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Acupoint-tuina therapy promotes lactation in postpartum women with insufficient milk production who underwent caesarean sections

Ping Lu, MS[a], Zhi-qi Ye, MS[b], Jin Qiu, PhD[c], Xiao-yu Wang, MS[d], Juan-juan Zheng, PhD[a,*]

Abstract

Breast milk is recognized and strongly recommended by the World Health Organization (WHO) as the optimal feeding for all babies. Breastfeeding is associated with better nutritional and non-nutritional outcomes when compared to formula feeding, and has proven health benefits to both infants and their mothers. This clinical research is to examine the feasibility and efficacy of Acupoint-Tuina therapy in treating postpartum women who underwent C-sections and suffered from insufficient milk production.

The patients in the control group received standard medical care, while the patients in the Tuina group received Tuina therapy during the next 48 hours in addition to standard care, given once daily for 2 days. To evaluate the efficacy of Tuina therapy, patients of both groups were assessed for surface temperature of breasts, volume of breasts, volume of breast milk production, serum PRL level, and uterus recovery at various time points.

Tuina therapy significantly increased the milk production when compared to the control group, for as much as 13-fold and 10-fold of that in the control group on the third and fourth postpartum days. In addition, Tuina therapy also significantly increased the full breast enlargement and the serum PRL level change, and decreased the breast surface temperature rise. Last but not the least, Tuina therapy also accelerated the post-surgery recovery of uterus.

During the early postpartum days, Tuina therapy increases the milk production and promotes other physiological changes supporting lactation for postpartum women with C-section delivery and insufficient breast milk production. The novel intervention is warranted for further investigation and validation.

Abbreviations: C-sections = conduction of caesarean sections, ELISA = enzyme-linked immunosorbent assay, PRL = prolactin, WHO = World Health Organization.

Keywords: cesarean section, lactation, PRL, tuina

1. Introduction

Breast milk is recognized and strongly recommended by the World Health Organization (WHO) as the optimal feeding for all babies.[1] Breastfeeding is associated with better nutritional and non-nutritional outcomes when compared to formula feeding, and has proven health benefits to both infants and their mothers.[1,2,3,4] However, lactation deficiency or inadequate milk production is an increasingly prevalent problem for nursing mothers worldwide. In addition to congenital insufficient glandular tissue, poor production of breast milk can occur in many other circumstances such as preterm labor, illness of the mother, improper mother-baby separation, re-lactation after a prolonged suspension, and indirect lactation. In addition, anxiety, fatigue, and emotional stress can also lead to insufficient milk production. Even without any obvious pathological causes, lactation deficiency can occur in a substantial number of women, especially within the first 15 days postpartum. In some cases, lactation deficiency can even span the entire breastfeeding period.

Conduction of caesarean sections (C-sections) is another major reason causing lactation deficiency.[5,6] This is especially prevalent in China where the rate of C-section is the highest in the world at 46% as of 2008.[7] Postpartum women usually require additional medical care after a C-section compared with after a vaginal delivery, which could lead to a delayed onset of and a reduced amount of breast milk production. For example, it is known that medication administration in post-C-section women could interrupt the schedule of breastfeeding, which could potentially lead to decrease of breast milk production, or disorder of breastfeeding.[8]

Many efforts have been made to attempt to increase breast milk production in women who suffers lactation deficiency. Baby-mother physical contact has been proposed, such as in skin-to-skin holding.[9] In some cases, breast milk production can also be increased by psychological support and relaxation techniques.[10] In addition, chemical-based medicines, or so called galacta-

Editor: Daryle Wane.

The authors report no conflicts of interest.

[a] Teaching and Research Office of Basic Tuina Science, Shanghai University of Traditional Chinese Medicine School of Acupuncture-Moxibustion and Tuina, Shanghai, [b] Yueyang Hospital of Integrated Traditional Chinese and Western Medicine, Shanghai University of Traditional Chinese Medicine, [c] Shanghai Tenth People's Hospital, Tenth People's Hospital of TongJi University, [d] Shanghai XuHui Hospital, China.

[*] Correspondence: Juan-juan Zheng, Teaching and Research Office of Basic Tuina Science, Shanghai University of Traditional Chinese Medicine School of Acupuncture-Moxibustion and Tuina, 1200 Cailun Rd., Shanghai 201203, China (e-mail: juan_9040303@126.com).

Medicine (2019) 98:35(e16456)

Received: 16 October 2018 / Received in final form: 19 March 2019 / Accepted: 20 June 2019

http://dx.doi.org/10.1097/MD.0000000000016456

gogues, have also been recommended and prescribed by many clinics.[11] For example, prolactin is such a hormone that stimulates milk production.[12] While the above psychology, behavior, and chemical-based management methods were able to increase the milk production for many women, they may be ineffective for other women due to unknown reasons. Even for the women for whom some of these methods are effective, the amount of increase may still be insufficient. Therefore, there is an unmet need to develop additional approaches to boost milk production.

Accupoint-Tuina is an ancient form of medical massage in Chinese medicine, with applied finger pressure to points that are putatively sensitized by organ impairment.[13] It has been applied to manage a large number of medical symptoms, and its effectiveness has been reported for different conditions such as pain, nausea and vomiting, and constipation.[14,15,16] Here we introduce Accupoint-Tuina as a new approach to increase milk production for postpartum women with inadequate milk production. In this study, we aimed to investigate if the Tuina protocol we developed can effectively promote the breast milk production in women who underwent C-sections and suffered from inadequate milk production.

