The clinical effects and biomechanical mechanisms of Peony and licorice decoction fumigation in the treatment of poststroke cavovarus foot: study protocol for a randomized controlled pilot trial

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Title page

The clinical effects and biomechanical mechanisms of Peony and licorice decoction fumigation in the treatment of poststroke cavovarus foot: study protocol for a randomized controlled pilot trial

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Abstract

Background: As the most common functional disability in stroke patients with hemiplegia, poststroke cavovarus foot (PCF) seriously affects the life quality of patients and causes mental and emotional disorders. Some studies have suggested that the traditional Chinese medicine fumigation therapy could be an effective intervention method for PCF patients. This study aims to investigate the biomechanical effect of the classic prescription Peony and licorice decoction (PLD) fumigation in the treatment of PCF.

Methods/Design: This study is a multi-center, randomized, placebo-controlled, double blind trial. A total of 190 patients with PCF according to the inclusion criteria will be recruited in three centers and randomized and distributed to either the intervention group or the control group at a 1:1 ratio. All patients will receive standardized modern rehabilitation treatment according to the "Chinese Guidelines for Stroke Rehabilitation" (2011 version). Patients will stick to the treatments they used to take, and will be given present general treatment when acute exacerbation of stroke occurs during the trial. The intervention group will receive PLD fumigation treatment, while the control group will receive placebo fumigation treatment. The primary outcome measure is medial plantar area (M1 + M2 + HM) generating from the RSSCAN gait system. The secondary outcome measures contain the scores of clinical scales including Berg Balance Scale, Fugl-Meyer Assessment, Modified Ashworth Scale, Barthel Index, and Stroke-Specific Quality of Life Scale. All assessments will be implemented at baseline, 4 weeks after intervention and at the end of 3 month'

follow-up. Intention-to-treat analysis and per-protocol analysis will be applied in this trial.

Discussion: The results of this study are expected to provide detailed interpretations of clinical effects and biomechanical mechanisms of PLD fumigation in the treatment of PCF. If PLD fumigation treatment is confirmed as an effective option, this study may additionally set up the new treatment method for patients with PCF and provide foundations for further clinical studies on a larger scale.

Trial registration: Chinese Clinical Trial Registry, ChiCTR2000032433. Registered on 28 April 2020.

Keywords: Biomechanical mechanisms, Peony and licorice decoction, fumigation therapy, poststroke cavovarus foot, Multi-center randomized controlled trial, Study protocol

Background

Strokes are a type of cerebrovascular disease characterized by high incidence, high disability and high mortality. An authoritative survey in 2014 showed that strokes had become the leading cause of disability and the second leading cause of death in the world [1]. Epidemiological studies showed that the annual incidence of strokes in China was as high as 116-219 / 100000, and is rising year by year [2]. With the continuous improvement of modern medical technology, most patients with strokes can be treated in time, so the fatality rate of strokes can be controlled to a certain extent, but the disability rate keeps increasing. Poststroke cavovarus foot (PCF) is one of the most common functional disabilities in stroke patients with hemiplegia [3].

Studies showed that the incidence of PCF ranges from 17% to 38% in the population of patients with strokes, and 4% to 9% of stroke survivors were being disabled [4]. The life quality of stroke patients is seriously affected by the abnormal gait [5], balance disorder [6], life restriction and the consequent abnormal mental mood [7-9] caused by PCF.

Modern rehabilitation techniques such as foot support fixation, plantar inhibition and other good limb placement methods are used in the acute phase of stroke to prevent the occurrence of PCF [10]. To some extent, these methods reduce the incidence of PCF in stroke patients. However, because of the relatively serious condition of patients in the acute stage, most treatment schemes focus on the intervention of vital signs. However, the intervention of early rehabilitation treatment is often neglected. As a result, most patients begin rehabilitation only when their vital signs are relatively stable [11]. For the spasmodic cavovarus foo forming during the recovery period, modern rehabilitation medicine mostly adopts rehabilitation techniques such as passive joint activity training, weight loss gait training and so on. For the refractory cavovarus foot, Botox injection and surgery are used to inhibit the excessive flexion spasm of the medial muscles [12, 13]. However, the outcome of the above therapies are not satisfactory. Such situations drive us to seek a more effective method for the treatment of PCF.

