ORIGINAL ARTICLE

ANALYSIS OF RISK FACTORS, VISUAL OUTCOMES AFTER VITRECTOMY AND IOL IMPLANTATION FOR DROPPED NUCLEUS

Jignesh Y. Gosai¹, Tanuj Limbasiya², Nidhi Gajendragadkar³, Bhagyashree Natu⁴

HOW TO CITE THIS ARTICLE:

Jignesh Y. Gosai, Tanuj Limbasiya, Nidhi Gajendragadkar, Bhagyashree Natu. "Analysis of Risk Factors, Visual Outcomes after Vitrectomy and IOL Implantation for Dropped Nucleus". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 33, April 23; Page: 5705-5715, DOI: 10.14260/jemds/2015/834

ABSTRACT: PURPOSE: To determine predisposing factors and to analyze visual outcomes after a dropped nucleus in vitreous originating during cataract surgery. Evaluation of management and outcome of patients undergoing pars plana vitrectomy. Evaluation of risk factors for poor visual outcomes, comparison of visual acuity following various types of IOL implantation. **METHODS:** 30 patients were prospectively reviewed having dropped nucleus or retained lens matter over a period of 11 months to determine the various associated factors and prognosis after pars plana vitrectomy and IOL implantation. Pre and Post-operative visual acuity, intraocular pressure, slit lamp examination, fundus examination by indirect ophthalmoscopy and ultrasound was done. Risk factors, Type of IOL, type of cataract surgery, complications and final visual outcomes were analyzed. All patients underwent 21 G pars plana vitrectomy and lens fragments were removed with phaco-fragmentome, vitrectomy cutter or delivered through limbus. **RESULTS:** 30 eyes of consecutive patients were studied. There were 20(66.66%) males and 10(33.33%) females. Associated risk factors found were 2(6.66%) PEX, 1(3.33%) subluxated lens. The BCVA after 11 months of PPV was found to be >6/12 in 20(66.6%) and <6/12 in 10(33.4%). Visual Rehabilitation was done with PCIOL in 22(73.33%), ACIOL in 4(13.33%), SFIOL in 4(13.33%). Poor visual outcome following PPV was attributed to RD in 2(6.7%), CME 1(3.3%), raised IOP 9(29.9%) [8(26.6% before and 1(3.3%) After PPV]. Rise of IOP was found in 8(26.60%) before PPV and 1(3.33%) after PPV.

KEYWORDS: Visual outcomes, Nucleus drop, Pars plana vitrectomy, IOL implantation, aphakia, phacoemulsification.

INTRODUCTION: DISCUSSION: Posterior descent of the nucleus after posterior capsule rupture is a serious complication.

Removal of nuclear fragments can lead to a good visual recovery.¹

Loss of nucleus into vitreous cavity following either trauma or during cataract surgery – the mechanism leads to inflammatory response.^{2,3,4}

Both lens nucleus and cortex cause intraocular inflammation includes both antigen- antibody response and delayed hypersensitivity reaction.

Histopathological evidence suggests that PMN Cells immediately surround lens matter and chronic inflammatory cells in more peripheral zone.

Etiology: Any form of zonular weakness⁵ that can be due to preexisting disease like collagen vascular diseases, Marfan's syndrome, Ehler Danlos syndrome, homocystinuria, pseudoexfoliation syndrome predisposes to increased chances of nucleus drop following trauma or during cataract surgery. Zonular dehiscence or rupture of lens capsule is a pre requisite. Nucleus drop can occur during any type of cataract surgery but incidence is higher with phacoemulsification.⁶

ORIGINAL ARTICLE

RISK FACTORS:^{7,8}

Pre Existing Conditions: Mature/hypermature cataract, pre-operative zonular weakness, previous trauma, posterior polar cataract, subluxated lens, pseudoexfoliation, posterior lenticonus, small pupil, post complicated posterior segment surgeries and poor visibility due to corneal scarring/dense arcus.

Pre-Operative Conditions: Inexperienced surgeon,⁶ Surgeon overconfidence, topical anaesthesia in uncooperative patient, incomplete capsulorrhexis, capsulorrhexis with a weak spot, capsulorrhexis with peripheral extension, dense corticocapsular adhesions, radial extension of anterior capsule tear, zonular dialysis >3 clock hours, eyes with low scleral rigidity, posterior capsular dehiscence.

