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Original article

# Comparing the Effects of an Herbal Ointment (Based on Persian Medicine) and Silver Sulfadiazine Ointment on the Second-Degree Burn Wounds: a Single-Blind Randomized Clinical Trial

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## Abstract

**Background and Objective:** Burn injuries impose heavy costs on the healthcare systems. Since the available treatments for burn injuries are costly and have several complications, the present study aimed to compare the effects of an Iranian traditional medicine product in the form of an herbal ointment with silver sulfadiazine ointment on second-degree burn wounds. **Methods:** In this single-blind randomized clinical trial, the patients were divided into two groups of herbal ointment (*Rosa damascena*, *Solanum nigrum*, and *Malva sylvestris*) and SSD ointment (control). They were evaluated in terms of improvement, wound closure, wound appearance, and intervention complications prior to the treatment, on the fourth day, and after 1-4 weeks. **Results:** Fifty three participants completed the trial (27 in herbal ointment and 26 in SSD group). The mean burn wound healing time was 11.58±5.36 and 16.80±5.60 days in the herbal and SSD groups, respectively, which showed a significant difference in this regard (p=0.001). Moreover, the wound closure percentage in the first two weeks was significantly higher in the herbal group compared to the SSD group (p<0.05). Also, wound appearance was better in the herbal ointment group in all the assessment times. No significant difference was observed between the herbal and SSD ointment regarding the treatment complications. **Conclusion:** The herbal ointment containing *Rosa damascena*, *Malva sylvestris*, and *Solanum nigrum* showed more considerable effects on the second-degree burn wounds compared to the SSD ointment.

**Keywords:** burns; herbal medicine; silver sulfadiazine; traditional medicine

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## Introduction

Burn injuries are among the most destructive injuries, which are considered to be a major public health concern [1]. In fact, burns are the fourth most prevalent trauma following traffic accidents, falls, and interpersonal violence in the world. Each year, hundreds of thousands of individuals die due to burn injuries, and millions suffer from burn-related disabilities and disfigurements, which are associated with psychological, social, and economic consequences and impose heavy costs on the healthcare system, especially in developing

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countries [2-4]. Furthermore, burns may have severe adverse effects on the mental and physical health of the patients [5].

Partial-thickness burns are often treated with topical antibiotic ointments and daily dressing changes. In general, topical antibiotics prevent infection by reducing the microbial load in the wounds. Some of these antibiotics include silver compounds (e.g., silver sulfadiazine ointment), mafenide, nitrofurantoin, mupirocin, bacitracin, polymyxin B, nystatin, and iodine products [6,7]. However, these medications may have unwanted side-effects and skin graft loss, as well as delayed re-epithelialization, allergic reactions, leukopenia, and neutropenia [8]. It is also notable that these medications cannot be used in the vicinity of recently grafted areas 9].

Some of the integral parts of burn wound control are long-term hospitalization, multiple surgeries, and long-term rehabilitation, which are associated with significant costs and demand remarkable effort to minimize the hospitalization period of burn victims; therefore, it seems crucial to find effective medications with fewer side-effects for the control and treatment of burn injuries within a shorter period [10]. Over the past decades, the popularity and usage of natural medicines and traditional remedies have increased for the treatment of skin diseases and wounds [11]. In addition, several studies have been focused on the effectiveness of complementary medicine therapies on burn healing [12].

Iranian traditional medicine (Persian medicine) is a discipline of complementary medicine, with the history dating back to over a thousand years. It is considered to be a reliable reference of complementary medicine for research regarding burn injuries. Moreover, the effectiveness of herbal and natural products derived from Iranian traditional medicine on burn wounds has been evaluated in recent studies [8,13-15]. The practitioners of Iranian traditional medicine have been focused on the area of burn injuries, proposing various topical and oral treatments and physical therapies. A wide range of topical medicines were used in Iranian traditional medicine for these purposes, ranging from very thin liquids (e.g., aquatics) to concentrated compounds (e.g., ointments and creams) [16].

Due to the positive reports about healing effects of herbal plants including *Malva sylvestris* L. (Malvaceae), *Solanum nigrum* L. (Solanaceae) and *Rosa damascena* Mill. (Rosaceae) in previous studies [13], the present clinical study aimed to compare the effects of an Iranian traditional medicine product as an herbal ointment, along with SSD ointment, on healing of second-degree burn wounds.

## Material and Methods

### Ethical considerations

This single-blind randomized clinical trial was conducted at Shahid Motahari Hospital in Tehran, Iran during May 2019-January 2020. The study protocol was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (ethical code: IR.SBMU.RETECH.REC.1397.1330), and the study has been registered at the Iranian Registry of Clinical Trials (code: IRCT20190621043961N1). The protocol of study was in accordance with Helsinki declaration. Also, written informed consent was provided by all participants prior to entrance to the study.

