13]

In addition to taking a medical and ophthalmic history, we performed an ophthalmic examination, including best corrected visual acuity (BCVA), Ishihara Test, IOP, visual field (Humphrey® Field Analyzer 24-2 SITA test, Carl Zeiss Meditec, Inc, Dublin, CA), slit-lamp examination, posterior segment examination and imaging by Cirrus HD-OCT (Carl Zeiss Meditec, Dublin, CA)

FM100 Hue Color vision test was assessed unilaterally without mydriasis under standardized conditions 1000 lux (specify the daylight simulator). We assessed severity of color vision deficiency using the total error score (TES) and computed a confusion axis using the method described by Vingrys and King-Smith.[14]

For the purposed of analysis, color vision deficiency severity was classified thus:

- TES ≤ 40: None CVD
- 40 < TES ≤ 100: Slight CVD
- 100 < TES ≤ 180: Moderate CVD
- TES > 180: Severe CVD

In order to categorize the state of glaucoma, we used the glaucoma severity staging system (GSSs) proposed by Mills which is comprised of six ordered stages and is on the basis of the Humphrey visual field, as previously described.[15]

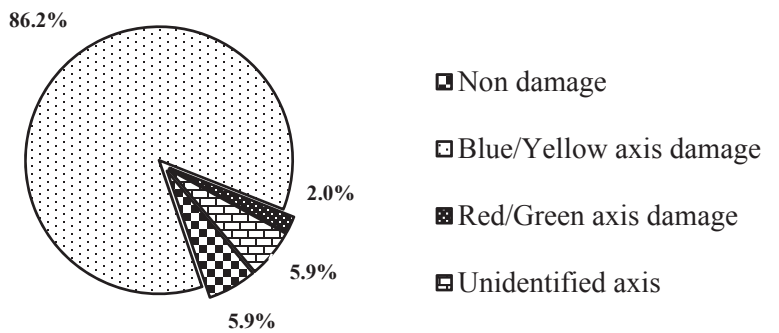
This research has been approved by the scientific and technical council of the Vietnam National Institute of Ophthalmology and the Hanoi Medical University. The diagnosis and treatment is for scientific and patients' health purposes only. There is no other purpose. Patients and families will be counseled, explain the purpose of the study, be informed results during the study. The study was conducted only in voluntary patients.

I hereby declare that this study is my own original work, except where acknowledgment is made below and where due reference is made in the text. All the examinations included in this study were performed in the Glaucoma Department-Vietnam National Institute of Ophthalmology in 2016.

Results

The study was performed on 51 eyes of 27 patients (18 females and 9 males). The mean age of patients was 44.3yrs (range 11-63 yrs). 48/51 eyes had a color vision defect, (TES 128.78 ± 117.93), amongst which 86.2% (44/51 eyes) manifested color vision defect on blue/yellow axis (Figure 1).

Figure 1. Acquired color vision defect profiles



Total Error Score (TES) was recorded and graphed according to visual field defect phases and glaucoma stages and showed a statistically significant difference (Table 1). Also, ACVD were similar between two eyes of a specific patient at the same stage of the disease (Figure 2). Further, the Wilcoxon signed- rank test showed the statistically significant difference of TES between two eyes of a patient at different stage disease (Figure 3).

Table 1. ACVD according to visual field defect phases and glaucoma stages

Classification	**Total Error Score (TES)**					***p****
	Ocular Hypertension (Earliest Glaucoma)	Early Glaucoma	Moderate Glaucoma	Advanced Glaucoma	Severe Glaucoma	
Visual field defect phases	93.2±33.2	103.6±43.9	60 ± 35.4	132.7±118.7	206.8±168.4	*< 0.05*
Glaucoma stages	100±43.2	88.7±28.3	89.8±52.5	97.1±82.3	198.4±166.7	*= 0.05*

(*) Kruskal - Wallis Test

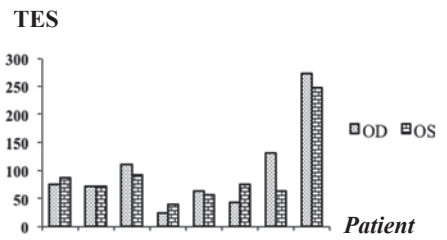


Figure 2. ACVD of two eyes in a specific patient with two eyes at the equivalent stages

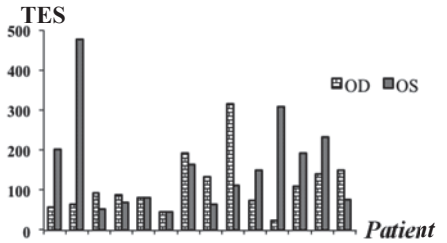


Figure 3. ACVD of two eyes in a specific patient with two eyes at different stages

Correlation between ACVD and visual field defect/ glaucoma stages was shown in Table 2 and 3. Patients with visual field defect and advanced glaucoma were more likely deficient in color perception. However, 19.6% eyes had signs of ACVD without visual field defect. And 7.9% eyes had signs of ACVD without optic nerve abnormalities on OCT.

Table 2. ACVD severity and visual field defect **(**VFD**)** phases

ACVD severities / **VFD phases**	**Normal**	**Mild**	**Advanced**	**Severe**	***Total***	***p*(*)**
Ocular hypertension		***8 (15.7%)***	***2 (3.9%)***		***10 (19.6%)***	
Early		5 (9.8%)	3 (5.9%)	1 (2%)	9 (17.6%)	
Moderate	2 (3.9%)	7 (13.7%)	1 (2%)		10 (19.6%)	*< 0.05*
Advanced	1 (2%)	2 (3.9%)	1 (2%)	2 (3.9%)	6 (11.8%)	
Severe		5 (9.8%)	3 (5.9%)	8 (15.7%)	16 (31.4%)	

(*) *Phi and Cramer's V test*

Table 3. ACVD severity and glaucoma stages

ACVD severities / **Glaucoma stages**	**Normal**	**Mild**	**Advanced**	**Severe**	***Total***	***p*(*)**
Ocular hypertension		***3 (5.9%)***	***1 (2%)***		***4 (7.9%)***	
Early		5 (9.8%)	1 (2%)		6 (11.8%)	
Moderate	2 (3.9%)	5 (9.8%)	2 (3.9%)	1 (2%)	10 (19.6%)	*< 0.05*
Advanced	1 (2%)	8 (15.7%)	3 (5.9%)	2 (3.9%)	14 (27.4%)	
Severe		6 (11.8%)	3 (5.9%)	8 (15.7%)	17 (33.3%)	

(*) *Phi and Cramer's V test*

Table 4 showed the correlation between ACVD with MD value in Humphrey visual test and with retinal nerve fiber layer (RNFL) thickness in OCT.

