

Clinical Research Progress on Ear Acupoint Pressure Pill Intervention for Myopia in Children and Adolescents

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Abstract: Ear acupressure pills, as an external treatment method in traditional Chinese medicine, are increasingly widely used in the prevention and control of myopia in children and adolescents. This article provides a systematic review of the mechanism of action, clinical research protocol characteristics, efficacy evaluation, and influencing factors. The mechanism involves the regulation of meridians, Qi and blood, improvement of ciliary muscle function, and neuro humoral regulation; Preliminary consensus has been reached on the selection of main acupoints, treatment frequency, and combination behavior/Western medicine intervention in the clinical plan; The therapeutic effect shows a gradient feature of pseudo superiority over low and low superiority over moderate, with better results observed in younger age and early onset of myopia. The existing research still has limitations, such as low methodological quality and inconsistent outcome indicators. In the future, large-scale randomized controlled trials should be conducted, with axial length as the core indicator, and a standardized protocol should be established.

Keywords: Ear acupressure pills; Myopia in children and adolescents; Clinical research; Mechanism of action

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1. Introduction

With the popularization of electronic products and the increase in academic pressure, myopia in children and adolescents has become a major public health problem, with a high incidence, younger age, and rapid progression trend. At present, Western medicine prevention and control measures, such as low-concentration atropine eye drops and corneal reshaping lenses, have certain effects, but they have limitations, such as photophobia, blurred vision, high economic costs, and some children may not tolerate or have poor compliance. Ear acupressure pills, as an important component of traditional Chinese medicine external treatment, are increasingly receiving attention in the field of myopia prevention and control due to their simple operation, non-invasiveness, high safety, and good acceptance among children^[1]. In recent years, the number of relevant clinical studies has significantly increased, but there is still significant heterogeneity

in the interpretation of mechanisms of action, standardization of protocols, and evaluation of therapeutic efficacy. This article systematically reviews the clinical research progress of ear acupressure pills in the intervention of myopia in children and adolescents, from the aspects of mechanism of action, research program characteristics, efficacy evaluation, and influencing factors, in order to provide a reference for clinical practice and subsequent research.

2. The mechanism of action of ear acupressure pills in intervening myopia in children and adolescents

2.1. Eye Qi and blood regulation mechanism based on meridian theory

The theory of meridians in traditional Chinese medicine holds that “the eye is the gathering place of the meridians”, and the ear and the body’s meridians and organs communicate with each other through meridians and Qi. Ear acupressure pills can continuously stimulate specific acupoints in the ear (such as the eyes, liver, kidneys, heart, etc.) with the help of Wang Buliuxing seeds, which can stimulate the corresponding meridian Qi and unblock local meridian blockages in the eye area. If the meridians and Qi and blood are unobstructed, the essence and fluid will be carried over to the eyes, improving the state of eye and body deficiency^[2]. Modern research using infrared thermography has found that after ear acupoint stimulation, the skin temperature around the eyes increases, indicating an increase in local microcirculation blood flow and accelerated clearance of metabolites^[3]. In addition, the auricle has abundant branches of the vagus nerve, and the mechanical pressure generated by the pressure pill can be converted into bioelectric signals, which are transmitted upwards along the meridian nerve pathway to the eye, forming a regulatory loop of “ear meridian eye”^[4].

2.2. Mechanisms for relieving ciliary muscle spasm and improving regulatory function

Continuous close-range use of the eye causes the ciliary muscle to remain in a state of tension and spasm for a long time, which is one of the core links in the occurrence and development of myopia in children and adolescents. Ear acupressure pills can regulate the tension balance of the ciliary muscle through autonomic reflex by stimulating acupoints such as “eye”, “liver”, and “heart” in the ear^[5]. Specifically, after compression stimulation of the vagus nerve innervation area of the auricle, signals are transmitted to the solitary tract nucleus of the brainstem, which in turn affects the excitability of the oculomotor nucleus and promotes coordinated activity between the parasympathetic and sympathetic nervous systems^[6,7]. Moderate excitation of the parasympathetic nervous system can enhance the alternating ability of contraction and relaxation of the ciliary muscle, avoiding its rigidity and spasms; Excitement of the sympathetic nervous system helps to relax the ciliary muscle and improve regulation delay^[8]. Clinical use of a dynamic adjustment analyzer has found that after treatment with ear acupressure pills, patients’ adjustment sensitivity and amplitude have significantly improved, confirming that it can effectively restore the elasticity and response speed of the ciliary muscle, thereby delaying or blocking the transition from pseudomyopia to true myopia.

