Abstract
The phenomenon of tooth retention is being observed more and more often. The development of radiological diagnostics enables clinicians to plan treatment more precisely, which leads to present this article documenting methods of management with regard to impacted teeth. The most common location and methods of directing the impacted teeth into the oral cavity are described. The case study consists of the cases of patients in whom impacted teeth were revealed on the basis of an intraoral examination as well as in-depth diagnostic imaging. In order to recreate the space and reorder the teeth, an archwire was applied in all the cases described. The process of exposure of the impacted teeth was conducted during the treatment. The preferred method was the tunnel technique, allowing to achieve a proper condition of the periodontium. The treatment is an interdisciplinary process, requiring the co-operation of experts in various fields of dentistry – an orthodontist, a dental surgeon, an endodontist, a periodontologist and a dental prosthetist. A therapeutic success can only be achieved by means of co-operation of these experts (Dent. Med. Probl. 2013, 50, 1, 88–95).

Key words: impacted teeth, orthodontic-surgical co-operation, tunnel technique.

Streszczenie

Słowa kluczowe: zęby zatrzymane, współpraca ortodontyczno-chirurgiczna, technika tunelowa.

Among the impacted teeth, that is teeth embedded within either the maxillary or the mandibular bone with the root fully formed, we can distinguish between teeth fully covered with soft and hard tissue – full retention and teeth partially covered with soft and hard tissue – partial retention [1].

An impacted tooth can be suspected if the root of the tooth is formed in two thirds and the crown is stuck within a significant distance from the edge of the alveolar process, and when the delay between the eruption of monomial teeth is at least half a year.

The reasons for this condition can be divided into [1–6]:

1) General: hereditary, endocrinological disorders, vitamin D deficiency, systemic diseases, tumors, developmental disorders of the facial part of the cranium, e.g. clefts, systemic disorders, e.g. dysostosis – cleidocranial dysostosis, Gorlin-Goltz syndrome;
2) Local:
- supernumerary teeth – e.g. mesiodentes
- cysts – Figure 2,
- odontogenic tumors, e.g. odontomas – Figure 3, 4,
- over-retained deciduous teeth,
- innate teething disorders,
- extensive inflammation accompanying deciduous teeth,
- premature deciduous teeth loss, resulting in changes in the corneous tissue covering the alveolar process and in mesialisation of adjacent teeth,
- ankylosis, reinclusion, lack of space in the dental arch, long eruption pathway, abnormal impacted teeth structure, dilaceration, abnormal tooth bud position,
- injury to the deciduous teeth at an early childhood, resulting in dislocation, deformation of the tooth bud or damage to bone tissue of the alveolar process in the maxilla or the mandible,
- uneven resorption of deciduous teeth,
- fibrous gingival overgrowth,
- premature completion of the tooth root growth,
- iatrogenic causes, e.g. incorrect positioning of orthodontic bands.

As the process of teeth retention is usually peaceful, the most common reason why the patients visit their orthodontist is the disharmony in the aesthetics of the smile – if it concerns the frontal part of the dental arch. Impaction in lateral parts of the dental arch is usually revealed during a routine X-ray.

Retention can lead to serious complications, including resorption of the roots of adjacent teeth, teeth buds cysts, abscesses, inflammation, over-retained deciduous teeth, occlusal disorders, pains, such as trigeminal nerve neuralgia, and even bone fractures [7–9].

The teeth which are most often subjected to retention are the third mandible molars, maxilla canines, third maxilla molars, second maxilla and mandible premolars, central maxilla incisors [6, 10].

Determining the treatment plan depends on many factors: the location and structure of the impacted tooth, the amount of space within the dental arch, any accompanying occlusal disorders and a conscious decision on the side of the patient. The age of the patient is a significant factor – the younger the patient is, the shorter the treatment is; there is also a smaller risk and the accompanying complications are less common [11].

The clinical procedure may include [3, 11]:
- deciduous teeth extraction – if the abnormal tooth bud location is found with a young patient. If there is enough space within the dental arch, observation is recommended for as long as up to 6 months after the procedure. If there is no progress in the treatment, therapeutic procedure should be introduced:
  - surgical-orthodontic procedure;
  - autotransplantation;
  - tooth extraction – if the prognosis is very uncertain or there is a risk of damage to the adjacent teeth. If the tooth causes pain.

Teeth stuck within the bone but not giving any symptoms nor causing any complications should not be extracted. In spite of the use of the most modern methods possible – such as laser, piezosurgery, ceramic milling cutters – the surgeons are afraid of the risk of nerve damage or bone fracture.

