eISSN (Online): 2598-0580

**Bioscientia Medicina: Journal of Biomedicine & Translational Research**

Journal Homepage: www.bioscmed.com

# Pseudophakic Retinal Detachment: A Narrative Review

**Karniela Ayuni Putri[1*], Weni Helvinda[1], Khalilul Rahman[1]**

[1] Department of Ophthalmology, Faculty of Medicine, Universitas Andalas, Padang, Indonesia

**ARTICLE INFO**

**Keywords:**
Retina
Phacoemulsification
Cataract
Retinal detachment
Narrative review

***Corresponding author:**
Karniela Ayuni Putri

**E-mail address:**
***karniela@gmail.com***

All authors have reviewed and approved the final version of the manuscript.

***https://doi.org/10.37275/bsm.v6i6.522***

**ABSTRACT**

Cataract surgery causes changes in intraocular conditions that are a risk factor for retinal detachment. One of the conditions that can occur during cataract surgery is posterior capsule rupture which can increase the risk of pseudophakic retinal detachment (PRD). PRD examination is often obstructed by opacification of the posterior capsule, a reflection of the intraocular lens (IOL), or poor mydriasis. Scleral buckle, pneumatic retinopexy, and primary pars plana vitrectomy, with or without a combination of the scleral buckle, are surgical techniques used in the management of PRD patients. Anatomical and functional postoperative success rates in PRD patients were found to be higher after primary pars plana vitrectomy (PPV) with or without a scleral buckle. This literature review aims to discuss the epidemiology, risk factors, pathogenesis, and management of PRD.

## 1. Introduction

Pseudophakic retinal detachment (PRD) is a rhegmatogenous retinal detachment after cataract surgery. It is estimated that more than 40% of patients who present with retinal detachment have a history of previous cataract surgery. The incidence of retinal detachment after cataract surgery ranges from 0.2% to 3.6%. In contrast, the incidence after extracapsular cataract extraction (ECCE) and phacoemulsification are lower than after intracapsular cataract extraction (ICCE).[1,2]

The risk of PRD is increased in young patients with myopia (axial length of eyeball > 25 mm), patients with vitreous loss during cataract surgery, and patients undergoing posterior Nd: YAG capsulotomy. The facts prove that the risk of retinal detachment increases 4-fold after Nd: YAG laser capsulotomy is performed, there is a history of previous retinal detachment or a family history of retinal detachment.[3,4]

Cataract surgery causes changes in intraocular conditions, which are a risk factor for retinal detachment. One of the conditions that can occur during cataract surgery is posterior capsule rupture which can increase the risk of PRD. In the phacoemulsification technique, the risk of postoperative detachment is expected to be smaller. The incidence of retinal detachment in the eye after ICCE occurs in 2-3%, after ECCE 0.5-2%, and after phacoemulsification 1%. Rhegmatogenous retinal detachment after cataract surgery occurs within 1 year or 6 months after posterior capsulotomy.[1,5,6]

Careful examination after surgery is very important in identifying risks. PRD examination is often obstructed by opacification of the posterior capsule, a reflection of the intraocular lens (IOL), or poor mydriasis. Scleral buckle, pneumatic retinopexy, and primary pars plana vitrectomy, with or without a combination of the scleral buckle, are surgical techniques used in the management of PRD patients.[7,8] The literature review aims to discuss the epidemiology, risk factors, pathogenesis, and management of PRD.

**Epidemiology and risk factors for pseudophakic retinal detachment**

Overall, cataract surgery is a safe procedure and has a high success rate. In the UK, the results of the UK National Cataract Survey showed that the best visual acuity with postoperative correction was 86% of vision, being 6/12 or better. One of the complications that can arise after cataract surgery is retinal detachment.[2,3] Rowe et al. observed for 10 years, and it was found that the risk of retinal detachment was 5.5 times higher in patients with a history of cataract surgery compared to those without cataract surgery.[2]

The incidence of retinal detachment is increased in high myopic patients undergoing cataract extraction. Taylor et al. conducted a retrospective study of 1000 cases of ICCE. In 500 cases, IOL implantation was performed. The other 500 cases were aphakia. The incidence of vitreous loss occurred in both groups. The incidence of retinal detachment was found to be higher in cases of aphakia (2.8%) compared to IOL implantation (0.2%). It was also reported that the incidence of retinal detachment after ICCE was higher in myopic than non-myopic patients. In a study conducted on 136 eyes with myopia by Hyams et al., the incidence of retinal detachment after ICCE was 6.7%. Jeffe et al. also reported a 6.3% incidence of retinal detachment in 112 myopic eyes after ICCE. All patients in this study were aphakia. The mean follow-up was 2.8 years with a minimum follow-up of 1 year.[3]

