



Effect of grape seed extract ointment on cesarean section wound healing: A double-blind, randomized, controlled clinical trial

Alimohammad Izadpanah^a, Sima Soorgi^b, Neda Geraminejad^c, Mahdi hosseini^{a,*}

^a Instructor, East Nursing and Midwifery Care Research Center Instructor, Department of Nursing, Faculty of Nursing and Midwifery, Birjand University of Medical Sciences, Birjand, Iran

^b East Nursing and Midwifery Care Research Center, Faculty of Nursing and Midwifery, Birjand University of Medical Sciences, Birjand, Iran

^c Instructor, Department of Anesthesia, School of Paramedicine, Arak University of Medical Sciences, Arak, Iran

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ABSTRACT

Background: and purpose: Complications of the delayed recovery of cesarean section (CS) wound can include stress, discomfort, and dissatisfaction of the mother in the postpartum period. This study tried to determine the effect of grape seed extract ointment on CS wound healing.

Materials and methods: This is a double-blind, randomized, controlled clinical trial incorporating 129 women eligible for CS in eastern Iran. Participants were selected through convenience sampling method and were subsequently randomly assigned into three groups: 2.5% grape seed extract ointment, 5% grape seed extract ointment, and petrolatum. CS wound healing indices were assessed before the intervention, and 6 and 14 days after the intervention using the REEDA scale (redness, edema, ecchymosis, discharge, and approximation).

Results: The mean scores on days 6 and 14 after intervention were respectively 2.02 ± 0.52 and 0.98 ± 0.61 in the 5% ointment group, 2.83 ± 0.54 and 1.58 ± 0.67 in the 2.5% ointment group, and 2.91 ± 0.51 and 1.55 ± 0.74 in the petrolatum group. While the mean score in the 5% ointment group was significantly different from those of 2.5% ointment and petrolatum groups ($P < 0.001$), the mean score in the 2.5% ointment group was not significantly different from that of the petrolatum group on days 6 and 14 after intervention ($P = 0.38$ and $P = 0.79$, respectively).

Conclusion: The current results suggest that 5% grape seed extract may have beneficial therapeutic effects in promoting CS wound healing.

1. Introduction

Cesarean section (CS) aims to provide health and to save the life of mother and infant and is best in situations where there are certain indications for the mother, the infant, or both [1]. On average, CS accounts for about 10%–30% of deliveries worldwide, while the World Health Organization (WHO) has set the desired cesarean rate by 15% [2]. CS is the most commonly used surgical procedure in the United States, with more than 1 million cesareans per year. The rate varies between 3% and 26% in the developing countries [3]. Statistics indicate that the CS rate in Iran is 40%, higher than the WHO's standard and those of the developed countries and the Eastern Mediterranean region. Indeed, Iran ranks fourth in CS after Brazil, Cyprus, and Colombia [4]. A meta-analysis study shows that 48% of deliveries in Iran are performed via CS, meaning that nearly one in two deliveries is through this procedure [5].

A highly important complication of CS is the insufficient healing/dehiscence of the wound, which reportedly ranges from 3% to 15% [6]. Insufficient healing may occur notwithstanding the administration of antibiotic prophylaxis, skin preparation before surgery, minimized trauma to the tissue, reduced application of cautery, observance of sterilization principles, and utilization of appropriate surgical techniques [7]. Besides, surgical site infection, which is associated with hematoma, serous distension, and wound disruption, is one of the most common causes of mortality following CS [8]. This leads to severe anxiety in the mother at a time when she should be emotionally communicative with the baby. In addition to maternal responsibilities, these postpartum mothers have to suffer from substantial pain and discomfort, which leads to delayed initiation of breastfeeding and early weight loss in infants [9]. This complication also results in frequent visits to the physician and longer hospitalization on the part of the patient for debridement or wound repair purposes as well as high

* Corresponding author. Nursing and Midwifery College, Birjand University of Medical Sciences, Ayatollah Ghaffari Avenue, Birjand, Iran.
E-mail address: Mahdi.hosseini@bums.ac.ir (M. hosseini).

economic costs [7]. As a result, the accelerated rate of wound healing can have many health and economic implications. In addition, faster wound healing can decrease the rate of wound infection [10].