Identification of posterior capsule dehiscence:⁹ Unusual deepening of anterior chamber, decentration of nucleus, loss of efficiency of aspiration (Occlusion of tip with vitreous), sudden transitory appearance of clear red reflex peripherally, newly acquired difficulty to rotate previously mobile nucleus, excessive tipping of one pole, partial descent of nucleus into anterior vitreous space, excessive lateral mobility/displacement of nucleus.

Retained lens fragments in vitreous cavity invariably incite an inflammatory response¹⁰ that can lead to Corneal decompensation, uveitis, glaucoma, cystoid macular oedema (Most common),¹⁰ retinal detachment.

Intra-Operative Management: If the nucleus has dropped, the AIM is to clear anterior chamber of vitreous and cortex, place an IOL and close the eye. Aggressive use of lens loop, phacoprobe, cryoprobe or vigorous irrigation of vitreous cavity is avoided. Aggressive pursuit of dislocated nucleus may cause:¹¹ Retinal tears, giant retinal tears, retinal detachment. Nuclear fragments in anterior chamber can be removed by micro instruments or viscoelastic substance. Cortical remnants in anterior vitreous can be removed by vitrectomy cutter. Nuclear fragments in vitreous cannot be phacoemulsified due to internal occlusion and cannot be adequately cut, thus PPV is used.¹²

Iol Implantation: Type of IOL to be placed depends on remaining capsular support: sufficient capsular support and good zonular integrity – PCIOL in Bag/sulcus if the capsular support is insufficient – SFIOL/ACIOL

Principles in Brief: Avoid aggressive pursuit, clean anterior chamber of all cortical matter, perform anterior vitrectomy to avoid anterior vitreous prolapse into wound, place an IOL if possible.

Timing of Vitreoretinal Surgery:^{13,14,15} Ideally in the same sitting. Early surgery is preferred if significant nuclear matter is retained, it reduces the incidence of post-operative glaucoma and is associated with better visual outcomes

Advantage of a late surgery is that the inflammation and corneal edema decreases and thus allows better visualization.

Surgery: A Standard 3 port vitrectomy¹⁶ is performed with infusion, light source and phaco fragmentome.

ORIGINAL ARTICLE

Key elements in safe and effective lens fragment removal include adequate initial vitrectomy – Any vitreous strands to nuclear fragments are cut so that manipulation may not result in vitreo-retinal traction and fragments are freely mobile.

High velocity of infusion fluid to create vortex currents to float the nucleus can be used, but can result in giant retinal tears. Use of perfluorocarbon liquids to float nucleus fragments from the retinal surface, has lesser risk of retinal traction.

Reducing fragmentation powers: To as low as 5–10% of maximum for smaller fragments allows more efficient extraction by continuous occlusion of the suction port and minimizes the risk of mechanical retinal trauma from projectile fragments.

Fragmentation is done after moving to mid vitreous cavity – to avoid suction or ultrasonic damage to retina inducing a posterior vitreous detachment–It minimizes post-operative retinal detachment. Retina should be examined with indirect ophthalmoscopy with scleral depression to make sure all fragments are removed. It should be evaluated throughout the peri operative course.

Post-Operative Complications after Vitrectomy:^{17,18} Corneal edema, glaucoma, persistent intra-ocular inflammation, retinal detachment, cystoid macular edema, epiretinal membrane.

MATERIALS AND METHODS: 30 patients having an intraoperative nucleus drop or retained lens matter were prospectively followed at M and J Institute of Ophthalmology, Ahmedabad for a period of 11 months to determine various associated factors and prognosis after surgery for the same.

Patient Selection: all patients having nucleus drop in vitreous cavity of any age or gender were included.

Visual acuity was recorded pre and post operatively with Snellen's chart.

IOP was measure by applanation tonometry using a Perkin's tonometer.

Uncontrolled glaucoma was defined as IOP $\geq$ 25 mm Hg.

Slit lamp examination was done pre and post operatively to assess the inflammation and to examine for any other pre disposing factor.

Intra ocular inflammation was defined as aqueous cells/flare $\geq$ +2.

Fundus examination with indirect ophthalmoscopy and Ultrasound was done.

All patients underwent 20G pars plana vitrectomy for lens matter removal.

Chi square test was performed comparing: Time interval between primary surgery and vitrectomy and best corrected visual acuity attained and for assessing relationship between different types of IOLs implanted and final visual outcome.

RESULTS AND DISCUSSION: Sex distribution in the study revealed 66. 7% patients were males and 33.3% were females.

