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Comprehensive prosthetic treatment of a patient after removal of an impacted fragment of an orthodontic wire in the area of tooth 13 – review & case report

Natalia Tarczyńska[1]; ORCID ID: 0009-0007-2760-9720; Natalia.protetyka@gmail.com

Szymon Górski[1]; ORCID ID: 0009-0006-1411-6524; szymon.gorski13@gmail.com

Joanna Okupniarek[2]; ORCID ID: 0009-0007-2446-4810; asiaokup22@wp.pl

Michalina Bartosik[3]; ORCID ID: 0009-0008-8541-1998; michalinabartosik03@gmail.com

1 WSPSP - 'Provincial Dentistry' L.L.C., ul. Zdrowotna 6, 85-826 Bydgoszcz, Poland

2 Ludwik Rydygier Collegium Medicum in Bydgoszcz Nicolaus Copernicus University in Toruń, Jagiellońska 13/15, 85-067 Bydgoszcz, Poland

3 Medical University of Łódź, al. Tadeusza Kościuszki 4, 90-419 Łódź, Poland

* Correspondence: szymon.gorski13@gmail.com

Abstract

Introduction: Impacted maxillary canines occur in approximately 1–4% of the population and are a significant clinical challenge due to their aesthetic and functional importance. Impacted canines are more common in women and significantly more common in the maxilla, as confirmed by epidemiological data. The causes of tooth 13 impaction can be complex and include lack of space in the arch, abnormal position of the tooth bud, retention of the deciduous tooth, and genetic factors. Modern prosthetics increasingly requires interdisciplinary cooperation, and orthodontic appliances left in the bone can be a source of potential inflammatory and mechanical complications. Their removal is a key step before performing the final prosthetic reconstruction. In the presented case, it was necessary to surgically decompress and remove the retained fragment of orthodontic wire, followed by prosthetic restoration using a temporary bridge to shape the tissues and a final metal-porcelain restoration covering teeth 15–21.
Purpose of work: The aim of this paper is to present a comprehensive surgical and prosthetic treatment of a patient after unsuccessful orthodontic treatment, which resulted in a piece of wire remaining in the area of tooth 13. The paper discusses the procedure for removing the foreign body, the stages of prosthetic reconstruction, and the evaluation of treatment results after three months of observation.
Materials and methods: The material describes the case of a 30-year-old female patient who presented in April 2025 for improvement of the aesthetics of the anterior maxilla. A clinical examination revealed a bridge covering teeth 15–12 and numerous fillings. In her medical history, the patient reported a previous unsuccessful attempt to extract the impacted tooth 13, after which a fragment of steel wire remained in the bone. The diagnosis was extended to include an OPG image, which confirmed the presence of a foreign body, impacted teeth 18, 28, 38, and alveolar bone resorption in the area of tooth 13.
The procedure was divided into two stages:
1. Surgical stage
infiltration anesthesia with Citocartin 200,
removal of the existing bridge,

incision of the envelope flap,
osteotomy of the bone surrounding the wire,
removal of the steel fragment,
extraction of tooth 12,
control OPG image confirming complete removal of the foreign body.
2. Prosthetic stage
assessment of abutments in terms of biomechanical principles (including Anta's law),
preparation of teeth 11 and 21 for crowns in accordance with the heavy chamfer / light chamfer principles,
fabrication of a temporary tissue-modeling bridge,
scanning of arches and CAD/CAM restoration design,
fitting of a trial construction,
cementation of the final metal-porcelain bridge 15–21,
check-ups: after 7 days, 6 weeks, 30 days, and 3 months (clinical and radiological).
Results: Post-operative healing proceeded normally, without complications such as oro-sinus communication or inflammation. The temporary bridge allowed the soft tissues in the area of the extracted tooth 12 and the wire to form. After the final prosthetic work was completed, a correct profile of the alveolar process, appropriate aesthetics, and color consistency of the restoration were achieved. The patient reported complete aesthetic satisfaction. An OPG image taken after 3 months confirmed bone stability in the treatment area and correct bridge placement. No mobility of the abutments or signs of overload were noted.

