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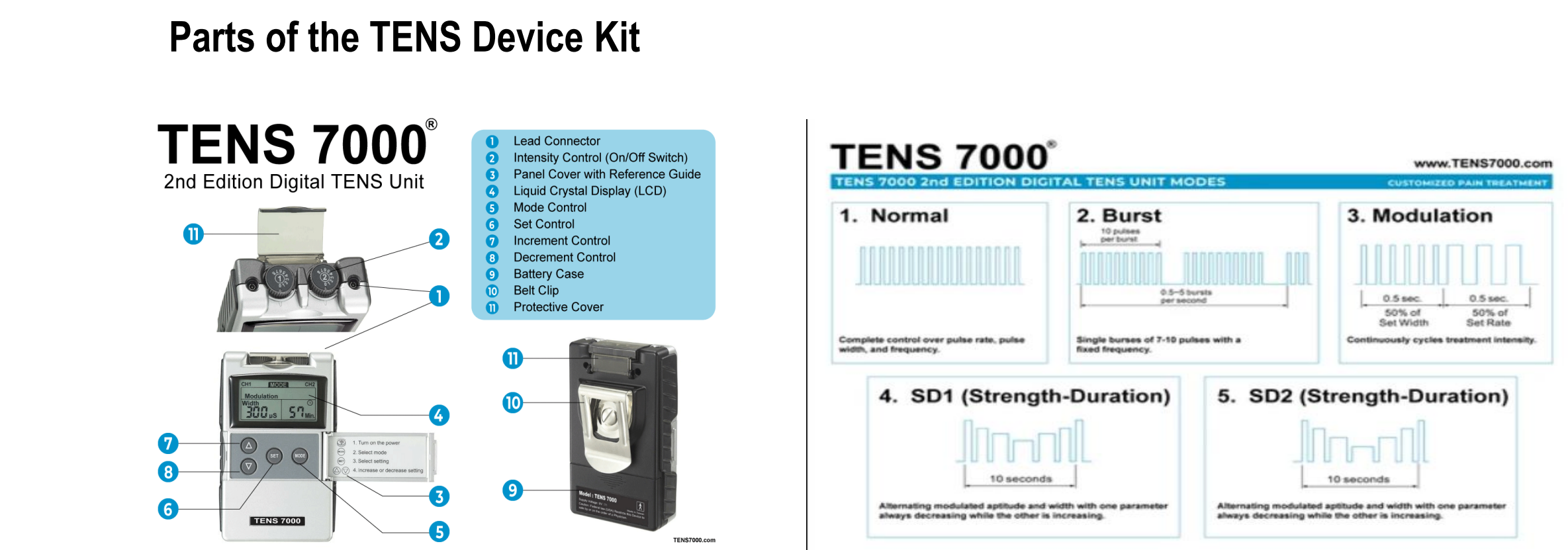
# Transcutaneous Electrical Nerve Stimulation (TENS) in Pain Management

