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Surgical correction of facial bone deformity and enophthalmos after tripod fracture using an acellular dermal matrix: a case report

Woo Young Choi, Jun Mo Kim, Ji Seon Cheon, Jeong Yeol Yang

Department of Plastic Reconstructive Surgery, Chosun University College of Medicine, Gwangju, Korea

This paper presents a novel approach to the correction of zygomatic malposition and secondary reconstruction orbital floor fractures, highlighting the use of hydrated acellular dermal matrix (ADM), specifically CGDerm One-Step, in a case where traditional solid implants failed to maintain structural integrity and volume. A 27-year-old woman with persistent facial deformities following a traumatic incident underwent a transformative procedure that utilized ADM for volume correction and structural support, addressing significant challenges such as enophthalmos and facial contour depression. This approach was necessitated by the descent of the entire orbital floor and a previously placed implant (Medpor), leading to unsatisfactory volume correction. By integrating ADM with titanium-reinforced fan plates (Synpor), the surgery successfully restored the patient's facial symmetry and addressed her functional concerns, including diplopia and limited eye movement. Postoperative evaluations demonstrated the long-term effectiveness of this method, with significant improvements in facial contour and eye symmetry. Our findings suggest that ADM, particularly in its hydrated form, offers a reliable alternative to traditional bone grafts and implants for correcting complex craniofacial deformities, providing both aesthetic and functional benefits. This case underscores the importance of adaptable, tissue-mimicking materials in facial reconstructive surgery, offering insights into their potential for broader application in post-traumatic facial corrections.

Abbreviations: ADM, acellular dermal matrix; CT, computed tomography

Keywords: Case reports / Enophthalmos / Facial injuries / Reconstructive surgical procedures / Soft tissue injuries / Tissue scaffolds

Case Report

INTRODUCTION

Facial deformities often impose a greater psychological burden on patients compared to deformities in other body regions, due to their conspicuous nature and integral role in social interactions [1]. The restoration of both aesthetics and functionality in these cases is not just a medical necessity, but also a critical component in improving the overall quality of life for these individuals.

In plastic surgery, a key principle is to reconstruct using tissue that closely resembles the original. Therefore, bone deformities are conventionally treated with bone surgery [2]. However, in certain situations, correcting soft tissue may offer a more feasible and effective method for addressing bone deformity.

A particularly challenging field of facial plastic surgery is the delayed correction or re-correction of post-traumatic facial deformities. These cases are challenging due to the intricate nature of the facial structure and the need for precise surgical interventions, especially when addressing orbital volume deficiencies and other complex craniofacial deformities [3].

Correspondence: Woo Young Choi
Department of Plastic Reconstructive Surgery, Chosun University College of Medicine, 309 Pilmun-daero, Dong-gu, Gwangju 61452, Korea
E-mail: Woo3847@gmail.com

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In this paper, we aim to introduce the innovative application of hydrated acellular dermal matrix (ADM), particularly CGDerm One-Step, in a secondary reconstruction case of zygoma malposition and orbital floor fracture resulting in enophthalmos and facial contour depression.

CASE REPORT

A 27-year-old woman presented with right lower eyelid area depression, enophthalmos, diplopia and limited eye movement during downward gaze. These symptoms had persisted since a traumatic incident 5 years earlier, after which she underwent orbital wall reconstruction and open reduction and internal fixation for a right tripod fracture, 6 days after the injury. After the trauma, the patient underwent multiple procedures, including fat grafting and double eyelid revision surgery, to correct aesthetic issues. However, she still experienced discomfort from sunken eyelids, leading to the consideration of additional surgical intervention. Exophthalmometer measurements indicated a 2 mm discrepancy between both eyes, and facial computed tomography (CT) imaging confirmed a depressed fracture with downward displacement of the right orbital floor and zygomatic malposition (Fig. 1).

A critical step in our approach involved addressing the infraorbital rim's height discrepancy, which CT and X-ray imaging revealed to be approximately 7 mm. To rectify this, we planned an incremental approach, initially utilizing an ADM with a thickness of about 3 mm. This ADM placement aimed to effectively initiate the correction of the volume deficit, thus addressing both structural and aesthetic concerns associated with the patient's condition.

