



Role of gut microbiome diversity in third molar postoperative healing

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ABSTRACT

Third molar extraction is one of the most frequently performed oral surgical procedures and may be followed by pain, swelling, infection, delayed soft-tissue healing, and alveolar osteitis. Increasing evidence suggests that microbial diversity and host–microbiome interactions play important roles in postoperative recovery. Although local oral microbiota have traditionally received greater attention, the gut microbiome may influence third molar healing through systemic immune regulation, inflammatory signaling, microbial metabolites, and interactions with the oral microbiome. Greater gut microbial diversity may support immune homeostasis and balanced inflammatory responses, whereas dysbiosis may contribute to excessive inflammation, impaired tissue repair, and increased susceptibility to postoperative complications. Microbiome-derived metabolites, particularly short-chain fatty acids, may further influence immune activity and wound-healing processes. Probiotics, dietary interventions, and microbiome-directed therapies therefore represent potential strategies for supporting postoperative recovery. However, the specific relationship between gut microbiome diversity and third molar healing remains insufficiently characterized, and current evidence is stronger for local oral microbial influences than for direct gut-mediated effects. Future investigations integrating gut microbiome profiling, oral microbial analysis, inflammatory biomarkers, and clinical healing outcomes may enable personalized risk assessment and microbiome-based postoperative interventions. Understanding this gut–oral connection could contribute to improved pain management, infection prevention, and tissue regeneration following third molar surgery.

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INTRODUCTION

Third molar extraction is a common oral surgical procedure performed to manage impacted, partially erupted, or pathologically affected teeth. Although generally predictable, postoperative recovery may be complicated by pain, edema, infection, delayed wound healing, and alveolar osteitis. Effective microbial control during and after surgery is therefore essential for maintaining a favorable healing environment. Advances in dental microbiology have emphasized that microbial communities can influence inflammatory responses

and tissue repair, while appropriate irrigation and microbial management remain important components of clinical care (Singh, 2020).

Recent attention has shifted from individual pathogens toward the broader ecological characteristics of microbial communities. In particular, the composition of microorganisms surrounding third molars may influence postoperative recovery. Todoric et al. (2024) demonstrated that differences in pericoronary microbiota composition are associated with the course of recovery following third molar alveotomy.

Table 1: Potential Gut–Oral Microbiome Pathways in Postoperative Healing

<i>Microbiome component</i>	<i>Potential effect</i>	<i>Relevance to healing</i>
Gut microbial diversity	Immune regulation	Balanced inflammation
Microbial metabolites	Systemic signaling	Tissue-repair modulation
Oral microbial composition	Local inflammatory response	Infection and healing outcomes
Dysbiosis	Inflammatory imbalance	Potential delayed recovery
Probiotics	Microbial modulation	Possible pain and recovery benefits

Similarly, microbial profiling of dry-socket lesions has revealed distinct microbial communities, supporting the importance of microbial balance in postoperative complications (Shen et al., 2019).

Beyond the oral cavity, the gut microbiome represents a major regulator of systemic immunity, inflammation, and metabolic activity. Its diversity may therefore influence the host response to surgical trauma and indirectly affect oral wound healing. Probiotics have also attracted interest because of their potential to modulate inflammation and postoperative pain (Fyntanidou et al., 2023). Furthermore, the broader role of microbiota in regenerative dentistry suggests that host–microbial interactions may be relevant to tissue and bone regeneration (Inchingolo et al., 2023). Although Singh (2019) primarily discusses bioceramic approaches to vital pulp therapy, its emphasis on biologically compatible approaches further highlights the importance of maintaining favorable biological conditions for dental tissue healing.

Thus, investigating the relationship between gut microbiome diversity and third molar postoperative healing may provide new insights into systemic factors influencing recovery and support the development of personalized microbiome-based postoperative strategies.

GUT MICROBIOME DIVERSITY AND THE GUT–ORAL AXIS

The gut microbiome comprises a complex community of microorganisms that contributes to immune regulation, metabolic activity, epithelial integrity, and systemic inflammatory balance. Microbial diversity, reflected by the richness and relative distribution of bacterial species, is generally associated with greater ecological stability and more effective host–microbe interactions. Disturbances in this ecosystem may promote dysbiosis and systemic inflammatory responses that could potentially influence postoperative recovery following third molar surgery.

The gut–oral axis describes the bidirectional relationship between intestinal and oral microbial ecosystems. Changes in gut microbial composition can influence systemic immunity and inflammatory signaling, while oral microorganisms and their metabolites may affect intestinal microbial communities. In the context of third molar surgery, this relationship is particularly relevant because postoperative healing requires coordinated control of inflammation, microbial burden, and tissue repair. Studies of pericorony microbiota demonstrate

that local microbial composition can influence recovery following third molar alveotomy (Todorčić et al., 2024). Similarly, distinct microbial profiles have been identified in dry-socket conditions, emphasizing the importance of microbial balance in postoperative oral healing (Shen et al., 2019).

Microbiota also have relevance to regenerative dentistry, where host–microbe interactions may influence tissue and bone regeneration (Inchingolo et al., 2023). Effective microbial control during dental procedures remains important for limiting undesirable microbial effects during healing (Singh, 2020). Furthermore, probiotic interventions may provide an opportunity to modulate microbial communities and postoperative inflammatory or pain responses (Fyntanidou et al., 2023). Although Singh (2019) primarily addresses bioceramic-based vital pulp therapy, its emphasis on biologically compatible approaches to dental tissue preservation supports the broader importance of maintaining favorable biological conditions during oral healing.

