



## Case report

# An esthetic clinical approach for the management of an infrapositioned implant-retained maxillary incisor crown

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## ABSTRACT

Infrapositioning of implants in the maxillary anterior region can cause esthetic complications, including soft tissue problems. These complications commonly occur in implants placed in young adults. However, there are many clinical reports of implant infrapositioning in the maxillary anterior region after the fourth decade of life. This clinical report describes a case of infrapositioning of the maxillary central incisor wherein esthetic results were obtained through surgical and prosthetic approaches. The surgical approach improved the gingiva shape using the tunnel technique, and the prosthetic approach increased gingiva thickness by adjusting the shape of the abutment, resulting in a shape similar to the natural teeth.

## 1. Introduction

In implant dentistry, esthetic concerns are paramount for both patients and clinicians. The buccolingual positioning of implants is critical in determining the midfacial mucosal contour. Soft-tissue volume grafting can be advantageous in mitigating facial mucosa recession when performed subsequent to immediate implant placement in cases with a thin soft-tissue biotype or concurrently with surgical treatment for peri-implantitis [1].

Single-implant restorations have a higher success rate than other tooth replacement approaches. However, like ankylosed teeth, osseointegrated implants do not follow the eruption pattern of the adjacent teeth. Instead, the implant remains fixed in the same position throughout the patient's lifetime. Accordingly, patients who undergo implant surgery during their youth may have restorations that are relatively inferior to the adjacent teeth [2].

Incorrect positioning of dental implants may precipitate both functional and esthetic compromises. Positioning inaccuracies can arise within three spatial planes: mesiodistal, corono-apical, and bucco-oral. To effectively manage the deleterious consequences of such errors, a deep understanding of both the underlying anatomical conditions and the contributory factors leading to the initial misplacement is essential. These complications are usually iatrogenic. If such errors result in unfavorable esthetic outcomes, correction can be challenging and, in some instances, unattainable [3].

However, implant infrapositioning has also been reported in fully grown adults. Specifically, there have been reports of infrapositioning by  $\geq 1$  mm in the esthetic zone, more commonly seen in women with long faces [4]. Infrapositioned implants can cause esthetic problems, including the relative movement of the soft tissue margin of the implant restoration towards the root along the incisal edge of the restoration [5]. These soft tissue defects can be classified according to the height of the soft tissue recession, as well

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as the color and position of the implant crown. Moreover, Zuchelli et al. (2019) [6] described treatment methods for each type of soft tissue defect.

Esthetic zone implant dilemmas often involve dehiscence-type defects of the midfacial tissues. The onus is on the surgical-restorative implant team to discern the etiology behind such defects and to propose treatment modalities that ensure predictable outcomes. The etiological factors implicated are: 1) suboptimal implant spatial placement; 2) inaccurate abutment contouring; 3) oversized implant diameter; 4) inappropriate horizontal biological width development; and 5) the periodontal phenotype. Remedial treatments may encompass: 1) implant submersion and natural soft tissue healing facilitated by a surgical cover screw, a process referred to as “implant decoronation;” 2) soft tissue augmentation via connective tissue grafts, when indicated; 3) secondary exposure of the implant; and 4) meticulous management of the abutment-crown contour, employing a flat or minimally undercontoured approach to sustain a healthy and stable soft tissue architecture over the long term.

This clinical report presents a case of restoration of a non-esthetic maxillary central incisor owing to implant infrapositioning through a combined prosthetic and surgical approach, which yielded esthetic results.

