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Master's Thesis

Tooth Extraction Techniques and Analysis of Complications

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Abstract

Tooth extraction is one of the most commonly performed surgical procedures worldwide and can be one of the simplest procedures as well as one of the most technically challenging. It also profoundly affects oral health status and often requires restorative procedures to replace the missing tooth. Tooth extraction uses a fundamental concept from the basic principles of physics, mechanics, and surgery. Every tooth extraction procedure can be subjected to difficulties, and the different tooth extraction techniques also incorporate individual risks. According to this, a literature search was performed to identify articles published in German and English using the following keywords: “surgical extraction”, “simple extraction”, and “complications”. Excluded were studies with patients with systemic diseases or a correlation with medication intake for the complications. Tooth extraction complications can occur intraoperatively or develop during the postoperative period. The survey showed intraoperative problems may include tuberosity fracture, nerve damage, or displacement of teeth into adjacent spaces. Postoperative problems include swelling, pain, trismus, prolonged bleeding, dry socket, infection, and sensory alterations of different nerves. The thesis emphasizes the risks of varying tooth extraction techniques for the prevalence of complications. Results of the study showed that surgical extraction with root separations had the most difficulties. Finally, the current strategies to reduce the incidence of tooth extraction complications are also presented.

Keywords:

tooth extraction; third molar; intraoperative complications; postoperative complications

CONTENT LIST

Abbreviations

1.	*N. alveolaris inferior*	Nervus alveolaris inferior
2.	*N. lingualis*	Nervus lingualis
3.	*N. mentalis*	Nervus mentalis
4.	NaCl	Natrium chloride solution
5.	CT	Computer tomography
6.	DOAKS	Direct oral anticoagulants
7.	MR sequences	Magnetic resonance sequences
8.	*N. suralis*	Nervus suralis
9.	CBCT	Cone beam computer tomography
10.	cm	Centimeter

1. INTRODUCTION

Problem statement

Tooth extraction is a daily procedure in the dental office. The dentists remove the teeth using conventional methods without thinking such a procedure poses risks and complications. This showed the articles and studies viewed during the search. Usually, the extraction technique is always done with the same routine method, and the dentists should have adapted the extraction technique to different cases. Before each extraction, it is crucial to consider the contributing risks and complications that can occur with each extraction technique (1). Also, the different extraction techniques have individual risks that the practitioner needs to be aware of. This is why dentists and oral surgeons should know which extraction technique leads to the most complications and when to use which extraction technique. Nevertheless, excellent communication with the family doctor is also necessary to avoid provoking complications because of medication intake or systemic diseases of the patient (2).

Aim of the thesis

The thesis aimed to analyze the prevalence of complications according to the chosen extraction technique.

Objectives

[1] To clarify the techniques of simple and surgical tooth extraction procedures

[2] To select the intra- and postoperative complications according to the different extraction techniques

[3] To identify the surgical work aspects that could reduce the occurrence of tooth extraction complications

Literature search strategy.

The study material was primarily collected from scientific articles and reviews. The literature search strategy included searches in the following databases: PubMed, Scopus and ScienceDirect. The included studies were retrospective, literature review, and systemic review. The last search to collect data was done in April 2023. The search is based on the relevant studies written in German and English. The number of managed sources is 116.

Content and scope

The thesis consists of an abstract, keywords, problem statement, literature search methods, history part, an explanation of simple and surgical tooth extraction, open and flapless extraction, post-surgical and intraoperative complications with a discussion of their most prone extraction technique, two included tables, conclusion, abbreviations and references. Finally, the work is accompanied in the attachment by a personal statement that deals with my internship in a dental hospital in Tanzania.

1.1. Overview

Tooth extraction was the earliest dental procedure in human history. The forceps stand as a symbol of tooth extraction until today. The procedure was complex and riskier for the patients in these early years (3). There were variations in dental practices during the heights of the Ancient Indian, Persian, and Chinese empires. Direct strikes to the crown or using a chisel of wood during tooth extraction caused the tooth to fracture (4). Tooth extraction aims to tear entire periodontal ligament structures (5). Dentists frequently view tooth extraction as a routine surgery that can occasionally have significant consequences. One of the biggest reasons for issues during the surgical operation is a lack of experience. The perfect extraction is when the tooth or dental root is completely removed without discomfort and with the least amount of tissue damage possible. Depending on the parameters involved, the extraction process might be simple or complicated (6). The severity of mandibular and maxillary teeth extraction depends on the tooth anatomy, the tooth's condition, the bone cortex's thickness compared to the proximity to the lower tooth canal, the need for a flap, osteotomy and the degree of impaction (7).

Regarding tooth extraction, a distinction is made between simple and complex procedures. The classic technique of extracting teeth with forceps and elevators can be described as simple. The success of the classical technique depends on the extension of the alveolar process, the rupture of the alveolar ligament, and the separation of the epithelial attachment (6). Extractions that cannot be done with the conventional method of forceps and elevators and need a surgical procedure involving flap lifting, osteotomy, or odontosection are called surgical tooth extractions. They also include multiple extractions that require the application of unique methods (8). It is helpful to utilize mouthwashes, such as 0.12% chlorhexidine formulations, after the anesthetic approach and procedure to reduce the risk of postoperative complications (9). The maxillary teeth are given local anesthetic using infiltrating procedures. It is done on the front teeth back to the premolars in the case of the lower jaw teeth. The epithelial insert is detached from the tooth to be extracted, and the tooth is totally encapsulated (10). Regardless of the technique, a surgeon's overall objective is to treat the patient as effectively as possible while causing the least harm to the tissues and structures involved. The subsequent thesis details the possible tooth extraction techniques and the potential difficulties that may occur during and after the procedure.

2. SIMPLE TOOTH EXTRACTION

2.1 Indications

The indication for removing one or more teeth is made after considering the anamnesis and the clinical and radiological findings. It includes deeply carious or severely destroyed teeth as well as persistent complaints. In addition, pathological processes in teeth with endodontic treatment, especially in the event of failure after a root tip resection, are more prone to extraction (11,12). In the case of advanced marginal periodontitis (e.g., teeth with a high degree of loosening or exposed furcation), orthodontic indications (e.g., crowded teeth), hyperdontia, or teeth that cannot be preserved after tooth trauma (e.g., longitudinal fracture) are clear indications for tooth extraction. A tooth extraction should also be considered in focus rehabilitation before immunosuppression, radiotherapy, chemotherapy, and antiresorptive drugs (7,13). In the retrospective study of Fathima et al., in which records of 86.000 patients were analyzed from January 2021 to April 2021, the reasons for tooth extraction and their percentage were determined by how often they appeared in the tested patients (Table 1). A little over 33% of patients had extractions using forceps, 33% using an elevator, and 34% using both. Approximately 23% had their molars extracted, 21% had their premolars extracted, 24% had their canines removed, and 32% had their incisors extracted (14).

