Medicinal Plant 2024, 15 (5): 31 - 34, 49 DOI: 10.19600/j.cnki.issn2152 - 3924.2024.05.008

Study on HPLC-DAD Fingerprint of Xueshuan Xinmaining Capsules

Chuang ZHAO[1], Yuling LIU[2], Longfei LIN[2], Chunmin WANG[3], Hui LI[2*], Yujie YANG[1*]

1. Chengde Medical College, Chengde 067000, China; 2. Institute of Chinese Medicine, China Academy of Chinese Sciences, Beijing 100700, China; 3. Chengde Neck Fukang Pharmaceutical Group Co., Ltd., Chengde 067000, China

Abstract [**Objectives**] To establish the HPLC-DAD fingerprint of Xueshuan Xinmaining Capsule (XXC). [**Methods**] The chromatographic conditions for the analysis of XXC solution were as follows: XSelect HSS T3 column; acetonitrile-0.1% phosphoric acid water was used as mobile phase, gradient elution; flow rate: 1.0 mL/min; column temperature 30 ℃; The injection volume is 10 μL. The quality of XXC samples produced by different manufacturers was evaluated by similarity evaluation and cluster analysis. [**Results**] In the HPLC-dad fingerprints of 15 batches of XXC, 23 common peaks were identified and 9 peaks were identified, and the similarity was greater than 0.95. According to the results of cluster analysis, 15 batches of XXC samples could be divided into two categories, S2, S5, S6, S7 and S8 batches belonged to category I, and the rest batches belonged to category II. [**Conclusions**] In this study, a representative and universal identification method of XXC HPLC-DAD fingerprint was established. The method has high precision, stability and repeatability, is simple and reliable, and provides a powerful reference for further improving the quality evaluation system of XXC.

Key words Xueshuan Xinmaining Capsule (XXC), HPLC-DAD, Fingerprint, Identification of chemical component, Quality evaluation

1 Introduction

Xueshuan Xinmaining Capsule (XXC) consists of ten Chinese herbal medicines, including as Chuanxiong Rhizoma (Chuanxiong), Sophorae Flos (Huaihua), Salviae Miltiorrhizae Radix Et Rhizoma (Danshen), Total Ginsenoside of Ginseng Stems and Leaves (Renshen Jingye Zongzaogan), *etc.* It has effects in invigorating qi, promoting blood circulation, inducing resuscitation, and relieving pain. This prescription composition follows the qi-blood syndrome differentiation theory of *The Medical Classic of the Yellow Emperor*, and is mainly used for treating cardiovascular and cerebrovascular diseases caused by atherosclerosis due to qi deficiency and blood stasis. Clinically, this drug has significant efficacy in the treatment of cerebral infarction, cerebral thrombosis, coronary heart disease, angina pectoris and other symptoms[1-8]. The total flavonoids, salvianolic acid B, Salviae Miltiorrhizae Radix Et Rhizomone IIA, cholic acid, muscone and other components[9-13] in the prescription have been studied in the literature to evaluate the quality of the product, but the content determination of a single component is difficult to reflect the overall quality of the product. As a quality control method, fingerprint technology has the benefits of simplicity, accuracy and convenience, and can be used to study and evaluate the quality of multi-medicinal materials and multi-components of traditional Chinese medicine preparations as a whole. However, the fingerprint of XXC has not been reported.

In this study, high performance liquid chromatography-diode array detector (HPLC-DAD) was used to establish the fingerprint of XXC, and the Similarity Evaluation System for chromatographic fingerprints of Traditional Chinese Medicines (TCM) (2012 Edition) and cluster analysis were used to evaluate it, which provided a scientific basis for the comprehensive control of the quality of XXC products.

2 Materials

2.1 Instruments and reagents Shimadzu HPLC LC-20AT (Shimadzu Corporation, Japan), XSelect HSS T3 (250 mm × 4.6 mm, 5 μm) column, acetonitrile (chromatographic pure, Fisher Company), electronic balance (METTLER TOLEDO XP105). Ultrasonic instrument (5510E-DTH), methanol (chromatographically pure, Fisher Company), DK-98 electric heating thermostatic water bath, methanol (analytically pure, Beijing Chemical Plant), other reagents are analytically pure, and the experimental water is Wahaha purified water.