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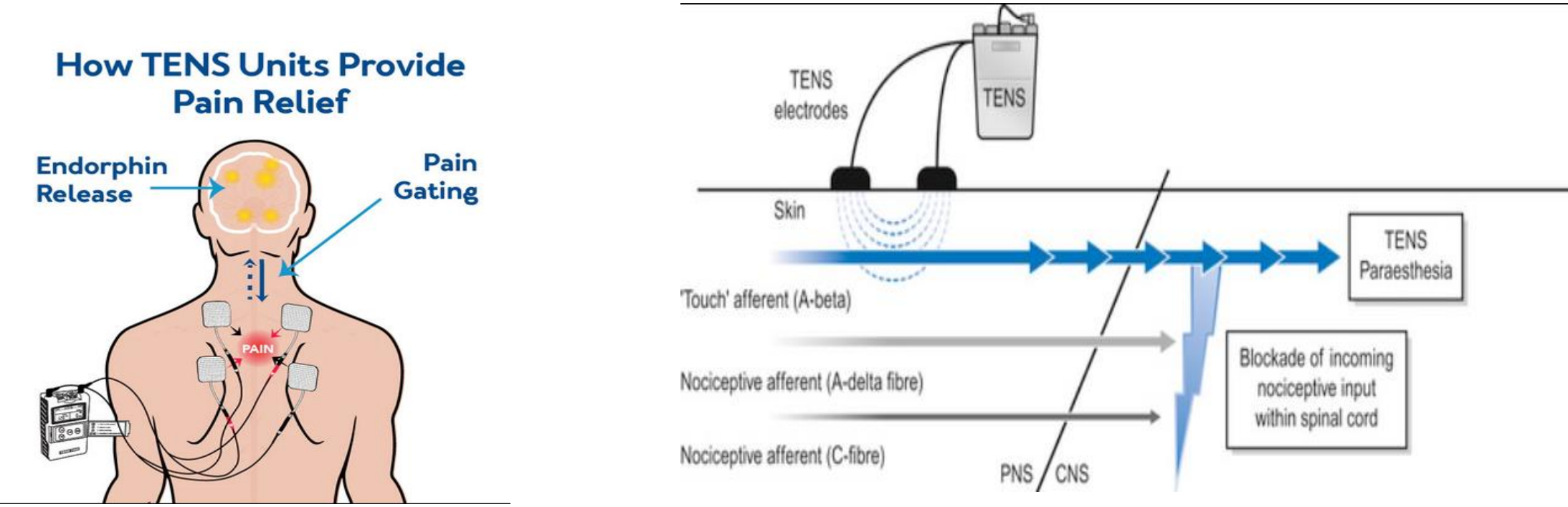
## INTRODUCTION

Pain is one of the most powerful factors causing stress. Pain affects the lives of over 70 million U.S. adults and 1.5 billion people globally, representing a pervasive challenge to public health. The need for pain relief often leads to use of opioids that, while effective, come with a risk of addiction and a heavy economic toll costing up to \$635 billion annually in the USA (3). TENS offers a non-drug alternative that can reduce pain and enhance the quality of life without the baggage of drug dependency. TENS affects neural pain pathways via non-invasive electrical stimulation bringing relief from various types of pain: chronic, acute, nociceptive, and neuropathic.



