The association between the duration of using ocular prosthesis and upper and lower conjunctival fornix depth

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ABSTRACT

Background: Ocular prosthesis is needed to replace the content of eyeball lost due to several factors. Adequate retention of ocular prosthesis requires an adequate upper and lower conjunctival fornix depth. **Objectives:** The objectives of the study were to evaluate the association between the duration of using ocular prosthesis and upper and lower conjunctival fornix depth. **Materials and Methods:** A case–control study was conducted in 30 anophthalmic socket patients aged 22–77 that using ocular prosthesis more than 6 months. The contralateral eye with healthy socket was chosen as a control group. Upper and lower conjunctival fornix depth were measure using fornicometer. We design a fornix depth measurer for objective measurement of upper and lower conjunctival fornix depth. **Results:** From 30 anophthalmic socket patients, males were about 14 times more often than female, with the average age that was 51. The mean upper conjunctival fornix depth in males was 10.8 ± 0.6 and lower conjunctival fornix depth was 6.2 ± 0.8. The mean upper conjunctival fornix depth in females was 10.80 ± 0.6 and lower conjunctival fornix depth was 5.5 ± 0.7. There is medium relationship between upper conjunctival fornix depth and the duration of using prosthesis ($cc = -0.435$; $P = 0.016$) and there is high relationship between lower conjunctival fornix depth and the duration of using prosthesis ($cc = -0.551$; $P = 0.002$). **Conclusions:** There was a significant association between the duration of using ocular prosthesis and upper and lower conjunctival fornix depth.

KEY WORDS: Ocular Prosthesis; Upper Conjunctival Fornix Depth; Lower Conjunctival Fornix Depth

INTRODUCTION

Anophthalmia is the absence of ocular tissue within the orbit and can affect one or both eyes.[1] The etiology of anophthalmia is congenital and acquired.[2] The cause of congenital anophthalmia remains unknown, but some studies suggest hereditary and environmental causes play an important role. Congenital anophthalmia may cause by genetic mutations and maternal infections during pregnancy.[3] Surgical removal of the eyeball is always related to acquired anophthalmia. Three types of surgical removal of the eyeball are evisceration, enucleation, and exenteration. There are several factors that may lead an acquired anophthalmia due to surgical removal of the eyeball such as ocular trauma, cancer, blind painful eye, and severe orbital inflammation.[4,5] Fornix depth measurement (FDM) becomes an important to maintain the ocular prosthesis after surgical removal of the eyeball.[6] FDM should be performed with an excellent intra- and inter-observer reliability. The instrument of fornicometer, FDM should meet the following requirements such as inexpensive, easy to carry, available, easy to use, and disinfect and the important thing is comfortable for patients. In anophthalmic socket, the condition and shape are influenced by the cause of the eye loss, the surgical technique, the type and size of the implant, and the length of time when the ocular prosthesis was used. Some problems can be found in anophthalmic socket

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patients such as the presence of secretions, dry eyes, poor ocular prosthesis cosmetics, decreased motility of the ocular prosthesis, inadequate retention of the ocular prosthesis due to silting of the fornix or socket contractures, and discomfort to pain in the anophthalmic socket.[7,8] Anophthalmic socket patients need rehabilitation to look normal and lead a stress-free life. However, the long-term experience of anophthalmic socket patients with ocular prosthesis has received little attention, and only a few studies have been published examining the problem of anophthalmic socket patients, or how the problem may change over time. This study aims to determine the relationship between the depth of the conjunctival fornix with age, sex type, and duration of use of ocular prosthesis in the anophthalmic socket which may be associated with socket anophthalmia syndrome or socket contracture.[8]

MATERIALS AND METHODS

This study was a case–control study that was conducted in 30 sockets of 30 anophthalmic socket patients. The sampling methods use for this study was consecutive sampling. The study was conducted in Aceh Tamiang General Hospital, Indonesia, from January to June 2020. The sample of this study was all outpatients diagnosed with anophthalmia socket and using polymethylmethacrylate (PMMA) ocular prosthesis after evisceration with dermis fat graft implantation more than 6 months and age more than 18. The contralateral eye with healthy sockets was chosen as a control group. We made a PMMA FDM to analyzed upper and lower conjunctival fornix depth, a ruler is embedded within the plastic with 2 mm black line gradations, and red lines indicating 10 mm and 20 mm.[6]

This study has received permission not only from Health Research Ethical Committee of Faculty of Medicine, Universitas Sumatera Utara but also from Aceh Tamiang General Hospital to perform research at the hospital.