To accelerate wound healing, there are numerous pharmacological and non-pharmacological measures that can be taken. Today, there has been an evolving interest in the application of medicinal herbs to reduce the side-effects of chemical drugs used for therapeutic purposes, especially in countries such as Iran, India, and China, where people are more interested in traditional medicine [11]. Among the herbal extracts used to treat wounds are those of grape seed, lemon, green tea, and rosemary. All these plants have a common feature, namely, the production of compounds with a phenolic structure [12].

The grape seed is a source of rich in phenolic compounds, such as catechins, epicatechins, and dimeric, trimeric, and tetrameric proanthocyanidins [13]. Studies have shown that proanthocyanidins in the grape seed extract cause the proliferation of areas with protected boundaries in epithelium and lead to greater cell density and increased deposition of connective tissue at the wound site, thereby contributing to the development of the elastin tissue and collagen improvement. This antioxidant potentially induces vascular endothelial growth factor in human cells and thereby improves wounds, reduces swelling, and enhances circulation [14,15]. Furthermore, the grape seed contains substances such as vitamin E and tannin. Vitamin E is a powerful reductant that helps maintain skin moisture and can accelerate wound healing. However, proanthocyanidins exert a 50-fold larger impact on the body than vitamin E [16]. Concerning the various studies on grape seed contents and their effect on the contributing factors to wound healing in animal studies, grape seeds can be used to accelerate wound healing in humans; therefore, this study aims to determine the effect of grape seed extract ointment on CS wound healing.

2. Materials and methods

The design of this randomized controlled, double-blind clinical trial was approved by the Ethics Committee of Birjand University of Medical Sciences (identifier: IR.BUMS.1393.6) and registered in the Iranian Registry of Clinical Trials (IRCT2014122220393N1). The trial was performed with 129 women eligible for CS in Birjand Valiasr Hospital in 2015. The sample size was determined according to Sehhati Shaffaie et al.'s study (2012) [17]. Nevertheless, to increase validity and given the possibility of attrition in the sample – assuming 20% loss of sample – a sample size of 43 people per group was considered.

The participants were selected through convenience sampling method and were subsequently randomly assigned into three groups: 2.5% grape seed extract ointment, 5% grape seed extract ointment, and petrolatum. Inclusion criteria consisted of Iranian pregnant women with a gestational age of 37–42 weeks, cesarean delivery with a lower transverse incision, age 18–35 years, Body Mass Index (BMI) in the range of 18.5–25 kg/m² at early pregnancy, single birth, no acute or chronic illness (diabetes mellitus, kidney disease, anemia, hepatic and mental illnesses), non-use of illicit drugs and tobacco, non-use of drugs affecting wound healing (glucocorticoids, anticoagulants, immune system suppressors, antibiotics, and pre-cesarean chemotherapy drugs), and no allergy to grape seed ointment. Exclusion criteria included discontinuing the cooperation, irregular ointment application, complications caused by seed grape ointment application, and incidence of wound infection (i.e., foul-smelling and purulent discharge). In summary, from among the 129 women eligible for CS, four were excluded. Thus, out of the 125 subjects, forty-two were assigned to the 5% ointment group, 41 to the 2.5% ointment group, and 42 to the petrolatum group. The CONSORT flow diagram of the study is displayed in Fig. 1.

The grape with the scientific name of *Vitis Vinifera* (genus: Vitaceae) was purchased from Taghab village of Birjand, eastern Iran. After a botanist from Birjand University of Medical Sciences had confirmed the identity of the grape, the fruits were deseeded. The seeds were

transferred to the pharmaceutical company of Dine Industry Complex (Iran) for the extraction and production of 2.5% and 5% grape seed ointment. Grape seeds were washed, dried, and subsequently powdered using an electric mill. Afterwards, the hydro-alcoholic extract was obtained using 70% alcohol concentration in two stages, as described below. First, 50 g of grape powder was added to 1050 ml of 70% alcohol and stirred with a mixer. The mixture was stored for 24 h in an oven at 40 ± 2 °C. Subsequently, the pulp was filtered, 450 ml of 70% alcohol was added to it and mixed using a mixer. It was stored again for 24 h in an oven at a temperature of 40 ± 2 °C and subsequently filtered. In the end, the total extract obtained was completely dried using an evaporator at 50 °C. To get 99 g of a hydro-alcohol extract of grape seeds, this process was repeated 5 times [15].

