RECENT ADVANCES IN ORBITAL IMPLANTS

Essay

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Abstract

Orbital implants are used to rehabilitate the anophthalmic socket and provide the patient with a cosmetically acceptable appearance.

A multitude of materials and shapes have been used as orbital implants, may be synthetic as gold, silicone, and acrylic in its various shapes, porous polyethylene, bioceramic, and Teflon or natural as the coralline hydroxyapatite orbital implant.
Surgical techniques differ according to the type of implant and
The complications may be operative or postoperative early or late.

Key words;
Eye – Orbital implants.

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List of Abbreviations

FDA	: Food and drug administration
HA	: Hydroxyapatite
MCP	: Motility coupling post
OTE	: Orbital Tissue Expander
PMMA	: Polymethyl methacrylate
PP	: Porous polyethylene
RAS	: Autogenous Rectus abdominus sheath

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INTRODUCTION AND AIM OF WORK

Placement of an orbital prosthesis is almost universally performed in tandem with an enucleation. 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. To achieve this, implants of various materials, shapes and sizes have been used from time to time. These included glass, gold, tantalum, vitallium and silicon **(Scoll, 1982)**.

With time certain newer materials were developed. These include hydroxyapatite **(Nunery et al., 1993),** goretex **(Die Ces et al., 1998)** and high-density porous polyethylene (**Su Gw and Yen, 2004)**.

Of all the biologically inert materials, **silicon** is most often used in ophthalmology. It offers a less hard and a weighty subsitute which is in itself an advantage, as the bigger the size of the implant the better the end result. Silicon also has the lowest rates of exposure and extrusion. **(Shoamanes et al .,2007)**

Several developments have already occurred in the past few years. In 1989, a patented implant called the Bioeye was released by the United States Food and Drug Administration. Today, over 25,000 people worldwide have benefited from this development, which is made from hydroxyapatite (HA), a material converted from ocean coral and has both the porous structure and chemical structure of bone. In addition to natural eye movement, this type of implant has reduced migration and extrusion, and prevents drooping of the lower lid by lending support to the artificial eye via a peg connection. **(Alan et al., 2006).**

Injectable hydroxyapatite paste is an option for ocular implantation after evisceration as small incision evisceration is possible with ocular volume replacement with an injectable orbital implant. However , further studies are required to establish the stability of this material for this application**. (Patrick et al., 2002)**.

With advancement in computer, electronics, and biomedical engineering technology, it may someday be possible to have an artificial eye that can provide sight as well. Work is already in progress to achieve this goal, based on advanced microelectronics and sophisticated image recognition techniques. Though it may take several more years before a prosthesis will both look and see just like a natural eye, a company is developing an artificial eye that will be connected either to the optic nerve or directly to the visual cortex. This eye consists of a rubbery lens that can change focus, a high-precision color processing system, and microscopic photo-receptors that sense the presence of objects and pick up motion**. (Alan et al., 2006)**

Aim of work:

The aim of this essay is to review and discuss the various orbital implants used recently after enculeation and evisceration. The techniques, advantages, disadvantages and complications of their implantation will be discussed in detail.

DEVELOPMENT OF ORBITAL PROSTHESIS

An artificial eye, or ocular prosthesis, is the visible part of the surgical changes to the socket and is used to restore the natural appearance of the eye and surrounding tissues. Artificial eyes are usually made of plastic (acrylic) or glass. Custom artificial eyes are hand-crafted by highly skilled ocularists to precisely match the look of the natural eye. While artificial eyes have been made for thousands of years, the first orbital implants were developed about 100 years ago (An orbital implant is used to replace the area in the orbit that was occupied by the eye. This small, spherical implant maintains the natural structure of the orbit and provides support for the artificial eye. The implant itself is not visible however.) These small spheres of glass or gold were later replaced by plastic or silicone spheres; but until recently, the basic design of these "first-generation" implants had changed little over the years. The first-generation implants were a major improvement for those wearing an artificial eye, but they were unable to deliver natural movement to the artificial eye. **(Tillman and Walter, 1987)**

This lack of movement was a major obstacle to restoring a natural appearance, which made the adjustment to wearing an artificial eye much more difficult. The first-generation implants also tended to migrate in the orbit and were often rejected (extruded) by the tissues of the body, making further surgeries necessary. These problems inspired researchers to search for a better orbital implant. **(Tillman and Walter, 1987)**

History

The study of artificial eye evolution draws one into remote times, mention of their use is found in records that date back to about 2500 years ago, and it is considered that they were used long before these records were made, perhaps as early as 5,000 years ago. The ancient Babylonian and Sumerian law codes show that eye operations were performed nearly 3,000 years B.C., for laws contained sections penalising doctors for unsuccessful eye operations.(**Edwards et al.,1965)**