### Traditional medicine product

Iranian traditional medicine product used in the present study was an herbal burn ointment, which was applied based on the study performed by Fahimi et al. using aqueous extracts of *Malva sylvestris* ("Panirak" in Persian) (4.85% of total formulation), leaves of *Solanum nigrum* ("Tajrizi" in Persian) (4.85%), and oily extract of *Rosa damascene* petals ("Gol-e-sorkh*"* in Persian) (33%) in a base containing white petrolatum (28%), beeswax (2%), and eucerin (25%), along with methylparaben (0.2%) and propylparaben (microbial preservatives) (0.06%) and butylated hydroxytoluene (BHT) (0.04) as an antioxidant [17].

*Malva sylvestris* and leaves of *Solanum nigrum* were collected from Shahriyar, Iran in July 2018, and the plant species were verified by a botanist (voucher number of TMRC-3377 for *Malva sylvestris l.* and TMRC-3375 for *Solanum nigrum* L.), and deposited at the Herbarium of Traditional Medicine and Materia Medica Research Center (TMRC), Shahid Beheshti University of Medical Sciences, Tehran, Iran. Also, the oily extract of *Rosa damascena* was purchased from Barij Essence Company (Kashan, Iran). It should be mentioned that the compound was formerly used in an animal research to control second-degree burn wounds [13].

**Control drug**

Silver sulfadiazine 1% cream (Sobhan Darou CO., Iran) was used as the control intervention in the present study owing to its common application in the treatment of second-degree burns in healthcare centers and in the form of control interventions in similar scientific papers [6].

**Inclusion and exclusion criteria**

The inclusion criteria of the study were as follows: 1) age more than 18 years; 2) second-degree thermal burns; 3) referral to the hospital within less than 48 hours after the incident; 4) lower burn percentage than 15% and 5) informed consent for enrollment. The exclusion criteria were as follows: 1) pregnancy; 2) patients with severe systematic diseases, such as seizure, diabetes, and immune system defects; 3) history of psychiatric disorders (e.g., paranoia), admission to psychiatric wards, and skin allergies to the components of the herbal products; 4) electrical and chemical burns; 5) allergies to the SSD or herbal ointments and 6) simultaneous use of antibiotics (oral/topical).

**Sample size**

The sample size per each group was determined to be 25 based on statistical calculations and similar studies. Considering 10% attrition, 27 patients were allocated to each group.

**Implementation method**

The statistical population included all the patients with second-degree burn wounds aged more than 18 years, who referred to Shahid Motahari Hospital in Tehran, Iran, and met the inclusion criteria. Initially, the burn degree of the patients was determined by a physician with emergency experience based on the Wallace rule of nines, followed by preliminary measures for burn injuries, including washing with normal saline and drying with sterile gauze. The research objectives were explained to the patients, and written informed consent for participation was obtained. In addition, they were allowed to withdraw from the study at any given time. Afterwards, the indices of age, type of burn injury, burn percentage, burned extremities, size of the burn wound, and drug allergy were recorded in a primary form by the researcher based on the statements of the patients and visual examinations.

The patients were randomly allocated to the groups of treatment with herbal ointment and 1% silver sulfadiazine cream using the Random RX software version 1 and random block method to homogenize the participants in terms of second-degree superficial and deep burns. In case of burn wounds on both sides of the body, the burns on the right side were labeled A, and the burns on the left side were labeled B. Correspondingly, the patients were randomly divided into two groups of treatment with herbal ointment on one side and 1% silver sulfadiazine cream on the other side.

The intervention continued until the complete healing of the burn wounds in the patients. Complete epithelialization, which is a recovery index recognized as the falling off of scabs with no fresh wound underneath, was determined by the attending physician.

This clinical trial had a single-blind design, so that the dressings soaked in herbal or SSD ointments could be applied by a nurse onto the patients who were unaware of the intervention. Notably, conducting a double-blind trial (blinded therapist) was not possible due to the color and odor differences between the herbal and SSD ointments.

After explaining the research implementation method to the patients, a thin layer of the herbal or SSD ointments (3 mm) was applied to the burn wounds based on the random division of the patients, and the wounds were covered with sterile gauze and routine bandaging of the ward. In addition, the patients were instructed on the care process of the wounds, dressing, and bandage, as well as their dietary regimen based on the ward routine. The patients were required to refer to the hospital every day in order to change the dressing and receive the recovery course examinations to assess the possible complications and treatment continuation.