2.2 Drugs Reference standard ferulic acid (batch No.: 110773-201614, purity: 99%), ginsenoside Rg1 (batch No.: 110703-202034, purity: 94%), ginsenoside Re (batch No.: 110754-201827, purity: 93.4%), ginsenoside Rb1 (batch No.: 110704-202129, purity: 94.3%) from China National Institute for Food and Drug Control; salvianolic acid B (batch No.: MUST-19062808, purity: 99.79%), ginsenoside Rd (batch No.: PS010161, purity: 95%), rutin (batch No.: MUST-20030218, purity: 99.47%), Salviae Miltiorrhizae Radix Et Rhizoma ketone IIA (batch No.: MUST-15092512, purity: 99.08%) from Chengdu MUST Bio-Technology Co., Ltd.; the reference substance quercetin (batch No.: AFBL0851, purity: 98%) was obtained from Chengdu Alfa Biotechnology Co., Ltd. 15 batches of XXC were purchased from Manufacturer A (No. S1-S4), Manufacturer B (No. S5-S8), Manufacturer C (No. S9-S11) and Manufacturer D (No. S12-S15). The batch numbers of S1 to S15 are 102200902, 102210502, 102200703, 102220501, 210703, 220304, 220806, 221108, 211103, 220606, 221004, 220106, 220903, 230201, and 230204, respectively.

3 Methods and results

3.1 Chromatographic conditions XSelect HSS T3 (250 mm ×

Received: June 11, 2024 Accepted: September 23, 2024
* Corresponding author. E-mail: 847272204@qq.com; lihuiyiren@163.com

4.6 mm, 5 μm) column was used; the mobile phase was acetonitrile (B) and 0.1% phosphoric acid solution (A), gradient elution: 0 – 10 min, 5% – 12% B; 10 – 20 min, 12% B; 20 – 30 min, 12% – 18% B; 30 – 45 min, 18% B; 45 – 55 min, 18% – 24% B; 55 – 90 min, 24% – 40% B; 90 – 110 min, 40% – 65% B; 110 – 125 min, 65% – 95% B; 125 – 130 min, 95% B; detection wavelength 210 nm; volume flow rate 1.0 mL/min; injection volume 10 μL; column temperature 30 ℃.

3.2 Preparation of sample solution

3.2.1 Mixed reference solution. Separately weighed ferulic acid, rutin, quercetin, salvianolic acid B, Salviae Miltiorrhizae Radix Et Rhizomone IIA, ginsenoside Rg1, ginsenoside Re, ginsenoside Rb1, dissolved a proper amount of ginsenoside Rd in methanol in different volumetric flasks to obtain reference solutions with concentrations of 49.6, 232.8, 225.4, 201.6, 208.1, 139.9, 212.9, 201.8 and 199.5 μg/mL, respectively. Precisely weighed 1 mL of each reference solution, put it into the same 10 mL volumetric flask, diluted it with methanol to the desired scale, and shook it up to obtain the mixed reference solution.

3.2.2 Test solution. Pulverized the contents of 10 capsules of XXC (batch No.:1022105021), took about 1 g, weighed accurately, put into a 25 mL volumetric flask, added methanol to the desired scale, performed ultrasonic treatment (power 490 W, frequency 50 kHz) for 30 min, then used methanol to fix the scale, shook up, and filtered with 0.22 μm microporous membrane, then the test solution was obtained.

3.2.3 Test solution of single medicinal material. Took nine medicinal materials (Chuanxiong Rhizoma, Salviae Miltiorrhizae Radix Et Rhizoma, Hirudo (Shuizhi), Root of Pubescent Holly (Maodongqing), Sophorae Flos, Bufonis Venenum (Chansu), Borneolum Syntheticum (Bingpian), Moschus (Shexiang), and Bovis Calculus Artifactus (Niuhuang), to prepare the extract powder of each single medicinal material according to XXC preparation process. Prepared the test solution of each single medicinal material and Total Ginsenoside of Ginseng Stems and Leaves according to the preparation method in Section **3.2.2**.

