

Surgical time aspect of learning curve in primary pterygium excision by ophthalmology trainees

Pakornkit Phrueksaudomchai^{1,2}

Promptorn patarajierapan³, Wichai Leelawongtawun²,
Supinda Leeamornsiri², Suntaree Thitiwichienlert²,
Nonthapan Narong², Chadsupad Tharawan³, Kosol Kampitak²

¹Thammasat University Hospital

²Department of Ophthalmology, Thammasat University, Pathumthani, Thailand

³Chulabhorn International College of Medicine, Thammasat University, Pathumthani, Thailand

Backgrounds: Pterygium excision is a standard procedure learnt and performed by first-year Ophthalmology trainees. Surgical time is one of the crucial aspects of the surgical learning curve and hence is essential for successful surgical training.

Objective: To study surgical time of primary pterygium excision amongst first year Ophthalmology trainees.

Methods: The study was conducted as a prospective comparative study amongst seven first-year Ophthalmology trainees. Surgical times were recorded for all pterygium excisions performed by the trainees throughout one year at Thammasat University Hospital. Among surgical times, data for baseline characteristics of trainees and patients were collected. The results were analyzed using one-way ANOVA, Fisher's exact test and linear regression. In addition, surgical time stabilization with consecutive cases is visualized by a Locally Weighted Scatterplot Smoothing (LOWESS) line of best fit.

Results: A total of 55 eyes of 55 patients with primary pterygium underwent pterygium excisions. There were no statistically significant differences amongst gender, side of surgery (left or right), anatomical location of pterygium (temporal versus nasal). An average of 7.9 pterygium surgeries per trainee were performed throughout the year. Mean for speculum insertion to local anesthetic injection time, pterygium excision time, graft placement by suture time, removal of speculum subsequent to graft placement time and total surgical time was 2.0, 29.7, 41.9, 2.1 and 75.7 minutes respectively. Speculum insertion to local anesthetic injection times, pterygium excision times and removal of speculum subsequent to graft placement to remove speculum times appear to be steady after the experience of five cases. Graft placement times decrease significantly after completion of five to ten cases.

Conclusion: Mean of total surgical time for pterygium excision was 75.7 minutes. The surgical time for primary pterygium excision seems to be more stable after five cases. Hence, it can be deduced that the greater the number of operations performed, the shorter the surgical time.

Conflicts of Interest: No conflicts of interest in this study.

Keywords: learning curve, surgical time, primary pterygium excision, ophthalmology trainees

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Correspondence to:

Pakornkit Phrueksaudomchai, Department of Ophthalmology, Thammasat University, Pathumthani, Thailand

Email: makorn273@gmail.com

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Introduction

Pterygium is a degenerative disease of the conjunctiva with corneal involvement. There are various known risk factors such as sunlight exposure, genetic conditions, abnormal immunologic responses, viral infection or inflammation of the ocular surface.¹ Pterygium is known to be a common disease in ophthalmology practice in Thailand. A recent study of the prevalence of dry eye disease in Bangkok found that more than half of patients have concurrent pterygium or pingecula.² Additionally, pterygium disrupts patients' daily life with a spectrum from mildly irritating symptom to chronic progressive blurred vision. There are several treatment options ranging from conservative medical treatment to definitive surgical treatment. In Ophthalmology training in Thailand, pterygium surgery is included in the curriculum since the beginning of first-year training. It is considered an important prerequisite for other advanced ophthalmic surgical skills. Despite several studies in Thailand and abroad on the duration of pterygium surgery as well as differences in surgical outcomes amongst surgeons with different level of experiences, data on each procedural step is still lacking. Moreover, few studies have looked into the effect of practice on shortening of operative time, namely the finding the duration of practice that allows operative time to become consistent. Therefore, this research intends to study the duration of pterygium surgery performed by first year Ophthalmology trainees in order to adapt and excel the teaching of Ophthalmology trainees.

Material and methods

This research is a prospective descriptive study. The population is first-year Ophthalmology

trainees in Thammasat University in the 2018 academic year consisting of 7 persons in total.

