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Research Progress on the Relationship between Acupuncture and Moxibustion and Imaging

Jiaojiao Chao[1,a], Xiaoqing Qu[2,b], Yijie Feng[2,c], Xinrong Guo[2,d,*]

[1]Shaanxi University of Chinese Medicine, Xianyang, Shaanxi, 712046, China
[2]Affiliated Hospital of Shaanxi University of Chinese Medicine, Xianyang, Shaanxi, 712000, China
[a]453607985@qq.com, [b]2755031370@qq.com, [c]897032486@qq.com, [d]gxr329@126.com
[*]Corresponding author

Abstract: *Acupuncture has a history of thousands of years as a traditional Chinese medicine method. It is based on the theory of meridians, which aims to treat diseases and promote health by applying acupuncture and conditioning on specific acupuncture points. However, acupuncture is a complex technique, and its effects and mechanisms are still not fully understood. Therefore, the background and purpose of this study are to explore the imaging basis and application of acupuncture and acupuncture by reviewing the relationship between acupuncture and imaging, in order to improve the effectiveness and scientificity of acupuncture treatment. Specifically, the purpose of this study is to systematically sort out the basic principles and methods of acupuncture and acupuncture, including the meridian theory, acupoint positioning methods, and acupoint extraction standards and requirements, so as to provide a theoretical basis for further exploring the relationship between acupuncture and acupuncture and imaging. The purpose of this paper is to look forward to the development prospect of acupuncture and acupuncture imaging research, explore the future research direction and focus, so as to contribute to the scientific development of acupuncture and acupuncture.*

Keywords: *Acupuncture; acupuncture; imaging; meridian theory*

1. Introduction

Acupuncture is one of the core technologies in traditional Chinese medicine, and it is widely used in clinical treatment and health care. However, the mechanism of acupuncture and acupuncture has not been fully elucidated, and it is difficult to accurately evaluate and apply it in clinical practice [1]. By combining the modern technology of imaging with acupuncture and acupuncture, it can provide intuitive observation and quantitative data, which helps to reveal the mechanism and effect of acupuncture and acupuncture. This is of great significance for promoting the scientific development of acupuncture and moxibustion and improving its clinical application value. In this review, the relationship between acupuncture and imaging can be studied, and the physiological and biological effects of acupuncture treatment can be studied and verified through modern imaging techniques, so as to promote the recognition and application of acupuncture in the scientific society. This will help to improve the disciplinary status and scientific development level of acupuncture, and win more recognition and support for acupuncture as an important medical therapy.

2. The basic principle of acupuncture and acupuncture

The meridian theory is one of the basic theories of acupuncture and acupuncture. According to the theory of meridians, there is a system of meridians inside the human body, and the meridians run through the whole body and are distributed between tissues and organs such as skin, tendons, and internal organs. Acupuncture points are the key to acupuncture and acupuncture. The method of acupoint location is the method for researchers to determine the location of acupoints according to the theory of meridians and anatomical knowledge [2]. At present, the commonly used acupoint positioning methods include empirical positioning method, measurement positioning method, imaging positioning method, etc. Among them, the empirical positioning method is to determine the location of acupoints according to specific anatomical landmarks and site relationships through the experience summarized in clinical practice. Through long-term clinical experience, acupuncturists can identify and locate acupoints by means of visual observation and palpation. This method is highly skilled by experienced acupuncture specialists

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in clinical practice, but it can be subjective and limited for beginners and inexperienced physicians. The measurement and positioning method is to determine the position of the acupuncture points by measuring and calculating specific distances and angles. This method usually uses knowledge of anatomy and geometry, combined with clinical experience, to determine the location of acupoints by measuring the distance between specific landmarks and reference points on the body, or angles. The measurement and positioning method is relatively objective, which can provide more accurate positioning results and reduce the influence of subjective factors. Imaging localization method is to use imaging techniques, such as CT, MRI, etc., to directly observe and calibrate the location of acupoints. In this method, imaging is performed on the human body to find and demarcate the location of the acupuncture points in the images. Imaging localization can provide intuitive and accurate information on the location of acupoints, which is helpful for objective evaluation and research of acupoints [3]. However, due to the use of special equipment and expertise required for imaging localization, it is costly, complex to operate, and not suitable for widespread application in clinical practice. In short, there are various methods of acupoint positioning, each with its own advantages and disadvantages. In practical application, the appropriate positioning method can be selected according to the specific situation, and the factors such as clinical experience, geometric measurement and imaging can be comprehensively considered to ensure the accuracy and reliability of the acupoint location.

