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Multidisciplinary management of missing maxillary first molar with severe sinus pneumatization: a case report with 4-year follow-up

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Background: Loss of the first molar frequently results in mesiodistal tipping of adjacent teeth and inadequate space for implant placement. Sinus pneumatization in the maxillary posterior region further complicates implant rehabilitation. Orthodontic intervention facilitates space regaining and optimizes implant site development.

Case Presentation: A 27-year-old male patient presented with insufficient restorative space in the left maxillary molar region due to mesiodistal tipping of adjacent teeth and sinus pneumatization after extraction of the first molar 3 years prior due to extensive caries. Orthodontic treatment was performed for space regaining, and a lateral window sinus augmentation was concurrently conducted during the orthodontic phase. Subsequently, a 5.0 × 7 mm TSIII SA implant (Osstem Implant Co., Seoul, Korea) was placed, and a prosthetic crown was delivered after successful osseointegration.

Results: Following implant placement and final prosthesis delivery, the patient demonstrated stable occlusion and healthy peri-implant soft tissue, without any complications during a 4-year follow-up. Furthermore, the patient reported high satisfaction with both esthetics and masticatory function.

Conclusions: This case demonstrates that a multidisciplinary approach integrating orthodontic and surgical treatment facilitates predictable, prosthetically driven implant placement and achieves long-term functional and esthetic stability in the maxillary posterior region. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2025;17(1):35-40)**

Key words: Orthodontic implant site development, Multidisciplinary approach

BACKGROUND

The first permanent molars, being the earliest to erupt, are crucial for establishing and maintaining the dental arch form and functional occlusion[1]. Because these teeth remain in function for the longest period, they are more susceptible to dental caries, endodontic or periodontal disease, excessive extrusion, ankyloses, and vertical root fractures, with most frequent loss in adults[1-3]. Such premature loss of the first molar causes rotation and mesiodistal tipping of the adjacent teeth[4], which reduces the available space for prosthetic rehabilitation and leads to occlusal complications, such as overeruption of the opposing tooth, premature contacts, and occlusal interferences, which may hinder proper prosthetic restoration[4]. Moreover, such cases are frequently accompanied by periodontal tissue deterioration, characterized by inflammation, pseudo-pocket formation around the tilted adjacent teeth, plaque accumulation, and an increased risk of interproximal caries[5].

Therefore, an appropriate restoration of the missing tooth is essential to prevent these complications. Several treatment options are available for replacing a missing posterior tooth, including conventional fixed bridges, resin-bonded bridges, removable partial dentures, and dental implants[6]. Among these options, dental implants are considered the most predictable and conservative for restoring function and esthetics in the edentulous area.

Implant placement and subsequent prosthetic restoration are generally performed without significant difficulty when the alveolar ridge at the intended implant site has sufficient bone width and vertical height, and the adjacent teeth are properly aligned. However, in many situations, implants are planned within narrow or tilted spaces, which may compromise the long-term function and esthetics of the final prosthetic restoration. To achieve a

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more physiological and functional outcome with minimal complications, an adequate and well-aligned restorative space that enables the fabrication of a prosthesis closely resembling the natural dentition should be established[7]. Hence, orthodontic treatment frequently serves as an adjunctive procedure to facilitate implant site preparation and optimize the restorative environment[8]. Such a multidisciplinary approach enhances treatment efficiency and the accuracy of prosthetically driven implant positioning.

This case report describes a patient with a missing maxillary first molar caused by caries and severe maxillary sinus pneumatization with limited residual bone height, who was successfully managed with a multidisciplinary treatment that involved orthodontic space regaining, sinus augmentation, and subsequent implant restoration.

CASE PRESENTATION

A 27-year-old male presented to our hospital for the restoration of a missing maxillary left first molar, which had been extracted approximately 3 years ago because of severe dental caries. The patient was systemically healthy with no significant medical history or contraindications for surgical procedure. The departments of prosthodontics, oral and maxillofacial surgery, and orthodontics performed a comprehensive multidisciplinary assessment.

Clinical and radiographic examinations revealed a missing maxillary left first molar with minor spacing between the left maxillary canine and left maxillary second premolar, and mesial tipping of the left maxillary second molar. The patient exhibited a skeletal Class III pattern with molar and canine relationships of Class III key occlusion. Cone-beam computed tomography (CBCT) revealed severe pneumatization of the left maxillary sinus, with a residual bone height of approximately 1 mm and the presence of a septal bone within the sinus. Sinus anatomy was unremarkable, showing an intact Schneiderian membrane and normal sinus mucosa thickness (Figure 1).