Digital images of the burn wounds of the patients were assessed before each dressing change. In addition, both groups were evaluated in terms of infection signs during each visit and excluded from the study in case of the following signs, which indicated infection and would lead to the change of the treatment by the attending physician: swelling at the burn wound site, along with induration and inflammation around the wound, the color change of the burn wound to dark red, brown, purple or black, the presence of excessive purulent, odorous secretions and fever during the treatment. It is notable that the

participants could contact and inform the researcher of the possible problems associated with the treatment process and research design.
The data of wound examinations were evaluated and recorded based on the recovery period, wound closure percentage, risk of infection, and appearance of the wound at the beginning of the treatment on the fourth day and every week until four weeks. General appearance of the burn wound was evaluated by the physician through a visual four-point scale (0-3): 0= poor, 1= fair, 2=good and 4=very good. Moreover, pain intensity and sensation of burning/itching at the burn site were recorded in a checklist prepared for this purpose at one-, five-, and 15-minute intervals after starting the use of the herbal and SSD ointments. These were considered as complications of interventions, and were assessed through four-point scale as following: 0=absent, 1= mild, 2= moderate and 3=severe. Also, satisfaction of the patients in the study groups was also assessed after the intervention and recorded in a form.

**Statistical analysis**

Data analysis was performed in SPSS version 18 using central and distribution indicators, measures, percentages, frequency tables, and diagrams to describe the data collected, in addition to mean and standard deviation to describe the quantitative variables and percentage to describe the qualitative variables. The Wilcoxon test and paired t-test were applied to compare the quantitative variables before and after the intervention. Moreover, Chi-square was used to compare the qualitative variables, and independent t-test and Mann-Whitney U test were employed to compare the mean values between the study groups. The analysis of covariance (ANCOVA) was also used to control the effects of the confounding variables. In all the statistical analyses, the p-value of 0.05 was considered as significant.

## Results and Discussion

Among 78 patients referring to the hospital, 67 cases met the inclusion criteria and were divided into two groups of herbal ointment (n=33) and SSD ointment (N=34). In total, 52 patients (35 women and 18 men) completed the study in the SSD ointment (n=26) and herbal ointment groups (n=27) (figure 1).

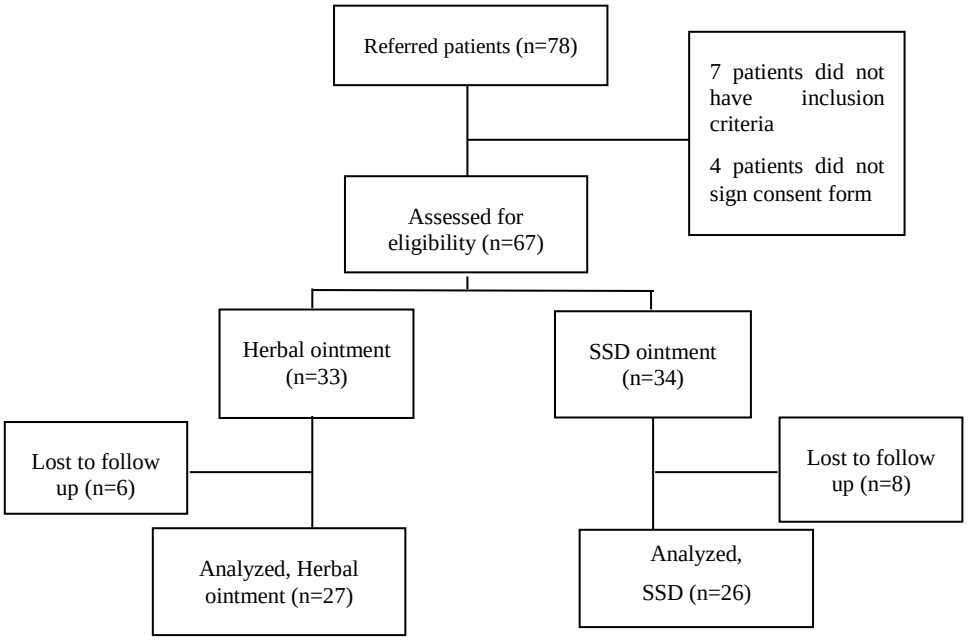


**Figure 1.** CONSORT flow diagram of clinical trial

**Table 1.** Characteristics of the participates of the study

| Characteristics | Herbal ointment n=27 | SSD* ointment n=26 | p value |
|---|---|---|---|
| Female N (%) | 17 (62.9) | 18 (69.2) | 0.630 |
| Male N (%) | 10 (37.1) | 8 (30.8) | |
| **Age, years** | | | |
| Mean ± SD | 39.44 ± 12.82 | 43.5 ± 15.1 | 0.315 |
| Median (IQR) | 37.0 (17.0) | 45.5 (25.0) | |
| **Age ranges, N (%)** | | | |
| <30 years | 7 (26.0) | 6 (23.0) | 0.971 |
| 30-45 years | 10 (37.0) | 10 (38.5) | |
| >45 years | 10 (37.0) | 10 (38.5) | |
| **Education, N (%)** | | | |
| Elementary | 3 (11.1) | 1 (3.8) | 0.274 |
| Under diploma | 10 (37.0) | 6 (23.1) | |
| Graduated | 14 (51.9) | 19 (73.1) | |
| **BMI** ($kg/m^2$) | | | |
| Mean ± SD | 24.68 ± 2.58 | 25.48 ± 2.98 | 0.292 |
| Median (IQR) | 23.67 (4.8) | 24.5 (7.2) | |

