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COMBINED ORTHODONTIC AND SURGICAL APPROACHES IN THE TREATMENT OF IMPACTED TEETH

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Abstract

Impacted teeth are one of the most complex challenges in orthodontics, requiring accurate three-dimensional diagnosis and careful biomechanical planning.

Aim and purpose: To review and analyze orthodontic strategies for the management of impacted teeth in children and adults, including biomechanical, surgical approaches and combinations of fixed and removable appliances, to ensure controlled, functional and aesthetic eruption.

Methodology: A clinical analysis of an orthodontic case with impacted teeth, treated with advanced orthodontic and surgical protocols, was performed in the Albanian University, dental clinic. Also, a literature review was conducted according to the PRISMA 2020 protocol, including searches in international scientific databases such as: PubMed, Scopus, Web of Science for the period 2015–2025.

Results: Skeletal anchorage with TAD and modified TADMAN/Beneslider appliances provided maximum control over the force vector, sustained distalization, and elimination of adverse effects in the anterior segment.

Conclusions: Treatment of impacted teeth requires accurate three-dimensional diagnosis, individualized biomechanical planning, and integration of modern anchorage and surgical exposure methods. RPE, TADs, Beneslider, and minimally invasive exposure techniques were found to be effective and safe in the management of complex impaction cases. The combined orthodontic–surgical approach provided controlled eruption, periodontal stability, and long-term functional and aesthetic results.

Keywords: *Impacted teeth, Surgical exposure, TAD, Beneslider, RPE, Orthodontic treatment.*

Introduction

Impacted or retained teeth represent a pathological clinical condition in which a tooth fails to erupt into the oral cavity within the expected physiological timeframe, due to mechanical factors, abnormal axial orientation, lack of dental space, or other local and systemic factors. The highest frequency is observed in maxillary canines and mandibular third molars, which often require combined orthodontic–surgical

interventions to restore function and aesthetics.

The management of impacted teeth requires a multidisciplinary approach that includes clinical evaluation, two-dimensional and three-dimensional radiographic analysis, orthodontic planning, and coordinated surgical intervention. Modern treatment strategies aim not only at surgical exposure and orthodontic traction of the impacted tooth but also at preserving periodontal health, preventing root resorption of adjacent teeth, and ensuring long-term occlusal stability.[1]

Treatment generally consists of creating adequate dental space through orthodontic techniques, followed by surgical exposure of the impacted tooth and the application of an orthodontic attachment to guide the tooth gradually into its natural position within the dental arch. The choice of surgical technique such as open or closed exposure, flap-assisted procedures, or minimally invasive techniques, depends on the three-dimensional position of the tooth, its angulation, depth of impaction, and the condition of the surrounding soft tissues.[2]

The importance of proper management lies in the fact that impacted teeth may lead to complications such as dentigerous cysts, root resorption of adjacent teeth, dental migration, occlusal asymmetry, and other pathological conditions. Therefore, early diagnosis and well-defined orthodontic–surgical protocols are essential to achieve optimal functional and aesthetic outcomes.[2]

Impaction of permanent teeth is frequently encountered in clinical practice, with reported prevalence ranging from 2.9% to 13.7%, varying according to population and geographic region. The teeth most commonly affected include third molars, canines, premolars, and central incisors:[3]

- Maxillary canines show a prevalence ranging from 1% to 3% in the general population, with a higher incidence in females.
- Mandibular third molars are the most commonly impacted teeth worldwide, with a reported prevalence of 20–30%, representing the most frequent group of dental impactions.
- Lateral incisors and premolars exhibit lower prevalence rates, generally below 1%.
- Impacted teeth occur more frequently in the maxilla than in the mandible, particularly in the anterior region.
- A gender-related predisposition exists, with females being more frequently affected, which has been associated with smaller dental arch dimensions and hormonal factors influencing the eruption pathways.

AIM AND PURPOSE

The aim of this paper is to review and analyze orthodontic strategies for the management of impacted teeth in pediatric patients, including biomechanical and surgical approaches, as well as combinations of fixed and removable appliances, in order to achieve controlled, functional and esthetic eruption.