After multidisciplinary consultation, two treatment approaches were considered. The first approach involved partial orthodontic treatment to regain sufficient space for implant placement at the first molar site by closing minor spaces between the premolars and applying a crown tip-back movement to the second molar. The second approach entailed mesial protraction of the second molar to substitute for the missing tooth. Following a thorough discussion with the patient, the first approach was selected, and a sinus lift procedure was planned for concurrent execution during the orthodontic phase. Corticotomy was considered an adjunctive option to facilitate accelerated tooth movement and improve alveolar bone remodeling if tooth movement proved inadequate. Treatment objectives were as follows: (1) orthodontic space regaining and proper alignment of adjacent teeth, (2) sinus floor elevation with adequate bone augmentation, and (3) implant placement with optimal prosthetic positioning.

TREATMENT SEQUENCE

1. Phase 1: Orthodontic Treatment (0~7 months)

Orthodontic treatment was initiated with bracket bonding on the maxillary left canine, first and second premolars, and second molar. A 0.014-inch nickel-titanium (NiTi) partial archwire was used to achieve leveling and alignment. After a month, the archwire was sequentially replaced with 0.016 × 0.016-inch NiTi and then 0.016 × 0.022-inch NiTi combined with an open-coil spring (OCS) to create adequate space for implant placement at the first

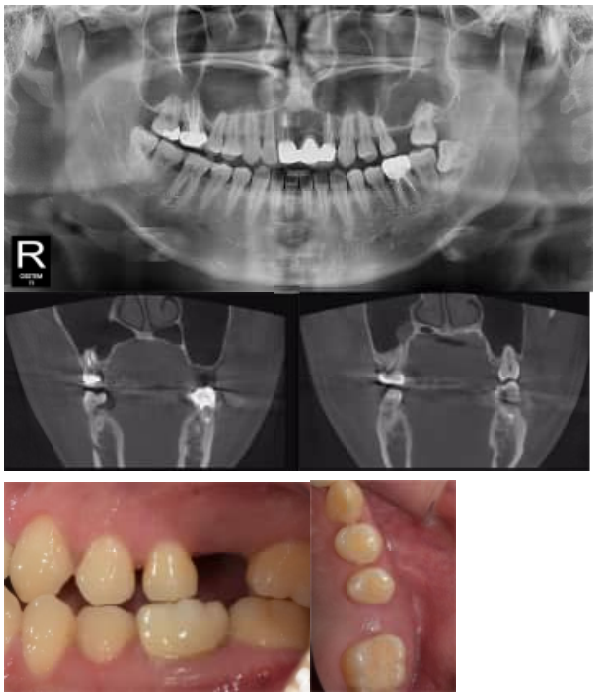

Figure 1. Preoperative clinical and radiographic findings. (A~C) Panoramic radiograph and cone-beam computed tomography demonstrating severe sinus pneumatization and residual bone height of approximately 1 mm at the left maxillary first molar site. (D, E) Intraoral photograph showing distal tipping of the second premolar and mesial tipping of the second molar, leading to spacing from the maxillary left canine to the second molar.

molar site.

Tooth movement was progressing satisfactorily after 4 months of initiating orthodontic treatment. Therefore, corticotomy was deemed unnecessary. The archwire was temporarily removed to enable sinus surgery and reinserted immediately afterwards to maintain appliance stability. Orthodontic force was withheld and resumed after 8 weeks to avoid excessive stress on the grafted site, as recommended by previous studies[9].

After 2 months, the OCS was reactivated, and the space at the first molar site had increased to approximately 10 mm. After 7 months of orthodontic treatment, a lingual fixed retainer with 3-strand twist-flex steel wire extending from the canine to second premolar and a buccal 0.016 × 0.022-inch stainless-steel wire retainer extending from the second premolar to second molar were used to maintain space.

2. Phase 2: Sinus Floor Elevation (Month 4)

A sinus lift with bone grafting was performed employing a lateral approach under local anesthesia. A full-thickness mucoperiosteal flap was elevated, and a lateral bony window was carefully prepared to minimize the risk of Schneiderian membrane perforation. A LAS kit (Osstem Implant Co., Seoul, Korea) was used for precise and controlled osteotomy. The sinus membrane was elevated without perforation, and the sinus cavity was grafted with 1 g of deproteinized bovine bone mineral (Bio-Oss®, Geistlich Pharma, Switzerland). Subsequently, a resorbable collagen membrane (Bio-Gide®, Geistlich Pharma, Switzerland) was used to cover the lateral window. The surgical site healed uneventfully without postoperative complications, including infection or membrane perforation.

