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Effect of essential oil on hypertrophic scars

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A B S T R A C T

Background: Hypertrophic scars are abnormal scars resulted from a disrupted wound healing process. Hypertrophic scars can affect the body aesthetic of the sufferers, but, on the other hand, conventional therapy has not been optimally effective. The application of essential oil combinations as an alternative therapy for hypertrophic scars has not been scientifically proven.

Purposes: This study was to determine the effectiveness of the essential oil as a hypertrophic scar therapy.

Methods: This study used a pre and post-test design. As many as 24 subjects aged 17-25 years with hypertrophic scars were given essential oil combinations every morning and evening for six months. Assessment of hypertrophic scars was done using the POSAS (Patient and Observer Scar Assessment Scale).

Results: The results showed that the POSAS score decreased after the essential oil combination administration for six months, 14.40±6.08 vs. 22.67±8.31 ($p<0.001$).

Conclusion: the combination of essential oil oils used in this study reduces hypertrophic scars based on the POSAS assessment.

INTRODUCTION

Hypertrophic scars are abnormal scars resulted from disruption of the physiological wound healing process. A disturbance in the balance between fibroblast proliferation or collagen synthesis and its degradation process causes these hypertrophic scars. Each year in developing countries, 100 million sufferers are complaining about scars. About 55 million scar cases occur due to elective surgical wounds, and 25 million scar cases occur in trauma surgery. These hypertrophic scars could affect the body image of the sufferers.[1]

Current treatments of hypertrophic scars are, among others, intralesional corticosteroid injection, cryotherapy, and laser therapy. The effectiveness of these therapies varies widely, and several recurrences were found.[1,2] The development of alternative hypertrophic scar therapy is needed for patients, especially those experiencing recurrences with conventional treatment. Several alternative therapies for hypertrophic scars that have been proven are topical silicone gel sheeting (SGS), garlic extract, and several flavonoids, such as quercetin, which can inhibit fibroblast proliferation.[1,3,4]

Essential oils are currently widely used by society for treating several diseases, including skin diseases.[5] Essential oils could penetrate the skin and are distributed under the skin.[6] Essential oils are extracts from natural ingredients that are oil/lipid-based. The combination of Helichrysum italicum, lavender, lemongrass, patchouli, and myrrh is one of several essential oil combination ingredients believed as hypertrophic wound therapies. Based on previous research, these essential oils have antibacterial and antioxidant effects and fibroblasts and collagen. Helichrysum sp essential oil concentration of 0.01% can significantly inhibit the production of type I and III collagen. Patchouli essential oil concentration of 0.00033% has antiproliferative properties and inhibits the production of PAI-1 (plasminogen activator inhibitor 1).[7] Lemongrass essential oil can reduce biomarkers of type I and III collagen tissue remodeling and epidermal growth factor receptors.[8] Topical application of lavender oil on the wound results in decreased expression of type III collagen.[9] Myrrh oil can increase the proliferation of skin epithelial cells and increase collagen cross-linking.[10]

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However, there is no scientific evidence regarding the effectiveness of this combination as a hypertrophic scar therapy. Thus, this study is conducted to determine the effectiveness of the essential oil combination prescription in reducing hypertrophic scars.

METHOD

Study Design

This study design was a quasi-experimental study using pre and post-test design.

Settings and Respondents

The research was conducted during June-December 2019 at the Faculty of Medicine, and Health Sciences, Jambi University, Jambi. The inclusion criteria of research subjects were college students aged between 17 and 25 years and owning hypertrophic scars. Hypertrophic scars can be identified from their characteristics that are merely limited to the wound size.[3,4] The exclusion criteria were signs of allergies to the essential oil combination used in the study and underwent a conventional hypertrophic scar therapy, such as corticosteroid injection. The allergy test was carried out by applying the essential oil combination to the normal skin area and looked for signs of allergies, forms of redness, or itching. This study's research subjects were 24 people, eight men and 16 women (1 subject could have more than one hypertrophic scar)—sampling using a purposive sampling method. Every subject participating in this study had provided informed consent.

Experimental Procedure

The essential oil used was from a well-known essential oil brand in Indonesia. The essential oil combination consisted of 1.67% Helichrysum italicum, 1% lavender, 1.3% lemongrass, 0.6% patchouli, 0.83% myrrh, and up to 100% vegetable oil. The essential oil was packaged in a dark bottle with a roller tip for easy application. The research subjects were given a combination of essential oils on hypertrophic scar tissue for six months at a dose of two times a day, morning and night. The amount of essential oil that is applied is sufficient not to spill and cover all scar areas. Subjects were asked to write the signs when applying the essential oil combination in the morning and night.

