Hyperostosis in an orbital defect with craniofacial implants and open-field magnets: A clinical report

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An orbital facial prosthesis wearer was found to have significant hyperostosis in an exenterated orbit exposed to long-term, open field, rare earth magnets attached to craniofacial implants. Localized exophytic osseous formation was found in multiple areas around the exenterated orbit. The overall thickness of the walls of the exenterated orbit was approximately double that of the unaffected side. Magnetic field effect on bone formation and recommended treatment are discussed. (J Prosthet Dent 2007;97:196-9.)

Fabrication of an orbital prosthesis is arguably the most difficult of the 3 single-site facial prostheses, including the orbital, nasal, and auricular prostheses. The difficulty is due to the fact that the orbital prosthesis contains within it a separate ocular prosthesis, which must be correctly matched to the remaining eye in size and contour, and positioned exactly in 3-dimensional space to simulate the correct gaze and correct interlid opening. These prostheses must be remade periodically due to deterioration of the silicone material from which facial prostheses are fabricated. Material deterioration is represented by changes in color caused by exposure to ultraviolet radiation, as well as atmospheric pollutants.[1,2] Change over time in the topography of the defect has also occurred in some situations, necessitating remaking of the prosthesis.

Both pulsed electromagnetic fields and static magnetic fields are well known to stimulate bone formation.[3-10] It was because of these potential tissue effects that closed-field magnet systems were used by Gillings[11,12] in his early work in developing intraoral magnets.

This clinical report describes the clinical findings and management of a patient with a long-term orbital defect who had been wearing an implant/magnet-retained prosthesis. The patient required refabrication of the prosthesis due to unusual changes observed in the osseous topography of the orbit.

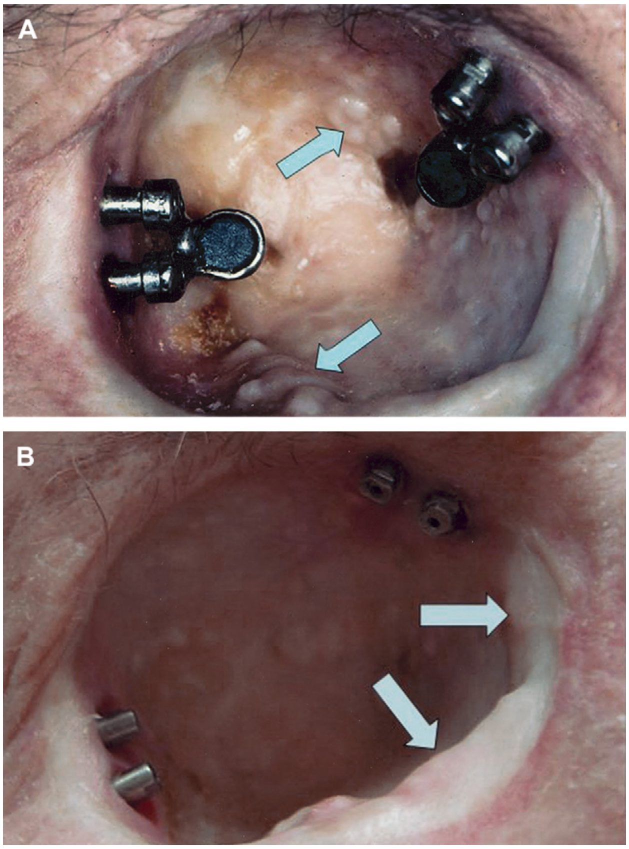

Fig. 1. A, Right orbit showing exophytic bony growths along floor and posterior wall. **B,** View made from different angulation accentuates hyperostosis on inferior and medial marginal rim of orbit.

CLINICAL REPORT

A 76-year-old white woman who underwent a right orbital exenteration due to malignant melanoma presented to the Department of Dentistry and Maxillofacial Prosthetics of the Roswell Park Cancer Institute, Buffalo, NY, for assessment and treatment with replacement of a craniofacial implant/magnet-retained orbital prosthesis. At the time of tumor resection in 1983, the orbit was lined with a split-thickness skin graft. The patient did not receive pre- or postoperative radiation treatment. The patient successfully wore an adhesive-retained orbital prosthesis for 8 years. In 1991, the patient had 4 craniofacial implants (4 mm; Bud Industries, Tonawanda,

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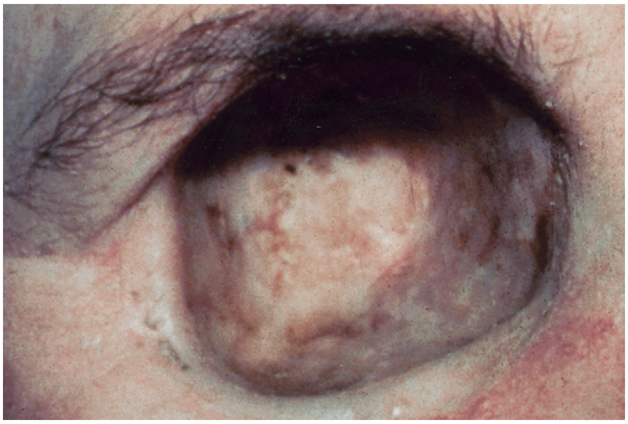

Fig. 2. Photograph made prior to implant placement in 1991, showing none of changes seen in Fig. 1, *A* and *B*.