Grape seed ointment with 2.5% and 5% concentrations was prepared with petrolatum as the base (Saj brand, Iran). For the third group, only petrolatum was used. To ensure double-blindness, a mixture of the caramel color (code 609), orange (code 16027), and red (code 40) (according to the pharmaceutical grade of colors) was utilized in order to allow for maximum color matching between the petrolatum ointment and the grape seed ointment.

In the end, 42 petrolatum ointment tubes, 41 grape seed 2.5% extract tubes, and 42 grape seed 5% extract tubes were prepared. The tubes weighed 30 g and were subsequently assigned random numbers from 2 to 130 by the pharmacist (who co-operated throughout the project with the research team) without the researcher being informed. When the informed consent form was signed by an eligible mother, the researcher delivered a coded ointment tube and a household teaspoon. They were trained how to use the ointment such that after washing the hands, they needed to fill the spoon with the ointment and slide it against the edge of the container, in which case the spoon would contain 1 g of the ointment [15]. Thereafter, they pulled the ointment over the wound and suture twice daily (12 ± 2 h) from the second post-operative day until the fifteenth day after CS. The mothers were also taught to wear cotton shirts during the study period; to bathe after discharge from hospital and then do it every other day; to avoid lifting heavy objects; to refrain from any movement that would cause too much tension on the suture site; to have sufficient mobility; to place hands on the suture line when coughing; to avoid eating flatulent foods and to consume fruits and vegetables on a daily basis to prevent constipation. The mothers' status was checked by the researcher via phone on the fifth and twelfth days of CS.

Data collection tools comprised of a demographics form (collecting data on age, education, employment status, income, and body mass index), an informational form related to CS (including number of previous pregnancies, number of deliveries, history of CS, history of abortion and stillbirth, history of abdominal surgery other than CS, cause of CS, and type of anesthesia), as well as the REEDA scale. The REEDA scale is an international scale used to check the status of wound healing. It contains five criteria with 4 options scored from 0 to 3, giving the total score range between 0 and 15 (Table 1) [18].

The CS wound healing status was assessed in three stages: 48 h after operation (prior to ointment application), on the 7th day after surgery (6th day of ointment application), and 15 days after operation (14th day of ointment application).

Wound healing status was examined in the supine position using a metal ruler and according to the REEDA scale by a researcher who was blind to patient allocations. The collected data were statistically analyzed in SPSS software (version 19) using analysis of variance (ANOVA), Tukey post hoc, Chi-square, Kruskal-Wallis, and Mann-Whitney tests. Kolmogorov-Smirnov test was used to examine the normality of data distribution. For quantitative variables with normal distribution, ANOVA and Tukey post hoc tests were employed, while for qualitative variables, Kruskal-Wallis and Mann-Whitney tests were applied. In addition, to compare the qualitative variables in the three groups, the Chi-square test was utilized. The significance level was set at $p < 0.05$.