Early artificial eye makers may not have been creating prostheses at all, but rather decorations for religious and aesthetic purposes. In the millennia B.C., the people of Babylon, Jericho, Egypt, China, and the Aegean area all had highly developed arts and a belief in the afterlife. Radiographs of mummies and tombs have revealed numerous artificial eyes made of silver, gold, rock crystal, lapis lazuli, shell, marble, enamel, or glass. The skill of the Egyptian artists was so great that they were probably asked to create artificial eyes for human use, especially if the afflicted were royalty. **(Edwards et al., 1965)**

It seems fairly certain that the priests in Egypt used primitive artificial eyes as early as 500 B.C. Many of these consisted of earthenware painted to resemble human eyes and eyelids, and which being cemented to flesh-colored cloth or skin, were held in place over the empty sockets by means of an adhesive gum. **(Garrison 1965)**

In 1579, the Venetians invented the first prosthesis to be worn behind the eyelids. These artificial eyes were very thin shells of glass, and therefore, did not restore the lost volume of an atrophied or missing eyeball. Because the edges were sharp and uncomfortable, the wearers had to remove the eyes at night in order to get relief from discomfort and to avoid breakage. (**Garrison, 1965).**

After the invention of this glass shell prosthesis, there were no significant advances in artificial eyes until the nineteenth century.

In the early 1800s, a German glassblower by the name of Ludwig Muller-Uri, who made life-like eyes for dolls, developed a glass eye for his son. Though it took 20 years to perfect his design, his success forced him to switch occupations to making artificial eyes full-time. (**Garrison, 1965).**

In 1880, Dutch eye surgeon Hermann Snellen developed the 'Reform' eye design. This design was a thicker, hollow glass prosthesis with rounded edges. The increase in thickness restored most of the lost volume of the eye and the rounded edges gave the patient much more comfort. Germany became the center for manufacturing glass artificial eyes. (**Coulomb, 1961)**

In the nineteenth century German Ocularists began to tour the United States, making glass artificial eyes on a national circuit, setting up for several days at a time in one city after another. **(Johnson and Colin, 1995)**.

Eye manufacture in the United States began about 1850. Eyes continued to be made of glass until the onset of World War II. German glassblowers were no longer touring the United States. Most German goods were being boycotted which compelled the development of an American technology for making artificial eyes**. (Johnson and Colin, 1995)**

It is believed that Fritz Jardon in conjunction with American Optical Company worked with the Army and a Navy dentist in the original research. Using acrylic resins that formed the basis of fabricating the modern ocular prosthesis, the technology continues today. Since World War II, plastic has become the preferred material for the artificial eye because of it's durability and longevity. **(Johnson and Colin, 1995)**

Although it is a common misconception that artificial eyes are made of glass, most artificial eyes produced in the United States are fitted and fabricated by ocularists from Methyl Methacrylate plastic. **(Johnson and Colin, 1995)**

An alternative was introduced by German-American glass blowers who were learning to make artificial eyes out of plastic using the Reform design. Though this type of artificial eye was an improvement, there were still problems with a persistent discharge of mucus from the eye socket. The wearers could sleep with the prosthesis in place, but were required to remove it every morning for cleaning. Despite these limitations, demand outpaced what the ocularists could handle, and therefore, a few large optical companies began mass producing the 12 most commonly used glass eye shapes. Called stock eyes, they have the disadvantage of not being properly fitted to the individual's eye socket. **(Johnson and Colin, 1995)**

The first-generation implants were a major improvement for those wearing an artificial eye, but they were unable to deliver natural movement to the artificial eye. The first-generation implants also tended to migrate in the orbit and were often rejected by the tissues of the body, making further surgeries necessary. These problems inspired researchers to search for a better orbital implant. **(Johnson and Colin, 1995)**

Several years later **in 1884**, a glass sphere was implanted for the first time in the scleral cavity after evisceration. An English doctor, ***Phillip Henry Mules***, used the implant to restore lost volume and to give the prosthesis some movement. The sphere implant was subsequently adapted for the enucleated socket as well.

Many materials such as bone, sponge, fat, and precious metals have been used for implants since then, but 100 years later, the Mules sphere is still used in the majority of cases. Eye sockets with spheres within the scleral cavity following evisceration continue to result in excellent cosmetic results. **(Tillman and Walter, 1987)**

In the **late 1960s** the modified impression method was developed by ***American Lee Allen***. This method included accurately duplicating the shape of the individual socket, as well as modifying the front surface of the prosthesis to correct eyelid problems. The back surface of the prosthesis must also be properly polished for an optimum fit. This method is widely used today. **(Johnson and Colin, 1995)**

Improvements will continue in the ocular prosthesis, which will benefit both patients and ocularists. Several developments have already occurred in recent years. A prosthesis with two different size pupils which can be changed back and forth by the wearer was invented in the early 1980s. In the same period, a soft contact lens with a large black pupil was developed that simply lays on the cornea of the artificial eye **(Tillman and Walter, 1987).**