The traditional Chinese medicine fumigation therapy uses the gas generated by the boiling of drugs and water to fumigate the patient's diseased area to achieve the treatment effect. Absorption through the skin plays a role in avoiding the stimulation

of drugs to the gastrointestinal tract, reducing the burden for the liver and kidney, making the incidence of adverse drug reactions being significantly reduced, and for the patients who are not suitable for oral administration of drugs, it is undoubtedly a good way to administer drugs [14]. From Zhang Zhongjing's Treatise on Febrile Diseases, the classic prescription Peony and Licorice Decoction (PLD), known as "traditional Chinese medicine morphine", is primarily used to treat visceral pain, painful muscle spasms, menstrual pain and so on [15, 16]. Modern research confirmed that total paeoniflorin in white peony and total glycyrrhizin in licorice have strong anti-inflammatory and analgesic effects, so that it has a strong relaxing effect for the smooth muscle [17]. The oral treatment of them can significantly improve limb motor function and activities of daily living for patients with spastic hemiplegia after a stroke [18]. But for the treatment of PCF, the clinical application of PLD is carried out mostly by oral administration, and there are few studies on the fumigation of PLD.

Therefore, this study aims to investigate the clinical effect and biomechanical mechanisms of PLD fumigation in the treatment of PCF with objective outcome measurement from the RSSCAN gait system.

Hypotheses

This trial aims to prove that fumigation therapy of PLD is an effective intervention process to relieve smooth muscle spasm and improve the life quality of patients with PCF.

Study objectives

The objectives of the study are (1) to evaluate the clinical effect of PLD fumigation

on PCF; (2) to investigate the biomechanical mechanisms of PLD fumigation in the treatment of PCF; (3) to provide detailed interpretations of the trial for future larger clinical studies.

Methods/design

Study design

This study is a multi-center, randomized, placebo-controlled, double blind trial. The patients according to the inclusive criteria will be recruited and then randomly allocated into two groups at a 1:1 ratio using SPSS 25.0 (IBM, USA) for Windows (Chicago, IL, USA). Both groups will receive standard modern rehabilitation treatment according to the "Chinese Guidelines for Stroke Rehabilitation" (2011 version) [19]. Patients will stick to the treatment they previously have had, and will be given present general treatment when acute exacerbation of stroke occurs during the trial. The intervention group will receive PLD fumigation treatment, while the control group will receive placebo fumigation treatment. The treatments will be taken once a day lasting 30 minutes, 5 days per week. An objective biomechanical parameter, the medial plantar area (M1＋M2＋HM) from the RSSCAN gait system, will be used to assess the outcome as the primary measure. Scores of Berg Balance Scale (BBS), Fugl-Meyer Assessment (FMA), Modified Ashworth Scale (MAS), Barthel Index (BI) and Stroke-Specific Quality of Life Scale (SSQOL) will be used to assess the outcome as the secondary measure. All assessments will be conducted at baseline, a 4-week treatment and a 3-month follow-up. All participants will provide signed informed consent before proceeding with the trial. The flow chart of this trial is

summarized in Fig. 1. The study timeline and event schedule are set up according to the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) 2013 Statement (Additional file 1), as detailed in Table 1 [20].

Fig. 1 Flow chart of study design

Note: PCF=poststroke cavovarus foot; PLD=Peony and licorice decoction.

Table 1 Timing of treatment visits and data collection

	Study period			
	Enrollment	Baseline	Treatment phase	Follow-up phase
Time point	-1 week	0 week	4 weeks	12 weeks
Enrollment				
Eligibility screen	×			
Informed consent	×			
Demographic information	×			
Stroke type	×			
Medical history	×			
Disease history	×			
Randomization	×			
Intervention				
PLD fumigation treatment		→	→	
PLD placebo fumigation treatment		→	→	
Standard modern rehabilitation treatment		→	→	
Primary outcomes				
Medial planter area (M1+M2+HM)		×	×	×
Secondary outcomes				
BBS		×	×	×
FMA		×	×	×
MAS		×	×	×
BI		×	×	×
SSQOL		×	×	×
Safety				
Adverse events		×	×	×
Success of blinding			×	

Note: PLD=Peony and licorice decoction, M1=Metatarsal 1, M2=Metatarsal 2, HM=Heel Medial, BBS=Berg Balance Scale, FMA=Fugl-Meyer Assessment, MAS=Modified Ashworth Scale, BI=Barthel Index, SSQOL=Stroke-Specific Quality of Life Scale.