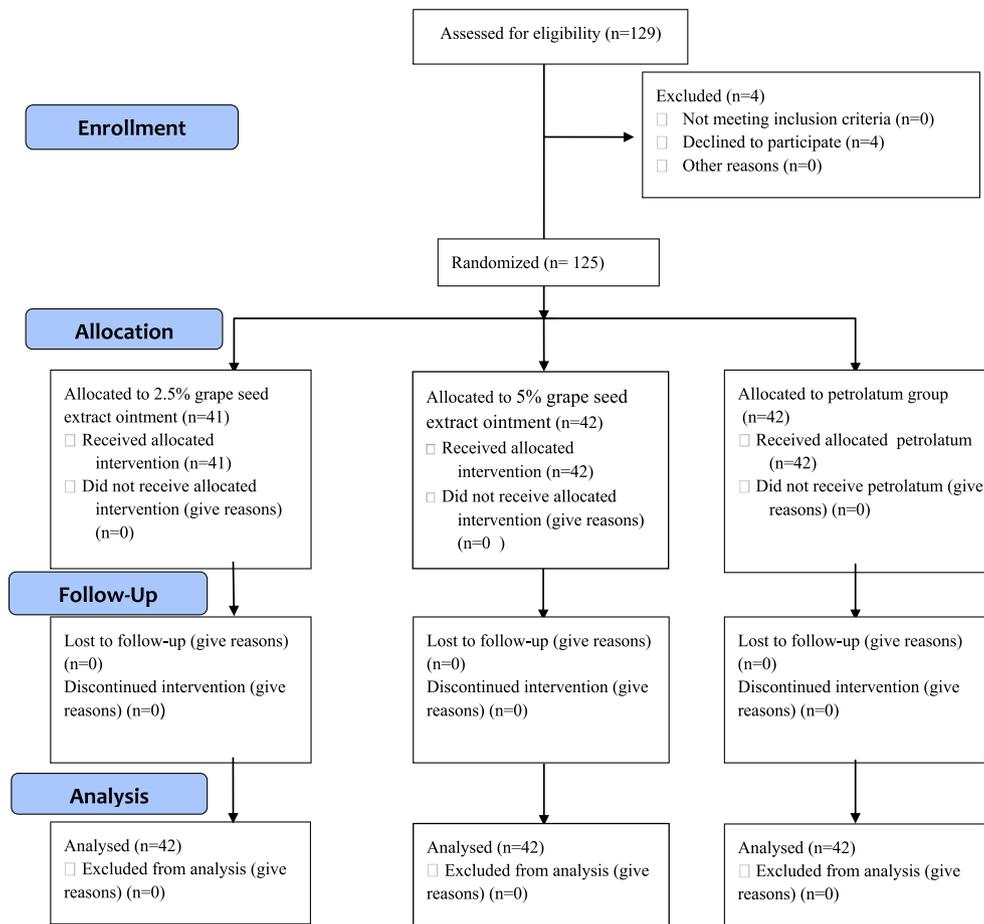


Fig. 1. CONSORT flow diagram of the study.

Table 1
International REEDA scale to examine wound healing status.

Criterion	Score
Redness	None = 0 Within 0.25 cm of the incision bilaterally = 1 Within 0.5 cm of the incision bilaterally = 2 Beyond 0.5 cm of the incision bilaterally = 3
Edema	None = 0 Less than 1 cm from incision = 1 1–2 cm from the incision = 2 Greater than 2 cm from incision = 3
Echymosis	None = 0 Within 0.25 cm bilaterally or 0.5 cm unilaterally = 1 Between 0.25 cm and 1 cm bilaterally or between 0.5 and 2 cm unilaterally = 2 Greater than 1 cm bilaterally or 2 cm unilaterally = 3
Discharge	None = 0 Serum = 1 Serosan-guinous = 2 Bloody, purulent = 3
Approximation	Close = 0 Skin separation 3 mm or less = 1 Skin and subcutaneous fat separation = 2 Subcutaneous fat and fascial layer separation = 3

3. Findings

There were 43 patients in each group. In the course of the study, four subjects were excluded, and the data were analyzed with 125 subjects (n = 42 in 5% ointment group, n = 41 in 2.5% ointment group, and n = 42 in the petrolatum group). Results showed that none of the variables related to CS and demographics were statistically

different across the three groups (P > 0.05) (Table 2 and Table 3).

According to the results, there was no statistically significant difference in the mean scores of redness, discharge, and approximation at baseline between the three groups. On day 6 of the intervention, the mean scores of redness and discharge were not significantly different across the three groups. The groups, however, had statistically significant differences concerning the mean scores of edema, echymosis, and approximation. There was no statistically significant difference in the mean scores of discharge 14 days after the intervention between the groups. Moreover, the three groups had statistically significant differences in terms of the mean scores of redness, edema, echymosis, and approximation 14 days after the intervention (see Table 4).

The total mean scores of the REEDA scale were significantly different between 5% and 2.5% ointment groups and between 5% ointment and petrolatum groups 6 and 14 days after the intervention (p < 0.001). However, the total mean scores showed no significant difference between 2.5% ointment and petrolatum groups 6 days (p = 0.38) and 14 days (p = 0.79) after the intervention (see Table 5).