*Silver sulfadiazine ointment

**Table 2.** Characteristics of burn in participants before trial

| Group | | Herbal ointment | SSD* ointment |
|---|---|---|---|
| Type of second degree burn N (%) | Superficial (II/A) | 7 (25.93) | 11 (42.31) |
| | Deep (II/B) | 10 (37.03) | 10 (38.46) |
| | Mixed superficial and deep (II/A and II/B) | 10 (37.03) | 5 (19.23) |
| Percentage of burn Mean ± SD | | 1.90 ±1.21 | 1.53 ±0.76 |
| Wound size ($cm^2$) | Mean ±SD | 43.01 ±10.30 | 48.63 ±9.99 |
| | Median (IQR) | 19.5 (43.41) | 40.0 (41.0) |
| Site of body, N (%) | Upper limbs | 16 (59.3) | 14 (53.9) |
| | Lower limbs | 7 (25.9) | 6 (23.1) |
| | Anterior (abdomen) | 4 (14.8) | 5 (19.2) |
| | Posterior (back part) | 0 (0.0) | 1 (3.8) |

*Silver sulfadiazine ointment

**Table 3.** Comparison of the mean healing time (days) between herbal ointment and SSD* groups according to type of burns

| | Overall (Mean±SD) | II/A** (Mean±SD) | II/B* (Mean±SD) | mixed II/A and II/B* (Mean±SD) | p value within groups |
|---|---|---|---|---|---|
| Herbal ointment (N=27) | 11.58±5.36 | 7.71±2.75 | 15.4±6.00 | 11.2±3.79 | 0.008 |
| Silver sulfadiazine (N=26) | 16.80±5.60 | 12.0±2.60 | 20.0±4.26 | 21.0±5.30 | 0.001 |
| P value between two groups | 0.0018 | 0.007 | 0.036 | 0.003 | |

*Silver sulfadiazine ointment; **Types of the second-degree burns

The characteristics of the patients in the study groups are shown in
Table 1. The participants were homogenous in terms of the demographic characteristics (p>0.05). The study groups were homogenous in terms of the burn degree (p value=0.281). The majority of the patients had burn injuries in the upper extremities, and the wound size was estimated 43.01 and 48.63 $cm^2$ in the herbal and SSD ointment groups before the intervention, respectively, indicating no significant difference in this regard (p value=0.156).
Table 2 shows the characteristics of the burn wounds in patients. The mean healing time of burn wounds was estimated 11.58±5.36 and 16.80±5.60 days in the herbal and SSD ointment groups, which demonstrated a significant difference in this regard (p value=0.0018). In the herbal ointment group, the healing time of degree II/A and II/B and mixed (II/A and II/B) burn wounds was 7.71±2.75, 15.4±6.00, and 11.2±3.79 days, respectively. Therefore, the healing time was shorter in the herbal ointment group in all types of burn wounds compared to the SSD ointment group (p value<0.05).
Table 3 shows the healing time of the burn wounds in the study groups based on the burn degree while table 4 classifies the healing time of the burn wounds in the study groups based on the anatomical site of the burns. As is observed, the healing time was shorter in the herbal group compared to the SSD group only in the upper extremities (p value<0.05).

**Table 4.** Comparison of the mean healing time between herbal ointment and SSD* groups according to anatomical sites of the burn

| | Upper limbs | Lower limbs | Abdomen | p value within groups |
|---|---|---|---|---|
| Herbal ointment | 11.31±4.06 | 11.85±6.86 | 14.0±8.08 | 0.761 |
| SDD ointment | 18.83±6.94 | 17.07±5.71 | 14.4±3.64 | 0.452 |
| p value between groups | 0.025 | 0.085 | 0.712 | |

*Silver sulfadiazine ointment

**Table 5.** General appearance score (0-3) of the healing burn wounds in two groups

| Time | Herbal , Mean(SE) | SSD* ointment, Mean(SE) | Effect size (Cohen's d) | p value |
|---|---|---|---|---|
| 1st day | 1.44±0.57 | 1.28±0.73 | 0.25 | 0.372 |
| 4th day | 2.07±0.47 | 1.32±0.55 | 1.46 | <0.001 |
| 1st week | 2.62±0.56 | 1.76±0.77 | 1.28 | <0.001 |
| 2nd week | 2.81±0.40 | 2.16±0.68 | 1.17 | 0.001 |
| 3rd week | 2.92±0.38 | 2.18±0.61 | 1.27 | <0.001 |
| 4th week | 2.96±0.19 | 2.40±0.57 | 1.33 | <0.001 |
| p value (within groups) | <0.001 | <0.001 | | |