2.3. Mechanisms of regulating neurohumoral factors on eye development

The progression of myopia not only involves local muscle dysfunction, but is also closely related to changes in the neuroendocrine and biomechanical microenvironment of the eyeball wall^[9]. Ear acupressure pills

may affect the process of scleral remodeling and axial elongation by regulating neurohumoral factors. Ear acupoint stimulation can regulate the secretion levels of various neurotransmitters (such as dopamine, gamma aminobutyric acid) and hormones (such as growth hormone, cortisol) through the hypothalamic pituitary axis^[10]. Among them, dopamine is a key signaling molecule that inhibits excessive axial growth, and ear acupoint stimulation is expected to upregulate retinal dopamine concentration. At the same time, the sustained mild stimulation generated by pressure pills can reduce cortisol levels in the blood, alleviate oxidative stress damage to scleral fibroblasts, and maintain the metabolic balance of the extracellular matrix of scleral cells^[11].

3. Characteristics of the clinical research plan for ear acupressure pills

3.1. Selection of main acupoints and rules of acupoint matching based on syndrome differentiation

In existing clinical studies, there is a relative consensus on the selection of the main acupoints for ear acupressure pills, often with “eyes”, “liver”, “kidney”, “heart”, “spleen”, and “Shenmen” as the core acupoints. Among them, “eye” refers to the point taken from the corresponding part, which leads directly to the disease site; The “liver” opens the eyes, taking it to nourish blood and soften the liver; The kidney stores essence, which is injected into the eyes and taken to benefit the eyes and improve vision^[12]. The heart governs the bloodline and promotes the inheritance of essence and blood; The spleen is responsible for regulating Qi and blood circulation, ensuring the source of Qi and blood biochemistry; The “Divine Gate” helps to calm the mind and relieve visual fatigue^[13]. In terms of acupoint differentiation, clinical practice often combines organ differentiation with Qi and blood differentiation: for liver and kidney Yin deficiency type, “liver” and “kidney” are added; for Qi and blood deficiency type, “spleen” and “stomach” are emphasized; for heart and spleen deficiency type, “heart” and “spleen” are added; for those with phlegm and dampness, “subcortical” is added. Some studies also adjust acupoint allocation based on differences in myopia types. For example, pseudo myopia focuses on “Shenmen” and “Subcortical” to relieve spasms, while low degree true myopia strengthens “liver” and “kidney” to strengthen the foundation.

3.2. Basis for setting treatment frequency and intervention cycle

The frequency of treatment and intervention period are key parameters that affect the efficacy of ear acupressure pills, and existing research shows a certain regularity. In terms of frequency, most schemes adopt the operation mode of “replacing the seeds of Wangbuliu every 3–7 days and alternately pressing the two ears”^[14]. Replace every 3 days for pseudomyopia or early treatment to maintain strong stimulation; Replacing every 7 days is more commonly used for stable periods or combination therapy, while also considering compliance^[15,16]. Patients are required to self-press 3–5 times a day, with each acupoint lasting 1–2 minutes, based on the degree of fever and soreness in the auricle. In terms of intervention cycles, clinical studies generally set treatment courses ranging from 4 weeks to 6 months, with 8–12 weeks being the most common^[17]. Short-term (4–6 weeks) is mainly used to observe the improvement of naked eye vision and accommodation function, while long-term (3–6 months) focuses on the trend of changes in refractive power and axial length. Some studies adopted an intermittent regimen of continuous treatment for 2–3 courses, with a one-week break between each course, to avoid local skin reactions on the auricle and evaluate the stability of the therapeutic effect^[18,19].

