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Original Research Article

A prospective study of myoconjunctival enucleation for enhanced implant motility

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ABSTRACT

Background: After enucleation rehabilitation and cosmesis remain the nemesis of an enophthalmic socket, the cosmetic goal is to replace the lost volume of the socket and to restore natural appearance and movement with an artificial eye. The aim of this is to determine implant motility after myoconjunctival enucleation technique.
Methods: The study was conducted in 35 patients who underwent myoconjuctival enucleation at M and J Western Regional Institute of Ophthalmology, Civil Hospital, Ahmedabad from the period November 2019 to December 2021. Simple random sampling method was used and subjects were selected based on the inclusion and exclusion criteria. All patients were evaluated on 1st post-operative day, 1st week, 4th week and 12th week of surgery. Post-operative results were compared on the follow-ups in terms of motility index.
Results: Average motility index (sum of medial movement, lateral movement, upward movement and downward movement divided by 4) of the 35 patients measured after first week of surgery was 3.2 mm, which was 3.21 mm in 4th week and at 12th week it was 3.23 mm.
Conclusions: In contrast to conventional enucleation technique, in myoconjunctival enucleation technique each rectus is sutured to the respective fornix thus preventing stretching, increasing implant stability and motility. Thus it is considered procedure of choice in primary enucleation.

Keywords: Myoconjuntival enucleation, Motility index, Orbital implant, Artificial eye

INTRODUCTION

Enucleation is a surgical procedure in which the globe and the attached portion of the optic nerve are excised from the orbit.[1] Rehabilitation and cosmesis remain the nemesis of an anophthalmic socket.[2] After enucleation, the cosmetic goal is to replace the lost volume of the socket and to restore natural appearance and movement with an artificial eye.

In enucleation surgery where the socket was left empty, many patients encountered the post enucleation socket syndrome (PESS): enophthalmos, superior sulcus depression, upper- and lower lid ptosis, and experienced little to no movement of the prosthetic eye.

Implants of various materials, shapes and sizes are used. These include glass, gold, titanium, vitallium and silicon, hydroxyapatite, protoplast (a combination of teflon fluorocarbon polymer and vitreous carbon) and gortex.

An orbital implant may be wrapped for protection of overlaying conjunctiva and for attachment of the rectus muscles. The rectus (and sometimes oblique) muscles may be attached to the wrapping at different positions directly to the implant fornices (myoconjunctival technique), or not reattached at all. The implant can be inserted directly after enucleation (primary implant), or at a later stage (secondary implant).

Major post-operative complications consist of socket infection, implant exposure or extrusion and socket contraction, all with a high chance of inevitable secondary surgeries.

We have used polymethyl methacrylate (PMMA) material as implant. PMMA is known in ophthalmology for its use in rigid and semi-rigid contact lenses, due to its excellent biocompatibility with ocular tissues and transparency to visible light. PMMA material offers a less hard and weighty substitute which is in itself an advantage. It also has the lowest rates of exposure and extrusion.[3] It is cheap, easily available, well tolerated and with low complication rate. PMMA is an excellent biomaterial for ophthalmic applications.

There are majorly three techniques employed for enucleation are conventional imbrication enucleation technique, integrated implant enucleation technique and myoconjuctival enucleation technique.

In the conventional PMMA implant technique, the muscles are imbricated to each other over the implant.

However, in the myoconjunctival PMMA implant technique, each rectus muscle is sutured to the respective fornix.

We have done a myoconjuctival technique of enucleation and motility index is used for quick and reliable assessment of implant motility.

METHODS

The prospective analytical study was conducted at M and J Western Regional Institute of Ophthalmology, Civil Hospital, Ahmedabad from April 2018 to March 2021 among 35 eyes of the patients who have undergone myoconjunctival enucleation for malignant and non-malignant indications. Subjects of all age group and both the sexes undergoing unilateral enucleation with primary implant were selected, and patients with enucleation without implant, conjunctival shrinkage, adnexal deformities, and patients posted for secondary implants and patients not willing to participate were excluded from the study.

Ethical measures were also adhered to throughout all phases of the study through the measures which recognized and protected the rights of the informants. Prior to conducting the study we explained the nature of the study and the responsibility of each participant. Subjects/guardians who participated were fully informed of the nature of the research and had the freedom to withdraw from the study at any point of time. Anonymity and confidentiality of the participants were protected.

Simple random sampling was used because study was conducted among enucleation in retinoblastoma, choroidal melanoma, anterior staphyloma patients and any sample drawn was unlikely to be seriously biased. The sample size consisted of 35 eyes of patients scheduled for primary enucleation in retinoblastoma, choroidal melanoma, and anterior staphyloma patients.

