In The Name of God
Ahwaz Jondishapur University of Medical Sciences  
Faculty of Medicine

Thesis for specialty in ophthalmology degree

Title:
Corneal Endothelial Cell Changes Following Pars Plana Vitrectomy and Silicone Oil Injection in Phakic and Pseudophakic Eyes

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Abstract

PURPOSE: To evaluate the effect of silicone oil (SO) on the corneal endothelium in phakic and pseudophakic vitrectomized eyes.

METHODS: This prospective comparative case-control study evaluated the corneal endothelial characteristics in SO filled vitrectomized eyes (case group 64 eyes) compared to the vitrectomized eyes without SO injection (control group 46 eyes). The preoperative and postoperative endothelial cell densities (ECD), coefficient of variation (CV), and percentage of hexagonal cells (hexagonality) at the corneal center evaluated by non-contact specular microscopy were compared between two groups. Exclusion criteria was consist of aphakia, any degree of anterior chamber inflammation, SO bubbles in anterior chamber and increased intraocular pressure in postoperative period.

RESULTS: Six months after SO injection the mean ECD was 2438 ± 327/mm² in the case group and 2463 ± 361/mm² in the control group (P = 0.714). Six months after operation hexagonality in the case group was 49 ± 6.8 and in control group was 54.6 ± 8.9. This difference was statistically significant (P = 0.001).

CONCLUSION: Although presence of SO in vitreous cavity of phakic or pseudophakic eyes cause slight reduction in number of endothelial cells but significant endothelial cell morphology changes occurs. Thus removal of SO after reaching the desired tamponade effect is recommended.

KEY WORDS: Pars Plana Vitrectomy, Silicone Oil, Corneal Endothelial Cells, Specular Microscopy
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Chapter 1:
Introduction
1.1 INTRODUCTION:

Silicone oil has been widely used as an internal tamponade for complicated retinal detachment surgery since it was first introduced in 1962. (1) It is common practice to remove SO after a period to reduce its well-known complications. (2-4) Although the tolerance for intraocular SO is generally good, a number of side effects have been reported, including keratopathy, elevated intraocular pressure, ocular hypotony, emulsification, cataract formation, iritis and endophthalmitis. (5) Numerous reports proposed some adverse effects of SO on the cornea. (6-8) Also SO in the eye has been linked to endothelial cell toxicity. (9) It was hypothesized that the adverse effects of SO on cornea are related to forward migration of SO to the anterior chamber and corneal touch. (6-8) Endothelial cell exposure to SO induces physiological and morphological alterations of the cornea. (10) The changes that derive from SO-associated keratopathy include band keratopathy, corneal thinning, retro-corneal membrane formation, and irreversible corneal endothelium cell loss. (11, 12) The SO might act as a barrier that deprives human corneal endothelial cells from the nutrition normally supplied by the aqueous humour. (6) Nevertheless, the possible indirect cytotoxic effect of SO on corneal endothelial cells has not been fully evaluated because SO has been assumed inert in ocular tissues. (13)

Early detection of endothelial pathology is crucial to prevent further corneal damage, and early removal of SO should be considered if the retinal condition allows. (14)
The structural integrity of the cornea seems unchanged after intravitreal SO injection in phakic or pseudophakic vitrectomized eyes. However, no study has focused on the corneal endothelial cells damage in presence of SO in vitreous cavity without direct touch to the cornea.

We evaluated the effect of intravitreal SO injection in phakic or pseudophakic vitrectomized eyes on endothelial cell density (ECD), coefficient of variation (CV), and the percentage of hexagonal cells (hexagonality) until 6 months after surgery.
1.2 Text Review

1.2.1 Pars Plana Vitrectomy

Pars plana vitrectomy is a closed-system technique that typically uses 3 ports, placed 3 - 4 mm posterior to the surgical limbus. One port is used to allow intraocular infusion of a balanced saline solution. Intraocular pressure (IOP) can be maintained at any level and is controlled by the surgeon. The remaining ports are used to introduce various instruments into the vitreous cavity to illuminate the posterior segment and manipulate intraocular tissues. (15)

