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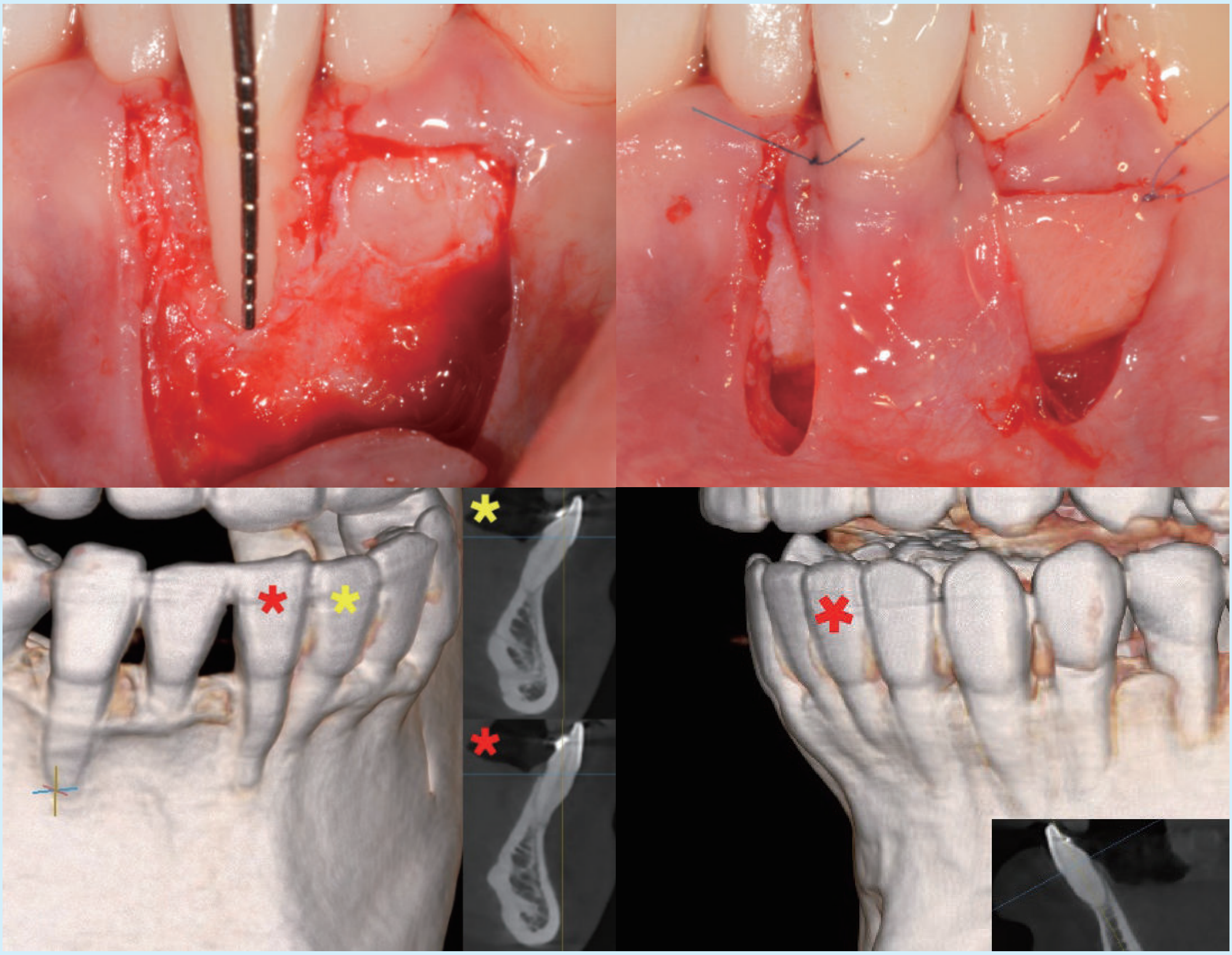
Vol.7. March. 2025

JCDD

Journal of Clinical & Digital Dentistry



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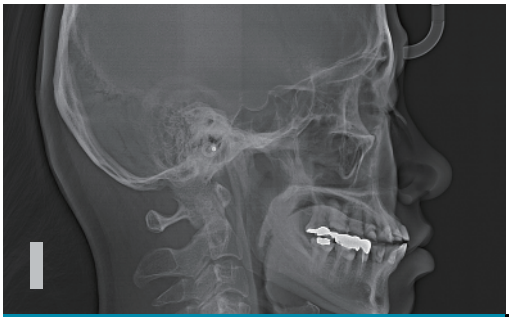

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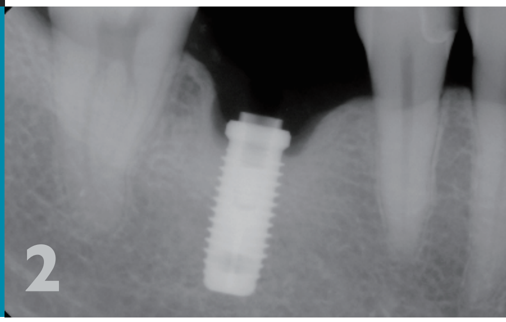

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About the Journal

The Journal of Clinical and Digital Dentistry are published four times (March, June, September, and December) annually since May 2019. The abbreviated title is "J Clin Digit Dent". In the journal, articles concerning any kind of clinical dentistry such as prosthodontics, orthodontics, periodontics, implant dentistry and digital dentistry are discussed and presented.

Aims and scope

This journal aims to convey scientific and clinical progress in the field of any kind of clinical and digital dentistry.

This journal publishes

· Original research data and high scientific merit in the field of clinical and digital dentistry.
· Review articles.
· Case reports in implant dentistry including GBR, digital dentistry, 3D printing, and prosthodontics.
· Short communications if they provide or document new technique and clinical tips.

About the Journal

Editorial Board

Editorial

Time always flows.

Time always flows.
Winter has passed, and before we know it, spring has arrived, bringing new sprouts. Nature consistently repeats its cycles of spring, summer, fall, and winter without deviation. Sprouts emerge, leaves turn green, flowers bloom, leaves change color, and eventually fall—over and over again. It is admirable how nature follows its course without needing to learn anything new.

In contrast, dentistry is not a field where procedures can be performed repetitively without continuous learning. Although dental treatments may seem routine, advancements in biomaterials, digital dentistry, and clinical research drive ongoing evolution in our profession. Moreover, unlike many other occupations, we as dentists are held accountable for the longevity and outcomes of the treatments we provide, even years after they are completed. Dentistry demands lifelong learning, adaptability, and an unwavering commitment to clinical excellence.

When first becoming a dentist, one tends to focus on treating individual teeth—extractions, cavity treatments, root canal treatments, and crown restorations. However, as we gain experience and treat more patients, we begin to take on comprehensive oral rehabilitation. The complexity and difficulty of cases naturally increase. Full-mouth rehabilitation is fundamentally different from treating individual teeth while maintaining existing occlusion. This is why many dentists find it challenging and often refer such cases to specialists.

In this edition of JCDD, there is a case report that explains the principles and treatment process of full-mouth rehabilitation. This article aims to help dentists who find full-mouth rehabilitation daunting by providing a clear understanding of the overall treatment process and principles. Through this, we hope dentists will gain confidence in performing such treatments. Additionally, this issue includes a paper on screw fractures in dental implants and another on periodontal surgery, which will help reduce the concerns and uncertainties of dentists.

As we welcome the warmth of spring, I hope that all dentists will approach their treatments with warmth and compassion throughout the year.

Wongun Chang, DDS MS PhD

Full mouth rehabilitation in a patient with a severely worn dentition: A case report ①

Wongun Chang, DDS, MS, PhD

Introduction

Full mouth rehabilitation presents a significant challenge for dentists. The process, extending from diagnosis to treatment planning and final rehabilitation, is prolonged, requiring active patient cooperation. Despite its complexity, the aesthetic and functional benefits of treatment are significant. Full mouth rehabilitation can be likened to the construction of a new building on a vacant lot.The process entails a thorough examination of the surrounding environment and ground conditions at the construction site. This is followed by the development of an architectural design, the execution of construction in accordance with the design, ongoing supervision throughout the building process, and a final inspection before the structure is deemed ready for use. Similarly, a full mouth involves a thorough diagnosis that considers both the patient's oral condition and overall well-being.

This evaluation serves as the foundation for formulating an optimal treatment plan. The treatment is then carried out in accordance with the prescribed regimen, culminating in the final restoration. Following the completion of treatment, the patient is advised to attend regular dental visits for check-ups and maintenance.

In order to successfully complete the entire treatment process of full mouth rehabilitation, determining the vertical dimension of occlusion must be the priority, and the patient's VDO is determined by the subjective judgment of the treating dentist.This case report aimed to illustrate the comprehensive treatment process of full mouth rehabilitation in a patient with a severely worn dentition.

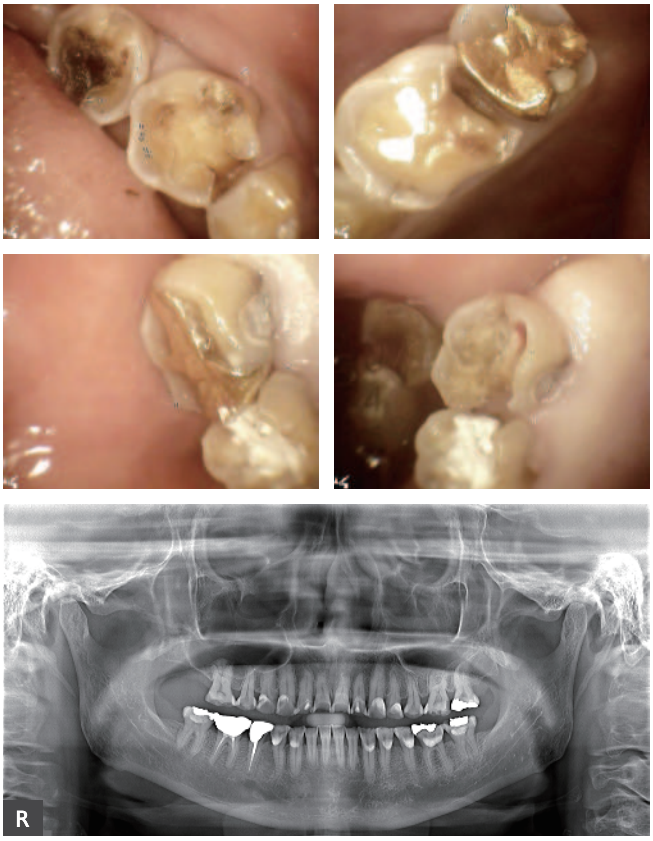
Wongun Chang

Dr. Wongun Chang graduated from Seoul National University College of Dentistry, and then earned MS degree from New York University College of Dentistry(NYUCD), PhD degree from Dept. of Dental materials sciences, Seoul National University College of Dentistry. He completed Advanced Specialty Program in Orthodontics for International grauduates(1997) and Advanced Education Program in Prosthodontics(2009), NYUCD. He gives lectures in various topic, especially occlusion, complete denture, orthodontics, and interdisciplinary dental treatment nationally and internationally. His books "The answer is COVAN, Harmonized stomatognathic system", and "Functional occlusal harmony in orthodontics"are best seller in Korea from 2019. He is an immediate president of Korean Academy of Esthetic Dentistry, a vice president of Asian Academy of Aesthetic Dentistry. and a President-elect of International Federation of Esthetic Dentistry. He is an editor-in-chief of JCDD and a head coach of Team CTS. He maintains a private practice in Milestones Dental Institute, Seoul, Korea.