Using a subciliary approach, we began by carefully releasing scar tissue until we reached the periosteum. Upon making the periosteal incision, we encountered the previously applied implant (Medpor), which, had failed to maintain its position. The entire orbit floor, along with the implanted Medpor, had descended, leading to an unsuccessful volume correction. This necessitated the removal of the implant and surrounding scar tissue. To effectively address the orbital floor correction and enophthalmos, we opted for a different approach by placing a 3 mm thick hydrated ADM, CGDerm One-Step, directly onto the orbital floor. This step was pivotal not only for providing a stable foundation for the titanium-reinforced fan plates (Synpor) but also for its significant role in augmenting orbital volume. The switch to ADM, coupled with titanium implants, was driven by the need for a durable volume correction that the previously used solid implant could not achieve. Given the patient's history of diplopia and limited eye movement, our strategy focused on ensuring a flat and stable orbital floor, a goal made achievable through the synergistic use of ADM and titanium

Fig. 1. Preoperative three-dimensional facial computed tomography scan. A 27-year-old woman presented with a depressed contour of the right lower eyelid area and enophthalmos, resulting from a fracture that caused the downward displacement of the right orbital floor and misalignment of the zygoma.

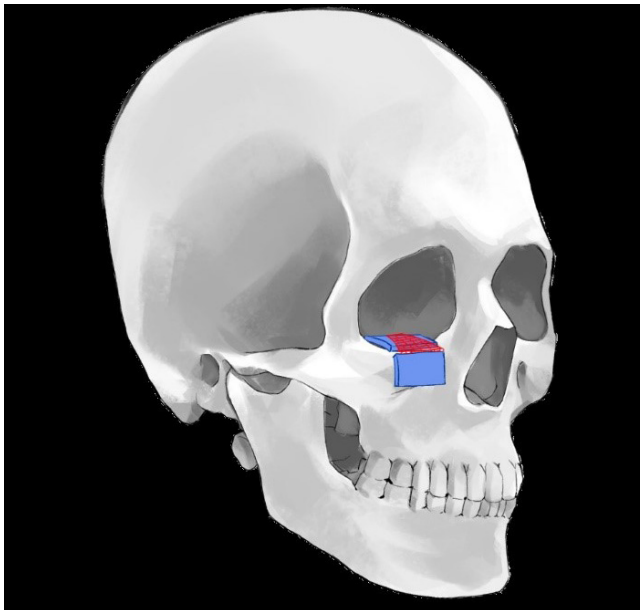

Fig. 2. Schematic drawing of surgical technique. The orbital floor is reconstructed with a hydrated acellular dermal matrix (labeled as CGDerm One-Step in blue) and a porous polyethylene implant with titanium-reinforcement (labeled as Synpor in red).

implants. Additionally, we inserted ADM between the incised upper and lower periosteum and then sutured it in place. It corrected soft tissue volume for a smoother appearance on the depressed infraorbital rim (Fig. 2).

Immediately after surgery, the facial CT scan revealed that the height of the hydrated acellular dermal tissue applied to the sunken maxilla was approximately 6.08 mm, effectively filling the soft tissue. A subsequent facial CT scan performed 6 months later showed that the height was maintained at 4.71 mm. The initial measurement of the hydrated ADM placed on the orbit floor was around 3.86 mm, and in the follow-up image taken 6 months later, it was observed to have remained at 3.02 mm, showcasing the long-term effectiveness of the procedure. These findings were corroborated by a comparison of the operated side to the normal side, indicating negligible height discrepancies and thus a symmetrical facial appearance (Fig. 3).

Six months post-surgery, the patient reported a notable improvement in her condition. The previously depressed area on the patient's infraorbital rim had undergone significant improvement (Fig. 4). Additionally, the discrepancy in exophthalmometer readings, initially recorded at 2 mm preoperatively, was markedly reduced to 0.5 mm. The diplopia experienced during downward gaze had completely disappeared. This favorable outcome resulted in a high level of satisfaction on the part of the patient, underscoring the successful nature of the intervention.