The incidence of retinal detachment after ECCE and phacoemulsification is almost the same and reported to be lower than ICCE. The incidence of retinal detachment after ECCE is estimated to be between 0 – 7.5% after a follow-up of 9 months and 8 years. Some literature reports that the incidence of retinal detachment after phacoemulsification is between 0 – 3.6% in a follow-up period of 4 months and 10 years.[4,5]

Coonan et al. found an increased risk of retinal detachment following Neodymium-doped Yttrium Aluminum Garnet (Nd: YAG) posterior capsulotomy. In a study of 842 cases, the incidence of retinal detachment was 3.2% in the group that underwent Nd: YAG posterior capsulotomy compared with 1% retinal detachment in eyes with an intact posterior capsule.[3]

Several studies assessed the risk factors that play a role in the development of retinal detachment after cataract surgery. These risk factors were grouped into preoperative, intraoperative, and postoperative.[3] The prevalence between men and women has the same risk of developing PRD. There are studies that have found that men have a higher risk of developing PRD.[4] Sheu et al., who conducted a 1999-2001 study on PRD in Taiwan, found that the incidence of retinal detachment during a 6-year follow-up was 0.56% in women, and 1.90% in men.[6]

The risk of PRD is increased in patients with high myopia.[7,8] Clayment et al. revealed that the risk of PRD in patients with eye axial length > 25 mm was 6.5 times higher than in patients with shorter eye axial length. Ninn-Pederson and Bauer found that an axial elongation of the eyeball 1 mm increased the risk of retinal detachment 1.3-fold. A study conducted by William et al. from 1995 to 1999 in Ireland assessed retinal detachment in post-cataract surgery patients with a history of myopia (axial length of the eyeball > 25 mm), the incidence of retinal detachment was 2.4% after cataract extraction. This result was higher than the control group (non-myopia), 0.5 – 1%. incidence of retinal detachment will increase if there is a history of retinal detachment after cataract surgery in the other eye.[4]

**Intraoperative and postoperative risks of cataract**

A vitreous loss that occurs during cataract surgery will increase the incidence of retinal detachment after surgery.[6,8] Troutman et al. reported a 5-fold higher incidence of retinal detachment after

phacoemulsification in cases complicated by vitreous loss. The same result was also reported by Javitt et al., patients with cataract extraction and anterior vitrectomy had a 4.5 times risk of developing retinal detachment within 4 years, which was 5%, compared to only 1.1% without anterior vitrectomy. [3] Posterior capsule tear is associated with an increased risk of retinal detachment after cataract surgery.[8,9,10] Tielsch et al. reported that patients with posterior capsule rupture during cataract surgery were at a 13-fold risk for retinal detachment in the future.[3]

The retinal detachment that occurs after Nd: YAG capsulotomy or secondary IOL implantation, the probability of retinal detachment is 47 – 59% within 3 months after surgery. Tielsch et al. reported that Nd: YAG posterior capsulotomy increases the risk of retinal detachment 4-fold after cataract surgery.[3]

**Pathogenesis of pseudophakic retinal detachment**

One of the forces that maintain the retinal adhesion mechanism is the mechanical factor. Mechanical factors consist of forces originating from outside the subretinal space and from within the subretinal space. Vitreous fluid and pressure not only play a role in the retinal adhesion process but can also cause detachment when the pathological condition changes.[11]

Intraocular pressure is evenly distributed in the vitreous cavity, and the fluid in this cavity will press against the inner wall of the eye, while there is osmotic pressure in the extracellular fluid in the choroid. These two opposing pressures will maintain adhesion to the subretinal space. An intact vitreous in the hyaloid membrane capsule prevents the vitreous from leaking into the subretinal space.[3,11]

In cataract extraction with rupture of the posterior lens capsule, a vitreous loss can occur if the pressure in the COA is lower than the posterior. So that when performing aspiration of the lens mass with inadequate pressure in the COA, the hyaloid membrane ruptures so that the vitreous will be pulled anteriorly. Loss of one of these barriers results in increased movement of vitreous into the subretinal space and the potential for retinal detachment.[11,12]

