·Clinical Research·

Autologous sclera-muscle flaps technique in evisceration with hydroxyapatite implantation

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Abstract

• **AIM: To provide superior cosmetic results and reduce complications, unlike traditional evisceration coupled with implant insertion technique and its modifications, we have developed a novel and simple technique for anophthalmic patients.**

• **METHODS: All patients who underwent the scleral-muscle flaps procedure in evisceration with the placement of hydroxyapatite implant were included in the study. Main outcome measures were complications such as exposure, infection, chemosis, conjunctival inclusion cysts, granulomas. Meanwhile, implant motility was indirectly measured and the results were collected and analyzed.**

• **RESULTS: A total of twenty-eight patients were enrolled in the study. Eighteen were men (64.29%) and ten were women (35.71%). Ages ranged from 18 to 65y (mean age, 32 years old). Mean follow-up was 12.32mo (range, 9-16mo). All patients received a hydroxyapatite implant. The average diameter of the implant was 19.29±1.36 mm (range, 18-22 mm). Minor complications occurred in 3 patients, and a major complication was observed in 1 patient. Mean motility were 11.04±1.45 mm horizontally (range, 7-14 mm) and 8.57±1.50 mm vertically (range, 5-12 mm).**

• **CONCLUSION: The sclera-muscle flaps technique in evisceration with hydroxyapatite implantation is simple and practical that eases the surgical procedure, enables a proper size hydroxyapatite implantation, distinctively reduces complications and provides superior surgery results, especially the motility of the implant.**

• **KEYWORDS:** sclera-muscle flaps; hydroxyapatite implantation; evisceration

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INTRODUCTION

It is widely accepted that eyes are significant to the facial appearance. However, for many diseases, such as endophthalmitis, phthisis bulbi, traumatic injury and glaucoma, removal of the eye or the eye content is necessary. After which, the patients with an empty or anophthalmic socket have been observed obvious facial deformity, such as enophthalmos and asymmetry eyes [1]. Consequently they developed a series of psychosocial difficulties [2]. Hydroxyapatite orbital implant insertion and prosthesis wearing is a predominant rehabilitation therapy for correcting facial deformity of anophthalmia nowadays. Among various methods to perform the plastic and reconstructive surgery, the most commonly used is evisceration coupled with implant insertion. Evisceration involves the complete removal of the internal contents of the eye with the preservation of the scleral shell and the extraocular muscle attachment, followed usually by placement of an orbital implant to replace the lost ocular volume. With hydroxyapatite insertion, couples of complications may occur. The most common complication of this intervention surgery is exposure of the implant, which would also lead to poor cosmetic results. An important cause of this complication is the placement of an orbital implant that is too large to allow closure of the sclera, Tenon's capsule, and conjunctiva without tension [3]. Based on the analysis above, we have developed a new evisceration technique to provide superior surgical results, especially to prevent tension on wound closure. Meanwhile our study was undertaken to evaluate the performance of this new technique with hydroxyapatite implantation.

SUBJECTS AND METHODS

Twenty-eight patients who underwent evisceration with the sclera-muscle flaps technique were included in the study. Patients not undergoing the described procedure were excluded. Patient demographics, indications, the size of the implant, duration of follow-up, motility and postoperative complications were recorded. Records were analyzed to

assess outcome. Ethics approval was obtained from the hospital Institutional Review Board and the study conformed to the provisions of the Declaration of Helsinki.