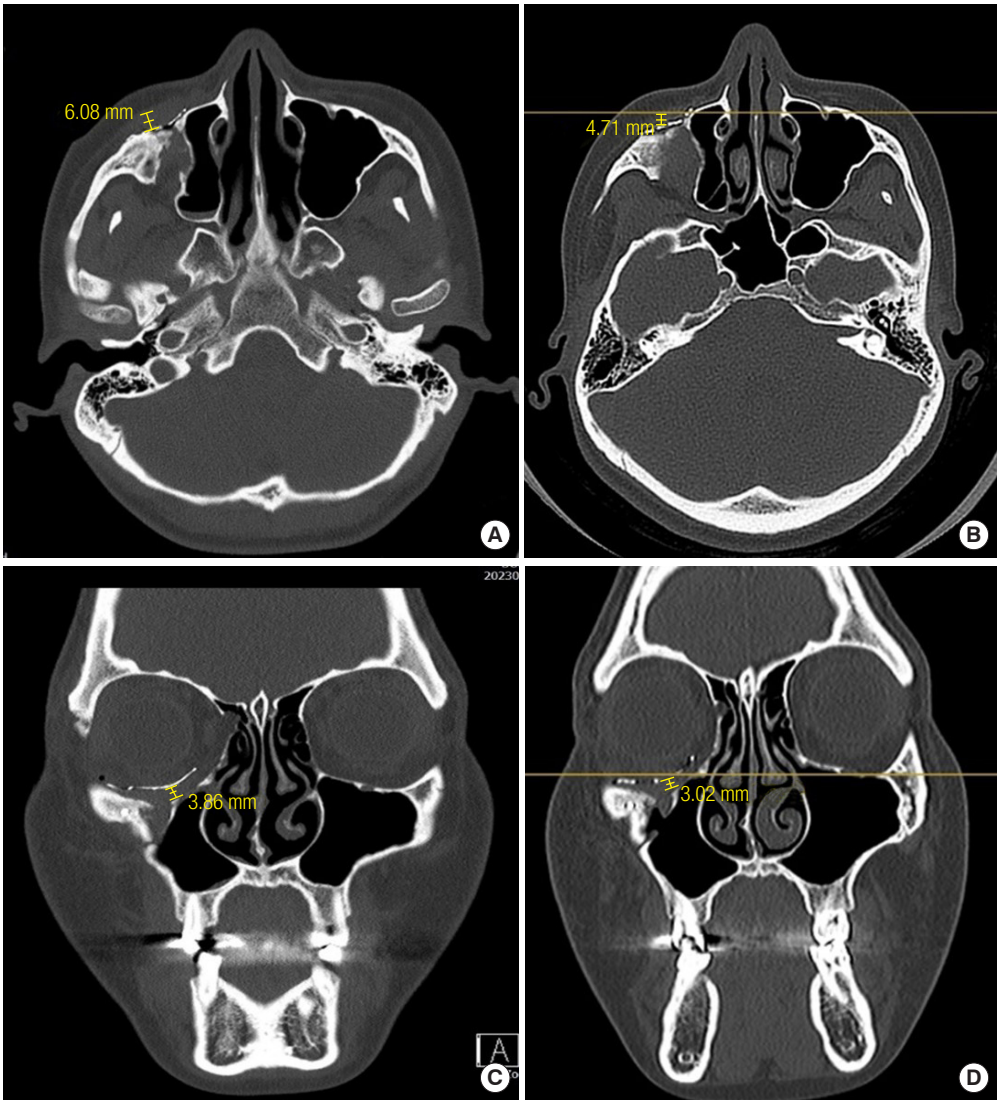

Fig. 3. Immediate postoperative orbital computed tomography scan. (A) Hydrated acellular dermal matrix in the depressed maxilla measured approximately 6.08 mm, effectively filling the soft tissue void. (B) The thickness of the soft tissue substitute 6 months after the reconstruction is approximately 4.71 mm. (C) The initial tissue height on the orbital floor is approximately 3.86 mm. (D) It remains stable at 3.02 mm as seen 6 months after the procedure.

