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Case Report
Cosmetic Surgery

Histopathological and scanning electron microscopy findings of retrieved porous polyethylene implants

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Abstract. Porous polyethylene (PPE) implants are biocompatible alloplastic materials commonly used for facial augmentation. However, the effect of sub-periosteal PPE application on the surrounding tissues has not been analyzed clearly. This report documents the case of a 22-year-old woman who underwent peri-alar augmentation with PPE to improve midface retrusion. Although no infection or inflammation occurred at the surgical site, the patient requested removal of the PPE implant for aesthetic reasons alone at 1 year after the surgery. The removed implant was subjected to histological and morphological evaluation using conventional histological staining and scanning electron microscopy (SEM). Histopathological staining revealed bone ingrowth into the pores of the implant near the boundary with the host bone. Little evidence of a foreign body reaction was observed. SEM revealed densely arranged collagen fibres and osteoblastic cells in the pores. Moreover, the outer surface of the PPE implant in contact with the periosteum showed fibrous tissue ingrowth, leading to tissue adhesion. These findings confirm bone ingrowth into the PPE pore structure in humans.

Key words: porous polyethylene implants; histology; peri-alar augmentation.

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Porous polyethylene (PPE) implants are used widely for the treatment of maxillofacial deformities and for reconstruction, including orbital floor defects, as well as augmentation of the mental region, zygomatic arch, the nose, and paranasal areas. Since onlay grafting of the alloplastic implants does not induce unpredictable graft resorption or donor site morbidity, they have become attractive alternatives to autogenous bone grafts for craniofacial bone reconstruction.[1,2] PPE is flexible, highly dense, has pore sizes ranging from 150 μm to 200 μm, leads to active fibrovascular tissue ingrowth, and is firmly stabilized by the surrounding tissue.[3,4] Moreover, it has low infection and extrusion rates. Patient discomfort and graft rejection after PPE sub-periosteal fixation are also rarely reported. Therefore, PPE is considered a reliable clinical option for onlay grafting in non-weight-bearing areas.[5]

Currently, the use of PPE in orthognathic surgery as an adjunctive paranasal augmentation method is widely accepted for the treatment of midface retrusion.[6] However, a histological report analyzing PPE implants explanted for cosmetic reasons and infection documented evidence

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of chronic inflammation.[7] That report claimed that PPE is not an immunologically inert material. Despite these findings, PPE is still accepted as a reliable alloplastic material, mainly because of its very low complication rate in facial reconstruction.[8] Nevertheless, studies analyzing the histological and morphological characteristics of retrieved PPE implants are scarce, and hence the host response to PPE needs to be investigated further in humans.

The case of a 22-year-old woman who had her PPE implant removed for aesthetic reasons alone is documented herein. The implant had been maintained successfully without any complication after peri-alar augmentation performed over 1 year previously. The histological and morphological findings of the explanted PPE implant were evaluated and the effect of peri-alar PPE application on the surrounding tissues was investigated.

Patient and methods

A 22-year-old woman with mandibular prognathism and midface retrusion was referred to the authors' institution. The patient had undergone mandibular setback surgery and bilateral peri-alar augmentation with PPE (Medpor; Porex Surgical Inc., Newnan, GA, USA). The PPE implant was fixed with a miniscrew on each side. The postoperative course was uneventful. However, the patient wanted the augmented PPE implant removed because of a pronounced midface after the surgery. Therefore, during mandibular plate removal 1 year after the initial surgery, the PPE implant and fixing screws were removed under general anaesthesia.

The presence of inflammation and the condition of the host bone were inspected. However, there was no evidence of infection, inflammation, or mucosal rupture over the implant. The external surface of the implant showed a light-brown tinge with some pinkish-red areas covered with thin fibrous tissue. The inner surface of the implant was darker than the outer surface because blood components had penetrated into the pores.

