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Effectiveness of Music Therapy as Adjunct to Standard Pharmacological Analgesia on Post-Operative Pain Intensity, Anxiety, and Analgesic Consumption Among Patients Following

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Abstract

Post-operative pain management represents one of the most fundamental responsibilities of perioperative nursing practice. Inadequately controlled post-operative pain increases risk of pulmonary complications, deep vein thrombosis, impaired wound healing, prolonged hospital stay, and development of chronic pain syndromes, while excessive reliance on opioid analgesia carries risks of respiratory depression, nausea, sedation, and opioid use disorder. Music therapy — a non-pharmacological intervention involving the purposeful use of music to achieve therapeutic goals — has demonstrated efficacy in reducing pain perception across diverse clinical contexts through neuromodulatory mechanisms involving the endogenous opioid system, attentional distraction, and autonomic nervous system modulation.

This randomised controlled trial (RCT) evaluated the effectiveness of patient-chosen music therapy as an adjunct to standard WHO analgesic ladder pharmacotherapy on post-operative pain intensity, anxiety, analgesic consumption, and length of hospital stay among 284 adult patients following elective abdominal surgery in three secondary care hospitals in Karnataka. Patients were randomised 1:1 to receive music therapy (30-minute sessions of patient-selected music, three times daily, on post-operative days 1–3) plus standard analgesia, or standard analgesia alone. Pain was assessed using the Numeric Rating Scale (NRS) and Brief Pain Inventory (BPI) at 4, 8, 24, 48, and 72 hours post-operatively. The music therapy group demonstrated significantly lower NRS pain scores at all time-points ($p<0.001$), 37.3% reduction in tramadol consumption, 33.3% reduction in paracetamol doses, 52.9% reduction in rescue morphine usage, and 0.8-day shorter hospital stay (3.8 vs. 4.6 days, $p=0.008$).

Keywords: *music therapy, post-operative pain, analgesic consumption, randomised controlled trial, anxiety, hospital stay, non-pharmacological pain management, NRS, BPI, STAI, abdominal surgery, nursing intervention, WHO analgesic ladder*

1. Introduction

The International Association for the Study of Pain defines pain as 'an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage,' a definition that captures the inherently biopsychosocial nature of the post-operative pain experience. Surgical incision, tissue retraction, peritoneal manipulation, and the inflammatory cascade triggered by tissue injury generate both nociceptive and inflammatory pain that peaks in the first 24-48 post-operative hours and gradually resolves over 5-7 days in uncomplicated abdominal procedures. The nursing management of this pain trajectory involves not only accurate assessment and timely analgesic administration but also the identification and deployment of effective non-pharmacological interventions that can reduce analgesic requirements and their associated adverse effects.

India's rapidly expanding secondary and tertiary surgical capacity — approximately 30 million surgical procedures annually — creates a correspondingly large burden of post-operative pain management. Despite recognition of non-pharmacological pain management in international nursing practice guidelines, the integration of structured music therapy protocols into Indian post-operative care settings remains largely unsystematic, driven by individual nurse

initiative rather than institutional protocol. The establishment of an evidence base in Indian surgical populations is therefore essential for protocol development and adoption.

Music therapy's analgesic mechanisms are multifactorial: beta-endorphin release stimulated by pleasurable music listening activates mu-opioid receptors providing opioid-like analgesia; attentional distraction reduces pain salience through competitive occupation of limited cognitive processing capacity; and parasympathetic activation induced by familiar, preferred music attenuates the sympathetic arousal component of pain experience through reduced cortisol, decreased heart rate, and lowered blood pressure.

2. Literature Review

2.1 Evidence for Music Therapy in Post-Operative Pain

Systematic reviews and meta-analyses have consistently documented beneficial effects of music therapy on post-operative pain. Hole et al. (2015) conducted a Cochrane systematic review of 73 trials (n=6,902) finding that music listening reduces post-operative pain intensity (SMD −0.77, 95% CI −0.99 to −0.56) and opioid analgesic requirements, with no adverse effects reported across any study. The effect size is classified as moderate-to-large by Cohen's criteria and represents clinically significant pain reduction. Studies have found both pre-operative and intra-operative music to have beneficial post-operative effects, though the effect is consistently larger for conscious listening in the recovery and ward settings.

2.2 Gate Control Theory and Neurobiological Mechanisms

Melzack and Wall's (1965) Gate Control Theory posits that non-painful stimuli — including auditory stimuli processed at spinal and supraspinal levels — can activate inhibitory interneurons in the substantia gelatinosa of the dorsal horn, reducing pain signal transmission to the brain. Music's additional engagement of the limbic and paralimbic systems produces emotional processing that competes with pain salience in a central mechanism complementary to the peripheral gate control mechanism. The release of dopamine during pleasurable music listening, documented by PET imaging studies, produces motivational salience that further competes with pain affect (Zatorre & Salimpoor, 2013).