In addition, there is also the influence of the Wieger ligament, which is disrupted during cataract surgery. The Wieger ligament is an attachment between the anterior vitreous cortex (hyaloid) and the peripheral lens capsule. This ligament serves to reduce the movement of the vitreous. After removal of the lens with or without zonular damage, the velocity of the potential vitreous increases during eyeball movement. In ICCE, the Wieger ligament is damaged, whereas, after ECCE, it is nonfunctional. Increased mobility of the vitreous after cataract surgery triggers general traction and pressure by the vitreous, which will interfere with vitreoretinal adherence to the vitreous base. Loss of stability in the vitreous and aqueous turbulence after cataract surgery are the causes of rhegmatogenous retinal detachment.[11,12]

**Changes after cataract extraction**

Vitreous changes after cataract surgery are associated with an increased incidence of retinal detachment in pseudophakic eyes. The most important change in the vitreous after cataract surgery is the occurrence of posterior vitreous detachment (PVD). PVD is more common in individuals with the removal of the eye's lens. [13,14] Friedmen et al. reported a 66% incidence of vitreous detachment in 200 aphakia patients. When PVD occurs, there is a 10-15% chance of a retinal tear leading to retinal detachment. [3]

The hypothesis of some experts says that the posterior part of the convex lens plays a role in reducing the traction of the vitreous on the peripheral retina in the eyeball. Changes in vitreous composition, including hyaluronic acid, also affect the development of retinal detachment after cataract surgery. Osterlin observed that there was a lower concentration of hyaluronic acid in aphakia eyes compared to phakic eyes. In addition, there was a clear difference in hyaluronic acid in the eyes with ECCE and ICCE, with lower concentrations in the vitreous in the eyes with ICCE compared to ECCE with the intact capsule. This finding proves a role for the posterior capsule in maintaining the vitreous colloid structure. Lack of hyaluronic acid in the vitreous body can lead to impaired vitreous stability, thereby increasing the risk of PVD.[3,12]

**After Nd: YAG posterior capsulotomy**

Several hypotheses have suggested that Nd: YAG posterior capsulotomy may lead to retinal detachment. However, retinal tears found in patients after Nd: YAG laser posterior capsulotomy is usually located in the retina anterior to the equator, not at the pole posterior. Vitreous herniation to the anterior chamber (COA) plays a role in the pathogenesis of retinal detachment after Nd: YAG posterior capsulotomy. The opening of the posterior capsule causes movement of the vitreous body anteriorly, resulting in PVD and peripheral retinal tears. However, this mechanism only occurs in a few cases. The fact is that most patients with Nd: YAG laser do not herniate the vitreous into the COA.[3,13]

Rupture of the anterior vitreous surface also plays a role in the pathophysiology of retinal detachment after the Nd: YAG laser. The patient, after the Nd: YAG laser, was found to have a significantly ruptured anterior vitreous surface. Because the anterior surface of the vitreous communicates with the vitreous base, such rupture may increase the risk of retinal traction at the ora Serrata and secondary to retinal tears.[13,14]

A torn posterior capsule also causes chemical changes in the vitreous. It is known that the fired laser produces short waves called acoustic transients and high-speed dispersion of particles through the vitreous base. This process can change the chemical structure of the vitreous and the physical dynamics of the vitreous base, causing retinal tears to form.[17,19] Learman et al. found a significant decrease in vitreous viscosity in rabbits and monkeys after Nd: YAG radiation to the posterior capsule and vitreous. Increased vitreous liquefaction causes vitreous traction and retinal tears that eventually develop into a retinal detachment. [3]

**Diagnosis of pseudophakic retinal detachment**

The diagnosis in a patient with PRD is established by history and physical examination. The anamnesis revealed that the patient had a history of previous cataract surgery. Complaints obtained in PRD patients resemble other rhegmatogenous retinal detachments, namely coming with complaints of flashes of light, floaters, decreased visual acuity, and visual field defects. Most cases of PRD present with detachment with macular involvement.[3.8.17]

Examinations performed on PRD patients can use an indirect ophthalmoscope with scleral indentation. This examination can help to find a retinal tear. The characteristics of retinal tears found during the examination were multiple, small, and mostly located in the superotemporal quadrant.[9]

There is a tendency to increase the incidence of proliferative vitreoretinopathy (PVR) compared to other retinal detachments. This high incidence of PVR in PRD is associated with three main causes: (1) high incidence of horseshoe tears, (2) changes in the vitreous after cataract surgery, and (3) damage to the blood. The ocular barrier in pseudophakic patients.[9]

**Management of pseudophakic retinal detachment**

There are several surgical techniques used in the management of PRD, including scleral buckle (SB), pneumatic retinopexy, and primary pars plana vitrectomy (PPV) with or without scleral buckle.