3. Phase 3: Implant Placement (Month 10)

CBCT evaluation after 6 months of the sinus lift confirmed successful bone regeneration with adequate vertical bone height (>6 mm) and sufficient bone density for implant placement. The CAS kit and 122 Taper kit (Osstem Implant Co., Seoul, Korea) were used for implant placement at the maxillary left first molar site under local anesthesia. A 5.0 × 7 mm TSIII SA implant (Osstem Implant Co., Seoul, Korea) was inserted in a prosthetically driven position, thereby ensuring ideal three-dimensional alignment and adequate buccolingual and mesiodistal spacing (Figure 2). The placement enabled an optimal emergence profile and crown contours. Primary stability was excellent. Resonance frequency analysis revealed implant stability quotient values of 75/77 at 4 months after placement, which increased to 75/78, respectively, 2 weeks later, confirming successful osseointegration.

4. Phase 4: Prosthetic Restoration (Month 14)

A titanium stock abutment (Osstem Implant Co., Seoul, Korea) was selected and a full zirconia crown were fabricated as a screw- and cement-retained prosthesis. The abutment was torqued to 30 N•cm, and the crown was cemented with self-adhesive resin cement (RelyX Unicem, 3M ESPE, USA). The screw access was sealed with Teflon tape and composite resin (Figure 2).

RESULTS

Standardized panoramic radiographs were acquired before and after orthodontic treatment under identical projection conditions to assess changes in the mesiodistal distance between the second premolar and the second molar. The hospital's radio-

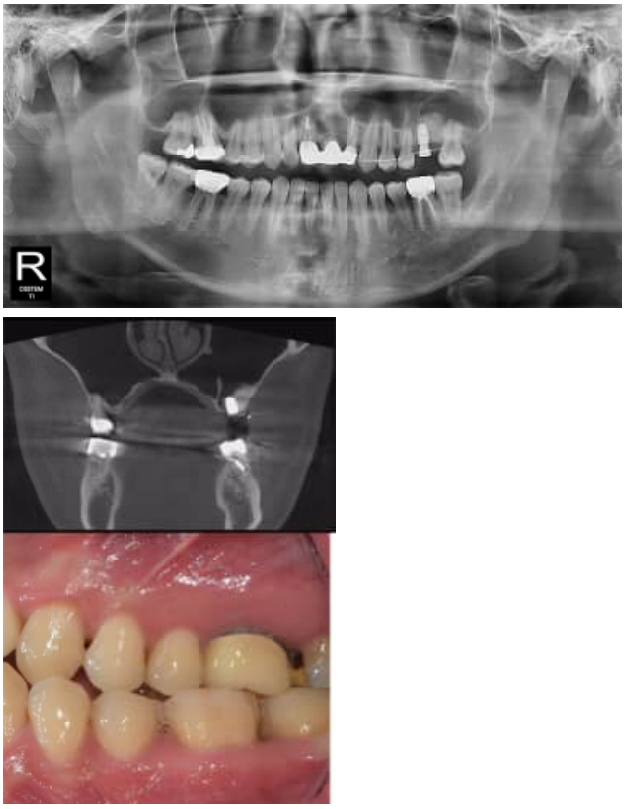

Figure 2. Implant placement and final prosthetic restoration. (A) Panoramic radiograph after implant placement. (B) Cone-beam computed tomography illustrating proper implant positioning and surrounding regenerated bone. (C) Intraoral photograph of the final zirconia crown restoration.

Table 1. Changes in mesiodistal distance between the second premolar and the second molar at the occlusal and cervical levels

Period	Occlusal level (mm)		Cervical level (mm)	
	Measured distance	Compared to the previous follow-up	Measured distance	Compared to the previous follow-up
Pre	5.85	–	8.80	–
5 M	10.25	+4.40	9.85	+1.05
1 Y	10.15	−0.10	9.80	−0.05
16 M	10.13	−0.02	9.78	−0.02

Pre: pretreatment, M: months, Y: year

Table 2. Changes in tooth angulation of the maxillary left second premolar, implant placed at the first molar site, and second molar during treatment and follow-up

Period	Angulation (°)		
	LU5 and LU7	LU5 and LU6i	LU6i and LU7
Pre-treatment	21.70	–	–
7 M	0.30	–	–
1 Y	0.70	5.65	4.95
16 M	0.73	5.60	4.87

LU5: left upper second premolar, LU6i: implant placed at the left upper first molar site, LU7: left upper second molar, M: months, Y: year

graphic imaging program (INFINITT PACS, INFINITT Healthcare Co., Seoul, Korea) was used to measure the distance at the occlusal and cervical levels. The mesiodistal distance was measured between the greatest convexities of both crowns at the occlusal level, and along the cementoenamel junction at the cervical level.

