ISSN 2765-3633
Vol. 16 No. 1, November 2024
The Journal of Korean Academy of Osseointegration 2024, 16(1) 25-30

Interdisciplinary approach for implant site development: orthodontic molar uprighting with long-term follow-up

Jung-Woo Kim[1], Sun-Jong Kim[1,2], Min-ji Kim[2], Heon-Young Kim[2,3]

[1]Department of Oral and Maxillofacial Surgery, Ewha Womans University Seoul Hospital, Seoul, [2]Graduate School of Clinical Dentistry, Ewha Womans University, Seoul, [3]Department of Oral and Maxillofacial Surgery, Ewha Womans University Mokdong Hospital, Seoul, Korea

The prolonged absence of teeth often results in mesial tilting of adjacent molars and bone resorption, creating challenges for implant placement. This case highlights a multidisciplinary approach combining orthodontic molar uprighting with mini-implant anchorage and ridge augmentation for implant site development in a patient with severe mesial tilting of the mandibular second molar. Orthodontic treatment created sufficient mesiodistal space (6.25 mm occlusally and 0.7 mm cervically) over 8 months, while ridge augmentation using Bio-Gide and Bio-Oss enhanced buccal bone volume for implant stability. A stable implant (Osstem TS III SA) and prosthesis were maintained for 12 years without complications, demonstrating the success of this combined approach. This case underscores the importance of addressing tooth angulation and bone deficiencies for functional and esthetic long-term outcomes. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2024;16(1):25-30)**

Key words: Tooth uprighting, Orthodontic tooth movement, Implant site development

INTRODUCTION

Clinicians frequently face challenges associated with inadequate mesiodistal space when performing dental implant procedures in edentulous regions. These challenges typically occur when tooth loss is left untreated for an extended period, resulting in tilting and mesial drifting of the adjacent teeth and edentulous ridge resorption[1]. Particularly in the posterior region, various problems may occur, such as insufficient space for implant placement, distal drifting of premolars, extrusion of opposing teeth, occlusal interferences during protrusive and lateral movements, and difficulties in prosthesis adaptation[2]. In such cases, clinicians may choose implant therapy while accepting certain restorative limitations or consider modifying the site to accommodate implant placement[3]. However, if adequate space for implant placement can be achieved, implant-supported restorations not only eliminate the need for additional preparation of adjacent teeth but also provide optimal functional and esthetic outcomes[1,4-7].

This case report describes a multidisciplinary approach applied to a 45-year-old male patient with severe mesial tilting of the mandibular second molar due to the long-term absence of the mandibular first molar. The treatment combined orthodontic molar uprighting with mini-implant anchorage and ridge augmentation to restore ideal conditions for implant placement. Notably, the outcomes were monitored over a long-term follow-up period of 12 years, demonstrating stable functional and esthetic results throughout this period.

CASE REPORT

A 45-year-old male patient visited our clinic with a chief complaint of difficulty chewing due to discomfort in both molar regions. His medical history was unremarkable and did not include health issues impacting dental treatment. With the prolonged absence of the mandibular right first molar, mesial tilting of the mandibular right second molar occurred (Figure 1). The plan was to create adequate space in the mandibular right first molar area by uprighting the mandibular right second molar, followed by implant placement. In the initial stages, after extracting the mandibular right third molar, the mini-implant was placed between the roots of the mandibular right first and second premolar for anchorage. To achieve indirect skeletal anchorage, the target tooth was positioned in an ideal position on a setup model, and a nickel–titanium (NiTi) spring was fabricated on the model teeth.

Received September 1, 2024, **Revised** November 5, 2024, **Accepted** November 23, 2024

Corresponding Author: Heon-Young Kim, Department of Oral and Maxillofacial Surgery, Ewha Womans University Mokdong Hospital, 1071, Anyang-cheon-ro, Yangcheoon-gu, Seoul 07985, Korea, Tel: +82-2-2650-2720, Fax: +82-2-6986-5721, E-mail: eumc01055@ewha.ac.kr