All the patients were followed up to 4 months, and the postoperative results were compared for motility of implant and the complications.

A thorough systemic and ocular examination was conducted. Whenever if posterior segment was not visualized than B-scan ultrasonography was done and magnetic resonance imaging (MRI) was requested to rule out involvement of optic nerve and orbital extension of intraocular malignancy.

All surgeries were performed by the same surgeon under general anaesthesia or peribulbar anaesthesia and a spherical PMMA orbital implant was used in all cases.

Implant size was decided by the following calculation.

$$AL - 2 = Implant\ diameter\ in\ mm$$

Where AL is axial length of the fellow eye in mm.

All patients were given topical antibiotics and steroids in tapering frequency for four weeks of the surgery. Artificial eye was given after 12 weeks of surgery.

For objective measurement of implant motility, with the patient looking in the primary gaze, a dot was marked in centre of the socket with a non-toxic marker.

Medial movement

The patient was instructed to look medially from the primary gaze and the position of the dot of ink mark was measured using a standard mm ruler for measuring medial movement.

Lateral movement

The patient was instructed to look laterally from the primary gaze and the position of the dot of ink mark was measured using a standard mm ruler for measuring lateral movement.

Horizonatal excursions

For measuring horizontal excursions the patient was instructed to look to the extreme left then extreme right excursion of the ink mark was measured using a standard mm ruler.

Upward movement

The patient was instructed to look upward from the primary gaze and the position of the dot of ink mark was measured using a standard mm ruler for measuring lateral movement.

Downward movement

The patient was instructed to look downward from the primary gaze and the position of the dot of ink mark was measured using a standard mm ruler for measuring lateral movement.

Vertical excursions

For measuring vertical excursions the patient was then instructed to look to the extreme upward and the extreme downward, excursion of the ink mark was measured using a standard mm ruler.

Motility index

Total horizontal and vertical excursions were calculated. The mean of upward, downward, medial and lateral movements was calculated and was be label as the "motility index" (MI).

$$MI = Medial\ movement + lateral\ movement + upward\ movement + downword\ movement/4$$

All patients were evaluated on 1st post-operative day, 1st week, 4th week and 12th week of surgery.

RESULTS

In this study myoconjunctival enucleation was done m 35 eyes of 35 patients who underwent enucleation.

We looked for symptoms like pain, and watering, lid oedema ecchymosis, chemosis/wound gape, haematoma, exposure/ extrusion of implant, and implant motility was measured.

Age group wise distribution of the 35 patients is depicted in Table 1.

Table 1: Age group wise distribution of 35 patients.

Age wise distribution	Number of patients	Percentage of patients
Below 5	31	88.57
Above 5	4	11.43

Gender wise distribution of patients who have undergone enucleation is represented in Table 2.

Average medial movement, out of 35 patients measured during 1st week after surgery was 4.16 mm which was increased to 4.17 mm in 4th week and at 12th week was 4.2 mm (Figure 1).

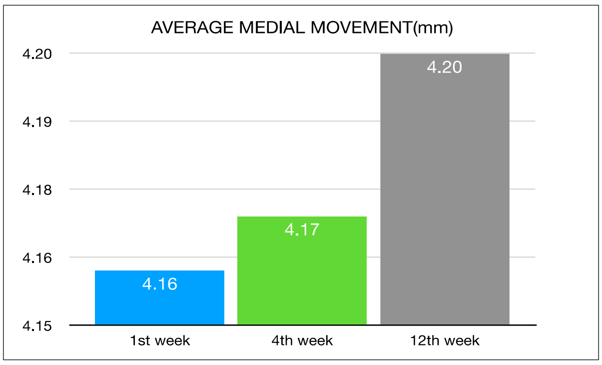

Figure 1: Average medial movement.

Table 2: Gender wise distribution of patients.

Gender wise distribution	Number of patients	Percentage
Male	16	45.71
Female	19	54.29

Average lateral movement, out of 35 patients measured during 1st week after surgery was 2.61 mm, which was 2.62 mm in 4th week and at 12th week was 2.64 mm (Figure 2).

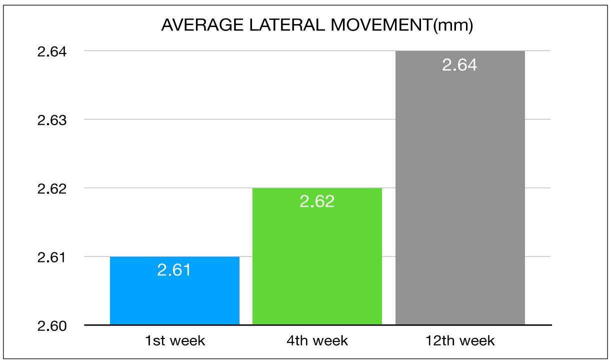

Figure 2: Average lateral movement.

