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Visual Outcomes In Pre And Post-Operative Macular Hole Surgery In Senior Citizen

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ABSTRACT

- **Aim:** To evaluate the difference in visual outcomes in pre and post-operative macular hole surgery.
- **Methods:** This study was proceeded in M.L Sheth Vaduwala Eye Hospital, Vadodara, with both urban and rural population of Vadodara. A total of 95 subjects were taken, who were affected due to macular hole including both males and females with the age group of 60 years and above.
- **Result:** The study found that the majority of patients experienced improvement in vision after surgery, with the highest improvement observed after a month.
- **Conclusion:** All total out of 100% of samples, 94% patients are seen having improvement in vision and 6% patients are seen having same vision post-operatively. It is observed that the number of females affecting due to macular hole are considerably more than the number of males.

Introduction

- A macular hole is an anatomic opening in the retina that develops at the fovea. Macular holes can be seen in highly myopic eyes or following ocular trauma, but the great majority are idiopathic. Pars plana vitrectomy has been used for more than a decade to treat full-thickness macular holes, which if left untreated cause a blind spot in central vision that only rarely improve naturally. Vitrectomy is a surgical technique involving the removal of the vitreous body (the clear gel that fills the eye).[1]
- The postoperative anatomical success rates vary from 86% to 95%, and visual acuity improvement of at least 2 lines has been achieved in more than 60% of operated eyes as a result of macular hole closure. Most patients with successful macular hole closure require eccentric fixation to obtain better visual acuity, because the foveal cones are abnormal and distributed around the macula.[2]
- After macular hole surgery, the mean visual impairment of surgical eyes decreased from 58% to 29%. Visual improvement in anatomically successful cases is appreciable, normal vision is not obtained. Nearly all patients will report some persistent visual deficit after macular hole surgery, even if 20/20 visual acuity is attained.[3]
- Holes are mostly idiopathic, also known as primary, but may be secondary to trauma or macular edema. Idiopathic FTMHs are age related, typically affecting older women, but unrelated to ocular or systemic conditions. The average duration of the macular hole ranged from 1 week to 13 months, with a mean of 5.6 months.[4,5]
- Vitrectomy improved visual acuity in participants with macular hole by about 1.5 lines of a standard distance acuity chart. Macular hole closure was much more likely with vitrectomy compared to observation, with mean closure rates of 76% versus 11%, respectively.[6]
- Vitrectomy is effective in improving visual acuity, resulting in a moderate visual gain, and in achieving hole closure in people with macular hole. However, these results may not apply to modern surgery due to technological improvements in vitrectomy techniques. Patients with successful hole closure whose fellow eyes

are healthy, however, usually tend to avoid using the operated eye and do not intentionally use the parafoveal visual field, because of the persistent visual deficit in the operated eye.[6,]

- Patients who undergo successful macular hole surgery with normal visual acuity in the fellow eye usually cannot use the operated eye well because their visual deficits, for example, mild visual impairment or metamorphopsia, persist after surgery. By contrast, patients with poor visual acuity in the fellow eye may find it easier to use the operated eye and are able to learn to use eccentric fixation, because vision in it is dominant over that of the fellow eye.[7]
- Bilateral visual function has been marked improving, post vitrectomy in many patients with macular hole in the fellow eye. The operated eye vision is equal or found to be better than the fellow eye. Posterior vitreous detachment is generally protective against development of a macular hole. The incidence of progression of stage 1 holes to full- thickness holes is 57–67%.[8,9]
- Macular hole surgery have measured visual success rates using final visual acuity, visual improvement, and rate of greater than or equal to 6/12 visual acuity. The finding of continuing visual acuity improvement after successful macular hole surgery corroborates claims to its efficacy. As surgical hole closure rates continue to increase, the benefits are especially applicable for patients in good health with a long life expectancy because patients who are operated on successfully can expect in proving visual function years after the initial procedure.[10]
- If the vitreous is attached, the eye has a higher risk of developing macular hole on the fellow eye. It is estimated that idiopathic macular holes occur in 33 of 10,000 individuals (0.33%) over the age of 55 years. Patients with full-thickness holes in the first eye (13%) develop full-thickness hole in the fellow eye, a 0.0429% incidence. The visual acuity in the first eye decreases to 0.1 or worse in 79% of cases within 3 years of follow-up without intervention.[11]
- Stage 1 macular holes (tractional foveal detachment without dehiscence) represent the earliest clinical stage of macular hole development and manifest as a yellow spot or yellow ring in the fovea without clinical evidence of a full-thickness retinal defect.[12]
- Macular holes represent full-thickness defects of the neural retina at the anatomic fovea that result in decreased central vision. They occur in the middle-aged elderly group and are most commonly unilateral. Bilateral macular holes are atypical. Surgical closure of bilateral macular holes at the same operating session has distinct advantages but also considerable disadvantages.[13]
- Vitrectomy combined with intravitreal gas tamponade has been verified as effective to close idiopathic macular holes (IMH) and contributes to both anatomical restoration and functional improvement. Optical coherence tomography (OCT) displays the retinal microstructure clearly and has become the primary imaging method for diagnosing IMH and confirming anatomical success after IMH surgery.[14]
- Macular hole surgery is one of the most common elective vitreoretinal procedures performed, but there is limited knowledge of the long-term outcomes of such patients. Although previous studies on macular hole surgery have established its effectiveness in hole closure by evaluating surgical outcomes and possible prognostic factors, long-term changes in visual acuity and foveal anatomy remain unclear.[15]
- BCVA continues to improve beyond 4 months to 6 months after macular hole surgery. Furthermore, 20% of the patients improved from non-driving visual acuity to driving visual acuity. Reconstruction of the foveal ellipsoid layer in the early postoperative period may reflect the structural and functional recovery of the foveal photoreceptors after macular hole surgery, and this recovery may continue for a number of years after surgery.[15]
- A multiple linear regression model was used with "visual acuity change from the 4- month to 6-month visit to final visit" as the dependent variable and the following as independent variables: Initial visual acuity, height of the macular hole, 4-month to 6- month OCT thickness, final OCT thickness, and maximum hole diameter; none of these factors statistically predicted the change from the 4-month to 6-month visit to final visit visual acuity change.[15]
- Historically, macular holes were uncommon, were attributed to trauma, and were observed in young individuals. It is now understood that idiopathic macular hole affects as many as 100,000 people in the USA, generally afflicting healthy women in their seventh and eight decades (mean age, 65 years) of life who have normal refractive errors.[16]
- Visual acuity can be misleading because macular holes may occasionally be found with 20/40 vision but generally occur with visual acuity of 20/80 or worse. The risk of progression to macular hole is significantly higher in eyes with stage 1 macular holes with best-corrected visual acuity of 20/50 or worse. It may be that some of these eyes with worse visual acuity may have occult macular holes.[16]