Case Report

A 46 years old female patient presented with a full dentition undergoing dental treatments. However, she continued to experience discomfort and pain and sought a comprehensive treatment regimen. She reported being referred to the clinic by her primary care dentist, who lacked the expertise required to perform full mouth rehabilitation, advised her to seek treatment from a specialist. During the initial consultation, the patient presented her previous dental records and provided a detailed account of her treatment history. The patient's persistent concerns and extensive questioning raised doubts about whether her referral was solely based on clinical necessity or influenced by the complexity of her case. After observing the patient express numerous complaints to the hygienist, who spent more than 30 minutes addressing her concerns during the first visit, avoiding involvement in her case seemed like a reasonable consideration.

The pre-treatment photographs of the patient's oral cavity revealed a severely worn dentition and extensive interproximal decay **(Fig.1-6.)** These findings indicated the necessity of comprehensive endodontic treatment and full mouth rehabilitation.



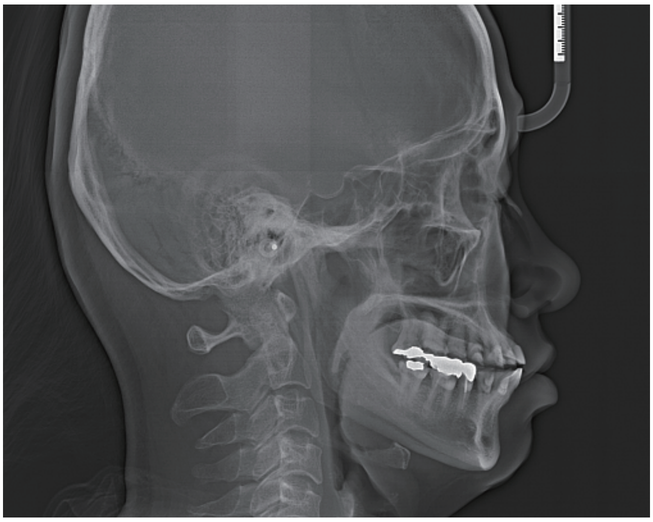


Fig. 1-6. Oral photographs and radiographs from the patient's initial visit to the dental clinic prior to treatment

A radiographic examination, including X-rays, was performed to assess the patient's current dental status **(Fig.7-13.)** The patient's previous dentist had completed the root canal treatment on the left mandibular molar. However, the patient continued to experience discomfort. Upon reviewing the panoramic radiograph, certain irregularities were noted. Although a Gutta percha cone was utilized, the sealer did not appear to be of a conventional type. Additionally, excessive penetration of the sealer into the periapical region was observed. The patient believed that the root canal treatment had been completed, yet the absence of a composite core suggested otherwise. This raised suspicion that the treatment had not been finalized. Furthermore, the referring dentist indicated that the condition could be monitored and retreated if necessary, leading to speculation that the current filling material might be temporary, possibly composed of calcium hydroxide. Cephalometric radiographs revealed an apparent open bite in the pre-treatment images taken by the previous dentist, raising the question of whether the patient had kept her mouth slightly open when the X-ray was taken.

The current occlusion is well aligned and the midline and exhibits a normal class I occlusion **(Fig.7-11.)** Except teeth #45 and #46, which had undergone restoration, all other teeth exhibited significant occlusal surface wear. During the course of treatment, the patient was asked about any history of bullemia, to which she disclosed a previous experience with the condition during her 20s. Bullemia typically affects the lingual surfaces of the maxillary anterior teeth and the palatal occlusal surfaces of the maxillary molars.

However, in this patient, significant wear was also observed across the mandibular teeth. Although bullemia was identified as a potential contributing factor to the patient's current dental condition, other underlying factors need to be elucidated.

Fig. 7-13. Intraoral photographs and radiographs from a visit to the Milestones Dental Clinic

Diagnosis through COVAN

1. C (centric relation): The mandibular position was stable and remains consistent with maximal intercuspation when guided centric relation. A stable condyle position indicates the absence of structural complications following restorative treatment. Therefore, when restorative procedures are performed with an appropriate occlusal scheme, stable CR position is preserved, minimizing the likelihood of subsequent complications.

2. O (occlusal scheme): The bilateral balanced occlusion resulted in significant posterior interference during lateral movements, as evidenced by the wear on the teeth. Although this pattern of tooth wear did not necessarily indicate a bilateral balanced occlusion, in this patient, both premolars were consistently in contact. The wear on the anterior teeth contributed to posterior interferences, which may have further exacerbated the occlusal wear.

3. V (vertical dimension of occlusion): The lower facial height was shorter than the midfacial height, with a reduced vertical dimension of occlusion due to severe occlusal surface wear.

Fig. 14. The ratio of midfacial to lower facial heights, highlighting the reduced lower facial height compared with the midfacial height (red arrow)

4. A (anterior teeth aesthetics and relation): The anterior teeth exhibit an aesthetic concern due to significant wear on the incisal edges, and their relationship is functionally inadequate. Neither proper overjet nor overbite is observed. This may have exacerbated the posterior interference. Additionally, the anterior teeth exhibit a pronounced labiolingual inclination. The severe proclination of the anterior teeth can hinder the establishment of a mutually protective occlusion following treatment, even when an adequate anterior tooth relationship has been achieved. This condition presents both functional and aesthetic challenges. Functionally, the severe proclination of the anterior teeth suggested that the anterior guidance angle may have been shallow from an early age and that posterior interference may have existed previously. Additionally, the incisal edges of the maxillary anterior teeth extended beyond the lips, disrupting the formation of an aesthetically pleasing smile line. Even in the absence of wear, their vertical positioning would have remained suboptimal.

5. N (neuromuscular system): The patient reported persistent tension in the muscles surrounding her jaw, neck, and shoulders.

Treatment plan

Given the need for full mouth rehabilitation, treatment options were relatively straightforward. Although the teeth exhibited significant wear, none appeared to require immediate extraction. The treatment plan prioritized the preservation of all teeth, with restorative procedures completed first. The extraction of problematic teeth was scheduled for a later stage, with implant placement planned for a subsequent phase of treatment. Consequently, the preemptive extraction of teeth with a poor prognosis was not considered. The primary challenge in developing a treatment strategy was determining whether to proactively improve the vertical position of the maxillary anterior teeth through orthodontic intervention. This procedure aimed to achieve aesthetic alignment of teeth with severe proclination while ensuring an optimal anterior guidance angle. When establishing a treatment plan, the decision was whether to actively improve the disharmony of COVAN through orthodontic treatment or to improve them only with prosthodontic treatment. Ultimately, the decision regarding treatment option rested with the patient. Therefore, the patient was informed of the benefits of orthodontic treatment followed by prosthodontic treatment to assist in the decision-making process.

Benefits of orthodontic treatment

1. The vertical dimension of occlusion can be improved through extrusion of molar teeth.

2. By deliberately improving the vertical position and labiolingual inclination of the maxillary anterior teeth, both esthetic and functional improvements can be achieved, resulting in a mutually protective occlusion.

The vertical dimension of occlusion can be improved through prosthodontic intervention alone, eliminating the necessity for concurrent orthodontic treatment. However, the enhancement of smile aesthetics, through the vertical positioning of the maxillary anterior teeth and the improvement of the labiolingual inclination, is limited when relying solely on prosthodontic treatments.

The patient was informed of two treatment options: orthodontic treatment to reposition the maxillary anterior teeth, followed by a comprehensive prosthodontic restoration, or prosthodontic treatment only devoid of orthodontic intervention. The patient indicated that she would defer her decision regarding the treatment plan until the completion of the root canal treatment on the remaining teeth. Following the root canal treatment, the patient returned for a follow-up consultation, during which she expressed a desire to prioritize orthodontic treatment to address her dental concerns. However, the patient said that she wanted to finish the treatment as soon as possible because she had suffered for so long because of her teeth, and that she would receive only prosthetic treatment without orthodontic treatment, even though it was her second choice. Since I fully understood how she must have suffered, I did not actively recommend orthodontic treatment to her.

Treatment sequence for prosthetic full mouth rehabilitation

1. Centric relation position : In cases where the centric relation is stable, as observed in this patient, determining the appropriate vertical dimension of occlusion can be made with minimal consideration. However, if the stability of the centric relation is compromised, resulting in a centric occlusion - maximum intercuspation (CO-MI) discrepancy, it is necessary to acquire an occlusal bite in centric relation before determining the vertical dimension of occlusion in that position. Therefore, the initial step is to ensure that the centric relation is stable. The greater CO-MI discrepancy, the greater the problem in the anterior teeth relationship, so it may be difficult to properly improve the anterior relationship with prosthetic restoration alone. Consequently, it may not be feasible to adequately improve the anterior teeth relationship with a prosthetic treatment alone. In addition, as the vertical dimension of occlusion is determined by the rotational motion of the mandible in centric relation, rather than its gliding motion, adjusting the vertical dimension of occlusion to ensure proper anterior teeth relationship in centric relation does not pose a risk to the jaw joint. If the intercuspal position is achieved in a patient with a CO-MI difference while the mandible is in a sliding motion, increasing the vertical dimension of occlusion based on the intercuspal position state may result in occlusal disturbances and changes after treatment. This occurs because the mandibular condyle is not in a stable position, and the CO-MI difference may become more pronounced.

2. Determining the vertical dimension of occlusion: For full mouth rehabilitation, determining the vertical dimension of occlusion is a prerequisite for any treatment approach. The centric relation position is performed first to establish the basis of rotation, as changing the vertical dimension of occlusion involves a rotational movement of the mandible position from the centric relation state. After identifying the centric relation, the appropriate vertical dimension of occlusion must be determined from that state to facilitate the subsequent steps. Failure to accurately establish the vertical dimension of occlusion can hinder the process of shaping a crown due to insufficient vertical space during the prosthetic restoration procedure. Additionally, it may result in the abutment being reduced in height, potentially leading to inadequate retention. The determination of the vertical dimension of occlusion is crucial, with considerations given to the aesthetic facial proportions and the vertical space available for the prosthetic restoration. Once the vertical dimension of occlusion has been accurately established, the restoration can be fabricated to meet the patient's needs while still allowing for subsequent modifications during the restoration process.

3. Determining the occlusal scheme: The appropriate occlusal scheme must be selected based on the treatment option. The occlusal scheme must be determined based on the treatment type. For complete dentures, options include bilateral balanced occlusion or mutually protective occlusion, depending on the patient's age, aesthetic needs, and alveolar bone condition. For natural teeth or implant prostheses, mutually protective occlusion with anterior guidance is used, or occlusion can be established through fixed prosthesis-treated teeth in mixed fixed and removable prostheses. In patients with healthy canines or those with absent canines and requiring implants, the optimal occlusal scheme must be determined. The decision to use canine guidance, progressive anterior guidance, or group functional occlusion should be made based on evaluation, which is conducted using a provisional restoration.