Under retrobubal anesthesia, an eyelid speculum was placed between the eyelids for retraction. A 360-degree conjunctival peritomy was performed with Westcott scissors. The anterior chamber was entered with a No. 11 blade at the corneal limbus in the temporal quadrant. By incising the sclera circumferentially posterior to the surgical limbus, the cornea was removed with Westcott scissors. The uvea was then separated from the sclera with an iris resetter, and the eye contents were delivered with an evisceration spoon. All visible uveal tissue was removed (Figure 1A). Stevens scissors were used to perform radial arcuate scleral incisions. The lateral incision was started from the limbus at 2 o'clock, arcuately extended to the equator at 3 o'clock, then carefully turned to the front, symmetrically performed to the limbus at 4 o'clock, avoiding damage to the lateral recuts muscle (Figure 1B). Then the sclera-muscle flap was made with the intact lateral rectus muscle attached to the scleral flap. Likewise, the medial radial arcuate incision was performed from the limbus at 10 o'clock to the equator at 9 o'clock and then turned forward to the limbus at 8 o'clock, leaving the attachment of the medial rectus muscle intact (Figure 1C). A proper size hydroxyapatite implant with pore diameter of 500 micron was placed in the scleral shell (Figure 1D). The two sclera-muscle flaps were easily brought over the implant, and were then interrupted sutured with 6-0 Vicryl suture without tension on the wound (Figure 1E). The vertical sclera shell was also interrupted sutured to the front-brought horizontal sclera-muscle flaps with 6-0 Vicryl sutures (Figure 1F). The overlying Tenon capsule closure was achieved with several interrupted 6-0 Vicryl sutures, and the conjunctiva was closed with a continuous 5-0 silk suture (Figure 1G). An appropriately sized conformer and antibiotic/corticoid ointment [Dikeluo/ Tobramycin and Dexamethasone Eye Ointment (TobraDex)] were inserted in both procedures. A temporary sterile gauze was then placed and a pressure dressing was applied for 48h. Postoperatively, oral antibiotics and steroid and antibiotic eye drops were prescribed. The conjuctival suture was removed 5 to 7d after surgery and prostheses were placed 4 to 6wk later. Postoperative follow-up evaluations were scheduled at 48h; 1, 2wk; 1, 3, 6mo and then once yearly.

Patients were examined for the presence or absence of complications, such as exposure, infection, chemosis, conjunctival inclusion cysts, granulomas. Implant motility was also indirectly determined by measuring the globe movement in extreme gaze positions at each follow-up visit, but only the results of the last follow-up were used for analysis. To measure the globe movement, the prosthesis was removed and conjunctiva was marked directly over the center of implant. Then the patient was directed to look in extreme gaze positions. The horizontal and vertical excursions of the marking were measured with a standard millimeter ruler. Each direction of gaze was measured 3 times and the mean value of the horizontal and vertical movements was calculated. The information gathered was analyzed by SPSS 21.

RESULTS

A total of 28 patients, 18 males (64.29%) and 10 females (35.71%) underwent the above described procedure. Indications for the surgery were painful blind eye, cosmetically unacceptable blind eye and acute trauma. Of the 28 patients, the average age at the time of surgery was 32y (range, 18-65y), while mean postoperative follow-up period was 12.32mo (range, 9-16mo). All patients received a standard commercial round hydroxyapatite implant at the time of surgery. Thirteen patients received a 18 mm implant, 12 patients received a 20 mm implant and 3 received a 22 mm implant. The average diameter of the implant was 19.29±1.36 mm (range, 18-22 mm). Postoperative complications occurred in 4 of 28 patients (14.29%). Mean motility was 11.04±1.45 mm horizontally (range, 7-14 mm) and 8.57±1.50 mm vertically (range, 5-12 mm).

A major complication was observed in one patient. In this case, a 44-year-old man developed an implant exposure 10mo after surgery. To treat the patient, an allogeneic sclera patch was used to cover the defect after the bulbar conjunctiva was reopened. And then bulbar conjunctiva was re-sutured. No re-exposition was observed after 12mo of follow-up. Minor complication occurred in 3 patients (10.71%). One patient developed granuloma. He was efficiently treated with a granulomas resection. One patient was observed a conjunctival wound dehiscence three days after surgery. The primary cause of the complication was that the patient had a severe chemosis, while the continuous suture was not knotted at the end. For most patients, the unknotted suture would not be loosened, however, for the patient with chemosis, it lacked sufficient tension to keep the wound close. Under local anesthesia, the patient was treated with multi-point acupuncture of the edematous conjunctiva with a 25 G syringe needle after the conformer was removed. Sterile cotton swabs were then applied to squeeze the edematous area. With the outflow of the interstitial fluid, the chemosis was mitigated, after which the conjunctiva was re-sutured and a pressure dressing was applied for 24h. TobraDex was then prescribed, and no conjunctival wound dehiscence was observed later. All the patients had excellent motility and satisfying cosmetic results after being fitted with a molded prosthesis. No other postoperative complications were documented (Table 1).

