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Audit of Macular Hole Surgery, Visual Outcome Prediction on OCT Appearance of Macular Hole

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Abstract: Full thickness macular hole patients undergoing, three port pars plana vitrectomy, ILM peel and phacoemulsification with lens implant. The audit compared anatomical closure and visual outcomes. Eleven out of 16 (69%) patients had a pre-operative best corrected visual acuity of 0.62 or worse on log-mar scale. Nine out of 16 (56%) patients had post-operative best corrected visual acuity of 0.30 or better.

Keywords: Macular Hole, Pars Plana Vitrectomy, ILM Peel, Phaco-vitrectomy, Hole Form Factor

1. Introduction

The purpose of audit was to compare our standards of practice with already established standards of care in the area/s of interest. There is paucity of available national guidelines/ audits on the macular hole surgery, improvement in patient outcomes and quality of care.

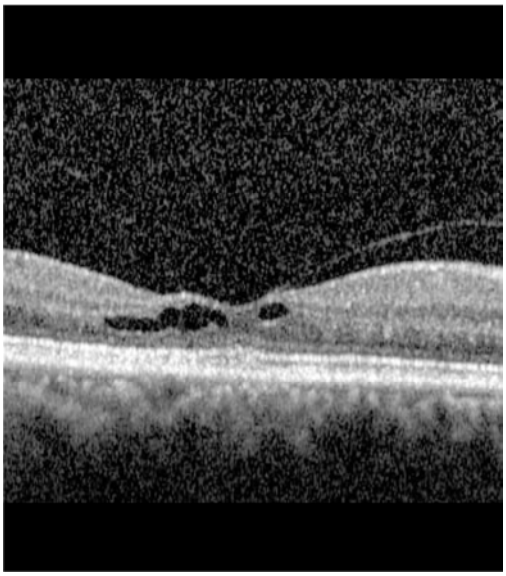

Figure 1. *Stage 1a/b macular hole[3] Vitreomacular traction without full thickness macular hole.*

In UK, incidence of macular hole is 1/10,000 population/ year, with male to female ratio of 2:1. [2] Mean age of onset 65 years. Aetiological factors include idiopathic, post-traumatic, cystoid macular oedema, vitreomacular traction, epiretinal membrane, rhegmatogenous retinal detachment, laser injury, pathological myopia with posterior staphyloma and hypertensive or diabetic retinopathy. Natural history of macular holes is variablee depending on stage.

Almost 40% of stage 1 macula holes progress to stage 2. About 11% of stage 2 holes regress. Larger holes tend to increase slowly in size with a drop in both visual acuity and potential for visual recovery after surgery. Ocriplasmin has been used to release vitreomacular traction in 27% and spontaneous recovery in 40% of stage 1 and 2 macular holes, fellow eye developing macular hole if PVD<1% and 10-2-% if no PVD in 5 years. [1]

Brief description of the staging of macular holes to better understand the treatment and outcomes of treatment. Stage 0 is basically asymptomatic vitreo-foveal adhesion and posterior hyaloid has partiallyy detached. Stage 1 is also asymptomatic, vitreomacular traction distorting foveal architecture but thee is no full thickness break. Lamellar defects and cysts on OCT examination. Stage 2 is full thickness defect with (usually) a cuff of subretinal fluid. Larger holes (>400 µm on OCT) are classified as stage 3.

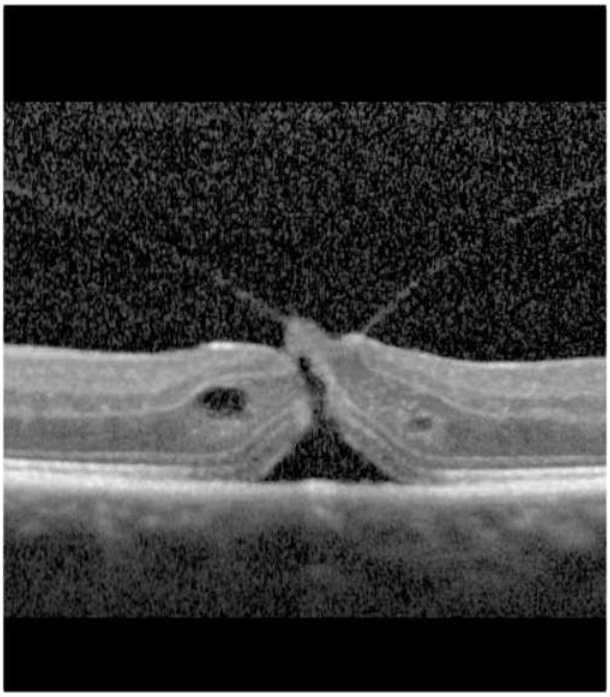

Figure 2. *Stage 2 macular hole [3] Full thickness macular hole with vitreo-macular traction.*

Figure 3. *Stage 3 macular hole [3] Larger full thickness hole <400 micron.*

There is vitreo-foveal separation although the vitreous remains attached to the disc. There is a small overlying operculum in stage 4.

