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Factors Influencing the Postoperative Course After Tooth Extraction: A Review of the Literature

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ABSTRACT

Tooth extraction is common. The postoperative course depends on many factors. The most common implications are alveolar osteitis (dry socket), infection, bleeding, swelling, trismus, and nerve injury. These factors may occur and negatively affect patient comfort and treatment results. The postoperative course is influenced by patient-related factors as age, systematic disease, smoking and oral hygiene and also local factors including the size of surgical trauma, the duration of the procedure, the operator's experience and the clot formation. This thesis summarizes present knowledge regarding factors influencing the postoperative course following tooth extraction.

Keywords: tooth extraction; postoperative complications; alveolar osteitis; dry socket; oral surgery; risk factors

1. INTRODUCTION

Tooth extraction is one of the fundamental procedures performed in dental practice. Although advances have been made in preventive care, restorative dentistry and endodontic treatment, there are many clinical situations where tooth removal is still necessary, e.g. severe caries, advanced periodontal disease, orthodontic procedures, periapical lesions, prosthetic planning and impacted or non-restorable teeth (Peterson, 2007; Peterson, 2008). Although the procedure is usually safe, its outcome depends on proper course of the process and minimization of the local inflammation response. The procedure can be associated with complications that affect the patient's quality of life and clinical outcomes (Blondeau & Daniel, 2007; Bouloux et al., 2007; Bui et al., 2003). Postoperative pain, swelling, infection, delayed healing, and functional limitations can impede with daily activities and prolong recovery (Bouloux et al., 2007; Bui et al., 2003; McGrath et al., 2003).

Understanding the biological mechanisms involved in healing and the factors associated with postoperative complications is therefore essential for oral surgeons. Subsequently, a controlled inflammatory response develops; neutrophils and macrophages remove necrotic tissue and bacterial debris. They simultaneously release molecules that regulate tissue repair (Peterson, 2007; Peterson, 2008). This is followed by proliferation, which is characterized by intense angiogenesis, fibroblast

proliferation, and collagen fiber deposition. Fibroblasts produce extracellular matrix components, and new blood vessels develop, supplying nutrients and oxygen to the healing tissues. Bone regeneration then occurs as osteoblasts lay down immature woven bone, which gradually transforms into mature lamellar bone (Peterson, 2007; Peterson, 2008).

Present-day research indicates that the postoperative course is determined by numerous systemic and local factors (Benediktsdottir et al., 2004; Bouloux et al., 2007; Bui et al., 2003; Susarla et al., 2003; Blum, 2002). Understanding these factors allows the physician to appropriately plan the procedure, deploy preventive measures, and minimize the risk of negative outcomes (Benediktsdottir et al., 2004; Susarla et al., 2003; Blum, 2002).

