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Transcutaneous tibial nerve stimulation: A promising non-invasive treatment for chronic anal fissure: Systematic review article

Mohammed Elnibras[1*], Haneen Barnawi[2], Mohamad Shawir[3]
[1,2,3]Department Of Surgery, Faculty of Medicine, University of Tabuk, Saudi Arabia; malnibras@ut.edu.sa (M.E.) h-brnawi@ut.edu.sa (H.B.) mshawir@ut.edu.sa (M.S.)

Abstract: Anal fissure is a linear tear in the anoderm located just below the dentate line. It is a prevalent anorectal condition that affects both men and women, with an incidence rate of 1 in 350 people. The primary symptom is severe, distressing post-defecation pain, along with bright red rectal bleeding and pruritus ani. The pain has a significant negative impact on the quality of life of affected patients. Chemical sphincterotomy using topical nitrates, botulinum, calcium channel blockers, and surgical sphincterotomy using left lateral internal sphincterotomy have been a mainstay of managing chronic anal fissure for decades. However, in recent years, neuromodulation using sacral or tibial nerve stimulation has emerged as an alternative non-invasive management. The aim of this study is to assess the effect of transcutaneous tibial nerve stimulation in managing anal fissures. The primary outcome is the healing rate, and the secondary outcome is the complication rate. Google Scholar, PubMed, and Web of Science are systematically searched for relevant and similar articles, using transcutaneous tibial nerve stimulation AND anal fissure as keywords. The pooled data analysis revealed that the healing rate of chronic anal fissures using transcutaneous tibial nerve stimulation is 69.6%, with a complication rate of 0%. Transcutaneous tibial nerve stimulation is an effective non-invasive method to treat chronic anal fissures, with no complications and a promising success rate, which may be useful to patients at high risk for fecal incontinence or who do not wish to undergo surgery.

Keywords: *Anal fissure, Tibial nerve stimulation, Transcutaneous.*

1. Introduction

Anal fissure is a linear tear in the anoderm located just below the dentate line. It is a prevalent anorectal condition that affects both men and women, with an incidence rate of 1 in 350 people [1]. This condition commonly impacts individuals in the middle age group (mean age of onset 39.9 years) Hananel and Gordon [2] although it can also occur, although less frequently, in the elderly and children. The primary symptom experienced by individuals with an anal fissure is severe, distressing post-defecation pain often likened to passing a piece of broken glass, along with bright red rectal bleeding and pruritus ani, the pain has a significant negative impact on the quality of life of affected patients [3, 4]. The precise etiology of anal fissures is still unclear. However, the current theory suggests that passing a hard stool can lead to tearing in the anoderm, causing severe pain. This pain can then result in an increased anal sphincter tone [5, 6]. Leading to reduced blood supply to the traumatized anoderm and hindering the healing process. Other factors that can cause anal fissures include childbirth in females and anal intercourse. There are two types of anal fissures: acute, which typically heals within 1 to 2 weeks, and chronic, which persists for over 6 weeks, may present with chronic features such as skin tags, visible sphincter fiber, and indurated margins [3]. The treatment of anal fissures varies, for acute anal fissures; it typically involves a high-fiber diet [7, 8]. Lidocaine ointment, and Sitz baths. However, chronic fissures may require more advanced treatments such as

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* Correspondence: malnibras@ut.edu.sa

Topical Nitrates [9]. Botulinum Toxin [10, 11]. Or Calcium Channel Blockers [12]. Surgical interventions like lateral internal sphincterotomy are often effective for managing chronic refractory anal fissures by reducing internal sphincter tone [13, 14]. The anal advancement mucosal flap is considered as an alternative to sphincterotomy, offering a lower risk of fecal incontinence. Nevertheless, this procedure is associated with a high rate of failure [14].

For years, the lateral internal sphincterotomy has been considered the gold standard procedure for managing chronic anal fissures [15]. It has demonstrated superiority over other methods in both short-term and long-term outcomes [16]. However, a notable drawback is the risk of flatus, mucous, and fecal incontinence in 30% of patients in some studies [4, 9, 14, 17-19]. Recently, transcutaneous Tibial nerve stimulation has emerged as a noninvasive approach for treating chronic and resistant anal fissures [20, 21]. Furthermore, it is beneficial for patients who are at high risk of fecal incontinence and those who opt not to undergo invasive surgical procedures.

