

# Intraocular Pressure Elevation Following the Use of Topical Dexamethasone Ointment After Squint Surgery

## Abstract

**Purpose:** To describe the pattern of intraocular pressure (IOP) changes after squint surgery in eyes of black Africans at the University College Hospital, Ibadan, Nigeria. **Materials and Methods:** This was a retrospective review of the clinical records of patients who underwent squint surgery between 2010 and 2019. Data on demographic characteristics, preoperative and postoperative intraocular pressure values, co-existing ocular pathology, type of strabismus, surgery performed, frequency and duration of postoperative topical steroid use and treatment received for elevated intraocular pressure were collected and descriptively summarised. **Results:** Thirty-six (39.1%) out of 92 patients who had squint surgery during the study period met study inclusion criteria. Mean age was  $20.5 \pm 13.6$  years. All patients were administered Maxitrol® ointment postoperatively. Baseline, peak and net change in IOP were  $12.9 \pm 2.6$  mmHg,  $21.3 \pm 6.8$  mmHg and  $8.39 \pm 7.2$  mmHg respectively. Thirty-one (86.1%) patients had elevation in IOP from baseline; 21 (67.7%) of these had significant IOP elevation. Topical steroid therapy was tailed off rapidly for all patients with significant IOP elevation. Twelve patients were commenced on topical IOP lowering medications, with normalization of intraocular pressure in majority of them by three months after surgery. **Conclusion:** Elevated intraocular pressure with the use of topical dexamethasone ointment after squint surgery was common in this study and majority of the patients had significant elevation in intraocular pressure. Close monitoring of the intraocular pressure of black patients, especially children, on topical steroid medication after squint surgery is strongly recommended.

**Keywords:** Black Africans, dexamethasone ointment, elevated intraocular pressure, squint surgery

## Introduction

Both increase and decrease in intraocular pressure (IOP) have been documented following squint surgery.<sup>[1-3]</sup> Topical steroid therapy is a known association and may be the major cause of elevated intraocular pressure after squint surgery. The elevation in IOP can occur as early as a few days to weeks after surgery.<sup>[3-5]</sup> Other reported causes of intraocular pressure elevation after strabismus surgery in the literature include aqueous misdirection and episcleral venous outflow obstruction.<sup>[6,7]</sup>

The mechanism of IOP elevation secondary to steroid use has been described to be a sequela of increased accumulation of non-digestible glycosaminoglycans (GAG) in the trabecular meshwork.<sup>[8]</sup> In addition, steroids reduce the release of lysosomal enzymes which break down GAGs.<sup>[9]</sup> Consequently, these non-digestible GAGs exert an osmotic effect, swell, and block the trabecular meshwork increasing resistance to aqueous outflow.<sup>[9,10]</sup> There is also

accumulation of debris in the anterior chamber angle due to steroid-induced reduction in leucocyte activity.<sup>[11,12]</sup>

Some risk factors have been identified for IOP elevation in response to steroid use. These include glaucoma, myopia, younger age (children), and family history of glaucoma.<sup>[13,14]</sup> Although the risk of IOP elevation increases with duration and frequency of steroid usage, it has been reported to occur as early as the first day postoperatively; with IOP returning to normal levels after discontinuation of steroids.<sup>[15,16]</sup> Prolonged duration of steroid use may, however, lead to persistently elevated IOP, often with very high values, even after stopping the steroid medication.<sup>[17]</sup>

Intraocular pressure elevation has been reported with the use of different types of corticosteroids, and a greater rise in IOP has been associated with the older generation of corticosteroids such as dexamethasone compared to newer ones such as fluorometholone or loteprednol etabonate.<sup>[4,15,18]</sup> A systematic review of studies on topical use of loteprednol etabonate reported less risk of a

Mary O. Ugalahi<sup>1</sup>,  
Folahan A. Ibukun<sup>2</sup>,  
Bolutife A.  
Olusanya<sup>1</sup>,  
Aderonke M.  
Baiyeroru<sup>1</sup>

<sup>1</sup>Department of Ophthalmology, College of Medicine, University of Ibadan and University College Hospital, Ibadan, <sup>2</sup>Department of Ophthalmology, University College Hospital, Ibadan, Nigeria