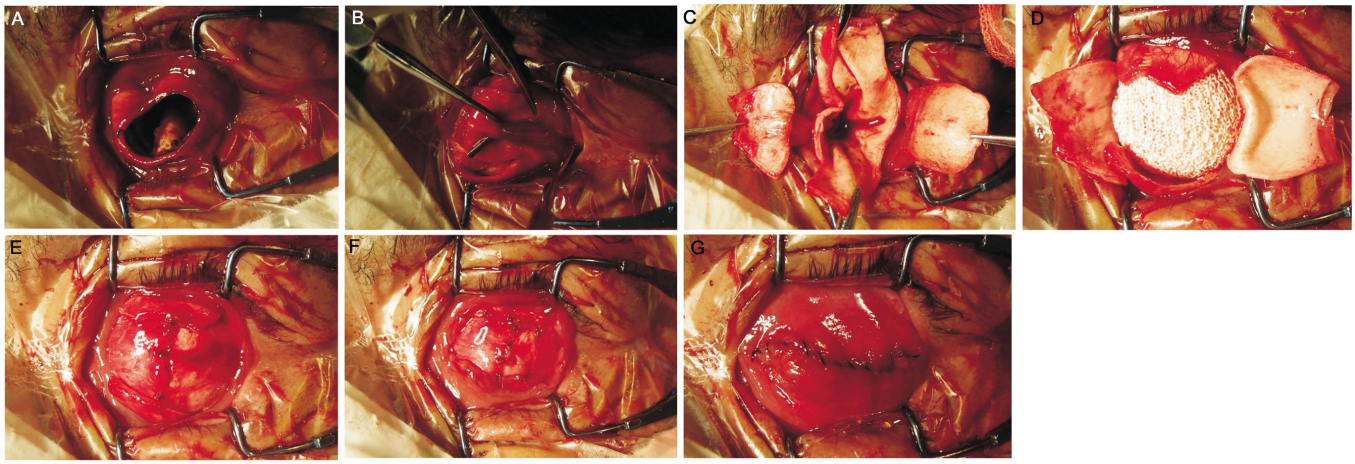

Figure 1 Surgical procedure A: The removal of eye contents; B: The lateral incision; C: The two sclera-muscle flaps; D: The implant placement; E: The horizontal sclera-muscle flaps suturing; F: The vertical sclera shell suturing to the sclera-muscle flaps; G The conjunctiva suturing.

Table 1 Complications

Complications	Cases	Gender	Age (a)	Indications	Implant size (mm)	Follow-up period (mo)
Major						
Exposure	1	M	44	2	18	13
Minor						
Chemosis	1	F	40	1	20	12
Conjunctival inclusion cysts	1	M	35	3	20	14
Granuloma	1	M	65	1	18	9

Indications: 1, painful blind eye; 2, cosmetically unacceptable blind eye; 3, acute trauma (refering to "Enucleation With Hydroxyapatite Implantation Versus Evisceration Plus Scleral Quadrisection and Alloplastic Implantation" [4])

DISCUSSION

Evisceration is a widely performed procedure for the treatment of painful blind eye or acute trauma. It is preferable to enucleation because of evisceration include less operation duration, relative preservation of orbital tissue, better cosmetic result, superior implant mobility, and lower extrusion rate of orbital implant [5-8]. The drawback of conventional evisceration is the inadequate volume replacement with small implants and significant exposure risk with larger ones[7].