1.1. Transcutaneous Tibial Nerve Stimulation

The management of anal fissures focuses on relieving pain to break the vicious circle of pain, sphincter spasm, mucosal ischemia, and persistent fissuring [22]. Neuromodulation by peripheral nerve electrical stimulation has become a rapidly growing area of chronic pain management in recent years due to the non-invasive nature of the procedure [22]. The gate theory of pain control is widely accepted as the primary explanation for pain relief resulting from stimulating the peripheral nerves [23]. The hypothesis suggests that stimulating large cutaneous (A-β) nerve fibers can inhibit the conduction of impulses through small-diameter nerve fibers (C). Other proposed mechanisms include inhibiting excited nerve cells and triggering the brain to release endogenous opiates [24]. The afferent fibers from the anal canal and pelvic floor travel to the central nervous system through the sacral nerves (S2–S4), electrical stimulation of these sacral nerves can help relieve pain in the anal canal and pelvic floor. In the past, Sacral nerve stimulation was utilized to treat chronic anal fissures, yielding promising results; however, the procedure is deemed invasive [20]. Given the similarity in neurophysiological targets, transcutaneou Tibial nerve (L4-S3), stimulation could serve as a more cost-effective and non-invasive substitute for Sacral nerve stimulation for managing chronic anal fissure [22].

1.2. Transcutaneous Tibial Nerve Stimulation procedure

Transcutaneous Tibial Nerve Stimulation, is commonly performed according to what has been described by Queralto, et al. [25] using a Transcutaneous Electrical Nerve Stimulation unit (TENS). This involves using adhesive electrodes, where the negative electrode is placed on the skin behind the medial malleoli and the positive electrode is positioned 10 cm above along the route of the posterior tibial nerve. The stimulation frequency is typically set at 10 Hz for 200 seconds, with a current range of 10 to 30 mA. The stimuli are adjusted to stay below the muscle contraction threshold to create tingling sensations without inducing muscle twitching or pain in the stimulated area. Correct electrode placement during stimulation has been observed to result in rhythmic toe flexion. Transcutaneous nerve stimulation, is typically administered initially by the practitioner to ensure correct application, subsequently, the patient is instructed to use it daily for 20 minutes, five days a week, for two to four consecutive weeks. In comparison to Sacral nerve stimulation Yakovlev, et al. [20] and percutaneous Tibial nerve stimulation Queralto, et al. [25] which were previously used to manage chronic anal fissures, transcutaneous Tibial nerve stimulation is considered cost-effective, non-invasive, and easy to perform since it does not require electrodes needle or device implantation.

1.3. Transcutaneous Tibial Nerve Stimulation Side Effect and Contraindications

Compared to Sacral nerve stimulation and percutaneous Tipial nerve stimulation, Transcutaneous Tibial nerve Stimulation does not involve the use of needles for implanting electrodes. Some reported side effects include skin reactions from adhesive electrodes Shehata, et al. [26] and Cui, et al. [27] but most patients tolerate the procedure well. Electrical nerve stimulation is contraindicated in patients

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with pacemakers, implantable defibrillators, epilepsy, pregnancy, and those with metallic ankle prostheses [28].

1.4. Transcutaneous Tibia Nerve Stimulation for Management of Chronic Anal Fissure

Sacral nerve stimulation and percutaneous posterior nerve stimulation have been extensively studied for managing pelvic floor disorders and chronic anal fissures [20, 29-31]. While these methods have shown promise, transcutaneous Tibial nerve stimulation is emerging as a non-invasive and cost-effective alternative. It relies on adhesive electrodes instead of needles, making it more convenient for home use than other methods.

2. Materials and Methods

The authors searched PubMed, Web of Science, Scopus, and Google Scholar databases, using the keywords "Transcutaneous Tibial nerve stimulation AND anal fissure, including similar and relevant articles. The study is considered eligible for inclusion if it was conducted on human subjects, written in English, and published between 2000 and 2024. The study must have utilized transcutaneous Tibial nerve stimulation to treat chronic anal fissures, with no limitation on the study type. Exclusion criteria encompassed studies involving non-human subjects, non-English language publications, and those employing other neuromodulation methods such as percutaneous Tibial nerve stimulation or Sacral nerve stimulation for managing chronic anal fissures. Adherence to PRISMA guidelines Page, et al. [32] (Figure 1), was strictly followed for the selection of included studies.

A datasheet was used to record the author's name, publication year, country of origin, study type, patient enrollment count, and outcomes related to healing and complication rates (Table 1).

Descriptive statistics were used to express the results as percentages. The primary outcome measurement was determined by evaluating the healing rate, which is defined as the complete disappearance of symptoms of anal fissure and mucosal healing during a clinical examination. A secondary outcome was assessed by evaluating complication rates, which refer to any adverse effects caused by the procedure.