4. Discussion

The use of plant products for wound healing has a long history, especially in Iran, India, and China where there is historical interest in traditional medicine and in the application of unknown plants to treat wounds [11]. Several studies have been conducted on wound healing in order to accelerate CS wound healing wherein honey, aloe vera, *Hypericum perforatum*, turmeric, pineapple, milk thistle, and green tea, among others, have been employed. For example, Heidari et al. (2013) conducted a prospective, randomized, double-blind clinical trial in order to determine the effect of honey on CS wound healing and CS

Table 2
Comparison of the frequency distribution of patients in terms of some demographic characteristics in the three groups.

Groups		5% grape seed ointment group ^a	2.5% grape seed ointment group ^a	Petrolatum ointment group ^a	Significance level ^b
Education	Illiterate	0 (0)	5 (12.2)	1 (2.4)	0.16
	Elementary school	10 (23.8)	10 (24.4)	12 (28.6)	
	Middle school	10 (23.8)	8 (19.5)	4 (9.5)	
	High school	13 (31.0)	8 (19.5)	13 (31.0)	
Employment status	Collegiate	9 (21.4)	10 (24.4)	12 (28.6)	0.29
	Unemployed Employed	27 (64.3)	30 (73.2)	31 (73.8)	
Monthly income level	< 200 USD ^c	15 (35.7)	11 (26.8)	11 (26.2)	0.29
	Between 200 and 400 USD	18 (42.9)	16 (39.0)	15 (35.7)	
	> 400 USD	18 (42.9)	24 (58.5)	22 (52.4)	
Cesarean cause	Previous cesarean	6 (14.3)	1 (2.4)	5 (11.9)	0.99
	Embryonic causes	17 (40.5)	18 (43.9)	18 (42.9)	
Type of anesthesia	Maternal causes	19 (45.2)	18 (43.9)	18 (42.9)	0.41
	General	6 (14.3)	5 (12.2)	6 (14.3)	
	Spinal	22 (52.4)	28 (68.3)	21 (50.0)	
History of abdominal surgery, except for cesarean section	Both	19 (45.2)	12 (29.3)	19 (45.2)	0.27
	Yes	1 (2.4)	1 (2.4)	2 (4.8)	
History of previous cesarean section	No	3 (7.1)	6 (14.6)	2 (4.8)	0.98
	Yes	39 (92.9)	35 (85.4)	40 (95.2)	
History of previous cesarean section	Yes	19 (45.2)	19 (46.3)	20 (47.6)	0.98
	No	23 (54.8)	22 (53.7)	22 (52.4)	

^a Number (percent).
^b Chi-square test (Fisher's exact test).
^c United States Dollar.

Table 3
Comparison of the average of certain demographic characteristics of patients in the three groups.

Groups		5% grape seed ointment group ^a	2.5% grape seed ointment group ^a	Petrolatum ointment group ^a	Significance level ^b
Age (year)		28.30 ± 5.21	28.70 ± 5.01	28.60 ± 4.60	0.94
Pre-pregnancy BMI ^c (kg/m ²)		21.80 ± 2.10	21.51 ± 2.00	21.71 ± 1.90	0.74
Number of previous pregnancies		2.50 ± 1.50	2.60 ± 1.70	2.71 ± 1.60	0.87
Number of childbirths		2.21 ± 1.20	2.50 ± 1.50	2.00 ± 0.90	0.28
Number of children		2.10 ± 1.21	2.40 ± 1.60	2.00 ± 0.92	0.39
Cesarean incision length (cm)		13.90 ± 1.00	14.00 ± 1.00	13.80 ± 0.91	0.71

^a Mean ± standard deviation.
^b One-way Analysis of variance.
^c Body Mass Index.

Table 4
Comparison of the mean scores of REEDA variables at different times in the three groups.

