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# Comparison of corticosteroid injections and conservative treatments for heel spurs

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## Abstract

**Background** Managing heel spurs presents challenges due to multiple treatment options and varying patient satisfaction. This study was conducted to compare the results of heel spur treatment with corticosteroid injections and conservative treatments in patients with heel spurs.

**Methods** This retrospective cohort study was conducted using convenience sampling on seventy patients with heel spurs in 2022. Among them, forty-four patients were in the treatment group, receiving local corticosteroid injections, and twenty-six patients were in the conservative treatment group. Data were collected using a checklist and analyzed using SPSS-26 statistical software. Both descriptive and inferential statistics were applied, with a significance level set at less than 0.05.

**Results** The average age of patients with heel spurs was 43 ± 11.2 years. 88.6% of patients were female. Among forty-four individuals receiving corticosteroid injections, 18 (40.9%) experienced favorable outcomes. out of the twenty-six individuals undergoing conservative treatment, 8 (30.8%) also had favorable outcomes. No statistically significant difference was found between the two treatment approaches ($P > 0.05$). Among the sixty-two women studied, twenty-six experienced positive outcomes; 18 (69.2%) underwent corticosteroid injections, while 8 (30.8%) received conservative treatment. None of the men examined showed any impact from the treatment and expressed dissatisfaction with it. Statistically, a significant association exists between the treatment results of the two groups studied and the gender of patients with heel spurs ($P < 0.05$).

**Conclusion** The results highlight the importance of considering demographic factors, particularly gender, when selecting treatment strategies for heel spurs. Both corticosteroid injections and conservative treatments were effective in treating heel spurs; however, corticosteroid injections are recommended as the preferred option due to higher patient satisfaction. Longer follow-up periods are needed to confirm these findings and explore additional variables that may influence treatment efficacy.

**Trial registration** Not applicable.

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**Keywords** Orthopedics, Treatment, Corticosteroid, Injection, Conservative treatments, Patient, Heel Spurs

## Introduction

A heel spur is a bony outgrowth that affects approximately 10% of the general population, often coexisting with plantar fasciitis and impacting daily activities [1]. A heel spur is a bony outgrowth that develops beneath the heel bone [2]. Repeated stress on the plantar fascia transmits pressure to its attachment point on the heel bone, contributing to spur formation. This repetitive tension and pressure lead to the formation of a bone spur in the heel bone, known as a heel spur. Even without a visible heel spur, inflammation of the plantar fascia can cause all symptoms experienced by the patient [3]. While some individuals may have heel spurs without symptoms, most experience heel pain due to inflammation and stretching of the plantar fasciitis in the sole, rather than the presence of the bony outgrowth [4]. A heel spur is detectable in plain radiograph images, while plantar fasciitis remains invisible in these images but can be observed in ultrasound images of the foot's soft tissue [5]. Heel spurs are typically not operated on, and surgery is uncommon. In rare cases and under specific conditions, skilled orthopedic surgeons may perform surgery to release the heel spur and fascia [6]. The treatment program aims to reduce inflammation in the soft tissue connected to the heel to restore normal foot function and condition. Each patient's treatment plan is tailored to their individual condition and may involve a combination of various methods [7]. Conservative treatments, such as stretching exercises, orthotics, physical therapy, and nonsteroidal anti-inflammatory drugs (NSAIDs), are widely recommended as first-line interventions [8]. Corticosteroid injections, known for their potent anti-inflammatory effects, are also frequently used to alleviate pain and inflammation in patients who do not respond adequately to conservative measures. Despite the widespread use of these treatments, the comparative effectiveness of corticosteroid injections versus conservative therapies remains a topic of ongoing debate in clinical practice [9, 10].

While corticosteroid injections and conservative treatments are commonly employed, there is no consensus on which approach yields superior outcomes in pain relief, functional improvement, and long-term recovery. Existing studies have produced inconsistent results, with some indicating that corticosteroid injections provide rapid but short-term relief, while others emphasize the sustained benefits of conservative therapies [8, 11]. Additionally, the potential risks associated with corticosteroid injections, such as fat pad atrophy or plantar fascia rupture, raise concerns about their safety compared to non-invasive methods [12, 13]. This gap in knowledge highlights the need for a comprehensive comparison to guide clinicians in selecting the most effective and safe treatment strategy for patients with heel spurs. The primary objective of this study is to compare the outcomes of heel spur treatment using corticosteroid injections versus conservative therapies. By evaluating treatment efficacy, we aim to provide evidence-based insights that can inform clinical decision-making. Through a clear comparison of these two treatment modalities, this study ultimately seeks to contribute to improved patient care and optimized therapeutic strategies for heel spurs.

