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Three-dimensional soft tissue change after paranasal augmentation with porous polyethylene

T.-G. Kwon, S.-M. Kang, H.-D. Hwang
Department of Oral and Maxillofacial Surgery, School of Dentistry, Kyungpook National University, Daegu, Republic of Korea

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Abstract. The aim of this study was to investigate the effect of porous polyethylene (PPE) in paranasal augmentation on midfacial soft tissue architecture. This retrospective study recruited patients with midface retrusion and mandibular prognathism. Twenty adult patients who had undergone bilateral PPE augmentation (ready-made type, thickness 4.5 mm, Medpor) to the piriform aperture and simultaneous mandibular setback surgery were included in this study. The soft tissue morphology and thickness of the midface were evaluated using three-dimensional reformatted images from cone beam computed tomography done before and 6 months after surgery. The soft tissue outline of the midface was augmented 1–4 mm. The average increase in soft tissue outline near the peri-alar region was 3.1–3.4 mm, which comprised 68–74% of the PPE thickness ($P < 0.01$). The nasolabial angle and columellar inclination were increased significantly (2.2° and 1.4°, respectively; both $P < 0.05$), whereas the nasal tip angle, nasal tip protrusion, columellar length, and bilateral nostril axis angle did not change. The alar base became wider on average by 2.2 mm ($P < 0.01$). The results showed that paranasal augmentation with PPE significantly increased the overlying soft tissue outline without influencing the nasal projection and could enhance paranasal aesthetics with minimal morbidity.

Key words: porous polyethylene; paranasal; augmentation; three-dimensional.

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The midfacial regions are important for an attractive appearance. Many patients with skeletal prognathism also have a midfacial deficiency. The concavity around the piriform aperture anteroposterior deficiency of the midface causes a 'dish shaped' facial profile, acute nasolabial angle, and deep groove in the subnasal area. Therefore, various techniques have been introduced to improve midfacial deficiency. The Le Fort I osteotomy or malar osteotomy, or a combination of the two, has been utilized to improve severe midface retrusion. For mild or moderate midface retrusion, various augmentation techniques using a variety of graft materials have been used.[1–3] Nowadays, alloplastic graft materials such as porous polyethylene (PPE) have been suggested as the best available facial bone substitute because of their biocompatibility, ease of handling, and reduced operation time.[4] The use of PPE in orthognathic surgery as an adjunctive augmentation method has been reported.[5]

Even though paranasal augmentation with PPE is widely accepted as a useful

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method for midface retrusion, evaluation of the outcomes has usually focused on postoperative morbidity,[4,6] or has presented non-quantitative data.[7–9] Therefore, the exact effect of sub-periosteal PPE augmentation on the overlying soft tissue has not been confirmed yet. At the same time, the effect on the nasal projection or nasal shape has not been investigated previously. This is because of difficulties in the superimposition of three-dimensional (3D) facial soft and hard tissue structures. The recent introduction of cone beam computed tomography (CBCT) and the development of computerized imaging software has allowed a precise analysis of 3D facial landmarks with reliable reference planes.[10–12] 3D assessment of the overlying soft tissue changes associated with paranasal augmentation has been attempted previously.[13] However, the authors of that study could not suggest a hard to soft tissue response rate because the PPE was not uniform in thickness or shape. To overcome this limitation, the shape and thickness of PPE need to be standardized. By using the 'ready-made' type PPE, the overall soft tissue reaction can be calculated quantitatively.

The purpose of this study was to investigate the overlying midfacial soft tissue response after paranasal augmentation with PPE. To determine the rate of augmentation material thickness to soft tissue change, we compared the preoperative and postoperative paranasal soft tissue contour and nasal shape after performing paranasal augmentation with PPE at the time of mandibular setback surgery using CBCT.

Subjects and methods

Subjects

This retrospective study included patients who had undergone paranasal augmentation with PPE and bilateral sagittal split ramus osteotomy (BSSRO) to correct skeletal class III malocclusion and anteroposterior midfacial deficiency. Preoperative and postoperative CBCT data sets were available for all of the patients. The surgery was performed by the same surgeon (TGK) at the study hospital between August 2010 and December 2012. Patients with facial asymmetry of more than 4 mm in chin deviation,[14] any history of facial trauma or scar, or previous experience of adjunctive cosmetic surgery at the midface were excluded from the study. A total of 20 patients (eight males and 12 females) were recruited into the study; the average age of the patients was 21.5 ± 3.3 years (range 17–29 years). This study was approved by the institutional review board.