2.1Aim

- To evaluate the difference in visual outcomes in pre and post-operative macular hole surgery.

2.2 Objectives

- To evaluate the variation between visual acuity, pre and post-surgery of macular hole
- To determine the level of problem seen in males and females due to the condition of macular hole
- To examine the impact of vitrectomy for macular hole on visual acuity
- To make an early diagnosis to treat the problem and protect the vision

2.3 Hypothesis

1. Null Hypothesis: There is no relation in upgradation of vision in case of pre and post macular hole surgery.
2. Alternate Hypothesis: There is a relation of upgradation in vision in case of pre and post macular hole surgery.

3.1 Review of Literature

- Mariacristina P, Fabrizio G, Yew C Yap, Stanislao Rizzo, Giani Virgili, conducted a study on 'Vitrectomy on idiopathic macular hole' with 270 subjects at USA and UK on May 12, 2015; published by Cochrane Database of Systematic Reviews, concluded that vitrectomy is effective in improving visual acuity, resulting in a moderate visual gain, and in achieving hole closure in people with macular hole in 6 to 12 post vitrectomy, the visual acuity was gained by 20/50 with the closure of macular hole.[17]
- Kazuaki Kadonosono, Kazuro Yabuki, Tadayuki Nishide, Eiichi Uchio and James A Marron conducted a study on 'Measured visual acuity of fellow eyes as prognostic factor in macular hole surgery' with 74 subjects at Yokohama city university medical center in April 2003; published by American Journal of Ophthalmology, which concluded that the visual recovery after successful macular hole surgery is inversely correlated with vision in the fellow eye. Learning to use eccentric fixation may contribute to visual improvement after macular hole surgery.[18]
- T D Polk, W E Smiddy, H W Flynn Jr. conducted a study on 'Bilateral visual function after macular hole surgery' with 71 subjects at Miami in March 1996; published by Elsevier Inc. American Journal of Ophthalmology which concluded that visual acuity was improved in operated eye with 35%, and was almost equal to visual acuity in the fellow eye. The bilateral visual function was enhanced and visual impairment was lessen from 52% to 35%.[19]
- Abdelrahman M. Elhusseiny, Stephan G. Schwartz, Harry W. Flynn Jr., William E. Smiddy, conducted a study on 'Long term visual outcomes after macular hole surgery' with 87 subjects in Miami, Florida in March, 2019; published by Elesevier Inc. American Journal of Ophthalmology, concluded that visual acuity improvement after MH surgery continued during the first 3 years after PPV and was maintained thereafter substantial fraction of patients, and final BCVA correlated with better preoperative BCVA and better postoperative OCT parameters.[20]
- R E Leonard 2nd, W E Smiddy, H W Flynn Jr, W Feuer conducted a study on 'Long- term visual outcomes in patients with successful macular hole surgery' with 137 subjects at University of Miami School of Medicine in October,1997; published by Elesevier Inc. American Journal of Ophthalmology, concluded that there was a considerable improvement in the visual acuity from 20/125 to 20/50 after 1 year of surgery and till 20/30 after 36 months. In 39% patients, the visual acuity in the operated eye was better than the fellow eye after surgery.[21]
- Zsuzsanna Szij conducted a study on 'Bilateral full thickness macular hole' with 1 subject at Hungary in February 2006; published by Annals of Ophthalmology, concluded that through the use of optical coherence tomography, a bilateral macular hole was found. This resulted in a Stage 2 hole in one eye, which required post-retinal vitrectomy for optimal closure and BCVA.[22]