3.3 Methodological investigation

3.3.1 Precision test. Took an appropriate amount of XXC sample (batch No.:1022105021), prepared the test solution according to the preparation method of the test solution in Section **3.2.2**, injected the sample for 6 consecutive times according to the chromatographic conditions in Section **3.1**, and recorded the retention time and peak area of the common peak. The results showed that the *RSD* values of retention time of the common peaks were less than 0.57%, and the *RSD* values of peak area were less than 2%, indicating that the precision of the instrument was good.

3.3.2 Repeatability test. Took 6 portions of XXC sample (batch No.:1022105021), prepared the test solution in parallel according to the method in Section **3.2.2**, determined according to the chromatographic conditions in Section **3.1**, and calculated the retention time and peak area of each common peak. The results showed that the *RSD* values of retention time and peak area of the common peaks were less than 0.38% and 3%, respectively, indicating that the method had good repeatability.

3.3.3 Stability test. Took appropriate amount of XXC sample (batch No.:1022105021), prepared the test solution in accordance with the method in Section **3.2.2**, injected and analyzed at 0, 3, 6, 9, 12, 24 and 48 h, respectively according to the chromatographic conditions in Section **3.1**, and recorded the retention time and peak area of the common peak. The results showed that the *RSD* value of retention time was less than 0.36%, and the *RSD* value of peak area was less than 3%, indicating that the solution was stable within 48 h.

3.4 Generation of fingerprint and identification of common peaks Took 15 batches of XXC samples from different manufacturers to prepare the test solution according to the test solution preparation method described in Section **3.2.2**, injected the sample for detection according to the chromatographic conditions in Section **3.1**, and recorded the chromatogram. The Similarity Evaluation System for chromatographic fingerprints of Traditional Chinese Medicines (TCM) (2012 Edition) issued by the State Pharmacopoeia Committee was used. The HPLC-DAD profiles of 15 batches of samples were analyzed. S1 was used as the reference chromatogram, the time window width was set as 0.1 min, and the median method was used for multi-point correction and chromatographic peak matching to determine 23 common peaks and generate the reference fingerprint, as shown in Fig. 1.

3.5 Similarity evaluation Using the Similarity Evaluation System for chromatographic fingerprints of Traditional Chinese Medicines (TCM) (2012 Edition)[14], we evaluated the similarity between the fingerprints of 15 batches of XXC samples and the reference fingerprints, and the results are shown in Table 1. According to the results, the similarity between the 15 batches of samples and the control was 0.994, 0.957, 0.993, 0.996, 0.999, 0.995, 0.989, 0.993, 0.992, 0.989, 0.991, 0.996, 0.998, 0.998, and 0.998, respectively, all greater than 0.95. The results showed that the quality of XXC among different batches was stable.

Table 1 Similarity of fingerprints of 15 batches of XXC

No.	Similarity	No.	Similarity	No.	Similarity
S1	0.994	S6	0.995	S11	0.991
S2	0.957	S7	0.989	S12	0.996
S3	0.993	S8	0.993	S13	0.998
S4	0.996	S9	0.992	S14	0.998
S5	0.999	S10	0.989	S15	0.998

3.6 Identification and attribution of common peaks

3.6.1 Identification of common peaks. Took the mixed reference solution, injected the sample for determination according to the chromatographic conditions in Section **3.1**, and compared the generated chromatogram with the reference chromatogram. Chromatographic Peak 5 was identified as ferulic acid, chromatographic peak 6 was rutin, chromatographic peak 12 was ginsenoside Rg 1,

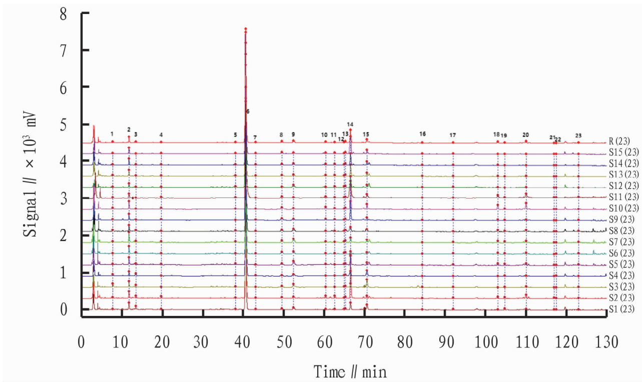

Fig. 1 Fingerprint of 15 batches of XXC under 210 nm

chromatographic peak 13 was ginsenoside Re, chromatographic peak 14 was salvianolic acid B, chromatographic peak 15 was quercetin, chromatographic peak 16 was Rb1, and chromatographic peak 17 was Rd, chromatographic peak 23 was tanshinone IIA, and the results are shown in Fig. 2 – 3.