**Scleral buckle**

Although reported to have a high anatomical success rate, the effectiveness of SB in pseudophakia is lower than in retinal detachment with phakia. The use of SB is reported in 80–100% of cases after one or more surgeries. In 35-57% of cases, there is an improvement in vision to 20/50 or more after surgery.[13,14]

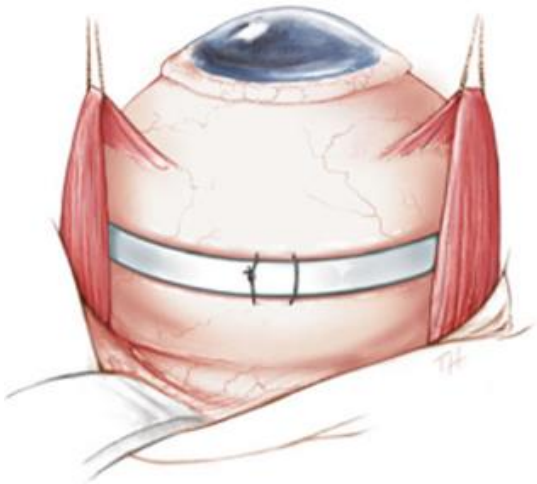

Figure 1. SB procedure with encircling[14]

The purpose of SB is to close the retinal tear by indenting the external sclera, and hopefully, the retinal sensory layer with the retinal pigment epithelium (RPE) can be reattached. In SB, trans-scleral cryopexy is used to create a permanent adhesion to the retinal tear area. SB techniques include encircling (figure 1), segmental or radial. The choice of technique used is determined by many factors such as the position of the tear, the size of the eyeball, the expertise of the doctor, and the vitreoretinal condition found (e.g., lattice, vitreoretinal traction, aphakia). External drainage of subretinal fluid and/or COA paracentesis may be performed if there is an increase in IOP due to volume changes in the SB. Complications of SB are inducing myopia, anterior ocular ischemia, diplopia, ptosis, orbital cellulitis, subretinal hemorrhage, and retinal incarceration in the drainage area.[4,14]

**Pneumatic retinopexy**

Pneumatic retinopexy was first introduced in the mid-1980s as a PRD therapy. This technique is recommended for PRD therapy if there is only one tear that is not larger than 1 hour in the area and is located within 8 hours of the superior fundus ocular area, or there is a small retinal tear within 1 hour of the area in the absence of proliferative vitreoretinopathy (PVR). Gasses that are often used for pneumatic retinopexy are perfluoro propanol (C3F8) and sulfur hexafluoride (SF6).[13,15]

McAllister et al. stated that pseudophakia with posterior capsule rupture does not perform well with pneumatic retinopexy. The success rate achieved was only about 43% in this group. Complications of pneumatic retinopexy as retinal detachment therapy, whether in phakia, aphakia or pseudophakia, include the discovery of a new retinal tear 4-26%, the development of a new retinal detachment 15-24%, delayed absorption of subretinal fluid 4-21%, macular detachment chronic 4.1%, PVR 3-24%, macular pucker 2-9%, gas in the subretinal space 2% and 1% endophthalmitis. Other rare complications include suprachoroidal gas, expanded retinal detachment, macular hole formation, and trapping of gas in the COA and pre-vitreous space.[3.15]