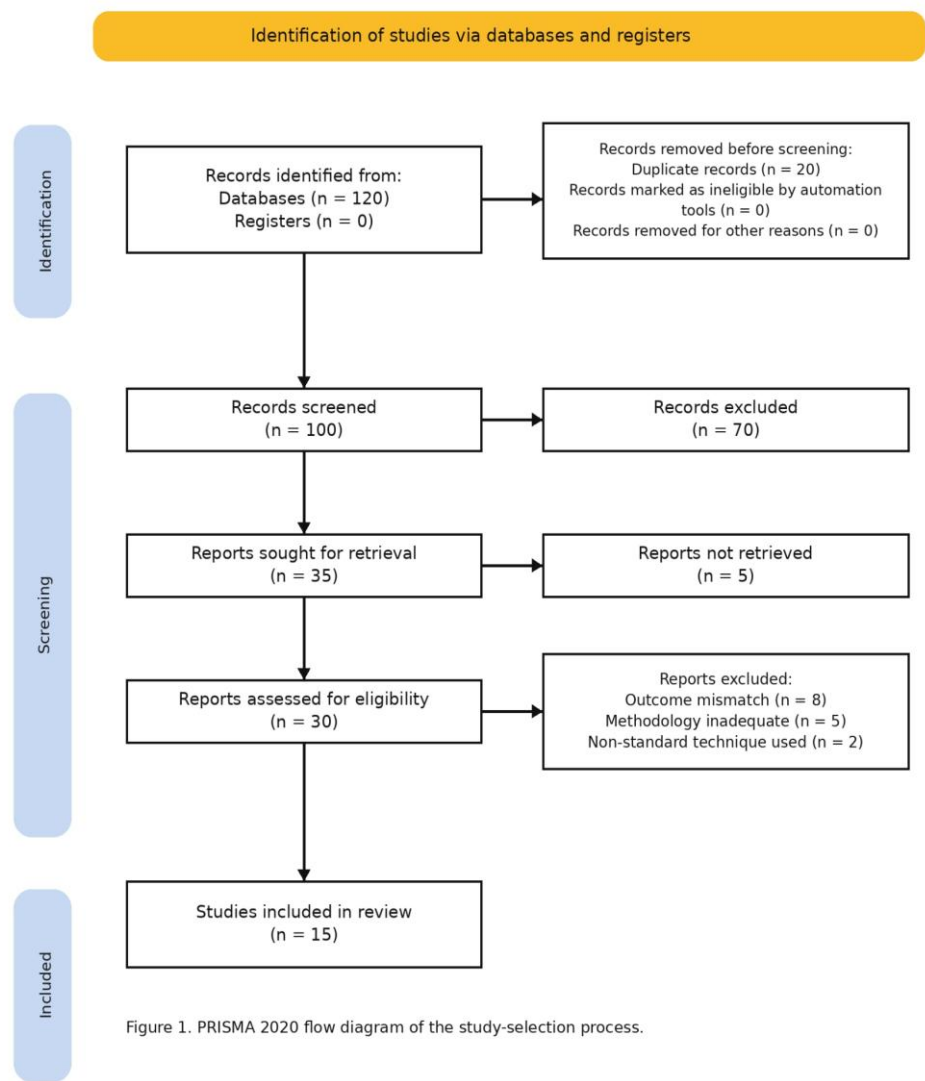


Figure 1. PRISMA 2020 flow diagram of the study-selection process.

Figure 1. PRISMA flow diagram

2. REVIEW METHODS

The review was conducted April-May 2026. The main biomedical databases were searched for literature published between 2000-26. Search terms: "tooth extraction", "dental extraction complications", "dry socket", "alveolar osteitis", "healing after surgery" and "complications after oral surgery".

Inclusion criteria:

- Clinical studies
- Reviews

Observational studies
Outcomes after extracting teeth
Risk factors and problems
Analysis of factors affecting how well wounds heal
Only English-language publications.

Exclusion criteria:

Studies that aren't available in full text
Research on animals or in vitro
Editorials, abstracts, commentary, letters, or case reports with fewer than five cases
Studies with unclear methodology or inadequate clinical outcome reports

The database search yielded 120 records. After eliminating 20 copies, 100 titles and summaries were checked, resulting in the removal of 70 unrelated articles. Full-text evaluation was conducted for 30 studies; 15 were removed: eight because the results were not relevant, five because the methods used were not good, and two because the surgery was not done in the usual way. 15 studies were selected for qualitative synthesis. The selection process and numerical breakdown are illustrated in Figure 1.

3. RESULTS AND DISCUSSION

The results of a comprehensive evaluation of the included literature demonstrate that postoperative recovery is mediated by an interplay between systemic host conditions, surgical technique, and local anatomy. Table 1 offers a structured overview of the key literature parameters and findings.

Table 1. Summary of key literature reporting risk factors and postoperative outcomes following tooth extraction.

Author & Year	Study Type	Main Parameters Investigated	Key Findings / Clinical Outcomes
Blondeau & Daniel (2007)	Retrospective Cohort	Age, anatomical difficulty, mandibular third molars	Complications are more likely in older patients. Nerve risk is increased in dense mandibular bone.
Bouloux et al., (2007)	Literature Review	Surgical trauma, flap design, systemic conditions	Atraumatic tissue management and conservative flap designs reduce swelling and trismus.
Bui et al., (2003)	Prospective Study	Operation duration, surgical experience, complication rates	Longer operating times lead to higher infection and pain rates.
Noroozi & Philbert (2009)	Review	Alveolar osteitis (dry socket), fibrinolysis, smoking	Nicotine and mechanical forces can disrupt blood clots, increasing alveolar osteitis risk.
Jerjes et al., (2006)	Clinical Trial	Operator experience, complication frequency	Surgeons lacking experience tend to have higher complication rates due to excessive damage to tissue.
Susarla et al., (2003)	Clinical Review	Preoperative risk assessment, CBCT imaging, systemic disease	3D imaging and risk control improve predictability.

Physiology of post-extraction socket healing

Proper post-extraction socket healing is a dynamic and multistage process. Immediately following tooth extraction, bleeding occurs leading to thrombocyte activation and formation of the fibrine clot. This clot protects the underlying bone and contributes a more effective tissue regeneration (Peterson, 2007; Peterson, 2008). The first phase of healing—the inflammatory phase—lasts from one to three days. During this phase, neutrophils and macrophages remove bacteria and necrotic tissue while releasing numerous cytokines and growth factors that initiate the process of regeneration. This is followed by the proliferative phase, characterized by intense angiogenesis, fibroblast proliferation and the deposition of collagen fibers. Over the subsequent weeks, granulation tissue is gradually replaced by immature bone. Bone regeneration occurs as osteoblasts deposit bone tissue in the tooth socket. This immature bone is over time remodeled into mature lamellar bone (Peterson, 2007; Peterson, 2008). Epithelial cells on the wound surface also grow quickly to form a protecting layer that stops the healing tissue from coming into contact with the mouth. This process takes up to several months.