Ethical issues

We will fully explain the details of this study to participants and their families before the patients take part in this research, including probable risks, potential benefits, as well as the obligations as stated in the Declaration of Helsinki 2013. Meanwhile, participants will also be told that the participation in the trial is entirely voluntary and they can withdraw from this study at any time for any reason. All recruited participants will be provided written informed consent before they take part in this study. The protocol has been registered with the Chinese Clinical Trial Registry: ChiMCTR2000003253. The Research Ethical Committee (REC) of Dongzhimen Hospital has approved the study protocol with identifier DZMEC-KY-2019-200. In case of any changes to the study protocol, written application will be submitted to the REC. Based on this, they will decide whether it is necessary or not to change the protocol.

Participant recruitment

This multi-center randomized controlled pilot trial will be conducted at three trial sites in Beijing in mainland China: (1) Dongzhimen Hospital Affiliated to Beijing University of Chinese Medicine, (2) Dongfang Hospital Affiliated to Beijing University of Chinese Medicine, and (3) The Third Affiliated Hospital of Beijing University of Chinese Medicine. Patients meeting inclusion criteria will be recruited

through posters in the in-patient or outpatient departments. In addition, we will communicate with prospective participants concerning the study details. If they are interested in participating, they will be invited into this study after presenting the signed informed consent. Recruitment will begin in June 2020 and will continue until 190 patients are enrolled.

Inclusion criteria

Participants meeting all of the following inclusion criteria will be included: (1) confirmed stroke patients with results from computed tomography (CT) or magnetic resonance imaging (MRI); (2) aged between 35 and 75, male or female; (3) first episode of stroke or with a history of stroke but with no serious neurofunctional disability and modified Ranking Scale (mRS) grade $\leq$ 2; (4) stable condition after stroke and within 6 months of the duration; (5) with cavovarus foot and be able to walk at least 6 meters; (6) blood pressure lower than 160/100 mmHG; (7) sufficient cognition to follow commands and Mini-Mental State Examination (MMSE) score >24; (8) never used fumigation treatment before; (9) the patients or their legal guardians sign the informed consents.

Exclusion criteria

Participants with any of the following exclusion criteria will be excluded: (1) received surgery or thrombolytic therapy; (2) duration of stroke is more than 6 months; (3) stroke without cavovarus foot or with cavovarus foot but could not walk 6 meters; (4) vital signs are not stable or with worsening conditions such as new infarction or bleeding; (5) combined with other cerebral diseases such as subarachnoid hemorrhage,

cerebral hemorrhage, brain tumor, brain trauma and so on; (6) combined with lumbar vertebrae disease, knee joint disease, foot disease and other diseases that can affect the patient's walking gait; (7) combined with severe dysfunction of heart, lung, liver, kidney and blood system; (8) combined with moderate to severe cognitive comprehension or visual impairment that can affect rehabilitation treatment or gait examination; (9) pregnant or lactating women; (10) participating in other clinical trials.

Sample size

The sample size calculation was based on the medial plantar area. According to previous studies [21], we assume the medial plantar area is 20.15 in the intervention group and 18.94 in the control group; therefore, the mean difference between two groups is 1.21 with standard deviations of 2.12 and 2.46.With a type I error of 5% (α= 0.05) and 90% power (β= 0.10), the estimated required sample size is 76 participants per group based on the formula:

$$n = 2\left[\left(\mu_\alpha + \mu_\beta\right)^2 \sigma^2\right] / \delta^2$$

Considering a 20% dropout rate during the study, 95 patients will be enrolled in each group and the total sample size will be 190.

Randomization and allocation concealment

The block randomization method will be applied in this trial. An independent statistician will generate the randomization sequence using SPSS 25. 0 (IBM, USA). All participants who meet the inclusion criteria will be randomly assigned to a intervention group or control group (95 cases each) at a 1:1 ratio by the

computer-generated random sequences. In accordance with best practice recommendations for randomized controlled trials, allocation concealment will be employed. A physician who will be trained before the study and will not participate in treatment will seal assignments in opaque envelopes. The assignment will be concealed to the outcome assessors and data statistical analysts. Moreover, the allocation of eligible participants will also be concealed from their caregivers and therapist. The therapists will only take charge of the allocated treatments for patients. Three clinical research coordinators of the trial sites will be responsible for enrolling patients, acquiring informed consent and requesting randomization.