Keywords: impacted canine, orthodontic wire fragment, prosthetic rehabilitation, metal-ceramic bridge, temporary bridge, alveolar bone defect, interdisciplinary dental treatment

Introduction

The primary goals of orthodontic treatment are to improve the appearance of the face and smile and to improve chewing function. To achieve these goals, the aim is, as far as possible, to align the teeth in their correct, natural order. It will not be possible to achieve one of these goals if one of the teeth is impacted. Impacted upper canines occur in about 2% of the population and are twice as common in women as in men, and twice as common in the maxilla as in the mandible. [1] It is assumed that their prevalence ranges from 1 to 4%. [2] The most common causes of impacted canines are: lack of space in the arch, abnormal position of the tooth bud, premature loss of a deciduous tooth, retention of a deciduous tooth for too long, abnormal position of the lateral incisor, genetic factors, deciduous tooth resorption disorders, jaw malformations, e.g., cleft palate, endocrine diseases or genetic syndromes (e.g., Down syndrome, Crouzon syndrome, trauma to the deciduous tooth bud, disorder in the order of tooth eruption, premature resorption of deciduous tooth roots, defective muscle function, systemic diseases, vitamin D deficiency. [3,4,5]. Despite the often unfavorable position of retained canines, attempts are made to orthodontically guide them into the arch. Such an attempt was also made in the case of the patient described. Modern dental prosthetics is increasingly combined with surgical and orthodontic treatment. Fragments of orthodontic elements left in the jawbone are a potential source of inflammatory and mechanical problems, and their removal is a prerequisite for prosthetic reconstruction. Prosthetic restoration after surgical intervention requires special attention to the aesthetics of soft tissues and the preservation of the proper profile of the alveolar process. For this purpose, temporary restorations made of composite materials on a structure that performs a forming and protective function are increasingly used. This article presents the case of a patient treated after surgical removal of a retained fragment of orthodontic wire, in which a temporary bridge was used to shape the tissues, followed by a metal-porcelain bridge covering teeth 15–21.

On April 15, 2025, a 30-year-old female patient visited "Stomatologia Wojewódzka" in Bydgoszcz to improve the aesthetics of her anterior maxilla. A clinical examination revealed the presence of a prosthetic restoration – a bridge covering teeth 15–12, and fillings in teeth 17, 16, 23, 26, 36, 45, 46, and 47.

The patient's history included an unsuccessful attempt to orthodontically reposition the impacted tooth 13 ten years earlier. Following orthodontic treatment, a fragment of a steel wire remained in the bone. The patient reported no pain or chronic illness. An OPG was then taken, capturing the wire fragment and canal filling after endodontic treatment on tooth 26, the impacted teeth 18, 28, and 38, and significant bone loss in the maxillary alveolar process surrounding tooth 13. The mobility of the remaining teeth was normal. The patient was thoroughly examined and proposed a two-stage procedure: surgical and prosthetic. She was informed about treatment options, all possible complications, and the possibility of failure.

Fig. 1. OPG photo with a fragment of steel wire and visible bone loss in the maxillary alveolar process in this area.

Fig. 2, 3. Photos of the initial prosthetic work on the day of surgery.

After obtaining written consent, a detailed treatment plan was established. The surgical portion included infiltration anesthesia with Citocartin 200, removal of the old prosthetic bridge, incision of an envelope flap, osteotomy of the bone surrounding the steel wire fragment from the area of tooth 13, and its subsequent removal. Subsequently, extraction of tooth 12. The procedure was uneventful, and no intraoperative complications were observed.

Fig. 4. Photo after removal of the primary bridge with a visible large loss of soft tissue in the vestibule area of tooth 13.

Fig. 5. Photo after flap detachment and partial osteotomy with steel wire visible.

Fig. 6. Photo with partially removed steel wire and extraction of tooth 12.

After the procedure, i.e. surgical tissue treatment, the patient was referred for a control OPG image to confirm the complete removal of the foreign body.

Fig. 7. Control OPG image after the procedure.

The patient was informed about the need to schedule another visit 7 days after the procedure to monitor and assess post-operative healing.

Fig. 8. Photograph of the patient 7 days after the procedure. Post-operative follow-up. Healing is normal.