## 2. Case presentation

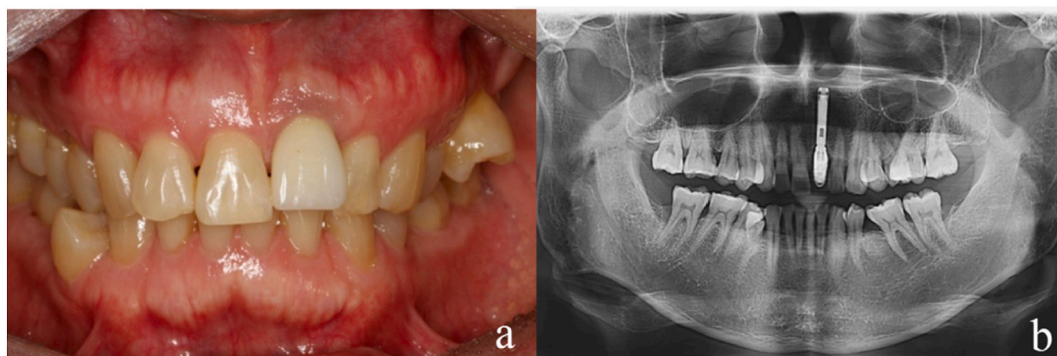
A 65-year-old male patient visited our dental clinic (Gangnam Severance Dental Hospital) to receive treatment for the restoration of an old, unesthetic implant restoration of his central incisor. In 1996, the patient received an implant (Nobel Biocare Standard 3.75 × 20 mm; Nobel Biocare, Kloten, Switzerland) and a cement-retained prosthesis in the maxillary left central incisor area. The patient’s occlusion was normal, and he had normal sagittal and vertical jaw relationship. Additionally, there are no signs of bruxism. The patient exhibited both canine and anterior guidance without occlusal interference and trauma on the maxillary left central incisor. Intraoral and radiographic examinations revealed that the incisal edge of the implant prosthesis was located 2 mm apical to the right central incisor and was labially inclined (Fig. 1a and b). Furthermore, it lacked a soft tissue contour compared with the contralateral side (Fig. 2a and b). The patient was informed of this clinical trial and informed consent was obtained.

Soft tissue deficiency was evaluated based on the classification method described by Zuchelli et al. (2019) [6]. The soft tissue margin of the implant prosthesis was apically displaced by approximately 2 mm relative to the contralateral tooth. When viewed from the occlusal plane, the prosthesis was located outside the imaginary line connecting the soft tissue margins of both adjacent natural teeth; however, the papilla was ideally positioned ≥3 mm above the gingival level (Fig. 3a–d). Therefore, the case was classified as Class IVa and a combined prosthetic-surgical approach was recommended. We prepared a treatment plan based on the recommended protocol.

The old prosthesis was removed using a diamond bur and an impression was made using polyvinyl siloxane material (HySil; Osstem Implant Company, Seoul, South Korea) at the fixture level. Subsequently, a low-height healing abutment was connected to the implant to secure the soft tissue [7]. A ready-made titanium abutment was connected to the plaster model, which was then manually milled. Next, a provisional restoration was fabricated using a self-curing acrylic resin, which reduced the buccal contour compared with the previous prosthesis. Although the soft tissue margin moved coronally, we could not achieve a symmetric height relative to the right central incisor.

At the next appointment, the minimally invasive tunnel technique was used to increase the soft tissue contour and move the gingival margin coronally. Under local anesthesia, a small vertical incision is made on the gingiva to create a tunnel. Through this tunnel, deproteinized bovine bone material (Geistlich Bio-Oss; Geistlich Pharma, Wolhusen, Switzerland) is carefully inserted into the defective residual bone and sutured (Fig. 4a–d). All the sutures were removed after 10 days. The patient was followed-up with monthly for 3 months. Intraoral scans were performed each time the patient visited the clinic to record soft tissue changes, and the scan data was superimposed using imaging software (Geomagic Control X; 3D Systems, Rock Hill, SC, USA). These scans revealed that soft tissue augmentation of approximately 1 mm was achieved around the implant.

At 3 months postoperatively, the patient was satisfied with the esthetics and stability of the soft tissue; therefore, we decided to obtain the final impression. To obtain an impression of the shape of the stable soft tissue, a custom impression coping was fabricated using autopolymerizing resin (GC Pattern Resin; GC Corp, Tokyo, Japan). Subsequently, an impression was taken using



**Fig. 1.** A) Clinical view B) Radiographic view in first visit.



Fig. 2. A) Frontal view B) occlusal view.