Prevalences of simple tooth extraction reasons	Prevalence in percentage
Decayed tooth	33 %
Root canal failure	33 %
Malpositioned tooth	34 %

Table 1: Most prevalent reasons for tooth extraction (14)

2.2. Contraindications

2.2.1. Systemic contraindications

Systemic contraindications are significant in the field of tooth extraction and the field of dentistry because they are often connected to medical problems. Communication between the family doctor and the dentist is vital to achieving a good result for patients with systemic diseases during and after tooth extraction procedures. A contraindication to tooth extraction is the presence of neurologically challenged patients, especially those with movement or cognitive deficits. Blood clotting abnormalities, which increase the risk of bleeding before or after tooth extraction, can be caused by several neurological illnesses, such as stroke (15). Cardiovascular-compromised patients (e.g., patients with hypertension or cardiomyopathy) are more likely to have complications during a tooth extraction (16). Liver disease like cirrhosis also often results

in a higher likelihood of bleeding in the patient (17). Patients with kidney diseases like uremia or glomerulonephritis bring similar complications to patients with cardiovascular compromised and patients with pulmonary disease (18–21).

2.2.2. Local contraindications

Patients generally require extraction when a tooth is associated with a cancerous growth. The tooth is typically mobile due to the periodontal tissues' degradation brought on by the underlying disease process. Such teeth should not be extracted because doing so could enable malignant cells to be deposited into the capillaries, encouraging the tumor's distant spread. There is a substantial danger of catastrophic hemorrhage while removing a tooth with vascular lesions, such as hemangiomas, aneurysms, arteriovenous malformations, etc. As a result, such extractions must be carried out under strict supervision while the pathology is being managed. Osteoradionecrosis is a serious risk when removing a tooth from an irradiated jaw since it is highly avascular. But after getting radiation therapy, such a tooth can be extracted (7,20,22).

2.3. Specific risks in tooth extractions

Injuries to the surrounding soft tissue, fractures of the crown and roots of the bones, fractures of the bony lamellae, and tube fractures are some of the specific dangers. Other risks associated with tooth extractions include the opening of the maxillary sinus, harm to nearby teeth that are already weak (such as those that have fillings, partial crowns, or are periodontally diseased), thermal injury from rotating instruments, and dislocation of teeth or root remnants in nearby structures (such as the maxillary sinus, soft tissue, or recesses). In addition, some specific hazards include dislocation of the temporomandibular joint and aspiration or swallowing of a tooth or tooth pieces. There is also a chance that the local anesthetic will cause nerve injury *(n. alveolaris inferior/ n. lingualis*) (23–25).

2.4. Clinical procedure for tooth extractions

At the beginning of the tooth extraction, the periodontal fibers are first loosened with an elevator after the local anesthesia's impact is assessed. The fibers are forcibly severed with a knife for a tissue-saving excision (such as during a tooth transplant). Elevators of increasing size are used to mobilize the tooth inside the alveolus. A finger from the opposite hand is used to prevent sliding as the elevator is advanced into the periodontal space as deeply as feasible in the longitudinal direction of the tooth (26). The elevator should rotate with gentle, controlled force after making bone contact with the alveolar limbus. The tooth starts to loosen due to the elastic bone wall of the alveolus being stretched. The elevator can frequently be used to luxate and remove wisdom teeth. Suppose forceps are needed to mobilize the tooth during extraction. In that case, the right forceps are chosen and applied along the root's longitudinal axis, with the

forceps' elements inserted as low as practicable below the cementoenamel junction (27). Controlled tilting and rotating motions are performed with calculated effort. The alveolus is enlarged by the tilting movements, which cut through the periodontal fibers. In general, teeth with round roots (upper front teeth, upper canines, lower premolars) are rotated, at least initially, whereas teeth with oval or many roots (upper premolars, upper molars, lower front teeth, lower canines, lower molars) are tilted from oral to vestibular. Depending on the bone resistance, controlled and combined luxating movements are advised. Moreover, a slight pull is exerted toward the root's longitudinal axis (7). According to the literature, rotational movements are typically used to remove upper anterior and canine teeth. Premolars in the mandible are first made loose by rotational movements, then largely tilted lingually and buccally to achieve an atraumatic extraction procedure (7). Maxillary molars with strongly divergent roots are isolated using a surgical drill while cooled by water and removed one at a time (28). After the serial or multiple teeth removal, the alveolar walls must be delicately smoothed out to prevent sharp bone edges that could subsequently perforate the mucosa if a prosthesis was put under mechanical stress. The literature showed that single-button sutures are used to adjust the wound margins and close the wound region. Offset papillae sutures are used to repair irregular mucosal edges (7).

2.5. Postoperative Controls and Benefits of new techniques

The movements and materials which are usually used in the conventional extraction techniques can be changed and done in a modified way as well. With the modifications, the literature showed decreased postoperative complications and better wound healing. The viewed articles and studies discuss the usage of physics forceps and periotomes. The mechanical advantage of the physics forceps is to extract teeth with less force. This benefit reduces root or alveolar bone fractures and aids in maintaining the nearby bone. It uses a first-rate lever action by delivering constant pressure that gradually raises the root from the socket. The bumper is placed in the extracted tooth's buccal vestibule area, and the thin beak is attached to the lingual side of the tooth. The soft-covered bumper serves as a center of rotation for the instrument used to gently extract the tooth from the socket in a very atraumatic way (29). The soft and hard tissues of the tooth, as well as the alveolar bone plates, can be also preserved during extraction by using a periotome. The literature indicates that the periotome provides a more non-traumatic extraction process and lowers the chances of alveolar bone fractures and apical third root fractures. This is because the practitioner can efficiently cut the periodontal ligament fibers without damaging the alveolar socket (30). Another newly developed technique to extract teeth is the method of surgical extrusion. The technique which the literature presents uses a vertical extraction

technique. It is possible to perform an extraction without stretching the alveolar bone by axial traction along the long axis of the root. The advantage of using this unique technique is that the surrounding hard and soft tissue is protected. The optimal environment ensures that alveolar bone loss is reduced. A trephine drill is used to determine the root axis and remove the present root canal filling material. It is advisable to use the diamond drill bit both in the center and the root fragment's axis. The diamond portion of the drill should be between 5 and 7 mm in the hard tissue. Depending on the case, the extraction screw is inserted with the insertion aid and the extractor is attached to the surrounding teeth. To ensure a clear view of the extraction screw, the opening of the round, rotatable segment plate is directed towards the vestibular side. The extractor must be positioned so the rope and the screw can reach the same axial direction. The pull rope is hooked onto the extraction screw, placed over the pulley, and then hooked into the holder of the extraction carriage. The extractor is directed in the correct position with a slight pull by turning the hand screw. This guarantees that the rope is in tension. The remaining periodontal fibers break after one to three minutes and the root detaches from the socket (31–33). Regardless of the method or technique by which the tooth was extracted, a wound check needs to be performed after one week. Any suture material is removed, and the wound is cleansed and disinfected. The sutures aren't taken out of a primary wound closure until 7 to 10 days have passed. Further examinations must be performed based on the wound and the patient's state (34).

