Research Progress on the Mechanism of Acupuncture in Treating Functional Constipation

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Abstract: Functional constipation (FC) is a common functional bowel disorder, categorized under "constipation" in Traditional Chinese Medicine (TCM) theory. As a key therapeutic modality in TCM, acupuncture has long demonstrated efficacy in managing constipation. In recent years, a growing body of modern medical research has provided supporting evidence for its use. This article reviews the effects of acupuncture on brain-gut axis dysfunction, intestinal motility disorders, visceral hypersensitivity, gut microbiota imbalance, abnormal intestinal secretion, pelvic floor muscle dysfunction, and psychological factors, exploring the mechanisms and theoretical basis of acupuncture for FC.

***Keywords*:** acupuncture; functional constipation; brain-gut axis; visceral hypersensitivity; gastrointestinal motility disorder; gut microbiota

1. Introduction

Functional constipation (FC) is primarily characterized by difficulty defecating, reduced defecation frequency, or a sensation of incomplete evacuation [1]. Its global prevalence is estimated at 10.1%–15.3% [2], with a significantly higher incidence in women than in men. FC severely impacts patients' quality of life and imposes a substantial socioeconomic burden [3]. Based on the primary pathological mechanisms, FC can be classified into four types: slow transit constipation, defecatory disorder, normal transit constipation, and mixed type [4]. The pathophysiology is not fully elucidated but is believed to involve multiple interacting factors, including brain-gut axis dysfunction, abnormal intestinal motility, impaired intestinal secretion, pelvic floor muscle dysfunction, visceral hypersensitivity, gut microbiota imbalance, genetic susceptibility, and psychological factors [5]. Current clinical management is based on lifestyle interventions, combined with pharmacological or non-pharmacological therapies according to clinical subtype, but limitations remain. As a traditional external therapy in Chinese medicine, acupuncture has a long history in treating FC [6-9]. Recent developments in modern medical research have led to new progress in understanding the mechanisms of acupuncture for FC. This article aims to systematically review the latest research advances in this field.

2. Etiology and Pathogenesis of FC in TCM

In TCM, FC falls under the categories of "constipation" (bianmi), "difficulty with defecation" (hou buli), "hard stool" (dabiannan), "spleen restriction" (piyue), and "fecal impaction" (mijie), among others. TCM theory posits that the core pathogenesis of constipation lies in impaired conveyance by the large intestine, closely related to dysfunction of the spleen and stomach organs. Etiological factors are often attributed to pathological elements such as cold, heat, dampness, dryness, and blood stasis, as well as dietary irregularities and emotional disturbances [10]. Acupuncture acts by stimulating specific meridians and acupoints to regulate the functions of the spleen, stomach, and large intestine, promote the flow of Qi and blood, harmonize the internal environment, thereby restoring normal intestinal peristalsis and function, ultimately alleviating constipation symptoms and treating FC [11].

3. Research on Modern Mechanisms of Acupuncture for FC

3.1 Regulating Brain-Gut Axis Function

The brain-gut axis is a complex bidirectional regulatory system composed of neural, endocrine, and immune mechanisms, also referred to as "brain-gut interaction." It closely links the central nervous system with the enteric nervous system to regulate intestinal function. The TCM classic *Huangdi Neijing* emphasizes a holistic view of "body-spirit unity," considering the "brain" as the pivot of vitality, governing overall physiological and mental activities. The TCM concept of "simultaneously regulating the brain and intestines" in treating FC aligns closely with the modern medical theory of the

brain-gut axis.

Studies indicate that acupuncture can modulate the functional balance of the brain-gut axis by stimulating relevant acupoints, affecting the expression and metabolism of various brain-gut peptides (such as substance P and vasoactive intestinal peptide), thereby regulating the nervous and endocrine systems, ultimately promoting gastrointestinal motility and modulating mood and psychological state [12-14]. Experimental research confirms that acupuncture can adjust levels of substance P and vasoactive intestinal peptide (VIP) in rat colon tissue, improving intestinal transit function [15]. In clinical practice, incorporating scalp acupuncture based on brain-gut axis theory alongside conventional point selection has shown significantly better efficacy for constipation compared to other treatments [16]. Neuroimaging observations also reveal that electroacupuncture treatment for FC induces corresponding changes in activity in related brain regions (e.g., anterior cingulate cortex, insular cortex, prefrontal cortex) in patients [17]. This evidence suggests that acupuncture may improve FC symptoms by modulating central nervous system processing of gut signals.

3.2 Modulating Gastrointestinal Motility

Gastrointestinal dysmotility is a common pathological manifestation in FC. TCM theory posits that meridian blockage or insufficient meridian Qi is a significant pathological basis during the development of FC. On one hand, if the Qi of the meridians associated with the large intestine, spleen, and stomach is deficient and weak, failing to propel Qi and blood effectively, visceral function declines, intestinal conveyance becomes impaired, leading to constipation. On the other hand, stagnation and obstruction of Qi in the relevant visceral meridians can also disrupt intestinal conveyance, causing constipation. Therefore, clinical treatment often focuses on regulating Qi and blood, unblocking meridians, and restoring gastrointestinal function to improve intestinal conduction and relieve constipation.

Research shows that electroacupuncture at points like Zusanli (ST36) and Neiguan (PC6) can modulate gastric motility via the vagus nerve reflex [18-20]. Electroacupuncture combined with a laxative decoction has been shown to promote gastrointestinal peristalsis and alleviate symptoms in a mouse model of constipation [21]. These findings suggest that acupuncture has a regulatory effect on gastrointestinal motility and can serve as an effective intervention for FC.