3.6.2 Attribution of common peaks. Prepared the sample solution of medicinal materials of each unit according to the method in Section **3.2.3**, injected the sample for determination according to the chromatographic conditions in Section **3.1**, and recorded the chromatogram. According to the retention time and ultraviolet spectral information, the chromatogram of each single medicinal material were compared with the XXC, and the attribution of the common peaks in the fingerprint was determined, as shown in Fig. 4. As shown in Fig. 4, peaks 2, 10, 11, 14, 21, 22 and 23 were attributed to Salviae Miltiorrhizae Radix Et Rhizoma, and peaks 4, 5, 18, 19 and 20 were attributed to Chuanxiong Rhizoma, peaks 1, 3, 6, 7, 8, 9 and 15 were attributed to Sophorae Flos, and peaks 12, 13, 16 and 17 were attributed to Total Ginsenoside of Ginseng Stems and Leaves.

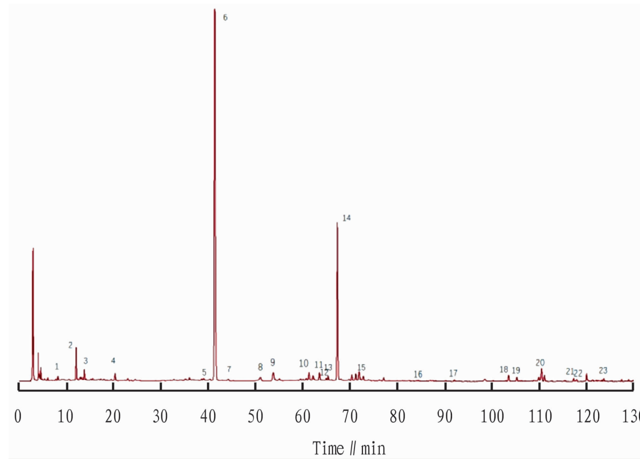

Fig. 2 Overlay of HPLC control characteristic chromatogram of 15 batches of XCC

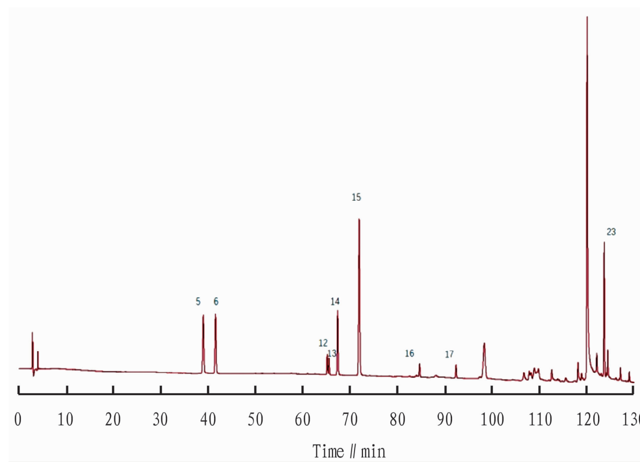

Fig. 3 HPLC-DAD chromatograms of mixed reference substances

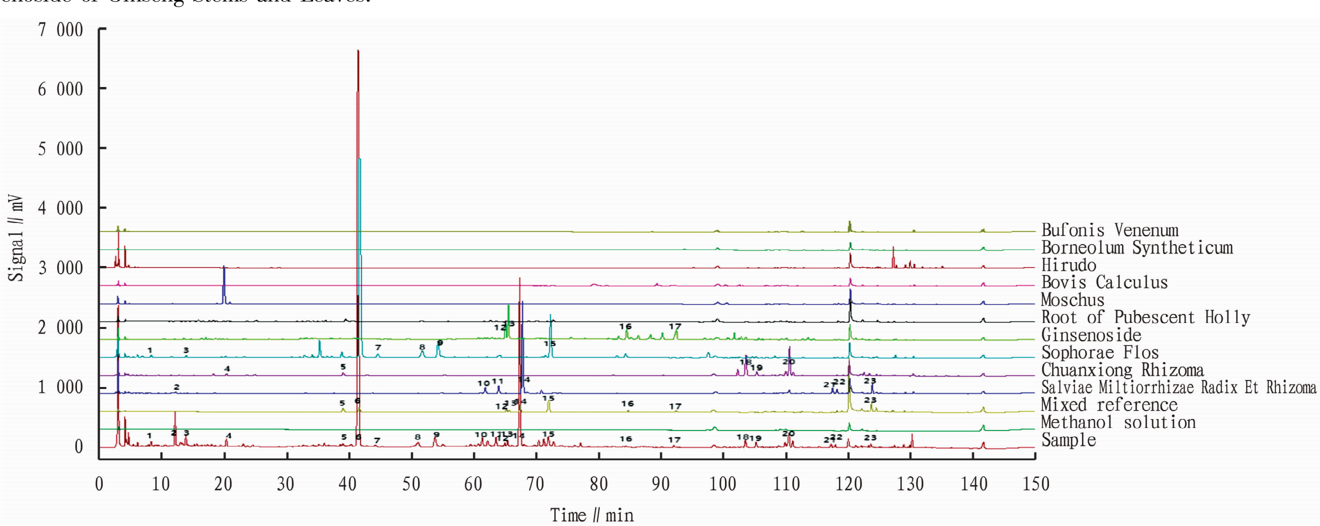

Fig. 4 Chromatogram of each common peak attribution in fingerprint of XXC

3.8 Cluster analysis In this study, the common peak area in the fingerprint of 15 batches of XXC samples was used as the variable, the squared Euclidean distance was used as the measure, and SPSS 21.0 statistical software was used for data clustering analysis[15]. The results are shown in Fig. 5. The results showed that when the squared Euclidean distance was 20, the 15 batches of samples could be divided into two categories, S2, S5, S6, S7 and S8 batches were category I, and the rest batches were category II.

