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Esthetic restoration of implant prosthesis for traumatic maxillary anterior teeth using digital technology

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Advances in digital technology have made the fabrication of dental prostheses more efficient in terms of time and cost. This technology also enables more information to be communicated to the technician, which was not possible with previous technologies, resulting in more accurate prosthetic designs. In this case, we would like to present a case involving the placement of dental implants and prosthetic restoration for the maxillary anterior teeth. We combined facial scanning and intraoral scanning to efficiently achieve the patient's desired aesthetics. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2023;15(1):1-5)**

Key words: Digital dentistry, Esthetic, Implant, Facial scan, Intraoral scan

INTRODUCTION

Advancements in digital technology have enabled the integration of a wide range of equipment and materials into dental treatments. Traditionally, the creation of wax patterns and casting was a manual process, but now, it can be designed using computerized CAD programs and machined. Manual methods necessitate a substantial amount of additional materials, such as plaster and resin, along with dedicated physical space and equipment for work. Moreover, they require more time to produce a physical result, such as a model, before proceeding to the next step. Given that the traditional method relies on the technician's visual and tactile skills to shape the materials, results can vary significantly based on the technician's expertise.

Fabrication of the maxillary anterior prostheses is more challenging than the posterior teeth due to their visibility, where even slight variations in shape, such as length and angle, can be noticeable. According to Dawson[1], maintaining proper anterior guidance is crucial for fixed prosthetic restorations. Therefore, in cases where anterior guidance is lost during the mandible's eccentric movements, it becomes necessary to establish the correct anterior guidance through anterior restorations. The following factors must be communicated: the degree of labial surface exposure below the upper lip, the teeth's rounded or angular shape, and their color, as well as the extent of exposure during a patient's smile. Adjustments and determinations are required for the horizontal and vertical overlap of the mandibular teeth and the anterior and lateral angles of the condylar pathway. These adjustments should be made in the provisional restoration and transferred to the final prosthesis to ensure consistency. Digital technology allows us to accurately replicate the teeth's shape through the scanning and superimposition process[2].

To create an aesthetically pleasing prosthesis, it's crucial to harmonize it with the patient's facial appearance. While various methods have been introduced for this purpose, such as using photographs of the patient's face, they are limited by their two-dimensional nature[3]. When working with information like a tooth-shaped model and a face-bow indicating the patient's maxillary position and occlusal plane, along with photographs, achieving the desired outcome can be challenging due to the lack of three-dimensional information about the patient's facial structure[4]. Furthermore, in the case of face-bows, it can be difficult for the technician to identify incorrect acquisition or deformation during the transfer process. However, digital facial scanners overcome these limitations by enabling the acquisition of three-dimensional images.

We would like to introduce a patient with a partially edentulous maxillary anterior region. In this case, implants were precisely placed using digital guidance in the desired area. Subsequently, a prosthesis was fabricated to achieve both the desired

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aesthetics and optimal function, utilizing intraoral and facial scans for precise measurements.

CASE REPORT

A 53-year-old female patient came to clinic due to an traffic accident. At the time of the accident, teeth #11 and #21 were slightly compressed in their original positions, and following the repositioning of #11 and #21, the anterior teeth from #13 to #23 were splinted using dental resin and wire (Figure 1). After the accident, the patient experienced persistent spontaneous pain in teeth #11 and #21, leading to endodontic treatment and several months of follow-up. As a result of the noise in the right temporomandibular joint (TMJ) that developed after the accident, she was diagnosed with temporomandibular joint derangement and treated with an occlusal splint, along with regular physical therapy.

After 6 months of follow-up, tooth #11 was extracted due to persistent pain, and TMJ arthrocentesis was performed to address ongoing TMJ pain and restricted mouth opening. At the 11-month follow-up, teeth #12 and #21 exhibited increased mobility and pain. X-rays showed no abnormalities in #12 and #21, and they still had pulpal vitality, but the pain had intensified. Despite the administration of analgesic and anti-inflammatory medication to alleviate TMJ symptoms, there was no improvement. Therefore, additional extractions were performed based on the patient's complaint (Figure 2).