At the occlusal level, the mesiodistal distance between the second premolar and the second molar increased to 10.25 mm at 5 months after orthodontic treatment and demonstrated no notable change at the 1-year and 16-month follow-ups, whereas at the cervical level, the distance increased from baseline to 9.85 mm at 5 months and remained stable thereafter (Table 1).

The angulation between the second premolar and the second molar was measured using an axis-based measurement tool in the PACS system. The angle decreased from 21.7° before treatment to 0.30° after orthodontic correction, indicating nearly parallel alignment. The tooth axes remained stable from implant placement to final prosthesis delivery without significant change (Table 2).

The patient was regularly followed up for 4 years without any complications or functional problems related to the implant or prosthesis. Clinical assessments revealed stable occlusion and healthy peri-implant soft tissue, and the patient reported high satisfaction with both esthetics and masticatory function.

DISCUSSION

This case indicates the successful rehabilitation of a maxillary first molar site with severe sinus pneumatization employing a multidisciplinary approach. Orthodontic treatment corrected the mesiodistal tipping of the adjacent teeth along with the resulting spacing that extended from the canine to the posterior region, thereby establishing a restorative space suitable for prosthetically driven implant placement. During the orthodontic phase, a sinus augmentation procedure was performed concurrently, followed by implant restoration, leading to stable functional and esthetic outcomes over the long term.

Loss of a permanent molar causes mesiodistal tilting and rotation of adjacent teeth, leading to reduced restorative space and occlusal disturbances such as overeruption of opposing teeth, premature contacts, and occlusal interference[10]. Overeruption of opposing teeth has been observed in 83%~92% of cases, with the amount of extrusion ranging from <0.5 mm to 5.4 mm[11,12]. Moreover, recent studies have reported a mean migration distance of adjacent teeth of 208 ± 137 μm for opposing teeth and 403 ± 605 μm for distal adjacent teeth following maxillary first molar loss, with corresponding monthly migration rates of 26.8 ± 21.2 μm and 48.5 ± 76.7 μm, respectively. Furthermore, this movement may be accelerated when occlusal contact is lost or chronic apical periodontitis is present[10].

When mesiodistally tilted posterior teeth continue to function without orthodontic realignment, occlusal forces are not properly transmitted along the tooth's long axis. This leads to reduced masticatory efficiency and progressive alveolar bone resorption[13,14]. Such unfavorable conditions may cause food impaction and retention, leading to patient discomfort and facilitating plaque accumulation, which increases the risk of periodontal disease and development of proximal caries[6,9]. Moreover, mesiodistal space reduction in the edentulous area imposes surgical and prosthetic limitations, thereby making the placement of an implant of the desired diameter challenging[14].

The posterior maxilla is particularly challenging for implant-supported prosthetic treatment due to anatomical limitations and biomechanical demands associated with pronounced sinus pneumatization and alveolar bone resorption after tooth loss[15]. These changes reduce residual bone height and density, thereby requir-

ing sinus augmentation procedures for successful implant placement. Moreover, orthodontic tooth movement for space recovery or inclination correction may be limited when the root morphology or bony wall configuration adjacent to the maxillary sinus is irregular[16]. Such constraints complicate restorative planning and affect the precision and duration of treatment.

A close collaboration among multiple specialties is crucial in such complex clinical situations. Various treatment alternatives have been proposed for patients with first molar loss or unusual extraction patterns[3]. Although fixed prosthetic restoration remains a conventional option, orthodontic implant site development may be selectively applied when adjacent tooth inclination or insufficient restorative space complicates implant placement[6,8]. In such cases, various orthodontic mechanics and auxiliaries—such as miniscrew anchorage, sectional archwires, or customized spring systems—can be used to regain the appropriate restorative space and correct tooth inclination based on the clinical condition[3,8,15,17]. However, treatment strategy selection may be identified based on a comprehensive assessment of various factors, including treatment timing, available space, adjacent teeth inclination, periodontal condition, anatomical characteristics, facial biotype, and other related clinical considerations[3,7,18].