The next visit was scheduled for 6 weeks after the post-operative check-up. In accordance with the assumption of appropriate local conditions during the bridge construction, aspects such as the appropriate spatial arrangement of future abutments, stabilization of abutments in the alveolar sockets, their correct anatomical shape, parallelism of the long axes of the teeth, and most importantly, the minimum number of abutments meeting Anta's law . According to this law, it will be performed based on the principle that “the total periodontal support surface of the abutment teeth should be equal to or greater than the hypothetical periodontal surface of the teeth to be restored” [6]. The 15-14-X-X-11-21 bridge fully complies with this principle because our abutment teeth, i.e., 15, 14, 11, and 12, have a total of approximately 4.6, and the teeth to be restored, i.e., 13 and 12, have approximately 2.5. The abutment teeth themselves are also evaluated – the ratio of the crown length measured from the alveolar bone of the maxilla to the occlusal surface to the length of the root fixed in the bone should optimally be 2:3, but in exceptional situations a ratio of 1:1 is acceptable. The shape of the natural abutment roots is also important – an increased vestibular-lingual dimension is more favorable than a mesial-distal dimension. The next step involved grinding the crowns of teeth 11 and 21. These were incorporated into the future prosthetic construction for aesthetic reasons, to achieve color consistency between the porcelain and the natural tooth. The grinding was performed in accordance with the guidelines in the book "Vademecum for the Fabrication of Fixed and Removable Prostheses," edited by Prof. Dejak. [6]

The labial surface of the incisor was prepared in two separate planes. The cervical section was ground parallel to the tooth's long axis, while the section closer to the incisal edge was modeled at a different angle, depending on the natural crown convexity. The incisal edge was reduced by approximately 2 mm, while maintaining its physiological inclination.

The palatal surface was prepared to a depth of approximately 0.7 mm, with the instrument angled 3–6° to the vestibular aspect. It was also necessary to create approximately 1.5 mm of space between the tooth being prepared and the opposing tooth to allow for the appropriate thickness of the future crown.

The labial gingival shoulder was created as a pronounced chamfer (heavy chamfer), or a rounded shoulder (radial shoulder) with a depth of approximately 1.2 mm could also be used. A light chamfer (approximately 0.7 mm deep) was created on the lingual and proximal surfaces. Less preparation of the oral surface allows for the preservation of more hard tooth tissue. This approach is acceptable provided that the palatal crown is not covered with ceramic. The edge of the shoulder should run smoothly and harmoniously along the gingival line. After preparation, all sharp edges should be smoothed and rounded.

Fig. 9. Photo of the completed crown grinding of teeth 11 and 21.

Following the procedure, a temporary bridge was constructed on a flow composite structure, spanning teeth 15–11. The temporary bridge protected and modeled the alveolar tissue in the area where teeth 12 and 13 had been.

In the next stage, scans of both the upper and lower arches were made in order to design the future restoration. The continuous development of computer technology and advanced data processing methods in dentistry contributes to the emergence of new diagnostic and therapeutic possibilities in the field of fixed prosthetics. [7] Traditionally, standard therapeutic procedures were based on conventional impression techniques and the production of plaster models, which were used to manufacture acrylic and porcelain reconstructions fired onto metal using the lost wax technique. In contrast to these methods, modern computer-aided design technologies ensure high, repeatable precision and predictable production results, while streamlining the work process and reducing manual labor. [8,9]

Fig. 10, 11. Scans of the upper and lower arch.

After intraoral scans were taken, a restoration was designed. A chrome-cobalt alloy was chosen for the substructure due to its affordable price, biocompatibility, high hardness, durability, and corrosion resistance [20,21,22], veneered with leucite ceramic. The choice fell on composite crowns Metal-ceramic prostheses are commonly used in dentistry due to the combination of the aesthetic qualities of ceramics with the high durability and strength of the metal substructure. This combination allows for reconstructions that look similar to natural teeth while maintaining favorable mechanical properties. [15,16] On the other hand, in order to meet aesthetic and clinical requirements, metal-ceramic crowns must undergo a specific set of porcelain firing cycles. Additional cycles may be necessary in the case of morphological or color corrections, but an increased number of cycles may adversely affect the strength of the metal-ceramic bond. [17]

An additional advantage is their relatively low cost compared to ceramic restorations, which makes them among the most frequently chosen permanent prosthetic restorations. Their durability is long – it is estimated that approximately 95% of them function properly after 10 years.