Determining the location of the tooth and choosing the method of the procedure are preceded by diagnostic imaging. A pantomography is used at this time as a reference. It is believed that an enlarged, blunt tooth shape and an angular direction of the long axis of the tooth indicates at a palatal location of the tooth, whereas a smaller size, a sharp tooth contour and a vertical direction of the axis suggests a vestibular location of the tooth. Synoptia, that is the location of the impacted tooth in relation to its surrounding structures, can also be inspected at a traditional occlusal X-ray by the use of the effect of parallax [4, 6, 12]. The modification of the X-ray at a 45° angle exposes a gap in the periodontium of the teeth adjacent to the impacted tooth. The most precise examination which dispels all doubts about the location and anatomical structure of the impacted tooth is the CBCT (cone beam CT), which displays all the abnormalities in three dimensions [13, 14].

The treatment of impacted teeth in the anterior segment of dental arch is a long and complex process. Which is why usually fixed appliances are introduced. These enable to recreate the location and parallel arrangement of the teeth roots. In few cases, a Schwarz appliance may be utilized. This concerns young patients until 12 years of age with positively impacted teeth, e.g. central upper incisors impacted as a result of supernumerary teeth. Directing of the teeth into the oral cavity is conducted by the use of elastic traction. However, more mobility of the impacted tooth is observed in this group of patients. In order for a therapeutic success to be achieved, the patients’ co-operation must be very good.

If the amount of space within the dental arch is accurate, and the tooth is stuck in the bone, a surgical procedure is necessary; the examples include [10, 15, 16]:
- gingivectomy – requires cutting out the mucous membrane covering the unerupted tooth (½
The location of the problem determines the beginning of treatment. Some authors suggest that in case of teeth impacted close to the surface level, after the surgical procedure of exposing the tooth crown and removing the bone the occlusion should be left without any further interference to enable the tooth to erupt on its own [19].

However, usually, after the exposure, the surface is etched and a retentive element, such as bracket, a button, or a hook, is attached. Afterwards, the tooth is being directed into the oral cavity with the use of such elastic elements as a chain, a ligature, a wire, segment archwires or additional nickel-titanium elements. Antoszewska claims that the device that is more and more commonly used is TISAD, Temporary Skeletal Anchorage Device, applied with the use of microscrews which are attached to the palate. Directing the impacted teeth into the oral cavity does not result in any unwelcome dislocations within the dental arch nor does it cause the loss of the anchoring, providing the dental health care provider with completely new technical and biomechanical opportunities [20]. The activation of the impacted tooth should begin as soon after the exposure procedure as possible – 2–3 weeks after the procedure at the latest [21]. According to Bishara [3], the force should amount to 20–60 g.

The extrusion of impacted teeth carries a risk of failure.

One of the reasons behind this is ankylosis. At times, synostosis prevents the mobility of the impacted tooth, and can even cause unwanted dislocation of anchorage of the teeth [21].

An auxiliary procedure is the luxation of the tooth and immediate application of extruding force.

In cases when the tooth is located very deep, the availability of the operating field is limited, which may lead to difficulties in attaching the bracket. Other problems include the surface to which the tooth is being attached, teeth rotation and maintaining dryness. The solution to this problem is a well-thought choice of the shape of the basis of the retentive element as well as the choice of the binding material – the best one is a chemically hardening cyanoacrylate material [22].

Sometimes the treatment is hindered by the need to reattach the retentive element or to expose the tooth once again.

A complication related to directing the impacted teeth located vestibularly is the elongation of the clinical crown. According to Dominiak [23], recession after orthodontic-surgical treatment can be successfully treated surgically.

Thanks to the potential of 3D imaging, the fraction of revealed cases of resorption caused by teeth impaction [13, 14]. Also iatrogenic damage to adjacent teeth caused wrong treatment plan has risen significantly [9].

Apart from the cases of third molars impaction, which cause concern for surgeons, the teeth most often affected with impaction are upper canines – the percentage of these cases is as high as 0.9–3.3%. Females are affected twice as often as males [7]. Eight percent of all the patients are affected with bilateral impaction [4]. Currently, two
Diagnosis and Treatment of Impacted Teeth

Major theories are ascribed to the cases of palatal impaction, which comprises 85% of all the cases of impaction [1]. The first of them, the genetic theory, implies that the reason behind the disorder is a genetic defect of the dental lamina [11]. The guidance theory rises from a maleruption of the tooth bud caused by a disparate structure or location of a lateral incisor which determines the eruption pathway. This condition very often accompanies the atrophic icicle-shaped incisors or the agenesia of the lateral incisors [2].