## Materials and methods

This retrospective cohort study was conducted in 2022 using a census method of 70 patients with heel spurs who were referred to the orthopedic clinic of Imam Khomeini Hospital in Jiroft, Iran. The inclusion criteria were: consent to participate in the study, a definitive diagnosis of heel spurs through radiographic imaging or plantar fasciitis via ultrasound examination, and the final opinion of an orthopedic specialist, the average duration of disease symptoms is 6 to 12 months before medical intervention, having a medical record at Orthopedic Clinic, and regular follow-up visits to the orthopedic clinic after treatment [2, 14, 15]. The exclusion criteria included incomplete medical records, pregnant individuals, Patients with any history of traumatic heel injuries such as fractures or Achilles tendon ruptures, Those with systemic disorders known to impair healing processes, including uncontrolled diabetes with neuropathy or rheumatoid arthritis, previous heel surgeries or corticosteroid injections within the preceding six months, incomplete medical documentation, failure to complete required follow-up visits, and unwillingness to continue participation in the study.

In this study, the researchers did not perform any interventions related to the research process on the patients. Instead, they only evaluated the treatment outcomes of patients referred to the orthopedic clinic. Based on the type of treatment, 44 patients were assigned to the corticosteroid injection group (methylprednisolone), and 26 patients were placed in the conservative treatment group (rest, use of medical heel insoles, and NSAIDs (naproxen 500 mg BID) [14]). In this study, the corticosteroid injection protocol involved administering methylprednisolone acetate (40 mg/mL) mixed with 1% lidocaine [2, 16] for local anesthesia to patients with heel spurs. The injection site was determined by identifying the point of maximum tenderness, typically at the insertion of the plantar fascia on the calcaneus. The area was sterilized with an antiseptic solution, and a 25–27-gauge needle was inserted at a 45–90° angle to deliver 1–2 mL of the corticosteroid-lidocaine mixture. Post-injection,

**Table 1** Distribution of demographic variables among patients with heel Spurs

| Variables | | Frequency | Percent |
|---|---|---|---|
| Age | 20–30 | 5 | 7.1 |
| | 30–40 | 18 | 25.7 |
| | 40–50 | 30 | 42.8 |
| | 50–60 | 7 | 10 |
| | 60–70 | 10 | 14.4 |
| Gender | Men | 8 | 11.4 |
| | Women | 62 | 88.6 |

**Table 2** BMI analysis and treatment groups of patients with heel Spurs

| Variables | Frequency | Percent | Mean | Standard Deviation |
|---|---|---|---|---|
| **BMI (kg/m²)** | | | 28.5 | 3.8 |
| 18.5–25 | 10 | 14.2 | | |
| 25–30 | 34 | 48.5 | | |
| > 30 | 26 | 37.3 | | |
| **Treatment Groups** | | | | |
| Corticosteroid Injection | 44 | 62.9 | | |
| Conservative Treatments | 26 | 37.1 | | |

patients were advised to avoid direct pressure on the heel for 24–48 h, apply cold compresses to reduce swelling. Follow-up evaluations were conducted at one- and six months post-injection to assess pain relief, functional improvement, and any adverse effects. Pain severity was evaluated during follow-up visits using a 10-point Visual Analog Scale (VAS), where 0 indicated no pain and 10 represented the worst imaginable pain, consistent with prior heel spur research. The VAS is widely validated for heel pain assessment [17–19]. Written informed consent was obtained from all patients, and they were thoroughly informed about the potential risks and benefits of the procedure. This standardized protocol ensured consistent and safe administration of corticosteroid injections as part of the treatment comparison.

Data were collected using a checklist completed by the researchers during patient interviews. The checklist consisted of two parts: the first part included questions related to demographic information such as age, gender, and BMI, while the second part focused on treatment outcomes. The questions in the second part were: (1) the patient's preference for corticosteroid injection or conservative treatments, and (2) the treatment outcome based on the orthopedic specialist's opinion. The researchers followed up with the patients by contacting them and scheduling two additional visits to the orthopedic clinic—one month and six months after the initial visit. During these follow-ups, the patients were interviewed again, and the checklist questions were completed.