Average horizontal excursions, out of 35 patients measured during 1st week after surgery was 6.77 mm which was to 6.79 mm in 4th week and at 12 week was 6.84 mm (Figure 3).

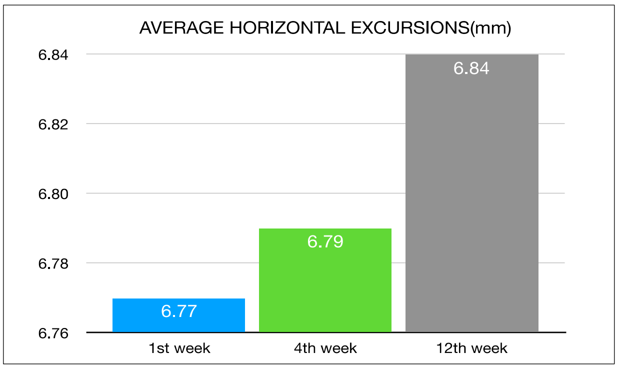

Figure 3: Average horizontal excursions.

Average upward movement out of 35 patients measured during 1st week after surgery was 3.07 mm, which was to 3.07 mm in 4th week and at 12th week was 3.10 mm (Figure 4).

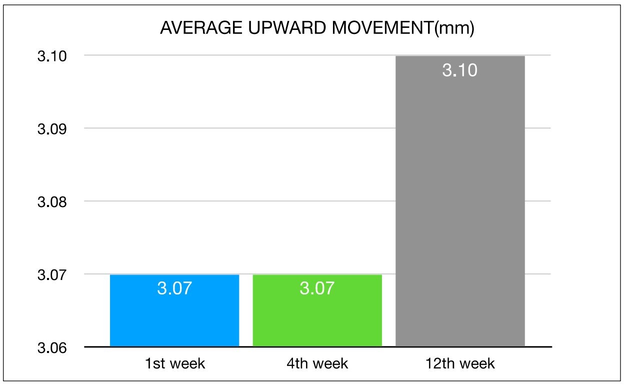

Figure 4: Average upward movement.

Average downward movement, out of 35 patients measured during 1st week after surgery was 2.98 mm, which was to 2.99 mm in 4th week and at 12th week was 3.00 mm (Figure 5).

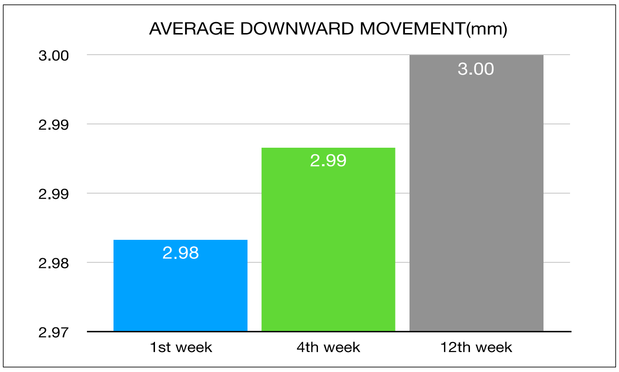

Figure 5: Average downward movement.

Average vertical excursions, out of 35 patients measured during 1st week after surgery was 6.05 mm, which was to 6.05 mm in 4th week and at 12th week was 6.10 mm (Figure 6).

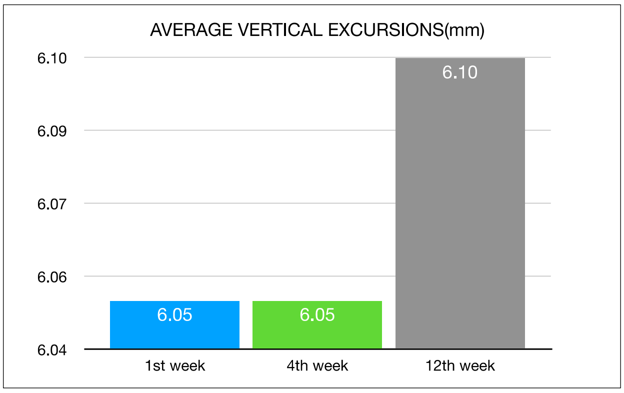

Figure 6: Average vertical excursions.

Average MI, out of 35 patients measured during 1st week after surgery was 3.20 mm, which was to 3.21 mm in 4th week and at 12th week was 3.23 mm (Figure 7).

Figure 7: Average motility index.