3. Imaging study of acupuncture and acupuncture

3.1. Imaging observation of the needle application process

The imaging observation of the acupuncture process is to observe and record the acupuncture process in real time through the use of imaging techniques, such as X-ray, ultrasound, magnetic resonance imaging, etc. Through these imaging observations, we can clearly see the entry of needles into the skin, the puncture of meridians, and the accuracy and safety of acupuncture operations. This observation method can help the acupuncturist better grasp the technique and position of the needle, and ensure the accuracy and effectiveness of the needle [4]. Imaging observation can also reveal the therapeutic mechanism of acupuncture by showing the temperature changes, blood flow changes, and tissue structure changes at the site of acupuncture. In addition, by observing the changes within the human body after acupuncture, such as brain nerve activity, endocrine system response, etc., we can further understand the physiological effects of acupuncture. Imaging observation of the acupuncture process can also be used for safety monitoring of acupuncture treatment, timely detection and prevention of possible complications or adverse reactions [5]. Through the imaging observation of the acupuncture process, we can have a deeper understanding of the therapeutic effect and mechanism of acupuncture, and provide a more scientific basis for the clinical application of acupuncture.

3.2. Impact on the organization

The effect of acupuncture on tissues refers to the physiological, pathological and functional changes of needle stimulation on human tissues. Through imaging studies, we can observe the effects of needle stimulation on tissues such as meridians, nerves, and blood vessels. For example, needle stimulation can change the filling of meridians, promote blood circulation and qi and blood flow, and enhance the nutrient supply and metabolic function of tissues [6]. In addition, needle stimulation can also regulate the activity of the nervous system, affecting pain conduction and the body's self-regulation mechanisms.

3.3. Needle application related technology and equipment

With the development of science and technology, the technology and equipment related to acupuncture and acupuncture are constantly innovating and improving [7]. The application of imaging technology makes acupuncture more precise and controllable. For example, a computer-aided acupuncture system (CAS) can combine imaging and computer technology to achieve precise control of acupuncture point positioning and needle application. The CAS system uses advanced 3D image reconstruction technology to extract a 3D model of the acupuncture points from the CT or MRI scan images of the head, and then accurately guide the needle to the target acupuncture point through computer-aided positioning. This technique not only improves the accuracy of acupuncture point positioning, but also avoids subjective errors in the traditional manual positioning process. In addition, transparent acupuncture technology can use infrared thermography and multimodal imaging technology to observe and evaluate the effect and effect of needle stimulation on tissues. Transparent acupuncture

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technology evaluates the thermal effect and tissue response of acupuncture by combining acupuncture needles with infrared thermal imaging cameras or other imaging devices to monitor temperature changes at the acupuncture site in real time. This technique can help acupuncturists better grasp the temperature changes and acupuncture effect during acupuncture, as well as judge the depth and direction of acupuncture. In addition, there are some acupuncture aids and equipment, such as acupuncture point detectors, acupoint massage instruments, etc., which also help to improve the safety and effectiveness of acupuncture and moxibustion. Acupuncture point detectors can be used to detect and locate resistance values or potential changes at acupuncture points, thus helping acupuncturists accurately locate acupuncture points [8]. The acupuncture point massage device can simulate acupuncture techniques through the massage action of the manipulator or electric manipulator, providing more accurate and uniform stimulation. In short, with the continuous advancement of imaging technology and related equipment, acupuncture and moxibustion have become more accurate and controllable, providing a more scientific and accurate means for acupuncture treatment. The application of these technologies and equipment makes acupuncture more safe and effective, and also provides more possibilities and directions for acupuncture research.