Statistical Analysis

SPSS version 17.0 was to analyze the data. This study used Pearson's Chi-square to conduct whether there is a significant association between variables and the correlation of Spearman's to evaluate the correlation between the duration of using ocular prosthesis and upper and lower conjunctival fornix depth.

RESULTS

A total number of 30 sockets' anophthalmic patients that using ocular prosthesis met the inclusion criteria in this study. There were 28 males and only 2 were females. FDM was performed after informed consent.

Table 1: Characteristics of subjects

Characteristics	*n*
Sex	
Male	28
Female	2
Mean age (y.o)	
Male	51 (22–77)
Female	51 (37–65)
Mean age of eye loss (y.o)	
Male	36 (10–65)
Female	9,5 (5–40)

Table 1 gives the information, based on gender male is about 14 times more often than female, with the average age was 51. Females tend to lose their eye (anophthalmia) in younger age than males with the mean age of 9, 5 and males were the age of 36. The youngest female in this study was 5, and the youngest male was 10.

Table 2 shows the decreasing of upper and lower conjunctival fornix depth in any age.

The shallowest upper conjunctival fornix depth was in the age of 70–79, and lower conjunctival fornix depth was at the age of 50–59. There was no significant relationship between upper conjunctival fornix depth and the age (corr. coeff. = −0.33; $P = 0.072$) and lower conjunctival fornix depth and the age (corr. coeff. = 0.0331; $P = 0.873$).

Table 3 shows that females were tend to have a shallow upper and lower conjunctival fornix depth than males. The mean upper conjunctival fornix depth in males was 10.8 ± 0.6 and lower conjunctival fornix depth was 6.2 ± 0.8. The mean upper conjunctival fornix depth in females was 10.80 ± 0.6 and lower conjunctival fornix depth was 5.5 ± 0.7. There was no relationship between upper conjunctival fornix and the sex ($r = 0.323$; $P = 0.082$), and there was no relationship between lower conjunctival fornix and the sex (corr. coeff. = −0.220; $P = 0.243$).

Table 4 shows that the shallowest upper conjunctival fornix depth (10.4 ± 0.5) was after 20 years and more of the using of ocular prosthesis, and the shallowest lower conjunctival fornix depth (5.5 ± 0.5) was also after 20 years and more of the using of ocular prosthesis. There is medium relationship between upper conjunctival fornix depth and the duration of using prosthesis (cc = −0.435; $P = 0.016$) and there is high relationship between lower conjunctival fornix depth and the duration of using prosthesis (corr. coeff. = −0.551; $P = 0.002$).

Table 5 shows that the shallowest mean upper conjunctival fornix depth was in the age of 60–69 (12.0 ± 0.5), and the shallowest mean lower conjunctival fornix depth was in the age of 70–79 (7.6 ± 0.5), in the age of 50–59, and in the age of 70–79 (7.3 ± 0.5). There was no relationship

Table 2: The characteristics upper and lower conjunctival fornix depth based on the age in anophthalmic socket patients (*n*=30)

Upper and lower conjunctival fornix depth (mm)	Age (years)						Corr. coeff. (*r*)	*P* value
	20–29 $\bar{x}$±SD	30–39 $\bar{x}$±SD	40–49 $\bar{x}$±SD	50–59 $\bar{x}$±SD	60–69 $\bar{x}$±SD	70–79 $\bar{x}$±SD		
Upper conj. fornix depth	11.5±0.7	11.0±0.9	10.5±0.5	11.0±0.7	10.5±0.5	10.3±0.5	−0.333	0.072
Lower conj. fornix depth	6.5±0.7	6.5±0.1	6.0±0.8	5.4±0.5	6.5±0.9	6.3±0.5	0.031	0.873