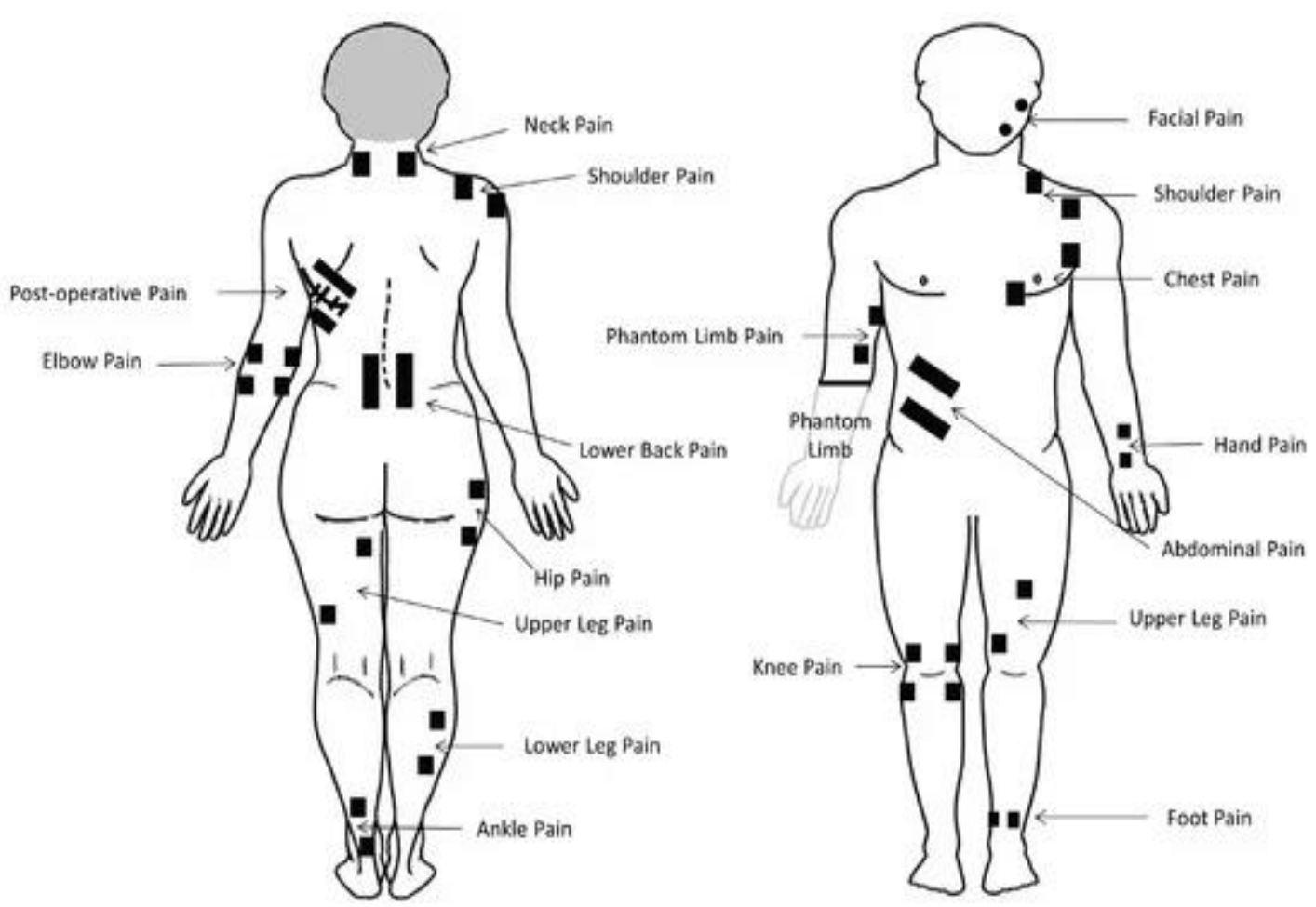
Parts of a TENS kit are shown in the left picture. On the right, different modalities of electric pulse series are shown. Usage of TENS arises from a growing demand for patient-centered care that prioritizes comfort, safety, and minimization of adverse effects associated with traditional pain management techniques, such as pharmacological interventions and invasive procedures. TENS use mitigates patients' fear of standard anesthesia and promotes a sense of control and safety<sup>16</sup>.

### How TENS Provides Pain Relief



TENS device sends small electrical impulses through electrodes placed on the skin. Electric current travels between pairs of electrodes and reaches nerve fibers in dermis. (Negative electrodes are colored red, positive electrodes are colored black.) Series of electric impulses effectively mitigate both acute and chronic pain. Conventional TENS activates low-threshold, large diameter myelinated afferent fibers (Aβ) transmitting signals related to non-painful touch and pressure to the brain. Efferent pathways from brain inhibit transmission of nociceptive stimuli at synapses with nociceptive C nerve fibers in the spinal cord. Pain perception is also mitigated by increased release of endorphins (endogenous opiates).

### Human Body Sites where TENS Electrodes Can Be Applied



Pairs of electrode pads are placed on the body where pain is located or at key nerve locations to deliver the therapeutic electrical impulses of the TENS unit. Proper placement of these electrode pads is crucial for efficacy of the TENS therapy. (Black squares represent the electrode pads.)

## OBJECTIVE

The purpose of our study is to review literature that evaluates the role of TENS in pain management practices. This assessment seeks to inform clinical guidelines and enhance patient outcomes and satisfaction by integrating TENS into pain management protocols and providing a background for future research and clinical applications. Customizing treatment to individual needs, including pain type, electrode placement, and variations in individual sensitivity to pain is important.

## MATERIALS AND METHODS

Literature was searched using search engines such as the PubMed, Google Scholar, and Cochrane Library databases, spanning the years 1989 to 2024. Keywords utilized in the search were "TENS", "non-pharmacological therapy" and "pain management", with a language restriction to English. We excluded duplicates, studies that lacked a defined sample size or failed to report specific effectiveness of TENS in pain management. We recorded title of the study, name of the first author, year of publication, sample size, study design, and the reported prevalence of TENS effectiveness. Standardized data collection procedure was employed to ensure uniform data capture.