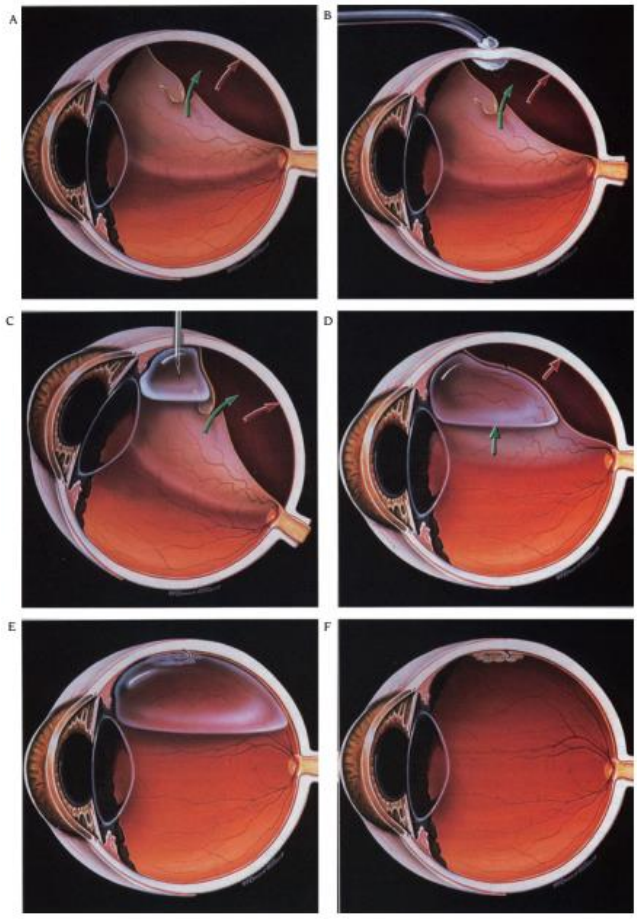

Figure 2. Pneumatic retinopexy procedure. (A) Subretinal fluid volume is determined by vitreous fluid flow (green arrow) and outflow through the RPE pump into the choroid (red arrow). (B) The retinal break area is treated with the application of transconjunctival cryotherapy. (C) with pars plana injection above, gas bubbles are injected into the vitreous with a 30G needle. (D) The head is positioned to place the break above, thereby closing the break with an intravitreal gas bubble. (E) With a closed break, the retina is usually reattached on the first postoperative day. (F) gas bubbles are absorbed spontaneously.[12]

Retinopexy is to seal the retinal tear with intraocular gas with sufficient time for the subretinal fluid to be absorbed and chorioretinal adhesions to form around the tear. The classic indications for pneumatic retinopexy are an identifiable retinal tear located in the superior 8-hour area with a 1-2-hour tear area, no grade C or D PVR, the patient is cooperative in postoperative positioning, and the media is clear. With air tampons directly on the torn retina, subretinal fluid is completely absorbed 6-8 hours in acute detachment.[3,12]

**Primary pars plana vitrectomy**

Pars plana vitrectomy (PPV) is used when visualization of retinal tears is difficult in PRD. PPV may or may not be combined with a scleral buckle. The advantage of PPV over SB alone is that it can identify retinal tears during surgery. Retinal tears that were not detected before surgery can be found at the time of PPV. If the tear is not identified the risk of failure is expected to increase.[16,17,18]

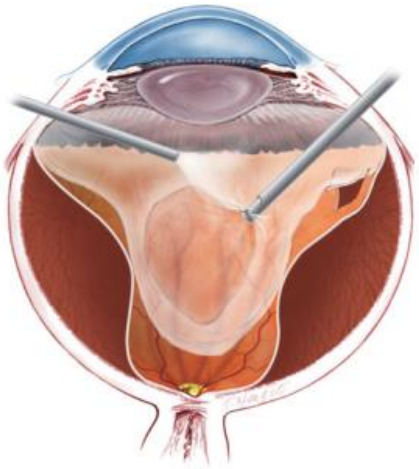

Figure 3. standard three-port vitrectomy procedure.

The goals of primary vitrectomy for retinal detachment surgery are to release the vitreous cortical adhesions with the retinal tear, drain the subretinal fluid directly, seal the tear (with air, gas, or silicone oil) and attach chorioretinal tissue around the retinal tear area with photocoagulation endolaser or cryopexyVitrectomy can be combined with SB. After core vitrectomy, the peripheral cortical vitreous is carefully removed to release the pull on the retinal tear. To drain the subretinal fluid and obtain an intraoperative retinal attachment, an intentional retinectomy or liquid perfluorocarbon technique can be performed. If PVR is present, the epiretinal (or subretinal) membrane may be removed for complete retinal fusion. Once the retina is back in position, laser photocoagulation or cryosurgery is required to attach the chorioretinal. Postoperative tamponade can be used with air or gas (SF6 or C3F8), and in complex cases, silicone oil can be used. Complications of vitrectomy are nuclear cataract, PVR, and retinal detachment.[16,17,19]