3. SURGICAL TOOTH EXTRACTIONS

3.1. Indications

When a tooth cannot be extracted with forceps or an elevator, it may be necessary to remove it surgically. It can happen when a tooth is impacted, misplaced, or both (35). They are typically teeth with ankylosed roots that fracture when the crown is attempted to be removed or, more generally, persistent residual roots (36). If a multi-rooted tooth is removed with diverging roots as gently as possible, especially in the region of the upper first molars, surgical tooth removal may also be necessary (37).

3.2. Contraindications

When patients are no longer operable due to their overall health, absolute contraindications typically result from the patient's medical history (chemotherapy, end-stage tumors, etc.). For instance, a transitory contraindication might be a temporary triple anticoagulant regimen that will soon be altered to dual or monotherapy (7). Acute (apical or pericoronal) infections are also a temporary contraindication since the surgery might not obtain a deep enough anesthetic

level. In these situations, inflammatory processes should be made chronic before surgical tooth extraction using disinfecting rinses, mechanical cleaning, or drainage (38).

3.3. Specific risks

Since surgical tooth removal always also necessitates an (intra-alveolar) osteotomy, whereby neighboring structures like the *n. alveolaris inferior*, the n. *mentalis* or the maxillary sinus mucosa may be injured, and specific risks arise from the general anamnesis (underlying diseases and medications) and the local anatomy. Depending on the severity of the ankylosis, there may also be heat development at the drill tip from a lack of irrigation, leading to heat necrosis (39). Thus, surgical tooth extraction is substantially more likely to result in postoperative complications such as wound healing issues (osteitis), which mainly affect the lower jaw, compared to non-surgical tooth extraction. In addition, the osteotomy must be expected to increase the risk of bleeding.

3.4. Local anesthesia

Both surgical and non-surgical tooth removal use the same local anesthetic. For the lower jaw, block anesthesia and buccal infiltration are frequently employed (40). During buccal infiltration of the upper jaw, anesthesia is given to the more prominent palatal or nasopalatine nerve. Ideally, the local anesthetic should contain a vasoconstrictor for suitably prolonged anesthesia and somewhat reduce intraoperative hemorrhage (41). Upper canines with extremely high offsets are situated in an unusual place. The root tips may extend posteriorly into the maxillary sinus or cranially to the nasal floor. In this case, buccal and palatal local anesthetic alone won't be sufficient to deliver enough local anesthetic depth, necessitating the pre-planning of either further intranasal anesthesia or possibly intubation anesthesia (42).

3.5. Clinical procedure step by step

3.5.1. Intraalveolar osteotomy of single-rooted teeth

Several textbooks have previously discussed tooth extraction with surgery, typically by creating a vestibular mucoperiosteal flap and osteotomized the buccal bone wall. There might be several patterns of absorption. Because of its shape, the buccal wall is frequently susceptible to resorption processes (43). With very few exceptions, the creation of a flap and osteotomies of the buccal wall might truly be regarded as outmoded procedures today (e.g., in the area of a lower or upper second molar with poor visibility and otherwise restricted access to a deeply retained, fractured root tip). Modern intraalveolar osteotomies aim to remove roots without creating a mucoperiosteal flap with the preserved buccal bone. Targeted root separation combined with a minimum osteotomy of the alveolar bone is intended to allow elevators to move a root. The crown is first taken off at the gingival level to reveal the root. Here, a diamond

drill or a Lindemann milling machine can be used. A Lindemann bur should be utilized when osteotomies are formed in the bone because its speed is slower than with diamond-coated burs. Therefore, preventing wound healing issues can benefit from using sterile, isotonic saline solution (44). The root gets split into two pieces after the crown is taken off. Splitting the root into a mesial and a distal half in a bucco-oral direction is advised. After that, an elevator can divide the root. The highly delicate buccal wall can be better preserved because of the bucco-oral separation, preventing force from being applied. If a portion of the root has been mobilized and removed, the opposing side will undergo an (intra-alveolar) osteotomy to make space between the remaining root and socket. The elevator is then utilized to lift the root through this gap. The osteotomy must be made wider and the opposing bone surrounding the root may need to be further weakened if the root does not shift. The postoperative complication rates will be lower. The postoperative recovery will be better if less bone is osteotomized (45).

3.5.2. Intraalveolar osteotomy of multirooted teeth

It is crucial to surgically remove the tooth while minimizing damage to the buccal alveolar wall and avoiding the formation of a mucoperiosteal flap. Diverging roots, which have a V-shaped structure, are more common in the first upper molar region. Forceps should not be used without separating the roots when extracting such teeth, which may cause more significant bone defects. The crown should be removed initially using a diamond drill or a Lindemann cutter, just like single-rooted teeth. Depending on their number and direction, the roots can then be separated from each other. The elevator can be used to mobilize each root, aiming to preserve the buccal wall completely (46). After removing the crown, the roots are usually split in the bucco-oral direction. Diamond-tipped drills should only be used on the tooth, as they can cause issues with wound healing if used for osteotomy with fast-rotating contra-angle handpieces without a sterile saline solution (47). To perform osteotomies in the bone area with sterile isotonic saline solution, using slowly rotating instruments or ultrasonic attachments, such as piezo surgery, is best (44). Once the two roots have been separated, it is essential to attempt to remove one to make room for the mobilization of the other root. If one of the roots is immobile, it should be divided again, and another osteotomy may be necessary. In addition to elevators, finer osteotomies, including specific root lifters, can be used (7).

4. SURGICAL TOOTH EXTRACTIONS IN IMPACTED TEETH

In contrast to the intraalveolar osteotomy, impacted and misplaced teeth require a mucoperiosteal flap, which cannot be prevented. The incision should be selected so the flap may be enlarged. It allows adequate visibility and ensures that the borders of the wound do not cover the osteotomy defect (48). The open flap technique describes an operation where