Table 4. Relationship between ACVD and MD in visual field test, RNFL thickness

ACVD Types of impairment	Normal or Mild	Moderate	Severe	$p^{(*)}$
MD $\left(\overline{x} \pm s\right)$	-9.99 ± 9.7	-13.05 ± 10.95	-22.41 ± 7.92	*< 0.05*
RNFL $\left(\overline{x} \pm s\right)$	76.97 ± 18.4	75.7 ± 21.8	59.73 ± 18.6	*< 0.05*

(*)*Kruskal -Wallis Test*

Discussion

This was the first study on Vietnamese patients, which showed similar results as the previous papers.[16-18] The study targeted young aged patients with glaucoma to eliminate cataract that can compromise color perception.[19] In the primate visual system, retinal ganglion cells projected to magnocellular, parvocellular, and koniocellular layers in geniculate nucleus, which responded preferentially to motion, red/green color, and blue/yellow stimuli, respectively.[20] Recent studies showed that blue/yellow perception was early altered because of specific features of Koniocellular pathway: low physiological storage, little cross-linking and large sized axon.[6, 9, 21, 22]

In this study, the average age of patients was relatively young (44.3 years old) and concentrated mostly in middle age. This was explained by the process of selecting study subjects, all factors could affect the ability to recognize colors especially cataract, were minimized. This study has shown that mean TES increased according to visual field defect phases and glaucoma stages, which can be clearly observed in patients with advanced disease. However, TES score in moderate stage was lower than ocular hypertension (earliest glaucoma) and early ones (Table 1). This abnormal reduction was due to the small sample size of this research, additionally, two patients had no ACVD at advanced stages (accounting for 1/5 of all eyes at this stage) made the average TES reduced. This required to be further investigated in a larger cohort study. Previous studies also revealed that about 25% of cases had no ACVD despite severe damage on visual field and RNFL thickness, leading to the hypothesis that two or more mechanisms could be involved in glaucoma pathogenesis.[17, 23]

A five-year prospective study of Flammer et al (1984) exploring glaucoma suspects and patients with early questionable field defects, has shown the progression of visual field defect in patients with early ACVD and the relationship between TES and MD on the Octopus perimetry.[24] More recently, Misiuk-Hojlo (2004) evaluated the clinical benefits of color vision test in the early diagnosis of glaucoma also demonstrated a linear correlation between TES and MD on visual field testing.[17] Our study showed inverse correlation between TES and MD. ACVD was found to be present even at the earliest glaucoma stage without trace of visual field defect.

We also observed that that ACVD occurred even when RNFL thickness was still within the normal range (Table 3). And decreased RNFL exacerbated ACVD (Table 4). Previous studies have found an association between ACVD RNFL loss.[25,26] Moreover, Polo et al. (1999) also found a correlation between visual field indexes (MD) with RNFL defect.[27]

Conclusion

In summary, our results suggest that ACVD may be an early biomarker of glaucomatous optic neuropathy. Given that the assessment of ACVD is comparatively cost-effective compared to perimetry, we suggest that

the assessment of color vision may be a suitable assessment tool in settings in which perimetry cannot be undertaken.

Conflict of interest disclosure

A.T. VU, None conflict of interest; H.D. PHAM, None; T.V. PHAM, None; H.P. NGO, None.

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Original Article

The change of corneal curvatures after micro-trabeculectomy surgery among glaucoma patients

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Abstract

Background: *There has been few reports on analysing astigmatism after standard trabeculectomy and only one study about micro-trabeculectomy by Vernon et al. in 1991; there were none which compared 2 groups in one individual study.*

Objective: *To compare the postoperative changes of corneal curvature (surgically induced astigmatism –SIA) between two different glaucoma surgery techniques: microtrabeculectomy and standard trabeculectomy.*

Methods: *A randomized clinical trial was done including 81 eyes (81 patients) who were randomized selected to perform either standard trabeculectomy (4x4 mm scleral flap) or micro-trabeculectomy (2x2 mm scleral flap), both with antifibrotic 5- Fluorouracil. Patients' pre- and postoperative detailed ophthalmologic examinations were documented and topographic keratometric values (flattest K, steepest K) were noted. Vector analysis was performed on the data using a computerized method to calculate the SIA for each eye at 1st day, 4th, 12th, 24th week follow-up postoperatively.*

Results: *The mean SIA power reduced gradually from 1.89 Diopter to 1.30, 0.95, 0.73, 0.60 Diopter in the standard group and from 1.03 Diopter to 0.92, 0.83, 0.74, and 0.73 Diopter in the micro group at 1 day, 1st week, 4th week, 12th week and 24th week follow-up respectively. The SIA power values in standard group were significantly higher than the values in micro group at 1st day and 1st week postoperatively. There was no correlation between SIA and IOP in standard and micro-trabeculectomy group.*

Conclusion: *Micro-trabeculectomy is an invasive filtration procedure which caused minimally statistically significant induced astigmatism.*

Keywords: *micro-trabeculectomy, surgically induced astigmatism, keratometer*

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Introduction

Trabeculectomy was firstly introduced in 1968 by Cairns to reduce the levels of intra-ocular pressure (IOP) by allowing more controlled aqueous drainage from the anterior chamber into sub-tenon space; because of the presence of a partial thickness scleral flap. It has become the gold standard surgical procedure for many glaucomatous eyes worldwide.[3] Since then, it has undergone multiple modifications, including changing the size, shape, and position of the sclerostomy and trapdoor, limbal, or fornix-based conjunctival incisions, and altering the method of performing the sclerostomy by trephination, sclerectomy, and the use of a scleral punch.[13,15]

Surgically induced astigmatism (SIA) is defined as the difference between preoperative and postoperative astigmatism which has been studied widely in cataract surgery, vitrectomy, trabeculectomy, etc.[9] SIA is not consistent because different eyes will heal differently.[6] Many factors affects the degree of SIA such as the type and location of the surgical incision, the amount of scleral cauterization performed, the suture material and how to place the sutures.[1] SIA is necessary considered in surgery because it delays visual rehabilitation and may cause an unwanted negative effect to patient's visual outcome.[8] In 1999, small flap trabeculectomy (micro-trabeculectomy) was recommended by Stephen Vernon as it produces smaller changes in corneal curvature that resolved sooner than previous reports of larger flap technique. Trabeculectomy using a small scleral flap appears to provide medium to long-term IOP control comparable to large flap techniques and may offer potential advantages which includes reduced surgical tissue trauma, a larger area of undisturbed sclera and conjunctiva should repeat surgery be required, and reduced astigmatism induction.[12] In literature, a randomized clinical trial study haven't been done so far; therefore, evaluation on surgical induced astigmatism of micro-trabeculectomy compared with traditional trabeculectomy is necessary.