In Category I, except that the manufacturer of S2 is A, the manufacturers of other batches are B. The batches of Category II samples include manufacturers A, C and D, and the samples of the same manufacturer are basically clustered in the same category. Combined with the similarity analysis results, it can be seen that the similarity between the peak area of the common peak of the second batch and the peak area of the common peak of other batches fluctuates, which may be related to factors such as the quality and origin of medicinal materials in different batches of manufacturers[16]. In general, the correlation results between samples obtained by cluster analysis and similarity calculation are consistent.

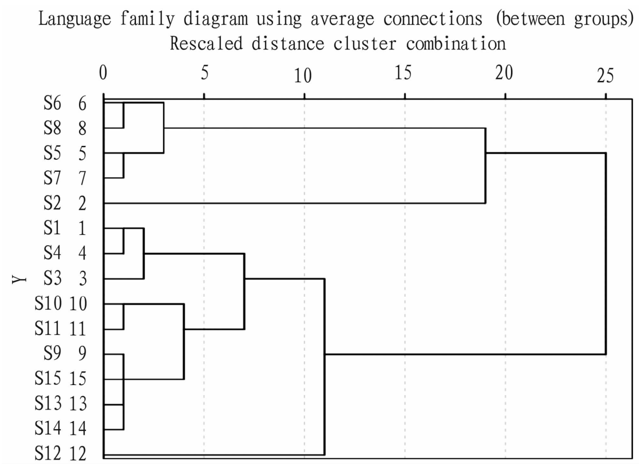

Fig. 5 Cluster analysis results of 15 batches of XXC

4 Discussion

In the establishment of method, we investigated the type of chromatographic column (XSelect HSS T3, Welch ultimate XB C_{18}, Waters XBridge C_{18}), the extraction method (ultrasonic, reflux), the mobile phase (acetonitrile-0.1% phosphoric acid, acetonitrile-0.1% acetic acid, methanol-0.1% phosphoric acid), extraction solvent (50% methanol, 75% methanol, methanol), and detection wavelength (190 – 300 nm). Finally, we determined the chromatographic conditions in Section **3.1** and the preparation method of the test solution in Section **3.2.2**.