In this case, long-term tooth loss and severe sinus pneumatization made orthodontic space closure less favorable, and orthodontic tooth movement through the maxillary sinus was not considered appropriate based on previous studies[3,15,19]. Therefore, a prosthetically driven implant placement was selected. A multidisciplinary approach that integrated orthodontic, surgical, and prosthetic perspectives enabled effective treatment of the anatomical and functional limitations, thereby achieving stable functional and esthetic rehabilitation of the atrophic posterior maxilla.

COMPETING INTERESTS

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

ETHICAL APPROVAL

Not required.

REFERENCES

1. Roig-Vanaclocha A, Bustamante-Hernández N, Solá-Ruíz MF, Fons-Badal C, Selva-Otaolaurruchi E, Agustín-Panadero R. Efficacy of Mini-screws in Gaining Prosthetic Space for a Dental Implant to Replace the Mandibular First Molar: A Case Series. Applied Sciences 2021;11:607.
2. Raveli TB, Raveli DB, de Mathias Almeida KC, dos Santos Pinto A. Molar uprighting: a considerable and safe decision to avoid prosthetic treatment. The open dentistry journal 2017;11:466.
3. Park JH, Lee M-Y, Chang N-Y, Choi S-K, Kang K-H, Chae J-M. Orthodontic space management in first molar missing or unusual extraction patients. AJO-DO Clinical Companion 2022;2:362-371.
4. Magkavali-Trikka P, Emmanouilidis G, Papadopoulos MA. Mandibular molar uprighting using orthodontic miniscrew implants: a systematic review. Progress in orthodontics 2018;19:1.
5. Zachrisson BU, Bantleon H-P. Optimal mechanics for mandibular molar uprighting. World journal of orthodontics 2005;6.
6. Cune M, van Waas M. Considerations of single tooth replacement. The choice between different treatment options. Nederlands Tijdschrift Voor Tandheelkunde 1999;106:203-207.
7. Cho Y. Necessity of Minor Tooth Movement For Restoration of Implant Prosthesis. The Journal of the Korean Dental Association 2023;61,591-600.
8. Borzabadi-Farahani A, Zadeh HH. Orthodontic therapy in implant dentistry: Orthodontic implant site development. Vertical Alveolar Ridge Augmentation in Implant Dentistry: A Surgical Manual 2016:30-37.
9. Ma Z, Wang Z, Zheng J, et al. Timing of force application on buccal tooth movement into bone-grafted alveolar defects: A pilot study in dogs. American Journal of Orthodontics and Dentofacial Orthopedics 2021;159:e123-e134.
10. Zhao F, Shi L, Huang Y, Wang Y, Yu M, Wang H. Adjacent tooth migration after maxillary first molar loss in patients with sinus augmentation: A retrospective research. Clinical Implant Dentistry and Related Research 2023;25:1080-1090.
11. Craddock H, Youngson C. A study of the incidence of overeruption and occlusal interferences in unopposed posterior teeth. British dental journal 2004;196:341-348.
12. Craddock HL. Occlusal changes following posterior tooth loss in adults. Part 3. A study of clinical parameters associated with the presence of occlusal interferences following posterior tooth loss. Journal of Prosthodontics 2008;17:25-30.
13. Jivraj S, Chee W. Treatment planning of implants in posterior quadrants. British dental journal 2006;201:13-23.
14. Kim I-h, Kim HG, Yun P-Y, Kim Y-K. Clinical outcomes of dental implants combined with limited orthodontic treatment: A retrospective case series study. Journal of Dental Implant Research 2021;40:1-9
15. Navarrete BNR, Blanco MVF, Guerrero EJC, Bastidas KSO, Córdova AAS. Peri-implant orthodontic correction on long-term implant stability in posterior maxillofacial regions with severe bone loss: a literature review. Florence: Interdisciplinary Journal of Health and Sustainability 2025;3:e25007-e25007.
16. Sabri R. Multidisciplinary management of permanent first molar extractions. American Journal of Orthodontics and Dentofacial Orthopedics 2021;159:682-692.
17. Rose T, Jivraj S, Chee W. The role of orthodontics in implant dentistry. British dental journal 2006;201:753-764.

18. Viglianisi G, Polizzi A, Lombardi T, Amato M, Grippaudo C, Isola G. Biomechanical and Biological Multidisciplinary Strategies in the Orthodontic Treatment of Patients with Periodontal Diseases: A Review of the Literature. Bioengineering 2025;12:49.

19. Bahamid AA, AlHudaithi FS, Aldawsari AN, Eyyd AK, Alsadhan NY, Alshahrani FAM. Success of Orthodontic Space Closure Vs. Implant in The Management of Missing First Molar: Systematic Review. Annals of Dental Specialty 2022;10:9-14.