Methods

A prospective, surgical intervention study was registered and approved by Science and Technology Committee of Ho Chi Minh Eye Hospital, Vietnam. Eighty one patients were randomly selected; 40 patients were done standard trabeculectomy (standard TRAB) and others underwent micro–trabeculectomy (micro–TRAB) with one surgeon. The inclusion criteria was based on the following points: (1) patient's age were between 40 to 60 years old, both gender; (2) patients diagnosed with POAG, PACG had successful trabeculectomies; (3) none of the eyes had had corneal abnormality preoperatively, previous ocular surgery (cataract removal, previous glaucoma surgery) and other ocular pathology (pterygium, OSD). The exclusion criteria was included: (1) patients had secondary glaucoma; (2) visual acuity was no light perception; (3) patients were unwilling or unable to give consent or unwilling to accept randomization and (4) patients were out of area and potentially unavailable for follow-up visits. All patients participated in the study had signed the given consent form.

All subjects were admitted for trabeculectomy using a standard technique (40 eyes) and micro technique (41 eyes). This consisted of a fornix based conjunctival flap, a partial-thickness scleral flap centered at the 90 degree meridian. A 2x2 mm scleral trap door was done with a crescent blade in micro–trabeculectomy group; while a 4x4mm scleral flap was performed in standard trabeculectomy group. 5-fluorouracil (50-mg/mL) was applied intraoperatively on the flap for 5 minutes. An anteriorly sited 0.75 mm diameter internal sclerostomy with a Kelly punch (Storz). A small basal peripheral iridectomy was followed by two 10/0 nylon scleral trapdoor sutures placed at the corners of the scleral flap and three

8/0 vicryl sutures to the conjunctiva. Topical antibiotics (Moxifloxacin 0.5%, 6 times a day), steroid (Prednisolone acetate 1%, 6 times a day) and atropine 1% bid were given. At the 1 week review the atropine was stopped and the steroid/antibiotic reduced at the discretion of the clinician. All patients continued topical steroids for at least 1 month but for no longer than 3 months postoperatively.

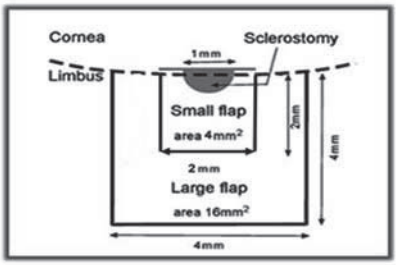

Figure 1. Diagram showing the relative proportions of the two flap sizes used and position relative to the internal sclerostomy by punch.

At the pre-operative assessment and at 1 day, 1 week, 4 weeks, 12 and 24 weeks post-operatively each patient was examined as follows: visual acuity (Snellen Acuity Chart converted to logMAR scale), intra-ocular pressure (Goldman Applanation Tonometry), and Carl Zeiss topography system Atlas 9000.

Vector analysis was performed on the data using a computerized method of calculating the surgically induced astigmatism (SIA) for each eye at every time postoperatively. All changes were compared with the preoperative data set and expressed in terms of negative cylinders. SIA was based on the theory that the combination of two crossed sphero-cylinders produces a third sphero-cylinder which provided a vector of induced cylinder for each eye at each time point.[11] Each astigmatism data was transferred into Cartesian coordinates based system which represented as vector (x, y) X, x = a cos2p, y= a sin 2p where "a" is magnitude of astigmatism and "p" is the axis of steep meridian. The angles of the astigmatisms were multiplied by 2 because the angles of the astigmatisms were expressed between 0° and 180° when in a trigonometric circle the angles change from 1° to 360°.

Sawhney *et al.* showed the vector analysis method uses trigonometric calculations to determine the SIA, "x" and "y" values generate for both pre- and post-operative data. Thus there were X pre, Y pre and X post, Y post.

To calculate Surgical Induced Astigmatism (SIA):
X SIA = X post - X pre; Y SIA = Y post- Y pre
Astigmatism vector: Magnitude
$$= \sqrt{XSIA^2 + YSIA^2}$$
Angle = 0.5 x arctan (YSIA/XSIA)

To get the final "Axis" which means 180^0 astigmatic scheme, the XSIA and YSIA decided:
If both XSIA and YSIA >0, then Axis = Angle
If XSIA <0, then Axis = Angle + 90
If XSIA >0, YSIA <0 then Axis= Angle + 180

The SIA data were calculated by using SIA calculator version 2.1.

At the end, there was the aggregate astigmatism data which had the magnitude and axis to analyze group changes. Those values gave a mathematical expression of the change in WTR or ATR or oblique astigmatism. WTR astigmatism is defined as corneal steepening in the vertical meridian corresponding to a positive induced cylinder at 90 degrees and ATR being the reverse.

Statistical analysis was performed using SPSS software version 20 (SPSS Inc, Chicago, Illinois, USA). Continuous variables were expressed as mean ± standard deviation (SD) and compared using *t* test or Mann-Whitney *U* test as appropriate. Categorical data were represented

by number (n), percentage (%) and compared using the Pearson χ^2 test or Fisher exact test. Spearman test was performed to study correlation between SIA and IOP changes. Statistical significance was accepted if p value <0.05 for either test.

Results

A hundred patients were randomly chosen in 2 subgroups: 50 patients in standard trabeculectomy (standard TRAB) group and 50 patients in micro- trabeculectomy (micro-TRAB) group. 19 patients were excluded from the study (10 in standard group and 9 in micro group) due to inability to follow up. At 6 months, we have totally 40 eyes in standard group and 41 eyes in micro group for the final analysis. Demographic data of standard and micro-TRAB groups was summarized in table 1.

Table 1. Demographics of patients

	Micro-TRAB	Standard TRAB	p value
Number of patients (n)	41	40	-
Gender (n, %)			
• Male	21 (46.7)	24 (53.3)	0.51*
• Female	20 (55.6)	16 (44.4)	
Age (mean±SD, years)	52.17 ± 9.59	55.00 ± 12.89	0.06**
Kinds of glaucoma (n,%)			
• PACG	18 (43.9)	19 (47.5)	0.5**
• POAG	18 (43.9)	13 (32.5)	
• APAC	5 (12.5)	8 (20.0)	
Visual acuity (logMAR)	1.27 ±1.08	1.07±0.99	0.38**
Pre-op IOP (mean±SD, mmHg)	29.44±13.02	32.78±10.81	0.21**
Pre-op Kf (mean±SD, Diopter)	43.67±1.67	43.69±1.57	0.97**
Pre-op Ks (mean±SD, Diopter)	44.57±1.56	44.59±1.37	0.99**

(*) Chi square test (**) Mann-Withney test

There is no significant difference between 2 groups in gender, age, kinds of glaucoma, preoperative IOP, visual acuity and K readings with $p > 0.05$.

SIA Power Between Groups

The change of the SIA power median values for the six-month follow-ups in micro and standard trabeculectomy groups were shown in table 2.

Table 2. SIA power median value comparison in diopter between 2 groups through time.