mucoperiosteal tissue is detached from the bone to generate better excess and visibility to the underlying bone structure (49). Different types of flaps can be performed. The pedicle flap requires an incision measured about 1 cm to be made to the third molar that curls towards the buccal sulcus and then extends about another 1 cm. There is also the triangular flap and the modified triangular flap. The modified triangular flap consists of two parts: a relieving incision from the ramus to the distobuccal aspect of the second molar, and an incision from the distobuccal edge of the second molar, getting at a little oblique angle and curving forward into the mandibular vestibule. The only difference between the triangle and modified triangular flap is the buccal oblique incision's forward curvature. Next is the envelope flap, which consists of a sulcular incision from the first to the second molar and a distal relieving incision along the external oblique ridge to the ramus. Compared to the original envelope design, the modified envelope flap has the incision end at the mesial aspect of the second molar (8). According to the reviewed literature, complications' prevalence differs with each flap technique. The systematic review by Bailey et al. analyzed the different outcomes, such as triangular and envelope flaps, and their complications. The study results showed that the envelope flap had better outcomes concerning trismus. The study results favored the short triangular flap according to the pain intensity. Still, the literature has no sufficient evidence to prove that a specific flap technique is the best to reduce the risks of complications (8). Each different flap method has its advantages and disadvantages. Compared to other extraction methods, they may increase the prevalence of postoperative complications like swelling, pain, trismus and periodontal disease in the retromandibular area (50). A flapless tooth extraction procedure causes less crestal bone reduction than an open flap extraction technique. Additionally, flapless extraction diminishes the disruption of the periosteum; therefore, the blood supply of the buccal plate is better maintained. The flap procedure with relaxation incision is most often used in soft tissue closure, but the blood supply will be disrupted with this kind of procedure. Different retrospective clinical studies where patients underwent open flap and flapless surgical extraction of an impacted third molar show that the patients had better outcome results with the flapless surgical extraction. The patients were observed and evaluated for pain, edema, attached gingiva, and pocket probing depth recovery (50–52). Another highly discussed topic is the preservation of buccal bone. Losing bone structure is also an indication of increased complications. In the literature, different methods of bone removal are explained, for example, piezoelectric or ultrasound bone removal. Piezoelectric bone removal showed reduced pain 24 hours after the operation compared to the conventional method with rotary bur removal. Furthermore, the swelling after 7 days was reduced with ultrasound bone removal. It can be

summarized from the study that most of the complications that appeared do not show sufficient evidence to determine one bone removal technique as the best (8). Even when avoiding the extraction with the flap's opening, the treating doctor usually needs to reduce at least the bone to see the formation of the roots before sectioning the tooth. An article in the British Dental Journal shows an alternative to this procedure. A more conservative approach is used to locate the roots' position. Therefore, the pulp chamber of the tooth was opened, and with the location of the root canals, the position of the roots was determined. After this, the surgeon could place the buccolingual cut with a fissure bur to section the tooth without reducing the bone (53). Following the conventional methods after creating a mucoperiosteal flap, the crown should be exposed with a ball or Lindemann burs under irrigation with sterile isotonic saline solution up to the greatest circumference. Following the osteotomy, an initial mobilization is performed to see whether the tooth can be moved in principle or to gain a sense of how much ankylosing has already occurred. Decapitation occurs next in the region of the enamel-cementum border after the initial mobilization using an elevator (54). This makes room and gives an excellent overview. The Lindemann milling machine separates the root or one of its components before mobilizing it. The elevator can then break the root and the mobile piece can be extracted using tweezers or residual root forceps. The root can then be moved into the resulting area using an elevator. For the elevator to be able to move, a tiny osteotomy may need to be performed beforehand between the root and the bone that is directly next (55). With precise rotations, the root can be pushed into the position of least resistance. The more ankylosed the tooth is, the deeper separation and osteotomy should be performed around a root. The complete removal of the root should be verified. Particularly in the event of more significant abnormalities, the surgical region might be filled with collagen fleece after curettage and cleaning (56). The soft tissue is stabilized and kept from collapsing in addition to the coagulum, particularly on the palate of retained canines. A bandage plate is used to cover the wound and protect it for the first several days, especially when eating. It can also be used as a dressing plate for individuals taking anticoagulants (56).

5. COMPLICATIONS OF TOOTH EXTRACTION

A successful outcome is achieved when the presenting symptoms and signs of the disease associated with the tooth have been eliminated and the tissues have fully healed with no residual functional deficit. During healing, it is normal for the patient to experience discomfort, swelling, or trismus over the first three postoperative days (57). Symptoms should gradually resolve over the next two weeks. According to the literature, patients, especially women, felt pain following basic, straightforward tooth extractions to the greatest extent in the evening after

the procedure. More than 50% of patients took analgesic medications. Therefore, in the first week following a tooth extraction, it is advised to administer regular analgesic medications (57). Also, hematoma and ecchymosis are of mild severity and quite common, so the patient should not be afraid of them. Usually, it is treated with ice packs for 30 minutes per hour for the first 24 hours after surgery, followed by intermittent hot moist packs. The patient should also be informed that the discoloration is from the accumulated red blood cells and that they disappear after their breakdown (58). Complications are classified according to the stage of the surgical process or the developmental time in which they occur, as follows: Indirect or postoperative consequences happen hours or days after the surgery. In contrast, immediate or intraoperative complications happen during the procedure and may impact soft or hard structures. The etiology is varied and frequently caused by associated factors, such as surgical technique, dental conditions, or diseases (59).

6. INTRAOPERATIVE COMPLICATIONS

6.1. Fracture of the alveolar bone

During a tooth extraction, alveolar bone fractures can appear, and they typically only affect the extraction socket, especially on the vestibular side. A preventable misshape frequently causes teeth to be torn or dislocated (60). As a result, alveolar bone fragments connected to the root may be visible when examining the extracted tooth. Often, this is caused by pathologic alterations in the bone itself, accidental trapping of the alveolar bone between the forceps' jaws, the arrangement of the roots, or the alveolus morphology (61). The damaged alveolar bone may separate from the periosteum or retain some attachment. The alveolar fragment can be left in place and fastened with sutures through the gingival borders of the extraction site because it is well lodged in the periosteum, thus preventing the development of irregular defects in the alveolar ridge (62). However, the bone fragment should be removed if it has lost more than 50% of its periosteal connection. It is not likely to survive without a blood supply, and keeping it in place could result in postoperative infection problems. Nevertheless, this procedure results in a sizable bone loss or an irregularity in the alveolar ridge's size, which makes it difficult to install a solid and balanced prosthesis afterward. Several methods, including alveolar osteogenic distraction and autogenous bone grafts, can resolve this condition (62,63). If there are still sharp bone edges inside the alveolar bone, the alveolus should be regulated using a standard motor drill. To thoroughly clean the surgical field, the region should also be irrigated with sterile distilled water or physiological saline (44). Hence, a complete alveolar revision must be carried out regardless of indications of an alveolar fracture after every tooth extraction. The vestibular and lingual/palatal cortex can be felt with the fingers to check for any bone chips

that have come loose. It is crucial to remember that the forceps should never enter the alveolar bone and should always rest on the tooth as far apically as possible. Otherwise, the alveolar bone may accidentally break (61). Usually, lower wisdom tooth extraction causes damage to the inner cortex. Although the lingual nerve is present here and can be affected by trauma, infection, or subsequent osteitis (64). Bone loss can happen due to surgical trauma or the characteristics of the extracted tooth (65). Using resorbable membranes, autologous bone, or biomaterials encourages bone regeneration. Tissue regeneration procedures can be applied, such as porous hydroxyapatite or demineralized cortical powder (66,67).