Patient-Related Risk Factors

One of the most important factors influencing the patient's recovery after surgery is the patient's age. Older patients usually take longer to heal and are more likely to get infections. Younger patients usually have better tissue regeneration because their bodies are more active and have a better blood supply.

Systemic diseases also have a significant impact. Diabetes, especially metabolically uncontrolled diabetes, is particularly important. Hyperglycemia leads to impaired leukocyte function, impaired tissue blood supply and reduced collagen synthesis. This increases the risk of infection and slowed wound healing (Bouloux et al., 2007; Susarla et al., 2003; Blum, 2002).

Smoking is also a big risk factor. Nicotine causes blood vessels to shrink, reduces the amount of oxygen that reaches body tissues, and stops new collagen from being made. Smoking can mechanically dislodge the blood clot, increasing the risk of dry socket. In addition, the chemicals in tobacco smoke can make it harder for your immune system to fight off infection, causing problems like swelling of the jaw and other issues after surgery (Noroozi & Philbert, 2009; Susarla & Dodson, 2005).

Nutritional status is also key. Problems with protein, vitamins A, C, and D, and trace elements like zinc and iron stop the body from healing itself. Obesity and long-lasting inflammations linked to metabolic diseases can make it take longer to heal (Bouloux et al., 2007; Susarla et al., 2003).

Surgical factors

The surgical technique used during extraction has a significant impact on postoperative recovery. Damage due to tissue manipulation can lead to inflammation, pain, swelling, and delayed healing. Atraumatic or gentle tissue manipulation will help to reduce some of the above negative factors (Bouloux et al., 2007; Peterson, 2008). Another major variable that will affect the recovery time after surgery is the length of the operation. Longer operations increase the likelihood of complications due to irritation from bacteria (Bui et al., 2003; Susarla et al., 2003; Blum, 2002). Therefore, effective pre-planning and efficient execution of the procedure will likely improve outcomes.

A third important variable is surgeon experience. Surgeons who have less experience with extraction and dental surgery may need to spend more time performing a single extraction and will often use more aggressive tissue manipulation than their more experienced colleagues (Jerjes et al., 2006; Sisk et al., 1986). For this reason, training, supervision, and compliance with evidence-based clinical guidelines are very important for maintaining high quality of care.

Flap design is another factor that can influence the extent of postoperative complications. Elevating flaps to obtain better visualization and access allows for easier removal of impacted teeth. However, overly aggressive flap elevation can lead to tissue edema (swelling) and pain as a result of impeded venous drainage from the elevated tissue. Use conservative flap designs and gentle tissue handling (Bouloux et al., 2007; Peterson, 2008).

Recent advances in "minimally invasive" surgical techniques utilize various mechanisms to reduce the amount of tissue trauma that occurs during extractions. Examples of these mechanisms include minimal elevation of flaps, selective tooth dissection, careful application of force, and enhanced visualization. The utilization of such mechanisms has been shown to decrease both the degree of postoperative pain and swelling, and the frequency of developing dry sockets (Bouloux et al., 2007; Susarla & Dodson, 2004).

Anatomical Factors

Anatomical features influence how difficult an extraction is and the risk of complications. Bone density varies among people and different body areas. The bone in the lower jaw is usually denser than that in the upper jaw, which often makes extractions of the lower jaw more difficult (Blondeau & Daniel, 2007; Benediktsdottir et al., 2004).

The way the roots are shaped can make surgery more or less complicated. Teeth with curved, divergent, or irregularly shaped roots may need to be cut into sections or have extra bone removed. This can make the procedure more difficult and cause more tissue damage. Impacted mandibular third molars are a common example of such complex extractions. These procedures often cause more pain, swelling, trismus, dry socket, and nerve injury than regular extractions. Proximity of anatomical structures is key to surgical risk. The inferior alveolar nerve/maxillary sinus are often found near sites where teeth are removed, e.g., during third molar surgery. If these structures are damaged, you may experience sensory disturbances or a communication between the oral and nasal cavities. It is very important to carefully assess the patient before surgery and plan the operation to minimize these risks.

