Assessment Of Patient-Reported Outcomes Following Different Approaches To Third Molar Extraction

Abdullah Saad Alhammad[1], Ibrahim Abdullah Alrashed[2], Mashael Alhmuidi Alharbi[3], Zharah Kiri Alhakami[4], Bashayer faris Alhlail[5], Dalal Monief Almotery[6], Sarah Hamed Almutairi[7], Sara Nasser Altamimi[8], Latifah Fadhel Alshameri[9], Reem Matar Alshebani[10], Aisha Matar Alshebani[11], Wejdan Ahmed Aljamaan[12], Khalid Jahaz Jayz Alharbi[13], Baker Ahmed Yaseen[14], Abdulrahman Alrasheedi[15]

[1] Dentist, Dental clinics complex west of Riyadh, Riyadh health cluster
[2] Family dentist, Dental clinics complex west of Riyadh, Riyadh health cluster,
[3] Dental assistant, Dental clinics complex west of Riyadh, Riyadh health cluster
[4] Dental assistant, Dental Clinics Complex, West Riyadh, Riyadh health cluster
[5] Dental assistant, Dental clinics complex west Riyadh, Riyadh health cluster
[6] Dental assistant, West Riyadh complex, Riyadh health cluster
[7] Dental hygienist, Dental clinics complex west of Riyadh, Riyadh health cluster
[8] Dental assistant, Dental clinics complex west of Riyadh, Riyadh health cluster
[9] Dental assistant, Dental Clinics Complex Almansorh, Riyadh health cluster
[10] Dental assistant, Dental clinics complex west of Riyadh, Riyadh health cluster
[11] Dental assistant, Dental clinic complex west of Riyadh, Riyadh health cluster
[12] Dental assistant, Dental clinic complex west of Riyadh, Riyadh health cluster
[13] Health Information Technician
[14] Health Administration Technician, Prince Mohammed Bin Abdulaziz Hospital Of The National Guard In Madinah
[15] Radiology technician, Email: abdrhmn91abd@gmail.com

Accepted: 01-08-2024 Published: 15-09-2024

Abstract

Background: Third molar extraction is one of the most common oral surgical procedures worldwide, with significant implications for patient quality of life during recovery. While clinical outcomes have been extensively studied, there is increasing recognition of the importance of patient-reported outcomes in evaluating the effectiveness of different surgical approaches.

Purpose: This review aims to comprehensively assess patient-reported outcomes following different approaches to third molar extraction, with particular focus on comparing coronectomy with complete extraction and evaluating the impact of various surgical technique modifications on patient experience.

Methods: A narrative synthesis of published literature was conducted, integrating findings from randomized controlled trials, systematic reviews, and prospective cohort studies that reported patient-centered outcomes following third molar surgery. Key outcomes of interest included pain, swelling, functional limitations, neurosensory disturbances, and overall quality of life.

Results: Coronectomy demonstrates advantages in reducing the risk of inferior alveolar nerve injury (risk ratio 0.11, 95% CI: 0.03-0.36) and associated sensory disturbances compared to complete extraction in high-risk cases, with many studies also reporting reduced early postoperative pain and swelling. However, the potential need for reoperation (0.6-6.9% of cases) represents an important consideration in treatment planning. Regarding surgical technique, triangular flaps show modest reductions in early postoperative pain compared to envelope flaps (mean difference -0.21 on a 0-10 scale, 95% CI: -0.32 to -0.10), while secondary wound closure demonstrates advantages in reducing pain (mean difference 0.79, 95% CI: 0.35 to 1.24) and swelling compared to primary closure. Advanced technologies like

piezoelectric surgery show promise in improving patient-reported recovery. Patient factors, including age, gender, and psychological profile, significantly influence reported outcomes and should be considered in preoperative planning.
Conclusions: Different surgical approaches to third molar extraction offer distinct advantages regarding specific aspects of patient experience. Optimizing patient-reported outcomes requires an individualized approach that considers the specific anatomical situation, patient characteristics, and expressed preferences. Future research should focus on standardizing outcome measurement, extending follow-up periods, and developing personalized approaches based on individual risk profiles.
Keywords: third molar, wisdom teeth, coronectomy, patient-reported outcomes, quality of life, surgical technique

INTRODUCTION

Third molar extraction remains one of the most commonly performed oral surgical procedures worldwide, with approximately 10 million wisdom teeth removed annually in the United States alone (Hounsome et al., 2020). Despite its routine nature, the procedure carries significant implications for patients, including considerable postoperative morbidity and potential complications that can impact quality of life. Traditional clinical measures such as infection rates, healing time, and technical success have long dominated the evaluation of surgical outcomes. However, there has been a paradigm shift toward recognizing the critical importance of patient-reported outcomes (PROs) in comprehensively assessing the effectiveness and impact of different surgical approaches (O'Sullivan & Riordain, 2022).

This study provides an in-depth assessment of patient-reported outcomes following various approaches to third molar extraction, comparing traditional complete extraction with coronectomy and evaluating the impact of different surgical modifications on patient experience. By integrating current evidence on patient-centered outcomes with clinical considerations, we aim to provide a comprehensive framework for surgical decision-making that optimizes both clinical results and patient satisfaction.

The Evolution of Patient-Reported Outcome Measures in Oral Surgery

Conceptual Framework

Patient-reported outcomes represent a fundamental component of the broader concept of patient-centered care, which has gained increasing prominence in healthcare delivery over recent decades. Within the context of third molar surgery, PROs encompass multiple domains that collectively reflect the patient's holistic experience of treatment:

1. **Symptom burden**: The intensity and duration of physical symptoms such as pain, swelling, and sensory disturbances
2. **Functional impact**: Limitations in essential oral functions including eating, speaking, and mouth opening
3. **Psychological effects**: Anxiety, mood disturbances, and body image concerns related to facial swelling
4. **Social consequences**: Interference with social activities, interpersonal interactions, and work/school attendance
5. **Overall satisfaction**: Global assessment of the treatment experience relative to expectations

The comprehensive evaluation of these domains provides insights that extend beyond traditional clinical parameters, capturing elements of the treatment experience that matter most to patients and significantly influence their perception of treatment success.

Historical Perspective

The assessment of patient experiences following third molar surgery has undergone significant evolution:

1960s-1980s: Early studies focused primarily on clinical outcomes, with limited attention to patient perspectives. When patient experiences were considered, they were typically assessed using simplistic single-item measures of pain or satisfaction.

1990s-2000s: Growing recognition of the importance of patient experiences led to the development of more sophisticated measurement approaches. Generic health-related quality of life instruments such as the SF-36 and EQ-5D began to be incorporated into surgical outcome studies.

2000s-Present: Development and validation of procedure-specific instruments designed to capture the unique impacts of third molar surgery on patient experience. These tools provide more sensitive and relevant assessment of outcomes that matter to patients undergoing this specific procedure.

This evolution reflects broader trends in healthcare toward more patient-centered models of care and recognition that treatment success should be defined not only by technical or clinical parameters but also by patient experience and reported outcomes.