In this study, we selected different batches of XXC samples from different manufacturers for fingerprint study, and established a representative and universal XXC fingerprint identification method, which provided an important reference for the promotion of the technology and the formulation and improvement of XXC enterprise standards, statutory standards and other standards.

The results of cluster analysis showed that there were some differences between XXC produced by manufacturer B and that produced by manufacturers A, C and D. Through analysis, we believed that the reasons are as follows: there are differences between manufacturer B and other manufacturers in the production process, which may be reflected in the production process, equipment model, power system, *etc.*; there are differences in the quality of APIs used by manufacturer B and other manufacturers. The S2 batch produced by Manufacturer A and the other three batches produced by Manufacturer A belong to different categories, which may be caused by the quality difference of APIs, and the specific reasons need to be further studied.

In this study, the XXC fingerprints established by different batches of XXC samples from different manufacturers are universal, but in the process of cluster analysis, it is found that there are some differences in the peak areas of different batches of samples from different manufacturers. This suggests that fingerprint similarity evaluation can be used for rapid identification of products, but the overall quality of a product needs to be evaluated by multiple means and from multiple perspectives.

5 Conclusions

In this study, high performance liquid chromatography-diode array detection (HPLC-DAD) was used for the first time to establish a fingerprint of XXC[17]. A total of 23 common peaks were identified, and 9 chemical components were identified by comparing with the reference chromatographic peaks. The similarity between the fingerprints of 15 batches of XXC samples and the reference fingerprint was greater than 0.95, indicating that there was a high similarity among the batches. The results of cluster analysis were basically consistent with the results of similarity evaluation, which showed that the chemical components of different batches of XXC based on fingerprints were consistent. In conclusion, the XXCHPLC-dad fingerprint established in this study can more comprehensively reflect the consistency and stability of product quality among multiple batches, and it is expected to provide a scientific basis for further research and clinical application of the product.

References

[1] GUO W. Effects of Xueshuanxinmaining capsule combined with conventional Western medicine on acute cerebral infarction[J]. Medical Journal of Chinese People's Health, 2022, 34(20): 95 – 98. (in Chinese).
[2] LI KL, CHEN JH, LIU YB. Clinical study on the treatment of cerebral thrombosis patients with Xueshuanxinmaining capsule [J]. For All Health, 2016, 10(8): 26 – 27. (in Chinese).
[3] HUANG Y, CHEN YX, FU M. Clinical study on Xueshuan Xinmaining Capsules combined with onosialotetrahexosylganglioside in treatment of cerebral infarction[J]. Drugs & Clinic, 2017, 32(5): 780 – 783. (in Chinese).
[4] CHEN GJ. Comparison of the efficacy of thromboxane capsule and vincristine in the treatment of type 2 diabetes mellitus combined with cerebral infarction[J]. Chinese and Foreign Medical Research, 2014, 12(6): 54 – 55. (in Chinese).
[5] REN JH. The effect of Xueshuanxinmaining capsule on inflammatory factors in patients with coronary heart disease[J]. Chinese Journal of Experimental Formulas, 2012, 18(23): 319 – 321. (in Chinese).
[6] MA YB, CHEN GQ, NI ZH. Clinical study on Xueshuan Xinmaining Capsules combined with nimodipine in treatment of acute cerebral infarction[J]. Drugs & Clinic, 2019, 34(4): 970 – 974. (in Chinese).
[7] MA ZG. Clinical efficacy observation of Xueshuanxinmaining capsule in the treatment of angina pectoris[J]. Chinese Journal of Clinical Rational Drug Use, 2016, 9(18): 64 – 65. (in Chinese).
[8] WANG LY, GONG YZ, WAN XJ. Clinical observation on the treatment of angina pectoris of coronary heart disease with Xueshuan Xinmaining Capsules[J]. Heilongjiang Medical Journal, 2001(11): 827. (in Chinese).
[9] LIANG Y. Determination of total flavonoids in Xueshuan Xinmaining Capsules[J]. Forum on Traditional Chinese Medicine, 2007(2): 41 – 43. (in Chinese).