Complete separation leads to "Weiss ring" formation.

Materials:

Cohort of patients selected had 8 male and 8 female patients. Age group as shown in graph 1 shows 8 patients out of 16 (50%) were between 70 to 80 years, showing the symptomatic age group. Known prognostic factors include duration of onset, pre-operative base diameter OCT, comorbidities like retinal detachment and cataracts.

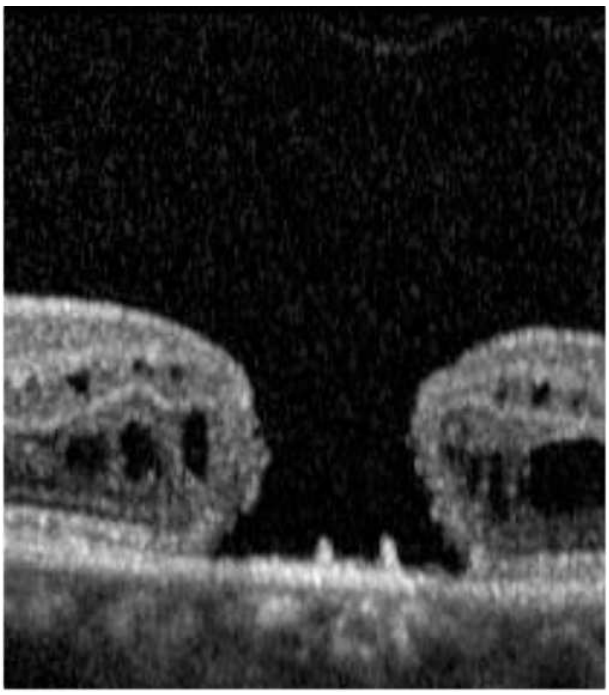

Figure 4. *Stage 4 macular hole [3]. Full thickness as in stage 3 plus operculum and separation of vitreous. Figure 1-4 Fig 1-4: OCT stages of macular hole.*

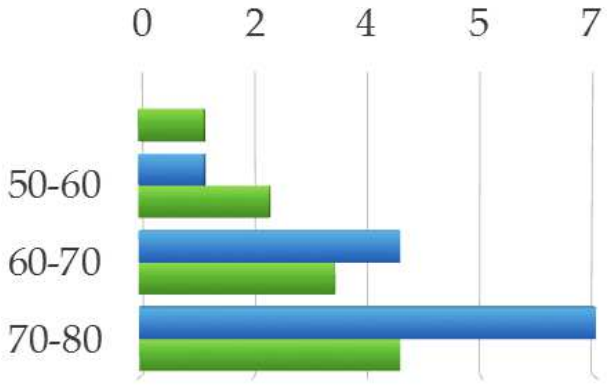

Figure 5. *Age group. The y axis has age in years and number of patients along x axis.*

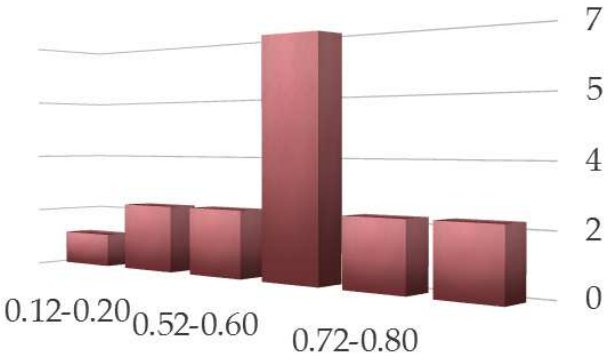

Figure 6. *Pre operative Visual Acuity Pre-operative visual acuity in log-mar scale along x-axis and number of patients along y-axis.*