## RESULTS

Transcutaneous Electrical Nerve Stimulation (TENS) has proven to be a highly effective and versatile tool in the management of various types of pain. This literature review is based on 15 clinical studies involving 748 participants. TENS was applied during surgeries such as colonoscopy without sedation (1), hysteroscopy without sedation (12), aspiration abortion without sedation (11), labor (2)(15), post-operative recoveries (4)(8)(14). TENS significantly reduced pain (case control study design, statistical difference p<0.05). Rate of significant pain reduction was 88.6% across the studies reviewed. Usage of TENS reduced reliance on opioids by more than 50% (1)(15).

**Table 1.** Study characteristics. Abbreviations: RCT, randomized controlled trial; FM, Fibromyalgia (3); CLBP, chronic low back pain (6); PISP, post-injection sciatic pain (14); HNC, head and neck cancer (10); Ces, Cesarean (9); Vag, vaginal delivery (9); MRM, modified radical mastectomy (5); hrs, hours (6).

#	First Author	Year	Country	Design	Sample Size	Diagnosis	TENS Group Sizes	Control Group Size	Conclusion
1	Dailey	2020	USA	RCT	301 (103/99/99)	FM	103	99	Effective
2	Elboim-Gabyzon	2019	Israel	RCT	41(18/23)	Fracture	18	23	Reduce pain, increase mobility
3	Njogu	2021	China	RCT	326 (161/165)	Labor	161	165	Reduce labor pain
4	Erden	2022	Turkey	RCT	80 (40/40)	Breast Cancer	40	40	Reduces MRM pain
5	Guy	2022	France	RCT	40 (20/20)	Dysmenorrhea	20	20	Reduces pain, can replace/combine analgesia
6	Ezema	2022	Nigeria	RCT	62 (31/31)	CLBP	31	31	Reduce pain up to 24 hrs post-treatment
7	Lerma	2021	USA	RCT	109 (55/54)	Abortion	55	54	Comparable to IV sedation
8	Jahangirifard	2018	Iran	RCT	100 (50/50)	Bypass	50	50	reduces pain, improves pulmonary function
9	Lee	2019	USA	RCT	30 (10/10/10)	HNC	10/10	10	improves pain, decreases fatigue
10	Kayman-Kose	2014	Turkey	RCT	Ces-100 (50/50) Vag-100 (50/50)	Labor	50-Ces 50-Vag	50-Ces 50-Vag	Effective and practical
11	Santana	2016	Brazil	RCT	46 (23/23)	Labor	23	23	decreases pain, delays analgesia need
12	Okonkwo	2018	Nigeria	n-RCT	72 (40/32)	PISP	40	32	effective pain reduction
13	Baez-Suarez	2018	Spain	RCT	63 (21/21/21)	Labor	21/21	21	high frequencies & pulse width are effective and preferred.
14	Lison	2017	Spain	RCT	138 (46/46/46)	Hysteroscopy	46	46	reduces pain, increases satisfaction
15	Amer-Cuenca	2011	Spain	RCT	90 (30/30/30)	Colonoscopy	30	30	effective pain relief

## DISCUSSION

TENS has proven to be an effective non-pharmacological method for managing pain across various clinical contexts. Our analysis supports incorporation of TENS into comprehensive pain management protocols, enhancing outcomes and reducing reliance on opioids. Critically, TENS offers a significant reduction of pain with no serious risk of adverse effects. The effectiveness of TENS is **maximized** through personalized care, emphasizing the importance of tailored electrode placement and device settings to meet individual patient needs to ensure efficacy and aligning with the principles of patient-centered care, offering a safe, adaptable, and non-invasive pain management strategy. Further research is necessary to fully understand the optimal conditions for TENS application, including studies that focus on long-term therapeutic effects.

## CONCLUSIONS

TENS provides a non-pharmacological alternative of pain management that enhances patient outcomes and satisfaction in routine medical procedures and post-operative care, thereby validating its integration into contemporary pain management protocols. It is also aligned with current healthcare objectives aimed at reducing opioid dependency and improving patient-centered care.

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