(To page 49)

tion, agency, and ownership[23].

5 Conclusions

A thorough systematic review and meticulous meta-analysis have been conducted to evaluate the impact of virtual reality-based mirror therapy on upper extremity function in cerebral ischemic stroke patients. The key findings reveal that this therapy significantly enhances FMA-UE and Box and Block Test (BBT) scores, while no statistically significant difference was observed in Manual Function Test (MFT) scores. Further, a subgroup analysis indicates that immersive VR-MT outperforms non-immersive VR-MT in improving FMA-UE scores, when compared to traditional mirror therapy, suggesting a potential advantage of immersive virtual reality therapy in upper extremity rehabilitation.

References

[1] FAN JL, BRASSARD P, RICKARDS CA, *et al.* Integrative cerebral blood flow regulation in ischemic stroke[J]. Journal of Cerebral Blood Flow & Metabolism, 2022, 42(3): 387 – 403.
[2] ABO M, KAKUDA W, MOMOSAKI R, *et al.* Randomized, multicenter, comparative study of NEURO versus CIMT in poststroke patients with upper limb hemiparesis: The neuro-verify study[J]. International Journal of Stroke, 2014, 9(5): 607 – 612.
[3] NIRKKO AC, RÖSLER K M, OZDOBA C, *et al.* Human cortical plasticity: Functional recovery with mirror movements[J]. Neurology, 1997, 48(4): 1090 – 1493.
[4] KIM J, SONG C. Postural difference between the interventions reflecting the concept of mirror therapy in healthy subjects[J]. Brain Sciences, 2021, 11(12): 1567.
[5] PAGE MJ, MCKENZIE JE, BOSSUYT PM, *et al.* The PRISMA 2020 statement: An updated guideline for reporting systematic reviews[J]. BMJ, 2021(372): n71.
[6] SONG X, CHEN S, JIA J, *et al.* Cellphone-based automated fugl-meyer assessment to evaluate upper extremity motor function after stroke[J]. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 2019, 27(10): 2186 – 2195.
[7] EVERARD G, OTMANE-TOLBA Y, ROSSELLI Z, *et al.* Concurrent validity of an immersive virtual reality version of the box and block test to assess manual dexterity among patients with stroke[J]. Journal of Neuroengineering and Rehabilitation, 2022, 19(1): 7.
[8] MIYAMOTO S, KONDO T, SUZUKAMO Y, *et al.* Reliability and validity of the manual function test in patients with stroke[J]. American Journal of Physical Medicine & Rehabilitation, 2009, 88(3): 247 – 255.
[9] HIGGINS JP, ALTMAN DG, GØTZSCHE PC, *et al.* The Cochrane Collaboration's tool for assessing risk of bias in randomised trials[J]. BMJ 2011(343): d5928.
[10] JO S, JANG H, KIM H, *et al.* 360° immersive virtual reality-based mirror therapy for upper extremity function and satisfaction among stroke patients: A randomized controlled trial[J]. European journal of physical and rehabilitation medicine, 2024, 60(2): 207 – 215.
[11] SIP P, KOZŁOWSKA M, CZYSZ D, *et al.* Perspectives of motor functional upper extremity recovery with the use of immersive virtual reality in stroke patients[J]. Sensors (Basel, Switzerland), 2023, 23(2): 712.
[12] WANG JY. Effects of virtual reality mirroring therapy on upper limb motor and cognitive functions after stroke[D]. Guangzhou: Jinan University, 2022. (in Chinese).
[13] HSU HY, KUO LC, LIN YC, *et al.* Effects of a virtual reality-based mirror therapy program on improving sensorimotor function of hands in chronic stroke patients: A randomized controlled trial[J]. Neurorehabilitation and Neural Repair, 2022, 36(6): 335 – 345.
[14] MEKBIB DB, DEBELI DK, ZHANG L, *et al.* A novel fully immersive virtual reality environment for upper extremity rehabilitation in patients with stroke[J]. Annals of the New York Academy of Sciences, 2021, 1493(1): 75 – 89.
[15] LIN CW, KUO LC, LIN YC, *et al.* Development and testing of a virtual reality mirror therapy system for the sensorimotor performance of upper extremity: A pilot randomized controlled trial[J]. IEEE Access, 2021 (9): 14725 – 14734.
[16] CHOI HS, SHIN WS, BANG DH. Mirror therapy using gesture recognition for upper limb function, neck discomfort, and quality of life after chronic stroke: A single-blind randomized controlled trial[J]. Medical SCIence Monitor, 2019(25): 3271 – 3278.
[17] GARRY MI, LOFTUS A, SUMMERS JJ. Mirror, mirror on the wall: Viewing a mirror reflection of unilateral hand movements facilitates ipsilateral M1 excitability[J]. Experimental Brain Research, 2005, 163 (1): 118 – 122.
[18] BULLOCK K, WON AS, BAILENSON J, *et al.* Virtual reality-delivered mirror visual feedback and exposure therapy for FND: A midpoint report of a randomized controlled feasibility study[J]. The Journal of Neuropsychiatry and Clinical Neuroscences, 2020, 32(1): 90 – 94.
[19] WON AS, BARREAU AC, GAERTNER M, *et al.* Assessing the feasibility of an open-source virtual reality mirror visual feedback module for complex regional pain syndrome: Pilot usability study[J]. Journal of Medical Internet Research, 2021, 23(5): e16536.
[20] CHA K, WANG J, LI Y, *et al.* A novel upper-limb tracking system in a virtual environment for stroke rehabilitation[J]. Journal of Neuroengineering and Rehabilitation, 2021, 18(1): 166.
[21] PALACIOS-NAVARRO G, HOGAN N. Head-mounted display-based therapies for adults post-stroke: A systematic review and meta-analysis [J]. Sensors (Basel, Switzerland), 2021, 21(4): 1111.
[22] JIN M, PEI J, BAI Z, *et al.* Effects of virtual reality in improving upper extremity function after stroke: A systematic review and meta-analysis of randomized controlled trials[J]. Clinical Rehabilitation, 2022, 36(5): 573 – 596.
[23] HEINRICH C, MORKISCH N, LANGLOTZ T, *et al.* Feasibility and psychophysical effects of immersive virtual reality-based mirror therapy[J]. Journal of Neuroengineering and Rehabilitation, 2022, 19(1): 107.