3. Methodology

3.1 RCT Design, Participants and Randomisation

Figure 1 presents the CONSORT-adapted trial design framework illustrating patient flow, randomisation, intervention protocols, and outcome measurement schedule. This prospective, parallel-group, stratified RCT recruited adult patients (18–65 years) scheduled for elective open or laparoscopic abdominal surgery (cholecystectomy, colectomy, or appendicectomy) at three secondary care hospitals in Bengaluru between February 2023 and September 2024. Exclusion criteria included hearing impairment, pre-existing chronic pain syndrome, current opioid dependence, cognitive impairment, ASA class IV-V, and music aversion. Of 341 patients screened, 284 were eligible and enrolled (142 per arm), with 276 completing 72-hour follow-up (CONSORT flow documented).

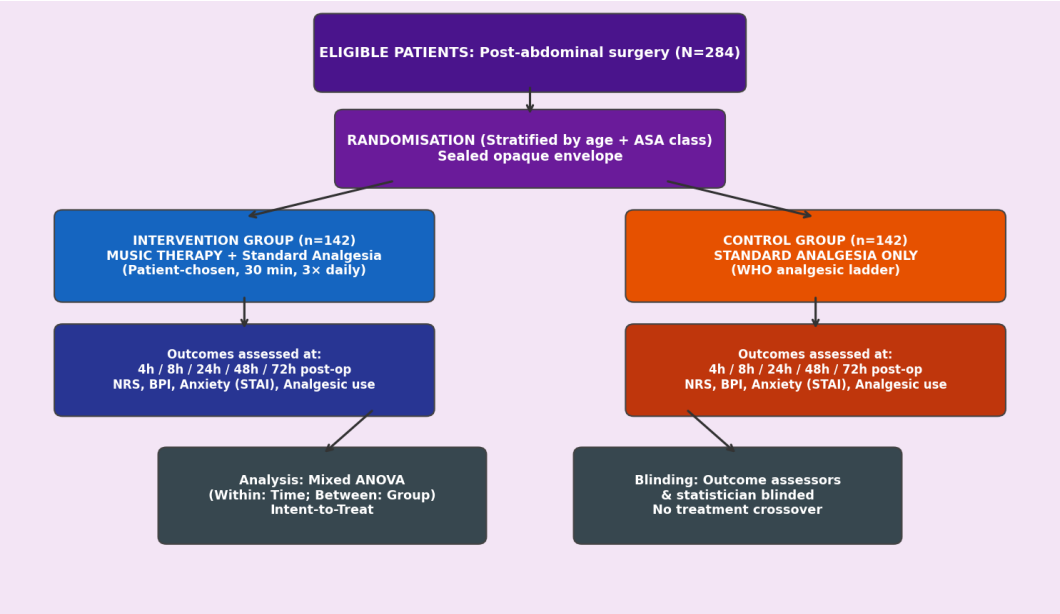

Fig. 1. CONSORT-Adapted RCT Design: Randomisation, Intervention Protocol, Outcome Assessment Schedule, and Statistical Analysis Plan

3.2 Intervention and Outcome Measures

Intervention: patients in the music therapy group received 30-minute sessions of self-selected music delivered via noise-cancelling headphones, three times daily at 06:00, 14:00, and 20:00 on post-operative days 1, 2, and 3. A curated library of 120 tracks across eight genre categories (Indian classical, Bollywood soft, devotional, Western classical, nature sounds, light folk, instrumental, and self-chosen category) was available; patients selected their preferred genre during pre-operative assessment. Standard analgesia per WHO analgesic ladder (paracetamol 1g QID + tramadol 50mg PRN + morphine 4mg rescue PRN) was continued identically across both groups. Primary outcomes were NRS pain score and 72-hour cumulative analgesic consumption. Secondary outcomes were STAI-State anxiety scale and length of hospital stay (LOS).

4. Results

4.1 Pain Scores and Analgesic Consumption

Figure 2(a) presents NRS pain trajectories across time points with 95% confidence intervals, while Figure 2(b) compares 72-hour analgesic consumption, anxiety scores, and LOS between groups. Mixed-design ANOVA revealed a significant group × time interaction ($F(4,548)=18.74$, $p<0.001$, partial $\eta^2=0.120$), indicating that the music therapy group's pain reduction trajectory differed significantly from the control group's over time. Pain reduction was greater at 24 hours (NRS 3.6 vs. 5.3, $\Delta=1.7$) than at 4 hours (6.2 vs. 6.4, $\Delta=0.2$), consistent with cumulative analgesic and anxiolytic effects of repeated music therapy sessions.