*Silver sulfadiazine ointment

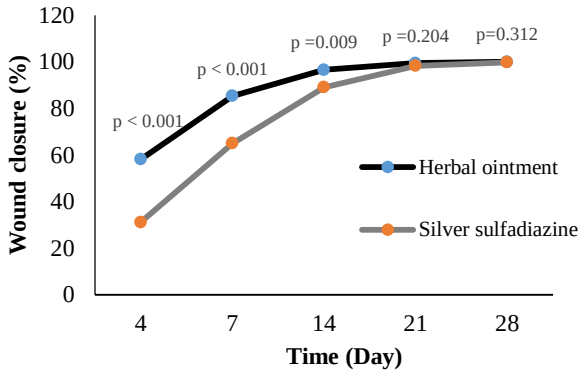


**Figure 2.** Comparison of intervention groups (herbal and silver sulfadiazine ointments) in terms of status of burn wound closure

According to the findings, the wound closure percentage was significantly higher in the herbal ointment group compared to the SSD group within the first two weeks after the intervention (p value<0.05). Passing the second week, the wound closure percentage in the herbal and SSD ointment groups was estimated 96.55±1.59 and 89.03±2.30, respectively (p value=0.0094). Figure 2 depicts the wound closure status in these groups.

The obtained results indicated no significant difference between the treatment groups in terms of the burn wound appearance based on a three-score indicator before the intervention. However, wound appearance improved in the herbal ointment group at any time during the intervention compared to the SSD ointment group (p value<0.001).

Table 5 shows the appearance of the burn wounds in the intervention groups based on the assessment time.

Figure 3 illustrates the appearance of the burn wounds in three patients in the herbal ointment group, and Figure 4 shows the wound appearance in two patients in the SSD ointment group.

In this section, complications of the interventions (including pain, burning, and itching sensation) following the use of the herbal and SSD ointments, were compared.

The itching scores (VAS-I) of the burn wound environments showed no significant difference after the first and second weeks between the two treatments (p value>0.05). The majority of the patients in the herbal ointment (n=23; 85%) and SSD ointment groups (n=22; 87%) had no itching in treatment site during the first week of the trial.

In the second week of the treatment with the herbal ointment, eight patients (30%) reported mild itching, four patients (14.8%) had moderate itching, one patient (3.7%) had very severe itching, but none of the patients had intolerable itching. Among the patients treated with the SSD ointment in the second week, eight cases (31%) reported mild itching, four cases (15.4%) had moderate itching, one case (3.8%) had severe itching, and none of the patients had very severe or intolerable itching. In addition, no itching was reported in the third and fourth weeks of the treatment in the herbal and SSD ointment groups.

The obtained results indicated no significant difference between the intervention groups regarding pain one, five, and 15 min after the use of the ointments as an indicator of intervention complications.

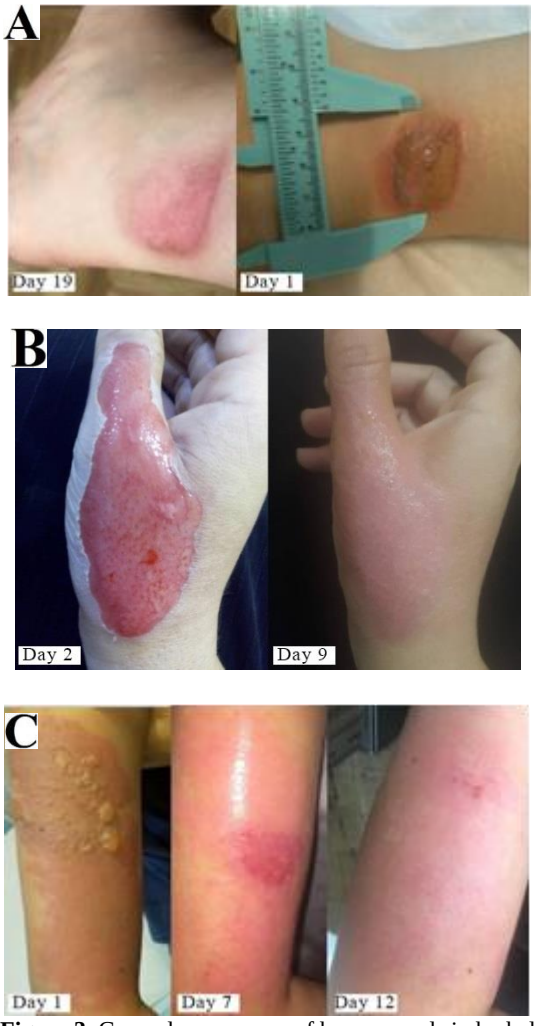


**Figure 3.** General appearance of burn wounds in herbal ointment group; A: a 21-years-old female with II/B degree burn in right lower limb; B: a 35-years-old female with II/B degree burn in right upper limb, C: a 42-years-old female with mixed (II/A and II/B) burn in right upper limb