4. Creating diagnostic wax-ups and provisional restorations: After determining the vertical dimension of occlusion, the stone cast can be mounted in the articulator. A diagnostic wax-up is done, considering the anterior tooth relationship and anterior tooth position in relation to the chosen occlusal scheme. A provisional restoration can be fabricated accordingly. Alternatively, modelless procedure is possible using an intra-oral scanner. After recording a bite with the predetermined vertical dimension of occlusion, an intra-oral scan can be taken, allowing the creation of a diagnostic wax-up and provisional restoration in a virtual articulator. Although the inclination of the condyle path should be determined through overbite when using a semi-adjustable articulator, it is acceptable to use an arbitrary condyle path inclination in diagnostic wax-ups. In cases like this patient where there are all teeth, taking a protrusive bite record is possible, but in cases of complete denture treatment or full mouth implant restoration, the protrusive bite record cannot be taken because there aer no teeth at all. When using a semi-adjustable articulator or a modeless virtual articulator, instead of relying on the patient's overbite to determine the condyle path inclination, the easiest and most effective method is to utilize Dr. Hobo's twin-table technique . Premolars and molars are adjusted with the condyle path inclination set to 25 degrees, whereas the anterior teeth are adjusted with the inclination set to 45 degrees, simplifying the reconstruction of a mutually protective occlusion with progressive anterior guidance.

5. Cementation and evaluation of provisional restorations: The patient is then evaluated with a provisional restoration that matches the shape and occlusal scheme of the definitive restoration, depending on the treatment options. During this evaluation period, the patient's bite, mastication, and mandibular movements are assessed, along with the definitive restoration, the relationship of the anterior teeth, and the color of the teeth. If the mandibular movements undergoes multiple revisions, the modified provisional restoration can serve as the basis for the final evaluation while the new provisional restoration is being used.

6. Use of the definitive restoration: Following the evaluation of the provisional restoration, which encompasses the assessment of its shape and occlusion, the definitive restoration can be implemented. It can be created as a single piece or separated into upper and lower jaws. When distinguishing between posterior and anterior teeth, it is always recommended to set the definitive restoration for the posterior teeth first and then fabricate the definitive restoration for the anterior teeth.

In summary, for full mouth rehabilitation, determining the vertical dimension of occlusion should always be a priority, regardless of the treatment option. As the change in the vertical dimension of occlusion is influenced by the rotation of the mandibular condyle in centric relation, the undefined position of condyle must be initially established through centric relation induction. Once the vertical dimension of occlusion is determined, the remaining steps of condyle must be become straightforward, as each treatment option can be applied accordingly.

Analyzing the causes of implant screw and abutment fracture and removal of the fragments

Seoung-Jin Hong, DMD, MSD, PhD
Sang Wook Kang, DMD, MSD, PhD

Introduction

Dental implants have become the choice of treatment for replacing missing teeth, with numerous studies reporting the stable outcomes and 10-year success rates or survival rates of >90%. However, cases of mechanical failure are not included in these values, given that the definition of implant failure is based on the removal of the implant fixture in most of these studies.

Examining the incidence of mechanical complications following implant-supported dental restoration in previous studies revealed an incidence rate of 24.8% in a study with a follow-up period of 5.3 years, 24.7% in a retrospective study with a follow-up period of 8.4–13.5 years, and 32% in longitudinal studies with follow-up periods ranging from 9 to 15 years. Thus, different rates of complications and failure were reported based on the period of follow-up and study design.

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The types of mechanical complications associated with dental implants vary from those that occur quite commonly yet can be resolved with straightforward procedures to those that do not occur frequently and necessitate the removal of the implant. Thus, mechanical complications range from screw loosening and minor chipping (involving partial fracture of the superstructure such as the crowns) to fracture of the superstructure, screws, abutment or the implant fixture, which necessitates the removal of the implant fixture and reimplantation.

Mechanical complications of dental implants can be attributed to the complex interplay among multiple factors. These complications can occur as a consequence of components of implants, such as the superstructure, abutment, screw, and fixture, being overloaded. Thus, adhering to the basic principles in the practice of prosthetic restoration and considering the characteristics unique to the biomechanics of dental implants are the most fundamental steps in their prevention and resolution. The risk factors of mechanical complications include the presence of a cantilever design in dental prostheses, poorly designed occlusion, inability to achieve passive fit, and presence of parafunctional habits such as bruxism. These risk factors increase the risk of mechanical complications. Poor proximal contact in dental prostheses can be attributed to the development of inflammation from food impaction between teeth; however, screw loosening may occur in addition to food impaction in patients with dental implants. Furthermore, owing to the lack of the periodontal ligament, the perception of pressure on chewing is lesser in regions with implants than that in those with natural teeth, and stress is distributed in the coronal part of the fixture.

Thus, the reduced perception of implants to the finer details of abnormal occlusion may lead to a reduction in the fine motor control of mastication, resulting in repetitive overloading. The length of the implant crown rather than the crown-to-root ratio can be used to predict the incidence of mechanical complications. Dental prostheses and occlusal schemes must be fabricated with considerations on reducing the lateral force in cases wherein the crown height space is ≥15 mm. Increasing the number of splinted implants in a prosthesis decreases the risk of mechanical complications such as screw loosening. However, splinting may lead to other types of complications such as fracture of connective parts in the superstructure. Thus, it should be performed such that a passive fit can be achieved.

Analyzing and determining the cause of the problems is the key to treating mechanical complications associated with dental implants. These complications arise as a result of a complex interplay between multiple factors rather than a single cause; thus, pinpointing a single cause may not be adequate.

Although in-depth understanding of the causes may require long-term clinical experience data regarding different types of failure, ongoing efforts to identify the cause of the detected problems is imperative. For instance, simply tightening the screw for a patient who visited the clinic due to screw loosening may result in the complication recurring within a few days or occurrence of screw fracture due to the effects of external forces such as a occlusal force secondary to screw loosening. Thus, comprehensive evaluation, such as examining the occlusion or interproximal contact and assessing the presence of any damage in the screw and abutment by removing the dental prosthesis, must be performed at the first onset of screw loosening. Mechanical complications occurring in the early stage, such as screw loosening, may indicate the application of excessive stress. These complications occur when occlusal stress exceeding the limit is applied onto the individual components of the implant. Notably, fatigue fracture may occur from the repeated application of forces or stresses less than the yield strength.

Screw fracture occurs as a result of the application of an external force that is greater than the fracture strength of the screw material. Screw fracture can occur in two modes: fracture caused by the excessive lateral movements of the dental prosthesis following screw loosening and fracture that can be attributed to external force without screw loosening. Differentiating between these two modes of screw fracture is crucial while analyzing the cause of fracture and selecting the strategy to remove the broken screw fragments, given that removing the debris of the fractured screw is the most critical step in the management of screw fracture

Abutment fractures occur as a result of the application of excessive force to the abutment following screw loosening, which weakens the clamping force of the screw, in the internal conical connection type implants. The abutment in an implant-supported prosthesis is firmly attached to the fixture through the clamping force of the screw, which resists against the external forces applied to the prosthesis. External forces may reduce this clamping force in some cases. The resistance to the external forces varies according to the connection type of the abutment and fixture. Notably, implants with internal conical connection type are mechanically advantageous in that they provide resistance against the lateral force. However, reduction in the clamping force of the screw owing to screw loosening leads to the abutment-fixture connection area being subjected to the entirety of the lateral forces applied, which can lead to abutment fracture. In clinical practice, the screw can be removed without difficulties in most abutment fracture cases as it is retrieved with the upper part of the abutment without fracture or removed with ease when fractured as it is not tightly clamped to the fixture. The difficulty to detect screw loosening at an earlier stage can be caused by the welding between the bottom of the abutment and the top of the fixture in the internal conical connection type implants. The frequency of abutment fracture is relatively higher in The gold-alloy UCLA abutment for screw-retained type prostheses and gold-cast abutment for cement-retained type prostheses are associated with a relatively higher frequency of abutment fracture. The diameter of the abutment connection area remains constant even when the diameter of the implant fixture increases. This finding indicates a high possibility of abutment fracture occurring in the molar area, which is subjected to a strong bite force.

This report investigated the causes of screw fracture and abutment fracture in dental implants through the analysis of the cases presented below. Furthermore, it proposed strategies for the effectively retrieval of the fractured components.

Case Report

[Case 1]

A 69-year-old man presented with a fractured screw for the implant #27i. Retrieval of the broken screw fragments was attempted unsuccessfully at the dental clinic; consequently, he was referred to the Kyung Hee University Dental Hospital in Seoul, South Korea. Panoramic and periapical radiographs confirmed the location and condition of the fractured screw fragments and the location of the fractured screw fragments in the implant. **(Fig. 1)**

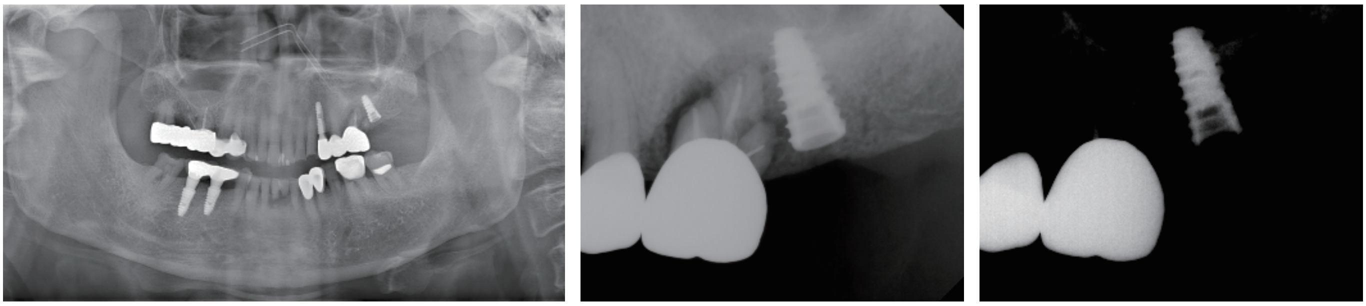


Fig. 1. A radiograph confirms the presence of screw fracture for the implant #27i, and the adjustment of the periapical radiograph allows clear visualization for the location of the fractured screw fragments.

The path of implant placement was in the distal direction, and the fabricated dental prosthesis may have been larger in the mesial aspect. Furthermore, the tooth was subjected to most of the bite force and was unable to bear the applied bite force owing to severe alveolar bone loss around #26. The fractured screw fragments were located deep within the implant, indicating that the screw was fractured by a strong external force while the screw was slightly loosened or not loosened at all. Another possibility was the fractured screw fragments moving deeper into the implant during the attempted retrieval of the fractured implant. The patient was possible to undergo replacement of the existing dental prosthesis following the retrieval of the fractured screw; thus, #26 had to be treated first, and the occlusal contacts in the mesial part of the occlusal table of the prosthesis was to be examined, and occlusal adjustment should be performed, if necessary.