DISCUSSION

The patients undergoing enucleation loose not just their self-esteem but also social acceptability due to poor cosmesis. Absence of implant results in absence of stimulation for bony orbital growth which can result in hemifacial hypotrophy. The conventional method of enucleation provides less motility of the socket and patients have no choice but to accept a suboptimal cosmesis.

Chen described the interrelationship of forniceal movement and prosthetic movement. Nunery and Chen together with McCord outlined the myoconjunctival technique (MCT) of enucleation.[4]

In the conventional PMMA implant technique, the muscles are imbricated to each other over the implant, this causes stretching of the muscles.

However, in the myoconjunctival PMMA implant technique, each rectus muscle is sutured to the respective fornix, thus preventing stretching. An important aspect of implant movement is the contraction of the rectus muscles.

According to the Starling hypothesis, muscle contraction is compromised by unduly stretching it beyond its original length, and this is believed to have been responsible for the decreased prosthesis movement after the traditional PMMA implant technique.[5]

Also, the displacement of the implant in the conventional enucleation had impaired implant movement further. Poor implant movement in turn leads to poor prosthesis movement because spherical implants impart movement to the prosthesis by providing a smooth pivotal surface over which the prosthesis glides passively. This accounts for poorer prosthesis movement in conventional enucleation.

Honavar et al found that the prosthesis movement associated with the myoconjunctival PMMA implant was better than that of the traditional enucleation with PMMA and porous polyethylene implant.[6] They also found that in the myoconjunctival PMMA implant technique, the attachment of the extraocular muscle to the fornices causes exaggerated deepening and shallowing of the fornices when the patient attempts to look in different directions of gaze, thereby causing further enhanced prosthesis movement.

Honavar et al found that in myoconjuctival technique adduction was 3.67 mm, abduction was 4.00 mm, horizontal movement was 7.67 mm, supraduction was 2.82 mm, infraduction was 3.18 mm, vertical movement was 6.00 mm, while in Yadava et al medial movement was 4.4 mm, lateral movement was 2.80 mm, horizontal excursions was 7.20 mm, upward movement was 3.20 mm, downward movement was 3.00 mm, vertical excursions 6.5 mm. In our study we found that medial movement was 4.20 mm, lateral movement was 2.64 mm, horizontal excursions was 6.84 nm, upward movement was 3.10 mm, downward movement was 3.00 mm, vertical excursions 6.10 mm.

MI was 3.40 in Yadava et al myoconjuctival enucleation, while in our study it was 3.23 m.[7]

According to Kaltreider et al, axial length of the fellow eye (measured by ultrasonography) can be used to predict the implant size before surgery.[8]

Thaller described the use of water displacement in a graduated measuring cylinder for predicting the implant size.[9] Optical sizers are also available for the same purpose. We used different size and same material (pre-sterilized PMMA) of the implant in all patients.

Honavar et al, 40% of the traditional PMMA implants were displaced, none of the myoconjunctival PMMA implants were displaced. In our study we did not found any implant migration or extrusion.

Honavar et al, Allen et al and Chen et al also found that the muscle migration over the anterior surface of the implant in the traditional PMMA implant technique was responsible for the higher rate of implant displacement. The deep orbital placement of the implant, the secure posterior tenon's capsule over it, and the suturing of the extraocular muscles to the fornices in the myoconjunctival PMMA implant technique have helped implant centration better.

According to Dortzbach implant extrusion is caused by orbital haemorrhage, infection and lack of secure closure of tenon's capsule.[10] According to Peyman, a spherical implant is easier to fit with prosthesis and minimizes pressure and friction points, thus preventing tissue necrosis and extrusion. Wrapping the implant with sclera prevents implant migration and extrusion. Nunery et al reported 0.84% extrusion with silicone implant. In our study, we did not find any postoperative complication or extrusion of implant.

Custers et al reported similar motility with silicon and HAP implants.[11]

Our study has certain limitations which can positively or negatively affect our study results, such as use of customized implants can show better motility and cosmetic results in post-operative period.

Moreover, the follow up could be maintained only up to 12 weeks and greater duration can give better results. Last but not the least, results of this study will give more significance if sample size is large.

CONCLUSION

In conventional enucleation muscles are attached to each other in front of the implant, causing stretching of the muscles. On the other hand, in myoconjuctival enucleation technique, each rectus is sutured to the respective fornix, thus preventing any stretching, this increases implant stability and provides good implant motility.

We therefore recommend the use of myoconjuctival enucleation technique with PMMA implant as the procedure of choice in primary enucleations in malignant and non-malignant conditions.

Myoconjuctival enucleation technique combined with a well-fitting and well painted prosthesis can make all the difference in the final cosmetic result.

Results can be further augmented by use of a custom-made prosthesis.

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