Received: 01-Feb-2022

Accepted: 22-Apr-2022

Published: 23-Aug-2022

Address for correspondence:

Dr. Bolutife A. Olusanya,  
Department of Ophthalmology,  
College of Medicine, University  
of Ibadan and University College  
Hospital, Ibadan, Nigeria.  
E-mail: bolutifeo@yahoo.com

Access this article online

Website:

www.jwacs-jcoac.com

DOI: 10.4103/jwas.jwas\_26\_22

Quick Response Code:



**How to cite this article:** Ugalahi MO, Ibukun FA, Olusanya BA, Baiyeroru AM. Intraocular pressure elevation following the use of topical dexamethasone ointment after squint surgery. J West Afr Coll Surg 2022;12:70-5.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

significant increase in IOP compared to prednisolone acetate or dexamethasone, either with short term use or long term use.<sup>[19]</sup>

Ocular hypertensive response to topical steroids in normal eyes was classified into three categories in 1964 by Armaly.<sup>[20]</sup> These are: (i) low response with a pressure rise of <6mmHg (mean of 1.6mmHg); (ii) intermediate response with a pressure rise of 6 – 15mmHg (mean of 10mmHg); and (iii) severe response with a pressure rise of >15mmHg (mean of 16mmHg).<sup>[20]</sup> The study has been a landmark in the classification of intraocular pressure elevation following topical steroid therapy.

Intraocular pressure elevation has also been reported with the use of dexamethasone ointment.<sup>[16]</sup> Ointment formulations of steroids have a longer duration of contact with the ocular surface than eye drops and thus may induce a greater increase in IOP. Patients who undergo squint surgery in our practice are usually placed on ointment formulation of dexamethasone. There is, therefore, a need to audit and document the pattern of intraocular pressure changes observed in them following steroid therapy.

Furthermore, virtually all our patients are of African descent and the black race has a higher risk of glaucoma, particularly the open-angle type.<sup>[21,22]</sup> Thus, evaluating the intraocular pressure changes after squint surgery in these eyes will provide evidence for clinical decision-making since steroid therapy forms an important part of postoperative care. This article describes the pattern of IOP changes after squint surgery in eyes of black Africans at the University College Hospital, Ibadan, Nigeria.

## Patients and Methods

This was a retrospective review of the clinical records of patients who underwent squint surgery over a 10-year period between 2010 and 2019. All patients were seen, evaluated, and had surgery performed by at least one of three Paediatric Ophthalmologists (MOU, BAO, AMB) in the Paediatric Ophthalmology Unit, Department of Ophthalmology, University College Hospital, Ibadan.

**Eligibility criteria:** Patients who had preoperative and postoperative intraocular pressure measurements after at least one week on topical steroid medication were included. Patients with pre-existing ocular disease affecting intraocular pressure such as glaucoma and retinal detachment were excluded from the study.

All patients had visual acuity assessment, squint evaluation, anterior segment examination using a Slit-lamp bio-microscope as well as posterior segment examination before surgery. Intraocular pressure measurement was performed with a Goldman applanation tonometer. All children and a few adults had surgery under general anaesthesia while most adult patients had surgery under local anaesthesia: peribulbar block and facial nerve block with 6 to 8mls of 2% lidocaine + 0.75% bupivacaine (mixed in the ratio of 3:2). Postoperatively, all patients were administered Maxitrol® ointment (0.1% Dexamethasone, Polymixin B, Neomycin; Alcon) for a period

of about six weeks to eight weeks either as thrice daily or four times daily dosing.

Baseline IOP was taken as the last recorded intraocular pressure before surgery in the operated eye. Peak postoperative IOP value was taken as the highest intraocular pressure recorded (for the operated eye or right eye if bilateral surgery) within two months of surgery. Time to reach peak IOP value was also noted. The net change in IOP was calculated as peak postoperative IOP minus baseline IOP. Patients were classified according to the level of response to topical steroids using the classification by Armaly.<sup>[20]</sup> Significant IOP elevation was taken as an increase of 6mmHg or more from baseline to peak IOP. Patients with significant IOP elevation were commenced on topical IOP lowering medications and steroid medication was tailed off. IOP lowering medications were discontinued when IOP returned to preoperative levels or values <21mmHg.