3.3 Improving Visceral Sensitivity

Visceral hypersensitivity refers to altered perceptual thresholds of internal organs to mechanical, chemical, and other stimuli [22]. In FC, it often manifests as reduced colonic sensitivity to stimuli like distension. Piezo1 and Piezo2 are two major mechanosensitive ion channels in the gut, involved in sensing intestinal tension, smooth muscle contraction, and related neural reflexes [23]. Studies have demonstrated that electroacupuncture treatment can upregulate the expression of Piezo1 and Piezo2 in enterochromaffin cells of FC model mice, enhancing intestinal perception of mechanical stimuli. This subsequently promotes the synthesis and secretion of serotonin, improves intestinal motor function, increases colonic sensitivity, and thereby alleviates FC symptoms [24].

3.4 Regulating Gut Microbiota

The gut microbiota is a crucial component of the human microbiome, primarily colonizing the gastrointestinal tract. Its dynamic balance plays a key role in maintaining intestinal homeostasis and regulating gastrointestinal function. Clinical studies show that the diversity of the gut microbiota in FC patients is significantly lower than in healthy individuals, and fecal microbiota transplantation can alleviate constipation symptoms [25]. Acupuncture demonstrates potential advantages in modulating the gut microbiota. Clinical trials indicate that acupuncture at specific points in FC patients not only helps improve clinical symptoms but also significantly increases the abundance of intestinal probiotics [26-27].

3.5 Modulating Intestinal Secretion

Abnormal intestinal secretion can lead to reduced mucus production, resulting in dry, hard, and difficult-to-pass stools, which can trigger FC. In TCM pattern differentiation, this presentation often corresponds to the "intestinal dryness and fluid depletion" pattern, typically caused by yin deficiency generating internal heat, which damages body fluids, leading to intestinal dryness and hard, straining stools. Treatment primarily focuses on moistening the intestines and promoting bowel movements.

Vasoactive intestinal peptide (VIP) is a neurotransmitter distributed in the gastrointestinal mucosa, which relaxes intestinal smooth muscle and promotes intestinal water and electrolyte secretion. VIP mainly regulates the expression of aquaporins (AQPs) in colon tissue via the cAMP-PKA signaling pathway, participating in intestinal water metabolism. Wang Lu et al. found abnormal expression in the VIP-cAMP-PKA-AQP1 pathway in FC model mice, and modulating this pathway improved intestinal water transport, exerting a laxative effect [28-30].

Furthermore, experiments involving electroacupuncture at Tianshu (ST25) and Shangjuxu (ST37) for FC showed that

acupuncture significantly regulated plasma levels of nitric oxide (NO), nitric oxide synthase (NOS), and VIP in rats, suggesting that acupuncture may influence VIP-related pathways to modulate intestinal secretory function, thereby improving FC [31].

3.6 Regulating Pelvic Floor Muscle Function

Pelvic floor muscle dysfunction refers to a series of clinical symptoms caused by injury or functional impairment of the pelvic floor support system, commonly seen in urological, gynecological, and colorectal-related disorders [32]. FC often follows a prolonged course, with patients suffering from persistent defecation difficulty. Excessive straining during defecation transmits force to pelvic floor muscles, ligaments, and fascia. Over time, this can lead to pelvic floor muscle laxity, further aggravating dysfunction and creating a vicious cycle of "defecation difficulty – pelvic floor injury – worsening symptoms."

Research by Lu Yu [33] demonstrated that warm acupuncture combined with biofeedback therapy was effective in treating constipated patients with pelvic floor relaxation symptoms. Post-treatment pelvic floor electromyography values were significantly higher than pre-treatment, confirming acupuncture's regulatory effect on pelvic floor muscle function.

3.7 Improving Psychological Factors

Extensive research indicates that chronic psychological stress can affect gastrointestinal function through various mechanisms, linking it to the development and progression of conditions like inflammatory bowel disease, irritable bowel syndrome, and FC. FC patients, due to long-term defecation difficulties, are prone to developing negative emotions such as anxiety and depression, which can in turn exacerbate constipation, forming a psychosomatic interactive vicious cycle [34].

Acupuncture therapy not only unblocks meridians and harmonizes Qi and blood but also regulates mental activity and soothes emotions, embodying the characteristic of "harmonizing body and spirit." It is commonly used for mood-related disorders. Studies show a high clinical comorbidity of depression and constipation. Patients with this comorbidity exhibit significant differences in gray matter volume in brain regions such as the frontal, occipital, and parietal lobes compared to healthy controls. Experimental research found that electroacupuncture combined with a laxative decoction increased the expression of tryptophan hydroxylase 2 in the prefrontal cortex and colon of a comorbid depression-constipation mouse model. It also elevated levels of 5-hydroxytryptophan in the colon, prefrontal cortex, and serum, and significantly increased prefrontal serotonin concentration. This treatment alleviated constipation while also effectively mitigating negative emotions such as depression, anxiety, and cognitive impairment in the model mice [21].

4. Summary and Prospects

In summary, substantial progress has been made in both basic mechanistic research and clinical efficacy validation regarding acupuncture treatment for FC. Acupuncture exerts comprehensive therapeutic effects through multiple pathways, including regulating brain-gut axis function, enhancing gastrointestinal motility, improving visceral sensitivity, restoring gut microbiota balance, and modulating intestinal secretion. With advantages such as high safety, minimal side effects, and ease of application, acupuncture is widely used in clinical practice. Future efforts should focus on further elucidating its mechanisms of action to provide stronger theoretical support and scientific evidence for acupuncture in treating FC.

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