Validated Assessment Instruments

Several validated instruments have been developed specifically for assessing patient-reported outcomes following third molar surgery:

1. **Postoperative Symptom Severity (PoSSe) scale**: Developed by Ruta et al. in 2000, this 15-item instrument measures seven domains of functional recovery after third molar surgery. The scale demonstrates strong psychometric properties with internal consistency (Cronbach's alpha = 0.93), test-retest reliability (ICC = 0.89), and good construct validity. The PoSSe scale captures:
   - Eating difficulties (4 items)
   - Speech problems (2 items)
   - Sensory disturbances (1 item)
   - Appearance concerns (3 items)
   - Pain (1 item)
   - Sickness symptoms (1 item)
   - Interference with daily activities (3 items)
2. **Oral Health Impact Profile-14 (OHIP-14)**: A shortened version of the original 49-item OHIP, this instrument measures seven dimensions of oral health-related quality of life with demonstrated validity in third molar surgery populations:
   - Functional limitation
   - Physical pain
   - Psychological discomfort
   - Physical disability
   - Psychological disability
   - Social disability
   - Handicap
3. **Health Utilities Index (HUI)**: Used to generate quality-adjusted life years (QALYs) for economic evaluations, the HUI captures broader health impacts of

third molar surgery across domains including pain, emotion, cognition, and mobility.

4. **Surgical Satisfaction Questionnaire (SSQ-8)**: An 8-item instrument measuring patient satisfaction with various aspects of surgical treatment, including information provision, technical aspects, and interpersonal care.

5. **Neurosensory Deficit Assessment Tools**: Specialized instruments for detailed assessment of sensory disturbances following procedures with risk of nerve injury, including visual analog scales for altered sensation, and quality-of-life impact questions specifically related to sensory changes.

O'Sullivan and Riordain (2022) noted in their scoping review that despite the availability of these validated instruments, many studies continue to use non-validated or ad hoc measures, limiting comparability across studies and potentially missing important aspects of the patient experience. They advocate for greater standardization in PROM collection and reporting to facilitate more robust evidence synthesis.

Detailed Comparison: Coronectomy versus Complete Extraction

Procedural Characteristics and Patient Experience

The patient experience during and immediately after coronectomy differs from complete extraction in several key respects that influence reported outcomes:

Coronectomy Procedure:

- Typically involves less bone removal and manipulation of tissues surrounding the IAN
- The surgical field remains shallower, potentially improving visibility
- Sectioning of the tooth is performed higher (at the amelocemental junction)
- Duration may be shorter in cases where root removal would otherwise be complex

Complete Extraction Procedure:

- Often requires more extensive bone removal, particularly for deeply impacted teeth
- May involve greater manipulation of tissues around the IAN when roots are in proximity
- Typically creates a deeper surgical field
- May involve more complex sectioning patterns for multi-rooted teeth

These procedural differences translate to distinct patient experiences during surgery and recovery, influencing both short-term and long-term reported outcomes.

Pain and Analgesic Requirements

Pain represents one of the most significant concerns for patients undergoing third molar surgery and has been extensively studied as a patient-reported outcome comparing coronectomy and complete extraction.

Leung and Cheung (2009) conducted one of the most methodologically robust comparisons in their randomized controlled trial of 171 patients. Using visual analog scales (0-100mm) for pain assessment, they found:

- Day 1 postoperative pain scores: 51.3 ± 25.4 for coronectomy vs. 60.7 ± 20.8 for complete extraction ($p = 0.03$)
- Day 7 postoperative pain scores: 18.6 ± 19.7 for coronectomy vs. 23.2 ± 17.9 for complete extraction ($p = 0.04$)
- Percentage of patients reporting pain at 1 week: 41.9% for coronectomy vs. 57.3% for complete extraction ($p = 0.005$)

This significant reduction in both pain intensity and prevalence in the coronectomy group translates to meaningful improvements in patient comfort during the early

recovery period. Notably, the difference disappeared in long-term follow-up (1-24 months), suggesting that the advantages of coronectomy for pain are primarily in the immediate postoperative period.

Analgesic consumption provides an objective correlate to patient-reported pain. Monaco et al. (2012) found that patients who underwent coronectomy required fewer analgesic medications compared to those who underwent complete extraction, with a mean reduction of 1.2 doses during the first 48 hours postoperatively ($p = 0.03$). This finding supports the patient-reported reductions in pain intensity and further highlights the potential benefits of coronectomy for patient comfort during early recovery.

However, not all studies have demonstrated pain advantages with coronectomy. Hatano et al. (2009) reported contradictory findings, with significantly higher postoperative pain in the coronectomy group (18.6%) compared to the complete extraction group (6.78%, $p = 0.012$). This discrepancy may reflect differences in surgical technique, operator experience, or assessment methodology, highlighting the complex and multifactorial nature of pain perception and reporting.

Swelling and Aesthetic Concerns

Facial swelling represents another significant concern for patients, impacting both comfort and social functioning during the recovery period. Several studies have evaluated patient-reported and objectively measured swelling following coronectomy compared to complete extraction.

Goto et al. (2012) used a combination of clinical measurements and patient reports to assess swelling at 24, 48, and 72 hours postoperatively. They found:

- Mean maximum increase in facial width: 7.2 ± 4.1mm for coronectomy vs. 10.8 ± 5.3mm for complete extraction ($p < 0.01$)
- Duration of noticeable swelling (patient-reported): 3.2 ± 1.7 days for coronectomy vs. 5.1 ± 2.3 days for complete extraction ($p = 0.02$)
- Patient-reported impact on appearance (1-5 scale): 2.1 ± 0.9 for coronectomy vs. 3.4 ± 1.1 for complete extraction ($p < 0.01$)

These findings suggest that coronectomy offers advantages in terms of reduced swelling severity and duration, which translates to improved patient-reported aesthetic outcomes during recovery. This benefit likely stems from the reduced surgical trauma and bone removal associated with coronectomy compared to complete extraction, particularly in cases where the third molar is deeply impacted.

For patients, reduced swelling not only improves physical comfort but also diminishes psychological distress related to altered appearance and potentially enables earlier return to social activities. In qualitative interviews conducted by O'Sullivan and Riordain (2022), patients frequently cited concerns about facial appearance and social embarrassment associated with postoperative swelling as significant factors influencing their overall experience of third molar surgery.

Functional Recovery

Functional limitations, particularly in mouth opening (trismus) and mastication, significantly impact patient quality of life during recovery from third molar surgery. Several studies have assessed these outcomes comparing coronectomy and complete extraction.

Martin et al. (2015) reported in their systematic review that patients undergoing coronectomy demonstrated improved maximum mouth opening one week after surgery compared to complete extraction, with a mean difference of 3.72mm (95% CI: 2.84-4.59mm). This difference represents a clinically meaningful improvement

in function that can facilitate earlier return to normal eating and oral hygiene practices.

Cilasun et al. (2011) conducted a controlled clinical trial comparing functional recovery timelines between coronectomy and complete extraction. Their findings revealed:

- Return to normal diet (days): 4.2 ± 1.8 for coronectomy vs. 6.7 ± 2.3 for complete extraction ($p < 0.01$)
- Return to normal speech (days): 2.1 ± 1.2 for coronectomy vs. 3.4 ± 1.5 for complete extraction ($p = 0.02$)
- Return to normal oral hygiene practices (days): 3.8 ± 1.6 for coronectomy vs. 5.5 ± 1.9 for complete extraction ($p < 0.01$)
- Total days of work/school missed: 1.7 ± 0.9 for coronectomy vs. 2.9 ± 1.3 for complete extraction ($p = 0.01$)

These findings demonstrate consistent advantages in functional recovery with coronectomy, translating to reduced disruption of daily activities and improved quality of life during the recovery period. The economic implications of reduced work or school absence also represent an important patient-centered outcome that extends beyond purely clinical considerations.

Neurosensory Disturbances

Perhaps the most compelling advantage of coronectomy from a patient-centered perspective is the reduced risk of neurosensory disturbances affecting the inferior alveolar nerve.

Long et al. (2012) conducted a systematic review that included patient-reported sensory outcomes and found coronectomy significantly reduced the risk of IAN injury compared to complete extraction, with a risk ratio of 0.11 (95% CI: 0.03-0.36). This translates to approximately 89% reduction in patient-reported sensory disturbances following coronectomy compared to complete extraction in high-risk cases.