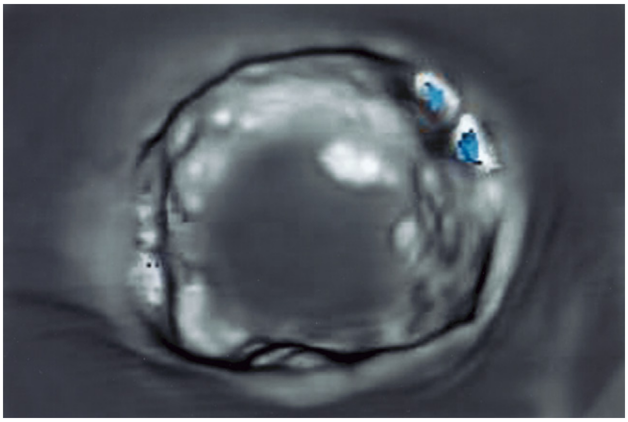

Fig. 3. Three-dimensional reformatted soft tissue image from CT scan shows areas of exophytic growth as lighter in contrast.

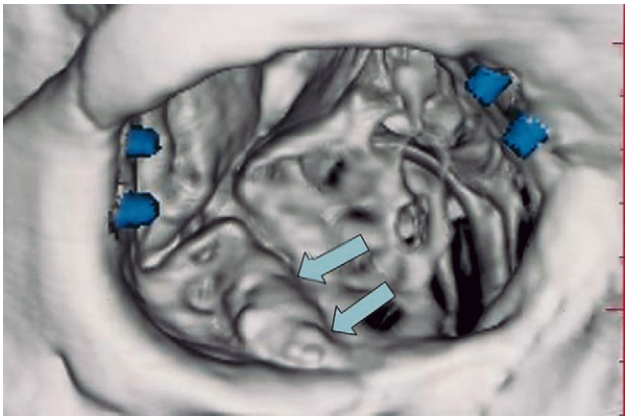

Fig. 4. Three-dimensional image of floor of affected orbit's bony architecture demonstrating enlargement of bone over infraorbital canal (*arrows*), with *blue* identifying implant abutments.

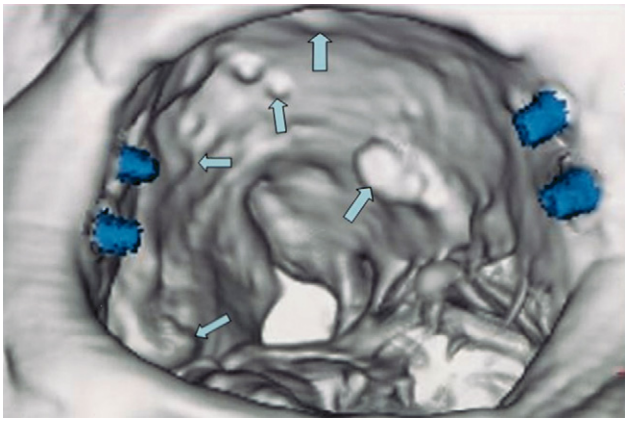

Fig. 5. *Arrows* depicting exophytic bone on posterior and lateral orbital walls.

NY), placed and a new magnet-retained orbital prosthesis was fabricated. Two open-field samarium cobalt magnets (Rare Earth Magnets; Factor II, Inc, Lakeside, Ariz), 5 × 1.5 mm, were placed in the orbit, with each magnet attached to 2 of the implants by custom cast gold alloy retentive rings. Two additional magnets of identical size were placed in the intaglio surface of the orbital prosthesis. The prosthesis was worn during waking hours only. By chance, the lateral-side magnet and the medial-side magnets had opposite (repelling) poles facing forward.