METHODOLOGY

The study included a clinical case involving orthodontic and surgical management of impacted maxillary teeth, treated during the period 2020–2025 at the University Dental Clinic of Albanian University, Department of Orthodontics. The clinical approach was based on contemporary MBT bracket protocols, controlled orthodontic biomechanics, and minimally invasive surgical techniques.

Patients presenting with severe periodontal disease, ankylosis of impacted teeth, or a previous history of unsuccessful orthodontic treatment for the same condition were excluded from the study.

A standardized diagnostic protocol was applied for the patient, which included:

- ✓ Extraoral examination (facial asymmetry, profile analysis, facial type)
- ✓ Intraoral examination (occlusion, dental crowding, dental classification, midline assessment)
- ✓ Radiographic analysis, including:

1. Panoramic radiograph
2. Lateral cephalometric radiograph (Steiner/ McNamara analysis)

3. Three-dimensional cone-beam computed tomography CBCT was performed for precise localization of impacted teeth and assessment of adjacent root resorption.
- ✓ Three-dimensional intraoral scanning was utilized for CAD/CAM-based appliance planning.
- ✓ Clinical photographs were obtained before and during orthodontic treatment for documentation and monitoring of treatment progress.

CLINICAL CASE

A male patient, L.K., aged 11 years, presented to the clinic with concerns regarding retention of a maxillary incisor. Extraoral examination revealed a dolichofacial pattern with a convex facial profile. Additionally, the maxillary dental midline was deviated 1 mm to the left.

Fig.1 Extraoral photograhy

The intraoral examination revealed a dental Class II malocclusion with increased overjet and overbite, accompanied by a normally developed maxilla and a slightly retrognathic mandible.

Fig.2 Pre-treatment intraoral photographs

Radiographic examination revealed an impacted maxillary left central incisor #tooth 21. However, patient history indicated that the patient had experienced an early childhood traumatic accident during kindergarten play activities. Additionally, palatal impaction of the maxillary left canine #tooth 23 was identified.

Fig.3 Orthopantomogram

Steiner cephalometric analysis confirmed a skeletal Class II relationship, with an ANB angle of 6°, accompanied by proclination of both maxillary and mandibular incisors. Additionally, the vertical parameter SN–GoGn measured 37°, confirming a dolichofacial growth pattern.

ikeleta Analysis (Steiner)	Norm (Steiner)	Your ceph
SNA	≈ 82°	83°
SNB	≈ 80°	77°
ANB	2°	6
Dental analysis	U_1–N_A	32
U1–NA (°)	22	32
U1–NA (mm)	4 mm	9 mm
L1–NB (°)	25	36
L1–NB (mm)	4 mm	8 mm
interincisal angle	131°	117
Vertical analysis	≈ 32°	37
N–GoGn / SN-Mand 'plane	≈ 32°	37
Upper lip to S–line, Steiner	0 mm	+2 mm
Lower lip to S-line	0 mm	−1 mm ≈

Fig.4 Lateral radiograph and cephalometric analysis

In order to fabricate a three-dimensional guide for the placement of two temporary anchorage devices TADs for a customized fixed functional appliance, a 3D scan was performed and the images were processed using the Smile-Check system.