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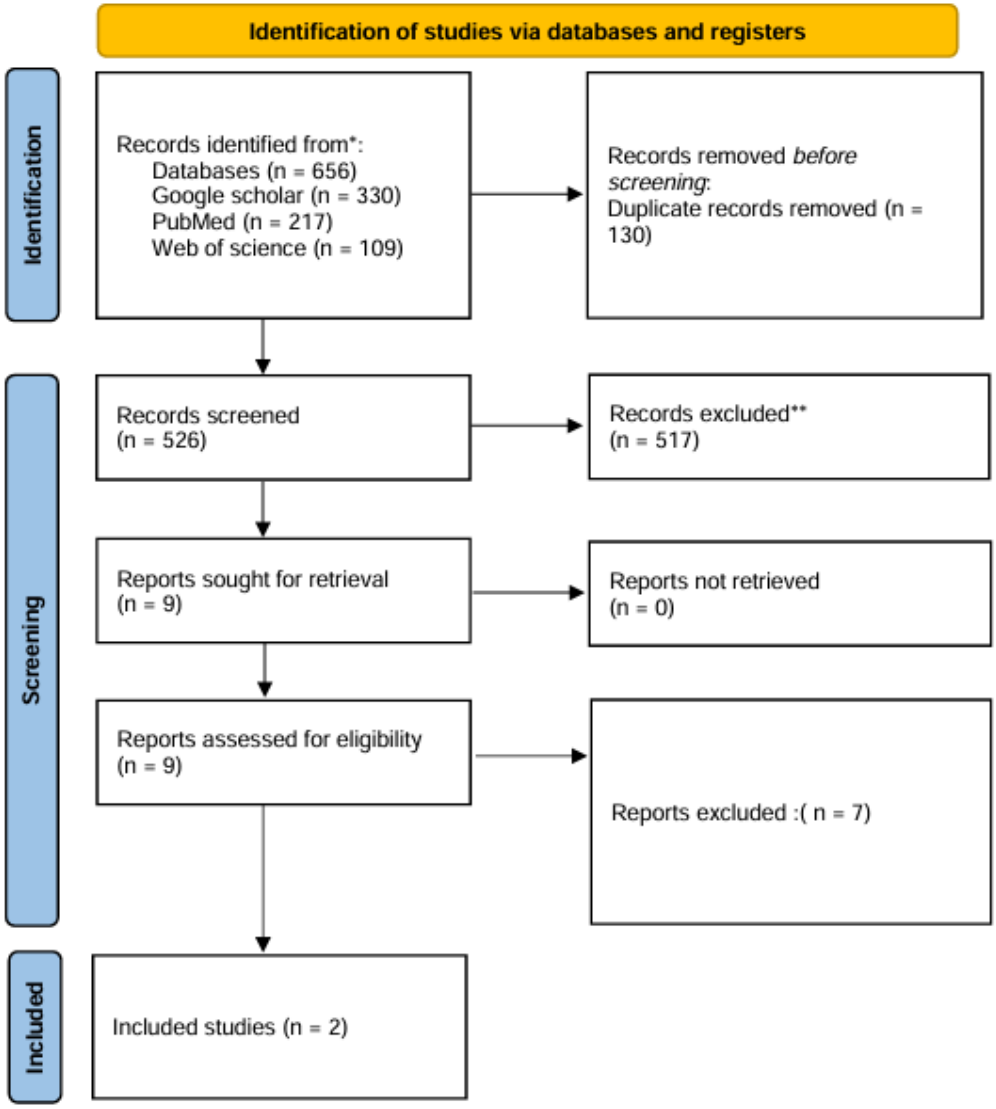

Figure 1.
The PRISMA flow diagram illustrating the study selection.
Note: Process for the Systematic Review.
* PRISMA guidelines
Source: Page, et al. [32]

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Table 1.
Studies on effect of transcutaneous Tibial nerve for management of chronic anal fissures.

Author	Year	Country	Study Type	No Patients	Nerve stimulation procedure	Outcome
Altunrende, et al. [33]	2013	Turkey	Case series	10	TTNS	Out of 10 patients, 6 healed no complication
Youssef, et al. [16]	2015	Egypt	Randomized Control clinical trial	36 in TTNS 37 in LIS group	TTNS	Out of 36 patients in TTNS group, 26 healed no complications. Out of 37 patients in LS group, 33 healed, 1 complication.