6.2. Tuberosity fracture

If elevators or forceps are misused while extracting a second or third upper molar, the maxillary tuberosity may fracture. Antral invasion of the tubercle, which frequently occurs with a solitary upper molar, may cause this problem. Particularly if the tooth has diverged roots, is hypercemented, or has excessive eruptions (68). A rare predisposing cause is a pathologic gemination between the upper second molar and the erupted or semi-erupted third molar (69). Forceps or elevator extraction must be stopped if a fracture is accompanied by substantial bleeding. Then a large vestibular mucoperiosteal flap must be constructed. A blunt dissection is used to release the soft tissue and shattered tubercle. After that, suturing is required, and the stitches can be removed (68). If the fragment is significant in size, it should be secured with sutures, splints, or palatal plates. Little fragments without periosteum should be removed since they have lost their irrigation. Without it, the bone will behave as a sequestrum and promote infection (70). Tuberosity fractures are rarely encountered when extracting upper molars. Tuberosity fractures were shown to account for 0.15% of the complications in a study that compared the frequency of complications following 8455 simple tooth extractions. The tuberosity fracture and oroantral communication within the maxilla were the most frequent complications in a retrospective study that analyzed pre- and postoperative complications related to third molar extraction, as opposed to only 0.08% of the tuberosity fracture in a similar study (71). According to the study of Bertram et al., 0.6% of simple extractions alone result in maxillary tuberosity fractures. When a bone is broken and detached from its periosteum, fragile veins near the posterior maxilla and tuberosity are easily ruptured (72).

6.3. Nerve complications

It is uncommon for oral surgery to cause nerve lesions. If they do, they generally impact the *n. lingualis* or the *n. alveolaris inferior* (73). Individual axons, which are made up of bundles of several individual nerve fibers, make up the two nerves. The endoneurium, perineurium, and epineurium are covered and shielded by a myelin sheath. Four distinct types of damage can be

identified when the nerve is mechanically harmed, such as surgical maneuvers, for example, retraction of the lingual flap, vertical tooth sectioning or surgeon experience (74). Complete nerve severance is referred to as neurotmesis. The division of an axon into the endo-, peri-, and epineurium is known as partial neurotmesis. There are still other undamaged axons (75). "Axonotmesis" refers to an axon with minor damage; the myelin sheath is unharmed. The individual axon is still present in neurapraxia, but there is a disruption in the transmission of stimuli (76). Different sensory and gustatory impairments depend on the type of damage. Depending on the extent of the damage, paresthesia, hypesthesia, or, in the case of total transection, anesthesia may manifest in the region of the inferior alveolar nerve (77). Dysgeusia is the term used to describe gustatory impairment in the region where the lingual nerve spreads. Patients who have had lingual nerve injuries describe sensory impairments. It causes a taste disruption in the anterior and middle thirds of the tongue on the affected side and numbness and foreign body sensation (78). With the use of a pointed cannula, the nociceptive feeling in the affected areas can be assessed. Gustatory sweet, salty, sour, bitter, and glutamate measurements are taken using specialized solutions (such as glucose). A lateral comparison should be used for all *n. lingualis* measurements (79). CBCT imaging diagnostics are required in such circumstances. The *n. lingualis* should be visualized using specific MR sequences, which typically reveal the nerve up to the level of the wisdom teeth. Anesthesia-induced surgical exploration is advised if a continuous transection is suspected (80). For example, a nerve end co-adaptation, an interposition utilizing, an *n. suralis* transplant, or an interposition using allogeneic donor nerves, are all treatment possibilities if the continuity is destroyed (81). After ten to twelve weeks, the choice to have surgery must be made. Early alterations show better outcomes than late reconstructions (81). Making a choice is more challenging when there is hypoesthesia or dysgeusia. Early detection of such damage allows for initiating a four-day corticosteroid antiedematous therapy. It is first advisable to wait for spontaneous regeneration in cases of neurapraxia and axonotmesis. If there is no improvement after 12 weeks at the latest, it should be decided if further treatment options should be pursued. Regular follow-up inspections are crucial in any situation. The type of injury, as well as the timing and nature of nerve reconstruction in the case of a revision, significantly impacted the prognosis. Research on nerve repairs shows that early repairs (12 weeks) had better results (80). A literature review by Sarikov et al. showed that the prevalence of inferior alveolar nerve damage after wisdom tooth removal was between 0.35 and 8.4%. It also needs to be mentioned that there was no case of permanent damage to the nerve. Included in the literature review were 14 different studies with a total patient test number of 18508 (82). Another systematic review by Lee et al. examined

the prevalence of lingual nerve damage after surgical extraction of the wisdom tooth with lingual flap retraction and found that 4,8% of cases result in permanent lingual nerve damage. For the permanent *n. lingualis* damage the incidence was very low (between 0.04-0.6%) (83).

6.4. Vascular complications

Blood vessels can be damaged or ruptured during surgery, resulting in bleeding (84). In addition, hyperemia of the oral tissue brought on by inflammation might worsen bleeding. The bleeding, brought on by tissue hyperemia, typically stops when the afflicted area is compressed locally (85). If a vascular lesion occurs, the affected blood vessel must be found and tied off using hemostatic forceps and silk or polyglycolic acid thread. The surgical area can be cleaned with sterile saline solution to ensure proper localization, and the bleeding vessel can be located with the proper suction technique. If bleeding occurs from the alveolar bone, absorbable hemostatic gauze is used as a tamponade (collagen, gelatin, fibrin, etc.). The practitioner must perform atraumatic methods and apply a suture, drawing the borders of the wound closer together to prevent bleeding. The mattress stitch is the one that is most frequently advised. To establish compression of the surgical site, the patient should be told to bite down on sterile gauze for 20 to 30 minutes (85,86). After having a tooth extracted, the patient shouldn't rinse for 12 to 24 hours because doing so could cause the clot that has developed in the socket to move. The patient should always be informed of this warning because it is one of the most typical reasons for bleeding following an extraction (86).