One year after the trauma, temporary dentures were placed following the extraction of #12 and #21. The TMJ pain and mouth opening showed varying improvement, but the anterior region pain was completely resolved. After confirming the absence of pain, Digital CT (DCT) and modeling were performed to plan implant placement in the anterior region using Implant Studio software (3Shape®, Copenhagen, Denmark). A 3-unit fixed prosthesis was planned with the implantation of #12 and #21 (Figure 3). The second surgery took place 4 months after the implant fixture (TS III mini, Osstem Implant Co., Ltd., Busan, Korea) was inserted. One month later, an impression was taken using an oral scanner, Medit i700 (Medit, Seoul, South Korea), for the fabrication of a fixed temporary prosthesis (Figure 4). Initially, a customized abutment and an upper PMMA (polymethyl methacrylate) temporary prosthesis were fabricated to evaluate the overall shape and function.

After the placement of the temporary prosthesis, the patient

Figure 1. Diagnostic panoramic view.

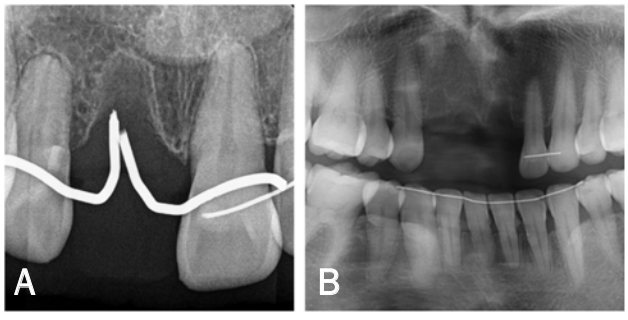

Figure 2. Extraction of teeth. (A) Right maxillary incisor site. (B) Additional extraction of adjacent teeth due to persistent pain.

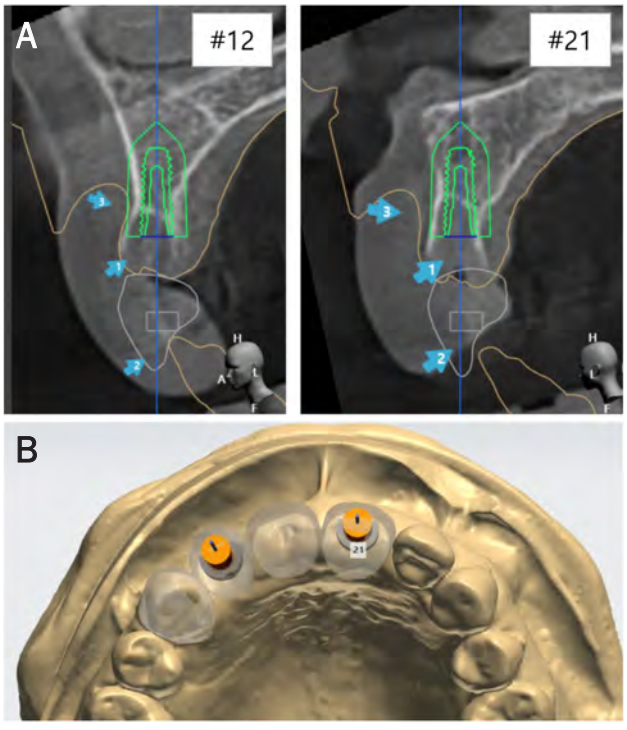

Figure 3. Implant planning. (A) Sagittal view of the implant fixtures placed in the planned area, (B) Planned implant position.