3.3. Application mode of combined eye hygiene behavior intervention

The therapeutic effect of simple ear acupressure pills is significantly regulated by eye habits, so the vast majority of clinical studies combine it with eye hygiene interventions. The joint mode mainly includes two types: standardized eye behavior guidance and personalized lifestyle habit management^[20]. In terms of standardized guidance, researchers generally require patients to control the total daily duration of close eye use ($\leq 4-6$ hours), strictly follow the “20–20–20” rule (look at objects 20 feet away for 20 seconds every 20 minutes), maintain a reading distance of 33–40 cm, and ensure sufficient lighting^[21]. In terms of individualized management, some studies have increased the requirement for outdoor activity duration ($\geq 1-2$ hours per day), restricted the use of electronic products (≤ 1 hour per day, excluding learning purposes), and guided correct reading and writing posture (“one foot one fist”)^[22]. The implementation methods of behavioral intervention are often through distributing eye manuals, regular parent-teacher meetings for supervision, or using mobile apps for daily clock-in feedback.

3.4. Collaborative plan with Western medicine prevention and control measures

With the promotion of the concept of combining traditional Chinese and Western medicine to prevent and control myopia, the collaborative application of ear acupressure pills and mainstream Western medicine methods has gradually become a research hotspot. There are two main types of collaborative solutions: one is combined with low-concentration atropine eye drops (0.01–0.05%), and the other is combined with corneal reshaping lenses^[23]. In the joint program with atropine, the ear acupressure pills are replaced every 3–5 days as usual, and atropine is administered once a night before bedtime. The treatment period is usually 6–12 months. The theoretical basis for its synergy lies in the fact that atropine paralyzes the ciliary muscle and inhibits axial growth by blocking M receptors, but can cause adverse reactions such as photophobia and blurred vision; Ear acupressure pills can improve regulation sensitivity, reduce fatigue, and may assist in upregulating retinal dopamine^[24,25]. The two mechanisms complement each other, and ear acupressure pills are expected to reduce the incidence of adverse reactions to atropine. In combination with corneal reshaping lenses, patients wear OK lenses at night and maintain good naked eye vision during the day. At the same time, ear acupoints are pressed to consolidate daytime adjustment function and delay residual refractive error progression^[26]. This type of collaborative approach typically requires long-term follow-up of 3–6 months or more to evaluate the control effect of axial length. Preliminary studies have shown that the collaborative group is superior to the monotherapy group, but high-quality, large-sample evidence is still insufficient.

4. Clinical efficacy evaluation and influencing factors of ear acupressure pills

4.1. Differences in therapeutic effects for different types of myopia

There is a significant gradient difference in the therapeutic effect of ear acupressure pills on different types of myopia, overall presenting the characteristics of “pseudo optimal, followed by low degree, and moderate limited”. For pseudomyopia, due to its main pathological basis being ciliary muscle spasm, there has not been any structural elongation of the eye axis^[27]. Ear acupressure pills can significantly improve naked eye vision within 4–8 weeks by regulating autonomic nerve tension and relieving muscle spasm, and even restore normal refractive power, effectively blocking the transition to true myopia. For low myopia (≤ -3.00 D), some studies have shown that it can delay the annual growth of refractive error by about 0.25–0.50D and improve the adjustment lag index, but the control effect on axial length is still controversial^[28]. For moderate myopia

(-3.00 D to -6.00 D), the use of ear acupressure pills alone has limited effectiveness and is more commonly used as an adjunct to combination therapy, with the main goal of slowing down rather than reversing the progression of myopia ^[29]. This difference in therapeutic effect suggests that ear acupressure pills should be intervened early to grasp the key window period of transition from pseudo to true.

4.2. Comparison of therapeutic effects at different ages and stages of myopia progression

Age and the stage of myopia progression are two closely related factors that affect the efficacy of ear acupressure pills. In terms of age, existing evidence shows that the 6–9 age group has the best therapeutic effect. During this period, eye development is in a rapid stage, with strong plasticity and a more sensitive response to ear acupoint stimulation; The efficacy is second only to 10–12 years old, but it is still an effective intervention window; For students aged 13 and above, especially those in the upper grades of junior high school, due to increased academic pressure and significantly increased eye strain, as well as slow axial growth but already high baseline refractive error, the effectiveness of ear acupressure pills alone is weakened ^[30]. In terms of the progression stage of myopia, patients with newly diagnosed myopia (within 1 year of initial diagnosis) or rapid progression of myopia with an annual progression of ≥ 0.50 D have a better response to ear acupressure pills than long-term stable patients. The rapid progression period often corresponds to a stage where eye regulation dysfunction and abnormal blood supply coexist, and the comprehensive regulatory effect of ear acupoints can intervene in multiple links simultaneously. On the contrary, after entering the plateau period, the growth of the eye axis tends to stabilize, and the marginal benefits of intervention decrease. There is an interaction between age and progression stage. Younger individuals with rapid progression are the best target population for ear acupressure intervention, while older individuals with slow progression are more suitable for combination therapy or switching to other prevention and control measures.