2. Materials and methods

2.1. Subject description

Under the approval of the Tongji University Intuitional Review Board and the Hospital Ethics Committee, 80 women who had their babies delivered via C-sections and received the subsequent inpatient care from September 2012 to July 2013 at the Shanghai No. 10 People's Hospital, affiliated to Tongji University, were recruited for the study. The inclusion criteria are as follows:

1. first-time pregnancy carried to the full-term (36–40 weeks);
2. delivered through a C-section;
3. no major complications after the C-section;
4. milk production less than 1 ml per feeding/expression at 48 hours postpartum;
5. no abnormal breast development;
6. no known breast diseases;
7. no disorders of major organs (heart, brain, liver, kidney and lung);
8. did not take Clindamycin after delivery;
9. consent to pursue breastfeeding.

The exclusion criteria were:

1. difficult breastfeeding due to inverted or flat nipples;
2. choosing not to breastfeed due to other subjective or objective reasons;
3. multiple birth; and
4. breastfeeding prohibited due to Clindamycin injection within the past week.

This study was approved by the Hospital Ethics Committee and the University Intuitional Review Board. A written informed consent from each patient was obtained. Patients were immediately randomized in a 1:1 ratio to the following 2 groups when they were enrolled in the study at 48 hours postpartum: the control group receiving the standard medical care, and the experimental group (the Tuina group) receiving daily peri-mammary Acupoint-Tuina therapy for 2 days in addition to the standard medical care. Figure 1 shows a patient flow diagram for these 2 groups and more details are described in the following sections.

2.2. Acupoint-tuina therapy protocol

In addition to standard medical care, the patients in the Tuina group received the daily Tuina treatment for 2 consecutive days after they were randomized into the group at 48 hours postpartum. The Tuina massage was conducted 1 side at a time, taking 15 minutes for each side and yielding a total treatment time of 30 minutes per day. The Acupoint-Tuina therapy was conducted as follows:

1. Massage *Sanyinjiao* with the middle finger, rub *Zusanli*, and massage *Xuehai* with the thumb, for 1 minute each. Apply appropriate pressure such that the patient will experience pressure and fullness but not feeling painful;
2. Massage *Jianjing* for 20 strokes, and then massage anterior shoulder for 50 strokes, totaling 1 minute;
3. Press *Tanzhong* with the middle finger for 1 minute;
4. Use 1 palm to hold the breast from the lower outer direction, and use 4 fingers of the other hand to massage the base of the breast using a swirling motion towards the nipple. Do this for 5 minutes;
5. Press *Yinchuang, Wuyi,* and *Qihu* with the thumb finger for 2 minutes;
6. Press and push *Rugen* upwards with the middle finger, then span the palm from the bottom of the breast to roll and push the breast upwards, and from the outer breast to roll and push the breast inwards. Do this for 2 minutes;
7. Spread the fingers of both hands, rub and massage the whole breast in a combing motion along the mammary ducts from the base of the breast towards the nipple using alternating hands. Do this for 30 seconds;
8. Spread the fingers of 1 hand and hold the breast. Gently shake the breast for 30 seconds.

Acupoints have been previously defined and described.[17] The acupoints massaged in the Tuina protocol are listed and briefly described as follows:

- *Sanyinjiao* (SP6): the tip of the internal malleolus, 3 inches above the tip of the medial edge of the tibia.
- *Xuehai* (SP10): 2 inches on the medial side of the fundus, at the medial muscle of the femoral bulge.
- *Zusanli* (ST36): 3 inches under the nose, along the connecting line between the nose and *Xiexi*.
- *Jianjing* (GB21): the midpoint between the spinous process of the 7th cervical spine and the lateral connection of the acromion.
- *Tanzhong* (CV17): the 4th intercostal space of the transverse plane, on the anterior midline.
- *Yinchuang* (ST16): the third intercostal space, 4 inches from the anterior midline.
- *Wuyi* (ST15): the second intercostal space, 4 inches from the anterior midline.
- *Qihu* (ST13): the lower edge of the clavicle, 4 inches from the anterior midline.
- *Ruigen* (ST18): the fifth intercostal space, 4 inches from the anterior midline.