Table 3: The characteristics upper and lower conjunctival fornix depth based on the sex in anophthalmic socket patients

Upper and lower conjunctival fornix depth (mm)	Sex		Corr. coeff. (*r*)	*P* value
	Males (*n*=28) $\bar{x}$±SD	Females (*n*=2) $\bar{x}$±SD		
Upper conjunctival fornix depth	10.8±0.6	10.0±0.6	0.323−0.220	0.082
Lower conjunctival fornix depth	6.2±0.8	5.5±0.7		0.243

Table 4: The association between upper and lower conjunctival fornix depth and the duration of using ocular prosthesis (*n*=30)

Upper and lower conjunctival fornix depth (mm)	The duration of using ocular prosthesis (years)				Corr. coeff. (*r*)	*P* value
	≤4 $\bar{x}$±SD	5–9 $\bar{x}$±SD	10–19 $\bar{x}$±SD	≥20 $\bar{x}$±SD		
Upper conjunctival fornix depth	11.2±0.5	11.2±0.4	10.5±0.8	10.4±0.5	−0.435	0.016*
Lower conjunctival fornix depth	7.5±0.5	6.6±0.5	6.1±0.7	5.5±0.5	−0.551	0.002*

Correlation coefficient for upper conjunctival fornix depth was−0.435 and lower conjunctival fornix depth was−0.551

Table 5: The characteristics upper and lower conjunctival fornix depth based on the age in control group (*n*=30)

Upper and lower conjunctival fornix depth (mm)	Age (years)						Corr. coeff. (*r*)	*P* value
	20–29 $\bar{x}$±SD	30–39 $\bar{x}$±SD	40–49 $\bar{x}$±SD	50–59 $\bar{x}$±SD	60–69 $\bar{x}$±SD	70–79 $\bar{x}$±SD		
Upper conj. fornix depth	12.5±0.7	12.8±0.7	12.8±0.5	12.6±0.5	12.0±0.5	12.3±1.1	−0.276	0.140
Lower conj. fornix depth	8.0±0.5	8.3±0.5	7.8±0.3	7.6±0.5	7.7±0.5	7.3±0.5	−0.350	0.058

between upper conjunctival fornix depth and the age (corr. coeff. = −0.276; *P* = 0.140) and no relationship either between lower conjunctival fornix depth and the age (corr. coeff. = −0.350; *P* = 0.058).

From Table 6, females in control group have shallower upper and lower conjunctival fornix depth compare with males. The mean upper conjunctival fornix depth in females is 12.0 ± 0.8 and males is 12.3 ± 0.6. The mean lower conjunctival fornix depth in females is 7.5 ± 0.7 and males is 7.8 ± 0.5. There was no relationship between mean upper conjunctival fornix depth and sex (corr. coeff. = −0.157; *P* = 0.407) and no relationship between mean lower conjunctival fornix depth and sex (corr. coeff. = 0.288; *P* = 0.123).

DISCUSSION

From 30 subjects of anophthalmia socket with dermis fat grafts, majority of the subjects were male (28 males vs. 2 females) with ratio 14:1. The duration of ocular prosthesis usage in post-evisceration anophthalmia socket study subjects with the most skin fat grafts was ≥20 years. There was no relationship between the mean depth of the lower conjunctival fornix and gender at the anophthalmic socket patients, and the mean depth of the lower conjunctival fornix was 5 mm for the duration of ocular prosthesis ≤4 years and 3.4 mm for the duration of ocular prosthesis ≥20 years. There was no relationship between the mean upper conjunctival fornix depth and the lower conjunctival fornix depth and the age in normal eyes. We also found no relationship between the mean upper conjunctival fornix depth and the lower conjunctival fornix depth and gender in normal eyes. However, in female subjects, the depth of the upper and lower conjunctival fornix was smaller than the male subjects. There is a significant difference between the mean depth of the upper and lower conjunctival fornix in the anophthalmic socket and the normal eye.