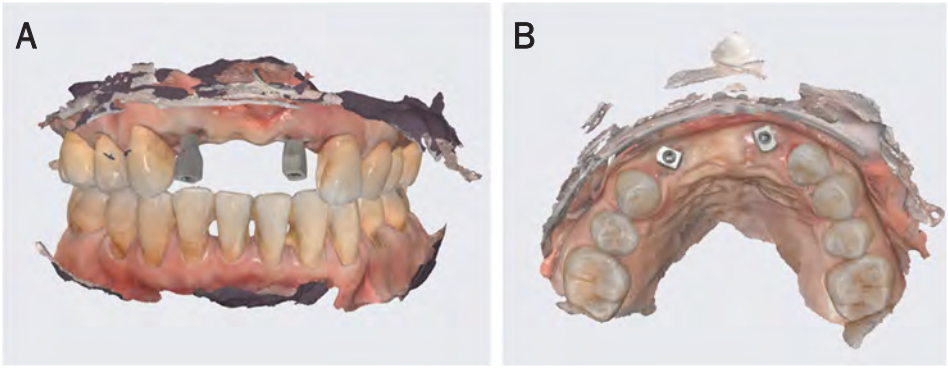

Figure 4. Intraoral scan. (A) Anterior side view with scan body, (B) maxillary occlusal view.

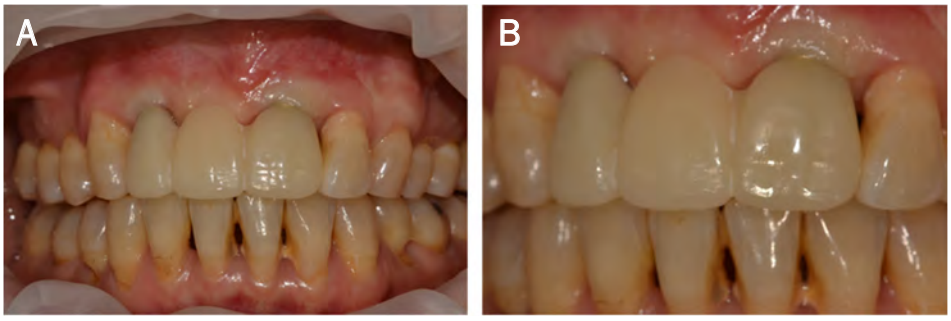

Figure 5. Provisional restrotation. (A) Anterior view, (B) Closer view showing gingival bleaching immediately after delivery of prosthesis.

was satisfied with the gingival appearance but experienced pronunciation discomfort. Upon intraoral examination, we observed an asymmetry in the lingual surface form and a misalignment in the horizontal overjet bite. The asymmetry in the horizontal overjet was attributed to the asymmetry in the mandibular dentition. Ultimately, we confirmed the crown form desired by the patient and made necessary adjustments (Figure 5). Along with the abutment-level impression and temporary bridge impression, we also acquired a facial scan (RAYface®, Raymedical, Seongnam, Korea) and sent it to the dental laboratory.

In the exocad CAD software program (exocad GmbH, Darmstadt, Germany), the facial scan file, model scan file, intraorally adjusted temporary bridge scan file, and customized abutment scan images previously stored in the library were loaded and aligned. Through the facial scan, we were able to assess the patient's lip shape, teeth exposure, smile line, and teeth arrangement from the front view. The scan provided alignment from the bottom to the top of the jaw, including the nose, maxilla, and mandible, allowing us to confirm the arrangement of the teeth. We observed asymmetry in the cervical contour between the area with the implant abutment, #21, and the pontic area without the fixture and abutment, #11, due to the presence or absence of the fixture. To achieve the closest possible match in shape, we made adjustments and replicated the adjusted occlusal surface condition within the oral cavity (Figure 6).

The definite zirconia fixed prosthesis was fabricated by milling, and after confirming the fit in the oral cavity, it was ultimately cemented using implant-specific cement (cem-implant). The patient expressed a high degree of satisfaction with the aesthetics, and during the 6-month follow-up, no inflammation or functional issues were detected, indicating that the prosthesis was well-maintained (Figure 7).