Visits	Micro-TRAB (mean±SD, Diopter)	Standard TRAB (mean±SD, Diopter)	*p* value (*)
1 day post-op	1.03±0.68	1.89±1.13	0.00
1 week post-op	0.92±0.50	1.30±0.74	0.01
4 week post-op	0.83±0.48	0.95±0.76	0.77
12 week post-op	0.74±0.44	0.73±0.66	0.44
24 week post-op	0.73±0.48	0.60±0.49	0.07

(*) Mann –Whitney test

The mean SIA power reduced gradually from 1.89 Diopter to 1.30, 0.95, 0.73, 0.60 Diopter in the standard group and from 1.03 Diopter to 0.92, 0.83, 0.74, and 0.73 Diopter in the micro group at 1 day, 1 week, 4 weeks, 12 weeks and 24 weeks respectively. By using the Mann-Whitney test, the SIA power median values in standard group was significantly higher than the value in micro group with $p < 0.05$ at 1 day and 1 week. The SIA power median in remaining follow-ups showed no significant difference between 2 groups. The progression of the SIA power in 2 groups were displayed in figure 2 which especially showed the higher elevation of SIA in standard TRAB compared to micro-TRAB at 1 day and 1 week post-operation. Moreover, the SIA of both groups were under 1 Diopter at 4 week postoperatively.

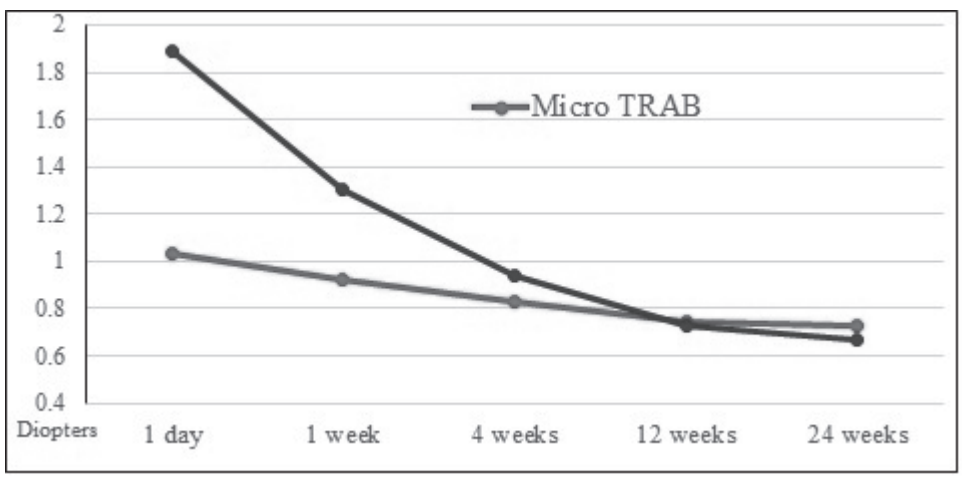

Figure 2. The progression of the SIA power in micro-TRAB and standard TRAB groups.

SIA Axis Between Groups

The SIA axis in 2 groups was compared and displayed in table 3. There was no significant difference in 1 day, 1 week, 4 week, 12 week, 24 week follow-up respectively.

Table 3. SIA Axis comparison between 2 groups through time.

Visits	Micro-TRAB	Standard TRAB	*p* value (*)
1 day post-op	85.97±38.97	98.65±51.17	0.18
1 week post-op	94.59±48.83	74.75±54.5	0.082
4 week post-op	76.41±52.58	84.15±52.43	0.461
12 week post-op	82.66±48.43	80.93±47.92	0.891
24 week post-op	81.34±47.19	90.55±48.16	0.362

*Mann-Whitney

Figure 3 showed the general polar map of both SIA power and axis. The micro group displayed a distribution of SIA power mainly located nearby circle 1 diopter and 2 diopter and few cases which were located at more than 2 diopter near 3 diopter circle. However, the SIA power in standard group was expanded nearby the 3 diopter and 4 diopter circle. The axis distribution looked similar between 2 groups.

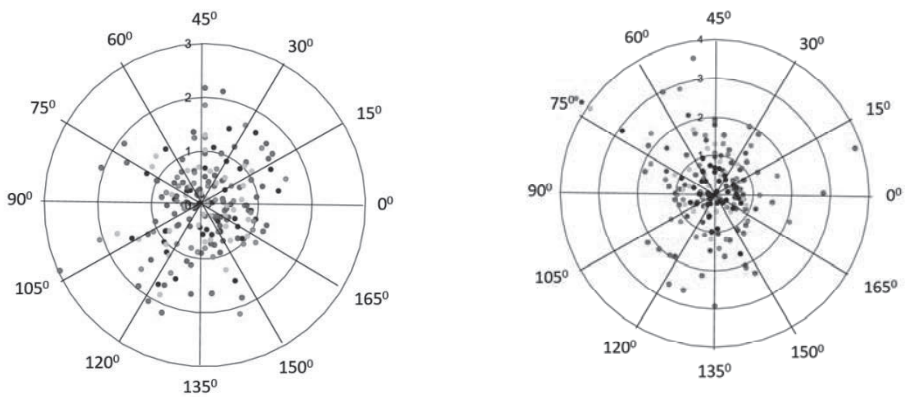

Figure 3. Demonstrating the surgically induced astigmatism distribution of every patient in microTRAB group (left) and standard TRAB group (right) on the vectorial map. Each circle represents 1D. Red, green, purple, yellow and blue dots symbolize 1st day, 1st week, 4th, 12th and 24th week values, respectively.

IOP Comparison

The Mann-Withney test showed no significant difference of postoperative IOP between 2 groups in all follow-ups (p>0.05) in table 4. The IOP decreased from the preoperative day till 24 weeks postoperatively. The mean IOP of both groups were under 18mmHg at the end of the study (14.10±7.78mmHg in micro group, 12.50±3.37 in standard group).

Table 4. Pre – and post-operative IOP in 2 groups.

	Micro-TRAB	Standard TRAB	p value (*)
Pre-op	29.44±13.02	32.78±10.81	0.21
1 day post-op	10.29±4.19	9.29±4.27	0.25
1 week post-op	9.29±4.98	7.63±3.82	0.10
4 week post-op	14.12±8.30	11.80±6.43	0.16
12 week post-op	13.78±3.93	12.05±3.79	0.05
24 week post-op	14.10±7.78	12.50±3.37	0.24

(*) Mann-Withney test

SIA and IOP Correlation

There was no correlation between SIA and IOP in standard and micro-trabeculectomy group in all follow-ups (p>0.05) which was shown in table 5.

Table 5. Correlation analysis between SIA and IOP (Spearman test).

	Micro-TRAB		Standard TRAB	
	r value	*p* value	r value	*p* value
1 day post-op	-0.18	0.25	-0.04	0.80
1 week post-op	0.04	0.80	0.15	0.37
4 week post-op	-0.18	0.36	-0.09	0.60
12 week post-op	0.25	0.12	0.07	0.65
24 week post-op	0.14	0.39	-0.26	0.88

Discussion

There has been few reports on analysing astigmatism after trabeculectomy (both standard and micro type) and there were none which compared 2 groups in one individual study. Most of the existing reports had very few patients and the result sometimes conflicted. We analyzed the change of astigmatism after trabeculectomy by calculating and comparing the SIA vector which was believed the standard way to report the change of the postoperative astigmatism on patient's eye.