Vitrectomy is performed using an operating microscope in conjunction with a contact lens or non-contact lens viewing system. Direct and indirect visualization are possible. The advantages of indirect visualization include a wider viewing angle as well as better visualization through media opacities, miotic pupils, and gas-filled eyes. The direct viewing systems allow greater magnification and enhanced stereopsis at the expense of a smaller field of view. (15)

1.2.2 Primary Vitrectomy for Retinal Detachment

Vitreous traction on focal areas of the peripheral retina causes retinal breaks and allows for the subsequent migration of intraocular fluid into the subretinal space, creating retinal detachment. Consequently, the goals of primary vitrectomy surgery for retinal detachment are to remove cortical vitreous adherent to retinal breaks, directly drain the subretinal fluid, tamponade the breaks (with air, gas, or SO), and create chorioretinal adhesions around each retinal break with endolaser photocoagulation or cryopexy. Postoperative tamponade is generally provided by intraocular air or
nonexpansile concentrations of SF6 or C3F8 gas, although complex cases may require the use of SO. Complications of vitrectomy for retinal detachment include postvitrectomy nuclear cataract, proliferative vitreoretinopathy (PVR), and retinal redetachment. (15)

Complex retinal detachment includes giant retinal tears, recurrent retinal detachments, vitreous hemorrhage, and PVR. Pars plana vitrectomy is necessary to remove proliferating tissue, unfold retinal structures, and remove media opacities—features that are commonly seen in patients with complex retinal detachment. (15)

**1.2.3 Vitrectomy for Diabetic Tractional Retinal Detachment**

Vitrectomy is indicated when progression of a tractional retinal detachment threatens or involves the macula. Whenever possible, attempts should be made to add or complete panretinal photocoagulation prior to surgery. The goal of vitrectomy surgery is to relieve vitreoretinal traction in order to facilitate retinal reattachment by elevating or peeling cortical vitreous/posterior hyaloid off the retinal surface. Point adhesions of cortical vitreous to surface retinal neovascularization can be addressed with a combination of scissors, picks, and forceps, using either unimanual or bimanual techniques. Various approaches to managing fibrovascular tissue removal have been described; these include segmentation, delamination, and en bloc and modified en bloc excision. Following removal of all tractional membranes, diathermy is applied to all fibrovascular tufts, and supplemental laser is applied. At the completion of the surgery, it is essential that the retinal periphery be carefully examined for retinal breaks. (16)
1.2.4 Complications of Pars Plana Vitrectomy

Nuclear sclerotic cataract is the most common complication of vitrectomy surgery. More than 90% of eyes in patients over age 50 will develop visually significant nuclear sclerotic cataract within 2 years of vitrectomy surgery. (17) New information suggests that vitrectomy surgery increases the long-term risk of open-angle glaucoma by 10%-20%. (18) Other complications of pars plana vitrectomy include more immediate concerns, such as retinal tears and detachment, subretinal perfluorocarbon, retinal and/or vitreous incarcerations, endophthalmitis, and recurrent vitreous hemorrhage. Endophthalmitis after vitrectomy is rare, but it is more common in patients with diabetes and in eyes with retained intraocular foreign bodies.(19)

1.2.5 Physiochemical Properties of SO

Silicone fluids, commonly called SO, are linear synthetic organic-inorganic polymers with a common macromolecular back-bone made of siloxane (-Si-O-) repeating units. Because of their stability at high temperature and their chemical inertness, SO have quickly replaced other compounds. Based on their substantial biocompatibility and unique physical and chemical characteristic, two type of silicone oil for vitreous substitution was introduced. They used both the lighter- and the heavier-than-water oils to create a tamponade effect on the superior and inferior retina respectively. In the eye, the dynamics of the SO tamponade involves the interplay of inter-facial surface tension, and viscosity. (20)
1.2.6 Corneal Endothelial Cells