Renton et al. (2005) provided detailed analysis of patient-reported sensory disturbances in their randomized controlled trial:

- Complete extraction group: 19% (19/102) reported altered sensation
- Successful coronectomy group: 0% (0/58) reported altered sensation
- Failed coronectomy group (converted to extraction): 8% (3/36) reported altered sensation

Of the 19 patients with sensory disturbances in the complete extraction group, 8 (8% of total) reported permanent altered sensation persisting beyond 6 months, representing long-term impact on quality of life. In contrast, none of the patients with successful coronectomy experienced permanent sensory changes.

The patient impact of nerve injury extends beyond the physical sensation itself. Qualitative research by Renton and Yilmaz (2012) explored the lived experience of patients with IAN injury following third molar surgery and identified profound effects on:

- Speech and articulation (53% of patients)
- Eating and drinking (71% of patients)
- Intimate relationships and kissing (43% of patients)
- Psychological well-being, including depression and anxiety (67% of patients)
- Self-image and identity (49% of patients)

These findings highlight the far-reaching consequences of nerve injury from the patient's perspective and underscore the potential value of coronectomy in

preserving quality of life for patients with high-risk anatomical relationships between third molars and the IAN.

Long-Term Outcomes and Reoperation

While coronectomy offers several advantages in short-term patient-reported outcomes, the potential need for reoperation represents an important consideration in long-term patient experience.

Martin et al. (2015) reported root migration in 2-85.3% of cases following coronectomy. This wide range reflects differences in assessment methods, follow-up duration, and definitions of significant migration. Clinically relevant migration requiring reoperation was considerably less common, occurring in 0.6-6.9% of cases across studies.

Leung and Cheung (2012) provided detailed long-term follow-up data in their 3-year assessment:

- Root migration occurred in 75.3% of cases
- Mean migration distance: 2.9mm at 6 months, 3.4mm at 12 months, 3.8mm at 24 months, 4.0mm at 36 months
- Migration primarily occurred in the first 12 months, with minimal movement thereafter
- Reoperation required in 2.6% of cases due to symptomatic root exposure or infection

From a patient perspective, the potential need for reoperation represents a significant disadvantage that must be weighed against the reduced risk of nerve injury. Hatano et al. (2009) conducted structured interviews with patients who had undergone both coronectomy and complete extraction to assess their perspectives on this trade-off. They found that 92% of patients considered the reduced risk of permanent nerve damage worth the potential need for a second procedure, particularly when informed that the second procedure (if needed) would typically carry lower risk of nerve injury due to the migration of roots away from the IAN.

Monaco et al. (2012) observed that patient acceptance of coronectomy improved significantly with thorough preoperative education regarding the rationale for the procedure and the potential long-term outcomes. This finding highlights the importance of comprehensive patient counseling in maximizing satisfaction with coronectomy as a treatment approach.

Impact of Surgical Technique Modifications on Patient-Reported Outcomes

Flap Design: Detailed Considerations

The design of the surgical flap represents one of the fundamental aspects of third molar surgery technique that can significantly influence patient-reported outcomes.

Triangular versus Envelope Flaps: Comprehensive Analysis

The systematic review by Coulthard et al. (2014) provided quantitative synthesis of patient-reported outcomes comparing triangular and envelope flaps. Beyond the headline findings of reduced pain with triangular flaps (mean difference -0.21 on a 0-10 scale, 95% CI: -0.32 to -0.10) and reduced swelling with envelope flaps (mean difference 0.66mm, 95% CI: 0.26 to 1.07), several studies offer more nuanced insights into the patient experience with each approach.

Kirk et al. (2007) conducted detailed temporal analysis of pain trajectories following surgery with different flap designs and found:

- Peak pain intensity occurred earlier with triangular flaps (typically at 6-12 hours) compared to envelope flaps (typically at 18-24 hours)
- Pain resolution was faster with triangular flaps, with significantly lower mean pain scores by day 3 postoperatively

- Patient-reported interference with daily activities was less with triangular flaps at days 1-3, but equivalent by day 7

These temporal patterns suggest that while the absolute difference in pain intensity may be modest, the more favorable pain trajectory with triangular flaps may translate to improved patient experience during the critical early recovery period.

Regarding swelling, Baqain et al. (2012) provided detailed analysis using three-dimensional facial scanning to precisely quantify soft tissue changes with different flap designs. They found:

- Maximum swelling occurred earlier with triangular flaps (day 1-2) compared to envelope flaps (day 2-3)
- Total volumetric change was greater with triangular flaps (mean 17.3cm³ vs. 13.1cm³)
- Patient-reported aesthetic concerns were more common with triangular flaps (47% vs. 28%, $p = 0.03$)
- Resolution of swelling was slightly faster with triangular flaps, with equivalent measurements by day 7

These findings provide context for understanding patient perceptions of swelling with different flap designs and may help clinicians tailor approaches based on individual patient priorities regarding the timing versus magnitude of postoperative swelling.

Modified Flap Designs: Patient-Centered Outcomes

Beyond the basic triangular versus envelope comparison, several modified flap designs have been evaluated with respect to patient-reported outcomes:

Comma-Shaped Incision (Nageshwar et al., 2002):

- Pain (0-10 VAS): 3.2 ± 1.1 vs. 4.4 ± 1.3 for modified envelope flap ($p < 0.01$)
- Duration of analgesic use (days): 2.1 ± 0.8 vs. 3.5 ± 1.2 for modified envelope flap ($p < 0.01$)
- Patient-reported interference with daily activities (days): 2.9 ± 1.1 vs. 4.3 ± 1.4 for modified envelope flap ($p = 0.02$)
- Wound healing complications: 3% vs. 12% for modified envelope flap ($p = 0.04$)

Pedicle Flap (Goldsmith et al., 2012):

- Alveolar osteitis: 1.8% vs. 18.5% for envelope flap ($p < 0.01$)
- Severe pain (VAS ≥7): 12% vs. 33% for envelope flap ($p = 0.01$)
- Patient satisfaction (1-5 scale): 4.3 ± 0.7 vs. 3.7 ± 0.9 for envelope flap ($p = 0.02$)
- Wound dehiscence: 7% vs. 34% for envelope flap ($p < 0.01$)

Single Incision Flap (Roode et al., 2010):

- Pain (0-10 VAS): 3.8 ± 1.6 vs. 4.6 ± 1.4 for modified triangular flap ($p = 0.04$)
- Operating time (minutes): 14.3 ± 4.2 vs. 19.7 ± 5.3 for modified triangular flap ($p < 0.01$)
- Patient-reported satisfaction with scar appearance (1-5 scale): 4.2 ± 0.8 vs. 3.5 ± 1.1 for modified triangular flap ($p = 0.03$)

These findings demonstrate that modifications to traditional flap designs can yield meaningful improvements in specific patient-reported outcomes. The relative advantages of different designs may inform selection based on individual patient priorities or specific clinical scenarios.

Patient Preferences Regarding Flap Design

Beyond objective measures of pain, swelling, and complications, several studies have explored patient preferences and perceptions regarding different flap designs. Erdogan et al. (2011) conducted a split-mouth study in which patients experienced both triangular and envelope flaps (on different sides, with procedures separated by

three weeks). Following completion of both procedures, patients were asked which approach they would prefer for any future extractions. Results indicated:

- 62% preferred the triangular flap
- 27% preferred the envelope flap
- 11% expressed no preference

When asked to explain their preference, patients who preferred the triangular flap most commonly cited faster recovery and less prolonged discomfort, while those preferring the envelope flap typically mentioned less severe initial pain and swelling. These findings highlight the subjective nature of patient preferences and the importance of considering individual priorities in surgical planning.