In the current study, even though the SIA power in both group decayed through time, but the SIA power in standard group had elevated significantly higher than the micro group at 1st day and 1st week follow-ups. At the 4th, 12th and 24th week, the SIA power in both group were about the same. New refraction and prescribed Rx could be considered to be given to the patient after 4 weeks since the residual SIA was not significant. After Kumari et al. stated that by using standard trabeculectomy procedure, the mean 1st post-operative SIA value was the highest value 2.73 D

(99 degree) which is larger than the current study value (standard group) which is 1.66 D. The mean SIA value in Kumari et al. research reduced to 0.41 D (3rd week) and 0.43 D (6th month) which is smaller than our study value 0.81 D (4th week) and 0.54 D (6th month).[7] The researchers concluded that the standard trabeculectomy showed significantly increased 1st post-operative day SIA which rapidly decreased to a minimum amount at just 3 weeks later. The standard trabeculectomy in Kumari study with larger conjunctival flap compared to the current study could be the reason for the opposed result. Moreover, all the surgery was done in Kumari study had not used the antifibrotic agent (5- Fluorouracil) but the current study did. The antifibrotic agent was considered as a factor that reduced the SIA also increased the healing rate of the bleb.[14] In comparison to standard trabeculectomy in Kumari's study, micro-TRABeculectomy in our study gave the median SIA at the first postoperative day 0.82 D which was remarkably smaller than the mean SIA in Kumari's study (2.73 D).

Previously, Vernon et al. had done the early research on corneal curvature changes after micro-trabeculectomy surgery with 4 follow ups in 1 year: 1 month, 3 months, 6 months and 12 months. The mean SIA value between the WTR and ATR SIA groups was compared to each other and found that there was significant induced WTR astigmatism at 1st month and 3rd month but not at 6 and 12 months postoperatively by measuring the topographic keratometry. Vernon found that by using the manual keratometry, the SIA power reduced from 0.68 D to 0.38, 0.52, 0.55 D and from 0.75D to 0.66, 0.59, 0.64 D by using topographic keratometry at 1 month, 3 months, 6 months and 12 month follow-up respectively.[14] Our micro-TRABeculectomy result were slightly higher than Vernon et al.'s result at most of the follow-ups even though our study had 40 eyes but Vernon et al.'s study only had 16 eyes. Hence, the current study supported Vernon et al.'s study with the similar surgical technique.

Ashai et al. also identified that there was a statistically significant change in vertical and horizontal k-reading after standard trabeculectomy in three follow-ups (2 weeks, 1 month and 3 months).[2] 100 subjects were involved in the study and the mean value of pre and postoperative K-readings were compared to each other which is not similar as the current study analysis but also showed the trend was toward the vertical steeping keratometry.

From 1999 until now, there was only one study done by Vernon that evaluated the change of corneal astigmatism after micro-trabeculectomy. The research had been done using topography, manual keratometry up to 1-year follow-up. The authors mentioned that the micro-trabeculectomy could controls IOP as well as previous reports of standard trabeculectomy (larger flap). Both two ways of analysis in the current study showed the same conclusion and gave a promising result compared to Vernon's study in which the induced astigmatism increased but not significantly in the 1st postoperative week, however it significantly decayed after that period.

By using TMS system, Claridge et al. identified that the largest group had an induced superior steepening of the cornea resulting in a mean WTR astigmatism of about 1 D which persisted to 1 year follow up.[4] The results were on eyes undergone trabeculectomy with 4x3 mm scleral trap door and two 10/0 nylon sutures. In comparison, the current study showed an unremarkably lowering induced astigmatism at week 4. The smaller scleral trap door produced in micro-TRABeculectomy (2x2 mm) was considered as the factor reduced the SIA.

By using manual keratometry, Cunliffe et al. conducted a study on 16 eyes undergone standard trabeculectomy with 5x3 mm scleral trap door.[5] They found a

significant WTR astigmatism up to 2 months but not at 10 months. Besides, Rosen et al. showed that with a 3x2 mm scleral trap door and 10/0 nylon suture trabeculectomy[10], the mean vector power induced at 3 months was 1.24 D which is more than what the current study achieved, 0.72 D at week 4 only.

The induced astigmatism after micro-trabeculectomy had a trend to shift toward WTR axis similar to most of the previous studies. The cause for this alter was alternatively overtight the scleral flap sutures could lead to a WTR shift in astigmatism in the same way that a tight cataract section causes corneal steepening.[4]

Claridge et al. stated that the steepening of the cornea would be caused from the contraction of tissues around the trabeculectomy position as a result of extensive scleral cautery.[4] Rosen et al. considered that the cautery was mainly the factor that lead to the induced astigmatism and it was appeared to develop more when excessive cautery was used in one patient.[10] The authors also found that suture lysis did not prevent astigmatic change whereas scleral cautery was associated with corneal steepening in the post-operative period. Vernon et al. suggested that the size of internal sclerostomy and amount of cautery play a main role in induced astigmatism. In the current study, the cautery was not involved in the micro-trabeculectomy by the surgeons.[12] The rapid and very small amount of induced astigmatism was found instead of higher values like previous studies could be due to the absent of cautery step in the procedure. If the scleral flap is loose, superior corneal flattening may develop from wound gape around the trabeculectomy site. Other reasons lead to superior corneal flattening could be a large drainage bleb or a post-operative ptosis.[13]

Conclusion

Microtrabeculectomy showed significant lower surgical induced astigmatism (SIA) power compared to standard technique at early postoperative follow-ups (< 4 weeks). The SIA caused by both techniques rapidly decayed under 1 Diopter after 4 weeks, hence the necessary prescription would be given for patient at that period of time.

Conflicts of Interest

None

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Original Article

The Outcome of Strabismus Surgery and Influencing of Surgical Success at Children Surgical Center, Cambodia

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Abstract

Introduction: *Strabismus is a condition in which the eyes are not properly aligned with each other. It may be accompanied by abnormal motility of one or both eyes with multifactorial factors including both genetic and environmental. A surgical treatment is one of the options.*

Objective*: To determine the outcome of surgery treatment of strabismus patients.*

Methods: *It was a cross sectional study conducted in Department of Ophthalmology at Children's surgical center that located in Kien Khleing National Rehabilitation Center, Phnom Penh, Cambodia from January 2009 to October 2014 with the sample size of 269 cases. All surgeries were conducted under general anesthesia, following routine pediatric techniques. Horizontal squint surgery was performed as the first surgery, using standard surgical dosage tables without modification.*

Results: *There were totally 269 strabismus cases consisting 34% male and 66% female found in this study. 91.82% of the cases were seen in the age group from 0-9 years. 59% of cases were considered as congenital (onset before 6 months old) against 41% of acquired strabismus (onset after 6 months old). 92% of the cases were treated by horizontal surgery whereas other 4% were vertical squint (2%) and torsional (2%). There were 68% of cases had orthotropia (fully corrected), 24% had undercorrected esotropia, 6% had undercorrected exotropia and 2% had overcorrected. The Majority of cases had successful surgery treatment without complication. However, there were some complication seen such as 1% of diplopia, 2% of re-operation and 0.37% of scleral perforation.*

Conclusion: *In conclusion to this study, we found that strabismus was affected in female more than male. Children from 0-9 years old are the most commonly seen in term of age. There was highest number of cases recorded from Kampong Cham province than other provinces. There were 96% of had surgery treatment and got better outcome and the complication was noted in just 3.5% of cases.*

Keywords: *Strabismus, esotropia, exotropia, Horizontal surgery, Complication*

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Introduction

Strabismus is a condition in which the eyes are not properly aligned with each other. Approximately 2-4% of children[1] and as many as 4% of the adult population are affected by strabismus.[2] Strabismus can be caused from sensory, motor, or innervational factors.