Pine *et al.* reported that anophthalmic patients are dominantly in males. In line with a study by Kumar *et al.*, this probably

Table 6: The characteristics upper and lower conjunctival fornix depth based on the sex in control group

Upper and lower conjunctival fornix depth (mm)	Sex		Corr. coeff. (*r*)	*P* value
	Males (*n*=28) $\bar{x}$±SD	Females (*n*=2) $\bar{x}$±SD		
Upper conjunctival fornix depth	12.3±0.6	12.0±0.8	−0.157	0.407
Lower conjunctival fornix depth	7.8±0.5	7.5±0.7	0.288	0.123

due to men tends to have more jobs and activities outside the home, while women mostly have jobs and activities inside home.[9,10,11] Ocular trauma is the most common cause of blindness after cataracts, glaucoma, macular degeneration, diabetic retinopathy, and trachoma. Meanwhile, in Indonesia, ocular trauma is the most common cause of blindness after cataracts and glaucoma.[12,13] In line with Teo *et al*., the mean duration of use of ocular prostheses in anophthalmic socket patients was 24.4 years.[14] Adequate depth of the conjunctival fornix is essential to maintain the ocular prosthesis in the anophthalmic socket. The inability to maintain the ocular prosthesis due to the fornix deformity is very disturbing to the psychic of the anophthalmic socket patient and will affect the patient's self-confidence and social life. Factors that can cause silting of the conjunctival fornix include infection, radiation, repeated socket operations, and the length of time using the ocular prosthesis.[15-17] The depth of the conjunctival fornix is measured using a FDM device (Fornicometer) which is specially designed to measure the depth of the conjunctival upper and lower fornix.[18,19] Kumar *et al*. reported that the depth of the upper conjunctival fornix in a socket anophthalmic patient aged 3 years was 6 mm, whereas in a patient aged 35 years, it was 7 mm and the depth of the lower conjunctival fornix in a socket anophthalmia patient aged 3 years was 3 mm whereas in a patient aged 35 years is 5 mm.[20] This study is in line with Teo *et al*. and Pine's research *et al*. reported that there was a significant association ($P = 0.01$) between retention of ocular prostheses and duration of use of ocular prosthesis.[11,14] In this study we found no relationship between the mean upper conjunctival fornix depth $P = 0.140$ ($P > 0.05$) and the lower conjunctival fornix depth $P = 0.058$ ($P > 0.05$) with the age in normal eyes. In contrast to previous studies by Jutley *et al*., reported that there was a significant relationship between the mean upper conjunctival fornix depth, $P = 0.04$ ($P < 0.05$) and lower conjunctival fornix depth $P = 0.04$ ($P < 0.05$) with age in normal eyes. Kumar *et al*., reported the significant differences between the mean depth of the upper and lower conjunctival fornix in the anophthalmic socket and the normal eye (contralateral eye).[20]

It is hoped that the measurement of the depth of the conjunctival fornix with knowledge of the normal range of depth of the conjunctival fornix will hopefully allow early identification of contraction of the conjunctival fornix. Schwab *et al*. first published age-based data for normal inferior conjunctival fornix using a short biconcave fornicometer. Jutley developed a modified Moorfields fornicometer that is elongated, to allow the measurement of

the depth of the upper conjunctival fornix. Khan *et al*., using a modified plastic fornicometer, have measured the depth of the conjunctival fornix in a population in South Asia.[21-23] However, the depth of the normal conjunctival fornix varies from population to population because they have different orbital shapes and also affected by age where there are gradual changes in the eye socket such as fat atrophy and weakness of the upper and lower eyelids with increasing age. The thickening of the inferior conjunctival fornix and drooping of the lower eyelid can be exacerbated by the severity of the ocular prosthesis.[23,24] This study is the first study that investigated the association the duration of using ocular prosthesis and upper and lower conjunctival fornix depth in Indonesian population. The limitation of this study is limited number of subjects.

CONCLUSIONS

Prolonged use of the ocular prosthesis may result in a reduced upper and lower conjunctival fornix depth in anophthalmic socket patients. Anophthalmic socket patients who use ocular prostheses should return to their ophthalmologist at least annually to assess the health of the socket, depth of the conjunctival fornix, and position of the ocular prosthesis.

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