MICROBIOME INFLUENCE ON POSTOPERATIVE HEALING AFTER THIRD MOLAR EXTRACTION

Postoperative healing following third molar extraction depends on coordinated inflammatory responses, microbial control, clot stability, soft-tissue repair, and subsequent bone remodeling. The microbiome can influence several of these processes, with both local oral microorganisms and systemic microbial factors potentially contributing to recovery. In particular, the composition of the pericorony microbiota appears relevant to the clinical course after third molar alveotomy. Variations in microbial communities may affect local inflammation and susceptibility to postoperative complications, highlighting the importance of host–microbe interactions during healing (Todorčić et al., 2024).

Microbial Dysbiosis and Postoperative Complications

Microbial imbalance may interfere with normal wound healing by sustaining inflammation and promoting pathogenic colonization. High-throughput sequencing has demonstrated distinct microbial profiles associated with dry socket, supporting the concept that microbial community structure, rather than the presence of a single organism, may contribute to alveolar osteitis (Shen et al., 2019). Effective microbial management, including appropriate irrigation, may therefore

Table 2: Microbiome-Related Factors Influencing Third Molar Healing

<i>Microbiome factor</i>	<i>Potential mechanism</i>	<i>Possible postoperative outcome</i>
Pericoronary microbial composition	Modulation of local inflammation	Altered recovery
Dysbiosis	Persistent inflammatory stimulation	Delayed healing or complications
Dry-socket-associated microbial profiles	Altered microbial community structure	Increased risk of alveolar osteitis
Gut microbiome diversity	Systemic immune and metabolic regulation	Potential influence on healing
Probiotic supplementation	Microbial and inflammatory modulation	Possible reduction in postoperative discomfort
Microbial control and irrigation	Reduction of pathogenic burden	Improved local healing environment

contribute to reducing microbial burden and supporting favorable healing (Singh, 2020).

Gut–Oral Microbiome Interaction

Although direct evidence linking gut microbiome diversity specifically to third molar healing remains limited, intestinal microbial diversity may influence systemic immune regulation and inflammatory balance. These effects could indirectly affect postoperative tissue repair. Microbiota are also increasingly recognized as relevant to regenerative dentistry and bone-related healing processes (Inchingolo et al., 2023).

Probiotics and Postoperative Recovery

Microbiome-directed interventions, particularly probiotics, may provide additional support for postoperative recovery through modulation of inflammatory and pain-related pathways. Evidence concerning probiotics in postoperative pain management suggests potential clinical value, although their specific effectiveness following third molar extraction requires further investigation (Fyntanidou et al., 2023). Biomaterial-mediated approaches to tissue preservation and regeneration may similarly benefit from improved understanding of host–microbiota interactions (Singh, 2019; Inchingolo et al., 2023).

Overall, microbiome composition represents a potentially important determinant of postoperative recovery, but the specific contribution of gut microbial diversity remains an emerging area requiring prospective clinical investigation.

CLINICAL IMPLICATIONS, THERAPEUTIC STRATEGIES, AND RESEARCH PERSPECTIVES

The potential relationship between gut microbiome diversity and third molar postoperative healing has important implications for personalized oral surgical care. Although direct evidence linking gut microbiota to third molar recovery remains limited, microbial composition at the surgical site appears clinically relevant. Todoric et al. (2024) demonstrated that pericoronary microbiota composition can influence the course of recovery following third molar alveotomy, emphasizing the importance of microbial balance during postoperative healing. Similarly, distinct microbial profiles have been identified in dry-socket conditions, suggesting that microbial dysbiosis may contribute to impaired recovery (Shen et al., 2019).

From a therapeutic perspective, effective local microbial

control remains essential. Appropriate irrigation and postoperative infection-control strategies may help reduce microbial burden and support favorable healing (Singh, 2020). Probiotics represent another promising approach because of their potential to modulate microbial communities and inflammatory responses, with evidence supporting their possible role in postoperative pain management (Fyntanidou et al., 2023). Maintaining biological compatibility and supporting tissue regeneration may also be important, particularly where microbiota interact with regenerative materials and host tissues (Inchingolo et al., 2023). Principles of biologically favorable treatment and preservation of tissue vitality further reinforce the importance of minimizing unnecessary tissue injury during clinical management (Singh, 2019).

Future research should investigate the gut–oral microbiome axis using longitudinal microbiome profiling, inflammatory biomarkers, dietary assessments, and standardized clinical healing outcomes. Identifying microbiome signatures associated with delayed healing, infection, or alveolar osteitis could facilitate risk prediction and individualized postoperative interventions. Larger clinical trials are also needed to determine whether probiotics, prebiotics, dietary modification, or other microbiome-targeted therapies can reliably improve recovery after third molar surgery.

CONCLUSION

Gut microbiome diversity represents a potentially important, yet still emerging, factor in third molar postoperative healing. Through interactions with systemic immunity, inflammatory regulation, microbial metabolites, and the oral microbiome, intestinal microbial composition may influence the biological processes involved in wound repair and recovery. Current evidence particularly supports the importance of local pericoronary microbial composition and its association with postoperative outcomes, while findings from dry-socket research further highlight the clinical relevance of microbial dysbiosis. Probiotics and other microbiome-directed strategies may offer additional opportunities for supporting postoperative comfort and modulating inflammation. Nevertheless, the direct contribution of gut microbiome diversity to third molar healing remains insufficiently established. Future research should integrate gut and oral microbiome profiling with clinical healing parameters, inflammatory biomarkers,

dietary factors, and patient-specific characteristics. Such approaches could improve understanding of the gut–oral axis and facilitate personalized prediction and management of postoperative complications. Ultimately, microbiome-informed strategies may complement conventional surgical and antimicrobial approaches, contributing to safer, more predictable, and biologically optimized recovery following third molar extraction.

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