Part 1 Trainees selection

Inclusion criteria

- All of first-year Ophthalmology trainees in Thammasat University in the 2018 academic year.

Exclusion criteria

- Doctors who had experiences in pterygium surgery before residency training.

Part 2 Patient selection

Inclusion criteria

- Age of over 18 years
- Patients who have pterygium
- Those who has given consent to undergo surgery by first-year ophthalmology trainees of the Ophthalmology Department, Thammasat University Hospital, Thammasat University.

Exclusion criteria

- Patients with multiple pterygium heads in one eye.
- Patients with history of pseudo-ptyerygium.
- Patients with history of recurrent pterygium.
- Patients with history of prior ocular surgery, active ocular inflammation, infection or pre-existing glaucoma or any other severe ocular disease.
- Patients with underlying disease contraindicating surgery.
- Patients unable to consent for follow-up according to the study protocol.

Pre-operative care

All patients diagnosed with pterygium and agreed to have surgery performed by first-year ophthalmology trainees were advised of the

surgical procedure and had discussions about risks and complications with assigned professors. Ophthalmologic examination was performed. Visual acuity assessment, intraocular pressure measurement, complete fundus examination and disc evaluation for glaucoma risk was done. Slit lamp bio-microscopy was performed to evaluate the appearance pterygium on the cornea.

Surgical technique

In operation, the surgical site was painted with 5% Betadine® (povidone-iodine) solution before draping in sterile fashion. After initial preparation, eyelid speculum was placed. Then, local anesthesia was achieved by topical eye drops of 0.5% tetracaine hydrochloride and subconjunctival injection, of 2% xylocaine without adrenaline, injected under the pterygium body. The pterygium head was then excised and associated subconjunctival tissue was removed. Bleeding point was checked and stopped. Hemostasis was achieved by pressure with sterile cotton bud tip or electrosurgery using a bipolar coagulator. Bare sclera was measured for sizing of the amniotic membrane graft or conjunctival autograft. Amniotic membrane graft or conjunctival autograft was prepared. The graft was placed on bare sclera and sutured using single suture using 8-0 or 10-0 Nylon along all graft margins by fixing at the episcleral tissue. Surgical time was recorded in seconds for different checkpoints of the procedure. Mean for speculum insertion to local anesthetic injection time, pterygium excision time, graft placement by suture time, removal of speculum subsequent to graft placement time and total surgical time were recorded. Surgical times were analyzed separately based on the type of graft used due to the difference in preparation times; the conjunctival autograft requires greater time in preparation compared to the amniotic membrane graft

Post-operative care and follow-up

Post-operative, patients were routinely followed up with appointments on the first day, week 1, month 1, month 3 and month 6 respectively. All were given topical steroids and antibiotic eye drops and combined antibiotic and steroid ointments. Drug administration and dose adjustment depended on the degree of inflammation assessed. Patients were routinely advised the same post-operative care. On every follow-up visit, we assessed visual acuity, intraocular pressure and performed slit lamp bio-microscopy to evaluate inflammation, infection and recurrence of pterygium.

Statistical analysis

Seven first-year ophthalmology trainees were monitored for operating times throughout one academic year. Data for baseline characteristics of trainees and patients were analyzed by ANOVA. Average predicted surgical times with consecutive cases were analyzed by linear regression. Operating time stabilization with consecutive cases is visualized by a Locally Weighted Scatterplot Smoothing (LOWESS) (line of best fit best-fit line). This research has been approved by the Research Ethics Subcommittee 1 of the Faculty of Medicine, Thammasat University.

Results

Part 1 Trainees selection: 7 ophthalmology trainees met the criteria, divided into 2 males (28.6 percent), and 5 females (71.4 percent). All of them had no experience in ophthalmic surgery.