The type of fractured structure, such as the screw or abutment, must be identified first, followed by the location of the fragments while attempting the retrieval of fractured screw fragment. Fragments located deep within the implant are difficult to retrieve using dental tools such as an explorer or an ultrasonic scaler irrespective of whether they are firmly engaged in the implant. A dedicated remover kit must be used in such cases. The fragments can be retrieved using the explorer or ultrasonic scaler if they are confirmed to be present in the upper part of the implant and can be rotated. The endodontic explorer, which facilitates deeper access in the linear direction, is more appropriate for assessing the degree of engagement of the fractured screw and retrieval of the fragment than other types of explorers. **(Fig. 2.)**

A dedicated kit for the retrieval of the fractured screw was used in the case of this patient. Several manufacturers have developed and released such kits as a commercial product. Clinicians can select an appropriate kit based on their requirements Familiarizing oneself with the user manual ahead of the actual procedure is recommended irrespective of the kit selected. In brief, a drill was used to drill a hole in the fractured screw. The drill is rotated counterclockwise subsequently to create a hole in the fractured screw fragment, and a rotational force is applied in the reverse direction to retrieve the fragment. Ensuring that the drill is rotated counterclockwise is essential. Notably, the fragments may move further into the implant when the drill is rotated clockwise; thus, caution must be exercised. In some cases, the drill can be located at the exact center of the fractured screw, and the drill path can be aligned with the implant such that the fractured screw can be retrieved by drilling; however, such cases are rare. A drill is used to create a hole in most cases, and a manual tool that allows connection to the hole is used for the removal. When using the drill, it is important to use a guide that matches the implant system, as it is of utmost importance that the drill is positioned on the center of the fractured fragment and aligned path with the implant. A guide protects the implant from being damaged by the drill; however, its most important role is providing appropriate guidance for the placement of the drill at the center of the fragment and facilitating the application of drilling force in alignment with the path of the implant. **(Fig. 3.)**

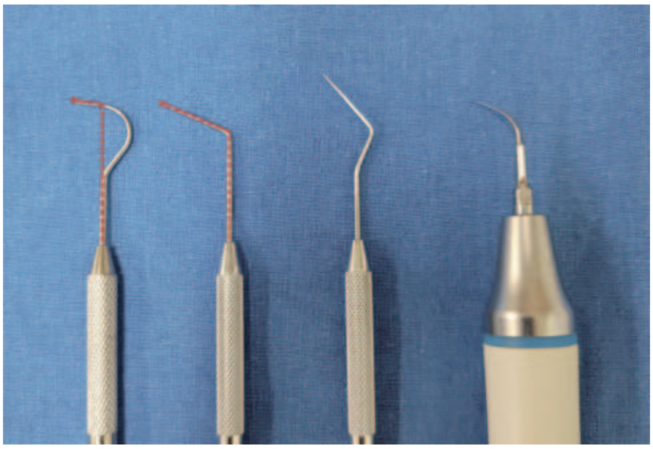


Fig. 2. For access to fractured screw fragments inside the implant, the endodontic explorer has a longer length available and moves in the linear direction, making it more advantageous to the movements of rotating the fragments compared to other types of an explorer.

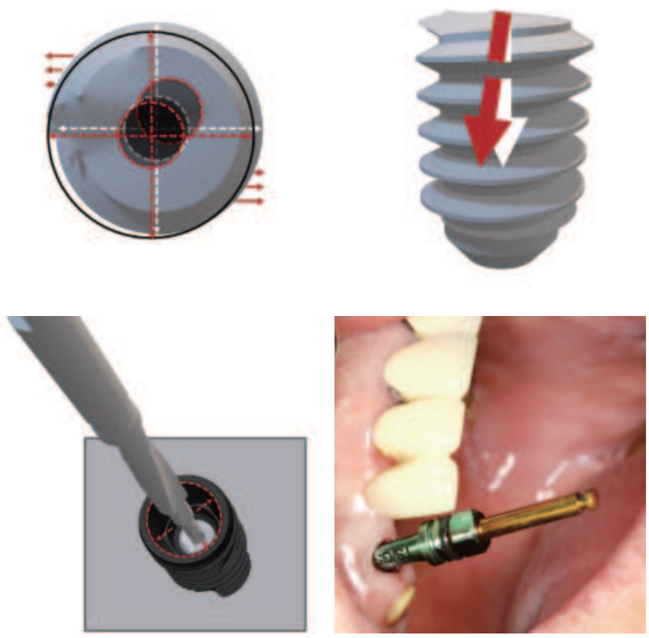


Fig. 3. When removing the fractured screw fragments using the drill of the remover kit, if the drill is not positioned exactly at the center of the fragment or is misaligned with the orientation of the implant, a hole can be created in the fragment but the drilling force cannot be applied exactly to the direction for the fragment removal, and what is worse, it can actually apply a force to push the fragment laterally towards the implant.

Retrieving the fragment by only drilling with achieving accurate placement and alignment with implant path drilling as described above is difficult unless the fragment is located in the upper region of the implant. In most cases, a drill is used to create hole, and manual tool in the remover kit is then connected to the hole and rotated. The rotational force for the manual tool must also be applied in the counterclockwise direction. A guide(Guide; Osstem Implant Co., Seoul, Korea) and a handle to hold the guide (ESR Handle; Osstem Implant Co., Seoul, Korea) were used in this case, and a hole was created using a drill (Reverse drill; Osstem Implant Co., Seoul, Korea). A manual tool (Screw Removal Tip; Osstem Implant Co., Seoul, Korea) and a torque wrench (Osstem Implant Co., Seoul, Korea) were used to retrieve the fractured screw fragments. **(Fig. 4.)**

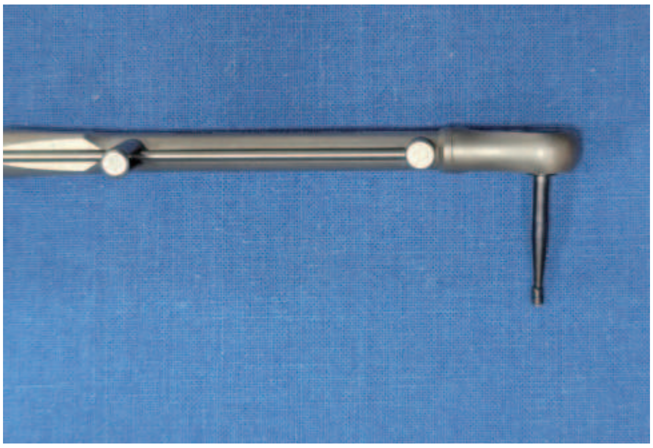


Fig. 4. Using a guide and a drill, a hole was created in the fractured screw fragment, and finally the fragment was removed using the Screw Removal Tip and torque wrench. When using the Screw Removal Tip and torque wrench, caution is required because excessively strong push in the lateral direction may cause breakage of the Screw Removal Tip

Tools such as the Screw Removal Tip are not used with a guide as the inability to retrieve the fragments using a drill often implies that the drilling path is unlikely to be aligned with the orientation of the implant even if the hole in the fractured screw fragment is located right at the center. The Screw Removal Tip (Osstem Implant Co.) was rotated in a random direction to retrieve the fragment in the present case. The use of a guide would have led to one direction rotation of the Screw Removal Tip which would have led to the tool creating a hole and preventing the removal of the fragment. **(Fig. 5.)**

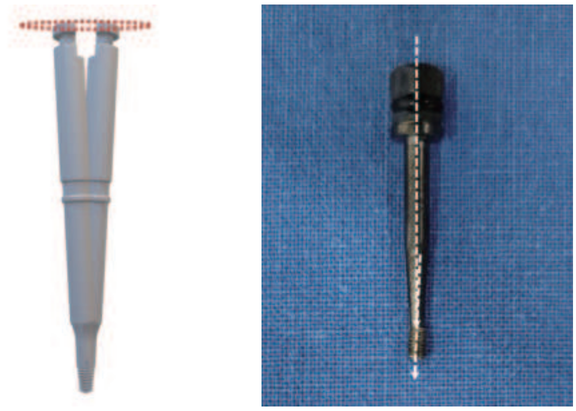
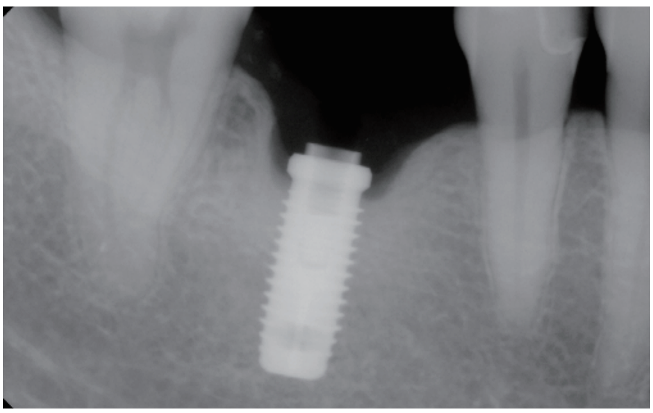


Fig. 5. When using a manual tool such as the Screw Removal Tip, not using the guide is recommended because the guide forces the one direction rotation when the tool needs to perform a random rotation. In fact, when trying to remove the fragments that could not be removed with a drill, the hole is not aligned with the actual axis of the implant orientation.

The dental prosthesis is often detached in cases of screw fracture, and the implant may be completely or partially covered by the gingiva. The location of the hole in the fragment or its movements during the retrieval process must be visually confirmed. Therefore, the field of vision must be secured before commencing the retrieval process such that a clear view of the implant is achieved.

[Case 2]

A 41-year-old man presented with a fractured screw with respect to #46i. Retrieval of the broken screw fragments was attempted unsuccessfully at the dental clinic; consequently, he was referred to the Kyung Hee University Dental Hospital in Seoul, South Korea. Given that the patient had been noticed loosening of the screw for an extended duration, it was clinically judged that the screw was fractured by the application of bite force after screw loosening. The goal of the treatment was to retrieve the fractured screw and replace the existing dental prosthesis. Thus, identifying the cause of screw loosening and resolution of the underlying issue, such as occlusal adjustment, was necessary. This case was unusual in that the patient had previously undergone panoramic radiography, and it was presumed that the fractured screw fragments had moved further downward within the implant when retrieval of the fractured screw fragments was attempted. **(Fig. 6.)**



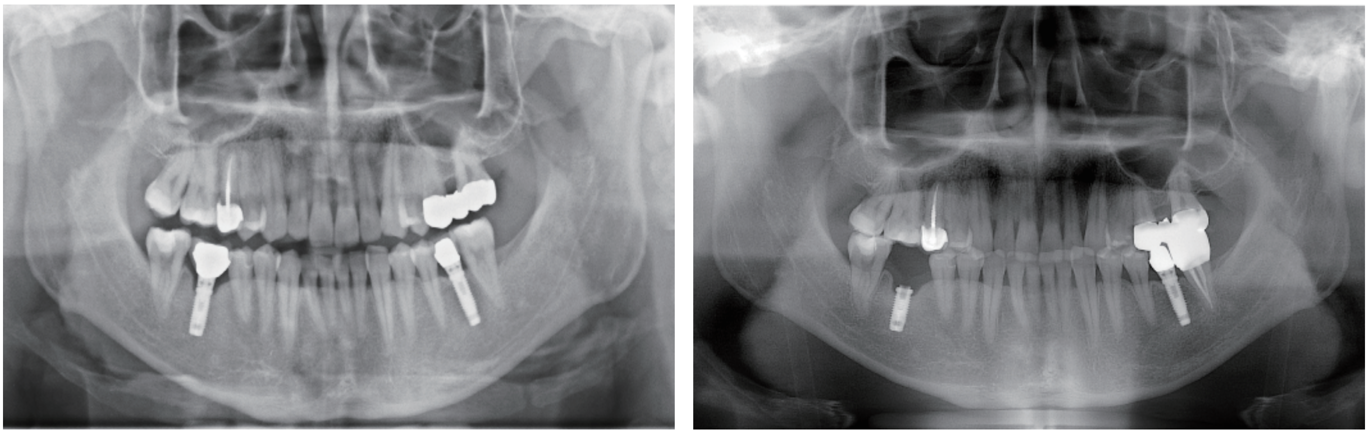


Fig. 6. Compared with the panoramic radiographs taken before the screw fracture, the fragments have moved downward inside the implant after the screw fracture.