Blinding

In this study, the double-blind method will be implemented. A “third party” staff that is trained and does not participate in the experiment will manage and supervise the performance of the blinding method. Firstly, the random computer-generated assignments will be sealed in opaque envelopes. The participants will only be told that they will be randomly allocated to either intervention group or control group, and both be treated with regular rehabilitation therapies. And the researchers including therapists, assessors, statisticians, and data analysts will be blinded to the group allocation. All of them will work independently and separately. Secondly, the placebo used in control group will be made of 5% PLD and 95% dextrin to ensure it mimics the appearance and smell of PLD.

All researchers will be trained before the trial to ensure the successful implementation of the blinding method. Unblind will also be considered if adverse

events occur or the trial ends.

Interventions measures

All patients in two groups will receive the same standardized modern rehabilitation treatment according to the "Chinese Guidelines for Stroke Rehabilitation" (2011 version). The main content of modern rehabilitation techniques is Bobath method and proprioceptive neurodevelopmental facilitation (PNF) technique, which includes good limb position, muscle strength and joint activity training, knee-ankle joint control training, weight loss gait training and so on. Five qualified and experienced rehabilitation specialists in three trial sites will select and conduct appropriate treatment programs according to the participants' symptoms. All of them will receive the unified training before the start of the trial. All patients will undergo 30 minutes of standardized modern rehabilitation treatment every day, once a day, five days per week (form Monday to Friday) across four weeks. Meanwhile, the patients will stick to the treatment they previously had, and will be given present general treatment if acute exacerbation of stroke occurs during the trial.

The intervention group will receive PLD fumigation treatment, while the control group will receive placebo fumigation treatment. An expert panel including three qualified therapists from the rehabilitation department and three senior doctors from the neurology department will set up the fumigation treatment program. According to the proportion of ancient prescription at 1:1, the main components of PLD are shown in Table 2. All Chinese herbal medicine will be made into granules in advance. Each bag of granules for fumigation treatment contains 240 g. The only difference is that

each bag of placebo contains 5% PLD only and 95% dextrin. The components of the PLD granules are produced and packed by Bei Jing Kang Ren Tang Pharmaceutical Co. Ltd. The clinical research coordinators before the trial to ensure that they meet required quality standards will inspect all granules, the clinical research coordinators will also take charge of dispensing granules to the therapists. Before each fumigation treatment begins, the therapist will obtain one bag of granules from the clinical research coordinator, then mix the granules with 400ml of boiling water and place them in the fumigation treatment machine (HB3000, Suzhou Hao Bo Medical Equipment Co. Ltd, Jiangsu Province, Taicang City) after the stirring and eventual dissolving of the drugs. The medial knee and ankle joints of the affected side will be selected as fumigation sites to relieve the spasm pain of the medial muscle group and the strain pain of the lateral muscle group. The fumigation treatment will last 20 minutes each time and will be implemented 5 times a week (form Monday to Friday) after daily standard modern rehabilitation treatment, lasting 4 weeks. Patients need to receive the fumigation treatment under the guidance of the therapists who are responsible for them. Any other fumigation treatment is prohibited during the treatment and follow-up period.

Table 2 Main components of Penony and licorice decoction fumigation treatment

Chinese name	Latin name	Amount (g)
Chinese herbal formula Penony and licorice decoction		
Bai shao	Radix Paeoniae Alba	120
Gan cao	Radix Glycyrrhizae	120

Follow-up

After finishing the 4-week treatment, all patients will enter the 3-month follow-up period. In view of the particularity of stroke rehabilitation and the ethical factors that need to be considered, we will not intervene on the behalf of patients to receive other possible rehabilitation treatment except for the prohibition of additional fumigation treatment. During the 3-month follow-up period, patients will be required to fill out a form to record their specific recovery process during this period. At the end of the follow-up, all forms will be returned to the researchers for evaluation and we will provide all participants the same RSSCAN gait system test and clinical scale score as before.

