

Case Report

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Vagus Nerve Stimulation as An Adjunct in Postoperative Rehabilitation After Knee Arthroplasty: A Case Report

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Abstract

Background: Vagus nerve stimulation (VNS) exerts anti-inflammatory and analgesic effects and has been explored in rheumatology and neurology. Its use in orthopaedic postoperative rehabilitation remains largely unreported.

Case presentation: We describe a 67-year-old woman with persistent severe pain and delayed wound healing three weeks after elective total knee arthroplasty. Pain was rated 8/10 on the visual analogue scale (VAS) despite multimodal analgesia including 40 mg/day oxycodone. As part of an interdisciplinary rehabilitation programme, she received adjunctive transcutaneous auricular VNS (taVNS; 25 Hz, 250 µs, 30 minutes, five sessions per week, for four weeks) in addition to standard rehabilitation. Within two weeks, pain decreased to VAS 5 and opioid use was halved. By week three, pain improved to VAS 4 without rescue medication, and by week five, complete wound closure and further pain reduction (VAS 2) were achieved. No adverse effects occurred.

Conclusions: Adjunctive taVNS may support pain reduction, opioid sparing, and wound healing in postoperative rehabilitation after joint replacement. Controlled studies are needed to confirm safety, efficacy, and optimal protocols.

Keywords: Knee arthroplasty; Pain management; Postoperative rehabilitation; Transcutaneous auricular vagus nerve stimulation; Vagus nerve stimulation; Wound healing

Abbreviations:

VAS: Visual Analogue Scale; VNS: Vagus nerve stimulation; taVNS: Transcutaneous auricular vagus nerve stimulation; TKA: Total knee arthroplasty

Background

Vagus nerve stimulation (VNS) has established applications in neurology and rheumatology due to its analgesic and anti-inflammatory properties mediated by the cholinergic anti-inflammatory reflex [1, 2]. Preclinical and early clinical studies

indicate potential benefits in musculoskeletal and perioperative settings [3-7]. However, reports on its use in orthopaedic rehabilitation are scarce. We present a case demonstrating adjunctive taVNS during postoperative rehabilitation after total knee arthroplasty (TKA).

Case presentation

A 67-year-old woman (BMI 29, medical history: left total hip arthroplasty in 2019, hypertension) presented with persistent pain and delayed wound healing three weeks after right TKA. Pain was rated VAS 8/10, and she required 40 mg/day oxycodone. Clinical findings included livid wound edges and serous discharge without signs of infection.

Intervention

As part of the rehabilitation programme, taVNS was applied using a commercially available auricular stimulation system (25 Hz, pulse width 250 μ s, patient-adjusted intensity, 30 minutes/session, five sessions per week for four weeks). Standard physiotherapy, lymphatic drainage, and multimodal pharmacological analgesia

continued.

Clinical Course

- Week 2: Pain decreased (VAS 5), oxycodone reduced to 20 mg/day.
- Week 3: Pain improved to VAS 4, no rescue analgesics required.
- Week 5: Complete wound closure, pain reduced to VAS 2, opioid-free.
- Adverse events: None.

Table 1 summarises the clinical course. Figure 1 illustrates the reduction in pain and opioid consumption.

Table 1: Timeline of clinical course showing pain (VAS), oxycodone dose, and wound status.

Week	Pain (VAS)	Oxycodone Dose (mg/day)	Wound Status
Baseline (Week 0)	8	40	Delayed healing, serous discharge
Week 2	5	20	Improving, partial closure
Week 3	4	0	Marked improvement
Week 5	2	0	Complete closure

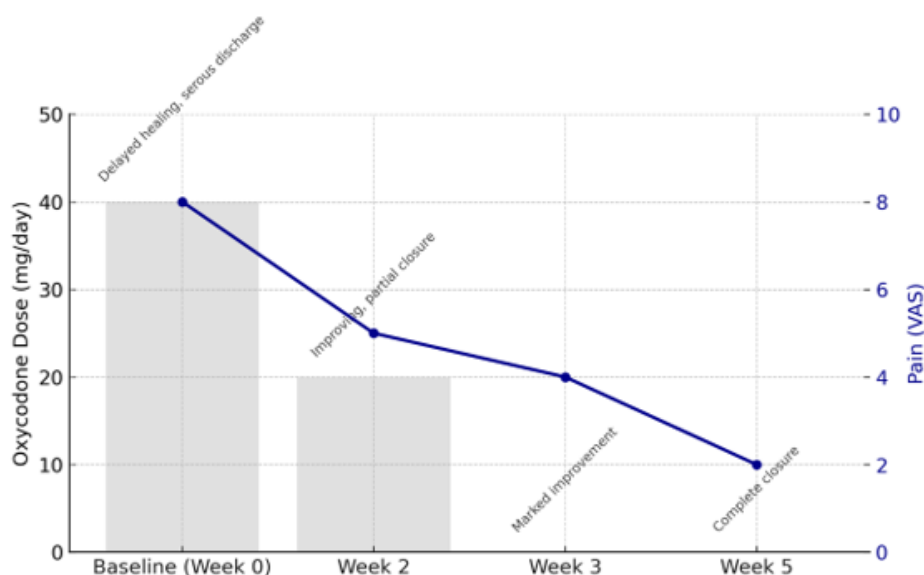


Figure 1: Visualization of the clinical course with two Y-axes: pain reduction (VAS, left axis, green) and oxycodone dose reduction (mg/day, right axis, purple) over time.

Discussion

This case suggests that adjunctive taVNS can reduce pain, decrease opioid requirements, and accelerate wound healing in postoperative rehabilitation after TKA. These findings align with

preclinical and pilot clinical studies reporting VNS-mediated suppression of pro-inflammatory cytokines and enhanced microcirculation [1-4, 8, 9]. Of particular relevance is the marked reduction in opioid use, a key challenge in postoperative pain management. Similar findings have been reported in recent clinical

studies investigating taVNS for acute postoperative pain [5-7]. The progressive wound closure observed in our patient is consistent with experimental evidence that VNS can promote tissue repair and bone remodelling [8-10].

Limitations of this case include its single-patient nature, lack of biomarker monitoring, and potential placebo effects. Nonetheless, the absence of adverse events and the clear clinical improvements support the feasibility of integrating taVNS into orthopaedic rehabilitation.

Conclusion

Transcutaneous auricular vagus nerve stimulation may represent a safe and practical adjunct in postoperative orthopaedic rehabilitation. Controlled clinical trials are warranted to determine its role, optimal parameters, and patient selection criteria.

Declarations

Ethics approval and consent to participate: Not required for a single case report in accordance with institutional and national guidelines.

Consent for publication: Written informed consent for publication of clinical details and images was obtained from the patient.

Availability of data and materials: Not applicable.

Competing interests: The authors declare no competing interests.

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Authors' contributions: C.R. managed the patient and drafted the manuscript. M.F. performed the literature review. C.R. and M.L.

contributed to manuscript revision. All authors approved the final version.

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