The Variable, Instrument, and Measurement

The assessment of hypertrophic scars was carried out using the patient and observer scar assessment scale (POSAS scoring table) consisting of assessments from subjects and observer.[11] POSAS assessments were carried out before treatment (pre-test) and six months after treatment (post-test). The subject should give each a score from 1-10 to the pain, itching, color difference, stiffness, thickness, and irregularity of the scar. Meanwhile, the observer should give each a score from 1-10 to observe vascularity, pigmentation, thickness, relief, and pliability of scars. Score 1 refers to no complain, as normal skin. While score 10 refers to the worst scar imageable or very different as normal skin. Observer POSAS score is done by calculating the total score from each observation result of an observer. Adherence assessment was calculated by the percentage of usage frequency obtained daily.

Data Analysis

Data were presented as percentages and analyzed using the paired T-test with a significant level of $p<0.05$ as the data is normally distributed.

Ethical Consideration

This research received ethical approval from the Faculty of Medicine and Health Sciences, the University of Jambi, under decree number B/635/UN.21.8/PT.01.04/2019.

RESULTS

The characteristics of the research subjects are presented in Table 1. Of the 24 subjects, most were female and aged 20 years. Out of a total of 37 scars suffered by all subjects, the scarring mainly occurred in the knee (37,8%), which was caused by trauma (54%), with a time-varying from 7-204 months.

Table 1. Characteristics of Subjects with Hypertrophic Scars (n=24) (n=24)

Characteristic	Result
Age (mean, min-max), years	20 (18-22)
Gender	
Male	8 (33.3%)
Female	16 (66.7%)
Hypertrophic scar location	
Thigh	1 (2.7)*
Calf	1 (2.7)*
Instep	1 (2.7)*
Knee	14 (37.8)*
Upper arm	1 (2.7)*
Forearm	2 (5.4)*
Back of the hand	3 (8.1)*
Ankle	2 (5.4)*
Toes	1 (2.7)*
Wrist	2 (5.4)*
Fingers	2 (5.4)*
Ankle	4 (10.8)
Stomach	2 (5.4)*
Chest	1 (2.7)*
Cause of scar	
Surgical wound	11 (29.7)*
Burns	2 (5.4)*
Torn from trauma	20 (54)*
Chemical trauma	1 (2.7)*
Scratching trauma	2 (5.4)*
Smallpox marks	1 (2.7)*
Scar onset (in months) median (min-max)	60 (7-204)

* percentage of 37 hypertrophic scars

The mean POSAS score according to subjects' assessment before (pre) the essential oil combination administration was 22.67±8.31, while the score after (post) the essential oil combination was 14.40±6.08 ($p<0.001$). According to the observers' assessment, the total mean score of observations before the essential oil combination administration was 20.19±6.6, and the score after the essential oil combination administration was 13.13±4.08 ($p<0.001$). There was a significant decrease in the POSAS score before and after the essential oil combination administration based on the assessment of the subjects and observers (Figure 1).

The mean percentage of compliance in applying essential oil is 73.80% (Mode is 80%; minimum 20%; maximum 95%). The compliance sheet observations revealed that the subjects used the essential oil once a day and skipped the morning or evening schedule. Changes in the hypertrophic scars before and after essential oil administration can be seen in Figure 2.

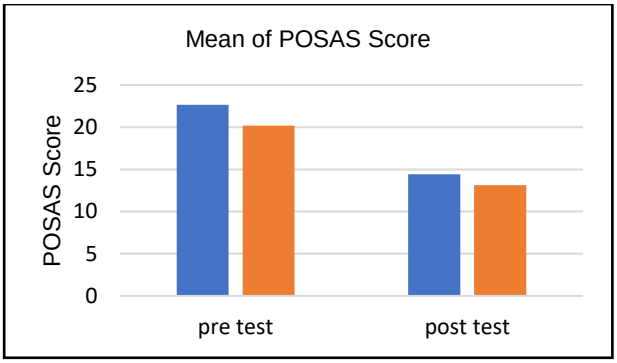

Figure 1. POSAS scores before and after six months of treatment based on the assessment of subjects (blue) and observers (orange)