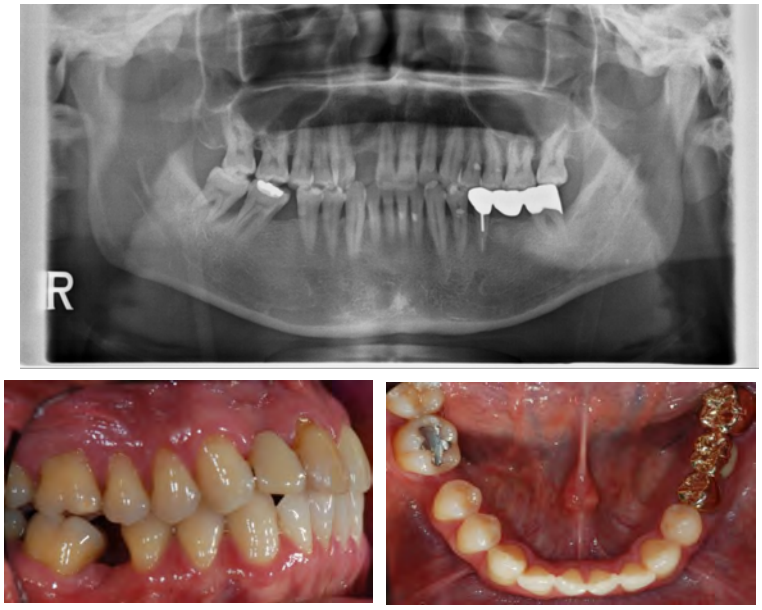

Figure 1. Pretreatment panoramic radiograph and intraoral photograph. Space reduction due to mesial tilting of the molar is observed.

The spring was then transferred to the planned position using light-cured resin. Subsequently, a 0.016×0.016 NiTi straight uprighting wire (Dany Harvest Co., Seoul, Korea) was engaged from the mandibular right second premolar to the mandibular right second molar to initiate molar uprighting[8]. The patient visited the dental clinic monthly for follow-up, including clinical examination and periapical radiography to measure the distance between the mandibular right second premolar and second molar (Figure 2). During visits when activation was no longer effective, the NiTi wire was replaced and reapplied with a new one. At the 8-month follow-up, uprighting and space creation were completed. Subsequently, an Osstem TS III SA implant (Osstem Implant Co., Ltd., Seoul, Korea) of 5.0 mm in diameter and 11.5 mm in length was placed in the area of the mandibular right first molar. The prolonged absence of the tooth resulted in buccal bone resorption (Figure 2), necessitating bone grafting to augment the buccal bone post-implantation. The grafting procedure used Bio-Gide (Geistlich Pharma AG, Wolhusen, Switzerland) of 13×25 mm and Bio-Oss (Geistlich Pharma AG, Wolhusen, Switzerland) 0.25 g grafting materials. The patient underwent a 3-month healing period after the bone graft. During this period, a .019×0.025-inch stainless steel wire (Tri-flex™, RMO®, Denver, CO, USA) was used for space maintenance. After the healing period, OSSTEL® (Osstel W&H, Göteborg, Sweden) was used to assess the implant's stability, which yielded an Implant Stability Quotient of 74/74, indicating good primary stability. Subsequently, a customized abutment and final porcelain-fused-to-Zirconia crown were fabricated and fitted. The crown, with shade A2, was selected to match the natural color of the adjacent teeth, restoring the patient's masticatory function (Figure 3).

After the prosthesis placement, periodic maintenance was performed annually, during which radiographs were taken, and periodontal and prosthetic evaluations were conducted. Additionally, angulation assessments were performed based on the radiographs, comparing the tooth axis of the mandibular second premolar and second molar with the axis of the mandibular first molar implant. The changes in angulation were analyzed by comparing the pre-treatment, post-treatment, and follow-up periods.

RESULTS

Table 1 shows the amount of space gained through orthodontic treatment. On the occlusal side, an increase of approximately 6.85 mm was observed over 8 months, whereas on the cervical side, an increase of about 0.7 mm was noted. During this procedure, no rotation or extrusion of the molar occurred, and the position of the second premolar, which served as the anchor, was maintained. With the successfully developed implant site, the dental implant placement and the bone graft around the implant were completed without any complications.

The final prosthesis has been maintained for 12 years without notable complications or bone loss (Figure 3). Table 2 illustrates