2.3. Assessment endpoints

2.3.1. Measurement of breast surface temperature. The thermal parameters of breast surfaces were detected using a

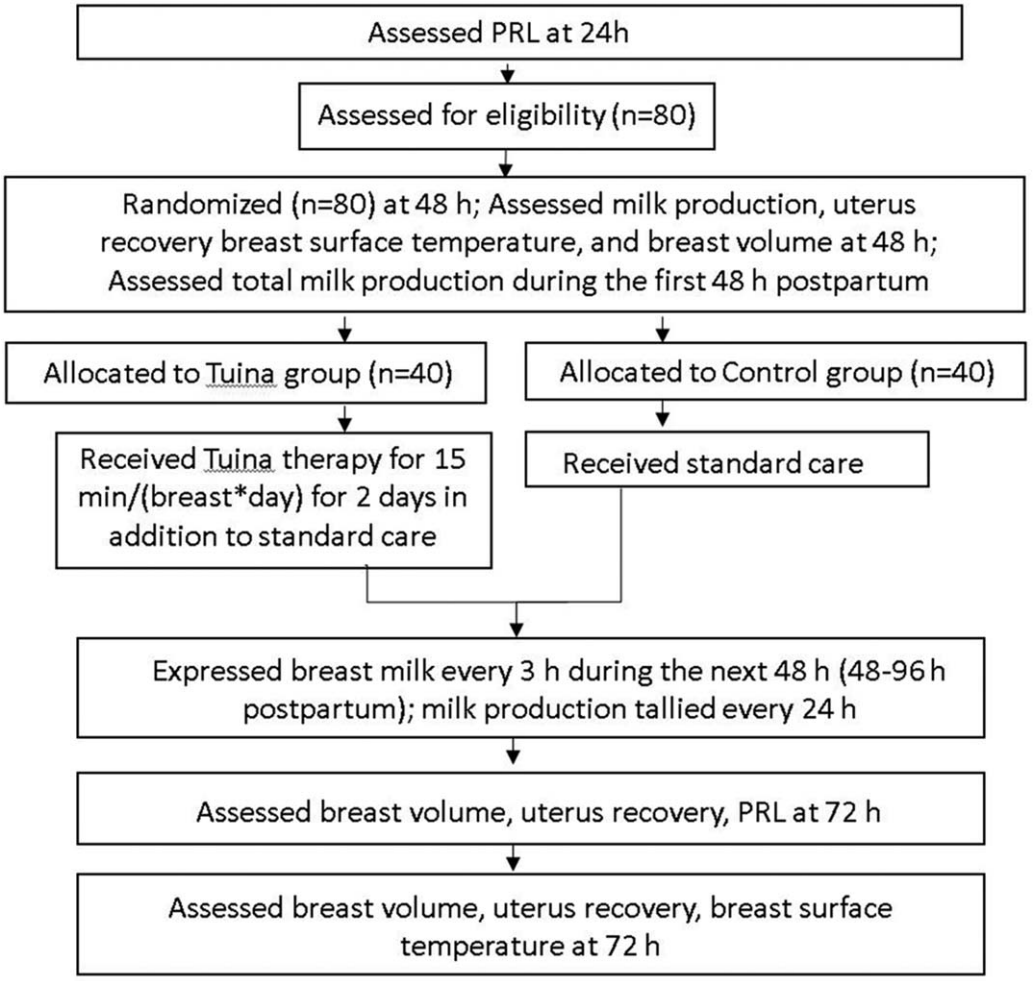

Figure 1. Patient flow diagram.

thermal imaging system, ThermaCAM^{TM}P30 (FLIR systems, Sweden), according to the manufacturer's protocol and measured by the microbolometer detector in the system. The result was analyzed by ThermaCAM Reporter2000 (FLIR systems, Sweden). The ambient environment was controlled at 25°C with a humidity of 50% to 60%. The patients were asked to remain in a resting state for at least 30 minutes before the measurement, that is no milk expression, no ingestion of hot beverages, and no heavy movements. The surface temperature was measured with the patient in a supine position and arms by the sides. The thermal camera was positioned 1 m from the breast surface in a controlled imaging geometry. The temperature was assessed at 48 hours and 96 hours postpartum, and the average temperature of each breast was used for data comparison.

2.3.2. Measurement of breast volume. The breast volume of each breast was measured using a special measuring caliper designed for breast volume measurement (Chinese pattern: ZL2012 20123439.X). Both the diameter (2 times the radius or 2r) and height (h) of the breast were measured and recorded, and the breast volume (V) was calculated by: $V = 1/3\pi r^2 h$, where π is the mathematical constant 3.14.

The breast volume was measured before lactation at 48 hours, 72 hours, and 96 hours postpartum.

2.3.3. Measurement of breast milk production. During the period of the treatment (48–96 hours postpartum), each patient lactated using an electrical breast pump every 3 hours. The volume of expressed breast milk was measured and recorded. The total expressed milk volume in every 24-hour window was tallied and compared between the groups.

2.3.4. Serum prolactin level. Blood samples of each patient were collected before and after treatment, and the levels of serum prolactin (PRL) were measured by the enzyme-linked immunosorbent assay (ELISA). The "before" measurement was conducted at 24 hours postpartum for all patients according to our clinical protocol. For the patients enrolled in this study, the "after" measurement was performed at 72 hours postpartum.

2.3.5. Measurement of uterus recovery after delivery. Uterus recovery was measured by the distance from the fundus of uterus to pubic symphysis at different postpartum time points using a soft tape measure. It was assessed at 48 hours, 72 hours and 96 hours postpartum.

2.4. Statistical analysis

All data except indicated otherwise were described as mean ± standard deviation. Mann–Whitney *U* test was used to compare

Table 1

Patient characteristics in the 2 groups ($\bar{x} \pm s$).

Group	*n*	Age (year)	Weight (kg)	Height (cm)	Gestation length (day)
Tuina group	40	28.72 ± 3.58	69.64 ± 5.27	160.46 ± 4.85	278.15 ± 9.93
Control group	40	28.76 ± 3.80	70.36 ± 11.91	161.32 ± 6.47	274.91 ± 9.65
P value	—	.119	.313	.817	.207

any 2 groups of data. The result was considered statistically significant when $P \leq .05$. Data analyses and statistical tests were performed using the SPSS for Windows version 13.0 software package (IBM Corporation, Armonk, NY).

3. Results

3.1. Patient characteristics

The basic characteristics of the 80 patients enrolled in the study were described in Table 1 comparing the 2 groups. There were no statistical differences between the 2 groups in age, weight, height, and gestation length.

3.2. Safety of tuina therapy

No complications were involved in the patients who received Tuina therapy during the 2-day period of treatment. There were no disorders of major organs such as heart, liver, kidney, and lung in any patient enrolled in this study.