The study adhered to the tenets of the declaration of Helsinki for medical research. Ethical approval was obtained from the institutional review board of the University of Ibadan/ University College Hospital Ibadan ethical committee.

Data was managed and analysed using IBM-SPSS version 21(IBM, Armonk, NY, USA). Variables were descriptively summarised with means and standard deviations for numeric variables, and frequencies and proportions for categorical variables.

## Results

### Demographic and clinical characteristics

A total of 92 patients had squint surgery during the study period, however, only 36 (39.1%) patients met the inclusion criteria for the study. Forty (43.5%) patients had no preoperative IOP value recorded while 14 (15.2%) patients had no post-operative IOP value recorded within two months of surgery. One (1.01%) patient had retinal detachment pre-operatively with an IOP of 0mmHg while another patient was being managed for glaucoma pre-operatively. There were more females ( $n = 20, 55.6\%$ ) than males. The mean age at presentation was  $20.5 \pm 13.6$  years (range: 5years to 57years). The age and gender distribution of the patients is presented in [Figure 1]. Eighteen (50%) patients had exotropia, 17(47.2%) patients had esotropia while one (2.8%) patient had hypotropia. Twenty (55.6%) patients had unilateral surgery while 16 (44.4%) patients had bilateral surgery. One (2.8%) patient had transposition of vertical muscles, five (13.9%) patients had surgery on both vertical and horizontal muscles while most patients (30, 83.3%) patients had surgery on only horizontal muscles.

### Duration of steroid use

All patients were placed on Maxitrol® ointment postoperatively, a majority were on four times daily dosing ( $n = 25/36, 69.4\%$ ) and others were on three times daily dosing ( $n = 11/36, 30.6\%$ ). One patient was changed to diclofenac eyedrops two weeks after surgery due to markedly elevated IOP. Two (5.6%) patients defaulted follow-up after one week, hence the duration of

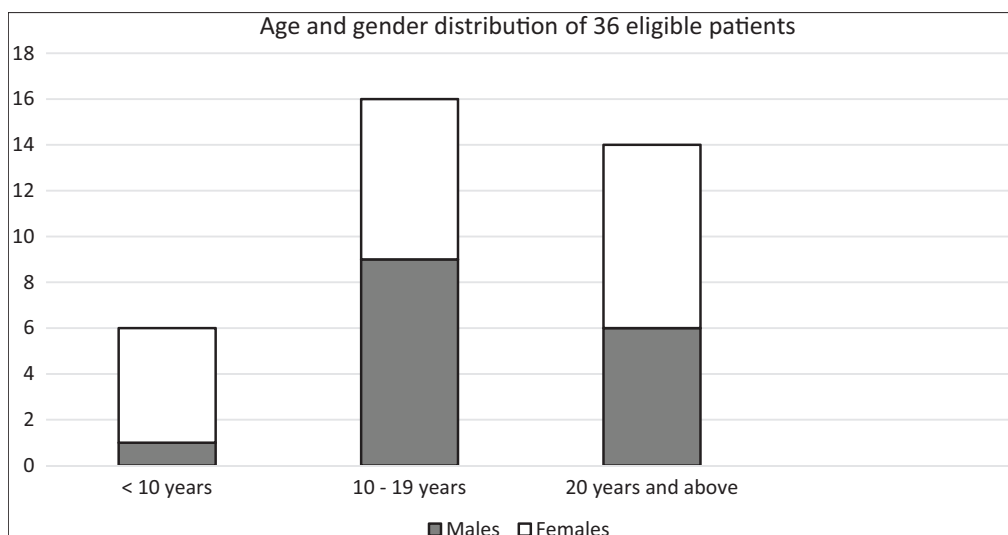


Figure 1: Age and gender distribution of 36 eligible patients

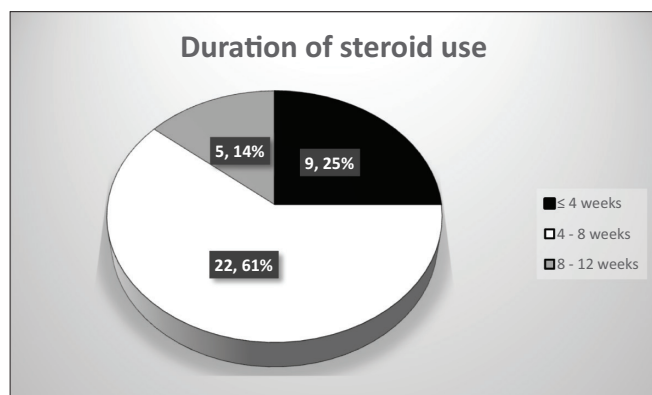


Figure 2: Duration of steroid use

steroid use could not be ascertained. Further details on the duration of steroid use are presented in [Figure 2].