Part 2 Patient selection: 55 patients met the criteria representing 7.9 pterygium surgery per 1 ophthalmology trainee: divided into 20 male patients (36.4 percent) and 35 female patients (63.6 percent). Patient's mean age is 64.2 years old. Pterygium was on the right side in 21 persons (38.9 percent) and left side in 34 persons (61.1

percent). The position of the pterygium was on the nasal side of the eye for 52 persons, (94.5 percent), on the temporal side for 2 persons (3.6 percent) and found both nasal and temporal side on 1 person (1.9 percent). The mean transverse size of the pterygium was 3.7 mm and the mean vertical size was 3.7 mm. The technique was amniotic membrane transplant for 49 persons (89.1 percent) and conjunctival autograft for 6 persons (10.9 percent). 48 persons were sutured

by non-absorbable sutures (87.3 percent) and 7 persons were sutured by absorbable sutures (12.7 percent). No complications were reported. There were no statistically significant differences amongst patient's sex, site of surgery (left and right), and location of pterygium (nasal and temporal) as shown in Table 1. Post-operative, patients were routinely follow-up appointments on the first day, week 1, month 1, month 3 and month 6 respectively, no significance reports

Table 1: Descriptive statistics in demographic data between patients and trainees.

Patients/Trainees	Trainee A	Trainee B	Trainee C	Trainee D	Trainee E	Trainee F	Trainee G	P value
Gender								0.451
Male	4(30.77)	5(55.56)	2(25)	2(28.57)	1(33.33)	1(14.29)	5(62.5)	
Female	9(69.23)	4(44.44)	6(75)	5(71.43)	2(66.67)	6(85.71)	3(37.5)	
Age (Range)	59-85	37-79	55-72	30-80	63-77	31-84	54-72	
Age (Means)	67.6	60	65	60.1	69	63.7	64.62	0.024
Site of surgery								0.802
Right	7(53.85)	3(33.33)	3(37.50)	3(42.86)	0	2(28.57)	3(37.5)	
Left	6(46.15)	6(66.67)	5(62.5)	4(57.14)	3(100)	5(71.43)	5(62.5)	
Location								0.923
Nasal	12(92.31)	8(88.89)	7(87.50)	7(100)	3(100)	7(100)	8(100)	
Temporal	1(7.69)	0	1(12.5)	0	0	0	0	
Both	0	1(11.11)	0	0	0	0	0	
Horizontal size of Pterygium (mm.) (Range)	3-9	2.5-10	1.2-4.7	1.8-2.5	3	2-5.2	2.5-5.5	
Horizontal size of Pterygium (mm.) (Means)	4.46	4.8	3.36	2.14	3	3.14	3.57	0.000
Vertical size of Pterygium (mm.) (Range)	3-7	2-12	2.9-3.8	1.2-2	3-3.5	2.5-4.5	3-6.5	
Vertical size of Pterygium (mm.) (Means)	4.38	5.28	3.23	1.46	3.17	3.57	3.86	0.000
Technique of surgery								0.011
Amniotic membrane transplant	13(100)	9(100)	4(50)	7(100)	3(100)	6(85.71)	7(87.50)	
Conjunctival autograft	0	0	4	0	0	1(14.29)	1(12.50)	
Type of suture								0.000
Nylon suture	10(76.92)	9(100)	0	5(71.43)	3(100)	5(71.43)	3(37.50)	
Vicryl suture	3(23.08)	0	8(100)	2(28.57)	0	2(28.57)	5(62.50)	

about complication were detached in 6 months. Post-operative, patients were routinely followed up with appointments on the first day, week 1, month 1, month 3 and month 6 respectively.

Surgical time was collected only in patients who met the criteria excluding patients with both nasal and temporal-sided pterygium. Mean

time for speculum insertion to local anesthetic injection was 2.0 minutes. Mean pterygium excision time was 29.7 minutes. The mean time for graft (conjunctival autograft or amniotic membrane graft) placement by suture was 41.9 minutes. The mean time for removal of speculum subsequent to graft placement was 2.1 minutes.

Table 2: Descriptive surgical time in each procedure and trainees.