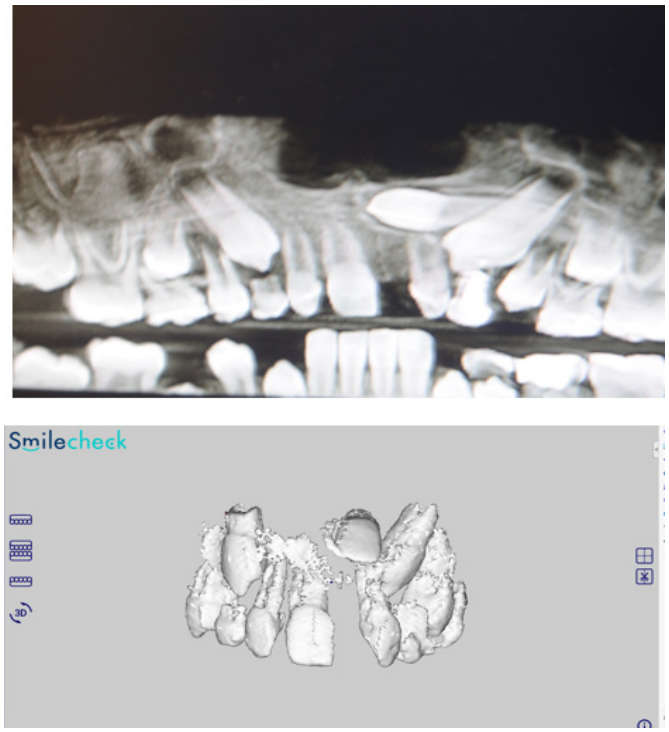

Fig.5 3D scanning dhe Smilecheck system

Within one week, a three-dimensional study model and an acrylic guide for the placement of TAD miniscrews were fabricated. This individualized planning approach allowed, precise and stable anchorage.

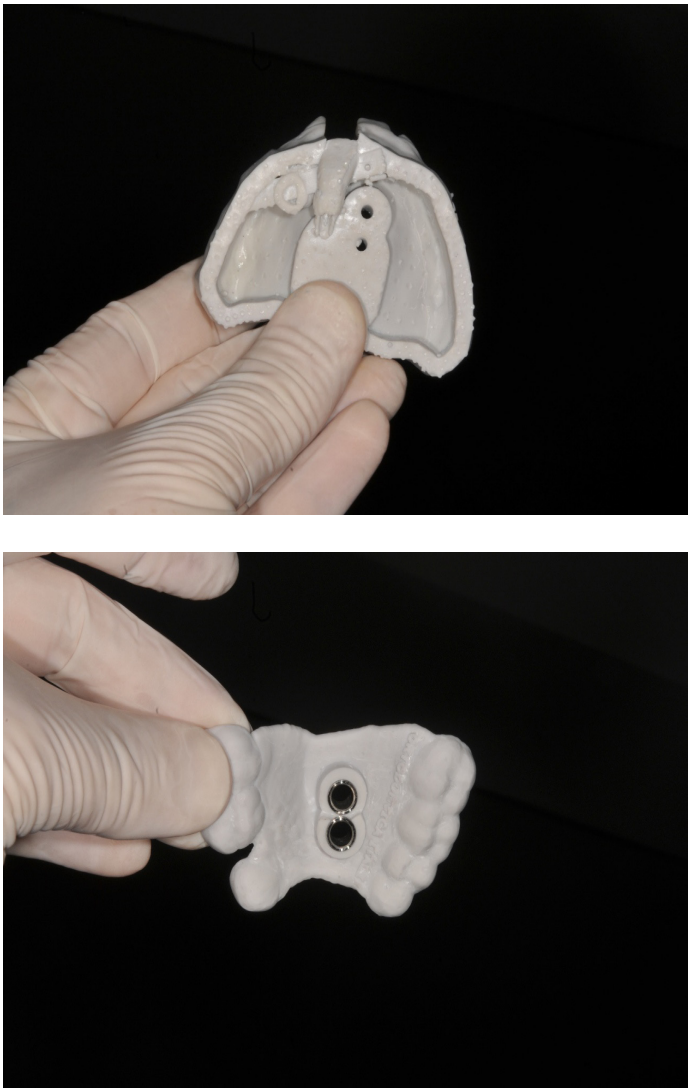

Fig.6 3D study model dhe surgical guide for TAD mini-screw placement

The treatment plan was implemented in three phases:

Phase I – Skeletal anchorage using palatal mini-screw TADs, modified with a CAD/CAM-designed TAD-MAN Beneslider system.

Phase II – Surgical exposure of the impacted teeth 21 and 23.

Phase III – Orthodontic traction and alignment of the teeth into occlusion using a fixed appliance and metallic ligatures.

After the placement of two paramedian palatal mini-screws using the 3D guide, which served as fixed force anchorage points and minimized undesirable orthopedic or dental effects, a customized CAD/CAM-modified TADMAN appliance was fabricated. In this system, the Beneslider was connected to the mini-screws via tubular arms and slider tubes.

This construction design allows distalization of the posterior segment with a high level of anchorage control, while distributing forces in a manner that reduces the risk of root resorption. Additionally, a lingual metal arm inclined toward the alveolar process in the region of tooth 11 was incorporated to prevent unwanted rotational movements during molar distalization.