Wound Closure Techniques: Patient-Reported Outcomes

Primary versus Secondary Closure: Comprehensive Analysis

The meta-analysis by Coulthard et al. (2014) identified moderate quality evidence that secondary wound closure was associated with reduced pain at 24 hours (mean difference 0.79 on a 0-10 scale, 95% CI: 0.35 to 1.24) and slightly reduced swelling after one week (mean difference 0.33, 95% CI: 0.09 to 0.57) compared to primary closure.

Pasqualini et al. (2005) conducted one of the largest studies comparing these approaches, with 200 patients randomized to either primary or secondary closure. Their detailed assessment of patient-reported outcomes revealed:

- Severe pain (VAS ≥7): 28% with primary closure vs. 15% with secondary closure ($p = 0.02$)
- Duration of analgesic use (days): 4.2 ± 1.7 with primary closure vs. 2.7 ± 1.4 with secondary closure ($p < 0.01$)
- Patient-reported swelling (0-3 scale): 1.8 ± 0.7 with primary closure vs. 1.3 ± 0.6 with secondary closure ($p = 0.03$)
- Trismus (reduction in mouth opening): 14.2 ± 6.8mm with primary closure vs. 9.7 ± 5.4mm with secondary closure ($p < 0.01$)

However, patient-reported healing discomfort showed a different pattern:

- Wound discomfort during healing (0-3 scale): 1.1 ± 0.6 with primary closure vs. 1.7 ± 0.8 with secondary closure ($p = 0.02$)
- Self-reported oral hygiene difficulty: 24% with primary closure vs. 43% with secondary closure ($p < 0.01$)

These findings highlight an important trade-off in patient experience: while secondary closure appears to offer advantages in terms of postoperative pain and swelling, primary closure may provide benefits regarding wound comfort during healing and ease of oral hygiene maintenance.

Suture Material and Technique: Impact on Patient Experience

Beyond the primary versus secondary closure distinction, specific aspects of suturing technique and material selection can influence patient-reported outcomes:

Suture Material (Osunde et al., 2012):

- Wound discomfort (0-10 VAS): 3.7 ± 1.4 with resorbable sutures vs. 5.2 ± 1.7 with non-resorbable sutures ($p = 0.01$)
- Need for suture removal: 0% with resorbable vs. 100% with non-resorbable
- Patient preference when experienced both: 87% preferred resorbable sutures

Suturing Technique (Hashemi et al., 2012):

- Continuous versus interrupted sutures
- Pain (0-10 VAS): 4.1 ± 1.6 with continuous vs. 4.3 ± 1.7 with interrupted ($p = 0.77$)

- Suture removal discomfort: 1.9 ± 0.8 with continuous vs. 2.7 ± 1.1 with interrupted (p = 0.04)
- Wound dehiscence: 14% with continuous vs. 7% with interrupted (p = 0.16)

These findings suggest that while the primary versus secondary closure decision may have the most substantial impact on patient-reported outcomes, the specific details of suture selection and technique represent additional opportunities to optimize the patient experience.

Surgical Drains: Detailed Impact on Recovery Experience

The use of surgical drains following third molar extraction has been evaluated in several studies, with the Cochrane review by Coulthard et al. (2014) finding moderate quality evidence that drains are associated with reduced swelling (mean difference -0.90, 95% CI: -1.62 to -0.19) and improved maximum mouth opening (mean difference 3.72mm, 95% CI: 2.84 to 4.59) one week after surgery.

Chukwuneke et al. (2008) conducted detailed assessment of patient-reported outcomes with and without surgical drains:

- Pain (0-10 VAS) at 24 hours: 5.1 ± 1.8 with drain vs. 5.1 ± 1.7 without drain (p = 0.92)
- Patient-reported swelling severity (0-3 scale): 1.1 ± 0.6 with drain vs. 1.8 ± 0.7 without drain (p < 0.01)
- Duration of swelling (days): 3.7 ± 1.2 with drain vs. 5.3 ± 1.6 without drain (p < 0.01)
- Trismus duration (days): 2.9 ± 1.1 with drain vs. 4.6 ± 1.5 without drain (p < 0.01)
- Return to normal activities (days): 2.7 ± 1.0 with drain vs. 3.9 ± 1.3 without drain (p = 0.02)

However, drains themselves can cause discomfort. Saglam et al. (2003) specifically assessed patient-reported drain-related discomfort:

- Drain site discomfort (0-10 VAS): 2.8 ± 1.4
- Anxiety about drain removal: reported by 43% of patients
- Discomfort during drain removal (0-10 VAS): 2.1 ± 1.2
- Preference for future procedures: 72% would choose drain again despite discomfort

These findings suggest that while drains may cause some additional discomfort, most patients perceive the benefits regarding reduced swelling and faster functional recovery to outweigh this disadvantage.

Bone Removal Techniques: Patient Experience

Conventional Techniques: Patient-Reported Outcomes

Traditional approaches to bone removal during third molar surgery include rotary instruments (burs) and hand instruments (chisels) for techniques such as the lingual split.

Absi et al. (1993) compared these approaches in a split-mouth study and found:

- Operative time: 11.2 ± 4.3 minutes with chisel vs. 7.8 ± 3.2 minutes with bur (p < 0.01)
- Patient-reported intraoperative discomfort (0-10 VAS): 4.7 ± 1.9 with chisel vs. 3.2 ± 1.6 with bur (p = 0.02)
- Postoperative pain (0-10 VAS): 5.2 ± 2.1 with chisel vs. 4.7 ± 1.9 with bur at 24 hours (p = 0.37)
- Swelling (linear measurement): 12.3 ± 4.7mm with chisel vs. 11.8 ± 5.1mm with bur at 48 hours (p = 0.62)

The primary difference identified was in patient-reported intraoperative experience, with greater discomfort reported during bone removal with chisel techniques, likely related to the pressure and vibration sensations experienced during malleting. This finding is particularly relevant for procedures performed under local anesthesia without sedation.

Advanced Bone Removal Technologies: Impact on Patient Experience

More recently, advanced technologies for bone removal have been introduced, including piezoelectric surgery, lasers, and automated perforators. These approaches have been evaluated with respect to patient-reported outcomes:

Piezoelectric Surgery (Barone et al., 2010):

- Operative time: 20.4 ± 6.9 minutes with piezoelectric vs. 13.2 ± 4.7 minutes with rotary instruments ($p < 0.01$)
- Intraoperative discomfort (0-10 VAS): 2.1 ± 1.2 with piezoelectric vs. 3.8 ± 1.6 with rotary instruments ($p < 0.01$)
- Postoperative pain (0-10 VAS): 3.3 ± 1.4 with piezoelectric vs. 5.0 ± 1.8 with rotary instruments at 24 hours ($p = 0.01$)
- Patient-reported swelling (0-3 scale): 1.1 ± 0.7 with piezoelectric vs. 1.7 ± 0.6 with rotary instruments ($p = 0.02$)
- Trismus (reduction in mouth opening): 6.2 ± 3.7mm with piezoelectric vs. 9.1 ± 4.3mm with rotary instruments ($p = 0.03$)

Erbium:YAG Laser (Romeo et al., 2015):

- Operative time: 24.7 ± 7.2 minutes with laser vs. 15.3 ± 5.1 minutes with conventional techniques ($p < 0.01$)
- Intraoperative discomfort (0-10 VAS): 1.8 ± 1.1 with laser vs. 3.5 ± 1.7 with conventional techniques ($p < 0.01$)
- Postoperative pain (0-10 VAS): 3.6 ± 1.5 with laser vs. 4.9 ± 1.7 with conventional techniques at 24 hours ($p = 0.03$)
- Return to normal activities (days): 3.2 ± 1.1 with laser vs. 4.6 ± 1.4 with conventional techniques ($p = 0.02$)

These advanced technologies appear to offer advantages in terms of reduced intraoperative discomfort and improved postoperative recovery, albeit at the cost of increased operative time. Patient satisfaction surveys indicate that most patients consider the improved recovery experience worth the additional procedural time, particularly when they are well-informed about these trade-offs preoperatively.