A single layer of corneal endothelial cells covers the posterior surface of Descemet's membrane in a well-arranged mosaic pattern. These cells are uniformly 5 µm in thickness and 20 µm in width and are polygonal (mostly hexagonal) in shape. The uniformity of endothelial cell size has been evaluated by statistical analysis based on photographs taken by a wide-field specular microscope. In young adults, the ECD is about 3500 cells/mm². The CV of mean cell area (standard deviation of mean cell area/mean cell area) is a clinically valuable marker and is about 0.25 in the normal cornea. An increase in the variability of cell area is termed polymegathism, Another morphometric parameter of the state of the endothelium is hexagonality. In the normal healthy cornea, about 70-80% of endothelial cells are hexagonal. However, endothelial damage can result in a decrease in the hexagonality value and an increase in the variability of cell area. Deviation from hexagonality is referred to as pleomorphism. ECD in the normal healthy cornea decreases with age. It is important that corneal endothelial cells are protected during surgery. The loss of endothelial cells for any reason results in enlargement of the remaining neighboring cells and their spreading to cover the defective area, without an increase in cell number. The indices based on specular microscopy fluctuate as endothelial damage is resurfaced by the migration and enlargement of the remaining endothelial cells. The CV of mean cell area is the most sensitive index of corneal endothelial dysfunction, whereas hexagonality is a good index of the progress of endothelial wound healing. (21)
1.2.7 Specular Microscopy

The specular microscope is unlike most microscopes. Instead of imaging light transmitted through a substance, the specular microscope images light reflected from an optical interface. The optical interface giving the most interest is that between the corneal endothelium and the aqueous humor. Noncontact specular microscopes use internal fixation points to provide a more standardized approach to consistently imaging the central endothelium, mid periphery, and periphery. With these systems, the patient view is shifted when the technician selects the desired region. Quantitative analysis of a specular photomicrograph is the objective description of the attributes of a selected cluster of individual endothelial cells from a specular photomicrograph. ECD alone is not the most sensitive measure of endothelial health. As the CV goes up and the percentage of hexagonal cells goes down, this would indicate that the cell population has a less stable thermodynamic relationship between the individual cell and the adjoining neighbor cells, which correlates with declining endothelial function. (22)
1.3 Literature Review

In 1995, Gary and his colleagues determine factors that were prognostic of corneal abnormalities in eyes following vitrectomy surgery with long-acting gas or SO for severe proliferative vitreoretinopathy. The incidence of corneal abnormalities at 24 months was 27% and did not differ significantly between treatment groups. Prognostic factors were preoperative aphakia or pseudophakia, preoperative iris neovascularization, reoperation, the absence of a fluid/gas exchange, corneal touch by SO, and the presence of aqueous cells or aqueous flare. They concluded prevention and early management of corneal touch by silicone oil should help to prevent corneal abnormalities. (2)

In the study performed by Barr and his colleagues in 1993 shown that intraocular pressure abnormalities are a common postoperative complication in eyes with PVR, and may occur with either C3F8 gas or with SO. (3)

In the study done by Sternberg, the clinical and morphologic changes that occurred in the corneas of 14 rabbits and 7 cats when the anterior chamber was filled with SO had been evaluated. Within six days, wide-field specular microscopy showed a 40% reduction in endothelial density in the area of the SO bubble in both groups. (6)

Long-term postoperative complications with the use of SO in 150 eyes after retinavitreous surgery by Federman in 1988 were observed between 6 months and 5 years of follow-up. Cataracts developed in all phakic eyes and all corneas with oil-endothelial touch showed band keratopathy within 6 months. Recurrent detachments were noted in 22% of eyes during SO tamponade and occurred in 13% of eyes after the oil had been removed. Without exception, within a period of 1 year the intraocular SO showed some
degree of emulsification, suggesting that the physicochemical characteristics of the oil injected may be an important variable in long-term complications. (7)

Irreversible silicone keratopathy was found in 50% of the eyes in the aphakic patients between 4 and 8 weeks postoperatively. An intact lens or capsule correlated well with the absence of this complication. In phakic eyes, secondary cataract was the most prominent early complication, developing by the end of the eighth week in 60% of eyes showed by Pang and Peyman in 1986. (8)

Norman and his colleagues had shown that SO with corneal endothelium touch rapidly induces physiologic and morphologic changes such as increase permeability. (10)