Outcome measures

The participation will be examined at baseline, reexamined after a 4-week treatment, and again at the end of a 3-month follow-up. Data will be collected and assessed by three trained, certified assessors.

Basic characteristic variables

Demographic information including gender, age, time from the onset of stroke, clinical history, use of medication and other details will be collected and evaluated at the baseline to describe the comparison and characteristics of the two groups. Nurses will measure vital signs such as the resting blood pressure, pulse, respiration rate, and body temperature on a daily basis.

Primary outcome measure

In the research, we will select data of medial plantar area (M1＋M2＋HM) generating from the RSSCAN gait system (RSSCAN International, Olen, Belgium) as primary

outcome measures. The RSSCAN gait system consists of a pressure test plate with sensors arrayed, a data collector and data acquisition software. The pressure test plate (2 m × 0.4 m, 16,384 sensors, 100 Hz) will be laid in the middle of the plastic runway, and the thickness of the runway is the same as the plate. The patients will be told to walk at their normal comfortable pace from one end of the plate to the other end with a natural gait. For each test, the patients will practice walking three times on the plate before beginning the formal test. The pressure test plate is directly connected to the data acquisition software through the data collector.

The criteria for the validity of the test data are as follows: the computer transmission system shows complete footprints; during the test, the participants look straight ahead and walk naturally without deliberately treading; there is no obvious gait change on the plate. The same qualified RSSCAN system operator who has received standardized training before the trial will accomplish all tests.

Secondary outcome measures

Berg Balance Scale (BBS) As the most widely used balance evaluation scale for stroke patients in the world, the BBS will be used to assess the patients' balance ability under static and dynamic conditions. Total score of the BBS is 56. The higher the score, the better the balance ability of patients.

Fugl-Meyer Assessment (FMA) The FMA will be applied to assess the motor function level of patients. Since this study focuses on the test of lower limbs, we will only select part of the lower limb evaluation with a total score of 34. This assessment will evaluate in detail the motor function and reflex activity of affected lower limb

joints including ankle joint and knee joint.

Modified Ashworth Scale (MAS) The MAS is a simple grading system that scores from 0 (normal) to 4 (severe), which will be used to evaluate the level of muscular tension of the patients briefly.

Barthel Index (BI) The BI contains ten basic daily activities and its total score is 100. We will use the BI to assess the daily living ability of patients by the score.

Stroke-specific Quality of Life Scale (SSQOL) The SSQOL consists of twelve aspects and seventy-eight entries including energy, family roles, language, mobility, mood, and so on. The SSQOL will be applied to fully evaluate the quality of patients' activities regarding daily living. The higher the score, the better the quality of patients' activities in carrying out daily living functions.

Safety assessments

Any adverse events that occur during the intervention period will be recorded and reported to the chief researcher and research ethics committees. They will analyze the causality with fumigation treatment and determine whether to unblind according to the condition. In the case of stroke recurrence or other worsening conditions, the patient will withdraw from the study and receive further treatment for free.

Data management and monitoring

Before this study, the Data Safety and Monitoring Committee (DSMC), composed of experts in rehabilitation, neurology, ethics, and statistics, will be set up for data management and monitoring. The committee is independent from trial investigators, and has no competing interests. All the researchers involved in data management will

be trained. Firstly, 3 assessors will be responsible for acquisition and assessment of patients' information during the study. After assessors finish the case report forms (CRF) completely, 2 data collectors will validate the completeness and consistency of the data, and then convert the credible paper data to electronic data. All paper and electronic data related to the study will be safely kept in the Clinical Research Center of Beijing Dongzhimen Hospital. Only the independent statisticians will have access to the final complete data, others who have any questions will be required written requests to the DSMC to get permission.

The DSMC is also in charge of monitoring. Members of the committee will monitor the overall quality and completeness of the data, interview assessors, examine original documents, and make sure that the study is implemented with the principles of this protocol. In case of any changes to the study protocol, the DSMC will submit the written application to the REC to obtain permission. In addition, the monitors will verify that all adverse events will be recorded in the correct format. The DSMC will audit the study through regular interviews and the periodic review will be done every 2 months.