4.3. Sensitivity and applicability of commonly used therapeutic indicators

The commonly used therapeutic indicators in clinical research of ear acupressure pills have their own characteristics, and there are significant differences in sensitivity, objectivity, and clinical significance. Naked eye vision is the simplest and most feasible indicator, with a sensitive response to short-term regulatory function improvement. Patients with pseudomyopia can show significant improvement after 2–4 weeks of treatment, but its subjectivity is strong, reproducibility is poor, and it is greatly influenced by the testing environment, psychological state, and effort level. It is suitable as a screening or initial efficacy evaluation indicator, and should not be used as the main outcome indicator ^[31]. Refractive power (based on ciliary muscle paralysis refraction) is the gold standard for diagnosing myopia, with objectivity superior to naked eye vision. The response period for the efficacy of ear acupressure pills is about 8–12 weeks, which can distinguish between changes in pseudomyopia and true myopia. However, attention should be paid to operational errors among different optometrists. Axial length is currently recognized as the core outcome indicator for preventing and controlling myopia, with the strongest objectivity and smallest error, and can truly reflect structural changes in the eyeball. However, the effect of ear acupressure on it usually takes 3–6 months or more to manifest, and it is ineffective for patients with pseudomyopia (whose axial length has not yet been extended).

4.4. Analysis of operational compliance, adverse reactions, and influencing factors

Operational compliance is the core influencing factor that determines the real-world efficacy of ear acupressure pills, rather than solely relying on the protocol itself. Compliance issues mainly manifest in three aspects: firstly, replacement compliance, where patients or parents fail to replace Wang Buliuxing seeds on time (usually 3–7 days), resulting in a decrease in stimulation intensity; The second is compression compliance, with insufficient self compression frequency per day (3–5 times required) or insufficient single compression time (1–2 minutes required), especially for school-age children who are prone to forgetting during boarding or busy academic periods; The third reason is improper local care of the auricle, such as peeling off the adhesive tape due to water after applying pressure, or irregular application cycles on both sides^[32]. In terms of adverse reactions, the overall safety of ear acupressure pills is relatively high. Common problems include local skin redness, pressure marks, mild pain, and tape allergies, with a very small number of cases of ear cartilage inflammation. The analysis of influencing factors suggests that the intensity of parental supervision, the age of the child (poor cooperation among young children), treatment expectations (high expectations can lead to early dropout), and the baseline level of myopia (weak perception of therapeutic effects and decreased compliance for moderate to severe myopia) all significantly affect compliance. The strategies to improve compliance include simplifying the plan (changing every 7 days, pressing twice a day), adding WeChat check-in reminders and issuing press record cards, and strengthening parental health education to form a family supervision mechanism.

5. Conclusion

In summary, the intervention of ear acupressure pills in children and adolescents with myopia involves meridian Qi and blood regulation, improvement of ciliary muscle function, and neurohumoral regulation in terms of mechanism. The clinical research plan initially formed the basic mode of selecting the main acupoint, setting the frequency cycle, and combining behavioral/Western medicine methods, and there are significant differences in the efficacy for different types and age groups of myopia. However, existing research still has significant limitations: the methodological quality is generally low, the sample size is small, and the implementation of randomization and blinding methods is insufficient; Inconsistent selection of therapeutic indicators and insufficient inclusion of objective outcomes such as axial length; Lack of direct comparison and long-term follow-up data for different scheme parameters. Future research should focus on conducting multi-center, large sample, strictly masked randomized controlled trials, establishing standardized acupoint, frequency, and cycle protocols, using axial length as the core outcome indicator, and extending follow-up to more than 1 year to evaluate long-term control effects and recurrence, while exploring the optimal synergistic mode of ear acupoint pressure pills and other prevention and control measures.

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