The patients underwent phacoemulsification 76.66% (n=23), small incision cataract surgery 13.33% (n=4) and extracapsular cataract excision 10% (n=3). Maximum incidence was found in patients who underwent phacoemulsification.

ORIGINAL ARTICLE

TYPE OF CATARACT SURGERY AND INCIDENCE OF NUCLEUS DROP:

Fig. 1

Pre-existing factors were found to be PEX in 6.66% (n=2) and subluxated lens in 3.33% (n=1) patients.

ASSOCIATION OF PREEXISTING RISK FACTORS WITH NUCLEUS DROP:

Fig. 2

BCVA was found to be $\geq 6/12$ in 66.6% (n = 20) and $< 6/12$ in 33.4% (n = 10) patients.

BCVA AFTER 11 MONTHS OF PPV:

Fig. 3

ORIGINAL ARTICLE

Causes of poor visual outcomes were attributed to pre-existing age related macular degeneration 2(6.67%), retinal detachment 2(6.67%) or cystoid macular edema 1(3.33%), POAG 1 (3.33%).

CAUSES OF POOR VISUAL ACUITY FOLLOWING PPV:

Fig. 4

23(76.66%) had Visual acuity improvement >2 lines in snellens chart, 2(6.66%) had the same pre op and post-operative vision, 5(16.66%) had an improvement of 1 line in snellens chart.

IMPROVEMENT IN VISION IN SNELLENS CHART:

Fig. 5

No improvement was found in n = 1 due to ARMD, n = 1 due to RD.

Improvement was <1 line in Snellen chart due to corneal edema in n = 1, POAG in n= 1, PEX in n = 1, ARMD in n = 1.

ORIGINAL ARTICLE

NO IMPROVEMENT/IMPROVEMENT <2 LINES IN VISION:

Fig. 6

The preexisting conditions before PPV which attributed to poor visual outcomes were attributed to uveitis 20% (n=6) and corneal edema 16.6% (n=5).

PRE EXISTING CONDITIONS BEFORE PPV AFFECTING VISUAL OUTCOMES:

Fig. 7

73.33% (n=22) had PCIOL, 13.33% (n=4) had ACIOL and 13.33% (n=4) had SFIOL implanted.

ORIGINAL ARTICLE

PERCENTAGE DISTRIBUTION OF VARIOUS TYPES OF IOL IMPLANTED DURING PRIMARY SURGERY OR LATER ON:

Fig. 8

All patients implanted with SFIOLs 100% (n=4) had BCVA $\geq$ 6/12 while it was found in 59.9% (n=13) PCIOLs and 75% (n=3) ACIOLs.

VISUAL ACUITY FOLLOWING DIFFERENT TYPES OF IOL:

Fig. 9

Raised IOP was seen in 29.9% cases, 26.6% (n=8) developed after cataract surgery and 3.33% (n=1) developed after PPV.

RAISE IN IOP IN NUCLEUS DROP: **Fig. 10**

RESULTS: In a study by Merani *et al.*¹⁹ a total of 223 eyes of 223 patients were included, with a mean follow up of 20.5 months after vitrectomy. Final BCVA was 6/12 or better in 159 patients (71.3%). Retinal detachment occurred in 20 patients (9%), with 11 diagnosed before or during vitrectomy, and 9 after vitrectomy. 10 patients (5%) developed raised IOP and 42 (23.2%) developed CME. Poor final visual acuity was associated with retinal detachment ($p = 0.0026$) and with poor visual acuity at presentation ($P=0.030$). There was a significant association between retinal detachment and a long interval (>30 days) between cataract surgery and vitrectomy ($P = 0.00047$) and between retinal detachment and younger age ($P=0.0070$).

In a study done by Vanner *EA et al.*¹³ of 257 articles identified, there were 43 unique studies (53 articles) for the systemic review, including 27(31 articles) for the meta-analysis. Early vitrectomies were statistically significantly associated with better outcomes for not good acuity (odds ratio: 1.13; 95%, $P=0.005$)

Bad visual acuity (odds ratio: 1.05; 95%, $P = 0.009$); previtrectomy retinal detachment (odds ratio: 1.13; 95%, $P=0.024$);

Increased intraocular pressure (Odds ratio: 1.23; 95%, $P=0.003$); and intraocular infection/inflammation (Odds ratio: 1.20; 95%, $P=0.041$).

This study found significantly better outcomes (Visual acuity, RD, increased IOP, Intraocular infection/inflammation).