3.3. Tuina therapy attenuated the breast temperature increase

As plotted in Figure 2, average breast surface temperatures arose in both breasts from 48 to 96 hours postpartum for patients of both groups. However, when comparing the net temperature increase, it was smaller in the Tuina group, at about half the magnitude, than in the control group. As shown in Table 2, the differences were statistically significant. This indicate that Tuina therapy attenuates the breast temperature increase at this time frame.

3.4. Tuina therapy boosted the breast volume increase

As plotted in Figure 3, breast volumes increased with time in both breasts for patients of both groups. Comparing the net volume increase between any 2 consecutive time points for the 2 groups, the Tuina group had significantly higher increases than the control group. The data and statistical results are described in Table 3.

3.5. Tuina therapy increased breast milk production

Figure 4 plots the total milk production during the first 48 hours postpartum, between 48 hours and 72 hours, and between 72 hours and 96 hours for each group. It is easy to note that, while the average milk production increased with time for both groups, the increases in milk production were much greater for the Tuina group than for the control group along these time points. As detailed in Table 4, prior to intervention, the milk production in the first 48 hours postpartum was not statistically different between the 2 group; after the intervention, the milk production

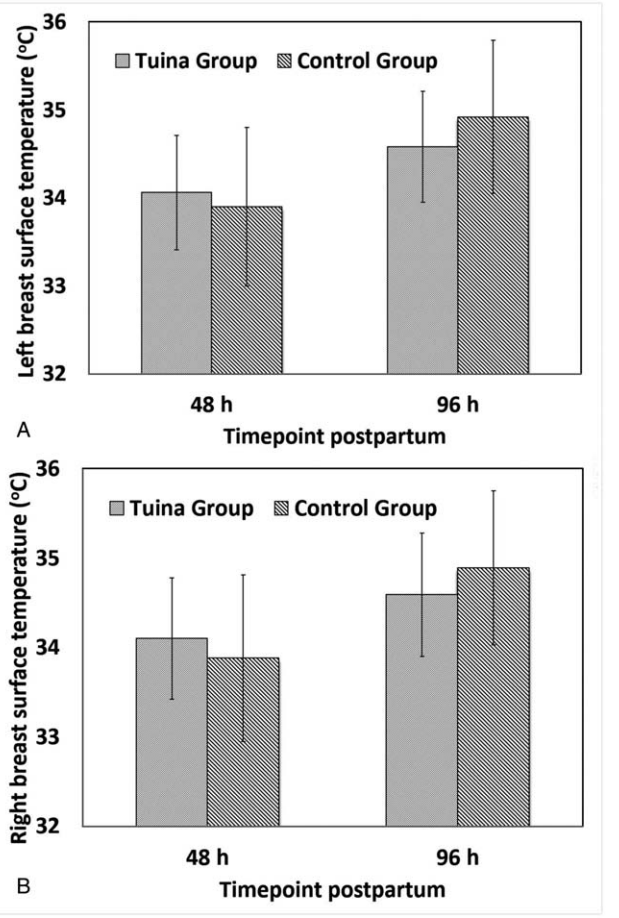

Figure 2. Tuina therapy attenuated the breast temperature increase. A. Average surface temperature of the left breast in the 2 patient groups at the 2 time points; B. Average surface temperature of the right breast in the 2 patient groups at the 2 time points. The mean value within the group is shown, with the standard deviation shown as the error bar.

Table 2

Net average surface temperature change in each breast from 48 to 96 hours postpartum as assessed by thermal imaging ($\bar{x} \pm s$, °C).

Group	Net average surface temperature change	
	Left breast	Right breast
Tuina group	0.52 ± 0.68	0.49 ± 0.76
Control group	1.02 ± 0.67	1.02 ± 0.74
P value	.002*	.004*

* indicates a statistical significance with $P \leq .05$ between the 2 groups.

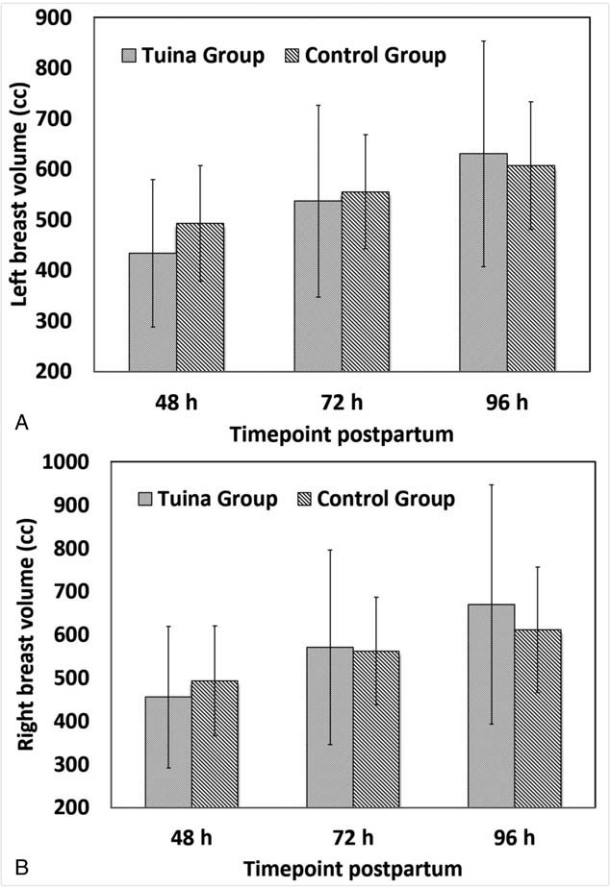

Figure 3. Tuina therapy boosted the breast volume increase. A. Measured left breast volumes before lactation in the 2 patient groups at the 3 time points; B. Measured right breast volumes before lactation in the 2 patient groups at the 3 time points. The mean value within the group is shown, with the standard deviation shown as the error bar.

in the 2 subsequent days was significantly higher in the Tuina group compared with the control group. During the 24 hours following the intervention, the average milk production in the Tuina group was over 13-fold that of the control group. During the next 24 hours, the average milk production in the Tuina group was close to 10-fold that of the control group.