Strabismus can happened any time in life, but most commonly in early childhood.[3] Congenital or infantile strabismus develops during the first six months of life. Strabismus onset after six months is referred to as childhood onset strabismus. Onset in adulthood is usually considered an acquired strabismus. Risk factors for developing strabismus include retinopathy of prematurity, mother smoking during pregnancy, low birth weight, and family history.[4] The hereditary factor was observed in the higher percentage of strabismus in children whose family members have strabismus, 17-30%.[5]

The exact causative gene remains unclear at this time. The heritability of strabismus is also demonstrated in twin study. One study analyzed a large sample of monozygotic and dizygotic twins resulted in a 64% heritability of esotropia, whereas exotropia is caused mostly by environmental factors.[6] They also showed that the heritability of esotropia is independent of refractive error. People with strabismus may experience double vision, eyestrain, vision loss, and poor depth perception, as well as cosmetic issues, which is the most upset part of them.[7] The present study aimed to determine the outcome of surgery treatment of strabismus patients.

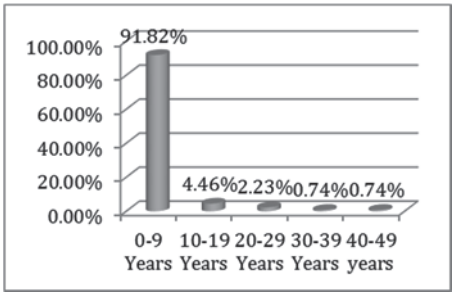
Methods

It was a cross sectional study, conducted in Department of Ophthalmology, Children's surgical center, Phnom Penh, Cambodia from January 2009 to October 2014 with the total population of 269, age ranged from 3 months to 40 years old. All patients underwent eye examination starting from VA (in subjects that we can take) until fundus examination. Regarding strabismus test, Hirschberg test was used to rule out pseudostrabismus then the cover/uncover test was performed to rule out another phoria. ACT w/Prism Diopter both near and distant was performed in case of good VA patient. Modified Krimski using Prism and light reflex was used in small kids or patients who has poor vision. All data were analyzed using Microsoft Excel-2010. The results were obtained as percentage (%), and presented as tables and graphs.

Results

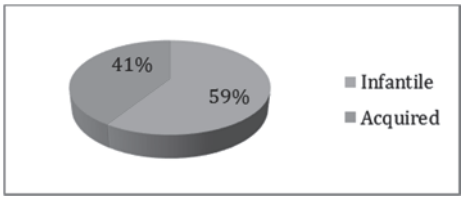
There were totally 269 strabismus cases consisting of 91 (34%) male and 178 (66%) female. This result clearly shows that the female sex was affected more than male. The highest number of cases (91.82%) belongs to 0-9 year's age groups. There were 4.46% cases in 10-19 years, 2.23% in 20-29 years, 0.74% in 30-39 years and 0.74% in 40-49 years old age groups.

Figure 1. Distribution of strabismus by age groups



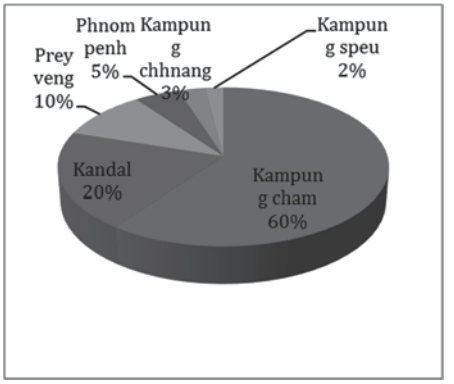
There were 59% of cases were infantile strabismus and 41% of cases acquired strabismus. This results clearly shows that the maximum number of cases got strabismus by birth.

Figure 2. Distribution of infantile and acquired strabismus



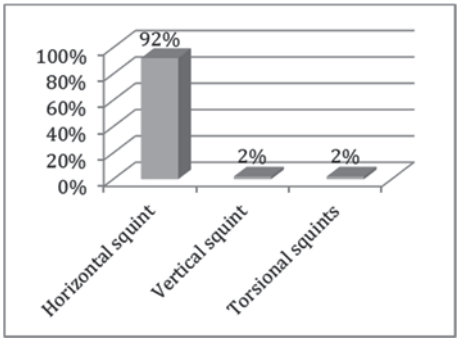
There were 60% of cases belong to kampong Cham province which was very high than any other regions.

Figure 3. Distribution of strabismus based on region



There were 92% of cases treated by horizontal squint, which was the most preferable surgery treatment than other types like vertical squint (2%) and torsional (2%).

Figure 4. Surgery treatment of strabismus



There was less number of strabismus cases had undergone non-surgical treatment such as 3% had Amblyopia and 1% had Spectacles.

Table 1. Non-surgical treatment of strabismus

Type of Non-surgical	Number	Percentage
Amblyopia	8	3%
Spectacles	3	1%
Total	11	4%%

For treatment outcome, there were 68% of cases had orthotropia (fully corrected), 24% had under-corrected estropia, 6% had undercorrected extropia and 2% had overcorrected.

Table 2. Treatment outcomes of strabismus

Treatment outcome	Number	Percentage
Orthotropia (fully corrected)	183	68%
Undercorrected Esotropia (ET)	65	24%
Undercorrected Exotropia (XT)	16	6%
Overcorrected (ET XT)	5	2%
Total	269	100%

There were few cases had complications such as 1% of diplopia, 2% of re-operation and 0.37% of scleral perforation.

