Maxillofacial Prosthodontics for the Pediatric Patient: "An Eye-Opening Experience"

Shantanu Lal*/ Aaron B. Schwartz**/ Toral Gandhi***/ Melvin L. Moss****

The following case report describes the expanding role of pediatric dentists in treating children with craniofacial pathology. Retinoblastoma is the most common intraocular malignancy in childhood and is approximately the tenth most common pediatric cancer in the United States. Treatment consists of enucleation, or removal of the entire globe followed by placement of orbital implants. Un-restored anopthalmic sockets exhibit growth retardation and can lead to facial disfigurement. Maxillofacial prosthetic (MFP) rehabilitation can be especially challenging in younger, pre-cooperative or behaviorally compromised children and requires the skills and participation of a pediatric dental specialist as part of the MFP team. The following case report involving a 3 yr-old girl with retinoblastoma describes such challenges. The objective of the maxillofacial prosthetic team was to provide custom-built, acrylic, bilateral ocular prostheses in as comfortable and atraumatic manner as possible. The case was a success and underscores the value of a multidisciplinary dental approach for the treatment of children with very special needs.

Key words: *Retinoblastoma, maxillofacial prosthesis, ocular prosthesis, children*
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INTRODUCTION

For many years, the specialty of maxillofacial prosthodontics (MFP) has provided care for children and adolescents with various acquired or inheritable craniofacial disturbances. Thanks to advances in medicine, this growing population is able to live longer and lead a better quality of life. However, treating children with special needs can be extremely difficult especially in the younger, pre-cooperative or behaviorally challenged age groups. The skills and participation of a pediatric dental specialist is crucial in gaining the cooperation of the child and thus facilitating treatment in as comfortable a way as possible for the patient. The following case report of a 3 yr-old girl with bilateral retinoblastoma highlights the challenges and discusses treatment options for the MFP team.

Retinoblastoma is the most common intraocular primary malignancy in childhood. Heritable forms of the malignancy are caused by a mutation in the RB1 gene, leading to intraocular tumors, and carries the risk of secondary tumors later in life, particularly in the colon.[1, 2] Patients present with leukokoria (white pupil); the mean age for diagnosis is 12 months for bilateral tumors and 24 months for unilateral tumors[3]. Retinoblastoma affects males and females equally, with an incidence of about one in 15,000-30,000 births.[4, 5] It is approximately the tenth most common pediatric cancer in the United States[6] and there are no differences in incidence by race, or by right eye versus left.[7] If left untreated, almost all patients will die of the disease. However with early diagnosis and surgical enucleation and/or external-beam radiation, retinoblastoma patients have been shown to have a five-year survival rate as high as 95%.[3, 8, 9]

CASE REPORT

A three-year-old girl from West Africa was referred from the Children's Hospital of New York to the Maxillofacial Prosthodontic Department at Columbia University College of Dental Medicine in need of bilateral ocular prostheses. The patient had a history of retinoblastoma and was subsequently treated in Africa with bilateral enucleation at age 18 months. She presented wearing stock conformers in both anophthalmic sockets (Fig. 1). Stock conformers are plastic shells that serve to maintain socket size and prevent excessive scar tissue formation before prostheses are made.[10]

* Shantanu Lal, DDS - Columbia University College of Dental Medicine
** Aaron B. Schwartz, MPH, D.D.S - Columbia University College of Dental Medicine
*** Toral Gandhi, DDS - Pediatric Dentistry Washington DC
**** Melvin L. Moss DDS, PhD - Columbia University College of Dental Medicine

Send all correspondence to: Shantanu Lal, DDS, Asst Professor & Director, Pre-doctoral programs, Division of Pediatric Dentistry, Columbia University College of Dental Medicine, P&S 3-454c, 630W 168th Street, New York, NY – 10032

Phone: 212-305-1041

Fax: 212-305-1034

E-mail: sl784@columbia.edu

Figure 1. Patient presented wearing stock conformers in each anophthalmic socket.

Figure 2. Irreversible hydrocolloid impressions of the internal and external socket walls were taken.

Upon initial examination, the child demonstrated uncooperative and combative behavior. Utilizing a team approach, the MFP team collaborated with the Division of Pediatric Dentistry to help the child cooperate and cope through a potentially traumatic and psychologically sensitive and procedure such as this.