3.6. Tuina therapy increased the serum PRL level

As shown in Figure 5, from 24 hours postpartum to 72 hours postpartum, the average PRL level in the control group showed a slight decrease, while that in the Tuina group showed a slight

Table 3

Breast volume increase between consecutive time points in each breast ($\bar{x} \pm s$, cm^3).

Group	Time duration 48–72 hours		Time duration 72–96 hours	
	Left breast	Right breast	Left breast	Right breast
Tuina group	102.97 ± 107.56	115.17 ± 127.94	93.81 ± 116.69	99.06 ± 125.46
Control group	42.64 ± 37.32	53.18 ± 41.36	45.57 ± 40.93	35.98 ± 30.52
P value	.000*	.001*	.014*	.01*

* indicates a statistical significance with $P \leq .05$ between the 2 groups.

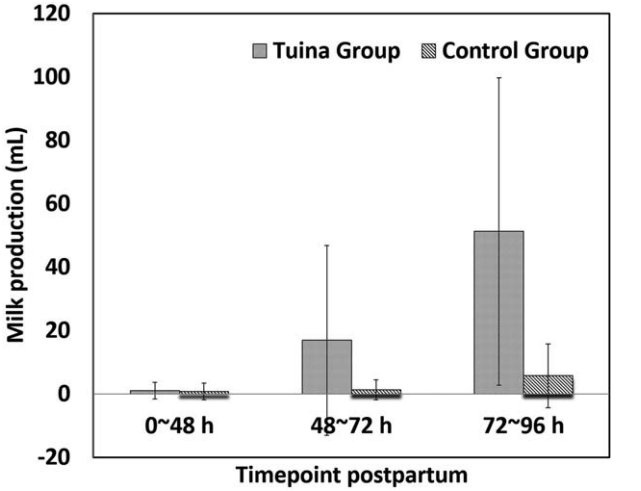

Figure 4. Tuina therapy increased milk production. Measured total milk production of the patient within each specified timeframe for the 2 groups. The mean value within the group is shown, with the standard deviation shown as the error bar.

Table 4

Breast milk production volume within each studied time frame for the 2 groups ($\bar{x} \pm s$, ml).

Group	0–48 hours	48–72 hours	72–96 hours
Tuina Group	1.00 ± 2.58	16.88 ± 29.95	51.25 ± 48.51
Control Group	0.75 ± 2.67	1.25 ± 3.15	5.68 ± 10.05
P value	.914	.000*	.000*

* indicates a statistical significance with $P \leq .05$ between the 2 groups.

increase. The net change was calculated for each patient by subtracting the PRL at 24 hours from the PRL at 72 hours. As described in Table 5, there was a statistical difference between the control group and the Tuina group in the PRL level change between these 2 time points.

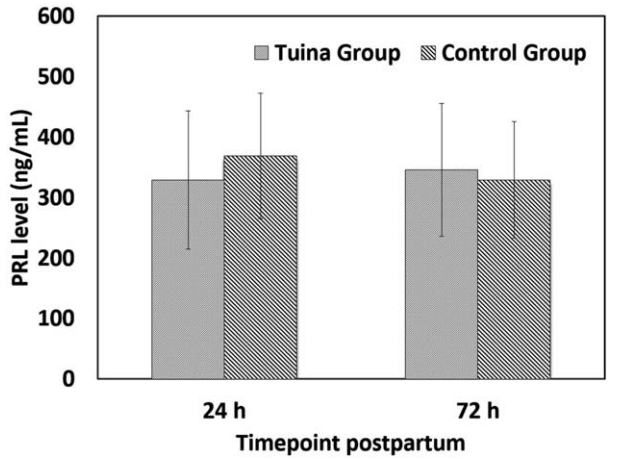

Figure 5. Tuina therapy increased the serum PRL level. Measured PRL levels at the 2 time points for the 2 groups. The mean value within the group is shown, with the standard deviation shown as the error bar.

Table 5

Serum PRL levels at the 2 measured time points as well as the net change between the time points for the 2 groups ($\bar{x} \pm s$, ng/ml).

Group	24 hours	72 hours	Net change (72–24 hours)
Tuina group	328.91 ± 114.09	345.62 ± 109.75	16.72 ± 117.62
Control group	369.02 ± 103.56	329.33 ± 96.35	−39.69 ± 82.40
P value	.113	.605	.011*

* indicates a statistical significance with $P \leq .05$ between the 2 groups.

Table 6

Net uterus-fundus-to-pubic-symphysis distance decrease between any 2 consecutive time points for patients of the 2 groups ($\bar{x} \pm s$ cm).

Group	48–72 hours	72–96 hours
Tuina group	2.16 ± 1.12	1.61 ± 0.80
Control group	1.16 ± 0.78	0.56 ± 0.62
P value	.000*	.000*

* indicates a statistical significance with $P \leq .05$ between the 2 groups.