Table 3. Complication after treatment

Complications	Number	Percentage
Diplopia	3	1%
Re-operation	6	2%
Scleral perforation	1	0.37%

Discussion

The present study found totally 269 strabismus cases including 91 (34%) male and 178 (66%) female subjects, which clearly show, the female gender mostly affected than male gender. The similar findings were reported from Tanaka A *et al.*[8] Another study from Kenyatta National Hospital found both male and female patients were nearly equal.[9] The role of heredity, prenatal, and parental factors had been studied by Aichmer H *et al.* in the development of strabismus in 42 patients (male : female ratio 0.8:1) with primary concomitant strabismus, and four patients

with secondary strabismus.[10] A study from Faghihi M *et al.*, found that the prevalence of strabismus in the students was 2%. Of female and male students, 2.4% and 1.4% had strabismus, respectively (P=0.160). Of the students with strabismus, 67.7%, 25.8% and 6% had exotropia, esotropia and vertical deviations, respectively.[11]

The prevalence of strabismus in young Singaporean Chinese children aged 6 to 72 months was 0.80% (95%CI 0.51-1.19), with the prevalence of exotropia and esotropia being 0.70% (95%CI 0.41-1.03) and 0.10% (95%CI 0.002-0.29) respectively.[12] MEPED study found the prevalence of strabismus among 6 to 72 month old Hispanic/Latino - African American children was 2.4% and 2.5% respectively.[13] BPEDS study found that the age between 6 to 72 months old - African American and white, the prevalence of Strabismus was 2.1% and 3.3% respectively.[14] Pathai *et al.* (2010) reported 2.1% of strabismus found in children aged between 3-5 year old.15 Chia *et al.*, (2010) reported that the age between 6-72 months old children, the prevalence of Strabismus was 0.8%.

The present study found that there was 59% of cases were infantile strabismus and 41% of cases were acquired. Some studies reveal that infantile esotropia is not congenital and most likely develops between age 2 and 4 months old, a duration which most infants are becoming orthotropic. It was also reported that the development of constant exotropia in a neurologically normal child 6 months of age. The accommodative esotropia has an average age of onset of 2 ½ years (a range of 1 to 8 years) however; cases have been documented prior to age 1. One-third of all children with esotropia become well aligned when wearing an optical correction for hyperopia, and another one third obtain significant but not complete reduction of the esotropia.

The present study found, there was 96% of strabismus cases had surgery treatment and just 4% of cases had non-surgery treatment. Dotan G reported that the most common surgery was a recession-resection.9 The recent study found that surgery on one eye was more effective (82% success) than surgery on both eyes (52% success).[12]

The present study found that there was 68% of cases had orthotropia, 24% had undercorrected estropia, 6 % had undercorrected extropia and 2 % had overcorrected. The previous study found that the success rate was 62.0% for esotropia and 57.0% for exotropia. There was no statistical difference between the two groups of diagnosis.[9]

Regarding the visual acuity, it was not statistical significance between pre- and post-op. The complication rate was seen 0.7% including conjunctival wound dehiscence and globe perforation. Sencond surgery was 12.9% (39/304) after one year.[16]

A retrospective analysis of 15 consecutive cases in children with Down syndrome who underwent surgery for strabismus, the surgical success (within 10 Delta of orthophoria) was achieved in 85.7%. The remaining 2 children (14.3%) had residual esotropia.[17]

A study from Nepal Eye Hospital, Tripureshwor, Kathmandu reported that female gender was affected more than male. After surgery a total of 40 patients underwent strabismus surgery, fully corrected achieved only in 22.5%, 2-8 prism diopters in 55% and 10-15 prism diopters in 22.5%.[18]

A retrospective reviewed the patients with secondary strabismus from myelomeningocele; who underwent surgery for correction in an institution for disabled children for 5 years; esotropia and A-pattern anisotropia was considered as the main indications for surgery. Excellent surgical outcomes were achieved in 60.9% of patients, satisfactory in 12.2%, and unsatisfactory in 26.9%.[19]

Binocular single vision and stereopsis can be restored during the period of cortical plasticity in children after strabismus surgery. Caputo R *et al.* reported an improvement in 35% of children with congenital esotropia after early surgery.[20] An unexpected sensory fusion is possible after excellent postoperative motor alignment in adult patient.[21] Apart from cosmetic, the restoration of binocular fusion and elimination of diplopia, expansion of binocular visual field in patient with esotropia and improvement in psychsocial function are also the most important reason to correct strabismus.[22]

A study by Kushner & Morton, a report of surgery for long-standing constant strabismus, 86% of patient showed binocular response with the Bagolini lens test almost immediately after surgery.[23] According to Thomas Satish, a good surgical outcome of large-angle strabismus can be corrected with a single surgical procedure.[24] Preoperative deviation and refractive errors were proved to be significant factors influencing a favorable outcome in patients with exotropia.[25]

In a study by Mets MB, the outcome of surgical correction in adults' strabismus includes the improvement in binocular function; it was seen in 42% of the patients.[26] Chan TY *et al.* reported that some degrees of stereopsis could be achieved in most cases even after delayed alignment in patients with infantile or early strabismus.[27] However, the study by Sabina Shrestha *et al.*, binocular single vision improved in only 3% of cases. The contributing factors for the same may be firstly, age less than 8 was only in three cases; secondly, anterior segment was abnormal in 12% right eyes and 15% left eyes and posterior segment was abnormal in 10% right eyes and 15 % left eyes.[18]

Conclusion

The strabismus was higher among female (66%) than male (34%) subjects. The highest number of subjects (91.82%) belongs to 0-9 year's age groups. The infantile strabismus consisting of 59% whereas acquired strabismus belong to 41%. There was 60% of strabismus cases belong to kampong Cham that was higher than other regions. There were 92% of strabismus cases treated by horizontal squint which was the most preferable surgery treatment than other types like vertical squint (2%) and torsional (2%). The less number of strabismus cases had undergone non-surgical treatment such as 3 % had Amblyopia and 1 % had Spectacles. There were 68% of cases had orthotropia – fully corrected, 24% had undercorrected estropia, 6 % had undercorrected extropia and 2 % had overcorrected. Majority of strabismus cases had successful surgery treatment without any complication. But there were few cases had complication such as 1% of diplopia, 2% of re-operation and 0.37% of scleral perforation.

Recommendation

The strabismus was seen more common in female gender. We suggest the physician and researcher to further investigate the associated factors contributing to female gender.

The present study found infantile strabismus slight higher than acquired strabismus; hence we suggest the physician to evaluate pregnancy and checking necessary tests related to pregnancy.

Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Educational Article

The big deal with teaching direct ophthalmoscopy in medical students – one session in the community equals many sessions in the hospital outpatients department

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Abstract

Background: *Fundoscopic examination with direct ophthalmoscopy is important for medical students. It can make an immediate diagnosis of a disease in the eye in addition to some systemic conditions. Skill is the factor that leads to success for fundus examination. Therefore, learning the utilization of a direct ophthalmoscope is essential for medical students.*

Objective: *To compare the effect of teaching environment on fifth year medical students' preferences for learning direct ophthalmoscopy skills between community-based practice and hospital outpatient.*

Type of study: *Qualitative research, focused group discussion*

Methods: *Fifth year medical students of Thammasat University, Chumphon Khet Udomsakdi Hospital campus were enrolled in this study. All twelve medical students were divided into two groups and have learned the skill of direct ophthalmoscopy with patients in three-hour sessions for both in the community and hospital outpatients. Both groups were taught by the same ophthalmologist instructor. Focused group discussion was performed to assess the medical student's skill and Self-confidence, Place and Timing, Patients and Knowledge Management of visual acuity (VA) testing.*

Results: *One-Hundred percent of students have concluded that the community based learning is better than hospital outpatients in almost all aspects. The skills gained in, self-confidence, place, timing, patients and knowledge management are superior in community based than hospital outpatients. Only 8.34% (one out of twelve) students reported no difference in the skill between community based and hospital outpatients.*

Conclusion :*Medical students learning in the community improved their skill and confidence with direct ophthalmoscopy more so than those learning in hospital outpatients and has used their knowledge in VA testing as opposed to depending outpatients nurses to perform VA testing. Therefore, these results may use to develop the teaching plan for medical students at Chumphon Khet Udomsakdi Hospital Medical Education Center in the future.*

Keywords: *Direct Ophthalmoscopy, Medical students, Community based, Outpatients, Focus group discussion*

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Introduction

The direct ophthalmoscope is an important tool for medical students and physicians.[1] It is necessary to evaluate retina lesions such as diabetic retinopathy, hypertensive retinopathy, papilledema and cytomegalovirus retinopathy. Direct ophthalmoscopy can be used in emergency room outpatient department, inpatient department and intensive care unit with good clinical skills in either dilated or undilated pupil.[2,3] However, using of direct ophthalmoscope is difficult for most medical students.[4] Most students cannot evaluate the fundus background, optic disc or even retinal vessels. Direct ophthalmoscopy skill is the important factor that leads to success for fundus examination. Therefore, the aim of this study is to compare the teaching of using direct ophthalmoscope between community based practice and hospital outpatient department.

Type of study

Qualitative research, focused group discussion

Methods

This study is a prospective design. All fifth year medical students (twelve students) of Thammasat University, Chumphon Khet Udomsakdi Hospital campus were enrolled in this study. There are six males and six females. Twelve medical students were equally divided into two groups and were instructed in the skill of direct ophthalmoscope with patients in for three hours in both the community and hospital outpatients separately (Figure 1). After the students completed their training in both learning environments, a focus group discussion[5,6] was performed to assess each group. The assess points are Skill and Self-confidence (using the direct ophthalmoscope), Place (the darkness and area of examination room) and Timing (timing to examine the retina by using direct ophthalmoscope per patient), Patients (the willingness of patients to be examined by medical students) and Knowledge Management (visual acuity testing has performed by medical students at community by themselves while at hospital outpatients had performed by nurses). The assessment form have attached in the appendix. Data was analyzed and compared and reported in percentages.

The focus group discussion was used as a tool for discuss between community-based practice and hospital outpatient. Each group of medical students were discuss with pros and cons of direct ophthalmoscopy learning skills in the context of Skill and Self-confidence, Place and Timing, Patients and Knowledge Management. The results of discussion (pros and cons) do not influence on the score of Ophthalmology learning program of the medical students. Overall 30 minutes of focus group discussion was done and the results were concluded.

Hospital outpatients	Community outpatients
- Class-based teaching- Direct ophthalmoscopy basics) Equipment basics(- Visual acuity testing by nurses - Fundus examination on patients)5 cases per 1 - medical student(- Patients have not only retinal problems	- Small group teaching - Direct ophthalmoscopy basics)Equipment basics(- Visual acuity testing by medical students - Fundus examination on patients)5 cases per 1 - medical student(- Patients have only retinal problems

Figure 1. Summarizes the differences in teaching activities for outpatients-based teaching and community-based teaching for direct ophthalmoscopy.

Results

The results were simply classified into four categories (Figure 2). The first category is the quality of direct ophthalmoscope examination (including skill and self-confidence). Eleven of twelve students (91.66%) have improved their skill and self-confidence in the community more than hospital outpatients and only one student (8.34%) has no difference in preference for his quality of examination skills gained from the teaching sessions. The second category included place, timing and environment. All twelve (100%) students agreed that the community based teaching for direct ophthalmoscopy has been more useful for them after having attended 3 hours of teaching for both groups. The third category are the patients (sample groups). One hundred percent of students have the same opinion that patients in community are more willing to be examined than in hospital outpatients. In the last category, was the knowledge of management of visual acuity. One hundred percent of students have used their knowledge more comprehensively for VA testing in the community compared to hospital outpatients.

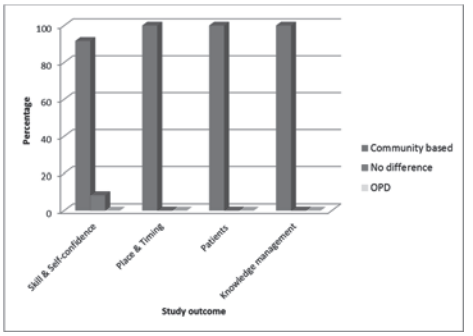

Figure 2. The bar graph showed four categories of fifth year medical students preference for learning environment in direct ophthalmology teaching in the domains of skill, self-confidence, place, timing, patients and knowledge management.

Discussion

Results showed that one-hundred percent of fifth year medical students assessed in the focus group session preferred community based teaching over hospital based teaching in the domains of patients. The focus group also found that the place and environment of community based teaching is more widespread, relaxed and isolated compared to hospital outpatients so the students have no pressure to examination the retina. The patients from the community are more likely to be willing to be examined. Therefore, the students can spend more time to improve their skill of direct ophthalmoscopy examination. Only one student has evaluated that he had no preference between community based practice and hospital outpatients in terms of skills gained in direct ophthalmoscopy training. Analysis in deep detail was found that he have got the good clinical skill of direct ophthalmoscope from the hospital outpatients. This data has changed our perceptions about learning skill of direct ophthalmoscopy is not limited in the hospital outpatients. Finally, the teaching plan of direct ophthalmoscopy may develop in next year that included the teaching in both community based and outpatients. Further studies are required to compare the results of new teaching plans in the next project. However, the darkness of examination rooms in community based practices is inadequate compared to hospital outpatients which may hinder examination. This is a minor factor that can be improved in the future by using the screen around the examination area. This project is the pilot study of the community based learning (direct ophthalmoscopy) because of the limitation of sample size therefore, the 6th and 4th year medical students will enroll in next study to give more statistically significant outcome.

Conclusion

Medical students improved their skill and self-confidence with direct ophthalmoscopy

community learning more than hospital outpatients and used their knowledge in VA testing as they had to rely on themselves rather than nurses. They are happy with community based learning and gained some appreciation of the differences in working in the community. Therefore, these results may use to develop the teaching plan for medical students at Chumphon Khet Udomsakdi Hospital Medical Education Center in the future.

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Appendix

Student ID……

Please fill the result by 4 categories (table)

Categories	Medical student's result
Skill & Self confidence	
Place and Riming	
Patients	
Knowledge management	

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