Surgical time	Trainee A	Trainee B	Trainee C	Trainee D	Trainee E	Trainee F	Trainee G	All range Mean time (Min)	P value
Speculum insertion to local anesthetic injection (Min) (Range)	0.95- 6.75	0.65- 2.76	0.3-4	1.16-1.5	0.58-5	0.15-1	0.83- 3.95	0.15- 6.75	
Speculum insertion to local anesthetic injection (Min) (Means)	2.96	1.71	2.0	1.36	3.56	0.78	1.89	2.03	0.000
Local anesthetic injection to finished pterygium excision (Min) (Range)	22.33- 57.4	28.4- 54.35	10.02- 24	23.5- 38.5	10-34.3	7.48- 70.02	5-69.93	10.00- 70.02	
Local anesthetic injection to finished pterygium excision (Min) (Means)	34.7	40.86	19.5	29.61	24.77	27.5	30.72	29.67	0.000
Graft placement (Min) (Range)	21.43- 79.35	29- 49.52	14.58- 37.3	31.75- 49.75	26-65	29.91- 68.16	31.23- 76.5	14.58- 79.35	
Graft placement (Min) (Means)	41.2	35.4	28.7	42.89	50.39	48.15	46.62	41.91	0.013
After graft placement to remove speculum (Min) (Range)	0.25- 2.93	0.16- 24.88	1.16-6	1-6	0.25-2	0.7-1.13	0.72-3	0.16- 24.88	
After graft placement to remove speculum (Min) (Means)	1.72	4.08	3.1	2.23	1.08	0.95	1.48	2.09	0.000
Total time (Min) (Range)	45.8- 129.12	68.63- 116.3	38.95- 76	61- 91.75	63- 95.41	60.45- 113.5	45- 113.62	38.95- 129.12	
Total time (Min) (Means)	80.59	82.06	53.40	76.08	79.80	77.38	80.73	75.72	0.077

The mean of total surgical time was 75.7 minutes. There were no statistically significant differences in total surgical times comparing all 7 trainees as shown in Table 2.

When considering the relationship between time spent on surgery and number of operations performed, the greater the number of operations performed, the shorter the time spent on each surgery. Analysis using linear regression and Locally Weighted Scatterplot Smoothing (LOWESS) best fit line shows no clear-cut point on the number of operations it takes for operation time to become consistent, as shown in Figure 1. However, due to a small sample size, data analysis is limited.

Furthermore, a variety of operative techniques were employed intraoperative. Inspecting the sequence of operative procedure, time from speculum insertion to local anesthetic injection is quite consistent since the first few cases and levels off after 5 cases, as shown in Figure 2. Time from anesthetic injection to pterygium excision time seems to be consistent, as expected, after the experience over 5 cases, as shown in Figure 3. Penultimately, for graft placement operative times would decrease significantly after surpassing 5 to 10 cases. It tends to be strongly decrease after 5 cases and becomes more consistent after 10 cases, as shown in

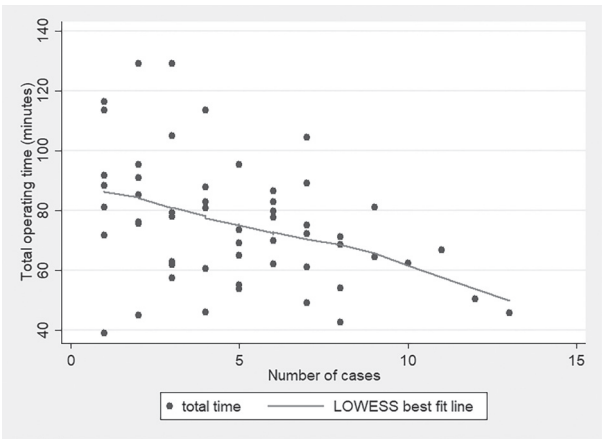


Figure 1: Total Pterygium excision surgical times with increasing number of cases