Since 1817, the early evisceration of the eye was introduced by Timothy *et al* [9], the evisceration technique had undergo various modifications in an attempt to allow a larger size implant insertion and to reduce closure tension as well [8]. In 1987, in an attempt to permit the placement of larger implants with a low exposure rate. Stephenson[10] reported 15 cases of patients who underwent evisceration procedures performed with expansion sclerotomies. It was noted that, because of scleral shrinkage might occur during the healing periods, the size of the implant was usually between 14 to 16 mm without the sclerotomy, thus it could not guarantee a tight implantation[10]. In 2000, Dresner and Karesh[11] reported a modified technique. According to their description, a 360-degree sclerotomy was performed around the optic nerve, and relaxing incisions were made in the sclera posteriorly between the extraocular muscles to enlarge the scleral pocket. This procedure enabled the placement of maximal 20 mm sphere. Over the past decade, scleral quadrisection and modified evisceration techniques have been developed, mostly involving additional scleral incisions that allowed the placement of larger implants (maximal 22 mm) while reducing complications[4,7]. In 2011, Smith *et al*[12] also reported a two-scleral-flap technique performed in 201 patients with a low exposure rate.

Recent years, we have used the sclera-muscle flaps technique carried out with placement of hydroxyapatite implantation to replace the orbital volume lost in 28 patients. In our series, eighteen were men (64.29%) and ten were women (35.71%). Ages ranged from 18 to 65y (mean age, 32 years old). Compared with the study of Smith *et al*[12] (mean age, 52y), our mean age is much younger. Two factors may contribute to this result. One is that some of the elderly Chinese patients have no cosmetic demand or no money for the cosmetic surgery and some prefer cyclocryopexy to evisceration or enucleation. The other is that young men take the major part of the manual labor, which in China, lack sufficient protective measures. Mean motility were 11.04 ±1.45 mm horizontally (range, 7-14 mm) and 8.57±1.50 mm vertically (range, 5-12 mm). Our results were similar with the study of Dresner and Karesh [11]. Their mean motility were 10.25±

1.99 mm horizontally (range, 5.9-15 mm) and 8.45±1.89 mm vertically (range, 4.3-12 mm). Our technique provides slightly better motility, especially in the horizontal direction. The superior motility is probably because the muscle attachment points were brought forward in our surgery. Complications occurred in 14.29% of patients; minor complications were observed in 3 patients (10.71%) and a major complication was observed in 1 patient (3.57%). In this case, a 44-year-old man developed an implant exposure 10mo after surgery. He was a patient with severe eyeball atrophy because of an ocular trauma in his childhood. Though the minimum diameter of the implant was chosen, we didn't have enough scleral shell to cut into flaps of proper size to cover the whole anterior surface of the implant. Conjunctival tissue's long period contact with the asperity surface of the implant lead to the implant exposure. To treat the patient, bulbar conjunctiva was reopened, an allogeneic sclera patch was used and the bulbar conjunctiva was re-sutured to cover the defect without re-exposure after 12mo of follow-up. It is suggested that with regard to patients with microphthalmia, allogeneic scleral patch should be placed, or the implant should be trimmed.

To ease the surgical procedure, our experience indicated that the two sclera-muscle flaps are adequate enough for the superior lax effect, there is no need to perform extra incision to make four sclera-muscle flaps. For sclera-muscle flaps selection, we prefer to perform the operation in the lateral nasal and temporal side direction than above and below. Because the superior and inferior oblique muscles lie in the vertical direction near the superior and inferior rectus muscles, operating in the horizontal direction would minimize the interference of the extraocular muscles.

For implant selection, we believe that hydroxyapatite with pore size of 500 micron, which has conspicuous merits, is the material of choice. First, hydroxyapatite is nontoxic, little immune rejection, and highly biocompatible. Second, hydroxyapatite was bio-inert and structurally strong. It can maintain the volume in the cavities, which helps to lower the risk of postoperative enophthalmos and provide better cosmetic results. Third, its microporous structure facilitates ingrowth of host fibrovascular tissue, because of which less migration and extrusion are found [13]. Though its rough surface might enhance the exposure risk, however, exposures associated with hydroxyapatite orbital implants has been proved decreased over time and have been managed successfully, both before and after pegging [14]. Besides, we prefer the pore diameter of 500 micron, of which size the facilitation of fibrovascularization and the structural solidity were balanced.