Postoperative Complications

Dry socket is the most common complication of a tooth extraction. Dry sockets typically develop as a result of the breakdown of the blood clot in the socket after extraction. This is largely a result of fibrinolysis (the dissolving of the blood clot), a bacterial infection, mechanical dislocation (Noroozi & Philbert, 2009). Typically, patients experiencing dry sockets experience extreme pain for at least 3 days after the procedure, and are left with what they describe as an empty socket which has exposed bone. Possible complications from having teeth extracted may include swelling, trismus, bleeding, and nerve damage (Blondeau & Daniel, 2007; Kim et al., 2015; Bouloux et al., 2007; Bui et al., 2003). Some of these complications can resolve on their own, but each one can be extremely painful and extend the time it takes to recover.

Postoperative care is important for optimum healing and usually involves cessation of smoking, vigorous rinsing, and mechanical trauma until the clot has formed and stabilized (Noroozi & Philbert, 2009). Pain and inflammation can be treated with anti-inflammatory drugs. Antibiotics may be needed in immunocompromised patients or if wide-ranging manipulation of the sinuses is performed, but are not routinely prescribed (Bouloux et al., 2007; Susarla et al., 2003).

Maintaining thorough oral hygiene is vital, though the surgical site itself should not be disturbed during the first few days. General hygiene reduces the bacterial load in the mouth, helping faster tissue repair and preventing secondary infections. Ultimately, patient compliance is the strongest determinant of a successful recovery. This includes following a soft-food diet, complying with recommended hygiene routines, and strictly avoiding tobacco (Kim et al., 2015; Bouloux et al., 2007). Immediate communication between the clinician and the patient guarantees that these risks are understood and that the recovery process remains on track.

Risk Assessment and Surgical Planning

Doing a lot of checks before an operation can reduce the chance of problems afterwards. Include things like medical history, smoking habits, systemic diseases, medication, oral hygiene, and local infection. If a patient is at high risk, the clinician may modify the treatment plan and implement preventive measures. These might include mouth rinses, minimally invasive techniques, postoperative monitoring, and collaboration with medical providers for systemic diseases (Susalra et al., 2003; Blum, 2002).

Modern imaging technologies have helped to improve surgical planning. Panoramic radiography is still widely used. Cone beam computed tomography provides a detailed three-dimensional visualization of root morphology, bone structures, and surrounding anatomical landmarks (Benediktsdottir et al., 2004; Susarla et al., 2003). Modern imaging tools improve surgical accuracy, risk assessment and can help in reducing complication rates, especially in third molar surgery (Bouloux et al., 2007; Susarla et al., 2003; Blum, 2002).

Future Perspectives

In recent years, attention has focused on regenerative methods to speed tooth extraction healing. Promising is platelet-rich fibrin, various bone graft materials, which support tissue regeneration and maintain bone density while healing. These strategies are important for patients who will have implant treatment in the future, as keeping the bone ridge intact is important for successful implant placement.

These techniques may be especially beneficial when future implant placement is planned. Preservation of bone volume contributes to long-term implant stability and esthetic outcomes.

The growing service of digital technologies has significantly changed how oral surgical procedures are planned and performed. Tools such as cone-beam computed tomography (CBCT) and computer-assisted planning allow clinicians to evaluate anatomical structures more accurately and improve the safety and predictability of treatment (Susarla et al., 2003). At the same time, ongoing advances in biomaterials, tissue engineering, and regenerative medicine are creating new possibilities for improving wound healing and reducing postoperative complications.

Despite recent advances, many aspects of how the tooth heals after it has been taken out are still not fully understood. More investigation is needed to understand how biological processes, the features of patients, and surgical factors work together during recovery. This may help improve patient outcomes (Bouloux et al., 2007; Susarla et al., 2003; Blum, 2002).

4. CONCLUSION

Healing after getting a tooth pulled depends on many things. These include how the body reacts, the patient's characteristics, the condition of the area where tooth was removed, and the way the surgery was done. For a patient to recover well, it is important to prevent the blood clot from breaking down, make sure there's enough blood flow, and control any swelling. Healing often depends on whether a person smokes, how old they are, if they have long-term health issues, or how well they clean their teeth. If surgery takes longer, causes more tissue damage, involves removing teeth that are difficult to remove, or relies on the operator's skill, the results can be very different. Sometimes it depends on how thick the jawbone is, the shape of the roots, or how close things are to nerves and sinuses.

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All writers have read and agreed with the published version of the manuscript.

Informed consent

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Conflict of interest

The authors declare that they have no conflicts of interest, competing financial interest or personal relationship that could have influenced the work reported in this paper.

Data and materials availability

All data associated with this study will be available based on reasonable requests to the corresponding author.

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