Several years later, findings of Norman etc. study about the cytotoxic effect of SO was repeated by Yang and his colleagues in 2008 on cultivated human corneal endothelium. The bioassay showed that contact of silicone oil inhibited corneal endothelium proliferation. The higher viscosity SO suppressed cell cycling significantly more than the lower viscosity SO. (9)

Friberg and Guibord in 1999 present data regarding endothelial cell loss in aphakic and pseudophakic SO filled eyes when oil was retained for many months after multiple vitreoretinal procedures. They concluded endothelial cell loss occurs after vitreoretinal surgery and is exacerbated by long term SO retention. The corneal endothelial cell damage is probably cumulative from procedure to procedure. Endothelial cell loss may be pronounced in eyes without a physical barrier between the anterior segment and the vitreous cavity, and in eyes where oil migrates into anterior chamber. Their study showed both gas and retained SO contribute to the loss of corneal endothelial cell
density. The average endothelial cell loss in the 10 eyes with oil retained for an average of 10 ± 12 months was 68.8 ± 31.4%, as compared to the fellow eye. The average cell loss was higher in the three eyes with SO in the anterior chamber (range 44 to >95%). Pseudophakic eyes fared better, on average, than aphakic eyes with respect to cell loss. (23)

Lee and his colleagues in Soonchunhyang University College of Medicine, Seoul, Korea in 2011 studied the effect of pars plana vitrectomy and gas tamponade on corneal endothelial cell density. The corneal ECD was examined with a noncontact specular microscope 3 months pre- and post-operation. The mean endothelial cell loss was more significant in eyes underwent pars plana vitrectomy combined with gas tamponade (26 eyes) than in eyes underwent pars plana vitrectomy alone (32 eyes) ($P = 0.012$). However, after excluding 6 eyes that had blood in the center of the corneal endothelium as a result of being in the prone position following gas tamponade, the mean endothelial cell loss in gas tamponade was not less than in control group. (24)

Karel and his colleagues followed twenty-one patients for at least 6 months after pars plana vitrectomy and liquid silicone injection into the vitreous for complicated retinal detachment by means of specular microscopy. In 17 eyes without silicone penetration into the anterior chamber, only insignificant changes were observed. In contrast, in 4 eyes, where a large drop of liquid silicone penetrated into the anterior chamber, the ECD rapidly decreased to critical values. (25)

To elucidate factors contributing to corneal complications after vitrectomy in diabetic patients in Japan, Hiraoka recorded a series of 129 diabetic patients (202 eyes) who underwent pars plana vitrectomy between March 1997 and February 1999. This
study showed the degree of surgical invasion during vitrectomy was significantly correlated with the occurrence of epithelial disturbance and corneal edema. (26)

Szaflik & Kmera-Muszyńska evaluate corneal morphology by confocal microscopy after vitreoretinal surgery complicated by passage of SO into the anterior chamber in a case control study in 2006. Eight eyes that had undergone vitreoretinal surgery and had SO in the anterior chamber compared with eight eyes that had undergone vitreoretinal surgery with application of SO tamponade but who had no SO clinically observable in the anterior chamber. In patients with SO in the anterior chamber, confocal microscopy imaging reveals early morphological alterations of the cornea before their clinical manifestation. (27)

To evaluate the morphological changes in the cornea by in vivo laser scanning confocal microscopy (LSCM) with SO endotamponade after vitreoretinal surgery, Qihua and his colleagues studied 99 eyes in 2012. The average ECD and hexagonality of eyes with corneal abnormalities were significantly lower than those of normal corneas, whereas the average CV was significantly larger. (28)
1.4 OBJECTIVES & HYPOTHESIS

1.4.1 General Objective:

Corneal endothelial cell changes following pars plana vitrectomy and SO injection in phakic and pseudophakic eyes

1.4.2 Specific Objectives:

- Compare mean ECD between two groups one month post operation
- Compare mean ECD between two groups six months post operation
- Compare mean CV between two groups one month post operation
- Compare mean CV between two groups six months post operation
- Compare mean hexagonality between two groups one month post operation
- Compare mean hexagonality between two groups six months post operation
- Compare mean ECD preoperative and one month postoperatively in control group
- Compare mean ECD preoperative and six months postoperatively in control group
- Compare mean ECD one month and six months postoperatively in control group
- Compare mean ECD preoperative and one month postoperatively in case group
- Compare mean ECD preoperative and six months postoperatively in case group
- Compare mean ECD one month and six months postoperatively in case group
- Compare mean CV preoperative and one month postoperatively in control group
- Compare mean CV preoperative and six months postoperatively in control group
- Compare mean CV one month and six months postoperatively in control group
چکیده:

عنوان:

بررسی تاثیر تزریق روغن سیلیکون داخل فضای ویتره به دنبال عمل جراحی پارس پلانا ویترکتومی در بیماران فاکیک و پسودوفاکیک بر روی سلول های اندوتیوم قرنیه

هدف از اجرای تحقیق:

بررسی تاثیر تزریق روغن سیلیکون در چشم های فاکیک و پسودوفاکیک ویترکتومی شده بر روی سلول های اندوتیوم قرنیه

روش انجام تحقیق:

در یک مطالعه آینده نگر مورد - شاهدی خصوصیات سلول‌های اندوتیوم قرنیه در چشم های ویترکتومی شده با حاوی روغن سیلیکون (گروه مورد 64 چشم) با چشم های ویترکتومی شده بدون تزریق روغن سیلیکون (گروه شاهد 46 چشم) مورد مقایسه قرار گرفتند. دانسیته سلول های اندوتیوم، ضریب تغییرات و درصد سلول های هگزاگونال هنگام تزریق روغن سیلیکون در فضای اتاق قدامی و افزایش فشار چشم پس از عمل بین دو گروه با هم مقایسه گردید. معیارهای خروج از طرح شامل آفاکیک بودن، التهاب داخل آفاکیک بودن، اسهال داخل قرنیه، وجود روغن سیلیکون در فضای اتاق قدامی و افزایش فشار چشم در دوره پس از عمل میباشد.
نتایج:

شش ماه پس از عمل میانگین دانسیته سلول های اندوتلیوم قرنیه در گروه مورد ۴/۴ ± ۲/۲۷۷ /mm² و در گروه شاهد ۴/۴ ± ۲/۶۲۳ /mm² میباشد (P = ۰/۷۱۴). همچنین پس از شش ماه هگزاگونالیتی در گروه مورد ۴/۹ ± ۱/۸۸ و در گروه شاهد ۴/۹ ± ۱/۸/۸ است که از لحاظ آماری این اختلاف معنی دار میباشد (P = ۰/۰۰۱).

نتیجه گیری:

اگرچه وجود روغن سیلیکون در فضای ویتره چشم های فاکیک و پسودوفاکیک تنها باعث کاهش مختصر در تعداد سلول های اندوتلیوم قرنیه شده است اما تغییرات مورفولوژیک قابل توجه روی سلول های اندوتلیوم مشاهده گردید. بنابراین خارج کردن روغن سیلیکون پس از رسیدن به اثر تامین مورد نظر توصیه میشود.

واژگان کلیدی:

پارس پلانا ویترکتومی، روغن سیلیکون، سلول های اندوتلیوم قرنیه، اسپکولار میکروسکوپ
دانشکده علوم پزشکی و خدمات بهداشتی درمانی جنوب استان اصفهان

فرم صورتجلسه دفاع از پایان نامه

با تأییدات خرداد ملکعلی جلسه دفاع از پایان نامه خانم دکتر علی‌اصفهانی به شماره دانشجویی ۹۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸۸
دانشگاه علوم پزشکی و خدمات بهداشتی درمانی جنوب شرقی اهواز

دانشکده پزشکی
پایان نامه جهت اخذ مدرک دکترای تخصصی در رشته چشم پزشکی

عنوان:
بررسی تاثیر تزریق روغن سیلیکون داخل فضای ویتره به دنبال عمل جراحی پارس پلانا ویترکت و فاکیک و پسودوفاکیک بر روی سلول های اندوپولیوم قرنیه

محل انجام پژوهش:
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شماره پایان نامه:
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تیر 1390

تاریخ دفاع پایان نامه:
فروردین 1392

کلیه حقوق این پایان نامه برای معاونت پژوهشی دانشگاه علوم پزشکی جنوب شرقی اهواز محفوظ است.