6.5. Breakage of the instrument

It is possible to break a piece of dental extraction equipment, despite how challenging it may seem. This is typically caused using inadequate materials or excessive force. For instance, spoon handles can crack, drill bits are severely worn, or the instruments, like certain elevators, are overly thin (87). This instrument fragment, typically found in the alveolus or in the surrounding tissue in this kind of misshape, should be taken out simultaneously (88). If not, another surgical treatment must be arranged to remove the foreign body because it frequently causes many problems. In the study of Kuncai Li et al., the incidence of breakage and displacement of a high-speed handpiece bur in surgical tooth extraction was around 0.06%. The study concluded with three main factors to avoid drill displacement. The number of times the bur is used, its integrity, and general condition should be closely examined to prevent fracture of the high-speed handpiece bur. Additionally, slight pressure and lateral force should be applied, especially during surgical tooth extraction with sectioning, the risk of fracture is increased. Furthermore, overheating of the bone and the handpiece must be avoided. To prevent significant effects, the retrieval technique should be decided upon based on the imaging

findings and carried out as quickly as possible if bur breakage and displacement occur. When impacted mandibular third molars are extracted, the two tools most often utilized for tooth sectioning by high-speed dental handpieces are surgical fissure burs and diamond burs. The surgical precision bur, which is constructed of tungsten carbide, has a substantially longer length (up to 28mm) and a comparatively small and narrow working area (about 1mm) compared to the diamond bur. These qualities prevent harm to the adjacent tooth and soft tissue. However, they increase the bur's susceptibility to breaking (89).

6.6. Perforation of the maxillary sinus

The maxillary sinus floor may be accidentally or traumatically perforated. When teeth are extracted, an oroantral connection may form because the roots of the teeth, usually the molars and upper premolars, are anatomically close to the maxillary sinus (90). Traumatic perforations are those provoked with an elevator while luxating a root or with a spoon while performing premature curettage (91).Observing tooth displacement into the maxillary sinus after extraction procedures is unusual. These misplaced teeth should be removed even in asymptomatic cases to prevent the onset of sinus pathology (90). If the connection is not very large, it is sometimes not visible because the blood clot can block the tiny perforations. In other cases, an established communication may be found because the patient's nose is watering while rinsing (92). In this case, the sinus perforation is usually significant. When there is an oroantral communication, the treating doctor must act immediately and not attempt to do excessive testing on the patient to confirm the diagnosis, as these only serve to enlarge the opening and increase the likelihood of infection (93). In some cases, the clinical signs are very limited, and to emphasize communication, several diagnostic tests, such as the nose-blow test or the alveolar probing, can be performed (92). The correct treatment consists of approximating the edges of the wound with a stitch to close the alveolar space previously filled with absorbable hemostatic gauze as much as possible. If there is not enough gum tissue, a vestibular and palatal flap may be necessary to close it correctly. Alternatively, an alveoloplasty may be required to reduce the bone height and thus close the communication with a suture of the gingival margins (92). Based on the study of Rothamel et al., who researched the occurrence of sinus perforations after extraction, they summarized that a larger degree of impaction, an older patient population, and intraoperative root fracture all increase the risk of oroantral perforation. One hundred thirty-four interventions (13%) of the 465 extractions and 592 osteotomies of the upper third molars were directly connected to diagnosing a ruptured maxillary sinus. In 88 of 370 patients (24%) where entirely impacted teeth were extracted, 23 of 222 instances (10%) where partially impacted teeth were extracted, and 23 of 465 cases (5%) where fully erupted third molars were

removed, acute oroantral communication resulted. The oroantral perforation's diameter was smaller than 3 mm in 111 (83%). A buccal sliding flap was employed to seal the extraction site in 25 (19%) of all sinus defects (94).

7. POSTOPERATIVE COMPLICATIONS

Some complications that can occur after tooth extraction are listed below. These complications can be severe and, in some cases, even fatal, especially in severe infections, which is why they need to be treated in a timely manner (95).

7.1. Alveolitis

Alveolitis sicca occurs after tooth removal and is an extraordinary inflammation of the alveolus. Although the terms dry socket or *dolor post extractionem* describe symptoms, they are also found in the literature as a diagnosis (96). The classic cardinal symptom is the disintegrating coagulum, which presents as gray-greenish or can be completely absent and is associated with particularly severe accompanying pain (97). The classic analgesic medication is usually insufficient to alleviate the symptoms. In addition, halitosis often develops. Risk factors include smoking, poor oral hygiene, and infections before tooth extraction, such as pericoronitis (69). The only adequately documented preventive measure is regular chlorhexidine lavage during the wound healing phase. Clinically, a "dry" socket or a gray-greenish lining of the socket can be seen. An exposed bone may also be visible. The area in and around the socket feels very painful (98). The therapy primarily aims to refresh the wound to enable the subsequent establishment of a stable coagulum in the alveolus. Under local anesthesia, the remaining soft tissue is cured with a sharp curette or possibly supported by a local osteotomy. After rinsing with NaCl or iodine, applying an iodoform gauze strip coated with an antiseptic and analgesic paste is suitable for alleviating the symptoms. The strips should then be changed at individually specified intervals of one to three days (99). Adjuvant systemic antibiotics should be considered in patients at risk. The absolute necessity of a smoking break should be communicated to the patient again. *Alveolitis sicca* can prolong the pain period between five to seven days of a neuralgic character, including severe and intense pain. If symptoms persist, the differential diagnosis must include osteomyelitis or a possible compromise of bone metabolism by systemic antiresorptive medication (69). The systematic review by Herrera-Barraza et al. aimed to describe and analyze the complication incidence in simple tooth extraction. In the described study, 14.975 patients were analyzed, and 2.618 patients, or 11.7%, had complications of alveolitis after simple tooth extraction. The study revealed that the time of the operation has a remarkable impact; the longer the duration of the extraction, the higher the complication rate (24). Another study by Tong et al. investigates the frequency and correlation of complications

after a simple extraction. In total, 412 simple extractions were performed, whereas the incidence of alveolitis was 7.7%, with 56% being the most common complication. First and second molar extractions were the typical reasons for alveolitis. The academic standing of operators and the prevalence of complications after simple tooth extraction differed statistically significantly, with inexperienced operators having a higher incidence of complications than more experienced dentists (100).

7.2. Abscess

Dental emergencies most frequently include odontogenic abscesses. A pus-filled bubble that has been encapsulated is an abscess. The cause of such an accumulation of pus can be, e.g., apical or marginal periodontitis, infected root residues or cysts or pericoronitis. Similar abscesses can also arise during oral surgery from a bacterial infection that occurs during the healing period of the wound (101). The most frequent causes of postoperative wound healing issues are tooth extractions and surgical tooth extractions, with implantology procedures or cyst surgeries occurring less frequently. Most of these illnesses appear one to two weeks following oral surgery (102). When germs outnumber immune cells, an infection involving pus production takes place. It may be localized in the surgical area or moved to other anatomical areas. Anatomically, a distinction is made between different types of abscesses. It can be differentiated between gingival abscesses, periapical abscesses and periodontal abscesses in the oral cavity. Abscesses are typically variable, tight-elastic, and frequently painful to the touch (103). The presence of a fever or a swallowing issue in the patient must first be clinically determined. Fever denotes a local inflammatory process' with systemic impact (104). A patient has to be hospitalized if they exhibit reddening and displacement of the palatine arches in addition to dysphagia, which is a symptom that their airways are already blocked (105). Surgery or drainage are the two methods to treat an abscess. Abscesses can also be treated with intravenous antibiotics, intraoral incisions performed under local anesthesia, and extraoral incisions performed under general anesthesia (106). Following the incision, a drain is introduced, and the area is rinsed with NaCl and iodine. It is meant to allow the wound to drain and enable rinsing in the coming days. Surgical resurfacing may be recommended if the alveoli are affected during wound healing (106). In most cases, the primary drainage comes before this. Early surgical drainage, washing, and close follow-up checks are essential for postoperative abscesses. It can stop the chronification of conditions like chronic osteomyelitis. Systemic administration of antibiotics is indicated for abscesses, for example, with ampicillin, amoxicillin or penicillin in their dosages (107). In the study of Yue Yi et al., the postoperative infection rate after tooth extraction was analyzed. Over six years, 1821 simple and surgical