DISCUSSION AND CONCLUSION

This is a case involving a middle-aged female patient with relatively healthy dentition, who unfortunately lost a tooth due to an accident. The loss of maxillary anterior teeth in younger patients can be psychologically devastating and can also limit their social activities. The patient is eager for a rapid restoration to resume her normal daily life.

Digital technology offers the advantage of achieving a more aesthetically pleasing and faster restoration by simplifying the prosthetic process and enhancing result predictability. It facilitates easier communication with the technician, allowing you to visually convey your specific instructions. Unlike traditional methods that only replicated the shape of the teeth, facial scanners now enable the inclusion of soft tissue appearance and CAD-designed

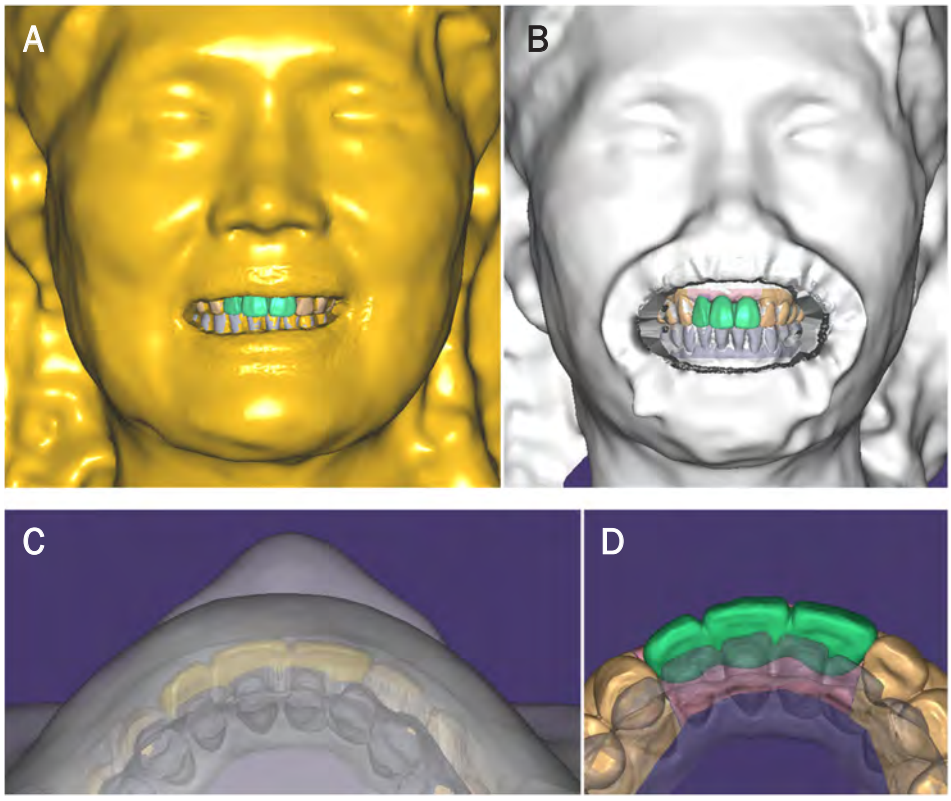

Figure 6. Digital wax–up on the virtual patient. (A) Wax up on the superpositioned model, (B) Successful matching of facial scan teeth and model scan teeth. (C) Inferior site view of the vertical axis showing the relationship between wax up and soft tissue. (D) Virtual wax up showing appropriate overjet.