3.7. Tuina therapy promoted post-delivery recovery of uterus

Using the distance from the fundus of uterus to pubic symphysis as a surrogate of post-delivery uterus recovery, as plotted in Figure 6, both groups exhibited a continuous uterus recovery during the assessed timeframe; however, the Tuina group showed a greater recovery compared with the control group. Table 6 compares the distance decrease between any 2 consecutive time points between the 2 groups, and the differences were statistically significant.

4. Discussion

Acupoint-Tuina therapy, or Tuina therapy in short, is an ancient therapeutic measure first described in Chinese medical texts more than 2000 years ago[13] which has been and continues to be used to address many medical conditions. In addition to China, it is also actively practiced in many other Asian countries, such as Japan and South Korea. The basis of Tuina therapy is the belief in Chinese traditional medicine that stimulation at specific acupoints can lead to changes of inner physiology in the human body. In Tuina therapy, stimulations at acupoints through carefully-designed massage maneuvers can adjust and balance "Qi" (pronounced as "Chi") and "Xue" in the human body, hence promoting health and providing disease relief. In Chinese traditional medicine, "Qi" is an active principle part of the human body: the "life force" or "energy flow". Symptoms of various illnesses are believed to be resulted from the disrupted, blocked, or unbalanced "Qi" movement through the body's meridians, as well as deficiencies or imbalances of "Qi" in various organs. "Xue" is a dense form of body fluids that have been acted on and energized by "Qi", which goes beyond the definition of "blood" in Western medicines to include the additional medium that travels within the meridians.

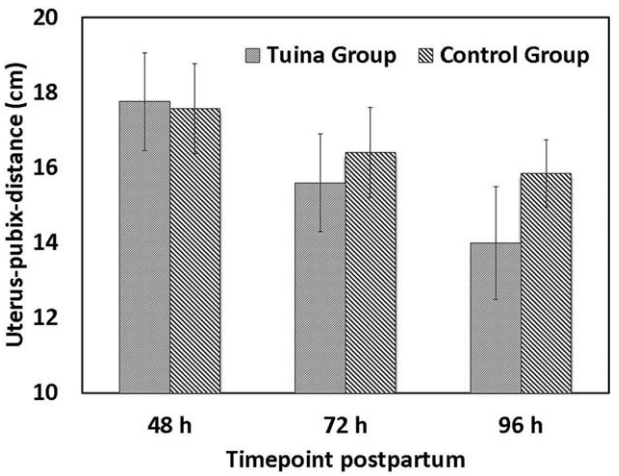

Figure 6. Tuina therapy promoted post-delivery uterus recovery. Measured distance from the fundus of uterus to pubic symphysis at different time points for patients of the 2 groups. The mean value within the group is shown, with the standard deviation shown as the error bar.

In regards to the case of inadequate postpartum milk production, especially after a C-section, it is thought that it is caused by imbalance or disruption of the "Qi" and "Xue" in the mammary area, which then manifests as the suppression of the mammary glandular cell activities and the inhibition of milk production. In addition, the imbalance of "Qi" and "Xue" can also lead to the obstruction of mammary ductal and lobular systems, which is also responsible for the reduced milk secretion. Therefore, our Tuina therapy protocol was designed to follow the "Qi" and "Xue" network of the human body and stimulate the key acupoints that control the mammary gland functions as well as the central balance of the entire body. The rebalance of the "Qi" and "Xue" is a prerequisite for the improved mammary gland functions. For example, pressing and massaging the "Sanyinjiao", "Zusanli" and "Xuehai" acupoints can effectively reinforce the normal functions of "Pi" and "Wei", 2 essential organs in the 5-organ network Oriental medicines are based on, which in turn stimulates the balance of "Qi" and "Xue" in the whole body. In addition, our Tuina protocol also specifically massage the breast tissue in order to activate the "Qi" and "Xue" running in the mammary area. We hypothesize that the combination of rebalancing the central "Qi" and "Xue" system and adjusting the localized mammary system through the Tuina therapy can lead to an efficient stimulation on milk production and secretion.

In our randomized prospective study, the efficacy of Acupoint-Tuina therapy for promoting milk production was examined and demonstrated in several different aspects. Comparing the 2 groups, a substantial relative increase of milk production was observed for the Tuina group than for the control group. In addition, statistical differences were also identified between the 2 groups on other indicators of the physiological condition of breast during lactation. For example, the breast surface temperature has been previously reported to increase slightly during lactation.[18,19] At the same time, it is also known that an excessive increase of temperature suggests abnormality such as inflammation and is associated with lactation inhibition.[20,21] Using an accurate and sensitive thermal imaging approach, our study found that the surface temperature increase was attenuated in the Tuina group for both breasts when comparing with the

control group. This suggests a fine-tune of the breast physiology and a possible prevention of inflammation by Tuina therapy. Similarly, breast volumes are known to increase for lactating women and the amount of healthy expansion (not swelling) could associate with the volume of milk production.[22,23] Our study showed that Tuina therapy significantly boosted the enlargement of the full breasts (i.e., before lactation) when compared with the control groups, which suggests that Tuina therapy may promote mammary tissue development for lactating women and therefore stimulating lactation. Another objective endpoint assessed in our study was the serum PRL level. PRL is a major hormone that controls the underlying physiology of lactation.[12,24,25] Tuina therapy was also found to increase the serum PRL level compared with the control group. Lastly, it has been reported that postpartum uterus recovery is associated with lactation.[26] In our series, patients in the Tuina group also showed faster and greater uterus recovery compared with the control group. Taken together, the increased milk production and other physiological indicators all unequivocally pointed to the effectiveness of Tuina therapy in promoting lactation for the studied patient group.