Groups		5% grape seed ointment group ^a N = 42	2.5% grape seed ointment group ^a N = 41	Petrolatum ointment group ^a N = 42	Significance level ^b
Redness	Before intervention	1.55 ± 0.50	1.45 ± 0.50	1.55 ± 0.50	P = 0.68
	Day 6	0.98 ± 0.20	1.00 ± 0.00	0.88 ± 0.40	P = 0.06
	Day 14	0.79 ± 0.40	0.30 ± 0.93	0.52 ± 0.50	P < 0.001
Edema	Before intervention	1.14 ± 0.35	1.41 ± 0.50	1.48 ± 0.50	P = 0.003
	Day 6	0.19 ± 0.40	0.83 ± 0.40	1.05 ± 0.40	P < 0.001
	Day 14	0.05 ± 0.20	0.41 ± 0.50	0.74 ± 0.40	P < 0.001
Ecchymosis	Before intervention	0.40 ± 0.50	0.17 ± 0.40	0.19 ± 0.40	P = 0.03
	Day 6	0.35 ± 0.14	0.02 ± 0.15	0.02 ± 0.15	P = 0.04
	Day 14	0.95 ± 0.30	0.0 ± 0.00	0.00 ± 0.00	P = 0.02
Discharge	Before intervention	1.64 ± 0.50	1.68 ± 0.50	1.73 ± 0.41	P = 0.64
	Day 6	0.02 ± 0.15	0.07 ± 0.30	0.02 ± 0.15	P = 0.42
	Day 14	0.00 ± 0.00	0.00 ± 0.00	0.02 ± 0.15	P = 0.37
Approximation (mm)	Before intervention	1.05 ± 0.20	1.00 ± 0.00	1.00 ± 0.00	P = 0.14
	Day 6	0.69 ± 0.50	0.90 ± 0.30	0.95 ± 0.20	P = 0.002
	Day 14	0.05 ± 0.20	0.24 ± 0.40	0.26 ± 0.40	P = 0.02

^a Mean ± standard deviation.
^b Kruskal-Wallis test.

Table 5
Comparison of the mean changes in the REEDA score at different time points.

Groups			
Time point	5% ointment with 2.5% ointment ^a	5% ointment with petrolatum ointment ^a	2.5% ointment with petrolatum ointment ^a
Day 6	P < 0.001 Z = -5.69	P < 0.001 Z = -6.30	P = 0.38 Z = -0.87
Day 14	P < 0.001 Z = -4.01	P < 0.001 Z = -3.63	P = 0.79 Z = 0.26

^a Mann-Whitney test.

scar. A total of 130 participants were randomly assigned to three groups of honey, placebo, and control. The findings of the study showed that the mean scores for wound healing in the honey, placebo, and control groups were not significantly different on days 10 and 40 of CS [9]. Another example involves Molazem et al.'s study (2015) where the effect of aloe vera gel on CS wound healing was investigated with 90 patients 24 h after surgery and 8 days later, indicating the positive effect of aloe vera gel on CS wound healing [19]. In Samadi et al.'s study (2010), *Hypericum perforatum* (St John's wort) extract was applied to CS wound, indicating a positive effect of this plant on the wound healing process [20]. Similarly important is Mahmudi et al.'s study (2015), which was conducted on the effect of turmeric cream on the wound healing of cesarean scar, followed on the 7th and 14th days after CS. Results showed that the wound healing process was faster in the intervention group than in the placebo or control groups [21].

While herbal medicinal products have shown positive effects on CS wound healing, the effect of grape seed extract on humans has received significantly less attention. Extensive studies suggest that grape seed extract has health benefits in many ways as a result of its antioxidant effect. There are some animal studies using grape seed extract to show a positive effect of the extract on wound infection improvement [22–24]. In a study on rabbits, for instance, Hemmati et al. (2011) demonstrated that the application of 2% grape seed extract improved and accelerated the process of wound contraction and closure; improvement was reportedly noticeable from the first day of treatment and reduced the wound healing time from 20 days to 13 days. In fact, the extract has been reported to override phenytoin in stimulating recovery [25]. Also, in Nayak et al.'s study on rats (2010), where the powder of grape skin was employed to improve full-thickness skin lesion in comparison with petrolatum and mupirocin, 100% wound contraction and full recovery were achieved on the 13th day after treatment initiation [22]. Khanna et al. (2002) conducted a study on 9 male mice (BALB/c) aged 4–6 weeks to determine the effect of grape seed extract on wound contraction and closure. Results showed that the topical administration of grape seed extract (containing proanthocyanidin) accelerated wound contraction and closure ($p < 0.05$). Treatment by this extract was associated with a more well-defined epithelial hypo-proliferative region, more cell density, greater connective tissue storage, and better tissue structure. The extract also resulted in a higher production of vessel enclosure growth factor (VEGF) at the edge of the wound. Altogether, the topical application of this extract facilitated skin wound healing [14].