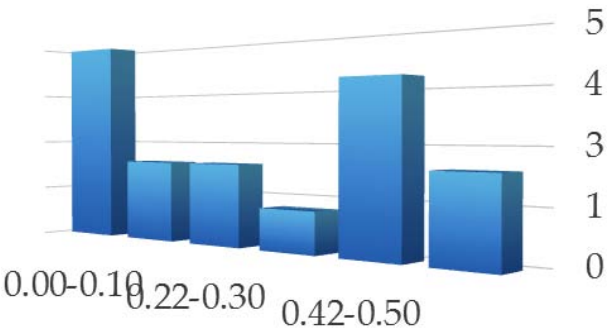

Figure 7. *Post operative Visual Acuity Post-operative visual acuity in log-mar scale along x-axis and number of patients along y-axis.*

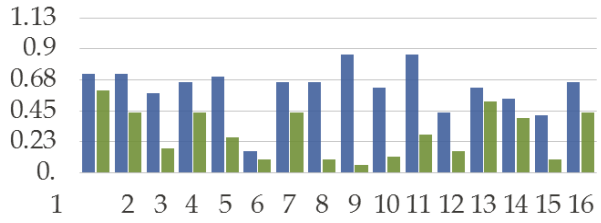

Figure 8. *Individual Best Corrected Visual Acuities.*

Visual acuity in log-mar scale along x-axis and number of patients along y-axis. operative Visual Acuity

Cohort of patients who had full thickness macular hole in one eye. None of the patient any previous retinal pathology or surgery. Three had history of hypertension on treatment, two type two diabetic and one with both without any retinopathy. One treated for rheumatoid arthritis and one for atrial fibrillation. Operated with three port pars plans vitrectomy, internal limiting membrane peel and C2F6 (16%) ±cataract surgery and lens implant under local anaesthetic. Ethnic origin 100 % (16 patients were white).

Although the small number of patients in our cohort of patients. But the results were numerically, visually and anatomically quiet unidirectional.

The selection of patients was from a consecutive group of patients undergoing the same procedure was performed as a standard. Selection of 25 gauge pars plant vitrectomy, C2F6 (16%), internal limiting membrane peel with dual blue as standard for every patient without any associated co-morbidity. Face down posturing was advised for next three days as standard for all the patients keeping in view, inter-patient variability of compliance and angle of posturing. Some patients had cataract surgery with intraocular lens implant for co-existent cataract. One of the patients developed it later but his best corrected visual acuity afterwards was taken into consideration.

2. Results

The audit compared anatomical closure and visual outcomes. Eleven out of 16 (69%) patients had a pre-operative best corrected visual acuity of 0.62 or worse on logmar scale. Nine out of 16 (56%) patients had post-operative best corrected visual acuity of 0.30 or better.

Complications were limited to high intraocular pressure which resolved with topical intra-ocular pressure lowering medications.

Comparison of our results to other studies and national dataset was extremely encouraging with regards to not only the anatomical and visual outcome but also extremely low rate of complications. (statistically insignificant).

Our results regarding anatomical success and final visual acuities showed a inverse relationship between post operative visual acuities and pre-operative “hole form factor” as shown in Table 1 and 2.

Base diameter and hole form factor (HFF) [4, 5, 6] been used previously as a prognostic factor for macular hole surgery. Ullrich, S., et al. "Macular hole size as a prognostic factor in macular hole surgery." British Journal of Ophthalmology 86.4 (2002): 390-393. To Calculate “the hole form factor” (HFF), originally created by Puliafito the ratio between the overlying tissue dimensions and the hole base diameter. It has been found to be of greater influence on the anatomical success rate than the base diameter alone. In their study 80% anatomical success rate in patients with HFF greater than 0.9 less than 25% in patients with HFF under 0.5. The association between HFF and anatomical success rate was found to be statistically significant in their study p value.0.05%. With respect to the correlation coefficient, r, the minimum diameter measured with OCT seemed to be a better predictor than the HFF. Figure 5.

Ullrich, S., et al. "Macular hole size as a prognostic factor in macular hole surgery." [4] They calculated the hole form factor (HFF), originally created by Puliafito.

He considered the ratio between the overlying tissue dimensions and the hole base diameter to be of greater influence on the anatomical success rate than the base diameter alone.

Puliafito found an 80% anatomical success rate in patients with HFF greater than 0.9 and an anatomical success rate of less than 25% in patients with HFF under 0.5. [4, 5, 6]

The association between HFF and anatomical success rate was found to be statistically significant. With respect to the correlation coefficient ‘r’, the minimum diameter measured with OCT seemed to be a better predictor than the HFF.