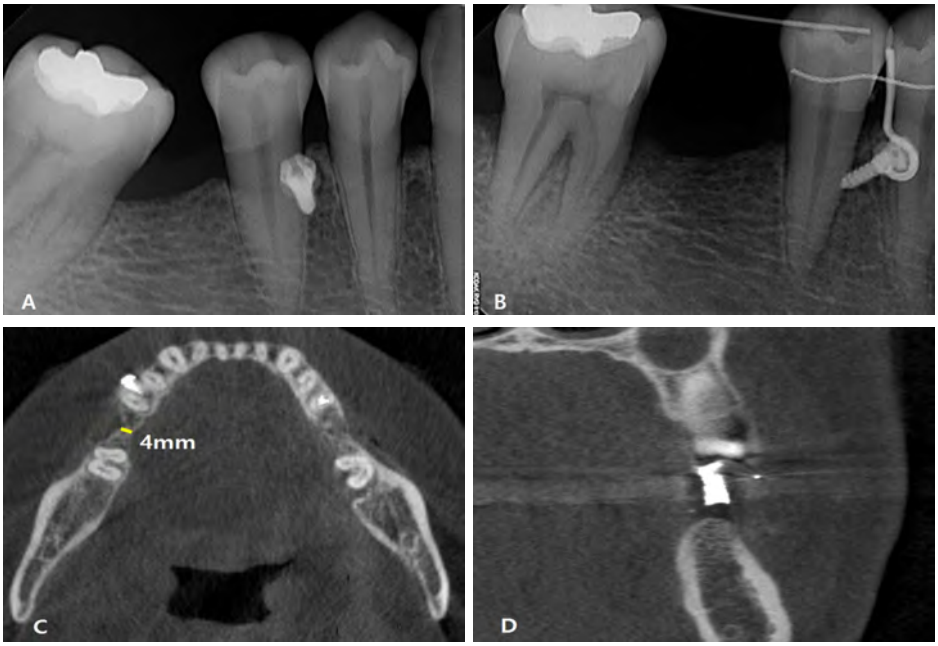

Figure 2. Progress periapical radiographs and preoperative CBCT. (A) Before uprighting. (B) After 8 months of appliance delivery. (C) An axial view of preoperative CBCT revealed an atrophied ridge on the buccal side of the mandibular right first molar region. (D) Coronal view with a surgical stent.

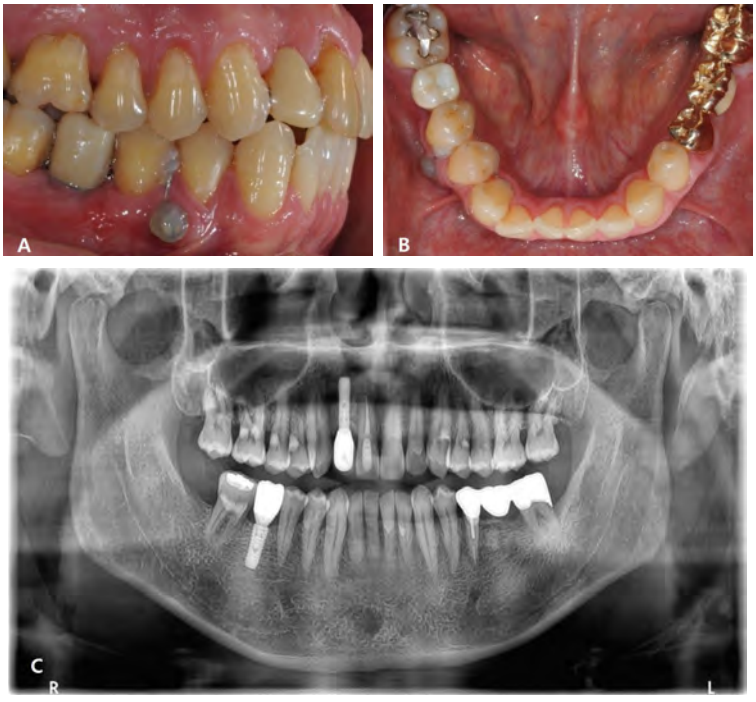

Figure 3. Intraoral photographs and a panoramic radiograph showing the results of the treatment. The images show no signs of periodontal pathology and demonstrate stable maintenance of the final prosthesis without significant complications. (A, B) Intraoral photographs taken after the completion of the implant prosthesis. (C) Panoramic radiograph taken 12 years after follow-up.

the angles of the teeth and implant based on the long axes. In the pre-treatment stage, radiographic analysis revealed a tilting of 37.5 degrees, which improved to 8.2 degrees following orthodontic treatment. During the 10-year follow-up period, no significant changes in this angle were observed. Moreover, the angle between the adjacent teeth and the implant remained stable

Table 1. Mesiodistal edentulous space measurements

Period	Occlusal side (mm)		Cervical side (mm)	
	Measured distance	Increase compared to the previous follow-up	Measured distance	Increase compared to the previous follow-up
Pretreatment	2.75	-	9.8	-
2 months	3.65	0.9	10.1	0.3
3 months	4.25	0.6	10.25	0.15
5 months	5.75	1.5	10.35	0.1
6 months	7.25	1.5	10.45	0.1
8 months	9.0	1.75	10.5	0.05

Table 2. Changes in angles based on the long axis of the teeth during orthodontic treatment

Period	Angulation (°)		
	Between RL5 and RL7	Between RL5 and RL6i	Between RL6i and RL7
Pre-treatment	37.5	-	-
After upright completion	8.2	-	-
After implant placement	7.9	3.7	4.2
5-year follow-up	7.9	3.6	4.3
10-year follow-up	7.8	3.5	4.3

RL5: right mandibular second premolar; RL6i: right mandibular first molar implant; RL7: right mandibular second molar

throughout the follow-up period. Although the analysis was based on periapical and panoramic X-rays, rather than three-dimensional CBCT superimposition, the results provide valuable insights into the long-term stability of the treatment.