4. The correlation between acupuncture and imaging

4.1. Application of imaging in acupuncture and acupuncture

The application of imaging in acupuncture and moxibustion is mainly to help acupuncturists accurately locate acupoints and determine the depth of acupuncture by collecting and analyzing image data [9]. Through the use of different imaging techniques such as ultrasound, CT and magnetic resonance imaging, the anatomy and tissue status of the human body can be clearly visualized. Acupuncturists can use these images to guide the accuracy and safety of acupuncture extraction. For example, ultrasound imaging can show the direction of the meridians and the location of the acupuncture points, helping the acupuncturist find the correct acupuncture points. The application of imaging in acupuncture and acupuncture has improved the accuracy of acupuncture application and reduced errors and risks. At the same time, imaging can also help the acupuncturist determine the depth of the needle. By looking at the images, the acupuncturist can understand the thickness of the skin and tissues and thus adjust the depth of the acupuncture. This is essential to ensure the safety and comfort of the needle. In addition, imaging can also detect changes and feedback in the acupuncture points, providing the acupuncturist with information about the effect of the needle. For example, magnetic resonance imaging can be used to observe changes in the tissues around the acupoints during needle application. This information helps the acupuncturist to evaluate and adjust the effect of the needle. In general, the application of imaging in acupuncture and acupuncture has brought more scientific, accurate and safe technical support to acupuncture practice [10].

4.2. Evaluation of the effect of acupuncture on imaging

The evaluation of the effect of acupuncture by imaging is mainly through observation and analysis of tissue changes and physiological responses after acupuncture. By using imaging technology, changes such as blood flow rate, inflammation, etc., can be observed in real time after acupuncture. These observations can help assess the effectiveness of the needle administration and the intensity of the stimulation. For example, dynamic magnetic resonance imaging can observe changes in brain activity after acupuncture, revealing the therapeutic mechanism of acupuncture. Imaging evaluation can also objectively quantify the effect of acupuncture treatment, providing reliable data basis for research and clinical practice [11]. At the same time, imaging techniques can also evaluate tissue structure changes after acupuncture, such as blood perfusion, nerve activity, etc. For example, ultrasonography can observe blood flow to tissues after needle prick, and local blood flow changes caused by stimulation can be quantitatively assessed by techniques such as color Doppler ultrasound. In addition, radiological imaging techniques such as X-rays, CT scans, and magnetic resonance imaging can assess the effects of acupuncture on organs and tissues. These imaging evaluation methods can provide more intuitive and objective data, which is helpful for the evaluation of the efficacy and clinical application of acupuncture treatment. However, it is important to note that the results of imaging evaluation need to be combined with clinical efficacy and patient feedback to consider the overall effect of acupuncture.

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4.3. Verification of acupuncture theory by imaging research

The verification of acupuncture theory by imaging research is to verify the mechanism and efficacy of acupuncture by observing and analyzing the effects of acupuncture on related organs, nervous system and physiological functions. Imaging techniques can provide a non-invasive observation method to help researchers explore the biological effects of acupuncture [12]. For example, functional magnetic resonance imaging can observe the effects of acupuncture on brain activity, validating the neuromodulatory effects of acupuncture. In addition, imaging studies can also verify the regulatory function of acupuncture by observing the effects of acupuncture on organs. By using imaging techniques such as ultrasound, CT, and MRI, researchers can observe the hemodynamic changes and tissue structure changes of acupuncture on internal organs, and further verify the regulatory effect of acupuncture. Imaging studies provide an important scientific basis for in-depth understanding of the mechanism of action of acupuncture and optimization of acupuncture treatment programs. Through the imaging study of acupuncture methods with remarkable efficacy, the therapeutic mechanism can be further verified and provide a more reliable basis for the clinical application of acupuncture. The validation of acupuncture theory by imaging studies can also help promote the application of acupuncture in fields other than traditional medicine, such as sports rehabilitation, pain management, mental health, etc. Although imaging studies have achieved certain results in the verification of acupuncture theory, there are still some technical and methodological challenges. For example, how to capture and quantitatively analyze the dynamic changes in the acupuncture process in real time, and how to quantitatively compare the effects of acupuncture on different individuals are all issues that need further research [13]. The future development direction includes combining more imaging technologies and methods, in-depth exploration of the overall regulatory effect of acupuncture on the human body, and carrying out multi-center and large-sample clinical studies to provide a more solid scientific basis for the application of acupuncture.