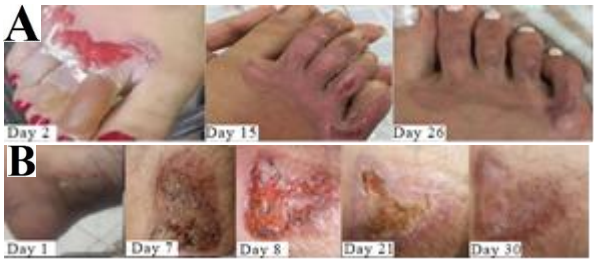


**Figure 4.** General appearance of burn wounds in SSD ointment group; A: a 29-years-old male with mixed (II/A and II/B) degree burn in right lower limb; B: a 31-years-old male with II/B

The results regarding pain intensity in the patients of the herbal and SSD ointment groups were assessed after the ointment application in 1, 5, and 15 min after dressing (figure 5).

In terms of burning one, five, and 15 min after the ointment use as an indicator of intervention complications, no significant difference was observed between the groups at the mentioned intervals (p value>0.05), with the exception of the 15-min interval on the first and seventh days. At these times, the burning level was significantly lower in the SSD group compared to herbal ointment group (p value<0.05) (figure 6) shows the obtained results regarding the burning severity of the patients in the herbal and SSD groups after the ointment use. Figure 5 shows the complication of the two interventions (including pain), and figure 6 depicts the complication of the interventions (including itching) after the application of the herbal and SSD ointments based on the assessment times.

Table 6 shows the risk of infection in the study groups. As is depicted, the risk of infection was observed in three patients in the herbal ointment group and four patients in the SSD ointment group only on the first and fourth days of the intervention, demonstrating no significant difference in this regard (p value>0.05). All participants had minor risk of infection, so the burn wounds did not become infected.

The side-effects of the interventions (erythema, edema, and infection) were assessed and recorded in the study groups at specific intervals (days 1, 4, 7, 14, 21, and 28). According to the findings, no side effects were reported at the end of study, and nobody was excluded from the study because of infection or any side effects such as allergic reaction.

**Table 6.** Risk of infection in two groups during trial

| Time | Herbal ointment No. of patients with risk of infection | SSD* ointment No. of patients with risk of infection | p value |
|---|---|---|---|
| 1 day | 2 | 3 | 0.699 |
| 4 day | 1 | 1 | >0.999 |
| 1 week | 0 | 0 | - |
| 2 week | 0 | 0 | - |
| 3 week | 0 | 0 | - |
| 4 week | 0 | 0 | - |

*Silver sulfadiazine ointment

The score of satisfaction with the treatment were determined using the VAS-S, which indicated moderate and high satisfaction of the majority of the patients of two groups (table 7).