The substructure was made using selective laser melting (SLM/DMLS) technology. It is an additive, incremental method in which the device used in selective laser melting technology consists of a laser, a laser guidance system, and a working platform placed in a chamber filled with inert gas. A computer-controlled laser beam is directed onto the surface of the platform, onto which a layer of powdered metal is evenly applied. Under the influence of the high temperature generated by the laser, the powder particles undergo local melting and bonding into a layer approximately 20–200 μm thick. The platform is then lowered and another portion of powder is applied to the resulting layer, which is again fused by the laser. In this way, the laser successively sinter individual sections of the model, creating the entire structure layer by layer. After the process is complete, the finished metal component is heat treated in an argon atmosphere to reduce internal stresses in the material. This technique produces restorations with a homogeneous and compact structure, free of voids, shrinkage pores, and impurities typical of traditional casting. Components made in this way are characterized by high hardness and high resistance to loads. The thickness of the metal crown substructure made using this method is usually in the range of 0.3–0.5 mm.

Additional advantages of SLM technology include very good manufacturing precision, tightness of the obtained structures and efficient use of material.

Fig. 12. Intraoral situation, fitting of the future prosthetic restoration in the oral cavity.

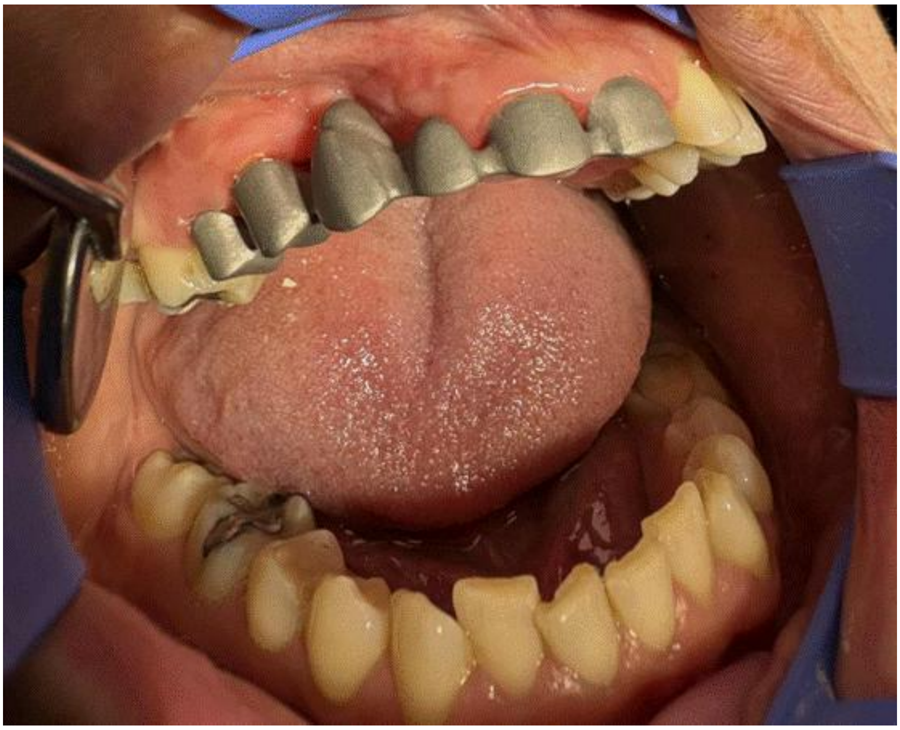

Fig. 13. Try-in of the framework for the future prosthetic restoration in the oral cavity. View from the right.

Ten weeks after the procedure, the final restoration was cemented in place. The veneering ceramic was the aforementioned leucite ceramic. The restoration was cemented with glass ionomer cement (Ketac CEM). Glass ionomer is made from finely ground aluminosilicate glass combined with an aqueous solution of polycarboxylic acids. [10] This material is characterized by high tensile and compressive strength, low thermal expansion coefficient, and anti-caries properties that promote remineralization of tooth tissue. The latter feature results from the gradual release of ions in the aqueous environment of the oral cavity. [10,11]. Glass ionomer cements are also semi-transparent and less soluble than zinc phosphate cement. [13] However, one of the significant disadvantages of these materials is their low pH (approximately 3.5), which may cause clinical problems, including hypersensitivity in patients with a low pain threshold. In addition, the strength of glass ionomer cements is reduced if they are exposed to moisture too early, due to cation leaching and progressive erosion. This phenomenon increases the risk of cracking, so the material requires adequate protection, e.g., with a protective varnish or petroleum jelly, in the initial stage of setting. [14] The choice of the right cement is very important, as there have been cases of permanent works being aspirated into the respiratory tract. [18] Cementing with this type of cement requires the substructure to be prepared for the process. This is done as follows:

The interior of the restoration is sandblasted with aluminum oxide with a grain size of 50–110 µm, at a pressure of approximately 2.5 bar, from a distance of approximately 1 cm for 10–20 seconds. Next, the structure is cleaned with alcohol, rinsed with distilled water, and thoroughly dried. The abutment tooth is isolated, washed with distilled water, and dried. Glass ionomer cement is prepared by mixing it with a spatula on a plate or paper according to the manufacturer's instructions.