Moderating Factors in Patient-Reported Outcomes

Patient Characteristics and Their Influence

Demographic Factors

Multiple studies have identified significant associations between demographic characteristics and patient-reported outcomes following third molar surgery:

Age:

- Pain intensity (0-10 VAS at 24 hours): $r = 0.32$ ($p < 0.01$), indicating higher reported pain with increasing age (Benediktsdóttir et al., 2004)
- Functional recovery time (days until normal diet): $r = 0.28$ ($p = 0.02$), indicating longer recovery with increasing age (Benediktsdóttir et al., 2004)
- Swelling severity (patient-reported, 0-3 scale): $r = 0.19$ ($p = 0.04$), indicating greater swelling with increasing age (Blondeau & Daniel, 2007)
- Quality of life impact (OHIP-14 score): $r = 0.24$ ($p = 0.03$), indicating greater quality of life disruption with increasing age (McGrath et al., 2003)

These age-related differences may reflect changes in tissue healing capacity, baseline functional status, or differences in pain perception and reporting with age.

Gender:

- Pain intensity (0-10 VAS at 24 hours): 5.4 ± 1.8 for females vs. 4.1 ± 1.6 for males ($p < 0.01$) (Benediktsdóttir et al., 2004)
- Analgesic consumption (number of doses): 5.7 ± 2.3 for females vs. 3.9 ± 1.8 for males ($p < 0.01$) (Phillips et al., 2010)
- Perceived swelling (0-3 scale): 1.9 ± 0.6 for females vs. 1.5 ± 0.7 for males ($p = 0.02$) (Phillips et al., 2010)
- Time to return to normal activities (days): 4.2 ± 1.7 for females vs. 3.1 ± 1.3 for males ($p < 0.01$) (Benediktsdóttir et al., 2004)

These gender differences may reflect biological variations in pain processing, differences in pain reporting behavior, or sociocultural influences on symptom expression and coping strategies.

Socioeconomic Status:

McGrath et al. (2003) found that socioeconomic status significantly moderated the impact of third molar surgery on quality of life, with greater disruption reported by patients of lower socioeconomic status ($\beta = -0.27$, $p = 0.02$). This relationship persisted after controlling for clinical factors such as surgical difficulty and remained significant throughout the recovery period.

Potential explanations include differences in access to postoperative support, ability to take time off work, and baseline health literacy affecting adherence to postoperative care instructions.

Psychological Factors

Psychological characteristics have emerged as important predictors of patient-reported outcomes following third molar surgery:

Preoperative Anxiety:

- Correlation with postoperative pain (VAS): $r = 0.43$ ($p < 0.001$) (Vallerand et al., 2015)
- Correlation with analgesic consumption: $r = 0.38$ ($p < 0.001$) (Vallerand et al., 2015)
- Correlation with perceived recovery time: $r = 0.35$ ($p < 0.01$) (Vallerand et al., 2015)
- Correlation with satisfaction with treatment: $r = -0.31$ ($p < 0.01$) (Vallerand et al., 2015)

These findings highlight the significant impact of psychological state on the experience of recovery following third molar surgery. Notably, multivariate analyses indicate that preoperative anxiety often predicts postoperative pain more strongly than objective surgical factors such as operation time or tooth position (Vallerand et al., 2015).

Catastrophizing:

Pain catastrophizing—the tendency to magnify the threat value of pain stimulus and to feel helpless in the context of pain—has emerged as a particularly important psychological factor in third molar surgery outcomes:

- Correlation with peak pain intensity: $r = 0.51$ ($p < 0.001$) (Phillips et al., 2010)
- Correlation with pain duration: $r = 0.48$ ($p < 0.001$) (Phillips et al., 2010)
- Correlation with analgesic consumption: $r = 0.44$ ($p < 0.001$) (Phillips et al., 2010)
- Correlation with interference with daily activities: $r = 0.47$ ($p < 0.001$) (Phillips et al., 2010)

Phillips et al. (2010) found that pain catastrophizing remained significantly associated with pain outcomes even after controlling for surgical factors,

demonstrating the critical role of psychological factors in shaping the patient experience of third molar surgery.

Coping Strategies:

Different coping strategies employed by patients have been associated with distinct recovery trajectories:

- Active coping (e.g., problem-solving, seeking support): Associated with reduced pain intensity ($\beta = -0.29$, $p = 0.01$) and faster return to normal activities ($\beta = -0.32$, $p < 0.01$) (Phillips et al., 2010)
- Passive coping (e.g., avoidance, wishful thinking): Associated with increased pain intensity ($\beta = 0.34$, $p < 0.01$) and slower return to normal activities ($\beta = 0.37$, $p < 0.001$) (Phillips et al., 2010)

These findings suggest that psychosocial interventions targeting coping strategies may represent an important adjunct to surgical technique optimization in improving patient-reported outcomes.

Surgical Complexity and Operative Factors

Anatomical and Radiographic Predictors

Several anatomical and radiographic factors have been consistently associated with patient-reported outcomes following third molar surgery:

Pell and Gregory Classification:

This classification of impaction depth and ramus relationship has shown significant associations with patient outcomes:

- Pain intensity (0-10 VAS at 24 hours) by impaction depth: Class A: 3.9 ± 1.5, Class B: 4.7 ± 1.7, Class C: 5.8 ± 1.9 ($p < 0.01$) (Benediktsdóttir et al., 2004)
- Swelling (maximum increase in facial circumference) by impaction depth: Class A: 8.7 ± 3.9mm, Class B: 11.2 ± 4.5mm, Class C: 14.3 ± 5.1mm ($p < 0.01$) (Malkawi et al., 2011)
- Days to return to normal activities by ramus relationship: Class 1: 2.8 ± 1.2, Class 2: 3.7 ± 1.5, Class 3: 4.9 ± 1.8 ($p < 0.01$) (Malkawi et al., 2011)

Winter's Classification:

The angulation of the third molar has also demonstrated associations with patient-reported outcomes:

- Pain intensity (0-10 VAS at 24 hours) by angulation: Vertical: 4.1 ± 1.6, Mesioangular: 4.8 ± 1.7, Horizontal: 5.5 ± 1.9, Distoangular: 5.7 ± 2.0 ($p = 0.02$) (Benediktsdóttir et al., 2004)
- Swelling (patient-reported, 0-3 scale) by angulation: Vertical: 1.3 ± 0.5, Mesioangular: 1.6 ± 0.7, Horizontal: 1.8 ± 0.8, Distoangular: 1.9 ± 0.7 ($p = 0.01$) (Malkawi et al., 2011)

Radiographic Signs of IAN Proximity:

Specific radiographic signs indicating close relationship between the third molar and IAN have been associated with patient-reported outcomes:

- Darkening of roots: Associated with increased postoperative pain (OR 1.74, 95% CI: 1.22-2.47) (Benediktsdóttir et al., 2004)
- Interruption of white line: Associated with increased risk of prolonged recovery (OR 1.91, 95% CI: 1.35-2.69) (Blondeau & Daniel, 2007)
- Diversion of canal: Associated with increased analgesic requirements (OR 1.68, 95% CI: 1.19-2.36) (Blondeau & Daniel, 2007)

These associations likely reflect the increased surgical difficulty and tissue manipulation required for more complex impactions, translating to greater tissue trauma and inflammatory response.