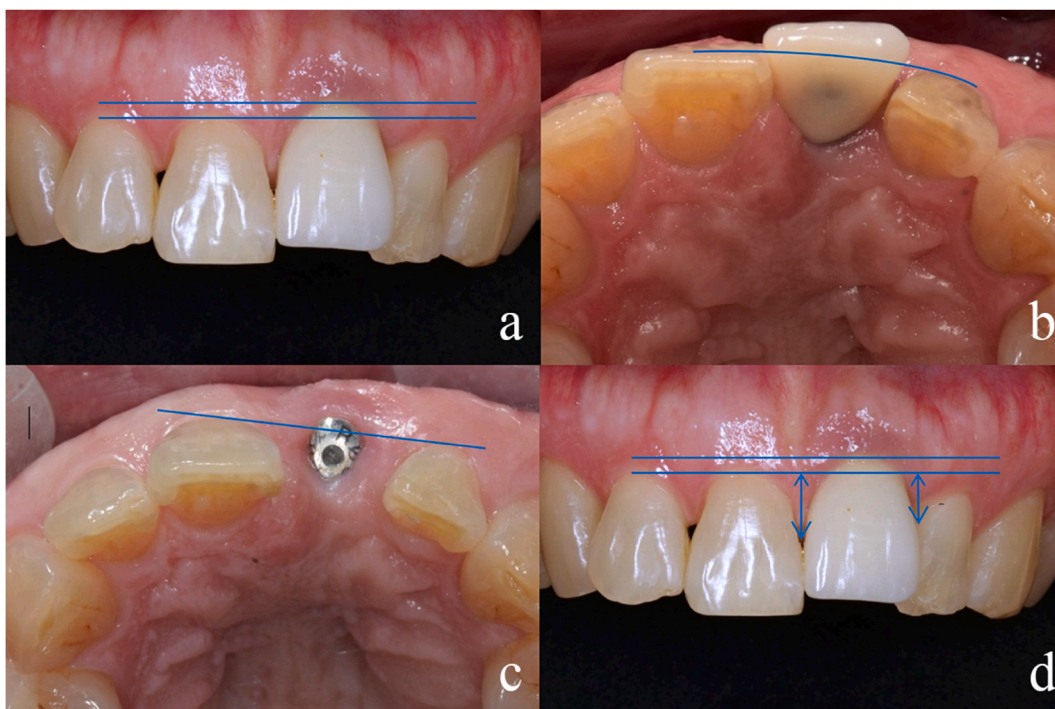


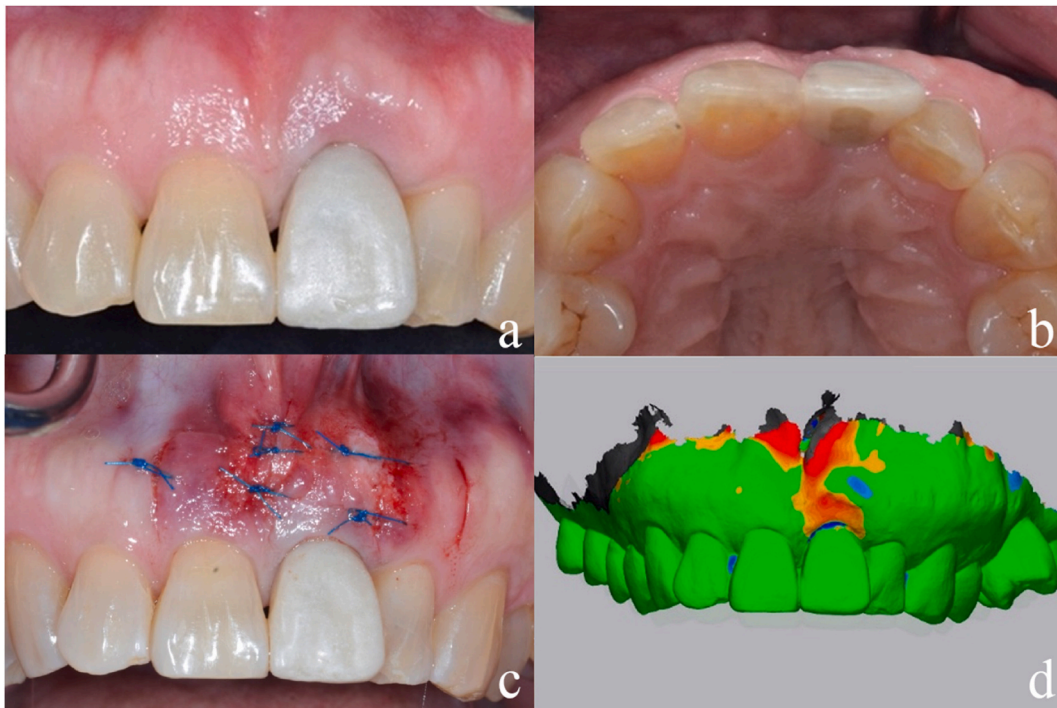
Fig. 3. A) The soft tissue margin was located more apical to the ideal position of the gingival margin of the homologous natural tooth. B) The i21 crown profile was located outside the profile of the adjacent teeth. C) The i21 implant head was located outside the gingival margin of the adjacent teeth.