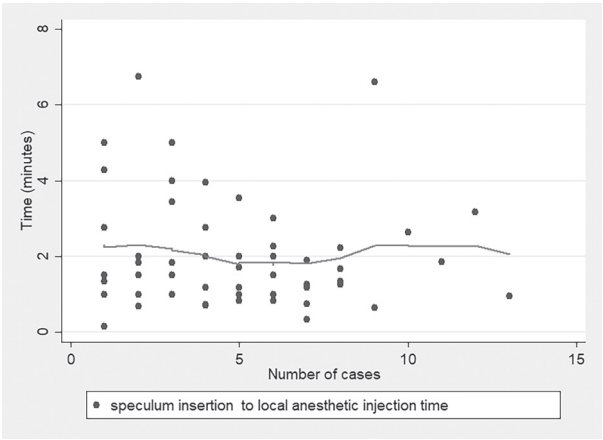


Figure 2: Speculum insertion to local anesthetic injection times with increasing number of cases

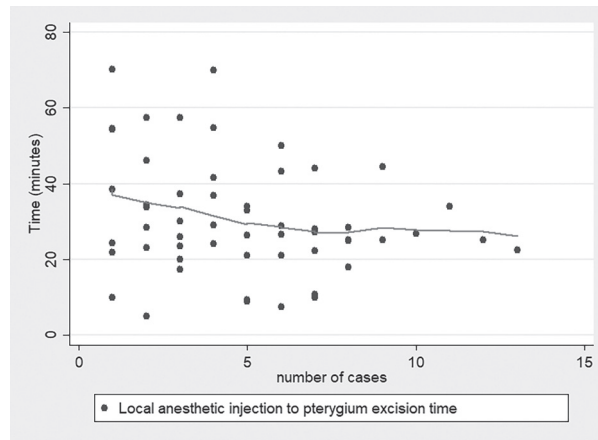


Figure 3: Local anesthetic injection to finished pterygium excision time with increasing number of cases

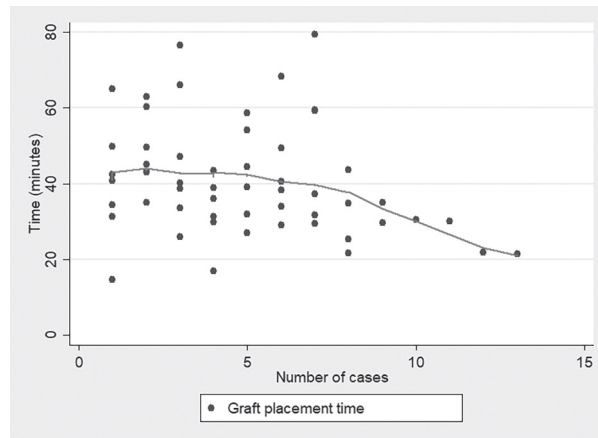


Figure 4: Graft placement times with increasing number of cases

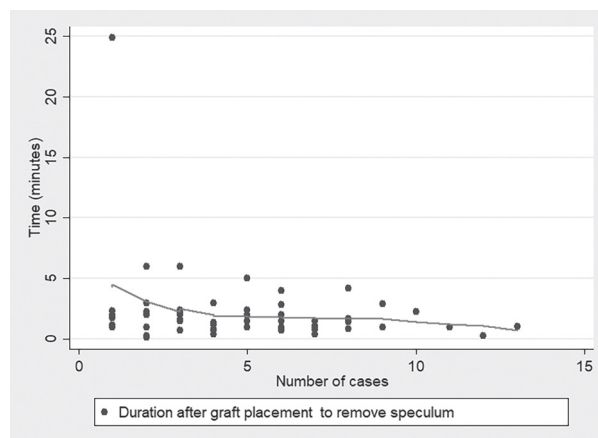


Figure 5: After graft placement to remove speculum times with increasing number of cases

Figure 4. In the last step, the learning curve for removal of speculum subsequent to graft placement is saturated. The results are comparable to speculum insertion to local anesthetic injection times, levelling off after 5 cases, as shown in Figure 5.