Despite the widely recognized health benefits of breastfeeding to both infants and mothers, there exist many voluntary and involuntary hurdles for the breastfeeding practices. Inadequate milk supply of the mother is 1 major hurdle and a prevalent but unsolved problem in the modern medicine.[27,28,29] To date, there is no clear answer to how to address this problem, although many different methods have been proposed and shown effective. In this randomized study, a new approach, Acupoint-Tuina therapy, has been evaluated and shown to enhance milk production during the early postpartum period for women with an inadequate milk supply post C-section. While the exact mechanism of this new approach remains unclear except for the explanations provided in the traditional Oriental medicines about "Qi" and "Xue", some similarities are shared with other existing approaches such as the "skin-to-skin" contact and herbal or pharmaceutical galactagogues. For example, these approaches may all act via mediating complex processes involving the interaction between physical and physiological factors. Among the most important factors are hormones, which could be dysregulated after a surgery such as a C-section. Among all hormones, PRL, induced throughout the pregnancy and delivery, is considered the most important one for lactation.[24] Other existing approaches often act by stimulating this important hormone.[11,30,31] Interestingly, in our study Tuina therapy also significantly increased the PRL levels, while the PRL levels actually decreased over time for women who merely received the standard care. This provided a very interesting link between Tuina, a traditional therapy approach, and the modern medicine. With the promising results of the current preliminary study, it would be an interesting future direction to test combination therapies using Tuina therapy and other modern medicine approaches such as galactagogues, and see if there are synergistic effects between Tuina therapy and the modern medicine to further increase breast milk production.

There are some limitations to our study. For example, the therapy was only conducted for 2 days and the endpoints were also only evaluated in the early postpartum period because this study was designed to conveniently conduct the experiment and rigorously assess the effects in the inpatient setting during this temporal window. Therefore, the effects of Tuina therapy at later time points were not evaluated. Similarly, whether the observed enhancement of milk production for women receiving Tuina therapy is a true net increase over the control group or just an earlier onset of normal milk production levels cannot be assessed. Many studies have shown that C-section is associated with a delayed initiation of breastfeeding and many women can later catch up to have normal breastfeeding over time.[32] Therefore it is possible that the substantially increased milk production following Tuina therapy identified in our study is actually just the effects of expediting the breastfeeding initiation for these women, and some women in the control group could eventually catch up with the milk production of the Tuina group. A future study with a longer follow-up duration could be designed to answer this question. On the other hand, even if Tuina therapy has only an effect of expediting the initiation instead of a net increase of lactation, it is still clinically meaningful as C-section has been known as a persistent barrier to early initiation of breastfeeding,[32] and delayed breastfeeding initiation increases risks of neonatal mortality and morbidity as well as increasing the likelihood of quitting breastfeeding by the mother.[33,34,35,36,37] Assessing the long term effect of Tuina therapy on breast milk production will be important, and is warranted based on the important results found in our initial study and assessments during the early postpartum period. In addition, because of the nature of the therapy, the women participated in the study could not be blinded from the randomization results, a placebo effect therefore cannot be ruled out. Nevertheless, the milk production increase observed for the Tuina group in our study demonstrated the great promise of this new approach in helping women with lactation deficiency. Since the stimulation to the acupoints is applied through massage techniques, it is also noninvasive and safe to conduct. Tuina therapy has had a long standing in Asian countries where the traditional oriental medicines are practiced. The encouraging results from our study could be especially helpful for the women in these countries given the very high rates of C-sections in some of these countries.

5. Conclusions

The feasibility and efficacy of applying Acupoint-Tuina therapy to postpartum women with C-section delivery and insufficient breast milk production have been tested in a prospective, randomized study. During the early postpartum days, Tuina therapy increases the milk production and promotes other physiological changes supporting lactation. The novel intervention is warranted for further investigation and validation.

Author contributions

Data curation: Ping Lu, Xiao-yu Wang.
Funding acquisition: Juan-juan Zheng.
Investigation: Zhi-qi Ye.
Writing – original draft: Ping Lu.
Writing – review & editing: Jin Qiu, Juan-juan Zheng.

References

[1] Gartner LM, Morton J, Lawrence RA, et al. Section on breastfeeding. Breastfeeding and the use of human milk. Pediatrics 2012;129:e827–841.
[2] Committee on health care for underserved women, American College of Obstetricians and Gynecologists. ACOG committee opinion no. 361: Breastfeeding: maternal and infant aspects. Obstet Gynecol 2007;109(2 Pt 1):479–80.
[3] Galson SK. The 25th anniversary of the surgeon general's workshop on breastfeeding and human lactation: the status of breastfeeding today. Public Health Rep 2009;124:356–8.