Fig.7 Customized TADMAN appliance with skeletal anchorage

After two weeks, the patient returned for surgical exposure of tooth 23 from the palatal aspect. A muco-periosteal flap was created, and cortical bone was removed through osteotomy to expose the tooth crown. An orthodontic attachment was bonded to the coronal surface of the impacted canine using composite resin, and a long metallic ligature was attached to allow controlled orthodontic traction of the canine toward its proper position within the dental arch. The flap was then repositioned and sutured using continuous resorbable 3-0 sutures.

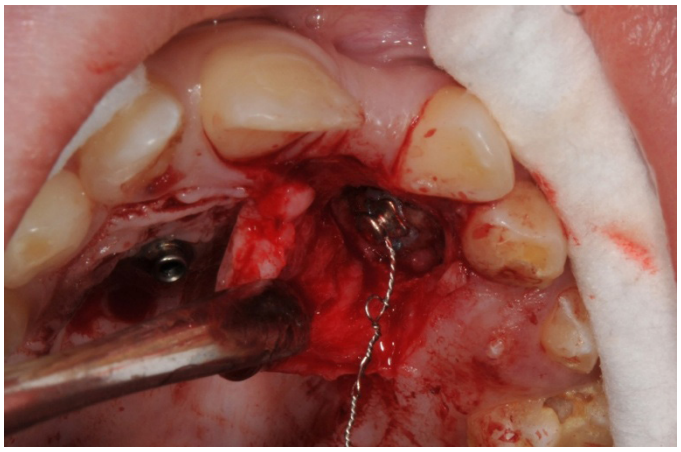

Fig. 8 Surgical exposure of #tooth 23

For the surgical exposure of #tooth 21, a semilunar flap was created, followed by the preparation of an oval window through removal of the overlying bone covering the tooth crown.

An orthodontic attachment was bonded to the exposed crown, and a metallic ligature was attached to enable controlled orthodontic traction. The flap was sutured using resorbable 3-0 sutures, and the TADMAN appliance was subsequently placed.

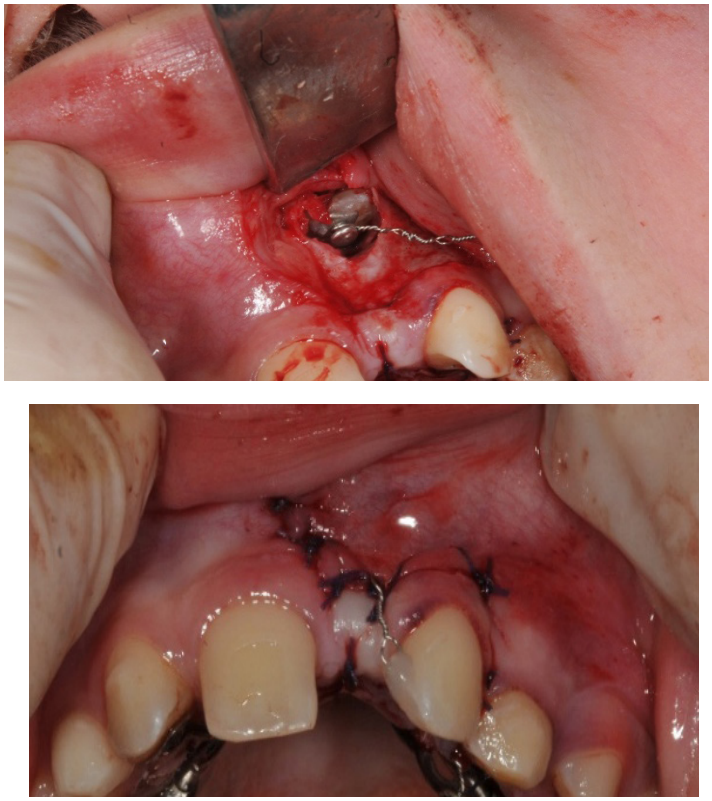

Fig. 9 Surgical exposure of impacted #tooth 21 followed by suturing

One month later, the patient returned for follow-up evaluation, which revealed satisfactory soft tissue healing with no signs of inflammation. Two additional palatal metal cantilever arms were incorporated into the TADMAN appliance for #teeth 21 and 23 to achieve improved torque control. Additionally, the posterior distalization springs were activated.