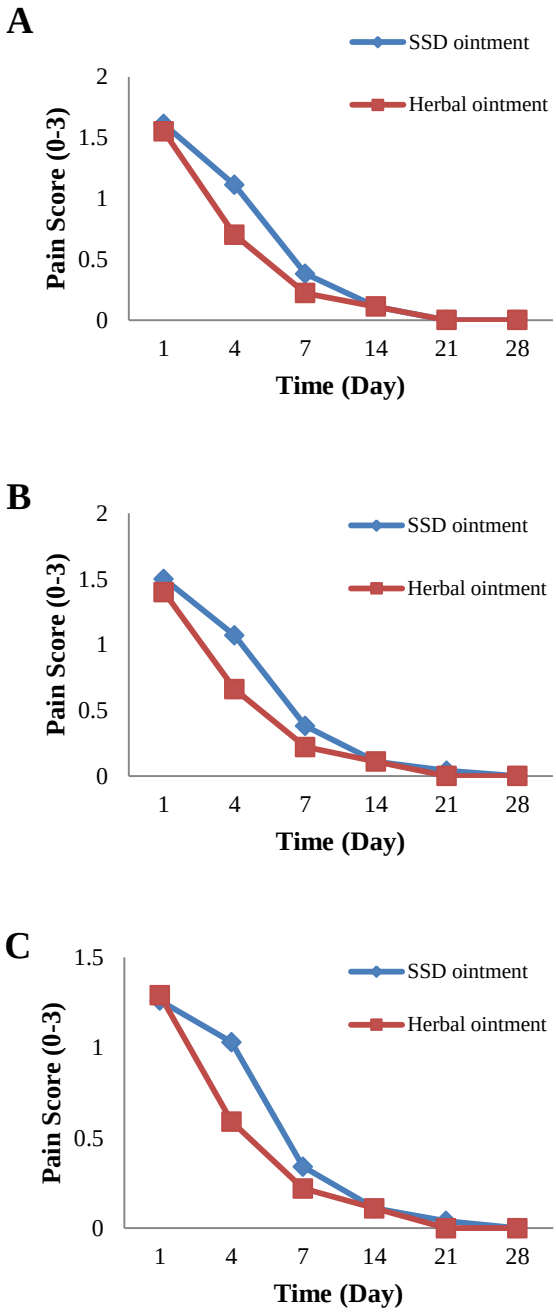


**Figure 5.** Pain score after application of herbal and SSD (silver sulfadiazine) ointments on burn wounds 1 (A), 5 (B), and 15 (C) min after dressing change on days 1, 4, 7, 14, 21, and 28 after burn treatment

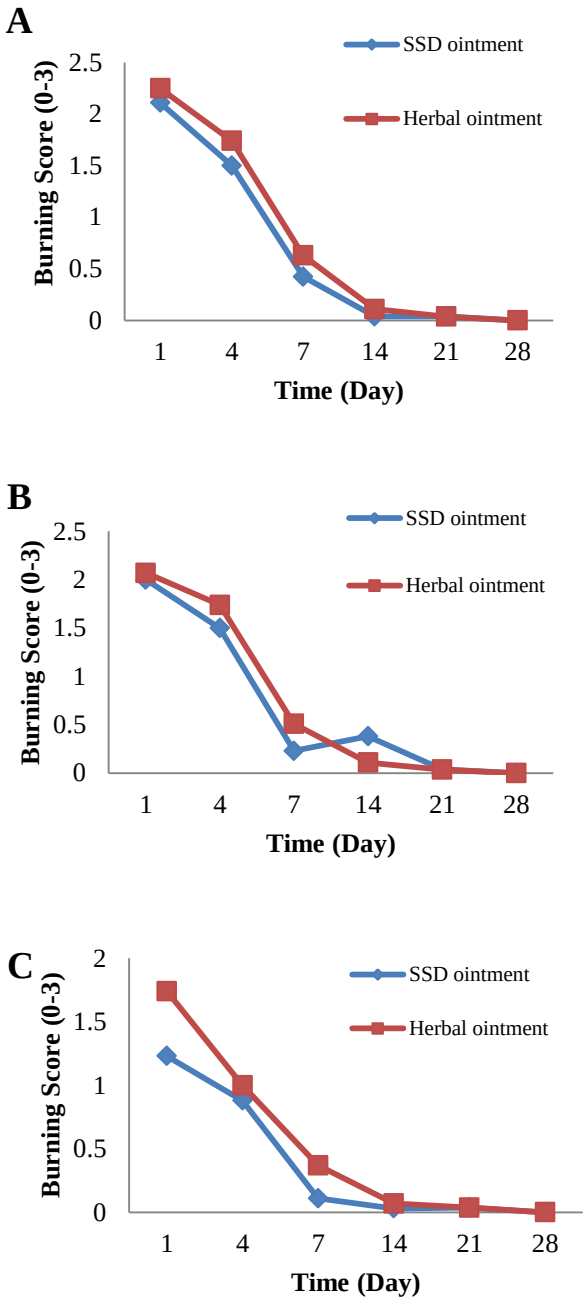


**Figure 6.** Burning score after application of herbal and SSD (silver sulfadiazine) ointments on burn wounds 1 (A), 5 (B), and 15 (C) min after dressing change on days 1, 4, 7, 14, 21, and 28 after burn tratment

This single-blind clinical trial was designed based on the similar research in this regard, such as the study by Nasiri et al. [8], to compare the effects of an herbal product derived from Iranian traditional medicine and SSD ointment.

Considering the complications reported in conventional medicines in the treatment of burns injuries (e.g., SSD) [18], there has been a tendency to shift to herbal medicines for burn wound healing, which have been employed in several studies to find alternative treatments [19].

**Table 7.** Satisfaction score of two groups after intervention

| Group | Herbal ointment N (%) | SSD* ointment N (%) |
|---|---|---|
| moderately satisfied | 2 (7.5) | 8 (30.8) |
| satisfied or good | 15 (55.5) | 12(46.2) |
| very satisfied or very good | 8 (29.6) | 5 (19.2) |
| excellent | 2 (7.4) | 1 (3.8) |
| P value between two groups | 0.176 | |

*Silver sulfadiazine ointment

The review of the literature in this regard indicated that most studies have been conducted on cellular and animal models, and few studies have been in the form of clinical trials [19,20] which highlights the superiority of the current research over the majority of the studies regarding the effects of herbal medicines on burn wound healing.