4.1 Methodology

- Study Site: M.L Sheth Vaduwala Eye Hospital, Vadodara
- Study Design: Clinical based cross-sectional study
- Study Duration: 6 months (March to August)
- Study Population: Population of vadodara at M.L Sheth Vaduwala Eye Hospital.
- Sample Size: $n = \frac{}{1 + x e^2} = 95$

Study Criteria

- **Inclusion Criteria**

✓ Subjects with history of macular hole problems

✓ Subjects with age group 60 and above including both male and female

➢ **Exclusion Criteria**

✓ Subjects with emmetropic eye with no history of ocular problems specially macular hole

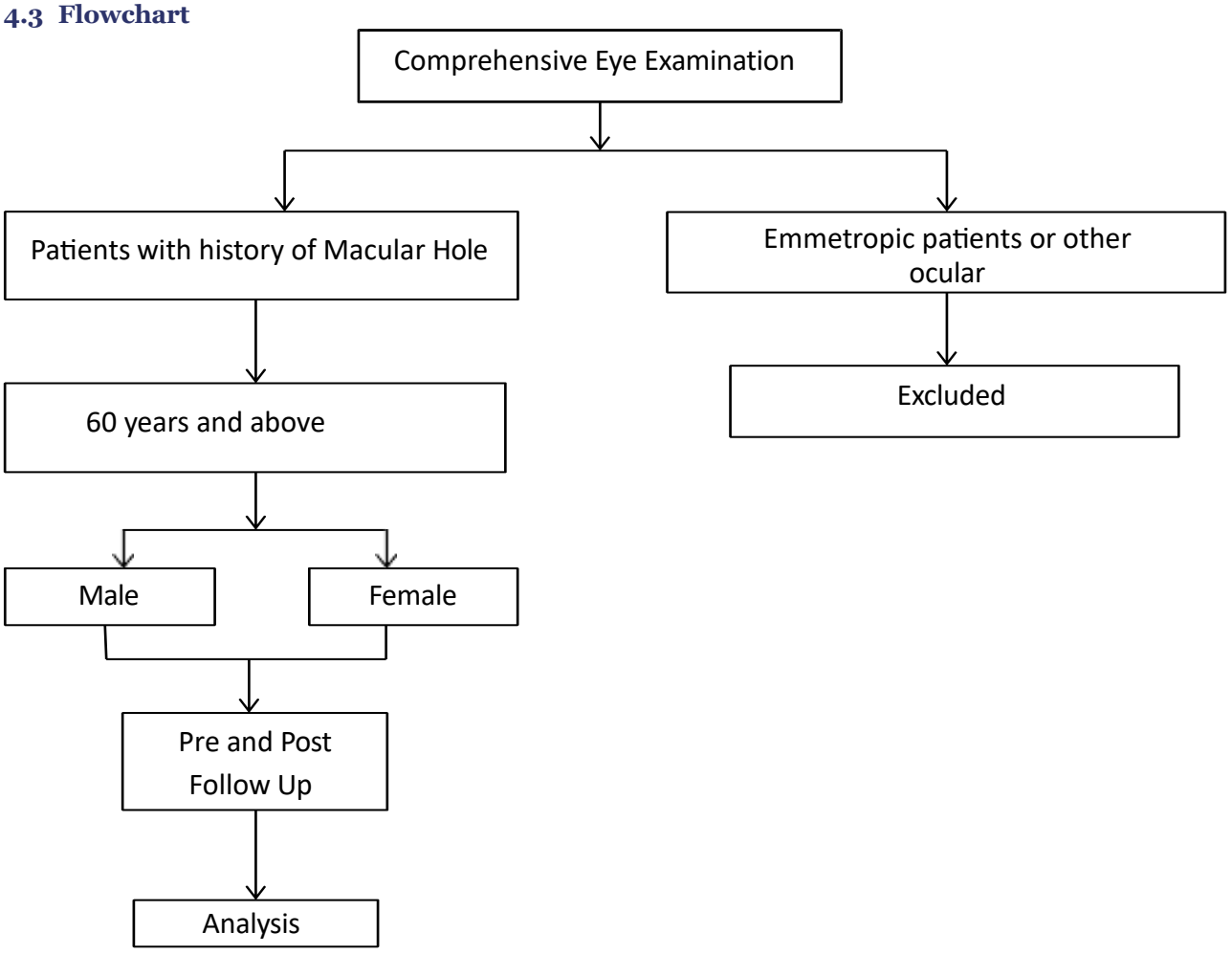
✓ Subjects below 60 years of age

4.2 Data Collection Procedure

➢ This study was proceeded in M.L Sheth Vaduwala Eye Hospital, Vadodara, with both urban and rural population of Vadodara. A total of 95 subjects were taken, who were affected due to macular hole including both males and females with the age group of 60 years and above. In these 95 patients, a comprehensive eye exam was performed which included the checking of visual acuity with the help of snellen's chart. Both distance and near visual acuity were noted. A torch light examination was also performed in all the subjects to check the pupil reaction. Also the history of these patients was noted and patients who were having history of macular hole were separated from the patients who were emmetrope and had any other ocular diseases, ocular traumas or any ocular surgery. The patients with age group of 60 years and above were included in the study and the others were excluded.