Place the prepared cement in the restoration (or, in some cases, directly on the tooth). Place the prosthetic work on the tooth and stabilize it until the material has set. Remove excess cement with a probe and dental floss..

Fig. 14. Intraoral situation after final cementation of the work, view of the upper arch.

Fig. 15. Intraoral situation after final cementation of the work, view from the right side of the upper arch.

The next visit took place 30 days after cementing the final restoration.

Fig. 16. Intraoral situation, control 30 days after cementation, view from the right side of the upper dental arch.

Fig. 17. Intraoral situation, control 30 days after cementation, view of the upper dental arch.

The next follow-up visit was carried out 3 months after cementation, and a control OPG image was taken.


Fig. 18. Intraoral situation of the work 3 months after cementation.

Fig. 19. Intraoral situation of the work 3 months after cementation. View from the right.

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Fig. 20. OPG photo of the final prosthetic work, taken 3 months after final cementation.

Prosthetic bridges are well-known and widely used restorations. Literature data indicate that metal-porcelain structures achieve a survival rate of approximately 74–79% after 15 years of use, and approximately 66% after 20 years. However, it should be emphasized that their durability largely depends on the correct design of the restoration, especially taking into account the principles of biomechanics. Proper planning reduces the risk of excessive loading on the teeth serving as abutments. [6]

The **advantages** of metal-based bridges (metal-porcelain composite) include:

- the structure of the restoration is relatively slim, as it does not require contact with the mucous membrane;
- they are characterized by high durability;
- they exhibit high mechanical resistance;
- chewing forces are transferred physiologically through the periodontium to the maxillary and mandibular bones, thus preventing stress on the soft tissues;
- they provide a satisfactory, natural appearance;
- patients usually tolerate them better than removable restorations because they take up less space in the mouth and offer a more aesthetic result.

The disadvantages of complex bridges include:

- it is necessary to grind down the abutment teeth, which involves permanent loss of hard tissue and the risk of complications after the procedure, such as hypersensitivity or even pulp necrosis;
- if the bridge is damaged, its repair may be difficult or limited;
- maintaining proper hygiene within the bridge can be problematic, as it promotes the formation of hard-to-reach retention areas for bacterial plaque.

After the prosthetic bridge has been fitted, the patient should receive detailed instructions on proper oral hygiene. In addition to basic recommendations, such as thorough brushing, flossing, and regular check-ups every six months, attention should be paid to the need to use special hygiene accessories. It is worth informing the patient about the use of floss designed for bridges (e.g., Super Floss) or interdental brushes, which allow cleaning of hard-to-reach areas around the abutments and under the bridge span. In addition, the use of an irrigator is recommended to help maintain proper cleanliness in these areas.

CONCLUSIONS

Comprehensive surgical and prosthetic treatment of a patient with a retained orthodontic wire fragment required close interdisciplinary cooperation and a step-by-step approach. Removal of the foreign body enabled proper prosthetic reconstruction, and the use of a temporary bridge allowed for optimal soft tissue shaping. The final metal-porcelain bridge ensured a good aesthetic and functional effect, while maintaining the biomechanics of the abutments. A three-month observation confirmed the stability of the treatment result and the correct course of healing processes. The case emphasizes the importance of accurate diagnosis and individual prosthetic treatment planning in patients who have undergone previous orthodontic treatment.

Disclosure
Author's Contributions:

Conceptualization: Natalia Tarczyńska, Szymon Górski, Joanna Okupniarek, Michalina Bartosik

Formal analysis: Natalia Tarczyńska, Michalina Bartosik, Joanna Okupniarek

Investigation: Joanna Okupniarek, Michalina Bartosik

Writing rough preparation: Natalia Tarczyńska, Szymon Górski, Joanna Okupniarek,

Writing review and editing: Natalia Tarczyńska, Szymon Górski, Michalina Bartosik

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