Furthermore, the patient had an external connection type implant. Securing a field of vision in the mandible is easier than that in the maxilla; thus, the fragments could be retrieved in a straightforward manner. However, the length of the fractured screw within the implant in the case of an external connection type implant is longer than that in the internal connection type implant, and the lower tip of the fractured screw was located deep within the implant. These factors complicated the retrieval of the fragments even if they are not engaged within the implant. The features of the external connection type implant hinder the fixing of the guide; thus, creating a shallow hole in the fractured screw using a drill and confirming its presence at the center is recommended before proceeding with the actual process of drilling. The fractured screw cannot be removed using a drill alone owing to above reason; thus, it is recommended to use a manual tool for connection to remove the fractured screw if an adequate hole was created using a drill.

A guide (Guide; Osstem Implant Co.) and a handle for holding the guide (ESR Handle; Osstem Implant Co.) were used in this case as described previously, and a hole was created using a drill (Reverse drill; Osstem Implant Co.). An additional tool (Screw Removal Tip; Osstem Implant Co.) and a torque wrench (Osstem Implant Co.) were used to retrieve the fractured screw fragments. However, the fractured screw fragments could not be retrieved when removal was attempted through the alternate use of the Reverse drill (Osstem Implant Co.) and Screw Removal Tip (Osstem Implant Co.). Retrieval was deemed difficult as the fragments had moved downward into the implant, resulting in firm attachment with the implant. Therefore, the status of the remaining fractured screw fragments was examined to see visualize the progress different from a different perspective. Radiography revealed the upward movement of the fragment compared with the initial position. The radiographs acquired following the use of the Screw Removal Tip (Osstem Implant Co.) confirmed further upward movement of the fragment. **(Fig. 7.)**

Fig. 7. When compared with periapical radiographs taken immediately after the visit to this hospital, the fractured screw fragments have gradually moved upward.

The fractured screw was examined after retrieval, **(Fig. 8.)** Review of the removal process revealed that the fragment was not strongly adhered to the implant; rather, it was located deep inside the implant.

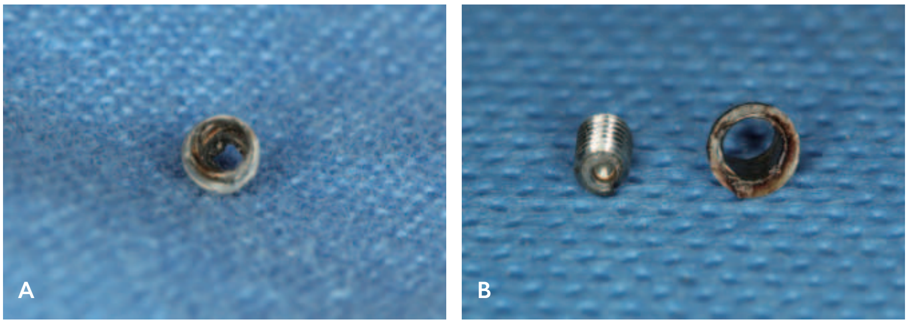


Fig. 8. When examining the removed fractured screw fragments, there are traces of using the drill multiple times. For a typical case of removing a fractured screw fragment, a pattern similar to Figure B can be seen.

This resulted in the hole not aligning with the orientation of the implant axis. The Screw Removal Tip did not succeed in achieving the angle to enable connection with the fragments, resulting in connection failure. The gradual upward movement of the fragment was attributed to the Screw Removal Tip rotating by pushing the side of the hole created. The rotation angle of the Screw Removal Tip can be increased as the fragment moves to the upper part of the implant, thereby facilitating the easier retrieval of the fragment.

[Case 3]

A 71-year-old male patient presented with a fracture of the abutment for #37i, and screw loosening was also confirmed. **(Fig. 9.)**

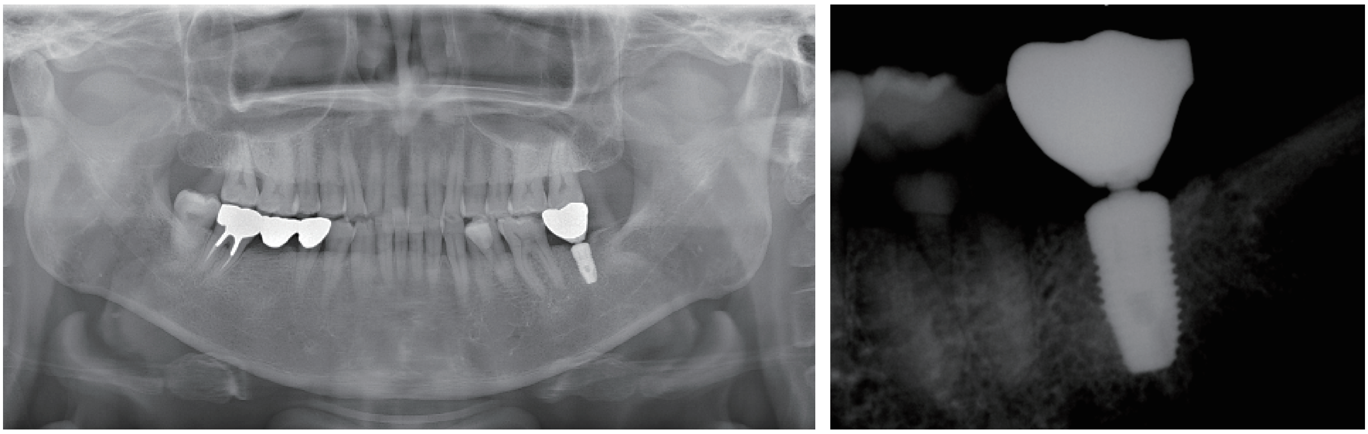


Fig. 9. Abutment fracture for the implant of #37i is presented, and panoramic and periapical radiographs also confirm screw loosening.

Screw loosening precedes abutment fracture in most cases. The dental prosthesis was refabricated and placed again in the case of this patient. Clinician must continuously monitor for any screw loosening and address the underlying issue causing such loosening. The fractured abutment fragments usually adhere to the implant, strongly. However, Unless the abutment fracture and screw fracture occurred simultaneously, the retrieval of the fractured abutment fragments was performed with ease compared to cases of screw fracture. The use of a dedicated remover kit was recommended in the abutment fracture case. The retrieval process was performed in a straightforward manner after selecting a tool with an appropriate diameter suitable for the space in the fragment. If a tool that fits the implant system is available, then its use must be prioritized. The abutment of the dental prosthesis can be used to assess the diameter. **(Fig. 10.)**

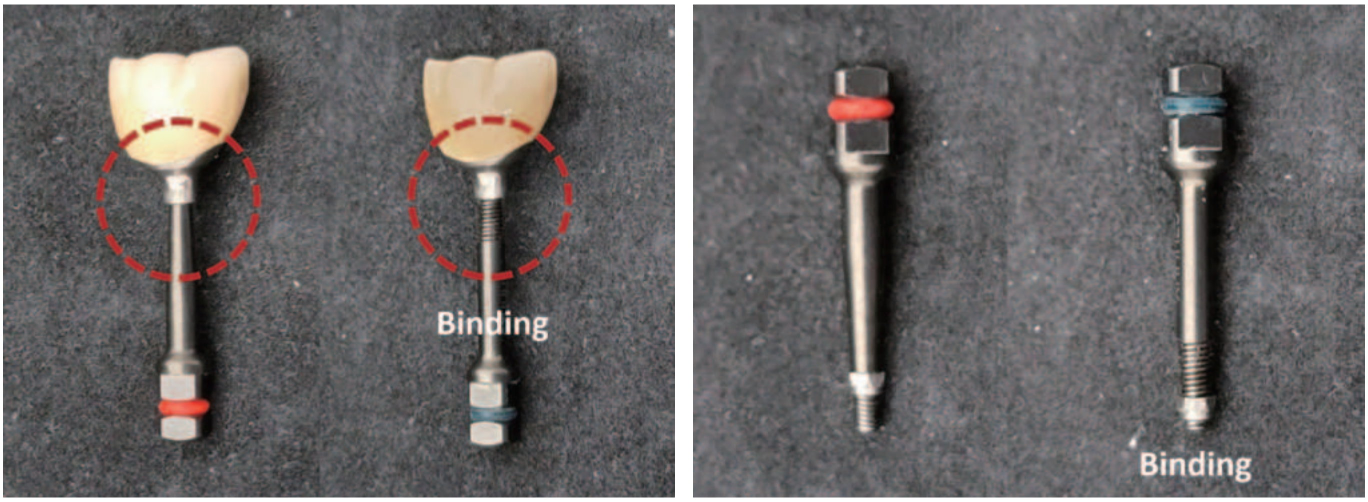


Fig. 10. When choosing a remover tool, selecting the appropriate diameter is crucial, and the decision can be easily made using the abutment of the dental prosthesis

The remover tool was placed on the fractured abutment fragment and rotated counterclockwise to engage it to the fragment. A dedicated rachet or torque wrench was used to achieve more firm engagement. The tool was moved in the buccal, lingual, mesial, or distal direction similar to a joystick utilizing the leverage effect to remove the adhered fragment.

Abutment Hex Remover (Dentium Co., Seoul, Korea) and a rachet (Dentium Co., Seoul, Korea) were used to retrieve the fractured abutment fragment in this case. Abutment fractures are mainly observed with the use of prefabricated abutments. This may be attributed to the relatively thin diameter of the upper part of the hex structure. However, the case of this patient was unique in that the fracture occurred with a custom abutment. **(Fig. 11.)**

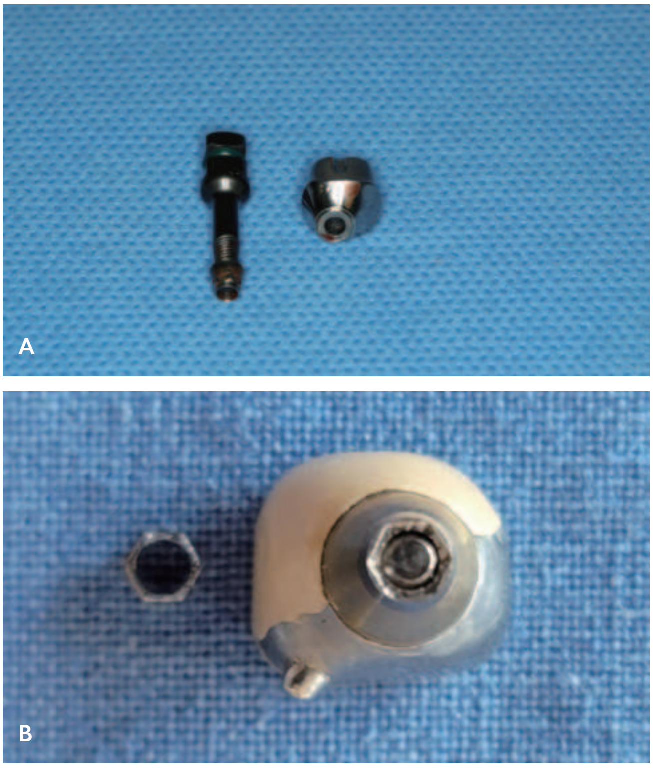


Fig. 11. Abutment fractures usually occur in prefabricated abutments with thin diameters of the upper part of the hex structure, as shown in Figure B, but in this case, the fracture occurred in a custom abutment.