Thus, with respect to the effect of grape seed powder and extract on wound healing, these products have been introduced into human studies. Hemmati (2015) conducted a double-blind clinical trial with the aim of investigating the topical effect of 2% grape seed extract cream on the healing process of surgical wounds in 40 patients referring to Imam Khomeini Dermatology Clinic of Ahvaz, southwestern Iran. The participants were randomly assigned to intervention and placebo groups. Surgeries were performed on the patients' skin lesions, including skin tags and moles on the neck, trunk, and extremities (except for the face). Subsequently, they were asked to apply the cream on the wound surface

two times daily, each time to sufficient size (half a knuckle). Transparent sheets were used to measure the area and shape of the lesion. In addition, at each visit, the ulcers were photographed with an 8-megapixel Canon camera. Results showed that there was a statistically significant difference between the two groups, such that the ulcers of the intervention group members had total remission on the 8th day, while those of the placebo group members were healed on the 14th day [15].

The findings of the present study indicated that the 5% ointment was more effective than both 2.5% ointment and petrolatum in improving the CS wound. Nevertheless, 2% ointment of grape seed extract was used in Hemmati et al.'s study, where higher concentration percentages of ointment were reported not to have better results. This finding is not in line with the results of our study, which can be due to the difference in the nature of CS wounds as compared with skin surgery ulcers.

Considering the results of this study and other studies, the grape seed extract has been shown to contain antioxidant, antihistamine, anti-allergic, and anti-inflammatory properties and to strengthen the immune system. Moreover, it has been demonstrated that the grape is a rich source of phenolic compounds, including gallic acid, catechins, and resveratrol, as well as a wide range of procyanidins, a small amount of which can increase collagen levels to improve skin ulcers [26]. In addition to the phenolic compound, the grape seed contains substances such as tannin and vitamin E, which can accelerate wound healing. Besides, the grape seed contributes to the entrance of vitamin C into body cells, thus reinforcing membrane cells and protecting the cell against the damage caused by oxidation [13]. Other studies have shown that phenolic compounds are effective in the treatment of skin diseases, aging skin, and skin lesions including wounds and burns. In fact, they reduce the wound healing time and, by creating constriction at the wound site, facilitating reconstruction of the epithelial cells [27].

In the present study, we tried to yield reliable results by using a standardized tool for wound healing assessment, incorporating a relatively sufficient sample size, maximizing efforts to obtain blindness, controlling the confounding variables in CS wound healing, and monitoring the mothers intermittently to ensure that the participants follow the intervention. One of the limitations of this study was the lack of complete control over personal hygiene and individual differences of the participants in terms of the type of tissue, wound healing power, type of nutrition, and mobility of individuals. These have impacts on the wound healing speed and were out of the researchers' control. However, by randomizing the selection and allocation of the participants and providing face-to-face training and telephone follow-ups, these factors were to a large extent controlled by the research team. Moreover, to prevent the effect of treatment differences of gynecologists, the patients of only one specialist were recruited. One final important limitation of this study, as concerned with the discussion section, was the fact that investigations reporting the application of grape seed extract on humans are very rare. This made it difficult to make comparisons.

5. Conclusion

Based on the results of this study, 5% grape seed extract seems to be more effective than 2.5% grape seed extract and petrolatum ointment in healing CS wounds. The current results, therefore, suggest that 5% grape seed extract may have beneficial therapeutic effects in promoting CS wound healing. Future research should focus on different concentrations of grape seed extract ointment and a larger cohort of cesarean section and other wounds.

Conflicts of interest

The authors declare no conflict of interest.

Author criteria statement

Study conception and design was done by AI, SS and MH. Following that, analysis and interpretation of data was done by AI and MH; drafting the article and revising it critically for important intellectual content was done by AI, SS, MH and NG. Final approval of the version to be published was done by AI, SS, MH and NG.

We confirm that all authors meet the authorship criteria and that all authors are in agreement with the content of the manuscript.

Ethical approval

Research and Ethics Committee of BUMS approved this study (IR.BUMS.1393.6) and obtaining IRCT code (IRCT2014122220393N1).

Authors' contribution

A. I. conceived of the presented idea. M. H. did the literature review and developed the theory. S. S. and N. G. collected the data and did the analysis of the data. All authors discussed the results and contributed to the final manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ctcp.2019.03.011>.

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