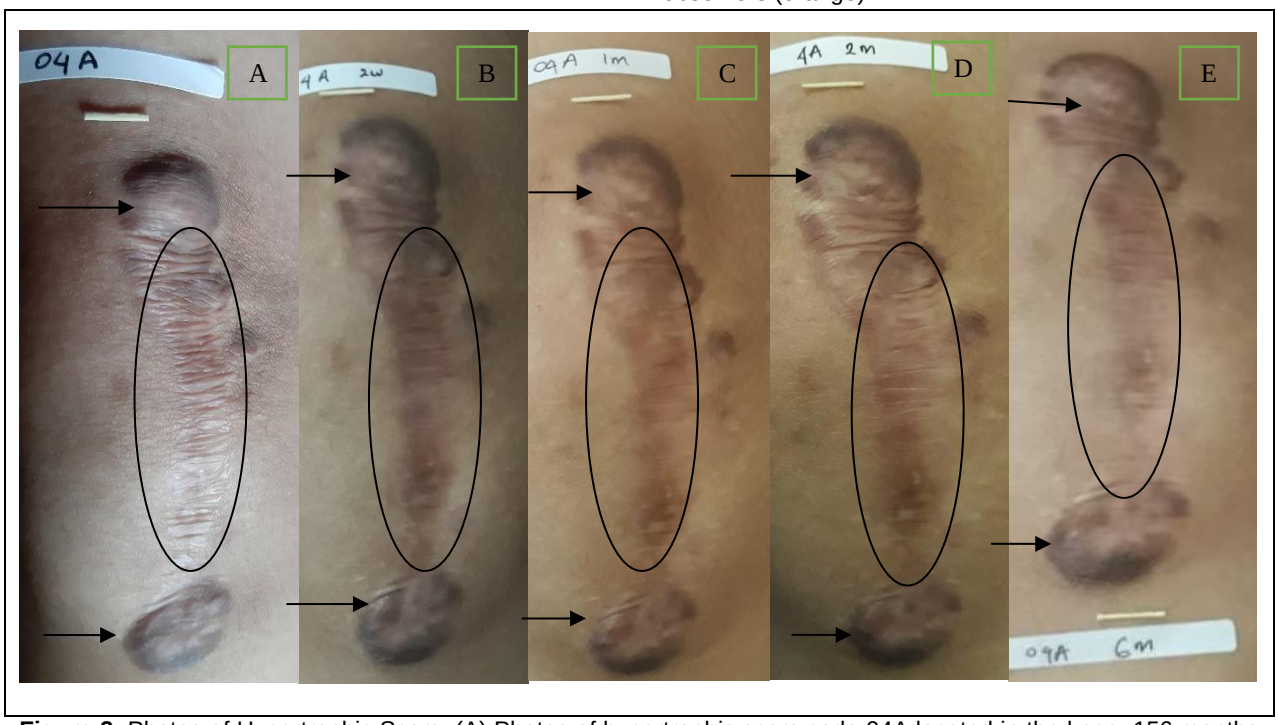

Figure 2. Photos of Hypertrophic Scars. (A) Photos of hypertrophic scars code 04A located in the knee, 156 months onset, before essential oil combination administration. The hypertrophic scar code 04A has a subject's total POSAS score of 47 and a observer's total POSAS score of 29. B, C, D, and E are photos of hypertrophic scars after two weeks, one month, two months, and six months after oil application, respectively. The percentage of application adherence is 95%. Hypertrophic scars thinning appears as indicated by arrows. The subject's total POSAS score decreases to 25, and the observers' total POSAS score decreases to 15. Both subjects and observers noticed the changes in color, size, and elasticity of the hypertrophic scars. The subject did not feel pain or itching after the essential oil combination administration.

DISCUSSION

Hypertrophic scars are abnormal scars that arise due to irregularities in the physiological wound healing process.[3,4] Hypertrophic scars can be identified from their characteristics that are merely limited to the wound size and usually occur 4-8 weeks after trauma. Hypertrophic scars can be caused by irritations or deep wounds that reach the dermis.[12] The deep wound stimulates skin fibroblasts to produce collagen and inflammatory mediators, such as transforming growth factor-beta 1 (TGF-beta1).[13,14]

A balance disorder between deposition and degradation of extracellular matrix proteins causes the emergence of ab-

normal scarring. Hypertrophic scars are caused by increased fibroblast proliferative capacity and or fibroblast apoptotic resistance. There are mutations in exon 7 of fibroblasts. Also, a dysregulation transforming growth factor β (TGF-β), which is the main stimulator in collagen production, overexpression of TGF- β will cause hypertrophic scars. Disturbances in the inflammatory phase can also cause abnormal scars. Cytokines, such as IL-4, IL-5, IL-10, and IL-13, are known to be involved in forming abnormal scars.[3,4]

The best therapy of hypertrophic scar is prevention by influencing the signaling processes in cells involved in the excessive proliferation of fibroblasts and collagen, reducing inflammation, skin tension, and strain.[15,16] Type I or III collagen reduction is one of the therapeutic targets in hypertrophic scars.[17] For hypertrophic scar, available treatment options are pressure dressings, laser resurfacing, topical or intralesional agents. One of intralesional agent is corticosteroids. Corticosteroids can inhibit fibroblast growth, promote collagen degradation, inhibit TGF-beta 1 expression and induce apoptosis in fibroblasts.[15] Some essential oils can affect the wound healing process involved in scar tissue formation.