### Intraocular pressure changes

Intraocular pressure values of the right eye were used for analysis in those patients who had bilateral surgeries as no significant difference was found between preoperative IOP of the right eyes versus left eyes on paired t-test ( $P = 0.324$ ). Thirty-one (86.1%) patients had elevated IOP from baseline, of which twenty-one (67.7%) had significant IOP elevation [Table 1]. The mean pressure rise for the low IOP response group was  $4.1 \pm 0.5$  (3 - 5) mmHg, that of the intermediate response group was  $9.5 \pm 1.9$  (6 - 12) mmHg and that of the severe response group was  $21.5 \pm 1.8$  (18 - 24) mmHg. The mean time to peak IOP was  $3.3 (\pm 1.7)$  weeks [Table 2]. Changes in intraocular pressure by age are presented in [Figure 3]. There was no statistically significant difference across age groups with regards to the IOP changes.

### Treatment and time to normal IOP

The frequency of topical steroid therapy was reduced and tailed off rapidly for all twenty-one patients with significant IOP elevation. Twelve (57.1%) patients out of these, were

**Table 1: Pattern of change in intraocular pressure**

Variable	Frequency/ Value (%)
<b>The direction of Net change in IOP</b>	
Increase	31 (86.1%)
Decrease	4 (11.1%)
No change	1 (2.8%)
Total	36 (100%)
<b>Classification of the net increase in IOP</b>	
Low response (< 6mmHg)	10 (32.3%)
Intermediate response (6 – 15mmHg)	15 (48.4%)
Severe response (>15mmHg)	6 (19.4%)
Total	31 (100)

**Table 2: Mean values for intraocular pressure and Time to reach peak intraocular pressure**

Intraocular pressure values	Mean $\pm$ SD (Range)
Baseline IOP	$12.9 \pm 2.6$ (7 - 18) mmHg
Peak IOP	$21.3 \pm 6.8$ (12 - 36) mmHg
Net change in IOP	$8.39 \pm 7.2$ (-4 to +24) mmHg
1 week postoperative IOP	$19.6 \pm 6.5$ (8 - 35) mmHg
1 month postoperative IOP	$20.1 \pm 7.0$ (10 - 35) mmHg
2month postoperative IOP	$14.5 \pm 2.9$ (10 - 18) mmHg
3 month postoperative IOP	$12.3 \pm 1.8$ (10 - 14) mmHg
<b>Time to reach peak intraocular pressure</b>	
Overall average	<b><math>3.3 \pm 1.7</math> (1 - 7) weeks</b>
Mild responders	$2.9 \pm 1.4$ (1 - 4) weeks
Moderate responders	$3.7 \pm 1.9$ (1 - 7) weeks
Severe responders	$3.2 \pm 1.5$ (1 - 5) weeks

commenced on topical IOP lowering medication. Eleven were commenced on guttae timolol and one was commenced on guttae Misopt® (combination of timolol and dorzolamide). Of the twelve patients commenced on IOP lowering medications, two (16.7%) patients required a change in medication due to inadequate IOP control. One patient who had initially been