According to the results of the present study, the herbal ointment yielded more considerable results in terms of burn wound healing time, wound closure, and wound appearance compared to the SSD ointment. Correspondingly, the burn wounds of the patients in the herbal group were healed within a shorter period (5.22 days less than the other group; 31%) compared to the SSD group. The difference was clinically significant since it would reduce hospital costs and improve the outcomes of burn patients [8, 21].

Wound closure occurred earlier in the herbal ointment group compared to the SSD group, so that the wounds of most of the patients in the herbal group (85.37%) closed during the first week of the treatment, which was 23% higher compared to the similar timespan in the SSD group. Moreover, the burn wound appearance of the patients in the herbal group showed more suitable condition compared to the SSD group in all the burn degrees. Nonetheless, the difference in this regard was more evident in the mixed II/A and II/B burn degrees. In terms of the anatomical site of the burns, burn wounds in the upper extremities of the patients in the herbal group healed significantly faster (7.5 days less) compared to the SSD group. In this respect, our findings are in line with the results obtained by Nasiri et al., who compared the effects of an herbal ointment containing *Arnebia euchroma* with the SSD ointment. Similar to the present study, the wound healing time was significantly shorter in the herbal ointment group compared to the SSD group in the mentioned research. Nevertheless, the results obtained by Nasiri et al. were indicative of fewer complications in the herbal group compared to the SSD group [8]. However, in the present study, both intervention groups were almost homogenous in terms of the complications of the ointment use.

In the mentioned research, the patients in the herbal group were significantly more satisfied with their treatment compared to the SSD group [8] while in the current research, the patients in both groups showed similar satisfaction levels with the treatment regardless of the better effects of the herbal ointment compared to the SSD ointment. This might be due to the single-blind design of our study and lack of a former experience of using conventional medicines in the majority of the patients, which led to their inability to compare the effect of the intervention with another herbal ointment.

Some studies have denoted the superiority of herbal interventions over SSD ointments. For instance, Amilkanthwar and Mali performed a clinical trial, reporting that an herbal ointment containing *Manjishthasiddha ghrita* showed better effects on turning the burn site color into a normal color and reducing itching compared to SSD ointment [22,23]. Similarly, Khorasani et al. conducted a clinical trial, reporting an *Aloe vera* cream to be more effective in wound healing within a shorter period and improving re-epithelialization compared to the SSD group [24]. In another clinical trial by Shahzad et al., burn wounds were healed within a shorter period in the *Aloe vera* gel group compared to 1% silver sulfadiazine cream [25].

Several studies have confirmed the effectiveness of herbal ointment components (e.g., *Malva sylvestris*) in the healing of burn wounds [26,27]. In addition, studies focused on the effectiveness of *Rosa damascena* have confirmed the reduction of pain intensity after dressing change in burn patients [28]. *Solanum nigrum* has also been proposed in previous studies as an herbal medicine with the potential to heal wounds [29].

Regarding the mechanism of the effects of herbal ointments, Fahimi et al. reported the healing effects of the herbal ointment used in their research on burn wounds through the anti-inflammatory, antioxidant, and antimicrobial properties of the components of the herbal product, which contained *Rosa damascena*, *Malva sylvestris*, and *Solanum nigrum*. Accordingly, the effects were mostly associated with the presence of herbal compounds such as polyphenols and tannins as the main constituents

of the product [13]. Various studies have demonstrated the effects of herbs containing polyphenols (e.g., green tea and *Tragopogon graminifolius*) on the healing of burn wounds [30-33]. The published studies in this regard have also supported the positive effects of tannin-containing medicinal compounds on wound healing through antibacterial and angiogenic activities in burned tissues [34].

In the present study, no significant difference was observed between the herbal and SSD ointments in terms of the treatment complications (pain, itching, and burning sensations as indicators) after using the ointments at the intervals of one, five, and 15 min on six different days. Moreover, no side-effects were reported by the patients in the intervention groups; therefore, it could be claimed that the herbal ointment had no more complications than the conventional medicines used for burn healing (e.g., SSD).

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## Author contributions

Mehdi Alizadeh was responsible for recruiting, visiting and evaluating the participants. He was also involved in designing the study, and writing the manuscript; Mostafa Dahmardehei, burn specialist, was involved in the original design of the study and was responsible for evaluation of the burn wounds of the participants; Shirin Fahimi prepared the traditional herbal ointment; also, she gave valuable comments throughout the study and was involved in the original design of the research proposal. Sajjad Sadeghi was responsible for writing and revising the manuscript. He also suggested some substantial recommendation in writing of research proposal. Roshanak Mokaberinejad was supervisor of the research, and was involved in designing and coordinating the study as well as analyzing the data and drafting the manuscript.

## Declaration of interest

The authors declare that there is no conflict of interest. The authors alone are responsible for the accuracy and integrity of the paper content.

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## Abbreviations

SSD: silver sulfadiazine