In this study, The statistical results of the POSAS score at post-therapy with essential oil were significantly lower than that before therapy. This decrease in mean POSAS score implies that the combination of essential oils works synergistically to reduce hypertrophic scars. This is consistent with research conducted by Puri and Talwar (2009), where the application of silicone gel which has been widely used as a hypertrophic scar therapy, has been proven effective in reducing rather than eliminating hypertrophic scars.[18] At two weeks of use, the study subjects began to feel changes. The subjects who initially felt pain in the scar tissue area when obtaining pressure became less of pain. Based on the photos, after two months of use, there were no remarkable changes. The application was continued for six months to see the possibility of a delayed effect considering the relatively long age of hypertrophic scars among the study subjects. After six months of administration, scar tissue was only reduced and could not disappear completely.

A combination of these essential oils has anti-inflammatory activities, fibroblast, and collagen reduction. Some studies showed that helichrysum essential oil and lemongrass inhibited type I and III collagen production. Lemongrass essential oil, lavender, and patchouli also have anti-proliferative activity on skin fibroblast cells.[7,8] Lavender oil is known to have a linalyl acetate component, which is cytotoxic to fibroblasts and endothelial cells, reducing scarring.[19,20] Helichrysum italicum, patchouli, lemongrass, and lavender have anti-inflammatory activities.[7,8,21-23] Meanwhile, Myrrh essential oil has antibacterial activities.[10] Antibacterial and Anti-inflammatory activities can prevent excessive inflammatory responses that can interfere with the normal wound healing process lead to hypertrophic scar formation.[3,4,15]

Hypertrophic scars in the subjects of this study were scars occurring a long time ago. The essential oil may work by influencing the factors involved in the degradation of mature collagen. The age of hypertrophic scars may affect the effectiveness of these essential oils. Based on the studies that have been mentioned above, these essential oil has anti-proliferative fibroblast and collagen, and only lavender has a cytotoxic effect on fibroblast. As is known, fibroblast proliferation occurs during the proliferation phase of the wound healing process on days 7-14.[3,4] herefore, it is likely that the earlier timing of this oil in the event of injury will likely lead to a more effective reduction of scar tissue. Further research needs to be carried out on subjects with early hypertrophic scars or even when the injury occurs in individuals who possibly develop abnormal scarring.

Other studies have shown different results regarding the use of essential oils for wounds and scarring. The 85% methanol extract of Helichrysum graveolens has anti-hyaluronidase and anti-collagenase activities.[21] Hyaluronidase and collagenase degrade the excessive extracellular matrix. Patchouli extract is known to reduce MMP1 and MMP3 expression.[22,23] MMP is an enzyme that functions in the degradation of the extracellular matrix. The lavender extract can accelerate epithelialization and increase FGF2 (fibroblast growth factor-2)[19], upregulation of TGF-β expression, increased synthesis of type I and III collagen at the beginning of the phase, and replacement type III collagen to type I at a later stage and fibroblast differentiation.[9] The examination of Myrrh extract on fibroblasts showed that the extract increased fibroblast proliferation, accelerated fibroblast cell cycle, and upregulated type III but not type I collagen mRNA expression.[24] A study has shown that myrrh extract inhibited collagenase MMP1 and anti-tyrosinase activity and had no effect on type I of procollagen.[25] The working mechanism of this combination oil on hypertrophic scars needs further investigation.

Limitation in this study, assessing the volume and size of the scar that is more objective and can be compared quantitatively was not performed due to limited tools. Also, there was no control group in this study. The effect of essential oil combination on hypertrophic scars was assessed using the POSAS score. POSAS is a scar tissue assessment involving both the patient and the observer. Several studies have shown that POSAS is reliable and valid.[26] However, POSAS assessments are semi-qualitative.[27] The relatively long duration of the study that can affect the compliance on applying the essential oils is also a weakness of this study.

CONCLUSIONS AND RECOMMENDATION

Administration of a combination of Helichrysum, lavender, lemongrass, patchouli, and myrrh essential oils for six months can reduce but cannot remove the long-formed scar tissue. This study was unable to assess the mechanism of essential oil combinations in reducing scars. This study was also unable to evaluate the active substances that primarily contribute to reducing hypertrophic scars. Further research is needed to determine the mechanism pathways and active substances in the essential oil combinations on hypertrophic scars.

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