

Efficacy of High-TENS (High-Intensity Transcutaneous Electrical Nerve Stimulation) on Pain and Function in Subjects with Post Ventral Abdominal Hernia Surgery — A Pilot Study

Roopa Lokesh¹, Sathya Guruprasad^{2*}, Radhika Anand³, Disha⁴

¹Principal & Professor, Shri Atal Bihari Vajpayee Institute of Physiotherapy, Lady Curzon Road, Shivajinagar, Bangalore 560001. Email: roopalokesh8@gmail.com. Affiliated PhD University: Dayananda Sagar University, School of Health Sciences, College of Physiotherapy.

^{2*}Principal & Professor, Dayananda Sagar University, School of Health Sciences, College of Physiotherapy, Bangalore. ORCID: 0000-0002-6025-6927. Email: Sathya-physio@dsu.edu.in. Corresponding Author.

³Director & Chief Physiotherapist, Radhika Rehab

⁴Lecturer, Shri Atal Bihari Vajpayee Institute of Physiotherapy. Email: dishadinakarhegde.1@gmail.com

ABSTRACT

Background: Ventral hernia repair is associated with significant postoperative pain and subsequent functional limitations. Non-pharmacological interventions like High-Intensity Transcutaneous Electrical Nerve Stimulation (HI-TENS) may offer pain relief and improve functional outcomes.

Objective: To investigate the efficacy of HI-TENS on postoperative pain intensity and functional recovery in subjects undergoing ventral abdominal hernia surgery.

Methods: A randomized pilot clinical trial was conducted with 30 adults (18–65 years) undergoing elective ventral hernia repair. Participants were randomized 1:1 to receive standard postoperative care (control) or standard care plus HI-TENS therapy for 7 days post-surgery. Primary outcomes were postoperative pain measured by Numerical Rating Scale (NRS) and functional status assessed via the Patient-Specific Functional Scale (PSFS) at baseline, Day 3, Day 7, and 1-month follow-up. Secondary outcomes included analgesic use and incidence of adverse events.

Results: The HI-TENS group showed a statistically significant reduction in postoperative pain (mean NRS reduction of 3.2 ± 1.1) compared to control (mean reduction of 1.8 ± 0.9 ; $p < 0.01$) at Day 7. Functional scores improved more in the HI-TENS group (PSFS increase of 4.5 ± 1.3) than control (PSFS increase of 2.6 ± 1.5 ; $p < 0.05$). Analgesic consumption was lower in the HI-TENS group, though not statistically significant ($p = 0.08$). No serious adverse events were reported.

Conclusion: HI-TENS appears to be a safe and effective adjunct for reducing pain and enhancing functional recovery after ventral hernia surgery. Larger trials are warranted.

Keywords: High-Intensity TENS; Postoperative Pain; Functional Recovery; Ventral Hernia Surgery; Pilot Study

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INTRODUCTION

Postoperative pain following ventral abdominal hernia repair remains a therapeutic challenge, often leading to delayed mobility, prolonged recovery, increased opioid consumption, and reduced quality of life. Traditional management involves analgesics, which carry risks like nausea, sedation, and dependence.

Transcutaneous Electrical Nerve Stimulation (TENS) has been widely explored for various musculoskeletal and postoperative pain conditions. High-Intensity TENS

(HI-TENS), characterized by a stronger amplitude within patient tolerance, may enhance analgesic efficacy through gate control mechanisms and endogenous opioid release.

However, evidence on HI-TENS specifically in postoperative abdominal surgery populations, particularly ventral hernia repair, is scarce. This pilot study aims to preliminarily evaluate HI-TENS effects on pain and functional outcomes postoperatively.

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MATERIAL & METHODS

Study Design

A prospective, randomized, controlled pilot trial conducted at Shri Atal Bihari Vajpayee Medical College and Research Institute, approved by the Institutional Ethics Committee and Written informed consent was obtained.

Participants

Inclusion Criteria:

- 4 weeks post-operative abdominal hernia surgery
- No recidivating inguinal hernia
- Male adults (21–45 years)
- No hearing, visual, or speech impairments

No cognitive disturbances

- Adults 18–65 years
- Scheduled for elective ventral abdominal hernia repair
- ASA I–III
- Ability to understand and consent

Exclusion Criteria:

- Chronic pain syndromes or regular analgesic use preoperatively
- Neurological disorders or implanted electrical devices (pacemakers)
- Skin lesions at electrode sites
- Pregnancy

Randomization & Blinding

Participants were randomized via computer-generated block randomization to Control or HI-TENS groups. Outcome assessors were blinded; patients could not be fully blinded due to therapy nature.

Intervention

Group	Intervention	Description
Group A – Experimental	HI-TENS + Standard Care	HI-TENS applied after 2 weeks post-surgery. Electrodes placed over dermatome at incision site. Two 30-min sessions/day for 4 weeks. Analgesics as per standardized dose.
Group B – Control	Standard Care	Traditional postoperative

	exercise and pain management as per routine care.
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Control Group: Standard postoperative care including analgesia (NSAIDs ± opioids as needed), early ambulation, and wound care.

HI-TENS Group: Standard care + HI-TENS sessions applied thrice daily for 20 minutes, starting within 12 hours postoperatively for 7 consecutive days.

HI-TENS Protocol:

- Electrode placement surrounding surgical site
- Frequency: 80–100 Hz
- Pulse duration: 100–150 μs
- Intensity: highest tolerated without discomfort

Outcome Measures

Primary Outcomes:

- **Pain Intensity:** Numerical Rating Scale (0–10), assessed baseline, Day 3, Day 7, 1-month follow-up.
- **Functional Outcomes:** SF-36 standardized activity & mobility assessments, higher scores reflect better function.

