

Biocompatibility of high-density porous polyethylene covered with fascia lata in dorsal nasal augmentation-an experimental study in rabbits

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Abstract: Ten New Zealand Albino rabbits were used in this study. A lateral incision was made on the nasal dorsum and a pocket formed in the subperiosteal plane to replace the implant. A fascia lata graft was obtained from the regio femoralis. High-density porous polyethylene (HDPP) was cut and covered with fascia lata. The material was positioned in the pocket formed on the nasal dorsum. Four months post-procedure, magnetic resonance imaging (MRI) was performed to evaluate the resorption of the material. Animals were then sacrificed and the nasal dorsum, including the graft material, was removed and subjected to macroscopic and histopathological examinations. All rabbits survived the 4-month period. MRI revealed that all the graft materials were intact; no sign of resorption was evident. Macroscopically, no rejection was observed. Histopathologic examination revealed that the HDPP remained intact on the nasal dorsum. HDPP covered with fascia can therefore be used for augmentation of the nasal dorsum. HDPP is easy to work with and will avoid the increased operative time and morbidity associated with autograft harvesting.

Key words: High-density porous polyethylene, biocompatibility, nasal dorsum, augmentation, rabbit

1. Introduction

Reconstruction of the damaged nasal dorsum is a challenge in facial plastic surgery (1). Autologous grafts are typically preferred, but are associated with some limitation (2). Finding adequate graft material from the nose can be difficult, particularly in revision rhinoplasty cases and traumatic nasal deformity (1). If graft material is obtained from a different donor site, e.g., costal cartilage, the operative time is prolonged, increasing the likelihood of donor site morbidity. Grafts may also have some degree of aesthetic failure due to visible graft contour, displacement, and warping (3).

Development of alloplastic materials provides a new alternative to autogenous grafts. Silicone, supramid mesh, proplast, mersiline, hydroxyapatite, and high-density porous polyethylene (HDPP) are now available and have been used for nasal augmentation with variable success rates (2). In contrast to autologous materials, HDPP is readily available and is not associated with donor site morbidity. Recent studies proposed that the inert and stable nature of HDPPs increase the resistance of the nose to trauma and scar contracture, and may prevent recurrences related to cartilage memory (4). However,

the major disadvantages of these materials include high infection and rejection rates (5).

HDPP is an inert, radiolucent, pure, and linear polyethylene that allows tissue ingrowth into its pores (6). Tissue ingrowth minimizes capsule formation, promoting implant fixation and maintenance of the immune response (7). In the past, HDPP has been used to correct craniofacial pathologies, including temporal, nasal, orbital floor, malar, and chin areas (8,9). The aim of the present study was to evaluate the biocompatibility of HDPP in an experimental rabbit model.

2. Materials and methods

Ten healthy (5 male, 5 female) New Zealand albino rabbits were used. The ethics committee of İstanbul University İstanbul Medicine Faculty DETAM Department approved the study protocol. The study, including operations and postoperative care, was performed in the İstanbul University Veterinary Medicine Faculty, Anatomy Department. Room humidity was maintained at 40%–60%. Room temperature was maintained at 21 °C. While under general anesthesia, rabbits' body temperatures were maintained at 37.5–39 °C using an electrical heater. The rabbits weighed 3700–4400 g.

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Rabbits were operated under 7.5–15 mg/kg xylazine and 40–60 mg/kg ketamine anesthesia. A lateral incision was made to the nasal dorsum. For subperiosteal dissection, a subperiosteal pocket was formed. A fascia lata graft was obtained from the region femoralis. The high-density porous polyethylene (Medpor, Porex Surgical Inc., Newnan, GA, USA) was cut to the appropriate size and covered with fascia lata. The implant was placed into the pocket. No suture was used to stabilize the graft. The incision lines were sutured as the animals awakened. Methyl prednisolone sodium succinate IM (0.5–2 mg/kg) was administered on the first postoperative day and cefazolin sodium 10 mg/kg was administered twice per day for 5 days. Butorphanol 0.1–0.5 mg/kg IV was administered twice a day for postoperative pain. B-complex vitamins (1–2 mg/kg) were also administered during the postoperative period.

Four months after the procedure, an MRI scan was performed to evaluate the graft condition. The rabbits were then sacrificed. The whole nasal dorsum, including the graft material, was completely removed and subjected to macroscopic and histopathological examinations to evaluate implant biocompatibility.

3. Results

All animals completed the 4-month study period. MRI revealed that all graft materials were intact and not resorbed (Figure). Macroscopically the materials were on the dorsum. Microscopic examination revealed that the implants remained intact with no sign of inflammation or infection. Granulation tissue was inserted within porous areas and showed continuity with the implant.