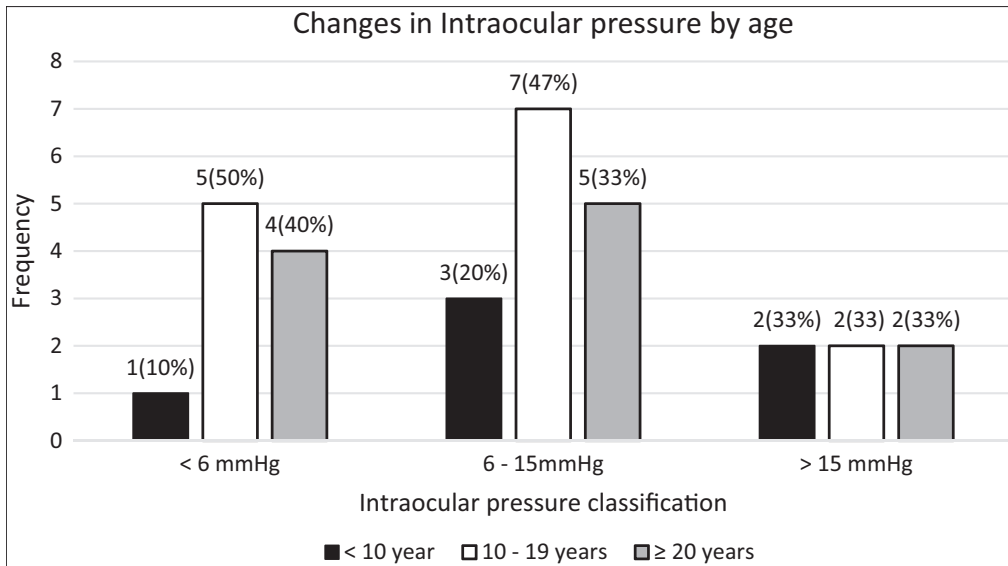


Figure 3: Changes in intraocular pressure by age

commenced on guttae timolol at one week post-op had guttae brimonidine added at 5 weeks post-op, while a second patient had her medication changed from guttae timolol to guttae Misopt® one month after surgery.

Of the twelve patients commenced on medications, intraocular pressure normalized in eight patients within the first 3 months after surgery. IOP returned to normal at 6 months and 7 months post-op respectively in two patients. Two patients defaulted follow-up after 1-month post-op: one of these represented at 18 months with normal intraocular pressure value while the other is still at large, therefore, further IOP measurements were not documented.

### Discussion

The intermediate level of response was the most common (48%) ocular hypertensive response seen in this study with a mean IOP rise of 9.5 mmHg in that group. This was followed by the group with a low level of response (31%) with a mean IOP rise of 4.1 mmHg. This is similar to reports by Lee *et al*<sup>[16]</sup> but contrary to findings by Armaly<sup>[20]</sup> where most (66.2%) participants had a low response. This may be due to the older age of participants in the study by Armaly<sup>[20]</sup> as majority (71%) were between 21 – 25 years of age.

Intraocular pressure elevation with ocular steroid use post-surgery has been shown to depend on the age of the patient.<sup>[13,14]</sup> Ohji *et al*<sup>[15]</sup> studied the effects of topical dexamethasone application on two age groups of patients after squint surgery: children under 10 years and patients ≥10 years of age. They reported elevated intraocular pressure >20 mmHg in nine out of eleven children younger than 10 years as opposed to the older children whose intraocular pressures did not rise above 20 mmHg. In the same vein, Lee *et al*<sup>[16]</sup> reported a higher frequency of intraocular pressure elevation in children 5 years old or younger. These studies reported rapid onset and

more severe increases in intraocular pressure in response to steroid use in children when compared to adults.<sup>[15,16,18]</sup> This is postulated to be due to the immaturity of the angle structures. Remé and Lalive d’epinay<sup>[23]</sup> in their study reported that although the human eye has all constituent structures of the anterior chamber angle in place at birth, restructuring and maturation of components continue up to eight years of age. In our study, however, the age group with the highest change in intraocular pressure was the 10 - 19 years category. This may be related to the fact that almost half of our patients were aged between 10 and 19 years.

Severe intraocular pressure response to topical steroids was the least common level of response observed in previous studies.<sup>[16,20,24]</sup> Findings in this study are in keeping with this, as less than one-fifth of patients had severe intraocular pressure response to topical steroids. On the contrary, Kwok *et al*<sup>[18]</sup> reported that more than half (56.25%) of their participants had severe intraocular pressure response. This could be due to the higher frequency of steroid usage in their study and the smaller sample size compared to other studies.<sup>[16,20,24]</sup> [Table 3] contains a summary of our results in comparison with findings of previous studies.