Exophytic bony growths were noticed as follows: an 8 × 20-mm anteroposterior linear elevation on the floor of the orbit; numerous circular elevations, 2 to 8 mm in diameter, were observed on the posterior and medial walls; and the inferior orbital rim and nasal rim of the orbit appeared to have elevated areas as well (Fig. 1). In contrast, a photograph made at an unknown date between the original surgery in 1983 and prior to implant placement in 1991 showed no such exophytic changes (Fig. 2). Clinically, osteogenesis appeared to be a continuing process, requiring the patient to be seen for periodic adjustments due to bony expansion. A computerized tomography (CT) study was performed to determine whether any information could be obtained to explain the changes in orbital shape. The CT study of the orbits was requested to compare the surgical with the normal side. Preoperative CT scans were not available for comparison.

The neuroradiologist's report for the CT study confirmed that the area of examination demonstrated bony overgrowth, with some osteophytes in the superior and inferior orbital rim on the right, and involvement of the brow and zygoma on the right as well. Figures 3 through 6 demonstrate various CT views of the changes described. Treatment planning recommendations to the patient included replacement of the intraorbital implants with stainless steel keepers, with closed-field magnets

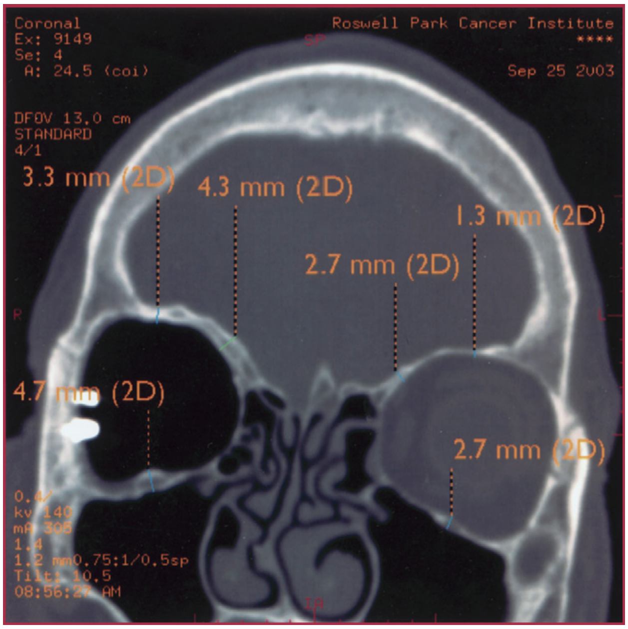

Fig. 6. Coronal CT image showing thickness of bone in right orbit is approximately twice thickness when compared to contralateral unaffected normal left orbit.

placed in a new prosthesis. The patient refused replacement of the magnets and accepted only a new prosthesis. The patient has since moved out of state and has been lost to follow-up.

DISCUSSION

After studying the CT scans of this patient, it was hypothesized that the open-field magnets were the direct cause of the orbital bony thickening. Although 1 patient cannot prove cause and effect, neither can it be assumed that the constant magnetic field present in this orbit was not a contributing factor to the osteogenesis seen. This is especially true considering the known effects of magnetic fields on bone.[3-10]

Open-field magnets (Hicorex Samarium Cobalt magnets; Factor II Inc., Lakeside, Arizona) have largely been replaced by closed-field magnets (Technovent Ltd, Leeds, UK) for retention of maxillofacial prostheses where magnetic retention is chosen over mechanical attachments. The reasoning behind the use of closed-field magnets is that they decrease the external magnetic field significantly. It cannot be said that they completely eliminate the creation of the magnetic field. Figure 7 shows a closed-field magnet with attached keeper commonly used in facial prosthetics, demonstrating a magnetic field effect on a compass that is nearly the same as an open-field magnet of the type used on the patient presented in this study. This contradicts the statement by Gillings[12] that there can be no possibility of a magnetic field effect on tissue when a closed-field magnet is used.

Fig. 7. Closed-field magnet with attached keeper showed deflective effect on compass at distance of 75 mm. Photograph shows how compass needle has moved from its resting position of true north.

Because the closed-field magnet is embedded in the prosthesis and the keeper is attached to the implant abutment, there is no magnetic field effect when the prosthesis is removed overnight. In this manner, the daily magnetic exposure is reduced by about one third.

The cause(s) of the increased bone formation post-exenteration in the patient presented is speculative. The authors recommend the use of either closed-field magnets for retention against stainless steel keepers attached to the implant abutments, or the use of other systems of mechanical attachments, such as the bar and clip attachment system (Hader Bar; Sterngold Dental, Attleboro, Mass) or resilient attachments systems such as Bredent (Bredent, Witzighausen, Germany), and Locator (Zimmer Dental, Carlsbad, Calif).

SUMMARY

This clinical report describes the clinical observations and CT studies of a patient who demonstrated significant osseous remodeling and thickening in the exenterated orbit compared to the nonsurgical side. These changes have not been previously described in a patient with open-field magnets attached to craniofacial implants. The implications and recommendations are discussed.

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