Surgical technique

After completing the BSSRO (8.1 ± 2.4 mm of mandibular setback; range 6–10 mm at B point), povidone–iodine preparation was again performed to the maxillary vestibular sulcus. A vestibular incision was made above the root of the central incisor to the canine eminence. There was no need to reflect the anterior nasal spine. After sub-periosteal reflection of the paranasal area near the piriform aperture, the ready-made paranasal PPE (Medpor paranasal left #9519, right #9520; width 28 mm, height 26 mm, thickness 4.5 mm; Porex Surgical, Inc., Newnan, GA, USA) was adapted to the depressed recipient site. The thin margin of the PPE can be trimmed slightly according to the individual anatomical structure. The smooth transition of the graft margin to the recipient bone was carefully confirmed.

The centre of the paranasal PPE was immobilized with fixation using a 7–9-mm miniscrew (diameter 2 mm; KLS Martin Co., Tuttlingen, Germany). No additional alar base cinch suture was applied. The overlying mucosa was closed bilaterally with interrupted sutures. Representative preoperative and postoperative 3D images of a patient and the intraoperative position of the PPE are shown in Fig. 1.

Image acquisition and processing

The patients were subjected to CBCT (Hitachi CB MercuRay CBCT unit; Hitachi Medical, Tokyo, Japan) before and 6 months after the surgery. CBCT images were taken with 19-cm field of view, 120 kVp, 15 mA, and a contiguous 0.4-mm slice thickness. The CBCT data files

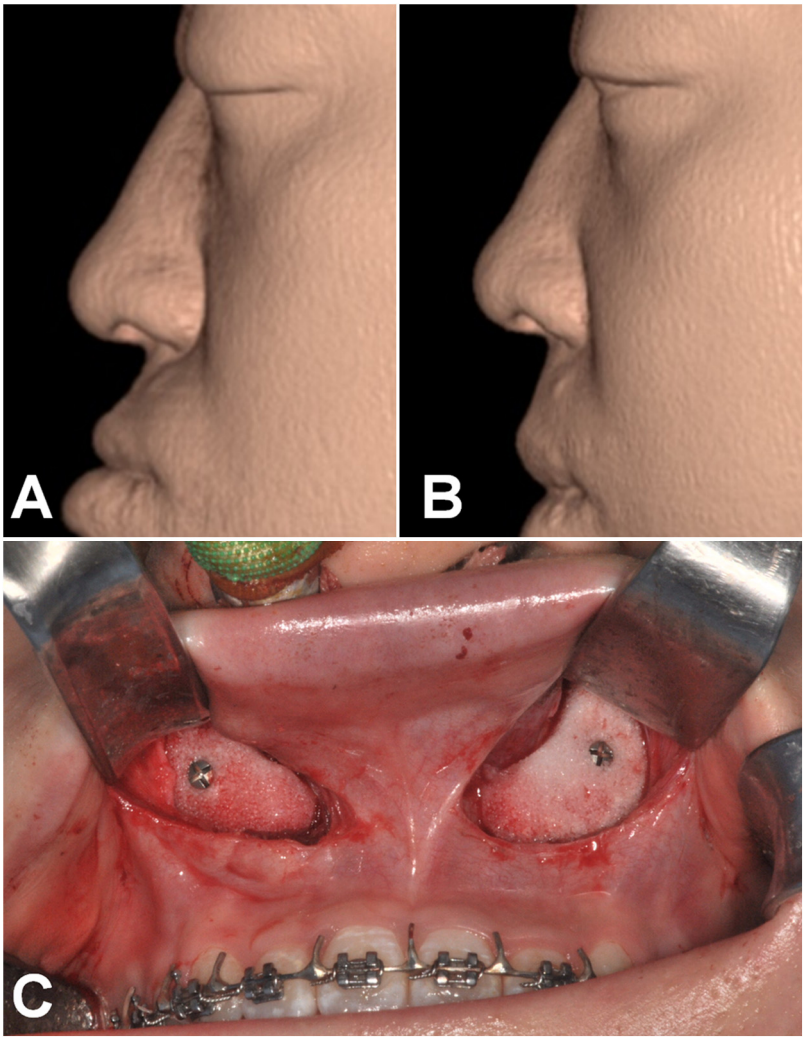

Figure 1. 3D CBCT images: (A) preoperative, and (B) postoperative outcome after surgery. (C) Intraoperative view of paranasal augmentation with porous polyethylene fixed with miniscrews.