Lee *et al*<sup>[16]</sup> reported the following intraocular pressure changes after strabismus surgery: an increase, with peak value in the first week; and a decrease by 1 month with a return to preoperative values by 3 months postoperatively. Intraocular pressure changes followed a similar pattern in this study, rising from preoperative values, and returning to preoperative values by 3 months in majority of patients. Mean time to reach peak IOP was however longer in this study (3.3 weeks) compared with the study by Lee *et al*<sup>[16]</sup> (1.2 weeks). This may be due to the younger age of participants in their study (mean age 6.49 ± 2.7 years) compared with ours (mean age

**Table 3: Comparison of ocular response to 0.1% dexamethasone in different studies**

Variables	Kwok <i>et al</i> <sup>[18]</sup> (dexamethasone arm)	Lee <i>et al</i> <sup>[16]</sup>	Armaly <sup>[20]</sup>	Ohji <i>et al</i> <sup>[15]</sup> (group A)	Ohji <i>et al</i> <sup>[15]</sup> (group B)	Biedner <i>et al</i> <sup>[24]</sup>	Present study
Age (years)							
Mean	6.1±0.56	6.5±2.7		5.5	20.6	9.7	20.5±13.6
Range	<10	3 - 16	16 - 40	3 - 8	12 - 49	4 - 19	5 - 57
Sample size	16	96	80	11	9	44	36
Frequency of adm (times/day)	6	2 - 3	3	3	3	4	3 - 4
Duration of adm (weeks)	4	3	4	At least 2	At least 2	6	6.3±2.7
Mean Baseline IOP	15.18±2.89	13.6±2.9				11.2±2.0	12.9±2.6
Mean Peak IOP	30.66±8.35	20.6±4.9					21.3±6.8
Mean time to reach peak	15.56±8.29days	8.5±5.9days					23±12 days
Low responders	6.25% (1)	35.4% (34)	66.2% (53)	0% (0)	77.8% (7)	89% (39)	30.6% (11)
Intermediate responders	37.5% (6)	56.3% (54)	28.8% (23)	45.5% (5)	0% (0)	9% (4)	41.7% (15)
Severe responders	56.25% (9)	8.3% (8)	5% (4)	36.4% (4)	0% (0)	2% (1)	16.7% (6)

20.5±13.6 years) as children have been reported to have more rapid increases in intraocular pressure than adults.<sup>[18]</sup>

Intraocular pressure often returns to normal levels following discontinuation of topical steroids even without the use of intraocular pressure-lowering medications.<sup>[16]</sup> Thus, tapering off steroid medication is the initial step in managing intraocular pressure rise. Use of intraocular pressure-lowering medications can be undertaken to shorten the duration of optic nerve exposure to damaging levels of intraocular pressure. We commenced pressure-lowering medications in our patients with significantly elevated intraocular pressure.

We acknowledge that our study has limitations with regards to its retrospective design and the small number of patients who were eligible for inclusion in the study. Notwithstanding, our findings demonstrate the importance of monitoring intraocular pressure changes in black Africans who receive topical steroid therapy after squint surgery.

## Conclusion

Mild and moderate increases in intraocular pressure were more commonly encountered after squint surgery, and intraocular pressure returned to normal after steroid discontinuation in most of our patients. Medications may be needed to lower intraocular pressure in severe cases as was observed in our cohort. We recommend close monitoring of intraocular pressure of patients on topical steroid medication after squint surgery; particularly, because IOP measurement may not be a routine focus of their postoperative evaluation. This is to enable early institution of appropriate treatment to prevent steroid induced glaucoma.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