5. Relevant research and progress

5.1. A review of relevant research at home and abroad

The research on the relationship between acupuncture and imaging has received extensive attention at home and abroad. The relevant research in China is mainly focused on the fields of anatomy, physiology and acupuncture. Many studies have used anatomical observations and electrophysiological experiments to verify the presence and properties of meridians and acupoints. Through the application of techniques such as autopsy and non-destructive tomography, researchers are able to accurately determine the location, depth, and anatomy of acupoints [14]. At the same time, electrophysiological experiments revealed the influence of acupoints on electrophysiological activity, and confirmed the physiological basis of the existence of acupoints. In addition, there are studies that have evaluated the efficacy and safety of acupuncture through clinical trials and randomized controlled trials. These studies usually focus on specific acupuncture techniques and acupoint selection, and explore the clinical effects and mechanisms of acupuncture by comparing the efficacy differences between the treatment group and the control group. Overseas research is also actively carried out, mainly in the fields of imaging and neuroscience. Based on imaging techniques such as MRI, CT and PET, researchers sought to explore local and global physiological, functional and metabolic changes after acupuncture, as well as the effects of acupuncture on brain activity. Through observation and analysis of imaging data, the researchers found that after acupuncture, local tissue blood circulation increased, inflammation was reduced, and immune function was regulated. In addition, acupuncture alters the release of neurotransmitters and the activation patterns of brain regions, regulating pain transmission and emotional response [15]. These imaging studies provide rich empirical evidence for the relationship between acupuncture and imaging, and reveal the biological mechanism and therapeutic effects of acupuncture. In summary, studies at home and abroad have confirmed the relationship between acupuncture and acupuncture and imaging. Future research needs to further explore the biological basis of acupuncture, in-depth study of the imaging characteristics of different acupoints and acupuncture techniques, and the overall regulatory effect of acupuncture on the body. This will help to improve the clinical effect and scientificity of acupuncture treatment, and promote the development of acupuncture and moxibustion.

5.2. New progress in acupuncture and acupuncture imaging research

With the continuous advancement of technology, new progress has been made in the research of acupuncture and acupuncture imaging. In recent years, magnetic resonance imaging (MRI)-based

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research has been widely used. Through MRI technology, morphological and functional changes of tissues after acupuncture can be observed, such as changes in the fibrous structure of subcutaneous tissues, changes in blood flow and oxygenation, etc [16]. In addition, functional magnetic resonance imaging (fMRI) has also been used to study the effects of acupuncture on brain activity. By recording the activity patterns of the brain, the mechanism of action of acupuncture in neuromodulation can be further revealed. In addition, bioluminescence imaging technology has also been applied to acupuncture and acupuncture imaging research, and the effect of acupuncture on cell metabolism and immune function can be understood by observing the changes in the luminescence signal of tissues. These new research advances provide us with new methods and perspectives to better understand the relationship between acupuncture and imaging. In addition, in recent years, some new technologies and methods have been applied in the imaging research of acupuncture and acupuncture. For example, ultrasound imaging can observe the changes in the tissue during the acupuncture process in real time, including the interaction between the needle tip and the subcutaneous tissue, the deformation of the tissue, etc. Infrared imaging can be used to measure the temperature changes in local tissues after acupuncture to assess the efficacy of acupuncture [17]. At the same time, optical imaging techniques have also been used to study the light scattering characteristics and light intensity distribution of local tissues after acupuncture to explore the mechanism of acupuncture. The introduction of these new technologies and methods has made the research on acupuncture and acupuncture imaging more comprehensive and in-depth. In conclusion, the new progress in acupuncture and acupuncture imaging research provides us with powerful tools and methods for in-depth understanding of the treatment mechanism and efficacy evaluation of acupuncture.