polyvinylsiloxane material (Hysil; Osstem) to create a working model (Fig. 5a and b).

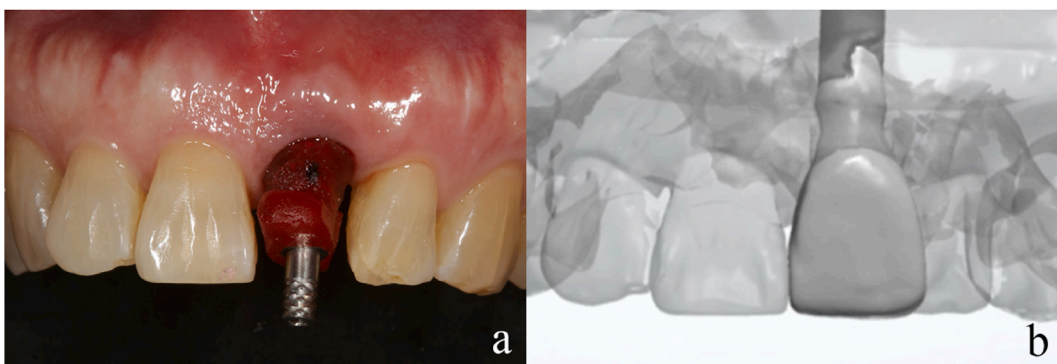
A scan of the provisional restoration, an intraoral scan, and a digital implant scan were merged to analyze the thickness of the molded soft tissue around the implant. If the margin is too shallow, there may be an esthetic problem in which the titanium abutment is visible. Therefore, the soft tissue thickness was measured using an image obtained through the sagittal section of the superimposed scan file (Fig. 6). The prosthesis margin was set to 1 mm below the soft tissue margin. The abutment was anodized to esthetically improve the soft tissue and to cover the grayish tint of the titanium abutment.

Initially, we planned to use a screw cement-retained-type prosthesis, which lacks residual cement concerns and is easy to retrieve and repair. However, since the long axis of the implant was directed towards the prosthetic incisal edge, we had to use a 10°-angled screw channel to form a screw hole on the palatal surface. This need was additionally confirmed using an image obtained from the sagittal section of the superimposed scan file.

The shape of the provisional restoration was reflected in the final restoration. Moreover, the prosthetic material selected was zirconia without a metal collar. Two weeks after the final impression was made, as the final prosthesis, zirconia crown cemented with anodized and concaved customized titanium abutment was delivered to the patient. The soft tissue contour was comparable to that of the natural teeth, with the gingival zenith at the same level as the contralateral central incisor, and the prosthesis successfully



**Fig. 4.** A) Frontal view of the provisional crown before tissue augmentation. B) Occlusal view of the provisional crown before tissue augmentation. C) Frontal view of the provisional crown after the tissue augmentation. D) Digital superimposition of gingiva before and after the tissue augmentation.