After this, the subjects were examined with a slit-lamp and the suspects of macular hole were separated. These subjects then were examined with Optical Coherence Tomography (OCT) to make a final diagnosis. After the OCT examination the final diagnosis was done, which was that the patients were having macular hole in the retina. After the final diagnosis the patients were separated according to the gender, i.e., males and females, from which we got a number of 46 and 49, respectively. After this, the patients with visual acuity of <6/60 were separated from those who had visual acuity of 6/60 to 6/24 pre-operatively. All the 95 subjects with macular hole had undergone the surgery of macular hole, i.e, Vitrectomy. Post surgery, the patients were called on follow-ups after 3 days, 15 days and 1 month. The patients who were having <6/60 visual acuity pre-operatively were separated from the patients with 6/60 to 6/24 visual acuity pre-operatively, on each of the 3 follow-ups. On every follow-up the visual acuity was noted of each of the patients and the improvement in the visual acuity was also seen. After collecting all the pre-operative and post-operative data of these 95 patients with macular hole was analyzed and a conclusion was made.

4.3 Flowchart



5.1Materials

1. Torch light examination
2. Visual acuity (distance & near)
3. Slit lamp examination
4. Optical coherence tomography (OCT)

6.1 Result

Socio-Demographic Data:

- Below table shows that the demographic distribution of female and male under age 60 years and above

Table 1: Distribution of subjects according to age and gender.

AGE GROUP	MALE	FEMALE	TOTAL
60 AND ABOVE	46	49	95

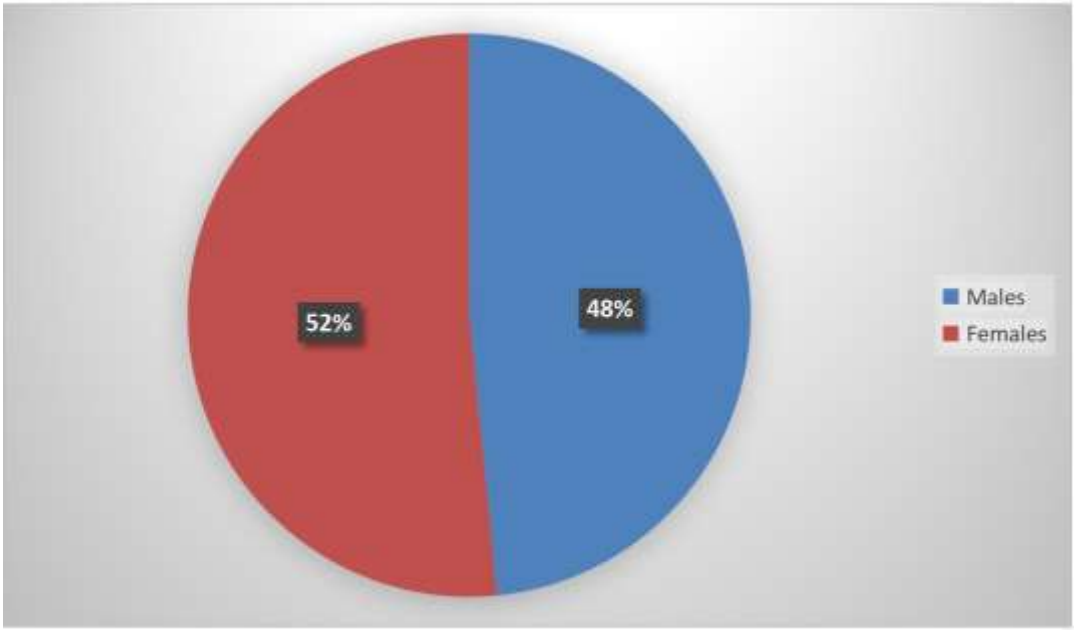


Figure 1: Showing the distribution of males and females.

- Vision recording of subjects at time of pre-macular hole surgery.