Statistical analysis

Statisticians who are independent from the trial will be responsible for the statistical analysis. The SPSS 25.0 (IBM, USA) for Windows (Chicago, IL, USA) will be used. Categorical variables will be presented with frequencies or percentages and continuous variables will be presented as the mean and standard deviation. The analysis will mainly compare efficacy between the intervention group and the control

group, including primary and secondary outcomes. Changes in all outcome measurements of before and after the treatment and of the between group will be analyzed. The demographic and clinical characteristics of the two groups will be compared at baseline applying unpaired two-sample t-tests (continuous data) and Chi-square analysis (categorical data). Rank sum test will be used when the normal distribution hypothesis is not met. Considering some participants may fail follow-up, we will conduct both intention-to-treat analysis and per-protocol analysis. The intention-to-treat analysis will include all the participants. The missing data will be treated by multiple imputations. The per protocol analysis will incorporate the participants who follow all the time points outcome measurement and fully comply with the treatment schedule in the intervention group. The statistical significance threshold will be set at 0.05 (2-sided), with 95% confidence intervals (CIs).

Discussion

Although PCF seriously affects the life quality of stroke patients during the recovery periods, there is a lack of effective treatment in clinics. At present, numerous domestic and foreign scholars think that exercise therapy is the basic treatment for PCF, however, the actual effect is less than expected. Oral or intrathecal injection of baclofen is also a common clinical method [22, 23]. Its effect is relatively significant, but it will also have an impact on normal muscle strength, which is not conducive to rehabilitation training. Therefore, seeking an effective treatment with few side effects appears to be particularly important.

In China, traditional Chinese medicine fumigation therapy is widely used in clinics

because of its characteristics of external treatment and direct action to the disease location. Previous studies have shown that the application of traditional Chinese medicine fumigation therapy in the rehabilitation of PCF has a good theoretical basis and certain therapeutic advantages [24]. However, there are few current studies on the application of PLD fumigation in the treatment of PCF, and there is no evidence of curative effect supported by clinical trials. Thus, it is necessary to conduct this study to determine its real efficacy.

In order to achieve the best performance in the field, the RSSCAN gait system used to be designed for providing accurate and objective biomechanical parameters to formulate and improve athletes' gait [25]. And research reveals it is also useful in clinical studies of diabetes, multiple sclerosis and knee osteoarthritis to provide quantitative assessments and achieved satisfactory results [26]. Based on it, we hope to determine the real effect of PLD fumigation in the treatment of PCF through the objective biomechanical parameters of the system. At the same time, the changes of objective biomechanical parameters may also explain the biomechanical mechanisms under its curative effect.

However, there are still some inevitable limitations of our study. Firstly, despite assessor-blinding, several patients who had been fumigated with traditional Chinese medicine will likely know which group they belong to according to the smell of the steam. Thus, we will select patients who have never received traditional Chinese medicine fumigation treatment before and keep patients separate from each other. Secondly, as this study is intended as a pilot study for further larger clinical studies,

sample size is another limitation.

We present the protocol of a pilot randomized controlled trial aiming at evaluating the clinical effect and biomechanical mechanisms of PLD fumigation in the treatment of PCF. Results of the current study will provide detailed interpretations of the clinical effect and biomechanical mechanisms of PLD fumigation treatment for PCF and foundations for future larger clinical studies.

Trial status

Recruitment of the trial will begin in June 2020. This trial started on 1 June 2020 and will end on 31 December 2020.

Abbreviations

BBS: Berg Balance Scale; BI: Barthel Index; CI: confidence interval; CRF: case report form; DSMC: Data Safety and Monitoring Committee; FMA: Fugl-Meyer Assessment; HM: Heel Medial; M1: Metatarsal 1; M2: Metatarsal 2; MAS: Modified Ashworth Scale; MMSE: Mini-Mental State Examination; mRS: modified Ranking Scale; PCF: poststroke cavovarus foot; PLD: Peony and licorice decoction; PNF: proprioceptive neurodevelopmental facilitation technique; REC: Research Ethical Committee; SPIRIT: Standard Protocol Items: Recommendations for Interventional Trials; SSQOL: Stroke-Specific Quality of Life Scale.

Declarations

Ethics approval and consent to participate

This trial has been approved by the Research Ethical Committee of Dongzhimen Hospital, the First Affiliated Hospital of Beijing University of Chinese Medicine (No.

DZMEC-KY-2019-200). Each participant will sign an informed consent form before he or she enters the trial and each consent form will be saved in the corresponding CRF.