**Fig. 5.** A) Fabrication of customized impression coping with acrylic resin. B) Superimposition of intraoral scan, scanbody, and provisional crown.

replicated the natural tooth's morphology and shade (Fig. 7a and b). Consequently, both the patient and the clinician were satisfied with the esthetic outcome. The patient was scheduled for subsequent dental hygiene visits at 6-month intervals (Fig. 8a and b).

### 3. Discussion

Factors associated with the timing of implant therapy relative to skeletal growth remain unclear. Oesterle et al. (1993) [8] suggested that age is a determining factor for the timing of implant surgery in patients who are still growing. However, age is not a reliable factor, some studies have reported continuous lifelong facial growth rather than growth cessation in the late teen years. One previous study observed clear vertical and anteroposterior changes in 100 individuals monitored after 40 years. Therefore, adult patients may still present mandibular growth after decades, which can lead to complications, such as implant infrapositioning.

In the present case, the patient received the implant during their late forties. The implant infrapositioned by 2 mm, which resulted in complex issues regarding the soft tissue margin height, and esthetic concerns in the maxillary anterior area. Given the importance of soft tissue thickness in esthetics, it is crucial to form a concave contour in the transmucosal area [7], which is facilitated by platform-switching implants. External connection implants that match the platform cannot sufficiently improve soft tissue esthetics in

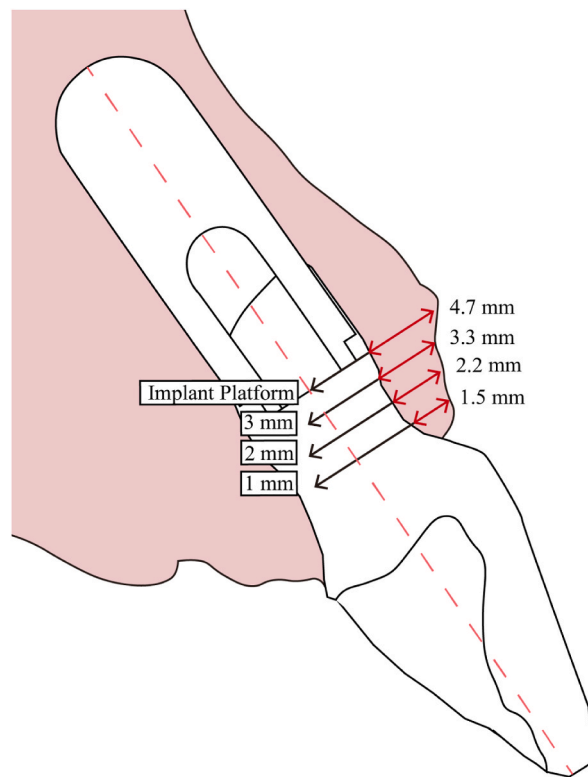


Fig. 6. Sagittal cross-section view of the provisional crown and surrounding soft tissue for measurement of buccal soft tissue.