DISCUSSION

The current case, treated in 2012 and first reported in 2014[8], demonstrates the successful application of a combined orthodontic and surgical approach to correct the tilt of the mandibular second molar and facilitate implant placement in the mandibular first molar region. This approach effectively simplified implant site preparation by correcting tooth angulation and addressing bone deficiencies. Moreover, a multidisciplinary strategy that integrated post-orthodontic implant placement and prosthetic restoration minimized the risk of relapse and ensured stable functional and esthetic outcomes, which were sustained over a 12-year long-term follow-up.

Before the implant placement, the available space is assessed based on the size and shape of the opposing and adjacent teeth, esthetics, occlusion, and the dimensions of the selected implant[9]. Placing an implant in an area with insufficient space can result in supporting bone loss on adjacent root surfaces, papilla blunting, and compromised esthetics[10,11]. Moderate to severe inclination of molars adjacent to edentulous spaces, often caused by the loss of adjacent teeth, negatively affects periodontal health and the prognosis of dental prostheses[12]. This inclination reduces the available space for restoration, making it challenging to create anatomically harmonious restorations, which can lead to irregular interproximal contact areas and excessive embrasure spaces[3]. These conditions may promote food impaction and plaque accumulation, which if inadequately controlled, have been associated with the development of peri-implantitis and peri-implant mucositis[13].

In this regard, the integration of orthodontic molar uprighting with ridge augmentation provides an effective solution for implant site development in patents with mesial tilting and significant bone loss. Correcting this tilt through orthodontic uprighting is crucial for creating adequate mesiodistal space and leveling the occlusal plane, enhancing prosthetic stability and helping prevent complications such as food impaction and caries[14-16].

Various devices have been developed for minor tooth movements[17-21], among which mini-implant anchorage allows for stable, controlled force application, enabling precise molar uprighting without affecting the adjacent teeth. This technique is widely supported in the literature for its effectiveness in achieving predictable molar angulation correction, which is beneficial for implant site preparation[22-24]. Using mini-implant for anchorage allows clinicians to minimize treatment time while enhancing periodontal health and setting a strong foundation for future implants[6,7].

Even with the use of mini-implants, achieving the desired outcomes may take several months[12,22,25,26], and when bone grafting procedures for implant site development are required, they are typically performed after the completion of orthodontic treatment, requiring additional time before implant placement[5]. To address these challenges, the combination of selective osteotomy

and ridge augmentation induces regional acceleratory phenomenon, accelerating bone turnover, reducing healing time, and simultaneously reinforcing structural support around the implant[22,23]. Additionally, Wang et al. reported two split-mouth comprehensive cases where ridge augmentation and orthodontic molar uprighting were simultaneously performed for implant site development, achieving surgically accelerated molar uprighting of 1.6 times faster and successfully attaining 2.5~5.0 mm of horizontal bone augmentation[1].

However, selecting the appropriate mechanics for molar uprighting requires careful consideration of various orthodontic and surgical approaches, as well as the anatomical characteristics and the patient's facial pattern[4]. This careful consideration helps prevent common complications, such as concomitant tooth extrusion, unintended movement of adjacent teeth, hyperocclusion or anterior bite opening[27]. During this process, the interdisciplinary approach is expected to minimize the need for additional interventions, shorten the overall treatment duration, and enhance patient satisfaction by providing a comprehensive solution for complex cases where conventional methods may be insufficient.

CONCLUSION

This case report emphasizes the importance of a multidisciplinary approach in optimizing implant site preparation for complex cases. Simultaneously addressing tooth angulation and bone deficiencies improves functional and esthetic outcomes while ensuring long-term implant success.

COMPETING INTERESTS

The authors report no conflicts of interest related to this study.

ETHICAL APPROVAL

Not required.