Conclusion

Screw and abutment fractures are generally caused by external forces such as bite force. Most cases of fracture occur secondary to screw loosening. Thus, clinicians must monitor for any signs of screw loosening during routine follow-up visits scheduled after the delivery of implant-supported prosthesis. Frequent instances of screw loosening indicate the requirement for careful evaluation and resolution of the underlying issue, rather than simply tightening the screw. The use of a dedicated remover kit facilitates the easier retrieval of the fragments. However, clinicians must familiarize themselves with the use of the tools in accordance with the intended purposes to ensure the efficient utilization of these tools.

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How to cite this article: Hong SJ · Kang SW. Analyzing the causes of implant screw and abutment fracture and removal of the fragments. *J Clin Digit Dent.* 2025;7(1):13-20. www.jcdd.org

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Proposal of a Gingival Grafting Technique to Overcome Root Prominence and Malposition: Laterally Positioned Flap Combined with Tunneling

Hochyul Han , DDS

Introduction

Tooth root protrusion and malposition are the primary etiological factors contributing to gingival recession and its progression. However, these conditions may influence the outcome of gingival grafting surgery, as they have the potential to interfere with graft engraftment. According to Miller's classification system, tooth malposition is categorized as class 3 or 4, indicating a high level of complexity or the non-feasibility of tooth extraction.

Gingival recession, particularly in the anterior mandibular region, is a common complication following orthodontic treatment. This condition is attributed to anatomical variations, including a thin gingival biotype, bony fenestration(s) or dehiscence, and a high labial frenular attachment.

However, the predominant etiology is malposition, characterized by the displacement of the tooth root from the alveolar bone housing during or after orthodontic treatment due to a failure to maintain proper alignment. In such cases, orthodontic treatment may be required to reposition the roots and manage the gingival recession.

Fig. 1. Frontal view of gingival recession 6 years post-orthodontic treatment

Hochyul Han

He earned his dental degree from Wonkwang University College of Dentistry and completed training in the Department of Periodontology at Kyunghee University Dental Hospital. He currently practices at Allbaro Dental Clinic in Hanam, in Gyeonggi-do, Korea.

Fig. 1-2. Lateral view of gingival recession 6 years post-orthodontic treatment

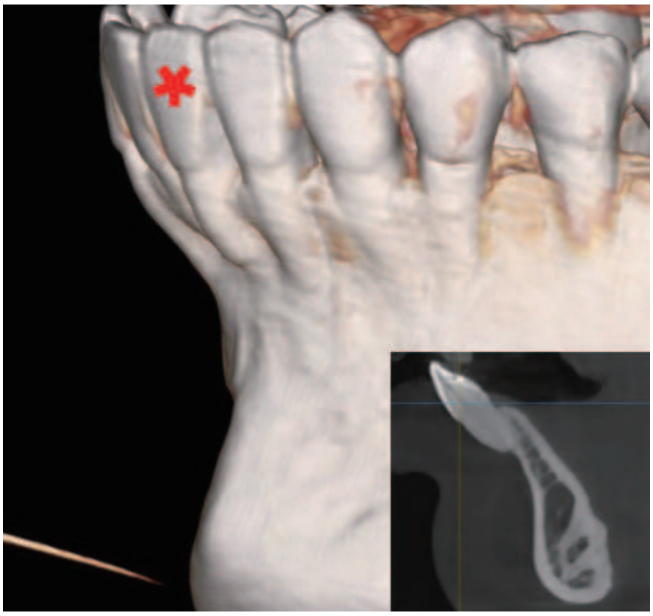

Fig. 1-3. CT view showing the root of the tooth with gingival recession protruding outside the bony housing

Fig. 2. Recalibration treatment using a clear aligner

Fig. 3-1. Frontal view of aligned bite post-orthodontic treatment, showing relief in the width and length of gingival recession

Fig. 3-2. Lateral view of aligned bite post-orthodontic treatment, with reduced width and length of gingival recession

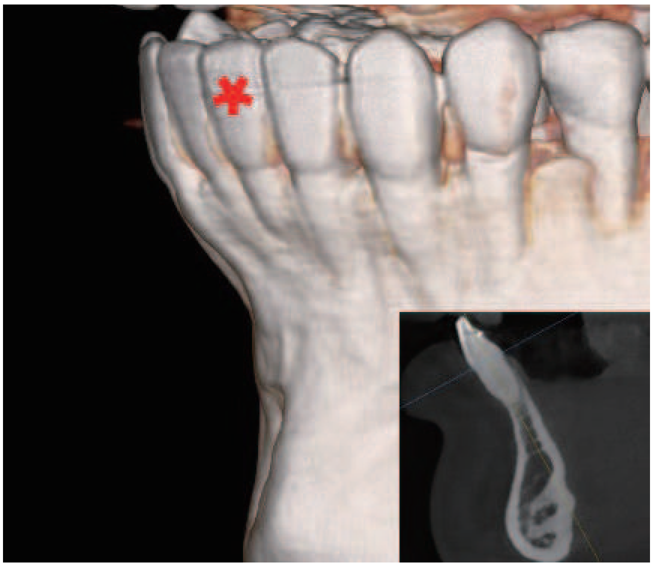

Fig. 3-3. CT view showing the root of the tooth with gingival recession retracted into the bony housing post-orthodontic treatment

Fig. 4-1. Frontal view at 1.5-year follow-up after gingival grafting surgery

Fig. 4-2. Lateral view at 1.5-year follow-up after gingival grafting surgery

However, the correction of all instances of tooth malposition and root protrusion through gingival grafting is not always feasible. In many instances, surgical intervention is required to overcome anatomical disadvantages. A multitude of factors have been demonstrated to significantly influence the healing process following root coverage procedures, including the width of the gingival recession, gingival biotype, local anatomy, and the patient's oral hygiene habits. Root coverage outcomes may be unpredictable in the presence of multiple unfavorable factors. Tooth root protrusion and malposition induce two primary complications: the flatness of the bed is compromised, reducing graft stability, and the blood supply is affected, rendering graft engraftment more challenging.

In this context, the laterally positioned flap combined with subepithelial connective tissue grafting is a viable bilaminar technique designed to enhance engraftment. A surgical approach to gingival grafting that fully accounts for the local anatomy can ensure the long-term stability of treatment outcomes. Extensive efforts have been made to develop and evaluate the efficacy of autologous soft tissue substitutes. Nevertheless, autologous soft tissue remains widely regarded as the "gold standard" for the treatment of gingival recession. The laterally positioned flap is indicated when the adjacent donor site possesses adequate keratinized gingiva and gingival thickness, lacks inferior dehiscence, and has favorable alveolar bone support.

Basic laterally positioned flaps and a vertical mattress sling procedure are suggested to accurately connect the laterally positioned flap to the anatomic bed of the papilla.

Fig. 5-1. Gingival recession of the left mandibular central incisor due to labial positioning from crowding

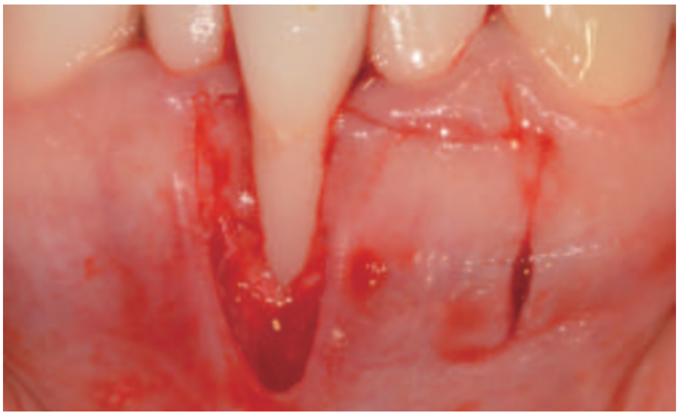

Fig. 5-2. Flap design for laterally positioned flap

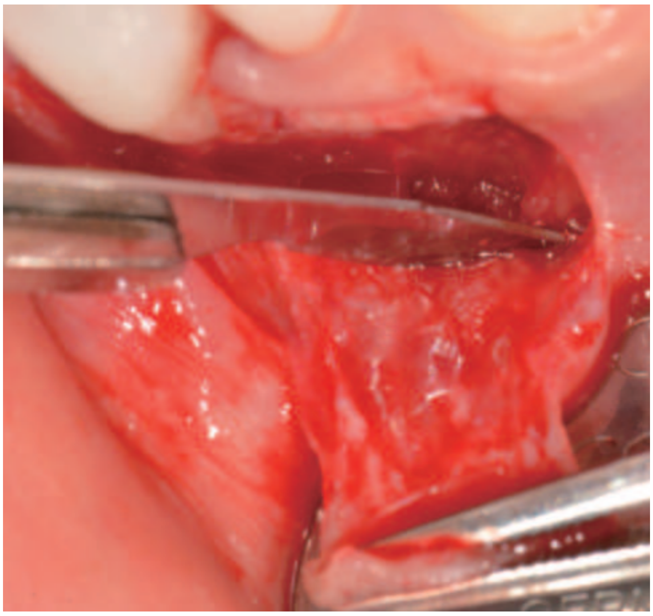

Fig. 5-3. Flap mobility achieved through the application of a releasing incision

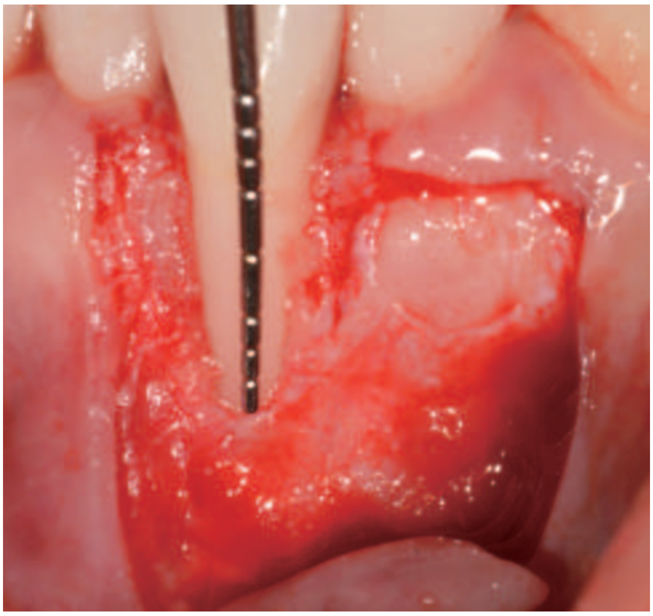

Fig. 5-4. Bony dehiscence of approximately 7 mm

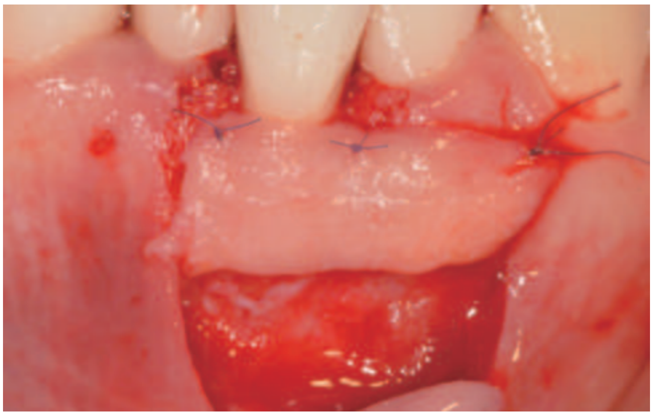

Fig. 5-5. SCTG fixation aligned with the CEJ

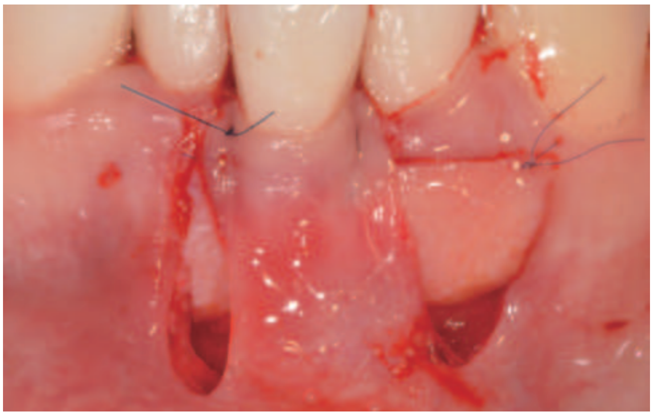

Fig. 6-1. Fixation of a laterally positioned flap using a vertical mattress sling suture