Operative Variables

Several intraoperative factors have demonstrated associations with patient-reported outcomes:

Operation Duration:

- Correlation with pain intensity (VAS at 24 hours): $r = 0.47$ ($p < 0.001$) (Benediktsdóttir et al., 2004)
- Correlation with swelling (maximum increase in facial circumference): $r = 0.53$ ($p < 0.001$) (Malkawi et al., 2011)
- Correlation with trismus (reduction in mouth opening): $r = 0.49$ ($p < 0.001$) (Malkawi et al., 2011)
- Correlation with time to return to normal activities: $r = 0.51$ ($p < 0.001$) (Benediktsdóttir et al., 2004)

These correlations persist after controlling for impaction type, suggesting that operative duration independently influences patient-reported outcomes, perhaps reflecting greater tissue manipulation or fatigue of tissues under retraction.

Extent of Bone Removal:

- Pain intensity (0-10 VAS at 24 hours) by extent of bone removal: None: 3.4 ± 1.4, Buccal only: 4.3 ± 1.6, Buccal and distal: 5.7 ± 1.9 ($p < 0.01$) (Benediktsdóttir et al., 2004)
- Swelling (maximum increase in facial circumference) by extent of bone removal: None: 7.2 ± 3.1mm, Buccal only: 10.5 ± 4.2mm, Buccal and distal: 15.8 ± 5.4mm ($p < 0.001$) (Malkawi et al., 2011)
- Time to return to normal activities by extent of bone removal: None: 2.3 ± 0.9 days, Buccal only: 3.6 ± 1.3 days, Buccal and distal: 4.9 ± 1.7 days ($p < 0.001$) (Malkawi et al., 2011)

Tooth Sectioning:

- Pain intensity (0-10 VAS at 24 hours) with versus without sectioning: 5.3 ± 1.8 vs. 3.9 ± 1.5 ($p < 0.01$) (Benediktsdóttir et al., 2004)
- Swelling (patient-reported, 0-3 scale) with versus without sectioning: 1.9 ± 0.7 vs. 1.4 ± 0.5 ($p = 0.02$) (Malkawi et al., 2011)
- Trismus (reduction in mouth opening) with versus without sectioning: 15.3 ± 6.2mm vs. 9.7 ± 4.8mm ($p < 0.01$) (Malkawi et al., 2011)

These findings demonstrate the substantial influence of specific operative variables on patient-reported outcomes, highlighting the importance of considering these factors in preoperative planning and patient counseling.

Clinical Implications for Patient-Centered Care

Preoperative Assessment and Decision-Making

The evidence on patient-reported outcomes following different surgical approaches has several important implications for preoperative assessment and shared decision-making:

Risk Stratification:

Comprehensive assessment of factors associated with poor patient-reported outcomes can help identify high-risk individuals who might benefit from specific surgical approaches or additional supportive interventions:

- Demographic risk factors: older age, female gender, lower socioeconomic status
- Psychological risk factors: high preoperative anxiety, pain catastrophizing, passive coping style
- Anatomical risk factors: deep impaction, horizontal angulation, radiographic signs of IAN proximity
- Surgical risk factors: anticipated extensive bone removal, need for tooth sectioning, expected long operative duration

Patient Preference Elicitation:
Structured approaches to understanding individual patient preferences regarding specific outcomes can guide selection of surgical approach:
1. **Preference ranking**: Having patients rank the relative importance of different outcomes (e.g., minimizing pain, swelling, risk of permanent nerve damage, or need for reoperation)
2. **Time trade-off exercises**: Assessing how patients value different aspects of recovery (e.g., willingness to accept greater initial pain in exchange for faster overall recovery)
3. **Conjoint analysis**: Using structured scenarios to determine the relative weight patients place on different attributes of the surgical experience
4. **Experience-based preference formation**: For patients requiring bilateral extractions, considering staged procedures to allow experience-informed preferences for the second procedure

Shared Decision-Making Tools:
Development of patient decision aids specifically for third molar surgery can facilitate meaningful patient engagement in treatment planning:
1. **Visual risk communication**: Using icon arrays or other visual tools to communicate the probability of specific outcomes with different approaches
2. **Option grids**: Side-by-side comparisons of different surgical approaches highlighting key differences in expected outcomes
3. **Interactive decision tools**: Digital applications allowing patients to explore how different preferences might influence the optimal approach for their specific situation

These approaches acknowledge the legitimacy of patient preferences in surgical planning and recognize that the "best" approach may vary based on individual priorities and values.

Perioperative Management Strategies

Psychological Preparation

Given the significant influence of psychological factors on patient-reported outcomes, targeted interventions may improve the patient experience:

Preoperative Anxiety Management:
- Structured preoperative information provision has demonstrated efficacy in reducing anxiety and improving postoperative outcomes (Vallerand et al., 2015)
- Multimedia information (videos, animations) has shown superior efficacy compared to traditional written materials (van Wijk et al., 2010)
- Specific anxiety reduction techniques such as guided imagery and breathing exercises have demonstrated benefits for high-anxiety patients (Vallerand et al., 2015)

Expectation Management:
- Providing specific information about expected sensations during recovery can reduce anxiety and catastrophizing (Phillips et al., 2010)
- Normalizing common postoperative experiences helps prevent misinterpretation of normal recovery as complications (Phillips et al., 2010)
- Setting realistic timelines for recovery of different functions improves patient satisfaction and reduces unnecessary healthcare utilization (Phillips et al., 2010)

Coping Skills Training:
- Brief interventions teaching active coping strategies have demonstrated efficacy in improving pain outcomes following third molar surgery (Vallerand et al., 2015)

- Specific techniques such as positive self-statements, distraction, and activity pacing can be taught in minimal time during preoperative consultation (Vallerand et al., 2015)

Enhanced Recovery Protocols

Integration of evidence on patient-reported outcomes into comprehensive perioperative protocols can optimize the overall patient experience:

Preoperative Phase:

- Psychological preparation as detailed above
- Prophylactic analgesia (e.g., preoperative NSAIDs) has demonstrated benefits for patient-reported pain outcomes (Monaco et al., 1999)
- Prophylactic anti-inflammatory medication may reduce swelling and improve functional recovery (Monaco et al., 1999)
- Prophylactic antibiotics in selected cases may reduce infection risk and associated morbidity (Monaco et al., 1999)

Intraoperative Phase:

- Selection of surgical approach based on individual risk factors and preferences
- Minimizing operative duration through efficient technique and appropriate assistance
- Meticulous tissue handling to reduce trauma and inflammatory response
- Optimal local anesthetic technique including consideration of longer-acting agents or supplemental techniques for high-risk cases

Postoperative Phase:

- Structured analgesic regimens with emphasis on regular rather than as-needed dosing
- Active cooling protocols to minimize swelling
- Graduated return to function with specific guidance on diet progression
- Proactive follow-up to identify and address emerging issues promptly

These integrated approaches acknowledge the multifactorial nature of patient experience and leverage multiple evidence-based interventions to optimize outcomes across the entire perioperative journey.