Discussion

This study focuses primarily on the surgical time aspect of the learning curve for primary pterygium excision among first-year Ophthalmology trainees. In actuality, there are a myriad of factors affecting surgical time and learning curve of the Ophthalmology trainees. The researchers have designed, gathered and analyzed the basic demographic data about the differences among all Ophthalmology trainees and the patients; the differences were not statistically significant, even though there were some variations in procedural steps and surgical techniques. Therefore, the timing of each surgical procedure has been recorded and analyzed separately in order to provide a more accurate data.

An Australian study has found that the rates of recurrence and surgical complications of primary pterygia excision are statistically different between consultant ophthalmologists (6.6%) and training ophthalmologists (23.3%).³ However, in our study, no surgical complications were observed at 6-months-follow-up. One possible limitation might be the follow-up period being too short for complications or recurrence to have occurred. When considering the duration of each step, it was found that the timing of the local anesthetic injection to finished pterygium excision procedure was found to be between 10.00 and 70.02 minutes, with a mean time of 29.67 minutes, which is more than a previous study done in Sweden which records a time of 13 to 17 minutes.⁷ In this study, the graft placement

took 14.58 to 79.35 minutes, with a mean of 41.9 minutes, which is more than a prior study in Oman, which took 25 to 40 minutes, with a mean of 32.5 minutes for this procedure.⁴ This may be because the first-year Ophthalmology trainees who performed primary pterygium excision in our study had no previous ophthalmic surgical experience, unlike those in the studies done in Sweden and Oman. Nevertheless, in comparison with the results of the study conducted amongst Ophthalmology trainees at the Faculty of Medicine, Chiang Mai University, it was found that primary pterygium excision with conjunctival autograft using Vicryl sutures, the total duration of the operation was 20 to 75 minutes, with a mean of 51.5 minutes, which is a shorter duration compared to our study.⁶ Likewise, from the study results of “The learning curve of improving operating time and recurrence rates in pterygium excision with sutured amniotic membrane transplantation among first year ophthalmology trainees”, the surgical duration was 28 to 100 minutes, with a mean of 50.38 minutes⁸, which is also a shorter duration as compared to this study.

In the surgical time aspect of learning curve of pterygium excision, the results showed that the duration for the surgical procedures of speculum insertion and speculum removal, which are the first and final steps respectively were relatively consistent throughout the course of study. A possible explanation is that these aforementioned procedures are basic procedures and thus have no significant capacity for learning. However, for durations of main surgical procedures, namely pterygium excision and graft placement, it was found to be more consistent after the experience of five surgeries. Furthermore, after surpassing the tenth surgery, the duration started to decrease steadily. Even so, in consideration of the total surgical duration alongside total pterygium

excision surgical times, it may be still be inconclusive whether increasing the number of cases will result in stabilization of the operating time. However, it can be concluded that the greater the numbers of cases, the shorter the surgical time. One limitation in this study is the small sample size available and short period of follow-up. This may be overcome by expanding data collection over a longer period of time as well as following the post-operative results for over a longer period of time in order to detect complications and recurrence.

Limitations

This study omits differentiating between conjunctival autograft and amniotic membrane transplant due to the very low sample size of those undergoing the former procedure, namely 6 out of 49 cases, inhibiting significance analysis and our learning curve. In the future, studies that correlate the two learning curves for the two aforementioned procedures will prove beneficial in determining the amount of training and experience needed for mastering those techniques.

Conclusion

Over a period of one year, seven first-year Ophthalmology trainees have operated on fifty-five pterygium surgical cases, an average of 7.9 eyes per 1 trainee. The average time for all procedures in the surgery was 75.7 minutes, separated into speculum insertion to local anesthetic injection time of 2.0 minutes, pterygium excision time was 29.7 minutes, graft placement time was 41.9 minutes and removal of speculum subsequent to graft placement time was 2.1 minutes. In conclusion, surgical duration becomes more stable after five cases, and after ten cases, the duration decreases steadily.

Potential Conflicts of Interest

Researchers have no financial interest in any products or instruments mentioned in this study.

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