Histopathological processing

A non-decalcified section of the harvested specimen containing PPE was fixed in 10% buffered formalin and stained with Villanueva bone stain for 1 week. After dehydration in a graded series of ethanol and infiltration with a mixture of isopropanol and epoxy resin, the sample was embedded in epoxy resin and polymerized in an oven at 60 °C for 7 days. The polymerized block was then cut in a buccolingual direction using a hard-tissue-cutting machine. The non-decalcified sections had an initial thickness of approximately 150 μm and were successively ground to a thickness of approximately 50 μm. The histomorphometric evaluations were performed at 40×, 100×, and 400× magnification using a colour video camera connected to a microscope (Olympus, Tokyo, Japan).

Scanning electron microscopy (SEM) examination

A scanning electron microscope (JSM-6700F; Jeol, Tokyo, Japan) was used to investigate the external and sectional surface of the PPE implant. Photomicrographs were acquired at 25×, 100×, 800×, and 10,000× magnification, and included the measurement bars. Three different surfaces of the PPE implant were photographed and analyzed: the periosteal, bone, and lateral sides.

Histological findings

Histopathological examination revealed fibrous connective tissue infiltration along the interconnected pores. The entire inter-pore space was filled with fibrous connective tissue. Haemorrhage was also observed at the contact area with the soft tissue, along with the deposition of haemosiderin pigments. Although a few giant cells were observed in some areas, an inflammatory or foreign body reaction was absent in most of the specimens. In some porous areas, up to 595 μm away from the bone contact area, significant bone formation was found with intact osteocytes (Fig. 1).

SEM findings

For comparison with the current case specimen, an identical but unused peri-alar PPE implant was used as a control specimen. The control PPE implant had pore sizes ranging from 350 μm to 500 μm and the inter-pore spaces were empty. The distance between the pores also varied. Although the surface texture of the pores was relatively smooth at lower magnifications, they had a slightly rough texture at higher magnifications. The overall surface of the control specimen exhibited a relatively constant pattern.

The outer surface of the removed PPE implant in contact with the periosteum was filled with fibrous connective tissue. An array of collagen fibres was very irregularly intertwined. The inner side of the PPE implant (the surface in contact with the bone) was covered with compact fibrous connective tissue. The collagen fibres were arranged in a relatively regular pattern. Observing the inner surface between the pores was difficult because the

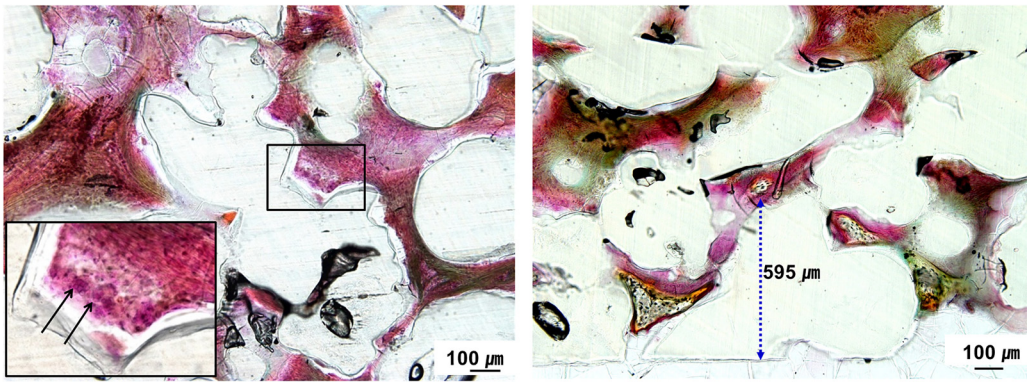

Fig. 1. Histopathological findings of the removed PPE implant. Fibrous connective tissue was seen infiltrating along the interconnected pores. The surface in contact with the bone was defined as the 'inner surface'. A few giant cells (arrows) could be observed in some areas, but the inflammatory response was not seen throughout the specimen (left). Intact osteocytes were found in the pores up to 595 μm away from the inner surface (right).

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