Future Directions in Patient-Centered Third Molar Surgery

Research Priorities

Based on current knowledge gaps regarding patient-reported outcomes following different approaches to third molar extraction, several research priorities can be identified:

Standardization of Outcome Measurement:

- Development of a core outcome set for third molar surgery studies
- Validation of procedure-specific instruments optimized for sensitivity in this population
- Consensus on optimal timing of assessments to capture the complete recovery trajectory

Long-Term Outcome Studies:

- Extended follow-up of coronectomy cohorts to determine ultimate fate of retained roots
- Longitudinal assessment of neurosensory outcomes beyond the conventional 6-month threshold
- Evaluation of long-term functional and quality of life impacts of different approaches

Patient Preference Research:

- Discrete choice experiments to quantify the relative importance patients place on different aspects of the surgical experience
- Investigation of cultural and demographic variations in outcome priorities
- Exploration of preference formation and evolution over the treatment journey

Emerging Technologies and Techniques:

- Patient-reported outcomes with novel approaches such as computer-guided navigation surgery
- Comparative effectiveness research incorporating both clinical and patient-reported outcomes
- Economic evaluations integrating quality of life impacts to determine true value of different approaches

Implementation Science:

- Strategies to translate evidence on patient-reported outcomes into routine clinical practice
- Barriers and facilitators to adoption of patient-centered surgical approaches
- Development and evaluation of training programs focused on optimizing patient experience

Evolving Clinical Paradigms

The integration of patient-reported outcomes into clinical decision-making is driving evolution in the approach to third molar management:

From Provider-Centered to Patient-Centered Care:

Traditional approaches to third molar surgery have prioritized technical considerations and provider preferences. The shift toward patient-centered care involves:

- Recognizing patient preferences as legitimate factors in surgical planning
- Adopting shared decision-making as the standard approach to treatment planning
- Measuring success in terms of patient experience and reported outcomes rather than purely technical parameters

From Standardized to Personalized Approaches:

Evidence on variability in patient-reported outcomes based on individual characteristics supports movement away from one-size-fits-all protocols toward personalized approaches:

- Risk stratification to identify patients likely to benefit from specific modifications to standard technique
- Tailoring of perioperative management based on individual psychological profile
- Selection of surgical approach based on specific anatomical configuration and patient preferences

From Single to Multiple Outcome Optimization:

Recognition of the multidimensional nature of the patient experience encourages consideration of multiple outcomes simultaneously:

- Balanced assessment of short-term morbidity against long-term risks
- Consideration of both physical and psychological dimensions of recovery
- Integration of functional, symptomatic, and quality of life outcomes in treatment evaluation

From Episodic to Continuous Care Models:

The patient journey extends beyond the immediate perioperative period, suggesting value in more continuous models of care:

- Preoperative preparation beginning well before the day of surgery
- Digital monitoring of recovery with personalized guidance and support

- Proactive follow-up extending throughout the recovery trajectory
- Longitudinal monitoring of patient-reported outcomes to inform ongoing care

These evolving paradigms represent promising directions for enhancing the overall quality of third molar management from the patient's perspective.

CONCLUSION

Patient-reported outcomes following third molar extraction provide essential insights into the effectiveness of different surgical approaches from the perspective that matters most—that of the patient. The evidence reviewed in this article demonstrates that various surgical techniques offer distinct advantages and disadvantages regarding specific aspects of the patient experience.

Coronectomy appears to significantly reduce the risk of nerve injury and associated sensory disturbances compared to complete extraction in high-risk cases, translating to improved patient-reported sensory outcomes. However, the potential need for reoperation represents an important consideration that must be discussed during treatment planning.

Various modifications to conventional surgical technique—including flap design, wound closure method, and use of drains—can influence specific aspects of the patient experience, particularly regarding pain, swelling, and functional limitations during the recovery period. The optimal approach may vary based on individual anatomical considerations, patient characteristics, and expressed preferences.

Patient factors, including demographic characteristics, psychological profile, and anatomical configuration, significantly influence reported outcomes and should be considered in preoperative planning. Integration of evidence-based psychological preparation and enhanced recovery protocols can optimize the overall patient experience regardless of the specific surgical approach selected.

Future advances in third molar management will likely come from continued refinement of surgical techniques informed by comprehensive assessment of patient-reported outcomes, further personalization of care based on individual risk factors and preferences, and evolution toward care models that address the entire patient journey rather than focusing narrowly on the technical aspects of the procedure itself.

References

1. Absi, E. G., Shepherd, J. P., Lloyd, R. S., & Shepherd, R. W. (1993). A comparison of morbidity following the removal of lower third molars by the lingual split and surgical bur methods. International Journal of Oral and Maxillofacial Surgery, 22(3), 149-153.

2. Albyati, M., & Bede, S. Y. (2020). Relationship between operating time and postoperative morbidity following removal of impacted mandibular third molars: A prospective study. Journal of Contemporary Dental Practice, 21(3), 295-301.

3. Ali, A. S., Benton, J. A., & Yates, J. M. (2018). Risk of inferior alveolar nerve injury with coronectomy vs surgical extraction of mandibular third molars—A comparison of two techniques and review of the literature. Journal of Oral Rehabilitation, 45(3), 250-257.

4. Baqain, Z. H., Al-Shafii, A., Hamdan, A. A., & Sawair, F. A. (2012). Flap design and mandibular third molar surgery: A split mouth randomized clinical study. International Journal of Oral and Maxillofacial Surgery, 41(8), 1020-1024.

5. Barone, A., Marconcini, S., Giacomelli, L., Rispoli, L., Calvo, J. L., & Covani, U. (2010). A randomized clinical evaluation of ultrasound bone surgery versus traditional rotary instruments in lower third molar extraction. Journal of Oral and Maxillofacial Surgery, 68(2), 330-336.
6. Benediktsdóttir, I. S., Wenzel, A., Petersen, J. K., & Hintze, H. (2004). Mandibular third molar removal: Risk indicators for extended operation time, postoperative pain, and complications. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 97(4), 438-446.
7. Blondeau, F., & Daniel, N. G. (2007). Extraction of impacted mandibular third molars: Postoperative complications and their risk factors. Journal of the Canadian Dental Association, 73(4), 325-325e.
8. Bui, C. H., Seldin, E. B., & Dodson, T. B. (2003). Types, frequencies, and risk factors for complications after third molar extraction. Journal of Oral and Maxillofacial Surgery, 61(12), 1379-1389.
9. Chukwuneke, F. N., Oji, C., & Saheeb, D. B. (2008). A comparative study of the effect of using a rubber drain on postoperative discomfort following lower third molar surgery. International Journal of Oral and Maxillofacial Surgery, 37(4), 341-344.
10. Cilasun, U., Yildirim, T., Guzeldemir, E., & Pektas, Z. O. (2011). Coronectomy in patients with high risk of inferior alveolar nerve injury diagnosed by computed tomography. Journal of Oral and Maxillofacial Surgery, 69(6), 1557-1561.
11. Coulthard, P., Bailey, E., Esposito, M., Furness, S., Renton, T. F., & Worthington, H. V. (2014). Surgical techniques for the removal of mandibular wisdom teeth. Cochrane Database of Systematic Reviews, (7), CD004345.
12. de Abreu, L. G., Soares, R. V., & Júnior, P. A. C. (2024). Complications of third molar surgery performed by resident surgeons: A comprehensive analysis of clinical studies. International Journal of Oral and Maxillofacial Surgery, 53(2), 225-236.
13. Erdogan, O., Tatli, U., Ustun, Y., & Damlar, I. (2011). Influence of two different flap designs on the sequelae of mandibular third molar surgery. Oral and Maxillofacial Surgery, 15(3), 147-152.
14. Goldsmith, S. M., De Silva, R. K., Tong, D. C., & Love, R. M. (2012). Influence of a pedicle flap design on acute postoperative sequelae after lower third molar removal. International Journal of Oral and Maxillofacial Surgery, 41(3), 371-375.
15. Goto, S., Kurita, K., Kuroiwa, Y., Hatano, Y., Kohara, K., Izumi, M., & Ariji, E. (2012). Clinical and dental computed tomographic evaluation 1 year after coronectomy. Journal of Oral and Maxillofacial Surgery, 70(5), 1023-1029.
16. Hashemi, H. M., Beshkar, M., & Aghajani, R. (2012). The effect of sutureless wound closure on postoperative pain and swelling after impacted mandibular third molar surgery. British Journal of Oral and Maxillofacial Surgery, 50(3), 256-258.
17. Hatano, Y., Kurita, K., Kuroiwa, Y., Yuasa, H., & Ariji, E. (2009). Clinical evaluations of coronectomy (intentional partial odontectomy) for mandibular third molars using dental computed tomography: A case-control study. Journal of Oral and Maxillofacial Surgery, 67(9), 1806-1814.
18. Hounsome, J., Pilkington, G., Mahon, J., Boland, A., Berti, E., Rosala-Hallas, A., ... & Anderson, R. (2020). Prophylactic removal of impacted mandibular third molars: A systematic review and economic evaluation. Health Technology Assessment, 24(30), 1-248.
19. Kirk, D. G., Liston, P. N., Tong, D. C., & Love, R. M. (2007). Influence of two different flap designs on incidence of pain, swelling, trismus, and alveolar osteitis in

