REVIEW

Remote Monitoring and Complication Detection: Artificial Intelligence for Postoperative Care

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Abstract. Postoperative care is one of the highest-risk, highest-cost phases of the surgical journey, and complications often develop between scheduled visits. AI-enabled remote monitoring, using smartphone images, structured symptom inputs, wearable sensors, and predictive models, can detect problems earlier, reduce unnecessary visits, and improve outcomes. This article surveys the landscape of AI-powered postoperative monitoring across surgical specialties.

Keywords: remote monitoring, postoperative care, complication detection, wearables, computer vision

1. Why Postoperative Remote Monitoring Matters

Complications often develop between scheduled follow-ups, when surgeons cannot directly assess patients. AI-driven monitoring closes this gap by detecting early wound issues, flagging trends in swelling, erythema, or drainage, identifying high-risk recovery patterns, improving adherence, and reducing unnecessary emergency visits and readmissions across general surgery, orthopedics, ENT, neurosurgery, urology, and plastic surgery.

2. Core Technologies

Computer Vision for Wounds

Models now detect infection, dehiscence, hematoma, seroma, excessive bruising, and abnormal swelling patterns. In plastic surgery this enables early identification of compromised flaps, detection of delayed healing in body contouring, and monitoring of graft take and donor-site healing.

Predictive Complication Models

Multimodal models combine patient history, operative details, pre- and postoperative photos, wearable data, and symptoms to predict infection risk, venous thromboembolism, poor wound healing, emergency-visit likelihood, and pain-trajectory deviations.

Wearables and Digital Check-ins

Wearable metrics include heart rate variability, sleep quality, mobility and step count, and temperature trends, increasingly used in enhanced recovery protocols. AI also triages patient-submitted questions about redness, swelling, and incision care, generating initial responses under surgeon supervision.

3. Clinical Applications Across Surgery

- General surgery: laparotomy incision monitoring, early infection detection, fluid-collection prediction.
- Orthopedics: incision healing after joint replacement, swelling and movement tracking, DVT risk.
- Plastic and reconstructive surgery: microsurgical flap monitoring, perfusion detection, edema and scar tracking.
- ENT, urology, and gynecology: identifying concerning discharge and abnormal swelling, postop reminders.

4. Implementation Requirements

- High-quality image-capture protocols with standard lighting and HIPAA-compliant upload.
- Clear escalation pathways for clinician review of flagged photos.
- Integration with EMR inboxes and existing messaging rather than standalone apps.
- Patient education on what AI can and cannot detect and how to take accurate photos.
- Prospective validation, bias checks, and evaluation of false-reassurance risk.

5. Strengths, Limitations, and Safety

Strengths include earlier complication detection, reduced readmissions, lower clinic congestion, and strong visual tracking for reconstructive and aesthetic cases. Limitations include lighting errors and poor photo quality reducing accuracy, potential misinterpretation by LLM triage, and overreliance delaying direct clinician contact. Major risks include missed or late detection, over-escalation, incorrect reassurance, and incomplete data. AI should augment, not replace, clinical judgment.

Key Takeaways

- AI-powered postoperative monitoring increases safety across all surgical fields.
- Computer vision is particularly effective for wound, swelling, and perfusion assessment.
- Plastic surgery remains a leading specialty for these tools due to its visual nature.
- Success requires safety oversight, patient education, and workflow integration.