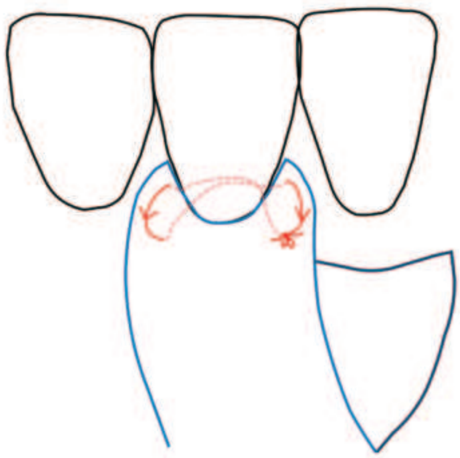

Fig. 6-2. Frontal view of the vertical mattress sling suture: The two self-supporting points at the top and bottom of the papilla ensure secure attachment of the valve without sliding off.

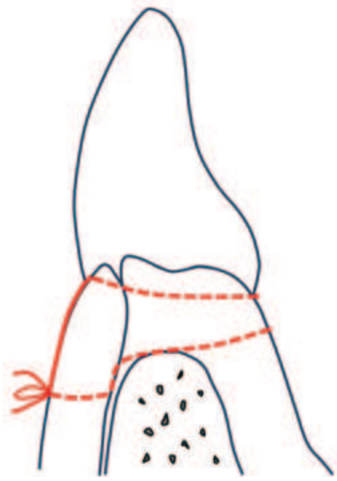

Fig. 6-3. Lateral view of the vertical mattress sling suture: The two suture rows span the lingual aspect of the tooth, with the inferior suture distributing the tension at the alveolar bone level where it crosses.

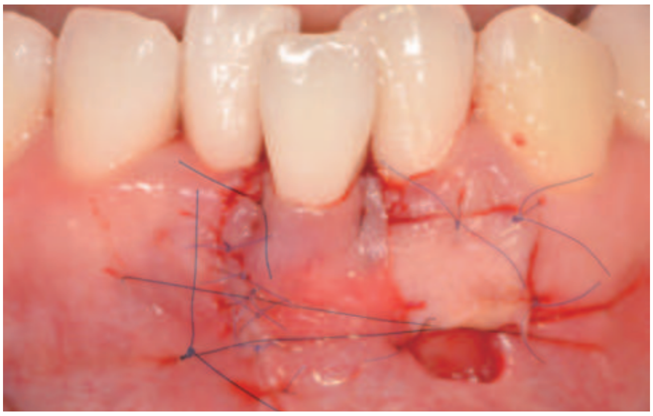

Fig. 7-1. Suturing completed

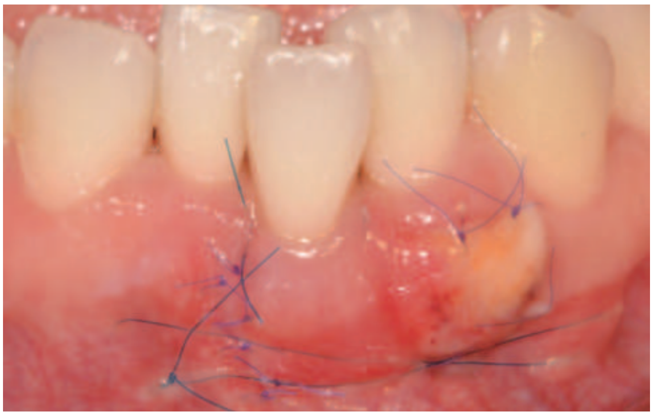

Fig. 7-2. Favorable healing observed after 10 days

Fig. 7-3. Eight-month follow-up

The two self-anchoring points on the superior and inferior papillae facilitate secure adhesion of the flap edges to the papilla without slipping **(Fig. 6-1, 6-2.)** The two rows of sutures effectively distribute tension at the alveolar apex, where the lingual sutures cross the lingual teeth and the inferior sutures extend across the alveolar bone **(Fig. 6-3.)**

Furthermore, when vascularization is particularly unfavorable, a combination of tunneling and laterally positioned flap may be employed to improve engraftment and surgical success. The advantages of this approach include ① improved maneuverability of the subepithelial tissue graft, ② increased blood supply to the subepithelial tissue positioned in the lower portion of the pocket, and ③ increased gingival volume in the treated area.

This case report presents two patients with gingival recession treated with LPF and its variants. The first patient experienced gingival recession following an orthodontic treatment. A combination of LPF and tunneling techniques was employed to address inadequate blood supply due to tooth root malposition, resulting in successful engraftment and healing.

The second patient presented with gingival recession in a maxillary canine. The condition was successfully treated using LPF and tunneling techniques despite a prior unsuccessful gingival grafting at another hospital. Notably, the procedure enhanced the gingival volume at the adjacent lateral incisor implant site while increasing graft engraftment at the canine site. Increased peri-implant gingival volume has been demonstrated to exhibit a positive effect on long-term implant stability.

These cases underscore the advantages of integrating tunneling and LPF, demonstrating its clinical efficacy, particularly in patients with a complex gingival recession where conventional techniques often fall short.

[Case 1]

A 20-year-old female patient presented to the Allbaro Dental Clinic with gingival recession of the right mandibular central incisor that occurred 6 years after the completion of orthodontic treatment (Figure 8-1).

Fig. 8-1. Gingival recession of the right mandibular central incisor 6 years post-orthodontic treatment, female patient in her 20s

Positional abnormalities, including elongation of the tooth and protrusion of the root, were observed in the affected incisor **(Fig. 8-2.)** Computed tomography (CT) showed that the apex of the tooth extended beyond the buccal cortical bone, with minimal positioning within the alveolar bone. By contrast, the apex of the adjacent mandibular left central incisor was securely positioned within the alveolar bone **(Fig. 8-3.)** Orthodontic treatment was recommended to correct tooth misalignment and root torque. However, due to financial constraints, only gingival grafting surgery was performed. To mitigate the challenges associated with inadequate blood supply and graft engraftment caused by root protrusion, a laterally positioned flap combined with tunneling was selected as the treatment approach.

Fig. 8-2. Lateral view showing the elongation of the tooth and root protrusion

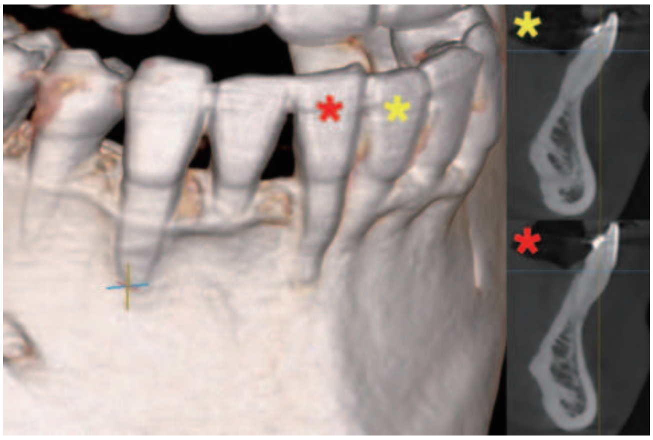

Fig. 8-3. Lateral view showing root protrusion to the extent that the apex of the affected tooth hangs over the buccal cortical bone, compared with the adjacent tooth

After designing the flap and making an incision at the right mandibular lateral incisor with adequate keratinized gingival width and the absence of inferior dehiscence defect as a donor site **(Fig. 9-1.)** flap mobility was achieved through the application of a releasing incision **(Fig. 9-2.)**

The design of a typical laterally positioned flap would normally conclude at this stage; however, an additional pouch was formed to enable tunneling at the contralateral left mandibular central incisor site **(Fig. 9-3.)**

The laterally positioned flap was secured with a vertical mattress sling suture, completing the suturing process **(Fig. 9-6.)**

Fig. 9-1. Flap design on the right tooth donor site for a laterally positioned flap

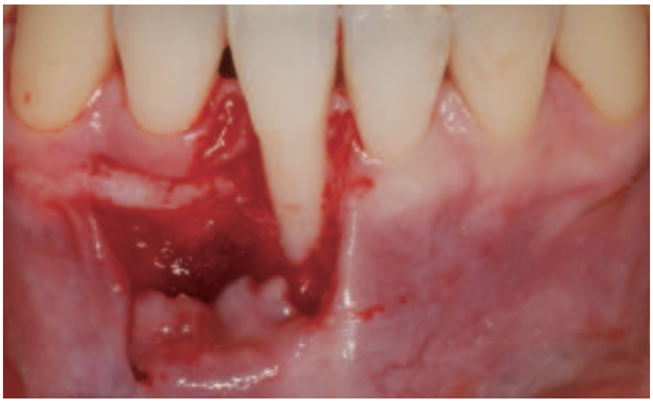

Fig. 9-2. Flap mobility achieved

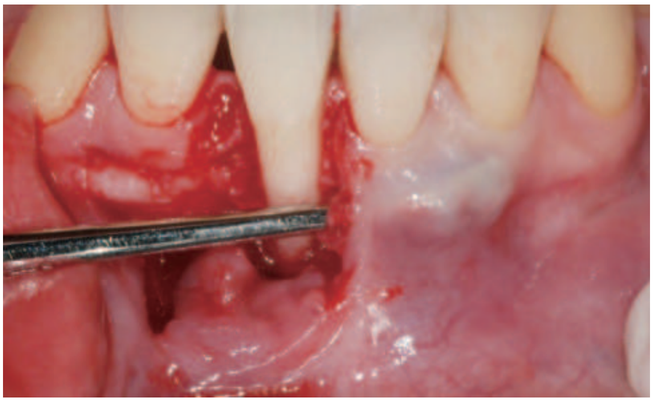

Fig. 9-3. Formation of an additional pouch on the left side

Fig. 9-4. Planning to position the collected connective tissue

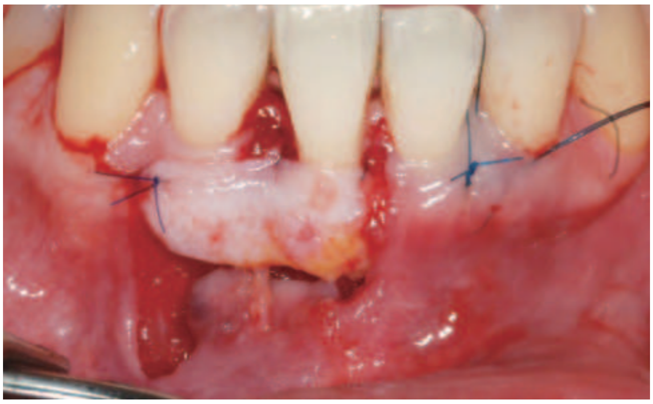

Fig. 9-5. Connective tissue inserted and secured in the left pouch area

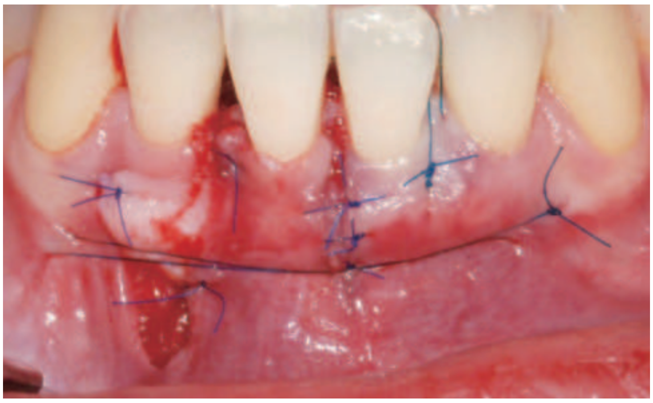

Fig. 9-6. Vertical mattress sling suture used to secure the laterally positioned flap, and suturing completed