Note: *TTNS Transcutaneous Tibal Nerve Stimulation
*LIS Laternal Internal Sphincterotomy

3. Results

In the systematic review, the authors identified 656 articles from three databases: Google Scholar (330 articles), PubMed (217 articles), and Web of Science (109 articles). After removing duplicates and irrelevant articles, we identified two studies that met our inclusion and exclusion criteria. The first study is a case series from Turkey, while the second is a randomized controlled trial from Egypt. In the Egyptian study, researchers compared the effectiveness of transcutaneous tibial nerve stimulation and lateral internal sphincterotomy in managing anal fissures. From the pooled data analysis, it was found that 46 adult patients underwent transcutaneous Tibial nerve stimulation, with 10 in the case series and 36 in the randomized controlled trial. The pooled dataanalysis revealed that the healing rate of chronic anal fissures using transcutaneous Tibial nerve stimulation is 69.6%, with a complication rate of 0%.

4. Discussion

Based on our review, the healing rate of anal fissures using transcutaneous Tibial nerve stimulation is 69.6%. This rate is considered promising for non-invasive procedures without complications and easy for application. The Sacral nerve stimulation has been used as a method of neuromodulation for the management of chronic anal fissures with a healing rate of 100% Tjandra, et al. [34] although the procedure is deemed invasive because it needs generator surgical implantation, and some complications have been reported in some patients, these complications include wound infection and discomfort at generator implant site [20, 21, 35]. Percutaneous Tibial nerve stimulation has been used as a method for neuromodulation of the Tibial nerve to manage chronic anal fissures [36]. It has shown a healing rate similar to transcutaneous Tibial nerve stimulation [29]. However, transcutaneous Tibial nerve stimulation offers the advantage of using adhesive electrodes instead of needle electrodes Youssef, et al. [16] making it easier to use and more comfortable.

The lateral internal sphincterotomy is still considered the gold standard procedure for managing chronic anal fissures, with a healing rate of up to 90% Poh, et al. [37] and few recurrences. In some studies, fecal incontinence has been reported to affect up to 16% of patients [38, 39]. While in others it may affect up to 30% [40]. Some studies suggest that chemical sphincterotomy should be the first-line treatment for chronic anal fissures due to the significant drawback of fecal incontinence with lateral internal sphincterotomy Haq, et al. [41]. Youssef, et al. [16] conducted a randomized controlled trial to assess the efficacy of transcutaneous Tibial nerve stimulation compared to left lateral sphincterotomy. The study involved 37 patients in the sphincterotomy group and 36 patients in the transcutaneous Tibial nerve stimulation group. After one month, all patients in the sphincterotomy group showed clinical improvement, while 75% of patients in the transcutaneous Tibial nerve group improved. The recurrence rate after one year was 2.7% in the sphincterotomy group and 40.7% in the transcutaneous Tibial nerve stimulation group. They conclude that lateral sphincterotomy is still considered the gold standard procedure for chronic anal fissures. However, transcutaneous Tibial nerve stimulation is

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emerging as a novel non-invasive procedure with minimal complications. This study is limited by not being blinded, which prevents the exclusion of the placebo effect.

In contrast, chemical sphincterotomy has been used for the treatment of chronic anal fissures with varying degrees of success and drawbacks. Glyceryl Trinitrate has been widely used in the treatment of chronic anal fissures, resulting in a healing rate of 60% to 80% [42, 43]. However, approximately 15% to 20% of patients experienced intractable headaches, leading some to discontinue treatment [44, 45].

The use of botulinum toxin injections is also utilized in the treatment of chronic anal fissures. Healing rates range from 60% to 80%, with flatus incontinence occurring in 18% of cases, and fecal incontinence occurring in 5% [46, 47].

Based on the comparison of healing and complication rates among different commonly used treatment options for chronic anal fissures, transcutaneous Tibial nerve stimulation shows promise due to its reasonable healing rate and non-invasive nature, along with a 0% complication rate. This provides hope for patients at high risk for fecal incontinence, such as multiparous women and those with recurrent chronic anal fissures after invasive procedures like lateral internal sphincterotomy, or those who refuse surgical intervention.

5. Limitation

There is a lack of literature on the use of transcutaneous Tibial nerve stimulation for managing chronic anal fissures, which restricts the scope of this study.

6. Conclusion

Despite limited literature, transcutaneous tibial nerve therapy is an effective noninvasive method to treat chronic anal fissures, with no complications and a promising success rate, which may be useful to patients at high risk for fecal incontinence or who do not wish to undergo surgery.

7. Recommendation

Further large studies are recommended to evaluate this novel non-invasive procedure for managing chronic anal fissures, as well as its financial cost and patient satisfaction.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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