Complications that occur after PPV with or without SB in PRD include increased intraocular pressure 17.9% - 48%, cystoid macular edema 16%, PVR and macular pucker 3-16%, iatrogenic retinal break 12%, anterior synechiae, and iris capture 4–9%.[17,20]

Several factors influence the anatomical and functional success of vitreoretinal surgery in PRD. The success rate will increase in the absence of macular involvement. The presence of PVR is an important factor influencing the outcome of PRD therapy. The likelihood of re-detachment is increased in cases of PVR.[19,20]

## 2. Conclusion

Pseudophakic retinal detachment is a severe complication that occurs after cataract extraction surgery. The risk factors for PRD are increased in young patients, myopia, vitreous loss during cataract surgery, after Nd: YAG laser capsulotomy, and previous history of retinal detachment. PRD can be treated with a scleral buckle, pneumatic retinopexy, or primary pars plana vitrectomy with or without a scleral buckle. Anatomical and functional postoperative success rates in PRD patients were found to be higher after PPV with or without a scleral buckle.

## 3. References


1. Skuta GL, Cantor BL, Weiss JS. Complications of cataract surgery. In: Lens and cataract. San Francisco. American Academy of Ophthalmology Section 11. 2014-2015; 184-5.
2. Olsen T, Jeppesen P. The incidence of retinal detachment after cataract surgery. Open Ophthal J. 2012; 79-82.
3. Lois N, Wong D. Pseudophacic retinal detachment. Ophthalmic Survey. 2003; 467-87.

4. Daien V, Pape AL, Heve D. Incidence, risk factors and impact of age on retinal detachment following cataract surgery in France: A national population study. National Population Study. 2015.
5. Haug SJ, Robert BB. Risk factors for retinal detachment following cataract surgery. Cataract Surg Lens Implantation. 2012; 7-11.
6. Sheu SJ. Male sex as a risk factor for pseudophakic retinal detachment after cataract extraction in Taiwanese adults. Am Acad Ophthal. 2007; 1898-903.
7. Mehdizadeh M, Afarid M, Haghighi MS. Retinal redetachment after cataract surgery in eyes with previous scleral buckling. J Ophthal Vision Res.2011; 73-5.
8. Bjerrum SS, Mikkelsen KL, Cour ML. Risk of pseudophakic retinal detachment in 202 226 patients using the fellow non-operated eye as reference. Ophthalmology. 2013; 2573-9.
9. Bonet M. Aphakic and pseudophakic retinal detachment. Retinal Detachment Microsurgery. 2000; 255-62.
10. Wadhwani M, Vankatesh P, Gogia V. Patterns of pseudophakic retinal detachment in a referral tertiary care center and the need for improving cataract surgical training. Eur J Ophthalmol. 2016; 361-3.
11. Marmor MF. Mechanisms of normal retinal adhesion. Retina. 2013; 447-64.
12. Brinton DA, Wilkinson CP. Retinal detachment principles and practice. 2009
13. Skuta GL, Cantor BL, Weiss JS. Vitreoretinal surgery. Vitreous Retina. San Francisco: American Academy of Ophthalmology Section 11; 2014-2015; 345-68.
14. William GA, Aberg TM. Techniques of scleral buckling. Retina. 2006; 2035-70.
15. Ross WH, Lavina A. Pneumatic retinopexy, scleral buckling, and vitrectomy surgeon in the management of pseudophakic retinal detachment. Can J Ophthalmol. 2008; 65-72.
16. Mariotti C, Nicolai M, Saitta A. Management of intraoperative and postoperative complications during vitrectomy for retinal detachment. 2015; 111-7.
17. Brinton DA, Wilkinson. Vitrectomy for retinal detachment. In: Retinal Detachment Principles and Practice.2009; 205-28.
18. Chang S. Vitrectomy for the primary management of retinal detachment. in: Primary Retinal Detachment Options for Repair.2005; 81-93.
19. Subedi S, Sharma MK, Sharma BR, Kansakar I, Dhakwa K, Adhikari RK. Surgical outcome of pars plana vitrectomy: a Retrospective Study in a peripheral tertiary eye care center in Nepal. Nepal J Ophthalmol. 2010; 2(3): 39-44.
20. Figueroa MS. Anatomical and functional outcomes of vitrectomy for the treatment of pseudophakic rhegmatogenous retinal detachment. Archinov De La Sociedad Espanola De Ophthalmology. 2010; 59-63.