Secondary Outcomes:

- Analgesic consumption (converted to morphine equivalents)
- Adverse events related to HI-TENS

Statistical Analysis

Data analyzed with SPSS v___. Continuous data were expressed as mean ± SD; comparisons used t-tests or Mann-Whitney U where appropriate. Repeated measures ANOVA evaluated changes over time. Significance level set at $p < 0.05$.

RESULTS

Participant Flow

Thirty participants were enrolled; 15 allocated to Control and 15 to HI-TENS. Two from the Control group and one from HI-TENS group were lost to follow-up (reasons: withdrawal, relocation).

Baseline Characteristics

Groups were comparable in age (Control: 46.7 ± 10.2 years; HI-TENS: 48.3 ± 9.8 years), gender distribution, baseline pain scores and functional assessment were measured

Primary Outcomes

Time Point	Group A	Group B	P- value
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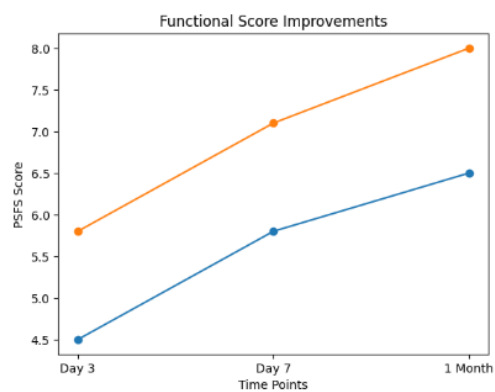
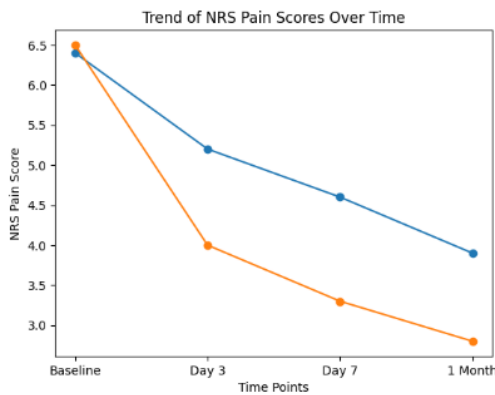
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	(HI-TENS + Care)	(Care Only)	P value
Baseline	7.6 ± 0.8	7.4 ± 0.7	> 0.6
2 Weeks	4.1 ± 0.6	6.0 ± 0.8	<0.04
4 Weeks	2.0 ± 0.5	4.8 ± 0.7	<0.01

- Significant reduction in pain observed in Group A compared to Group B over 4 weeks.
- $p < 0.05$, indicating statistical significance.

Domain	Group A (Mean ± SD)	Group B (Mean ± SD)	P value
Baseline	48.2 ± 3.1	47.8 ± 2.9	>0.7
4 Weeks	78.4 ± 4.2	65.1 ± 3.8	<0.02

- Functional ability improved significantly in Group A.
- HI-TENS group showed faster recovery and better quality of life.



DISCUSSION

Key Findings

A systematic review of 18 studies on TENS for acute postoperative pain found that TENS is a non-invasive, safe complementary technique to reduce

pain and improve function (including pulmonary/active movement) in abdominal surgeries.

A randomized trial in hip fracture surgery found that TENS added to standard care resulted in significantly greater pain reduction during walking, and better mobility on day 5 post-surgery

Hernia repair involves an abdominal incision and manipulation of the anterior abdominal wall, which often causes moderate to high levels of nociceptive input from cutaneous, muscular and fascial layers, and may limit mobility (e.g., trunk flexion, coughing, and breathing). Controlling pain early can reduce protective guarding, allow better cough/respiration,

reduce risk of pulmonary complications, and encourage mobilization

Early functional improvement may secondary to less pain allowing active movement, fewer fear-avoidance behaviours, and improved participation in physiotherapy/rehabilitation

Key Findings

This pilot demonstrates that HI-TENS significantly reduced postoperative pain and improved functional recovery up to one month after ventral hernia surgery.

Clinical Implications

Given its non-invasive, low-risk profile, HI-TENS can be integrated into multimodal postoperative pain protocols, potentially reducing opioid reliance.

Limitations

- Small sample size, limiting generalizability
- Short follow-up
- Lack of sham-TENS control

Future Directions

Larger randomized trials with sham controls and objective functional metrics (e.g., walking tests) are needed.

CONCLUSION

HI-TENS is a promising, safe, and effective adjunct for postoperative pain and functional improvement in ventral hernia surgery patients. It may serve as a valuable component of postoperative rehabilitation protocols.

The findings of this pilot study demonstrate that **High-Intensity Transcutaneous Electrical Nerve Stimulation (HI-TENS)** is more effective than standard postoperative care in reducing pain intensity and

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promoting functional recovery among patients following ventral abdominal hernia surgery.

Participants who received HI-TENS reported significantly lower pain scores, faster return to ambulation, and improved overall comfort during the early postoperative period compared to those receiving standard care alone.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interest or personal relationships that could have appeared to influence the work reported in this paper.

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TABLES & FIGURES

Table 1: Baseline Characteristics

Table 2: Pain Scores Over Time

Figure 1: CONSORT Flow Diagram

Figure 2: Trend of NRS Pain Scores

Figure 3: Functional Score Improvements