- Gomi CF, Yates B, Kikkawa DO, Levi L, Weinreb RN, Granet DB. Effect on intraocular pressure of extraocular muscle surgery for thyroid-associated ophthalmopathy. *Am J Ophthalmol* 2007;144:654-7.
- Hayashi S, Sato M, Miura H, Sugano A, Yamazaki M, Yamashita H. Intraocular pressure decreases after muscle union surgery for highly myopic strabismus. *Jpn J Ophthalmol* 2015;59:118-23.
- Lee D, Kim MM, Kim WJ. Effect of strabismus surgery on ocular axial length, anterior chamber depth, and intraocular pressure. *Medicine (Baltimore)* 2019;98:e15812.
- Kim J, Choi DC, Bae S, Choi DG, Lee JY. A randomized clinical trial of topical diclofenac, fluorometholone, and dexamethasone for control of inflammation after strabismus surgery. *J Ocul Pharmacol Ther* 2018;34:550-4.
- Ng JS, Fan DS, Young AL, Yip NK, Tam K, Kwok AK, *et al*. Ocular hypertensive response to topical dexamethasone in children: A dose-dependent phenomenon. *Ophthalmology* 2000;107:2097-100.
- Angmo D, Nayak B, Gup ta V. Post-strabismus surgery aqueous misdirection syndrome. *BMJ Case Rep* 2015. doi: 10.1136/bcr-2015-210489.
- Wutthayakorn W, Meethongkam K, Pukrushpan P, Chansangpetch S. Intraocular pressure elevation associated with blood in schlemm's canal after strabismus surgery. *Am J Ophthalmol Case Rep* 2020;18:100665.
- Johnson DH, Bradley JM, Acott TS. The effect of dexamethasone on glycosaminoglycans of human trabecular meshwork in perfusion organ culture. *Invest Ophthalmol Vis Sci* 1990;31:2568-71.
- Goel M. Aqueous humor dynamics: A review. *Open Ophthalmol J* 2010;4:52-9.
- Tschumper RC, Johnson DH, Bradley JM, Acott TS. Glycosaminoglycans of human trabecular meshwork in perfusion organ culture. *Curr Eye Res* 1990;9:363-9.
- Rohen JW, Linnér E, Witmer R. Electron microscopic studies on the trabecular meshwork in two cases of corticosteroid-glaucoma. *Exp Eye Res* 1973;17:19-31.
- Benedikt O, Roll P. Electron microscopy studies of the trabecular meshwork in pigmentary glaucoma. *Klin Monbl Augenheilkd* 1980;176:122-30.
- Kersey JP, Broadway DC. Corticosteroid-induced glaucoma: A review of the literature. *Eye (Lond)* 2006;20:407-16.
- Musleh MG, Bokre D, Dahlmann-Noor AH. Risk of intraocular pressure elevation after topical steroids in children and adults: A systematic review. *Eur J Ophthalmol* 2020;30:856-66.

15. Ohji M, Kinoshita S, Ohmi E, Kuwayama Y. Marked intraocular pressure response to instillation of corticosteroids in children. *Am J Ophthalmol* 1991;112:450-4.
16. Lee YI, Park CY, Woo KI. Ocular hypertensive response to topical dexamethasone ointment in children. *Korean J Ophthalmol* 2006;20:166-70.
17. Lam CS, Umi Kalthum MN, Norshamsiah MD, Bastion M. Case series of children with steroid-induced glaucoma. *Malays Fam Physician* 2018;13:32-7.
18. Kwok AKH, Lam DSC, Ng JSK, Fan DSP, Chew SJ, Tso MOM. Ocular-hypertensive response to topical steroids in children. *Ophthalmology* 1997;104:2112-6.
19. Sheppard JD, Comstock TL, Cavet ME. Impact of the topical ophthalmic corticosteroid loteprednol etabonate on intraocular pressure. *Adv Ther* 2016;33:532-52.
20. Armaly MF. Statistical attributes of the steroid hypertensive response in the clinically normal eye. i. the demonstration of three levels of response. *Invest Ophthalmol* 1965;4:187-97.
21. Leske MC, Connell AM, Schachat AP, Hyman L. The barbados eye study. Prevalence of open angle glaucoma. *Arch Ophthalmol* 1994;112:821-9.
22. Leske MC, Connell AM, Wu SY, Nemesure B, Li X, Schachat A, *et al.* Incidence of open-angle glaucoma: The Barbados eye studies. The Barbados eye studies group. *Arch Ophthalmol* 2001;119:89-95.
23. Remé C, d'Epinay SL. Periods of development of the normal human chamber angle. *Doc Ophthalmol* 1981;51:241-68.
24. Biedner BZ, David R, Grudsky A, Sachs U. Intraocular pressure response to corticosteroids in children. *Br J Ophthalmol* 1980;64:430-1.