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APPLICATION OF ORBITAL IMPLANTS IN ORBITAL IMPLANTATION AFTER EVISCERATION IN CHILDREN: CURRENT CONCEPTS AND CLINICAL PERSPECTIVES

Lyubava Yuryevna Bobokha
Assistant, Tashkent State Medical University (Tashkent, Uzbekistan)

Dilorom Teshaevna Makhmudova
Assistant, Tashkent State Medical University (Tashkent, Uzbekistan)

ABSTRACT

Removal of the eye in childhood requires not only elimination of the pathological process but also comprehensive anatomical and functional rehabilitation of the patient. At present, evisceration with primary orbital implantation is considered one of the most effective methods for the formation of a functional orbital stump after eye removal.

This review article presents current data on the use of orbital implants in children following evisceration. The paper discusses the main advantages of evisceration compared with enucleation, the specific features of stump formation in pediatric patients, and modern materials used for orbital implantation. Particular attention has been focused on polytetrafluoroethylene (PTFE) implants, which demonstrate high biocompatibility, stable volume maintenance, and a low rate of postoperative complications.

The article also analyzes the outcomes of modified evisceration techniques for buphthalmos using combined orbital implants, which allow compensation for orbital volume deficiency and reduce the risk of postanophthalmic enophthalmos. In addition, the major complications of orbital implantation and the factors influencing implant exposure are reviewed.

Modern approaches to reconstructive ophthalmic surgery suggest that eye removal in children should be regarded not as the final stage of treatment, but as the beginning of comprehensive functional and cosmetic rehabilitation.

Keywords: Evisceration, enucleation, orbital implants, polytetrafluoroethylene, anophthalmos, buphthalmos, children, orbital stump, ocular prosthetics, ophthalmic surgery.

INTRODUCTION

Removal of the eye in childhood remains a challenging medical and social problem. The issue involves not only elimination of the underlying pathology but also the creation of conditions for comprehensive long-term rehabilitation. According to published data, eye removal accounts for 1–4% of all ophthalmic surgical procedures [5]. Although the proportion is relatively small, the consequences are particularly significant in pediatric patients due to the ongoing growth of the facial skeleton and orbital structures.

Modern ophthalmic surgery no longer considers eye removal the final stage of treatment, but rather the beginning of reconstructive and functional rehabilitation. Formation of a functional orbital stump using orbital implants allows restoration of lost orbital volume, improves prosthesis motility, and prevents the development of post-enucleation socket syndrome [3,5].

The problem is especially relevant in children with buphthalmos and severe orbital tissue atrophy, where modified approaches to volumetric reconstruction are required [4].

CHOICE OF EYE REMOVAL TECHNIQUE

Two principal methods of eye removal are traditionally used: enucleation and evisceration [8,11]. Enucleation involves complete removal of the eyeball, whereas evisceration preserves the scleral shell into which an orbital implant is subsequently placed.

The choice of surgical method remains controversial and depends on the clinical situation. However, most oculoplastic surgeons emphasize that, whenever possible, preference should be given to techniques preserving orbital anatomical structures [8,11].

Evisceration offers an important advantage because preservation of the sclera provides more physiological transmission of movement from the extraocular muscles to the implant and subsequently to the ocular prosthesis. Clinical studies have demonstrated that stump and prosthesis motility are significantly better after evisceration, while prosthesis sinking occurs less frequently compared with enucleation [5].

IMPORTANCE OF ORBITAL IMPLANTS

Modern approaches to eye removal almost always include primary orbital implantation [10]. Orbital implants are necessary to compensate for lost orbital volume, prevent enophthalmos, and create a mobile orbital stump.

The history of orbital implantation spans more than a century. During this period, both biological tissues and various synthetic materials have been used [1]. Significant contributions to the development of orbital implantology were made by Gundorova et al. [1], as well as by Filatova, whose monograph was devoted to anophthalmos and its treatment [3].

Among modern materials, polytetrafluoroethylene occupies a special place. PTFE implants possess a porous structure, the ability to integrate with connective tissue, and high biocompatibility [5]. Long-term follow-up studies involving more than 1,500 patients demonstrated stable cosmetic outcomes and absence of implant-related complications over observation periods of up to 15 years [5].

Specific Features in Pediatric Patients

In children, orbital implants perform not only a compensatory function. They also play a crucial role in maintaining facial symmetry and stimulating proper orbital development. Insufficient orbital volume may result in upper eyelid retraction, deepening of the superior sulcus, and facial asymmetry.