Table 2: Distribution of vision before macular hole surgery

VISUAL ACUITY	**MALE**	**FEMALE**	**TOTAL**
6/60-6/24	45	47	91
<6/60	01	02	03
TOTAL	46	49	95

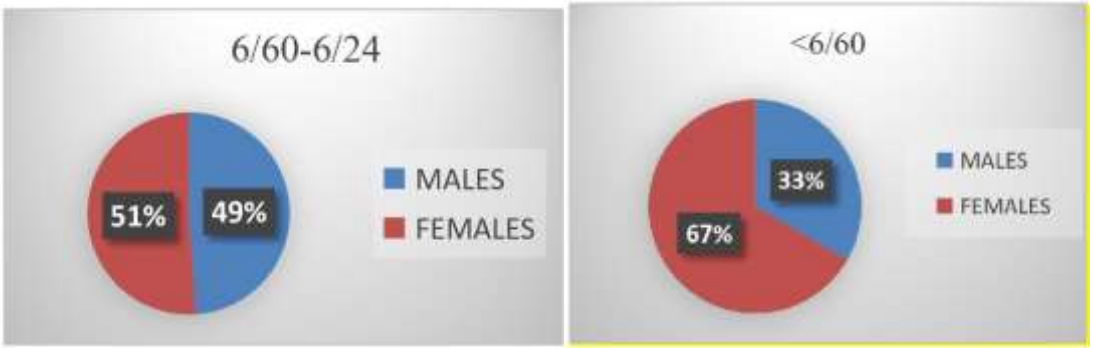


Figure 2: Pie chart showing distribution of male and female according to visual acuity 6/60-6/24 and <6/60.

➢ Therefore, it is seen that before surgery of macular hole there were 03 patients with a vision >6/60 and 91 of them were between 6/60 to 6/24 respectively. Also it was seen that in vision <6/60 females were more in numbers than males and the same way females were more in numbers with vision of 6/60 to 6/24, i.e., 02 and 47 respectively.

➢ **Follow up 1** (3 days of follow-up)

Table 3: Indication of vision after 3 days of surgery, i.e, post-operative vision of those patients whose pre-operative vision was 6/60-6/24.

VISUAL ACUITY	MALE	FEMALE	TOTAL
Improvement	29	33	62
Same	10	09	19
Diminished	06	05	11

Table 4: Indication of vision after 3 days of surgery, i.e, post-operative vision of those patients whose pre-operative vision was <6/60.

VISUAL ACUITY	MALE	FEMALE	TOTAL
Improvement	01	01	02
Same	0	01	01
Diminished	00	00	00

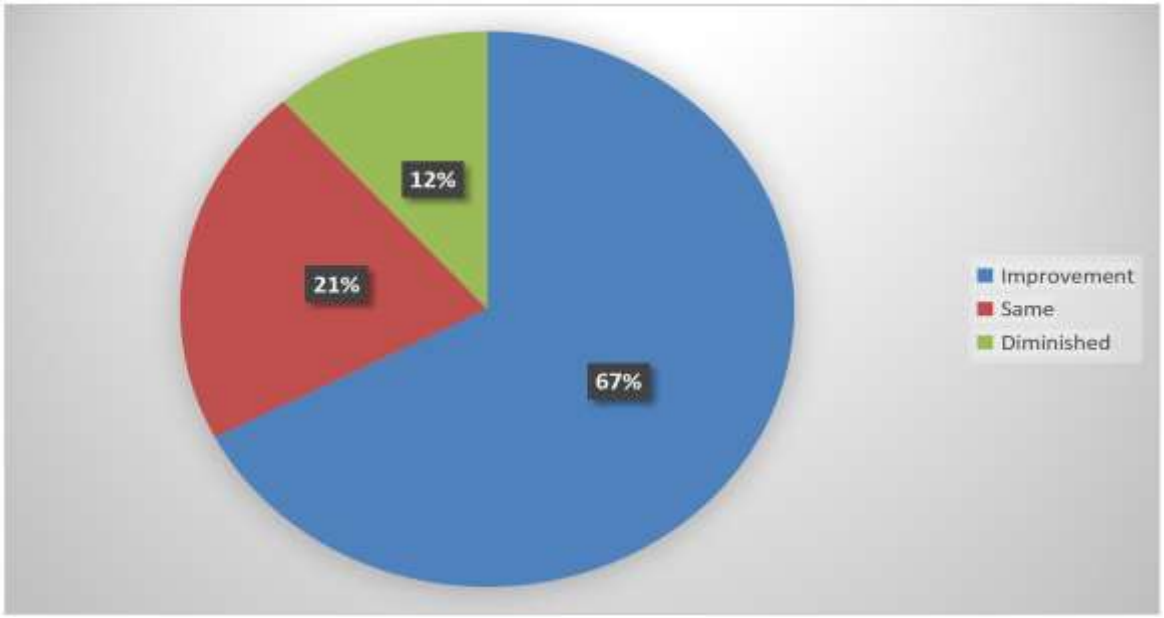


Figure 3: Showing the distribution according to visual acuity in all the 95 subjects after 3 days of follow-up, who were having visual acuity <6/60 and 6/60 to 6/24 pre-operatively.

➢ **Follow up 2** (15 days of follow-up)

Table 5: Indication of vision after 15 days of surgery, i.e., post-operative vision of those patients whose pre-operative vision was 6/60-6/24.

VISUAL ACUITY	MALE	FEMALE	TOTAL
Improvement	33	38	71
Same	08	06	14
Diminished	04	03	07

Table 6: Indication of vision after 15 days of surgery, i.e., post-operative vision of those patients whose pre-operative vision was <6/60.