4. Discussion

HDPP has been used as synthetic replacement material since 1947 (9). Previous studies have demonstrated successful use of these implants in rhinoplasty as spreader grafts and for correction of saddle nose deformity (8). The HDPP pores are 150–200 μm (10), allowing connective tissue ingrowth. Previous experiments show that the integration between the surface and material pores is observed from the day 14. After 3 months of remodeling, bone and fibrous tissue are observed in the interface region (7). We reported previously the successful use of HDPP in tracheal reconstruction in New Zealand rabbits (11). Although HDPP is somewhat rigid, it is now produced in variable thicknesses and sizes, allowing suitable implant contouring (4).

Although HDPP has been used in various parts of the body, its use in rhinological procedures is associated with a degree of rejection. Infection and direct contact between the graft material and the infected environment are the main causes of implant rejection. Until integration

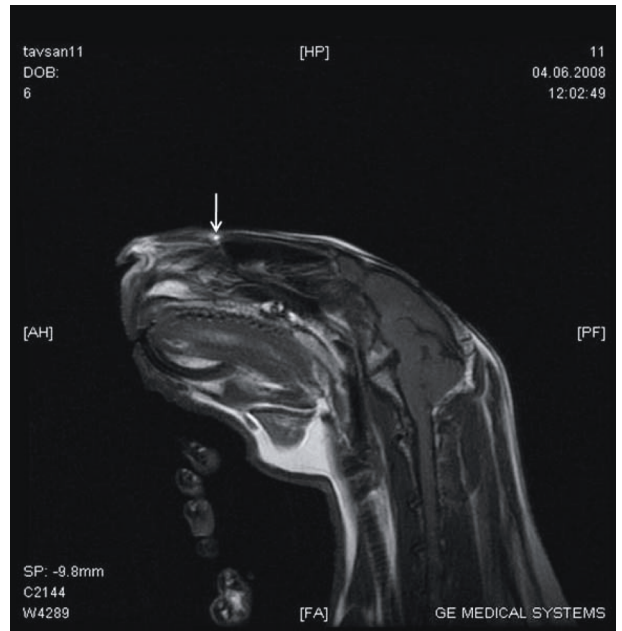


Figure. The MRI scan showed that the graft material is intact and not resorbed.

and fibrous tissue growth occur, the implants possess no vascular supply. In the case of bacterial contamination, no immune effectors or antibiotics can reach the implant area (10). To decrease rejection rates, we covered HDPP with the autogenic material fascia lata. Fascia is known to possess low metabolic requirements and allows vascularization and tissue growth on its surface (10). Although obtaining temporal fascia in humans is problematic, obtaining fascia lata in rabbits is a simple procedure.

The implant is placed in the subcutaneous or subperiosteal area. However, a previous study of 1317 subjects indicated that subperiosteal placement of an implant provides significantly more strength than subcutaneous placement (12). We therefore additionally replaced the implant in the subperiosteal plane. According to MRI, macroscopic, and histological examinations, our results indicate that HDPP is biocompatible and is an appropriate alternative to dorsal nasal augmentation.

The use of HDPP in nasal procedures supports our finding. In 18 subjects with crooked noses, HDPP was successfully used for reconstruction with a mean follow up of 20 months (range, 10–50 months). No extrusion or nasal deformity requiring revision was reported (4). In 14 patients who underwent revision rhinoplasty dorsal-shaped HDPP implants, success rates (excluding a single malposition) were high (13). In 32 subjects who underwent correction of traumatic nasal deformity, the overall aesthetic improvement rate was 90.6% after a mean follow-up period of 25.4 months. Three subjects (9.6%) experienced complications; 1 experienced implant

exposure and the remaining 2 implant infection (1). In a study of 18 revision rhinoplasty subjects, the success of 10 HDPP spreader grafts (SGs) compared with 8 autologous SGs (after 26 months' follow up of autologous SGs and 29 months' follow up for the HDPP graft) similar success rates were observed. Only 1 unilateral infection in the HDPP group and 1 case of erythema on the donor site (auricle) occurred (14), despite the shorter follow-up period. Godin et al. reported that the rejection period of a Gore-Tex implant material was prolonged to 44 months post-procedure (15).

HDPP covered with fascia therefore represents a promising material for nasal dorsal augmentation. HDPP

is easy to work with and avoids the increased operative time and morbidity associated with autograft harvesting.

In cases of revision rhinoplasty, saddle nose, and traumatic nasal deformities, obtaining wide, flat, and thick grafts is problematic. HDPP represents an alternative to nasal augmentation in humans. However, like other synthetic materials, HDPP is associated with a degree of rejection. Covering HDPP with fascia lata will decrease rejection rates by preventing the implant from becoming contaminated. Additional studies are needed to demonstrate the safety of this material, and long-term follow up is required to determine the long-term rejection rates.

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