Consent for publication

Not applicable

Availability of data and material

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

CYJ and LZ are co-first authors of this manuscript, contributing equally to the conduct of the trials, and drafting of the manuscript. JJA and ZHL conceived and designed the study protocol. YTS and JBW helped develop the study measures and data collection. The figure and tables are prepared by SZ. All authors read and approved the final manuscript.

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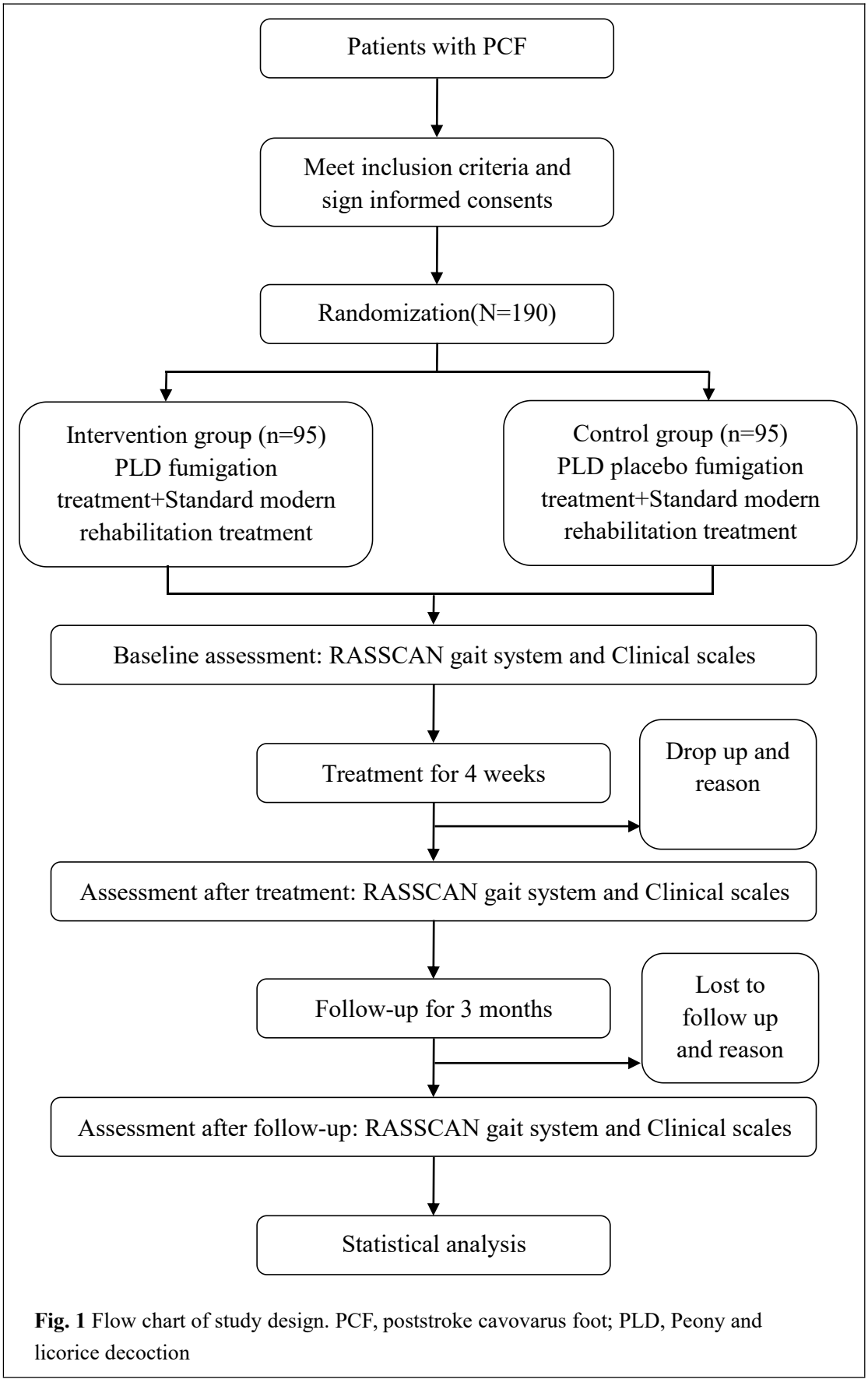