extractions were carried out. According to the reports, only 25 (1.4%) of the individuals had a postoperative infection. Pain with swelling (12 instances) and pain (11 cases) were the two most frequent postoperative infections seen in the patients, and just two patients exhibited suppuration and an increase in local edema. The only factor that significantly influenced the likelihood of postoperative infection following extraction was the complexity of the extraction; more difficult extractions were associated with higher infection rates. Any other variables, including the prescription of antibiotics, did not significantly influence the incidence of postoperative infection. Compared to a surgical extraction, a simple extraction decreased the chances of postoperative infection by 2.03 times (108).

7.3. Osteomyelitis

Osteomyelitis describes an inflammation in the bone marrow-containing lacunae of the spongiosa. A distinction is made between different forms of osteomyelitis. Clinically, there are acute and chronic forms. Chronic osteomyelitis can be divided into a primary and a secondary chronic form (109). Both acute and chronic forms of osteomyelitis can arise as a complication of oral surgery. Osteomyelitis usually occurs in the lower jaw, e.g., due to wisdom tooth removal or poorer vascularization. The pathogenicity of the pathogen, the patient's immune system, and the vascularization of the anatomical region determine the pathophysiological course (109). Radiological imaging is only suitable for delayed diagnostics since the demineralization of the bone only begins after about three weeks. The primary pain is often non-specific in the surgical region. These can be accompanied by swelling and pus formation (110). Concomitant hypoesthesia of the inferior alveolar nerve is referred to as Vincent's syndrome. Radiologically, osteolysis and, in some cases, swelling of the periosteum (periostitis) can be seen (111). Chronic forms can also appear as sclerosing of the bone. Intraoperatively, there are avascular, partially necrotic bone areas. The treatment of osteomyelitis consists of the long-term administration of antibiotics (112,113). Surgical revision with decortication may also be indicated. Here, a sequestrectomy and osteotomy are performed up to the limits of vascularized bone (114). Acute forms can progress to chronic forms. In these cases, lifelong recurrences with acute inflammatory phases can occur (111). Due to the poor vascularization of the mandible and the fact that the dense mandibular cortical bone is more vulnerable to injury and consequent infection during tooth extraction, acute and chronic osteomyelitis are significantly more related within the mandible than in the maxilla. Up to 3 to 19 times, more cases of mandibular pyogenic osteomyelitis occur overall than in the maxilla. In the jaw, the body, symphysis, angle, ascending ramus, and condyle are the most often affected areas by osteomyelitis (109).

7.4. Postoperative bleeding

Postoperative bleeding can be a severe problem in oral surgery. In the case of anticoagulated patients, especially before elective surgery, the focus is on determining the treatment strategy with the general practitioner or the treating cardiologist (18). If the procedure is to be carried out, a time in the morning and at the beginning of the week is suitable for scheduling to be able to react adequately to complications. The causes of the disturbance of hemostasis after an operation can be manifold. A general distinction is made between congenital and acquired coagulation disorders. In the case of congenital coagulation disorders, there is usually a lack of specific coagulation factors, which must be substituted preoperatively (69). It should be noted that, particularly in young patients, an oral surgical procedure such as tooth extraction can be the first operation with significant bleeding, and the history of the coagulation disorder is sometimes not even known here (38). In the case of acquired, drug-related coagulation disorders, three main groups are divided into platelet aggregation inhibitors, indirect oral anticoagulants (e.g., heparins, vitamin K antagonists) and direct oral anticoagulants (DOAKS or NOAKS for dual or synonymously new oral anticoagulants). The number and aggregation potential of the thrombocytes, functional disorders of thrombocytes or vessels and various influences on the coagulation cascade have different effects on the therapy of secondary bleeding and, therefore, must be clarified beforehand. In principle, blood pressure should be measured preoperatively in anticoagulated patients (115). According to the study of Herrera-Barraza et al., postoperative bleeding incidence in healthy patients is 0.1%, but in patients who are in anticoagulant treatment, the prevalence is much higher (approximately 21.8%). It shows that the communication between the dentist and the family doctor needs to be very good to lower the risks of such complications (24). Based on the research of Römer et al., instances of postoperative bleeding following oral surgical operations are found to occur between 0.2 and 3.3% of healthy individuals and between 8.3 and 32.1% of patients with coagulation problems (116).

Discussion of complications

After explaining possible intra- and postoperative complications and the extraction techniques, the question appears, which extraction technique results in the most common complications according to the literature? The retrospective analysis, which was done in the Department of Oral Surgery of Jagiellonian University Medical College in Kraków, observed 339 patients. The study aimed to analyze complications after wisdom tooth extraction and the incidence of complications according to three different extraction techniques: simple tooth extraction, surgical extraction with the flap's opening, and surgical extraction with separation of the roots.

The study recorded a prevalence of 15% of complications occurring perioperatively (51 cases). The complications that occurred were acute inflammation of the surrounding tissues in 31 patients, trismus in 13 lower third molars, oroantral communication after extracting five upper wisdom teeth, and one case with transient sensory alteration of lingual nerve and hematoma.

Method of extraction	Number of complications (n)	Percentage of complications (%)	p-value
Surgical extraction with flap formation	205	3,9%	<0.0013*
Surgical extraction with root separation	42	40.5%	<0.0013*
Simple extraction	92	28.3%	<0.0013*
Total	339 (100.0) n (%)	15.0%	<0.0013*

*statistically significant

Table 2. Method of extraction and complications in the study group

The result of the study is that, by concentrating on the extraction techniques and their resulting complications, postoperative complications appear more likely in surgical extraction techniques with separation of the roots (1).

8. RESULTS AND CONCLUSION

Tooth extraction is a surgical procedure that, if performed according to proper protocols and without fear of treatment, can cause mild discomfort that quickly disappears. The correct technique for tooth extraction leads to a successful outcome. Therefore, every surgeon must know the risks, indications and contraindications of each tooth extraction technique.

The surgeon needs to know how to select the intra- and postoperative complications according to the different extraction techniques.