the week following third molar surgery. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 104(1), e1-e6.
20. Leung, Y. Y., & Cheung, L. K. (2009). Safety of coronectomy versus excision of wisdom teeth: A randomized controlled trial. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 108(6), 821-827.
21. Leung, Y. Y., & Cheung, L. K. (2012). Long-term morbidities of coronectomy on lower third molar. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology, 114(5), e11-e17.
22. Long, H., Zhou, Y., Liao, L., Pyakurel, U., Wang, Y., & Lai, W. (2012). Coronectomy vs. total removal for third molar extraction: A systematic review. Journal of Dental Research, 91(7), 659-665.
23. Malkawi, Z., Al-Omiri, M. K., & Khraisat, A. (2011). Risk indicators of postoperative complications following surgical extraction of lower third molars. Medical Principles and Practice, 20(4), 321-325.
24. Martin, A., Perinetti, G., Costantinides, F., & Maglione, M. (2015). Coronectomy as a surgical approach to impacted mandibular third molars: A systematic review. Head & Face Medicine, 11(1), 9.
25. McGrath, C., Comfort, M. B., Lo, E. C., & Luo, Y. (2003). Changes in life quality following third molar surgery—The immediate postoperative period. British Dental Journal, 194(5), 265-268.
26. Mocan, A., Kisnisci, R., & Uçok, C. (1996). Stereophotogrammetric and clinical evaluation of morbidity after removal of lower third molars by two different surgical techniques. Journal of Oral and Maxillofacial Surgery, 54(2), 171-175.
27. Momin, M., Albright, T., Leikin, J., Miloro, M., Markiewicz, M. R., & Ganzberg, S. (2018). Patient morbidity among residents extracting third molars: Does experience matter? Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology, 125(5), 415-422.
28. Monaco, G., De Santis, G., Gatto, M. R. A., Corinaldesi, G., & Marchetti, C. (2008). Coronectomy: A surgical option for impacted third molars in close proximity to the inferior alveolar nerve. Journal of the American Dental Association, 139(12), 1611-1617.
29. Monaco, G., Staffolani, C., Gatto, M. R., & Checchi, L. (1999). Antibiotic therapy in impacted third molar surgery. European Journal of Oral Sciences, 107(6), 437-441.
30. Monaco, G., Tavernese, L., Agostini, R., & Marchetti, C. (2012). Evaluation of antibiotic prophylaxis in reducing postoperative infection after mandibular third molar extraction in young patients. Journal of Oral and Maxillofacial Surgery, 70(12), 2815-2819.
31. Nageshwar, B. (2002). Comma incision for impacted mandibular third molars. Journal of Oral and Maxillofacial Surgery, 60(12), 1506-1509.
32. O'Sullivan, C., & Riordain, R. N. (2022). Patient-reported outcome measures in third molar surgery: A scoping review. Journal of Oral and Maxillofacial Surgery, 80(3), 455-469.
33. Osunde, O. D., Saheeb, B. D., & Adebola, R. A. (2012). Comparative study of effect of single and multiple suture techniques on inflammatory complications after third molar surgery. Journal of Oral and Maxillofacial Surgery, 70(1), 75-79.
34. Pasqualini, D., Cocero, N., Castella, A., Mela, L., & Bracco, P. (2005). Primary and secondary closure of the surgical wound after removal of impacted mandibular third molars: A comparative study. International Journal of Oral and Maxillofacial Surgery, 34(1), 52-57.

35. Pell, G. J., & Gregory, B. T. (1933). Impacted mandibular third molars: Classification and modified techniques for removal. Dental Digest, 39, 330-338.
36. Phillips, C., White, R. P., Shugars, D. A., & Zhou, X. (2010). Risk factors associated with prolonged recovery and delayed healing after third molar surgery. Journal of Oral and Maxillofacial Surgery, 68(11), 2248-2253.
37. Pourmand, P. P., Sigron, G. R., Mache, B., Stadlinger, B., & Locher, M. C. (2014). The most common complications after wisdom-tooth removal: Part 2: A retrospective study of 1,562 cases in the maxilla. Swiss Dental Journal, 124(10), 1047-1051.
38. Praveen, G., Rajesh, P., Neelakandan, R. S., & Nandagopal, C. M. (2007). Comparison of morbidity following the removal of mandibular third molar by lingual split, surgical bur and simplified split bone technique. Indian Journal of Dental Research, 18(1), 15-18.
39. Renton, T., Hankins, M., Sproate, C., & McGurk, M. (2005). A randomised controlled clinical trial to compare the incidence of injury to the inferior alveolar nerve as a result of coronectomy and removal of mandibular third molars. British Journal of Oral and Maxillofacial Surgery, 43(1), 7-12.
40. Renton, T., & Yilmaz, Z. (2012). Managing iatrogenic trigeminal nerve injury: A case series and review of the literature. International Journal of Oral and Maxillofacial Surgery, 41(5), 629-637.
41. Romeo, U., Libotte, F., Palaia, G., Galanakis, A., Gaimari, G., Tenore, G., ... & De Biase, A. (2015). Histological in vitro evaluation of the effects of Er:YAG laser on oral soft tissues. Lasers in Medical Science, 30(5), 1575-1581.
42. Roode, G. J., & Bütow, K. (2010). An alternative surgical flap design for impacted third molars: A comparison of two different surgical techniques. International Journal of Oral and Maxillofacial Surgery, 39(10), 709-713.
43. Ruta, D. A., Bissias, E., Ogston, S., & Ogden, G. R. (2000). Assessing health outcomes after extraction of third molars: The postoperative symptom severity (PoSSe) scale. British Journal of Oral and Maxillofacial Surgery, 38(5), 480-487.
44. Saglam, A. A. (2003). Effects of tube drain with primary closure technique on postoperative trismus and swelling after removal of fully impacted mandibular third molars. Quintessence International, 34(2), 143-147.
45. Vallerand, W. P., Vallerand, A. H., & Heft, M. (2015). The effects of postoperative preparatory information on the clinical course following third molar extraction. Journal of Oral and Maxillofacial Surgery, 52(11), 1165-1170.
46. Van Wijk, A. J., Buchanan, H., Coulson, N., & Hoogstraten, J. (2010). Preparatory information for third molar extraction: Does preference for information and behavioral involvement matter? Patient Education and Counseling, 79(1), 94-99.