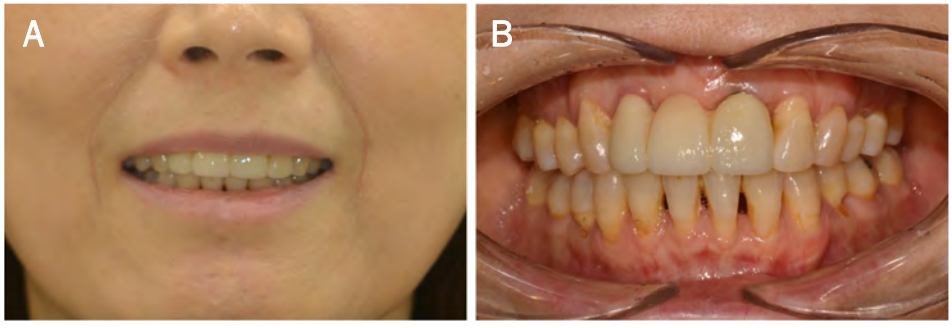

Figure 7. Photographs after the placement of definitive prosthesis. (A) Extraoral view with smile, (B) Intaroal view.

dental restoration into a virtual patient, resulting in a prosthesis that harmonizes with the patient's facial features[5].

Three-dimensional virtual diagnostics serve as a valuable visual aid, promoting effective communication among the dentist, patient, and technician. The creation of a 3D virtual diagnostic model using digital techniques efficiently supports the diagnosis of visible and predictable prosthetic restorations in a shorter timeframe, ultimately enhancing treatment satisfaction and the quality of the prosthesis design.

The initial step in fabricating an implant prosthesis for both aesthetic and functional purposes is the precise placement of the implant fixture. One approach to determining the fixture's position is known as 'prosthetic-driven implant placement,' which prioritizes the implant prosthesis in the planning process. For this purpose, implant surgical guides based on plaster models have been in use for an extended period. However, recent advancements in technology, such as cone-beam computed tomography (CBCT), oral scanners, model scanners, and impression body scanners, have made it possible to create three-dimensional reconstructions of the patient's oral cavity. This three-dimensional reconstruction allows for precise implant fixture placement through computer-guided implant placement simulation and surgical guidance, resulting in significantly improved outcomes[6]. A study conducted by David et al.[7] compared the planned and actual placement errors of fixtures in the alveolar ridge crest. They found that traditional implant guides resulted in a 1.5 mm

error, which was reduced to 0.9 mm when using surgical guides.

While dental implants are susceptible to lateral forces, anterior teeth in the maxilla can also experience lateral forces during eccentric mandibular movements. When implants are subjected to lateral forces, stress tends to concentrate at the alveolar ridge crest. Consequently, it is crucial to be attentive when achieving an occlusion that protects the implant during anterior guidance, while also allowing for disclusion in the posterior teeth. Misch[8] suggested that by adjusting the occlusion to evenly distribute the load between the implant and natural teeth in the dental arch when strong occlusal forces are applied, it is possible to reduce the typically concentrated force on the implant. Hence, it is crucial to pay close attention to the occlusal setting and adjustment of the anterior teeth, which should be thoroughly verified during the provisional phase. It's essential to transfer the occlusion data obtained from the provisional as accurately as possible to the technician, and digital techniques facilitate a more realistic final prosthetic design. As time passes, natural teeth can shift both vertically and horizontally due to wear and mesial drift. Since implants do not change position, the balance can be easily disrupted. Therefore, for anterior implant prosthetics, regular check-ups and adjustments are even more crucial[9].

In this case, a digital approach was employed, starting from the planning of implant placement to the acquisition of impressions in the maxillary anterior region. This allowed for precise implant placement in the desired location, enabling the prompt placement of the prosthesis in the edentulous area. The provisional restoration's shape was accurately replicated and easily communicated, resulting in patient satisfaction with the prosthetic process and its alignment with their facial features. This process is becoming routine in most clinics, and in the future, it will continue to expand with the increasing availability of additional digital resources and the ease of use of existing equipment. To achieve this, it is expected that clinicians will continue to be required to acquire proficiency in the equipment currently being widely introduced and be open to embracing new devices.

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