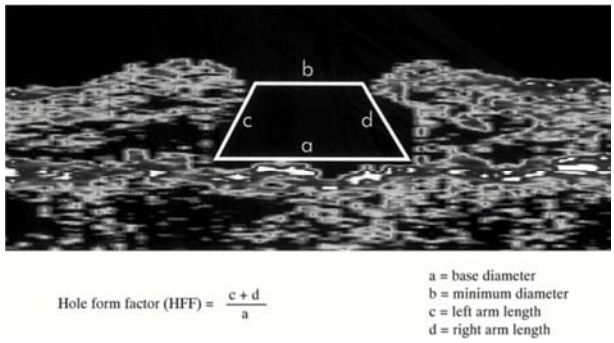

Figure 9. *Hole form factor.*

The various complications reported in the literature cataracts (50%) visually significant in two year period.1Retinal tear and detachment have been reported to be 1%, failure up to 10% anatomically and 20 % visually which

is a high number although keeping in view the case selection for these patients in our audit was completely unbiased.

Table 1. *Relationship between Post -op visual acuities and Hole form factor [4].*

Pre-op BCVA	Post-op BCVA	HFF
0.70	0.60	0.67
0.72	0.44	1.18
0.58	0.18	1.06
0.66	0.44	0.62
0.70	0.26	0.98
0.16	0.10	2.1
0.66	0.44	0.72
0.66	0.10	0.80
0.86	0.06	1.46
0.62	0.12	0.88
0.86	0.28	0.88
0.44	0.16	0.91
0.62	0.52	0.91
0.54	0.40	1.28
0.42	0.10	0.98
0.66	0.44	0.63

Table 2. *Correlation co-efficient and standard deviation of pre, post-operative visual acuities and Hole form factor [4].*

	PRE-OP BCVA	POST-OP BCVA	HFF
ST DEV	0.17	0.17	0.37
	Correlation Co-efficient 'r' -0.46		

Late opening was reported to be 5% [1] in literature. Our number of patients doesn't truly represent the rate of reoccurrence as the maximum follow up of patients was six months. Objective assessment and longer follow up or post operative period is a good indicator of percentage of actual recurrence and failure rates. The limitation in public health is delay in appointment times and lack of objective assessment of subtle signs of macular traction and delay in hospital appointments all lead to the worsening of anatomical and long term visual outcome of these patients. The purpose of this audit was not only to outline the various factors that contribute to the development of symptoms in these patients but also the various indicators of good visual prognosis.

The overwhelming factor was the need to do the Ocular Coherence Tomography scan of the macula at the early onset of these symptoms is probably the key to early diagnosis and better visual outcome. On the flip side of this picture is the awareness on part of the patients regarding the safety profile of surgery and when the surgical intervention is actually possible. We did not use any intervention like Ocriplasmin injections in our study or patients with previous history of these interventions. This is something that would be interesting to look at these patients and how they faired in the long run. Developing further therapies to prevent the progression of vitreomacular adhesion to traction or occult hole formation is something which will be helpful for future management of macular hole. Needless to say that co-morbidities like diabetes and other vitreo-retinopathies further aggravate the onset and progression of traction and atrophic changes after the onset and formation of macular hole.

3. Conclusions

Early detection of risk factors and close monitoring of at risk cases. Our results showed that early detection by OCT scans and determining the "hole form factor" is a helpful tool in assessing the level of risk. 10 out of 16 had phaco vitrectomy, in immediate post operative period one out of the other 6 developed cataract for which cataract surgery was performed. None required a redo procedure and one had post op high IOP and prolonged procedure during ILM peel. The same patient developed macular hole in other eye as had VMT, as well for which he was operated as well. Reduction in waiting time for surgery would improve final visual outcome as would prevent worsening of anatomical deterioration and better final anatomical and visual outcome post surgery. Better monitoring for at risk patients with vitreomacular traction as hole form factor seems to be lower in prolonged history and worse prognosis in terms of visual outcome. Macular hole dataset Royal College of Ophthalmologists 2015 [10] would prove to be of great value in further improving outcomes and associated co-morbidities. Duration between onset and final surgery is one of the limiting factors as well. Post operative refraction for all patients to ensure best corrected visual outcome measures recorded for all patients. All these measures are supportive and preventive in an ongoing basis and development of further treatment and monitoring strategies. Bigger group of patients, longer follow up is necessary to develop better prevention, care and management plan for these patients.

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