Schwartz *SG et al.*²⁰ studied a total of 3389 eyes which underwent cataract extraction, and 26 patients (0.8%) required pars plana vitrectomy (PPV) for retained lens fragments. One or more vision threatening complications occurred in 19 (73%) of these patients.

The most common complications were cystoid macular edema (CME) (8, 31%) and RRD (6, 23%). Additional surgical procedures were required for 9 (35%) eyes, the most common were repeat PPV (4, 15%), and placement of focal photocoagulation for diabetic macular edema (4, 15%). 6 month followup was available for 16 eyes of these BCVA was 20/40 or better in 5 (31%) and 20/200 or worse in 7 (44%). The most common reasons for limited visual acuity were RRD 3 (19%) and CME 3 (19%).

Borne *MJ et al.*¹² studied a total of 121 eyes of 121 patients who underwent pars plana vitrectomy with removal of retained lens material over the 3.5 year period. Nineteen eyes (16%) had

ORIGINAL ARTICLE

RD, eight were noted at the time of vitrectomy and 11 occurred after vitrectomy. The use of posterior segment phacofragmentation was associated with higher rate of RD, but the difference was not significant. Major cause of poor visual outcome included RD (6 eyes), CME (4 eyes), glaucoma (2 eyes).

In our study, PEX (6.66%, n=2) and subluxated lens (3.33%, n=1) were found to be associated pre-existing risk factors.

No association was found between interval between cataract surgery and PPV and final BCVA after 11 months. (3 patients who got operated on same day as nucleus drop were excluded; results were analyzed using Chi-Square test and $p > 0.05$) while most of the earlier studies revealed a better visual outcome if vitrectomy was performed on the same days as the drop.

On 11 month follow up BCVA was $\geq 6/12$ in 66.6% (n = 20) and $< 6/12$ in 33.4% (n = 10) 73.33% (n = 22) had PCIOL, 13.33% (n = 4) had ACIOL and 13.33% (n=4) had SFIOL implanted.

All patients implanted with SFIOLs 100% (n=4) had BCVA $\geq 6/12$ while it was found in 59.9% (n = 13) PCIOLs and 75% (n=3) ACIOLs.

Raised IOP was seen in 29.9% cases, 26.6% (n=8) developed after cataract surgery and 3.33% (n=) developed after PPV.

No correlation was found between type of IOL implanted and final visual outcome. (Analyzed by chi square test and $p > 0.05$).

Advantage of primary IOL implantation is rapid visual rehabilitation and avoiding secondary IOL implantation in an inflamed eye at the time of vitrectomy.

Proper management guidelines for retained lens matter depend on the size of dislocated matter and presence of complications directly related to lens fragments.

23 (76.66%) had Visual acuity improvement > 2 lines in snellens chart, 2 (6.66%) had the same pre op and post-operative vision, 5 (16.66%) had an improvement of 1 line in snellens chart.

Poor visual outcomes were related to pre-existing age related macular degeneration 2 (6.67%), retinal detachment 2 (6.67%) or cystoid macular edema 1 (3.33%), POAG 1 (3.33%) which correlated with previous studies.

CONCLUSION: The overall incidence of nucleus drop is 0.8%, The incidence for the experienced surgeon was 0.3% and for those learning it was 1.23%.⁶

Despite this complication 66.6% of eyes achieved $\geq 6/12$ best corrected visual acuity.

Adverse effects can be reduced if the surgeon recognizes the risk factors early and does the proper management timely for adequate visual rehabilitation.

Pre-operative counseling for the possibility of this complication should be done also explaining the prospects of a consecutive surgery if the same happens.

BIBLIOGRAPHY:

1. Blodi BA, Flynn HW, Jr., Blodi F, Folk JC, Daily MJ. Retained nuclei after cataract surgery. *Ophthalmology* 1992; 99: 41-44.
2. Wolter JR (1983) foreign body reaction to firm nucleus lens substance. *Ophthalmic Surg* 14: 135-138.