[4] Bibbins-Domingo K, Grossman DC, et al. Preventive Services Task Force USPrimary care interventions to support breastfeeding: US preventive services task force recommendation statement. JAMA 2016;316:1688–93.
[5] Prior E, Santhakumaran S, Gale C, et al. Breastfeeding after cesarean delivery: a systematic review and meta-analysis of world literature. Am J Clin Nutr 2012;95:1113–35.
[6] McDonald SD, Pullenayegum E, Chapman B, et al. Prevalence and predictors of exclusive breastfeeding at hospital discharge. Obstet Gynecol 2012;119:1171–9.
[7] Feng XL, Xu L, Guo Y, et al. Factors influencing rising caesarean section rates in china between 1988 and 2008. Bull World Health Organ 2012;90:30–9. 39A.
[8] Dewey KG, Nommsen-Rivers LA, Heinig MJ, et al. Risk factors for suboptimal infant breastfeeding behavior, delayed onset of lactation, and excess neonatal weight loss. Pediatrics 2003;112(3 Pt 1):607–19.
[9] Guala A, Boscardini L, Visentin R, et al. Skin-to-skin contact in cesarean birth and duration of breastfeeding: A cohort study. ScientificWorld-Journal 2017;2017:1940756.
[10] Feher SD, Berger LR, Johnson JD, et al. Increasing breast milk production for premature infants with a relaxation/imagery audiotape. Pediatrics 1989;83:57–60.
[11] Anderson PO, Valdes V. A critical review of pharmaceutical galactagogues. Breastfeed Med 2007;2:229–42.
[12] Nissen E, Uvnas-Moberg K, Svensson K, et al. Different patterns of oxytocin, prolactin but not cortisol release during breastfeeding in women delivered by caesarean section or by the vaginal route. Early Hum Dev 1996;45:103–18.
[13] Pritchard S. Tui na: A manual of chinese massage therapy. 2010;Elsevier,
[14] Kong LJ, Fang M, Zhan HS, et al. Tuina-focused integrative chinese medical therapies for inpatients with low back pain: A systematic review and meta-analysis. Evid Based Complement Alternat Med 2012;2012:578305.
[15] Tan JY, Molassiotis A, Wang T, et al. Current evidence on auricular therapy for chemotherapy-induced nausea and vomiting in cancer patients: A systematic review of randomized controlled trials. Evid Based Complement Alternat Med 2014;2014:430796.
[16] W Yong-mei SC. Observation on therapeutic results in tuina treatment of 56 cases of infantile constipation. J Acupunct Tuina Sci 2004;2:22–3.
[17] Stux G, Pomeranz B. Acupuncture: Textbook and atlas. New York: Springer; 2012. 455–462.
[18] Bystrova K, Matthiesen AS, Vorontsov I, et al. Maternal axillar and breast temperature after giving birth: effects of delivery ward practices and relation to infant temperature. Birth 2007;34:291–300.
[19] Meng X. Far-infrared heat map of breast during pregnancy and its correlation with postpartum lactation. J Pract Med Techn 2006;13:1410–1.
[20] Ying J, Shang Y, Li H. Infrared thermal spectra of acupoints in patients with hyperplasia of the breast. J Nanjing Univ Traditional Chin Med 2010;26:174–7.
[21] Betzold CM. An update on the recognition and management of lactational breast inflammation. J Midwifery Womens Health 2007;52:595–605.
[22] Kamal I, Hefnawi F, Ghoneim M, et al. Clinical, biochemical, and experimental studies on lactation. II. clinical effects of gestagens on lactation. Am J Obstet Gynecol 1969;105:324–34.
[23] Neifert MR, Seacat JM, Jobe WE. Lactation failure due to insufficient glandular development of the breast. Pediatrics 1985;76:823–8.
[24] Hill PD, Chatterton RTJr, Aldag JC. Serum prolactin in breastfeeding: State of the science. Biol Res Nurs 1999;1:65–75.
[25] Zimmer JP, Garza C, Heller ME, et al. Relationship between serum prolactin, lactation and changes in maternal blood B-cell (CD19+) percents during the first 8 months post-partum. J Reprod Immunol 1996;30:81–95.
[26] Chua S, Arulkumaran S, Lim I, et al. Influence of breastfeeding and nipple stimulation on postpartum uterine activity. Br J Obstet Gynaecol 1994;101:804–5.
[27] Gatti L. Maternal perceptions of insufficient milk supply in breastfeeding. J Nurs Scholarsh 2008;40:355–63.
[28] West CP. Factors influencing the duration of breast-feeding. J Biosoc Sci 1980;12:325–31.
[29] Li R, Fein SB, Chen J, et al. Why mothers stop breastfeeding: mothers' self-reported reasons for stopping during the first year. Pediatrics 2008;122 Suppl 2:S69–76.
[30] Bier JA, Ferguson AE, Morales Y, et al. Comparison of skin-to-skin contact with standard contact in low-birth-weight infants who are breast-fed. Arch Pediatr Adolesc Med 1996;150:1265–9.
[31] Moore ER, Bergman N, Anderson GC, et al. Early skin-to-skin contact for mothers and their healthy newborn infants. Cochrane Database Syst Rev 2016;11:CD003519.
[32] Rowe-Murray HJ, Fisher JR. Baby friendly hospital practices: cesarean section is a persistent barrier to early initiation of breastfeeding. Birth 2002;29:124–31.
[33] Edmond KM, Zandoh C, Quigley MA, et al. Delayed breastfeeding initiation increases risk of neonatal mortality. Pediatrics 2006;117:e380–6.
[34] Smith ER, Hurt L, Chowdhury R, et al. Delayed breastfeeding initiation and infant survival: a systematic review and meta-analysis. PLoS One 2017;12:e0180722.
[35] Khan J, Vesel L, Bahl R, et al. Timing of breastfeeding initiation and exclusivity of breastfeeding during the first month of life: Effects on neonatal mortality and morbidity–a systematic review and meta-analysis. Matern Child Health J 2015;19:468–79.
[36] Debes AK, Kohli A, Walker N, et al. Time to initiation of breastfeeding and neonatal mortality and morbidity: a systematic review. BMC Public Health 2013;13 Suppl 3:S19.
[37] Salariya EM, Easton PM, Cater JI. Duration of breast-feeding after early initiation and frequent feeding. Lancet 1978;2:1141–3.