Providing behavior management for a three year old, precooperative child can be fairly challenging, even for the pediatric dentist. Moreover, our patient was visually impaired and sensitized by previous medical examinations involving the manipulation of objects and materials inside of her anopthalmic sockets. The family only spoke Krio, a West-African dialect, which made communicative behavior management and treatment especially difficult for the team. Sedation was not an option, as some patient cooperation was required for involuntary ocular muscle movements during impression taking and try-in visits. Nitrous oxide conscious sedation/nasal hoods would interfere with the limited working area around the eyes, and is ineffective in crying children as they expel the inhalant orally. Given these limitations, a decision was made to utilize stabilization (papoose board with straps) integrated with nonverbal communicative management (appropriate contact and gentle handling), positive reinforcement, and voice control (whispering comforting phrases in the patient's native language, repeated by the pediatric dentist after hearing the mother communicate with her child). We loosened a portion of her papoose strap each time she stopped crying, and found that conditioning the three-year-old in this manner encouraged longitudinal improvements in her behavior. By enabling the child to cope during this time-intensive and demanding procedure, the MFP team was able to work efficiently and meet the treatment objectives.

PROCEDURE

After the initial examination of the socket, the team first prepared irreversible hydrocolloid impressions of the internal orbital socket. During the impression, natural movements of eyelids and ocular muscles were encouraged for a better fit (Fig. 2 and 3).

Figure 3. An intra-ocular impression is made.

The impressions obtained depicted internal occular structures with some herniation of surrounding tissue into the globe space. Such herniation makes the impression appear irregular unlike the perfect rounded contours of the eyeball. A dental stone mold was prepared around the impression. This mold helped construct a wax conformer, which was placed into the socket for evaluation. The team compared the soft tissue contours around the wax conformer. Sharp ridges and undesirable irregularities were eliminated for better comfort and esthetically satisfactory results. The wax pattern was processed and a custom conformer fabrication was prepared. To achieve superior esthetic results, the lab technician custom painted the iris and sclera, and red silk fibers were used to imitate a vein pattern. The final fitting and adjusting of the custom acrylic resin eyes included careful polishing to preserve the fine details (Fig. 4 and 5). Placement of prosthesis in carried out by gently reflecting the eyelids and inserting the prosthesis side-to-side, much like a denture in the mouth. The musculature in the sockets immediately guide and retain the prosthesis in place. Some natural "eye" movement can be expected if accurate impressions were obtained that incorporated ocular muscle movements

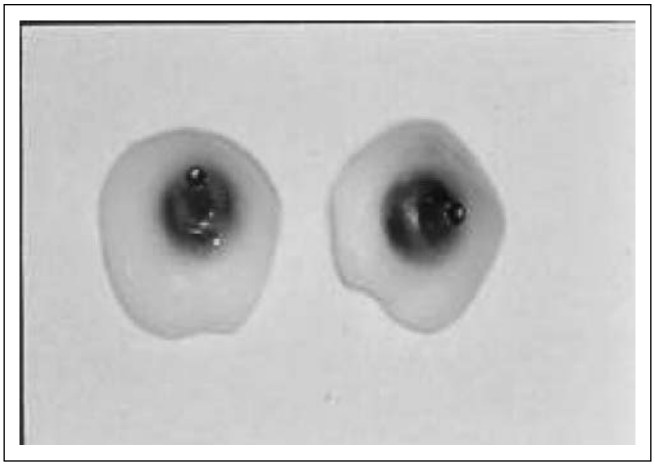

Figure 4. Custom acrylic resin eyes before final adjustments and polishing.

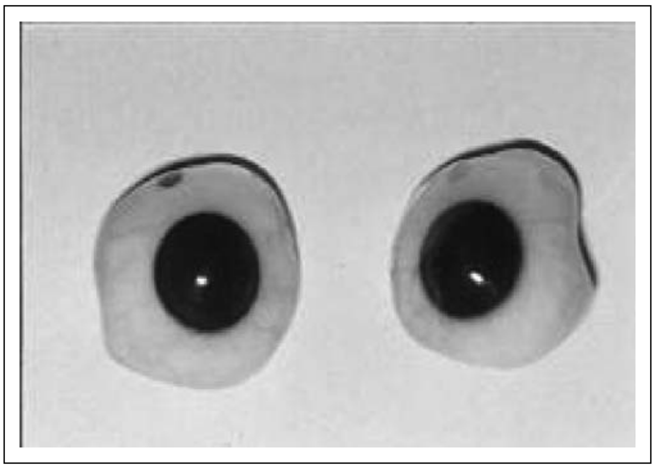

Figure 5. Custom acrylic resin eyes after final polishing. Note the red silk fibers to imitate vein patterns.