In comparison with other techniques in evisceration and implant insertion, our sclera-muscle flaps technique has several advantages. First, by bringing anterior the sclera-muscle flaps, the muscle attachment points are moved forward, which strengthens the muscle tension, resulting in superior motility (Figure 2). And yet no enophthalmos has been observed. Also, slight enophthalmos could be made up by the prosthesis. Second, isolating the sclera-muscle flaps from the scleral shell enables a direct wound closure without tension that is regarded as a key factor for the prevention of implant exposure. Meanwhile, it makes the surgical procedure easier to perform. In comparison to two sclera flaps technique reported by Smith *et al*[12] and other posterior evisceration technique with posterior sclerotomy or equatorial sclerotomy reported respectively by Nakra *et al*[6] and Huang *et al* [7], our technique is much easier to perform. The sclera was dissected from the limbus to the equator in our technique, while the sclera dissection performed by others was from the anterior limbus to posterior the optic nerve, or 360-degree equatorially. Our technique eases the surgical procedure and avoids unnecessary intraobital interference. Besides, compared with the quadrisection technique described by Dresner and Karesh [11], our technique has a superior lax effect. According to our clinical experience, the four scleral flaps directly connect to the optic nerve, which may restrict the scleral flap from moving forward. However, our technique permits the sclera-muscle flaps isolated from the sclera shell. Namely, the flaps are free from the posterior optic nerve and can be easily drawn to the front. Third, most part of the implant was wrapped by the autologous scleral shell, avoiding interference with the intraobital tissue, while the equatorial part of the implant directly contacts with orbital tissue, promoting fibrovascularization from the equatorial surface [6,15] (Figure 3). Last but not the least,

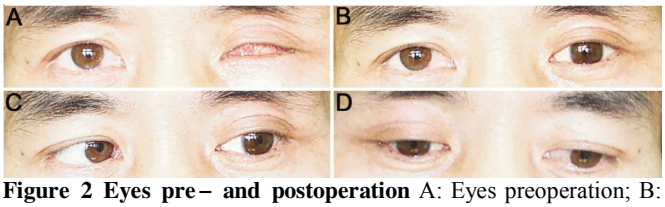

Figure 2 Eyes pre- and postoperation A: Eyes preoperation; B: Eyes posteroperation; C: Eye position in left gaze postoperatively; D: Eye position in downward gaze postoperatively.

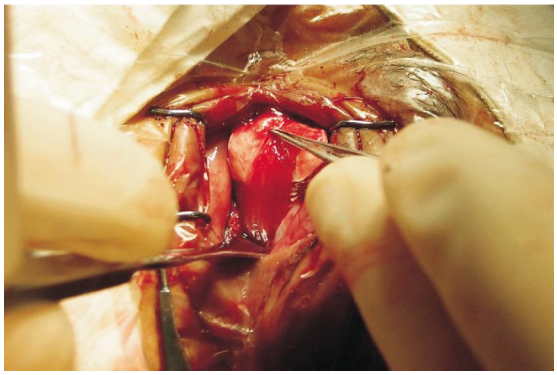

Figure 3 The equatorial part of the implant.

compared with the technique introduced by Soll [16], by avoiding muscle cone positioning, our technique avoid damage to the orbital fat by inserting the implant into the scleral shell, which would reduce intraobital adipose atrophy. Our study had certainly limitations. Our study size is small, and further research is needed to validate these results. A large series of patients should be observed over time to extend these results. Besides, the study lacks of a control group. A comparative study should be supplemented in the future.

In conclusion, we proposed and evaluated the scleral-muscle flap technique. It is a simple, safe, and useful procedure that allows a direct wound closure without tension. This technique enables proper sized hydroxyapatite implant insertion, promotes vascularization and implants integration, reduces the exposure rate and provides superior implant mobility. Finally, it provides an excellent cosmetic result with a low risk of major complications.

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Conflicts of Interest: Zhu Y, None; **Zhang H**, None; **Song YW**, None; **Guo JM**, None; **Xu XL**, None; **Wang JM**, None.

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