6. Problems and challenges

6.1. Problems in the imaging study of acupuncture and acupuncture

The problems existing in the imaging study of acupuncture and acupuncture include many aspects. First of all, the location and depth of acupuncture points are the key factors for acupuncture, however, due to individual differences in human structure and the influence of errors and deviations, there is no consistent standard and accurate positioning method. This leads to uncertainties and errors in the process of acupoint extraction, which affects the effectiveness of acupuncture application and the accuracy of efficacy evaluation. For example, there may be subjective perceptions and errors between different acupuncturists when taking acupuncture points, resulting in inconsistent acupuncture depths for the same acupuncture points, which may affect the efficacy of acupuncture. In addition, due to the differences in the structural and anatomical characteristics of the human body, there are also controversies about the positioning methods of specific acupuncture points, and there is a lack of unified positioning standards. Therefore, further research and exploration are still needed in the process of acupuncture and acupuncture to seek more accurate and objective acupoint extraction methods [18].

6.2. Challenges and difficulties

The imaging research of acupuncture and acupuncture is facing many challenges and difficulties. First of all, because acupuncture is an ancient therapy, its theory and practical experience have been accumulated for thousands of years. In the context of the development of modern science and technology, it is necessary to overcome the differences and barriers between tradition and modernity and establish an organic research framework and methodology to combine traditional acupuncture theory with modern imaging. There are certain differences between the meridian theory and acupoint positioning method of acupuncture and moxibustion and the anatomical viewpoint and positioning method of imaging, which requires in-depth communication and understanding to ensure the accuracy and scientificity of the research. In addition, the operation process and special techniques of acupuncture and acupuncture also pose challenges to the technical requirements of researchers, and it is necessary to ensure accurate and meticulous observation and recording to ensure that the obtained image results can truly reflect the process and effect of acupuncture [19]. Secondly, the imaging research of acupuncture and acupuncture requires interdisciplinary cooperation and exchange, involving professional knowledge in many fields such as traditional Chinese medicine, imaging, and biomedical engineering. Researchers need to have a solid disciplinary foundation and a broad knowledge base to be able to conduct in-depth research and analysis. In addition, the imaging study of acupuncture and acupuncture also needs to address ethical and safety issues. As human trials and observations are involved, ethical principles and regulations must be followed to ensure the safety and feasibility of the study. In addition, it is necessary to protect the privacy and personal information security of patients, and ensure that the data collection and processing during

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the study process comply with relevant laws and regulations. In the process of overcoming these challenges and difficulties, the imaging research of acupuncture and acupuncture will be gradually improved and developed, providing a more solid foundation for the scientific and clinical application of acupuncture treatment [20].

7. Outlook and future directions

In the field of acupuncture, the research on the relationship between acupuncture and imaging has broad development prospects. With the continuous advancement and development of imaging technology, such as computed tomography (CT), magnetic resonance imaging (MRI), ultrasound imaging (US), etc., the application in acupuncture and acupuncture will become more extensive and accurate. These modern imaging techniques will help to reveal the anatomical structure of acupoints, the distribution and changes of meridians, and provide a more reliable basis for accurate acupuncture. With computed tomography (CT), we can observe and measure the location, depth, and morphological characteristics of acupuncture points. Magnetic resonance imaging (MRI) can provide more detailed anatomical information to help us understand the organs and tissues surrounding the acupoints. Ultrasound imaging (US) can monitor the position of the needle in real time to ensure the accuracy and safety of acupuncture operations. The development and application of these imaging techniques will greatly facilitate research and clinical practice in the field of acupuncture [21]. Improving the accuracy and visualization of acupuncture is expected to further promote the development and innovation in the field of acupuncture.

8. Conclusion

In summary, the research on acupuncture and imaging has broad prospects and potential, and future research should be committed to improving methods, in-depth research mechanisms, applying big data and artificial intelligence, and strengthening international cooperation and academic exchanges, so as to promote the development of acupuncture and imaging, and provide a more scientific and effective basis for acupuncture treatment.

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