(having the patient simulate eye movement and eyelid closure during impression taking)

DISCUSSION

Replacement of an anophthalmic socket with a prosthetic eye is not a new concept. As early as 9th century BC, Egyptians were placing fabricated eyes made out of wax and jewels. During World War II, several soldiers presented to the Naval Hospital in Bethesda, Maryland with severe trauma to the orbit. There, the dental faculty built customized prostheses to repair the damage.[11] Currently, several different types of ocular prostheses/implants are available[12-16] (Table 1).

It is well recognized that enucleated sockets experience growth retardation resulting in facial asymmetry,[17-19] and it has been shown that adults who underwent enucleation without orbital replacement therapy experienced bony orbital collapse and impairment.[17] Children with anopthalmic sockets are at high risk of craniofacial disfigurement unless timely replacement of successively larger orbital prostheses are fabricated.[8,20, 21] The Moss' functional matrix hypothesis may explain this physiological response, stating that a functional relationship exists between muscles and the bones to which they are attached, whereby craniofacial growth is related to specific functional demands.[22, 23] The interplay between the muscles, soft tissues of the eye, particularly the globe, provides the essential movement for proper osseous orbital development.[24] In our case, a reduced functional demand in both anophthalmic sockets would have caused diminished growth of the orbital walls. By acting as the functional matrix, placement of successively larger orbital implants during rapid craniofacial development would stimulate a more natural development of the orbital cavity by distributing pressure equally along the orbital wall, providing the tissue stimulus necessary for orbital growth.[25] Although orbital volume varies with race and sex, imaging studies that plot orbital volumetric growth over time show that a significant proportion of final growth occurs by five years of age, and ends at approximately 15 years of age in males and 11 years of age in females.[26-28] Orbital volume increases rapidly until the age of three and then expands gradually up to the age of twelve.[17] A review of the literature found no standard guidelines for an orbital prosthesis replacement schedule. A curve displaying the mean orbital volumetric growth, adapted from Bentley *et al*,[26] may serve as a useful tool for orbital implant replacements in a growing child (Fig. 6).

Table 1. A brief list of orbital implants/prostheses available today

Type	Includes	Composition	Comment
Non-fibro-osseous integrated	Double-sphere, Allen, Iowa Universal, Silicone sphere	Acrylic, glass, silicone	Reduced cost and competitive motility make these implants desirable
Fibro-osseous integrated,	• Hydroxyapatite (HA)	Coral derivative	Motility is superior only with a costly follow-up procedure that fits the implant with a motlity peg[15]
Microporous	• Porous Polyethylene (Medpor),	Synthetic high-density powder	

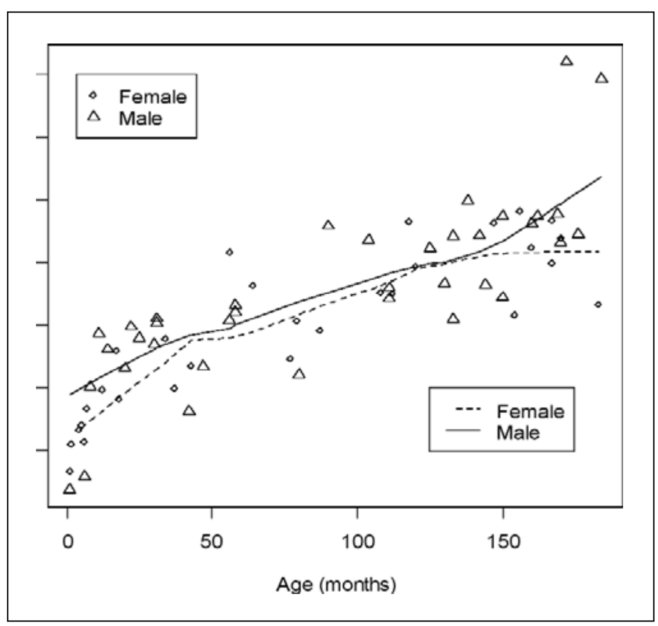

Figure 6. Orbital growth in children (males females)

SUMMARY

The psychological implications for placing ocular prostheses are truly significant. As mentioned above, anopthalmic eye sockets and failure of the orbit to grow properly results in facial disfigurement. A person with an asymmetrical face will be keenly aware of it and most likely suffer from a lack of self esteem and self confidence among other psychological effects. Pediatric dentists may have to expand their roles in order to provide support to MFP teams and other such specialists treating young children. Understanding the associated challenges can be vital to the future care for the pediatric population with complex medical needs. For our patient, the ocular prostheses were delivered in two weeks and were well received.

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