Palatal impaction usually results from the lack of space within the dental arch. As Ericson and Kurol [5] state, in as many as 12% of the cases, what happens is the resorption of the lateral incisor roots, and especially so if they are elongated. There are also cases of full resorption of lateral incisor roots due to the asymptomatic course of the process, which is why a palpation of the alveolar process in kids is so essential. In a child at the age of 9 the canine crowns should be palpable high in the vestibular fornix [4]. What should also put a dental health care provider at guard is an abnormal location of lateral incisors, as their distoinclination may indicate at the canine crowns pressuring at the surface of the roots [12]. Ericson and Kurol [5] show that in 78% of the cases of vestibularly impacted canines, where the crown covered less than a half of the lateral incisor root, after the deciduous tooth was extracted, there was a spontaneous improvement and the eruption pathway normalized. This proves the significance of a care-

Fig. 1. Impacted tooth 21, caused by a supernumerary tooth
Ryc. 1. Zatrzymanie zęba 21 z powodu zęba nadliczbowego

Fig. 2. Cyst in the area of tooth 55 causing the displacement of the bud of the tooth 15
Ryc. 2. Torbiel w okolicy zęba 55 powodująca przemieszczenie zawiązka zęba 15

Fig. 3, 4. CAT scan revealing the cause of the impaction of tooth 21
Ryc. 3, 4. Skan z tomografii komputerowej ujawniający przyczynę zatrzymania zęba 21

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Ryc. 3, 4. Skan z tomografii komputerowej ujawniający przyczynę zatrzymania zęba 21
ful preparation of the treatment process and placement of the directions of the orthodontic forces in a safe distance from the surrounding teeth.

**Case Reports**

**Case 1**

More and more adult patients arrive at a dentist’s surgery to improve their smile aesthetics. That was also the case of the patient named A.C. age 35. She came for appointment to the doctor because she was dissatisfied with the way her dentition looked. During the examination, the dentist discovered an over-retained tooth 63 (Figure 5, 6). The pantomography revealed palatally impacted tooth 23 positioned medially according to Mlosek’s classification [8], in 2nd stage of impaction according to Ericson and Kurol. The treatment began with applying an archwire and a TPa appliance in order to create enough space within the dental arch. The transpalatal arch was used to achieve the distalization of the canine so as to avoid the resorption of the roots of the adjacent teeth. The tooth was exposed through the use of the tunnel technique, and a bracket with a gold chain was applied. After the space within the dental arch had been recreated, the canine was relocated vestibularly, elongated and located axially. The result of the treatment is shown in Figure 7, 8.

**Case 2**

Supernumerary teeth, odontomas or injuries result in impaction of maxillary central incisors. The frequency of that situation amounts to 0.06–0.2% [6].

The patient named A.Z. reported to the dentist at the age of 11 because of the tooth 21 missing from the dental arch (Figure 9). Patient history revealed that the girl sustained an injury to her deciduous dentition, which resulted in crowding and damaging of the root of the tooth 21. After an analysis of the X-rays and a clinical examination, a decision was made to expose the crown of the tooth and attach a bracket with a metal ligature. The exposure procedure was conducted with the use of the tunnel technique, which created the most physiological eruption pathway, ensuring proper condition of the periodontium of the extruded tooth. An archwire was introduced to recreate the space and direct the impacted teeth into the oral cavity. The result after 18 months of the treatment is visible in Figure 10.

**Case 3**

The third most common location of impacted teeth is the area of mandibular second premolars. The patient named M.R. reported to the dentist at the age of 14 because of the tooth 45 missing from the dental arch. An analysis of the X-ray revealed the presence of the 45 impacted tooth at the lingual side of the mandibular alveolar process...
In order to expose the tooth, the Dominik fenestration procedure was conducted, and a bracket was attached to the vestibular surface of tooth 45, which was attached to the dental arch with an elastic wire. After 24 months of treatment, the dental arches were completely reordered (Figures 13, 14).

Conclusions

In orthodontic practice, the problem of teeth retention affects most of all upper canines, lower second premolars and maxillary central incisors. In all the cases presented above, orthodontic-surgical co-operation was essential. Archwires were applied to recreate space and reorder the teeth.
The surgeon conducted the procedure of exposing the impacted tooth. In order to maintain the best possible condition of the periodontium, the most commonly chosen technique was the tunnel technique. However, the choice of the technique depended also on the location and clinical conditions. In all the case studies depicted above, the surgical-orthodontic co-operation enabled re-ordering of the dental arches, eliminating existing occlusal disorders and directing the impacted tooth into the dental arch. Functional and aesthetic occlusal norm was successfully recreated.
References


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