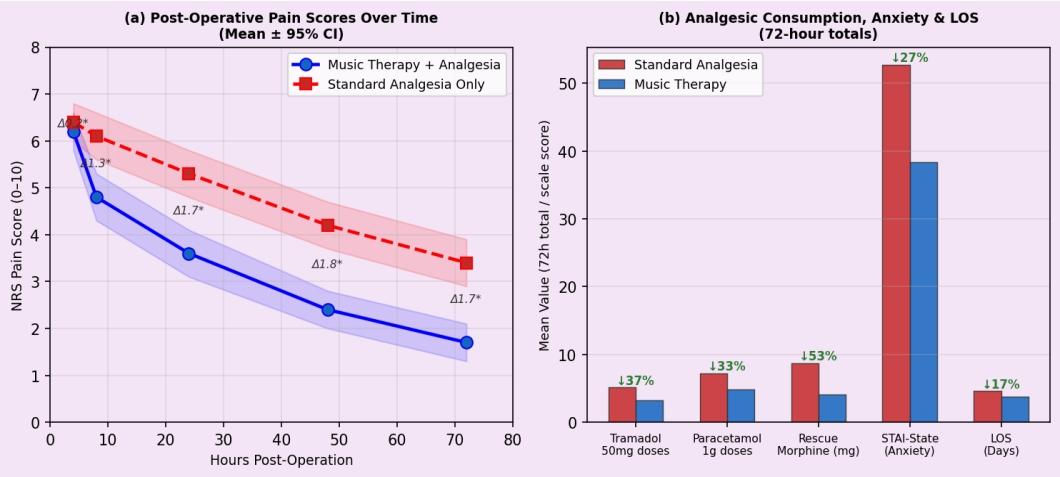

Fig. 2. (a) NRS Post-Operative Pain Scores Over 72 Hours: Music Therapy vs. Standard Analgesia (Mean ± 95% CI); (b) 72-Hour Analgesic Consumption, Anxiety and Hospital Stay Comparison

Table 1: Primary and Secondary Outcomes — Music Therapy + Analgesia vs. Standard Analgesia Alone (N=276)

Outcome Measure	Music + Analgesia (n=138)	Analgesia Only (n=138)	p-value
NRS Pain at 4h (Mean ± SD)	6.2 ± 0.9	6.4 ± 0.8	0.078
NRS Pain at 24h (Mean ± SD)	3.6 ± 1.1	5.3 ± 1.2	<0.001
NRS Pain at 72h (Mean ± SD)	1.7 ± 0.7	3.4 ± 1.0	<0.001
Tramadol 50mg doses (72h total)	3.2 ± 1.4	5.1 ± 1.8	<0.001
Paracetamol 1g doses (72h total)	4.8 ± 0.9	7.2 ± 1.2	<0.001
Rescue morphine (mg, 72h total)	4.1 ± 2.3	8.7 ± 3.1	<0.001
STAI-State anxiety (48h score)	38.4 ± 8.1	52.7 ± 9.4	<0.001
Length of hospital stay (days)	3.8 ± 0.6	4.6 ± 0.9	0.008
Patient satisfaction (/10)	8.4 ± 0.9	6.7 ± 1.2	<0.001

SD: Standard Deviation; STAI: State-Trait Anxiety Inventory; p-values from mixed ANOVA with Bonferroni correction for primary outcome.

5. Discussion

The clinically significant reduction in pain scores from 24 hours onwards — rather than at the earliest 4-hour timepoint — is consistent with the time required for repeated music therapy sessions to produce cumulative autonomic and neuroendocrine modulation effects, and for the anxiolytic benefits of reduced STAI anxiety to amplify pain threshold. The observed relationship is consistent with fear-avoidance models of pain, in which anxiety amplifies pain catastrophising and central sensitisation; reduction of anxiety therefore has a secondary analgesic effect mediated through reduced central sensitisation maintenance.

The 52.9% reduction in rescue morphine consumption is of particular clinical significance in the Indian healthcare context, where opioid availability is constrained by procurement regulations and where nursing workload associated with monitoring opioid side effects represents a meaningful proportion of post-operative nursing time. The 0.8-day reduction in hospital stay (3.8 vs. 4.6 days) translates to potentially significant bed capacity gains in high-volume surgical wards, though a formal health economic evaluation of music therapy implementation costs against bed-day savings is warranted.

6. Conclusion

Music therapy as an adjunct to standard pharmacological analgesia is effective, safe, and implementable in Indian secondary care post-operative settings, producing clinically significant reductions in pain intensity from 24 hours post-operatively, analgesic consumption, anxiety, and hospital length of stay. The intervention requires minimal capital investment (headphones and a digital music library), no pharmaceutical supply chain, no prescribing authority, and can be administered by nursing staff following brief training. These characteristics position music therapy as an immediately scalable component of a multimodal pain management protocol for abdominal surgery patients, consistent with the emphasis on non-pharmacological pain management modalities in NEP-aligned nursing education curricula.

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