At 12 postoperative days, optimal healing and engraftment were observed **(Fig. 10-1.)**

Stable gingival margins and gingival volume were maintained at the 2-year follow-up **(Fig. 10-2, 10-3.)**

Fig.10-1. Favorable healing after 12 postoperative days

Fig. 10-2. Two-year follow-up, frontal view

Fig. 10-3. Two-year follow-up, lateral view

[Case 2]

A male patient in his 40s presented to the Allbaro Dental Clinic with a chief complaint of gingival recession of the left maxillary canine **(Fig. 11-1.)**

The patient had undergone a gum graft procedure at another dental clinic 3 months earlier. However, he reported that the graft had failed to integrate. Clinical examination revealed scar tissue formation around the incisors **(Fig. 11-2.)**

In addition to a 7-mm gingival recession, a 5-mm periodontal pocket was observed, resulting in a total attachment loss of 12 mm **(Fig. 11-3.)**

The left maxillary lateral incisor in the mesial region was identified as an implant restoration **(Fig. 11-4.)** with the lateral incisor implant site exhibiting inadequate alveolar volume **(Fig. 11-5.)**

CT analysis revealed pronounced root protrusion in the retracted maxillary left canine and a significant reduction in alveolar bed flatness, resulting from the insufficient volumization of the lateral incisors **(Fig. 11-6.)**

Fig. 11-1. Gingival recession of the maxillary left incisor in a male patient in his 40s

Fig. 11-2. Failed engraftment and scar tissue formation following gingival grafting at a different dental clinic

Fig. 11-3. Gingival recession of 7 mm with 5-mm periodontal pockets

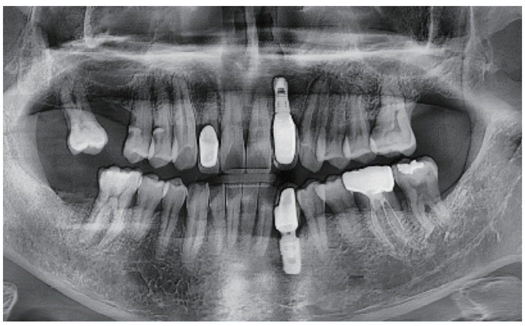

Fig. 11-4. Left maxillary central incisor restored with implants

Fig. 11-5. Lateral incisor implants with significant gingival volume deficiency

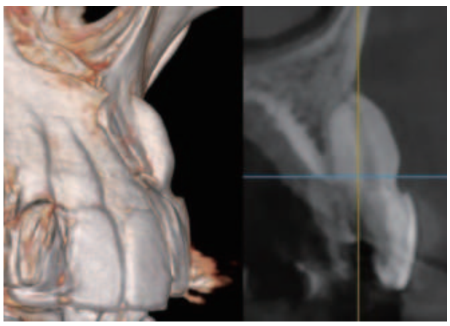

Fig. 11-6. Significant root protrusion in the maxillary left lateral incisor with gingival recession, CT view

A resin filling was applied to the crown of the non-carious cervical lesion, extending up to the expected maximum root coverage line of the tooth **(Fig. 12-1.)**

The flap design and incision were performed using a laterally positioned flap, with the distal premolar region serving as the donor site **(Fig. 12-2.)**

An additional pouch was created at the mesial lateral incisor implant site **(Fig. 12-3.)**

The harvested connective tissue was prepared for placement **(Fig. 12-4.)** and subsequently inserted and secured within the mesial pouch area or lateral incisal implant site **(Fig. 12-5.)**

A vertical mattress suture was utilized to secure the laterally positioned flap, completing the suturing process **(Fig. 12-6.)**

Fig. 12-1. Application of a resin filling on a non-carious cervical lesion, extending to the expected maximum root coverage line

Fig. 12-2. Flap design for a laterally positioned flap, with the distal premolar as the donor site

Fig. 12-3. Formation of an additional pouch at the mesial lateral incisor implant site

Fig. 12-4. Planning the placement of the collected connective tissue

Fig. 12-5. Inserting and securing the connective tissue at the mesial pouch site

Fig. 12-6. Use of a vertical mattress sling suture to secure the laterally positioned flap, with suturing completed

Favorable healing and graft engraftment were observed in the postoperative period **(Fig. 13-1.)**

The connective tissue graft inserted into the pouch contributed to volume augmentation while simultaneously providing blood supply to the avascular zone, promoting improved engraftment and healing **(Fig. 13-2.)**

The gingiva is currently undergoing a 1-month remodeling phase following the surgical procedure. The gingival recession of the lateral incisors has been corrected, and the previously exposed root surfaces have been covered **(Fig. 13-3.)**

Fig. 13-1. Favorable healing and graft engraftment observed 12 days after surgery

The implant prosthesis was removed to facilitate gingival molding **(Fig. 14-1.)** A temporary abutment was then used to secure the implant provisional chairside, enabling precise gingival contouring **(Fig. 14-2.)**

Two and a half months following the surgical procedure, the gingival molding process was completed **(Fig. 14-3.)**

A pick-up impression was taken using a customized coping, and a prosthesis was fabricated based on the contours of the molded gingiva **(Fig. 14-4, 14-5, 14-6, and 15-1.)**

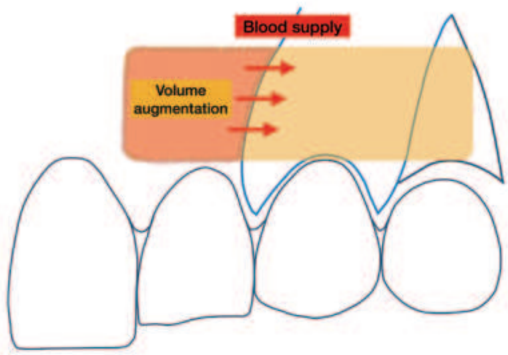

Fig. 13-2. Insertion of CTG into the pouch resulting in volume augmentation while simultaneously providing blood supply to the avascular zone, positively affecting graft engraftment and healing

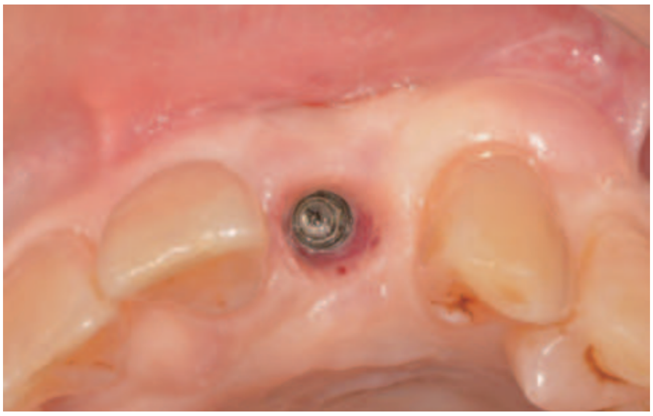

Fig. 14-1. Removal of the implant prosthesis for gingival molding

Fig. 13-3. Gingival remodeling in progress at 1 month after surgery

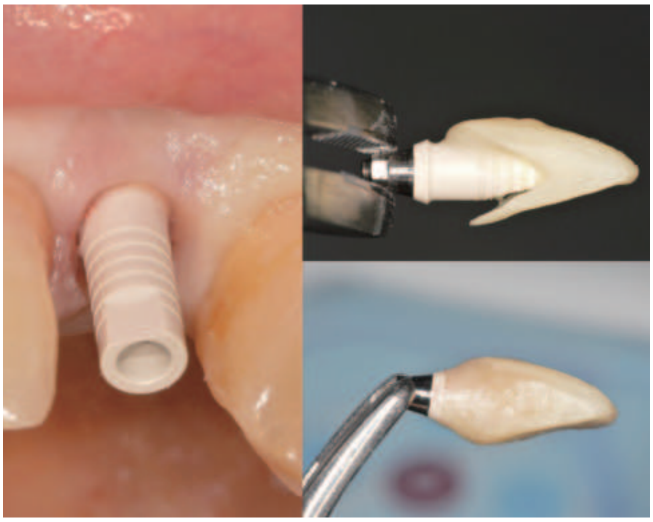

Fig. 14-2. Connecting the implant provisional teeth directly from the chairside using a temporary abutment

Fig. 14-3. Completed gingival molding, showing increased gingival volume at the left lateral incisor implant site and exposed root of the left incisor

Fig. 14-4. Bony dehiscence of approximately 7 mm

Fig. 14-5. Prosthesis fabrication

Fig. 14-6. Placement of the implant abutment

At the 2-year post-treatment follow-up, harmonious gingival margins and adequate volume were successfully maintained **(Figures 15-1, 15-2, 15-3, 15-4, and 15-5)**.

Fig. 15-1. Two-year follow-up, frontal view

Fig. 15-2. Two-year follow-up, lateral view

Fig. 15-3. Two-year follow-up, lateral view

Fig. 15-4. Two-year follow-up, smile

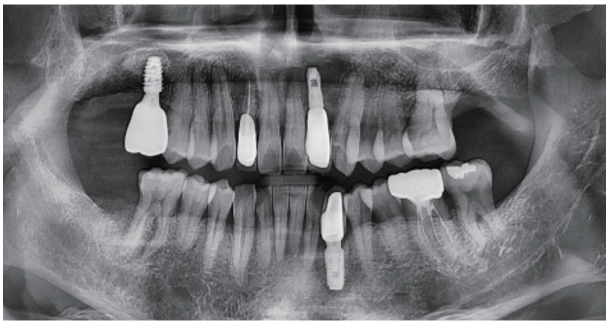

Fig. 15-5. Two-year follow-up, panoramic view

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How to cite this article: HAN HC. Proposal of a Gingival Grafting Technique to Overcome Root Prominence and Malposition: Laterally Positioned Flap Combined with Tunneling. *J Clin Digit Dent.* 2025;7(1):22-33. www.jcdd.org

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