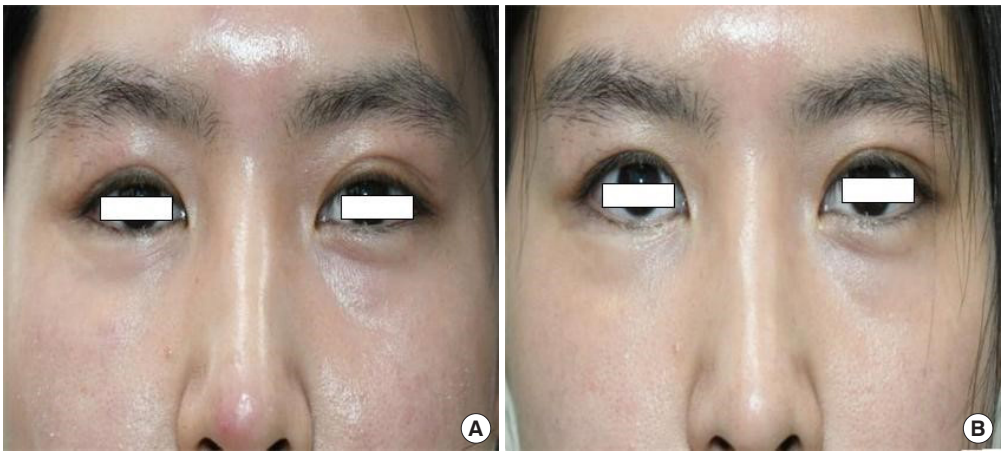

Fig. 4. Comparative preoperative and 6-month postoperative photographs. (A) Initial infraorbital rim depression and enophthalmos in preoperative image. (B) A 6-month postoperative image showing improvement in the infraorbital rim and correction of enophthalmos.

DISCUSSION

The complexity of post-traumatic enophthalmos and secondary repair requires a multifaceted approach. The primary goal in such cases typically involves the restoration of the skeletal structure, followed by addressing soft tissue complications [4,5]. However, as patients' experiences indicate, traditional methods like fat grafting, while commonly employed, can have limitations including low engraftment rates and complications at the donor site [6]. This was particularly evident in our patient's case, where repeated attempts at fat grafting failed to provide satisfactory outcomes.

While bone reshaping, flap coverage, and filler injections are still viable options, we have shifted our focus towards leveraging the unique properties of ADMs and metal implants for reconstruction. This approach was chosen due to the precision and ease of placement offered by hydrated ADM, alongside its capacity to achieve the desired volume and shape.

Understanding the critical role of the extracellular matrix in wound healing has led to the development and application of ADMs [7,8]. Their successful use in breast reconstruction for reinforcing soft tissue and minimizing complications, such as capsular contracture, provided a strong rationale for their application in facial reconstructive surgery [9]. Our study leveraged the strengths of ADMs, particularly the hydrated form, to augment volume and provide structural integrity in critical areas, offering an alternative to more traditional methods like fat grafting [10].

A review of literature on enophthalmos reconstruction reveals various methodologies [3-5], yet our approach is notable as it introduces a case involving the use of ADMs combined with metal implants [11]. Metal implants provide immediate, solid structural support, while ADM acts as a scaffold for new tissue formation, enhancing both volume and mechanical strength in the reconstructed area. The combination of ADMs and metal implants effectively compensates for volume deficits and ensures long-term stability, thereby reducing the likelihood of enophthalmos recurrence.

Given the challenges associated with secondary facial bone deformities, our study indicates that soft tissue correction may offer a less invasive, safer, and more effective treatment option. This approach addresses immediate aesthetic and functional concerns and highlights the potential for continued research and innovation in facial reconstructive surgery. As the field continues to evolve, it is imperative that we keep exploring and refining these techniques to enhance patient outcomes and overall quality of life.

NOTES

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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None.

Ethical approval

The report was approved by the Institutional Review Board of Chosun University Hospital (IRB No. 2023-11-028).

Patient consent

The patient provided written informed consent for the publication and use of her images.

ORCID

Woo Young Choi https://orcid.org/0000-0001-8849-1569
Jun Mo Kim https://orcid.org/0009-0009-3122-2101
Ji Seon Cheon https://orcid.org/0000-0001-8555-5088
Jeong Yeol Yang https://orcid.org/0000-0002-4343-4429

Author contributions

Conceptualization: Woo Young Choi. Formal analysis: Jun Mo Kim. Project administration: Woo Young Choi. Writing – original draft: Jun Mo Kim. Writing – review & editing: Woo Young Choi. Investigation: Jun Mo Kim. Supervision: Woo Young Choi, Ji Seon Cheon, Jeong Yeol Yang. Validation: Woo Young Choi.

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