REFERENCES

1. Wang CW, et al. Simultaneous ridge augmentation and accelerated molar uprighting for implant site development: two case reports with a split-mouth design. Int J Periodontics Restorative Dent 2017;37:423-30.
2. Capelluto E, Lauweryns I. A simple technique for molar uprighting. J Clin Orthod 1997;31:119-125.
3. Vargas AA, et al. Utilizing the regional acceleratory phenomenon and dental implant anchorage for distalization and intrusion of a Mesially tipped mandibular molar: a case report. Clin Adv Periodontics 2021;11:4-10.
4. Melo A, et al. Lower molar uprighting with miniscrew anchorage: direct and indirect anchorage. Int J Orthod Milwaukee, 2013.
5. Zhou J, et al. Selective osteotomy-assisted molar uprighting and simultaneous ridge augmentation for implant site development. Am J Orthod Dentofacial Orthop 2019;156:846-857.
6. Lindskog-Stokland B, Hakeberg M, Hansen K. Molar position associated with a missing opposed and/or adjacent tooth: a follow up study in women. Swed Dent J 2013;37:97-104.
7. Kim SH, et al. Clinical application of accelerated osteogenic orthodontics and partially osseointegrated mini-implants for minor tooth movement. Am J Orthod Dentofacial Orthop 2009;136:431-439.
8. Kim M, Kim M, Chun YS. Molar uprighting by a nickel-titanium spring based on a setup model. Am J Orthod Dentofacial Orthop 2014;146:119-123.
9. Chan E, Darendeliler M, Vicker D. Implants and orthodontics. Brighter futures Newsl Aust Soc Orthod 2006;3:1-4.
10. Wilson JP, Johnson TM. Frequency of adequate mesiodistal space and faciolingual alveolar width for implant placement at anterior tooth positions. J Am Dent Assoc 2019;150:779-787.
11. Grunder U, Gracis S, Capelli M. Influence of the 3-D bone-to-implant relationship on esthetics. Int J Periodontics Restorative Dent 2005;25:113-119.
12. Maeda S, et al. Molar uprighting with extrusion for implant site bone regeneration and improvement of the periodontal environment. Int J Periodontics Restorative Dent 2008;28.
13. Schwarz F, et al. Peri-implantitis. J Clin Periodontology 2018;45:S246-S266.
14. Aboul SMBED, et al. Miniscrew implant-supported maxillary canine retraction with and without corticotomy-facilitated orthodontics. Am J Orthod Dentofacial Orthop 2011;139:252-259.
15. Lee JK, Chung KR, Baek SH. Treatment outcomes of orthodontic treatment, corticotomy-assisted orthodontic treatment, and anterior segmental osteotomy for bimaxillary dentoalveolar protrusion. Plast Reconstr Surg 2007;120:1027-1036.
16. Shoreibah EA, et al. Clinical and radiographic evaluation of bone grafting in corticotomy-facilitated orthodontics in adults. J Int Acad Periodontol 2012;14:105-113.
17. Keles A, Sayinsu K. A new approach in maxillary molar distalization: intraoral bodily molar distalizer. Am J Orthod Dentofacial Orthop 2000;117:39-48.
18. Slighly C, Brousseau S. Orthodontic single tooth intrusion with a removable interocclusal device: A clinical report. J Prosthet Dent 2013;109:283-286.
19. Yao CCJ, et al. Maxillary molar intrusion with fixed appliances and mini-implant anchorage studied in three dimensions. Angle Orthod 2005;75:754-760.
20. Weber D, Handel S, Dunham D. Use of osseointegrated implants for orthodontic anchorage. J Clin Orthod 2017;51:406-410.
21. Hernández-Alfaro F, Egio E, Ruiz V. Transalveolar screw: A new con-

cept for orthodontic anchorage. Med Oral Patol Oral Cir Bucal 2009;14:E198-202.
22. Tuncay OC, et al. Molar uprighting with T-loop springs. J Am Dent Assoc (1939) 1980;100:863-866.
23. Moon CH, Wee JU, Lee HS. Intrusion of overerupted molars by corticotomy and orthodontic skeletal anchorage. Angle Orthod 2007;77:1119-1125.
24. Uribe F, et al. Corticotomy-assisted molar protraction with the aid of temporary anchorage device. Angle Orthod 2013;83:1083-1092.
25. Reddy V, et al. A simple mini-screw assembly for simultaneous molar uprighting and distalization–a case of adjunctive adult orthodontics. Int J Orthod (Milwaukee, Wis.) 2013;24:25-28.
26. Ruellas ACdO, Pithon MM, Santos RLd. Miniscrew-supported coil spring for molar uprighting: description. Dental Press J Orthod 2013;18:45-49.
27. Norton LA, Proffit WR. Molar uprighting as an adjunct to fixed prosthesis. J Am Dent Assoc 1968;76:312-315.