Fig. 1 Flow chart of study design. PCF, poststroke cavovarus foot; PLD, Peony and licorice decoction

Figures

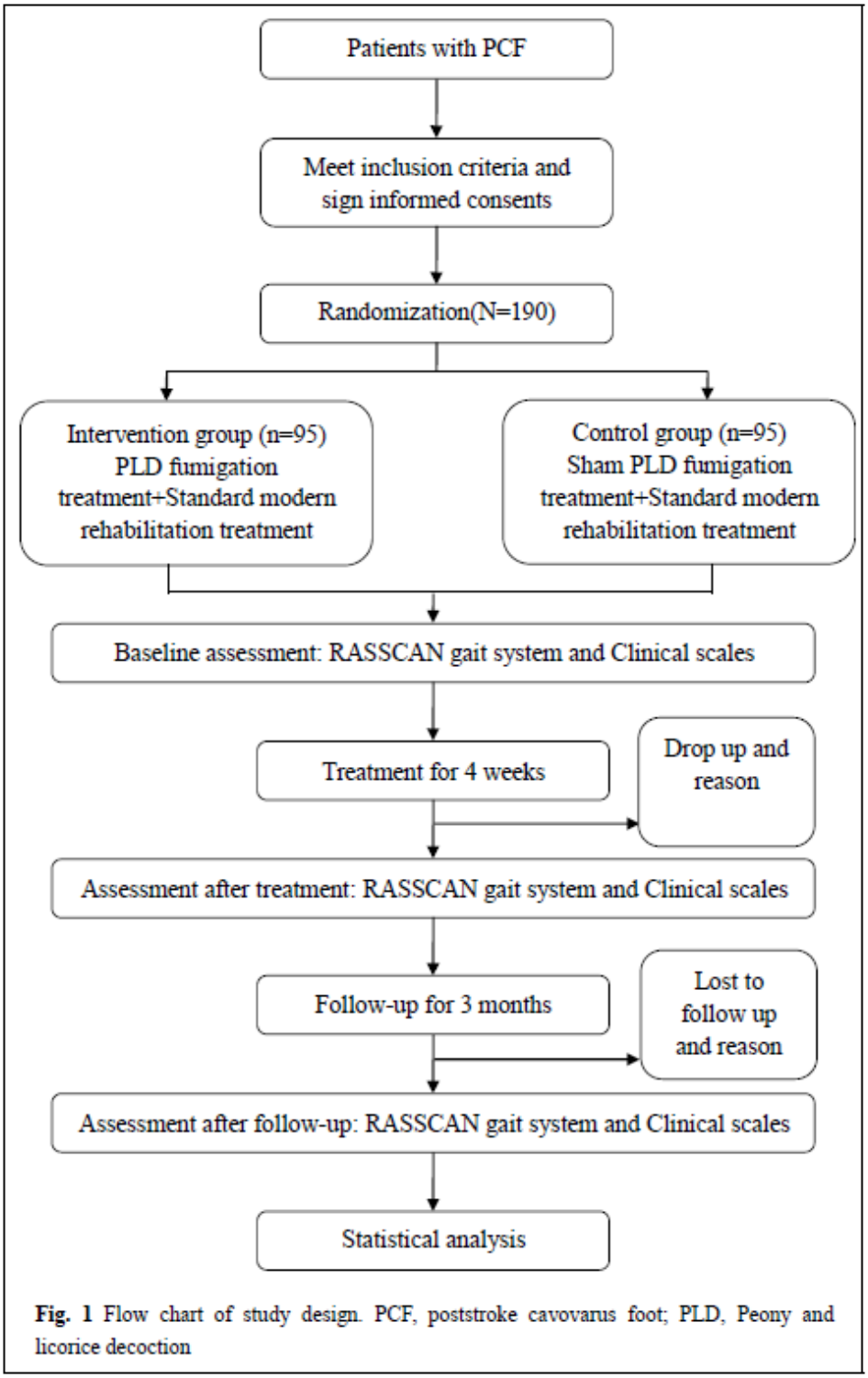

Fig. 1 Flow chart of study design. PCF, poststroke cavovarus foot; PLD, Peony and licorice decoction

Figure 1

Flow chart of study design. Note: PCF=poststroke cavovarus foot; PLD=Peony and licorice decoction.

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