(From page 34)

[10] CUI LN, SUN JM, ZHANG H. Determination of bile acids in Xueshuan Xinmaining Capsules by HPLC-ELSD[J]. Jilin Journal of Chinese Medicine, 2011, 31(2): 165 – 167. (in Chinese).
[11] CHEN SY. HPLC determination of thrombosis Xinmaining capsule content of Sal B[J]. Guiding Journal of Traditional Chinese Medicine and Pharmacy, 2010, 16(9): 101 – 102. (in Chinese).
[12] HUANG YG. Determination of tanshinone IIA in thrombosis Xinmaining capsuleby HPLC[J]. Strait Pharmaceutical Journal, 2009, 21(11): 72 – 74. (in Chinese).
[13] ZHAO XH, GUO ML. Determination of muscone in Xueshuan Xinmaining Capsules by GC[J]. Drug Standards of China, 2016, 17(3): 181 – 183. (in Chinese).
[14] ZHANG H, YE J, GAO S, *et al.* Establishment of HPLC fingerprints of Kunbao Wan[J]. Ginseng Research, 2023, 35(3): 25 – 27. (in Chinese).
[15] HU HJ, LIN LF, LIU YL, *et al.* Study on UPLC-PDA fingerprint of Xueshuan Xinmaining Tablets[J]. Chinese Traditional and Herbal Drugs, 2017, 48(20): 4268 – 4274. (in Chinese).
[16] DONG ZL, XIA F, GUAN L, *et al.* Study on fingerprints of Huagai San-medicinal materials based on peak pattern matching[J]. Chinese Traditional and Herbal Drugs, 2016, 47(3): 425 – 429. (in Chinese).
[17] CAO L, WANG ZG, WANG LZ. Application of chromatography in the study on traditional Chinese medicine fingerprint[J]. China Modern Medicine, 2012, 19(1): 16 – 17. (in Chinese).