A special category includes children with buphthalmos associated with congenital or secondary glaucoma. In such cases, prolonged orbital compression leads to atrophy of the retrobulbar fat tissue [4]. Standard implants may therefore be insufficient for adequate volume replacement.

To address this problem, a modified evisceration technique using combined orbital implants was proposed [4]. An additional implant component is positioned posterior to the sclera, allowing an increase in total stump volume by approximately 0.5–0.7 cm^3 and compensation for atrophic orbital tissues [4]. Clinical outcomes demonstrated superior functional and cosmetic results compared with both traditional evisceration and enucleation [4].

RISK OF COMPLICATIONS

One of the most serious complications of orbital implantation is implant exposure. According to international studies, the exposure rate of porous implants may reach 7% [16,17]. Several reports have described hydroxyapatite implant exposure in both adults and children [9,12].

At the same time, many authors emphasize that surgical technique, muscle suturing methods, and implant size selection play a major role in reducing complication rates [6,15]. Individualized selection of the surgical approach based on clinical findings and associated factors is therefore considered essential [8].

CURRENT PERSPECTIVES

Meta-analyses comparing porous and nonporous implants have demonstrated comparable functional outcomes despite differences in complication profiles [13]. Reports from professional ophthalmological societies also emphasize the importance of a comprehensive approach when selecting both the implant type and the surgical technique [7].

Thus, the modern concept of pediatric eye removal involves not merely elimination of the pathological eye, but the creation of a functional and anatomically stable orbital stump capable of providing effective prosthetic rehabilitation and harmonious orbital development.

Discussion. The choice between enucleation and evisceration in pediatric patients remains one of the most debated topics in reconstructive ophthalmic surgery. Although evisceration is associated with better implant motility and improved cosmetic outcomes, concerns regarding postoperative complications and long-term stability continue to be discussed in the literature [5,8,11].

Most contemporary studies support the advantages of evisceration due to preservation of the scleral shell and orbital anatomical connections. This allows more physiological transmission of movement to the prosthesis and reduces the severity of postanophthalmic socket syndrome [5]. However, some authors emphasize that the final outcome depends not only on the surgical technique itself, but also on the correct selection of implant size, implant material, and patient-related anatomical factors [6,15].

An important issue in pediatric orbital surgery is the continuing growth of orbital structures. Inadequate orbital volume replacement during childhood may lead to progressive facial asymmetry and secondary deformities. For this reason, many surgeons advocate early implantation with sufficient volumetric support. At the same time, there is still no universal consensus regarding the optimal implant material for growing tissues.

Porous implants, including hydroxyapatite and porous polyethylene materials, demonstrate favorable fibrovascular integration and prosthesis motility, but several studies report relatively high exposure rates [10,12,16,17]. In contrast, PTFE implants appear to provide a favorable balance between biocompatibility, stability, and affordability [5]. Long-term observations reported by Filatova et al. demonstrated stable functional and cosmetic outcomes with minimal implant-related complications over a follow-up period of up to 15 years [5]. Nevertheless, most available studies are retrospective and originate from single-center experiences, which limits the generalizability of the results.

Particular difficulties arise in children with buphthalmos associated with congenital glaucoma. In these patients, chronic enlargement of the eyeball causes orbital tissue remodeling and retrobulbar fat atrophy [4]. Standard implantation techniques may therefore fail to restore adequate orbital volume. Modified methods using combined orbital implants seem promising because they compensate not only for the volume of the removed eye but also for secondary orbital tissue deficiency [4]. However, evidence supporting these approaches remains limited, especially in pediatric populations with long-term follow-up.

Another unresolved issue concerns the prevention of implant exposure. Published data indicate that complication rates are influenced by multiple factors, including surgical technique, implant wrapping, tissue vascularization, and postoperative care [6,10,15]. This suggests that successful rehabilitation depends on a comprehensive individualized approach rather than on the implant material alone.

Overall, current evidence supports the use of primary orbital implantation after evisceration in children whenever possible. However, further prospective multicenter studies are necessary to establish standardized surgical protocols, determine the optimal implant characteristics for pediatric patients, and evaluate long-term craniofacial development after orbital reconstruction.

CONCLUSION

Evisceration with primary orbital implantation, in the absence of contraindications, is considered the preferred method of eye removal in children. Polytetrafluoroethylene implants demonstrate high biocompatibility and stable long-term outcomes [5]. In cases of buphthalmos, modified techniques with increased stump volume are advisable [4].

Reduction of complication rates largely depends on meticulous surgical technique and appropriate implant selection [6,15].

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