Fig.10 The clinical evaluation after one month

Three weeks later, a fixed orthodontic appliance was placed using a rectangular SS archwire 0.018 × 0.025''. At the level between #teeth 22 and 24, a passive loop archwire and a closed coil spring wereaplied to mainacted teeth.

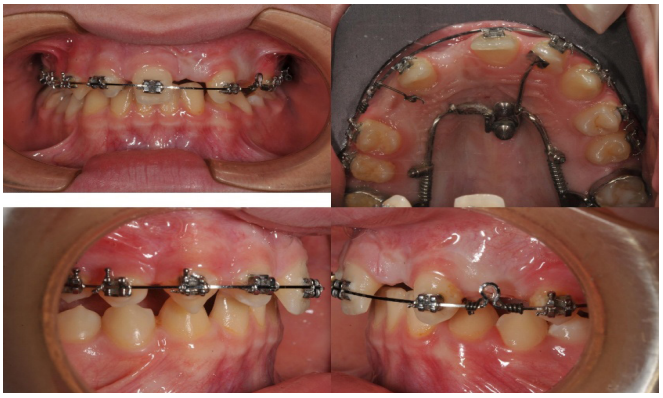

Fig.11 Bonding and placement of the fixed orthodontic appliance

After three months, #tooth 23 was successfully brought into occlusion and aligned through controlled traction using a metallic ligature attached to the looped archwire hook.

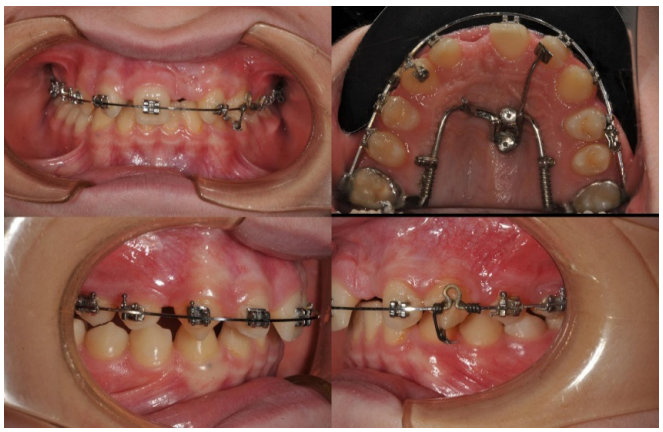

Fig.12 Orthodontic alignment and leveling of impacted #tooth 23

Orthodontic treatment is currently ongoing, with active traction of #tooth 21.

DISCUSSION

The treatment protocols applied in our clinical cases including rapid maxillary expansion, the use of palatal mini-screws TADs, controlled posterior distalization, and orthodontic traction of impacted teeth are fully consistent with contemporary trends reported in the literature.[4-5]

According to Lee et al. (2025)[6], rapid maxillary expansion remains a reliable method for transverse correction. Their meta-analysis demonstrated that conventional rapid palatal expansion RPE provides significant dentoalveolar expansion, whereas miniscrew-assisted rapid palatal expansion MARPE offers more pronounced skeletal benefits.

Our clinical outcomes, which achieved approximately 4 mm of transverse expansion and the formation of an interincisal diastema within two weeks, are comparable to the findings reported by Viarani et al. (2025)[7], who documented similar RPE effectiveness using two-band expanders in growing patients.

Regarding the use of TADs and appliances such as the TADMAN/Beneslider system, the findings from our clinical cases are consistent with the study by Oğuz et al. (2024)[8], which reported that TAD-supported distalization appliances provide stable skeletal anchorage, minimize unwanted anterior tooth movement, and offer superior torque control during molar distalization. Furthermore, these authors [7-8] emphasized that TADs significantly enhance the efficiency of complex orthodontic treatments, particularly in cases

involving impacted teeth, which parallels our clinical case featuring retention of the maxillary canine #tooth 23 and maxillary central incisor #tooth 21.

CONCLUSIONS

The use of modified TAD-supported appliances eliminates the risk of unwanted anterior tooth movement and allows for precise control of orthodontic forces. Progressive traction using metallic or elastic ligatures produces controlled three-dimensional tooth movement, enabling proper eruption and positioning into occlusion without periodontal complications affecting the roots of adjacent teeth.

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