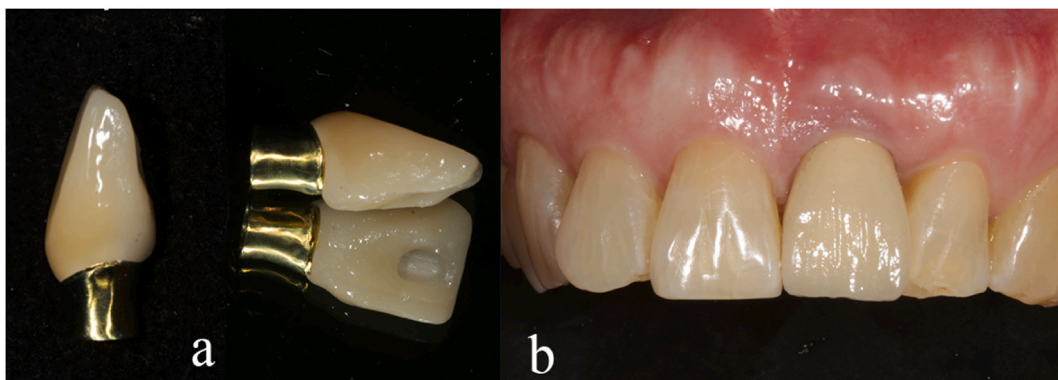
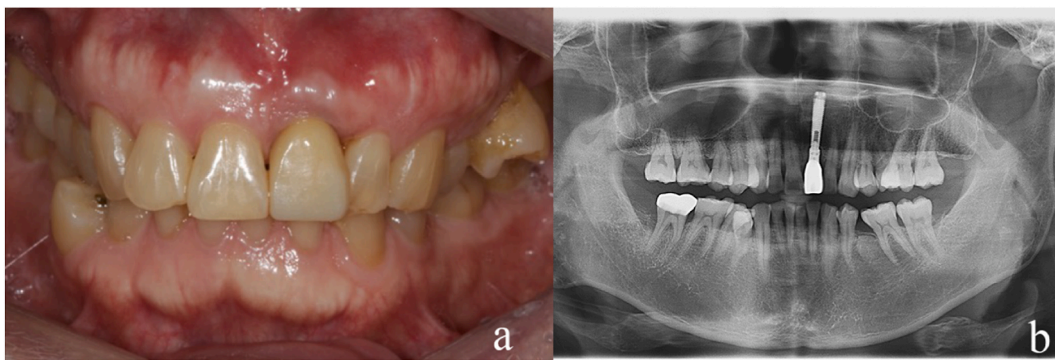


Fig. 7. A) Final prosthesis B) Delivering definitive crown.

this regard. Specifically, special consideration was required to ensure soft tissue thickness in our case since the prosthesis was made on an external connection implant. The tunnel technique, a minimally invasive procedure with long-term stability, was used to move the gingival margin coronally and improve soft tissue contour [9]. Consistent with our findings, previous studies have reported that allogenic bone grafts can allow contour augmentation and improvement of soft tissue margins.

Additionally, the implant was placed buccally to the ideal position; therefore, care was needed to achieve an esthetic color tone for the soft tissue and prosthesis. Moreover, it was important to prevent the shade of the titanium abutment from appearing through the marginal gingiva. The threshold soft tissue thickness that is unaffected by the abutment color is typically 2 mm [10]. When the facial gingiva thickness is < 2 mm, anodizing can be used to obtain esthetic results; furthermore, there is no significant difference in the biological response of the connective tissue. A previous study comparing the shade of soft tissue in prostheses with titanium abutments, anodized titanium abutments, and zirconia abutments found that zirconia abutments yielded the best esthetic results. However, given the risk of fracturing the zirconia abutment, we chose to anodize the titanium abutment.

Angulated screw channels can be used when the screw hole is located in an esthetic area and generally allow for an angle correction of up to 25° [11]. In several experimental studies, straight screw channels and angulated screw channels have shown comparable



**Fig. 8.** A) Clinical view B) Radiographic view after 6 months.

stability and resistance to prostheses fractures. In the present case, we used a screw channel with a 10° angle to form a screw hole on the palatal surface.

#### 4. Conclusion

This clinical report describes an interdisciplinary approach to restoring an infrapositioned implant. Surgical procedures and meticulous prosthetic analysis were required for the external connection of the implant. Moreover, the soft tissue thickness was analyzed using an intraoral scanner to develop the prosthesis. The patient was satisfied with the esthetics and function of the final prosthesis. We achieved an almost ideal symmetry with the contralateral central incisor, by replacing the unaesthetic restoration with an abutment with reduced buccal contour and enhancing the gingival contour using tunnel technique.

#### Data availability statement

No data was used for the research described in the article.

#### CRediT authorship contribution statement

**Jinwoo Han:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Se-Wook Pyo:** Validation, Supervision, Software, Project administration. **Sunjai Kim:** Visualization, Validation, Supervision, Project administration, Methodology, Investigation. **Jae-Seung Chang:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

#### Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Jae-Seung Chang reports financial support was provided by National Research Foundation of Korea. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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