VISUAL ACUITY	MALE	FEMALE	TOTAL
Improvement	01	02	03
Same	00	00	00
Diminished	00	00	00

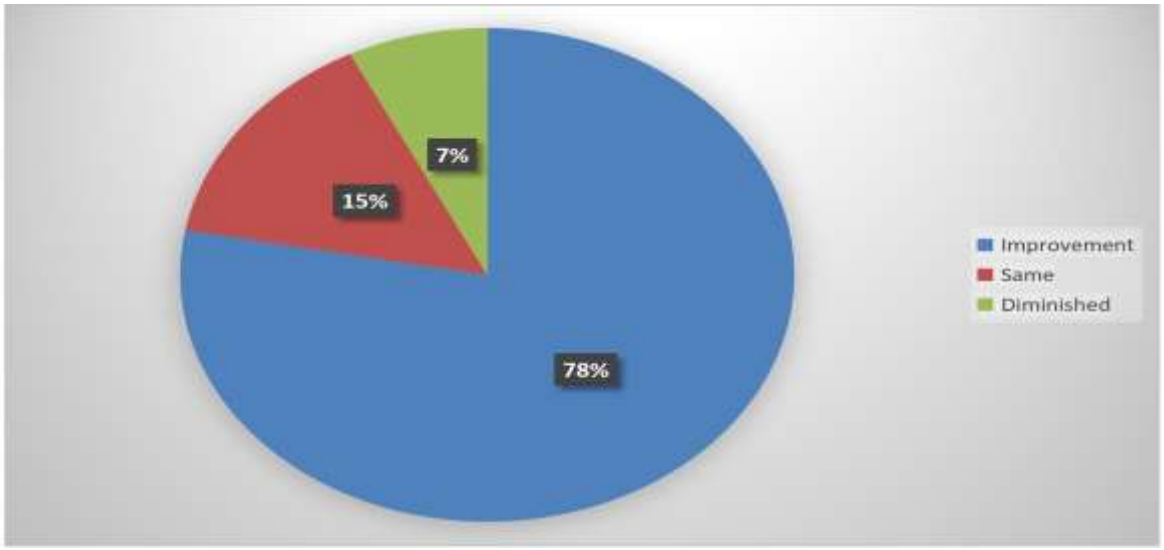


Figure 4: Showing the distribution according to visual acuity in all the 95 subjects after 15 days of follow-up, who were having visual acuity <6/60 and 6/60 to 6/24 pre-operatively.

- **Follow up 3** (1 month of follow-up)

Table 7: Indication of vision after 1 month of surgery, i.e., post-operative vision of those patients whose pre-operative vision was 6/60-6/24.

VISUAL ACUITY	MALE	FEMALE	TOTAL
Improvement	41	45	86
Same	04	02	06
Diminished	00	00	00

Table 8: Indication of vision after 1 month of surgery, i.e., post-operative vision of those patients whose pre-operative vision was <6/60.

VISUAL ACUITY	MALE	FEMALE	TOTAL
Improvement	01	02	03
Same	00	00	00
Diminished	00	00	00