ORIGINAL ARTICLE

3. Filipe JC, Palmares J, Delago L, et al. (1993) Phacolytic glaucoma and lens-induced uveitis. *Int Ophthalmol* 17: 289–293.
4. Franks WA, Limb GA, Stanford MR, et al. (1992) Cytokines in human intraocular inflammation. *Curr Eye Res* 11 (Suppl) 187–191.
5. Aasuri MK, Kompella VB, Majji AB. Risk factors for and management of dropped nucleus during phacoemulsification. *J Cataract Refract Surg*. 2001 Sep; 27(9):1428-32.
6. Mathai A, Thomas R. Incidence and management of posteriorly dislocated nuclear fragments following phacoemulsification. *Indian J Ophthalmol* 1999; 47: 173-6.
7. Managing the Dropped Nucleus, William J. Fishkind, Steve Charles, Mark Packer, http://crstoday.com/2009/04/CRST0409_17.php.
8. Narendran N, Jaycock P, Johnston RL, et al. The Cataract National Dataset electronic multicentre audit of 55,567 operations: risk stratification for posterior capsule rupture and vitreous loss. *Eye (Lond)*. 2009; 23 (1): 31-37.
9. *Br J Ophthalmol* 2013; 97: 2-4 doi: 10.1136/bjophthalmol-2012-301799.
10. Margherio RR, Margherio AR, Pendergast SD, Williams GA, Garretson BR, Strong LE, et al. Vitrectomy for retained lens fragments after phacoemulsification. *Ophthalmology* 1997; 104: 1426-32.
11. Lu H, Jiang YR, Grabow HB. Managing a dropped nucleus during the phacoemulsification learning curve. *J Cataract Refract Surg* 1999; 25: 447-50.
12. Borne MJ, Tasman W, Regillo C, Malecha M, Sarin L. Outcomes of vitrectomy for retained lens fragments. *Ophthalmology*. 1996 Jun; 103 (6): 971-6.
13. Vanner EA, Stewart MW. Vitrectomy timing for retained lens fragments after surgery for age-related cataracts: a systematic review and meta-analysis. *AM J Ophthalmol*. 2011 Sep; 152 (3): 345-357. e3. Epub 2011 Jun 17.
14. Lai TY, Kwok AK, Yeung YS, Kwan KY, Woo DC, Yuen KS, Loo AV. Immediate pars plana vitrectomy for dislocated intravitreal lens fragments during cataract surgery. *Eye (Lond)*. 2005 Nov; 19 (11): 1157-62.
15. Schaal S, Barr CC. Management of retained lens fragments after cataract surgery with and without pars plana vitrectomy. *J Cataract Refract Surg*. 2009 May; 35 (5): 863-7.
16. Lambrou FH, Jr., Stewart MW. Management of dislocated lens fragments during phacoemulsification. *Ophthalmology* 1992; 99: 1260-62.
17. PedroRomero-Aroca, Juan Fernández-Ballart, Isabel Méndez-Marín, Merce Salvat-Serra, Marc Baget-Bernaldiz, Jose A Buil-Calvo. Management of nucleus loss into the vitreous: long term follow up in 63 patients. *Clin Ophthalmol*. Dec 2007; 1 (4): 505–512.
18. Scott IU, Flynn HW Jr, Smiddy WE, Murray TG, Moore JK, Lemus DR, Feuer WJ. Clinical features and outcomes of pars plana vitrectomy in patients with retained lens fragments. *Ophthalmology*. 2003 Aug; 110 (8): 1567-72.
19. Pars Plana Vitrectomy for the Management of Retained Lens Material After Cataract Surgery Rohan Merani, Alex P. Hunyor, T. Justin Playfair, Andrew Chang, John Gregory-Roberts, Alex B. L. Hunyor, Domit Azar, Robert G. Cumming, *Am J of Ophthalmol*, September 2007 Volume 144, Issue 3, Pages 364-370.
20. Schwartz SG, Holz ER, Mieler WF, Kuhl DP. Retained lens fragments in resident performed cataract extractions. *CLAO J*. 2002 Jan; 28 (1): 44-7.

ORIGINAL ARTICLE

AUTHORS:

1. Jignesh Y. Gosai
2. Tanuj Limbasiya
3. Nidhi Gajendragadkar
4. Bhagyashree Natu

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Ophthalmology, M & J Institute of Ophthalmology.
2. 3rd Year Resident, M & J Institute of Ophthalmology.
3. 2nd Year Resident, M & J Institute of Ophthalmology.

FINANCIAL OR OTHER**COMPETING INTERESTS:** None

4. 3rd Year Resident, M & J Institute of Ophthalmology.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Jignesh Y. Gosai
T4/103, Devnandan Heights,
Opp. Avkar Villa, New CG Road,
Chandkheda, Ahmedabad-382424.
E-mail: dr_jigneshgosai@hotmail.com

Date of Submission: 17/03/2015.
Date of Peer Review: 18/03/2015.
Date of Acceptance: 11/04/2015.
Date of Publishing: 22/04/2015.