The indications and contraindications between surgical and simple tooth extractions are usually similar, but they have their own individual risks. This showed the literature used during the research. In the case of simple tooth extraction, the literature showed an increased prevalence of alveolitis in comparison to surgical tooth extraction. This is due to the increased force applied by the practitioner during the simple extraction to the alveolar socket. The force that needs to be applied can also result in a maxillary tuberosity fracture or an alveolar bone fracture. The

reviewed literature showed a higher prevalence of fractures to the alveolar bone and tuber when performing a simple tooth extraction. On the other hand, according to several articles, simple tooth extraction can reduce the risk of postoperative bleeding by 2.03 times. Due to the fact that an opening of a flap is not performed, there is less bleeding during the procedure. Additionally, the vascularization of the tissues is not interrupted. Another advantage of a simple tooth extraction is that there is no formation of scar tissue which is especially relevant in the esthetic regions. Surgical tooth extraction is usually performed when there is very little tooth structure left or in the case of impacted teeth. However, the incisions and flaps that need to be performed involve additional risks and complications during the procedure. Several studies concluded that, depending on the impaction degree, the risk of oroantral perforation increases equivalently. The literature also reports that the damage to the lingual nerve increases with the performance of surgical extraction, especially with the performance of lingual flap retraction. Therefore, incisions for opening the flap need to be performed very carefully to avoid damaging any surrounding nerve structures. Another disadvantage of surgical extraction is the formation of scar tissue. Several methods to reduce the formation of scar tissue were shown in the literature. The most reported way was that the incision should be done in the horizontal dimension according to the gingival margin line of the teeth. Vertical releasing incisions need to be performed in the non-esthetic area. Furthermore, the literature reports that complications like inflammation around the surrounding tissues, trismus, hematoma, and transient alterations of lingual nerve damage occurred the most during the surgical extraction with the separation of the roots.

When the correct extraction technique according to the clinical situation is chosen, the risks of complications are reduced and the tooth extraction can be performed with less incidence of complications and risks for the patient.

Nevertheless, the field of tooth extraction techniques and performance is developing constantly, so the practitioner needs to be aware of how to identify the surgical work aspects that could reduce the occurrence of tooth extraction complications. To reduce the occurrence of complications, the surgeon can perform the conventional methods to extract teeth in a modified way. According to the reviewed literature, several methods can be used to minimize individual complications. The use of physics forceps reported a reduction of root and alveolar bone fractures and made the simple tooth extraction procedure more atraumatic. This is due to the special anatomy of the extraction forceps, which significantly reduces the extraction force due

to the bumper on the non-working side. In order to preserve soft and hard tissue as well as alveolar bone plates, the use of periotome was mentioned in the reviewed literature. Due to the very efficient cutting possibilities of periodontal ligament fibers, tooth extraction can be performed in a very atraumatic way and reduces the risks of alveolar bone and tuberosity fracture. Another reported technique to extract a tooth is surgical extrusion. With this technique, the stretching and tearing of bone with an elevator and other instruments are minimized due to the extraction in the vertical direction only. This reduces the risk of alveolar bone loss in the surgical extrusion technique, which gives wider possibilities for overdentures or further implantation procedures. The surgical extrusion technique in tooth extraction is, according to the literature, very efficient, especially in autotransplantation or immediate implantation procedures. However, the current price for the required equipment is very high, so this technique is not very widespread yet.

Over all, clinical complications are rare and usually mild. The complications are often unexpected and sudden events due to or during a tooth extraction. Accidents or complications can occur due to many factors, including misdiagnosis, wrong extraction indication, improper procedure planning, factors related to the technique or incorrect use of instruments, excessive force, or insufficient visualization of the surgical site before the procedure as well as the condition of the patient himself. When those failures appear, the general prevalence of complications is very high. Therefore, good preparation and an excellent medical history are essential to ensure a complication-free procedure. Postoperative complications occur despite a correct preoperative examination, an adequate X-ray examination, impeccable surgical techniques, and clear, written instructions for the patient's postoperative care. Because of this, prevention is essential, as well as the use of verbal and written postoperative instructions and the distinction between a complication and a normal healing process at follow-up.

Annex

While preparing for the topic, various sources and opinions on tooth extraction were observed. It remains to be firmly established that tooth extraction is one of the procedures to stop a pathological process. It carries many risks. However, when used correctly, it can provide immediate relief from pain. Generally, when writing a treatment plan, the tooth should always be treated as conventionally as possible. If possible, the preservation of the tooth should always be the top priority. However, this is different in other parts of the world. During practice work in a 4-week internship in Tanzania, several aspects according to extraction techniques and

methods, as well as the prevalence of complications in tooth extraction, were observed. The period in which the internship took place was between 01/08/2022 and 02/06/2022 organized by a volunteering program. All findings were collected at the Levolosi Health Center in Arusha, which is a public medical center dependent on donations. The procedures were performed by dental students and local dentists. By far, the most commonly performed procedure was simple tooth extraction. Surgical tooth extraction procedures were not performed. The indications for a tooth extraction differ greatly from the indications of Western-oriented dentistry. This is due to the lack of material and instruments since no emphasis was placed on tooth-preserving measures (prosthetic solutions or endodontic solutions). Indications for tooth extraction were caries lesions on molars (caries media), fistula in the retromandibular area, and severe undiagnosed toothache that led to extraction due to religious belief. It should also be noted that the examination could only be carried out extraorally and intraorally, since there was no possibility of radiological diagnostics. The medication intake of the patients before extraction was not considered. Systemic diseases of the patients were also left out.

The extraction techniques also differ greatly from Western dentistry. The simple tooth extraction is only performed with an area-specific forceps and a spoon to clean the alveolus. Due to the missing elevator usage, the tooth extraction was performed in a much more traumatic manner. To separate the tooth from the alveolar socket, the periodontal ligament fibers were torn off by forcing pull movements. This led to an increased incidence of alveolar bone and tuberosity fractures. Root fracture was also a complication with a higher incidence than reported in Western literature. If the specific root forceps did not bring the desired success, there was no suitable treatment method for the occurred complications since there was no equipment for surgical intervention.

Due to the lack of radiological diagnostics and the administration of anesthetic with needles of 2mm diameter, the risk of nerve damage (e.g. to the *nervous alveolaris inferior*) was greatly increased. During the period of one month, no incident of nerve damage could be detected. However, the different extraction techniques, as well as a non-sterile working field, led to an increased incidence of complications. It was observed that the prevalence of alveolitis and abscess formation in the treated patients was significantly increased compared to Western studies. This can be attributed to the fact that the disinfection and sterilization of the instruments used cannot be adequately produced. The treatment methodology for postoperative complications is limited to prescribing antibiotics.

In summary, it can be stated that the simple tooth extraction, which was carried out exclusively in the hospital in Arusha, entails a significantly higher incidence of risks and complications than in a Western dental clinic.

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