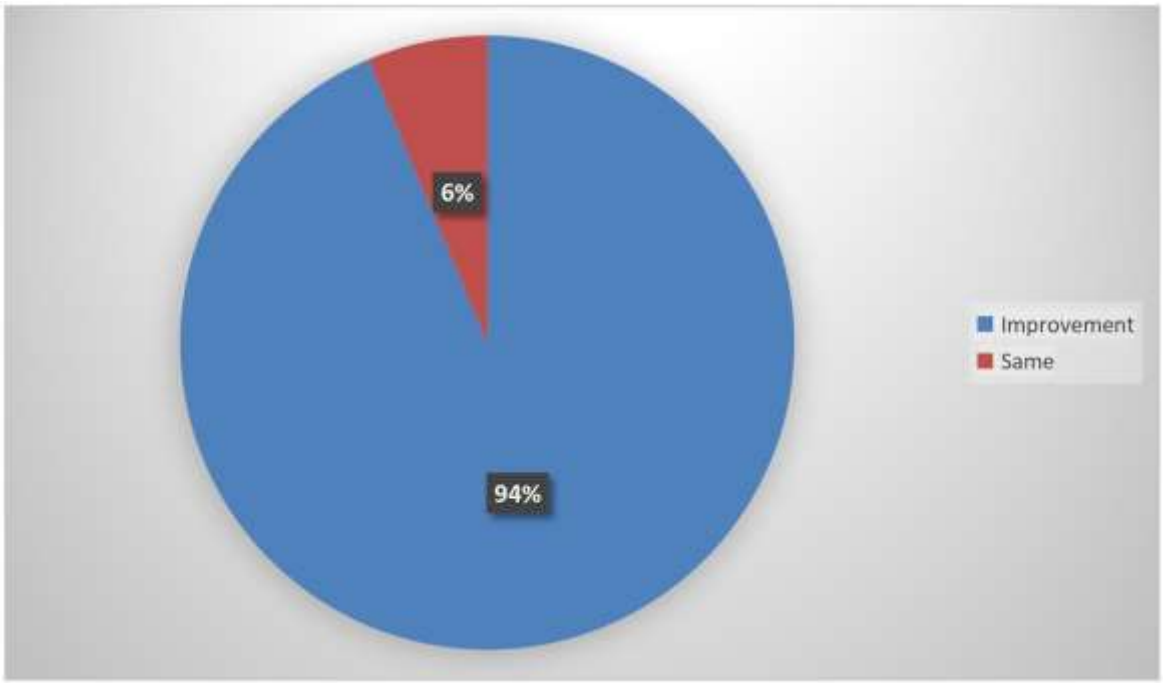


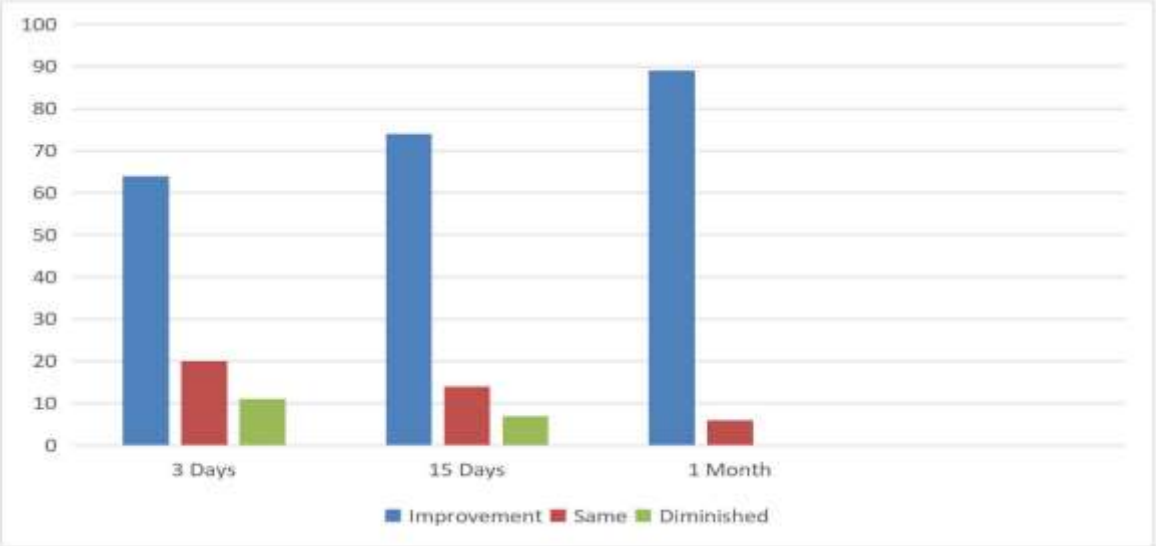
Figure 5: Showing the distribution according to visual acuity in all the 95 subjects after 1 month of follow-up, who were having visual acuity <6/60 and 6/60 to 6/24 pre-operatively.

- As seen in table 3 and table 4, it is seen that maximum number of patients, 62 and 2, respectively has shown

improvement in vision after 3 days of surgery, i.e., post-operative vision.

- As seen in table 5 and table 6, it is seen that maximum number of patients, 71 and 3, respectively has shown improvement in vision after 15 days of surgery, i.e., post- operative vision.
- As seen in table 7 and table 8, it is seen that maximum number of patients, 86 and 3, respectively has shown improvement in vision after 1 month of surgery, i.e., post- operative vision.

- **Bar Graph**
- The following bar graph shows the distribution of total number of subjects showing improvement in vision, same vision and diminished vision in each follow-up, i.e., 3 days, 15 days and 1 month.



7.1 Discussion

- Anatomical retinal openings that form at the fovea are known as macular holes. Although most macular holes are idiopathic, they can also occur as a result of ocular trauma or in very myopic eyes. The final visual acuity, visual improvement, and rate of more than or equal to 6/12 visual acuity have all been used to quantify visual success rates in macular hole surgery. The discovery of ongoing improvements in visual acuity following successful macular hole surgery supports the effectiveness of the procedure. Many studies have shown the visual improvement after macular hole surgery is up to 6/12 according to snellen's visual acuity chart but if a patients develops other retinal degeneration diseases after macular hole surgery, there may be chance of degradation of visual acuity to 6/36 or even less than that. In this study, we have taken a total of 95 subjects from M.L Sheth Vaduwala Eye Hospital, Vadodara with both urban and rural population of vadodara. We conducted a comprehensive eye examination on all the patients including visual acuity test and slit lamp examination. After the slit-lamp examination, the 95 subjects who were 60 years of age and above and were suspects of macular hole were told to have a OCT (Optical Coherence Tomography) examination. With this, we came to final results that these patients were having a macular hole. All these subjects were separated with the gender, i.e, male and female. A total of 95 subjects had 46 males and 49 females who were suffering from idiopathic macular hole. We excluded those patients who were below 60 years and were having any other ocular disease, ocular trauma or any surgery.
- The following data shows OCT reports of some of the patients which we included in our study:

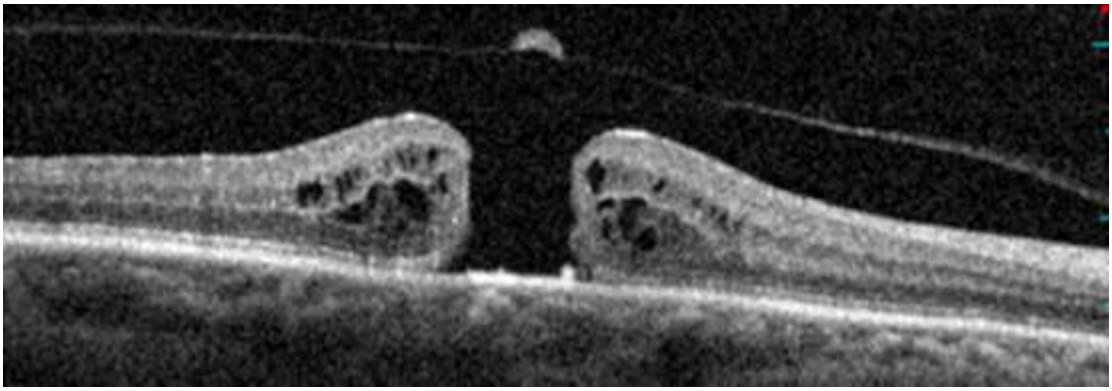


Image 1: OCT report of a female, aged 65, showing an idiopathic macular hole with visual acuity 6/60, pre-operatively.

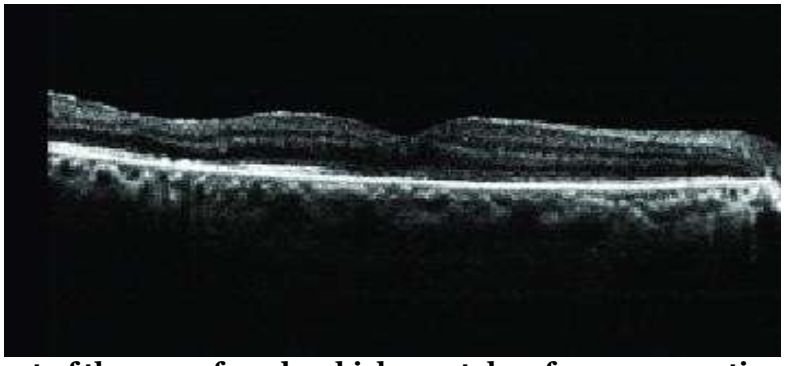


Image 2: OCT report of the same female which was taken for pre-operative OCT report, after vitrectomy was performed and the visual acuity was increased till 6/12 after 1 month.

➢ The subjects who were having <6/60 visual acuity were separated from those who had 6/60 to 6/24 pre-operatively. The patients with <6/60 visual acuity were 3 subjects and the patients with 6/60 to 6/24 visual acuity were 92 subjects. Males and Females were separated according to this data. The patients were called on follow-ups, after 3 days of surgery, after 15 days and after 1 month. On every follow-up the visual acuity of each patient was seen improving than previous follow-up. After 1 month, the visual acuity of patients with <6/60 vision pre-operatively, improved their visual acuity till 6/18. And the patients with 6/60 to 6/24 visual acuity pre-operatively, improved their visual acuity to 6/18 to 6/12. In this study, there were more number of females affected due to macular hole and also the improvement of vision was seen rapidly in females during the follow-ups.

8.1 Conclusion

➢ As a result, it is seen that after vitrectomy the visual acuity is increasing. After 3 days of surgery, the patients who were having 6/60-6/24 visual acuity pre-operatively has been increased to 6/36 and 6/24. After 15 days of surgery, the patients who were having 6/60- 6/24 visual acuity pre-operatively has been increased to 6/18 and 6/12, And the patients who were having <6/60 visual acuity pre-operatively has been increased to 6/24 and 6/18. After 1 month of surgery, the patients who were having 6/60-6/24 visual acuity pre- operatively has been increased to 6/18 and 6/12, And the patients who were having <6/60 visual acuity pre-operatively has been increased to 6/18 and 6/12. All total out of 100% of samples, 94% patients are seen having improvement in vision and 6% patients are seen having same vision post-operatively. It is observed that the number of females affecting due to macular hole are considerably more than the number of males.

9.1 Limitations

➢ In this study, only those patients with history of macular hole and patients with idiopathic macular hole were taken. The patients who were emmetrope or were having other ocular diseases were not taken. Patients who were below 60 years of age can be also included in the study but we have not included those patients, as there was an age limit set which was 60 years and above. The patients with history of strabismus (squint) can be also included but we did not include them because of the study criteria we have taken. Patients with history of undergoing surgery or surgery done in the past were also excluded from the study, as it may cause differences in vision in patients with macular hole. Patients with ocular trauma like globe injuries, blow-out fracture, penetrating trauma, chemical trauma, etc. were also excluded from the study. Very rare cases of macular hole in pediatrics and adolescents were seen, but they were also not included in the study. Low vision aids using patients were also excluded from the study, as they already had the retina related diseases and we were not considering any other ocular diseases other than macular hole.

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