Hydroxyapatite Orbital Implants

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The beginning of orbital implants dates back to the 1880's. Since that time there have been many advances in this area. Under the research of Dr. Arthur C. Perry, the field has moved away from the traditional orbital implants into the direction of hydroxyapatite implants, stemming from his first development of such an implant in the early 1980's.

Orbital implants are for those patients who have either suffered from enucleation (removal of the eye) or evisceration (removal of parts of the eye) and want a more natural appearance and movement that mimic that of their normal eye. The procedure for those who had lost an eye for many hundreds of years had been to get an artificial eye, such as a glass eye. In 1885, Dr. Mules developed the first unattached implant, a hollow glass ball that was inserted into the eye. The next big advance came when Dr. Arthur C. Perry developed an implant that used sea coral as its base. He used Hydroxyapatite (HA) that had been developed in a process that changes sea coral (calcium carbonate) into the mineral part of human bone (calcium phosphate.) This process is done through hydrothermal reaction. Hydrothermal technology uses the action of water, at elevated temperature and pressure levels that are created in a closed system, that leads to the formation of minerals. Sea coral had been discovered to have (in certain species) the same skeletal structure as human cancellous bone. The similarity between the two structures and the matching minerals makes the coral easily accepted by the body as natural. Another key feature of HA is that it matches the pore size almost exactly, making the HA fully incorporated into the tissues of the orbit, and attaching to the muscles allowing for mobility to be delivered directly to the eye.

The implant itself is surgically placed within the orbit, with the tissues being closed over it. A plastic spacer is fit between the tissues and the eyelid, making space for the artificial eye. The artificial eye is placed where the spacer was and it will move as the implant moves, "tracking" the natural eye movements. A procedure that is now quite common is to connect the artificial eye to the implant via a titanium peg. Studies have been done studying the increased mobility of the eye with the peg placement. It was found that with the mobility of unpegged implants had the horizontal mobility increased to 85.5% from 49.6% with peg placement, and the vertical mobility went from 51.3% to 54.3%. Out of ten patients studied nine said that there was significant increase in mobility and 1 said that there was some increase. The problems with the peg that have been studies range from infection to poor fitting of the peg.

A new study has found a material to be used for the orbital implant that overcomes the shortcomings of the coralline HA implant that has just been discussed. This material is a synthetic hydroxyapatite coated porous alumina. It provides higher biocompatibility and long-term stability that is beyond that of the coralline counterpart. The issues that stand with the current HA are that it undergoes gradual reabsorbtion over the years, there is the inability to control the size of the pore system, and the lack of the abundance of the natural coral that has the interconnected pore system. This new HA- coated alumina implant was developed using a polymeric sponge method, with the results of increased biocompatibility, stability, and correct pore size. The study was done on rabbits with the results of extensive fibrovascular ingowth throughout the implant center. With this bright outlook, it looks to be the new implant on the market. The ideal implant with the replication of the natural movements of the eye copied has yet to be developed, but so far in the medical world the advancements have brought us quite close.

Resources

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