The collected data were analyzed using SPSS version 26 statistical software. Frequency distribution tables, mean, and standard deviation were used to describe the data. Inferential statistical tests, such as the independent samples t-test and the chi-square test, were conducted to address the research questions. A significance level of less than 0.05 was considered statistically significant for all tests.

## Results

Table 1 illustrates the demographic characteristics of patients with heel spurs. The mean age of patients was 43 ± 11.2 years, with the highest occurrence in the 40 to 50 age group (42.8%) and the lowest in the 20 to 30 age group (10%). It is noted that 88.6% of patients with heel spurs were female.

Table 2 present data on the Body Mass Index (BMI) and treatment groups of patients with heel spurs. The average BMI of the affected individuals was 28.5 ± 3.8 kg/m². The most common BMI range among these patients was 25 to 30 kg/m² (48.5%), while the least common range was 18.5 to 25 kg/m² (14.2%). Out of the 70 patients evaluated, 44 (62.9%) received corticosteroid injections, and 26 (37.1%) underwent conservative treatments.

Table 3 displays data on the preference for corticosteroid injection versus conservative treatments in heel spurs. The findings reveal that among the 44 patients who received corticosteroid injections, 18 (40.9%) had favorable outcomes. Of the 26 patients in the conservative treatment group, 8 (30.8%) also experienced favorable results. Notably, there is no statistically significant correlation between the outcomes of the two treatment approaches (P_value > 0.05).

Table 4 present data on the correlation between treatment outcomes and patient demographics (age, gender, and BMI) in individuals with heel spurs. Among the 18 patients aged 30–40, 8 experienced positive outcomes, with 50% receiving corticosteroid injections and 50% undergoing conservative treatment. In the 40–50 age group (30 patients), 14 had favorable outcomes, with 71.4% receiving corticosteroid injections and 28.6% opting for conservative treatment. No significant

**Table 3** Assessment of the preference for corticosteroid injection over Conservative treatments in heel Spurs

| Variables | | Corticosteroid injection | | Conservative treatments | | P_Value |
|---|---|---|---|---|---|---|
| | | Frequency | Percent | Frequency | Percent | |
| Result Optimal | Yes | 18 | 40.9 | 8 | 30.8 | 0.451 |
| | No | 26 | 59.1 | 18 | 69.2 | |

**Table 4** Correlation between treatment outcomes and patient demographics (Age, gender, BMI)

| Variables | Favorable Outcomes | | Unfavorable Outcomes | | P-Value |
|---|---|---|---|---|---|
| | Corticosteroid Injection | Conservative Treatments | Corticosteroid Injection | Conservative Treatments | |
| **Age** | | | | | 0.183 |
| 20–30 | 0 | 0 | 6 (100%) | 0 | |
| 30–40 | 4 (50%) | 4 (50%) | 8 (80%) | 2 (20%) | |
| 40–50 | 10 (71.4%) | 4 (28.6%) | 6 (37.5%) | 10 (62.5%) | |
| 50–60 | 0 | 0 | 6 (100%) | 0 | |
| 60–70 | 4 (100%) | 0 | 0 | 6 (100%) | |
| **Gender** | | | | | 0.022 |
| Men | 0 | 0 | 8 (100%) | 0 | |
| Women | 18 (69.2%) | 8 (30.8%) | 18 (50%) | 18 (50%) | |
| **BMI (kg/m²)** | | | | | 0.785 |
| 18.5–25 | 2 (100%) | 0 | 6 (75%) | 2 (25%) | |
| 25–30 | 12 (75%) | 4 (25%) | 10 (55.5%) | 8 (44.5%) | |
| > 30 | 4 (50%) | 4 (50%) | 10 (55.5%) | 8 (44.5%) | |

association was found between treatment outcomes and age (P-Value > 0.05). Regarding gender, among 62 women, 26 had positive outcomes, with 69.2% receiving corticosteroid injections and 30.8% undergoing conservative treatment. None of the men experienced favorable outcomes, and a significant association was observed between treatment outcomes and gender (P-Value < 0.05). In terms of BMI, in the 18.5–25 kg/m² group (10 patients), 2 had positive outcomes, with all 2 (100%) receiving corticosteroid injections. In the 25–30 kg/m² group (34 patients), 16 had positive outcomes, with 75% receiving corticosteroid injections and 25% opting for conservative treatment. In the > 30 kg/m² group (26 patients), 8 had positive outcomes, with 50% receiving corticosteroid injections and 50% choosing conservative treatment. No significant relationship was found between treatment outcomes and BMI (P-Value > 0.05).

## Discussion

This study was conducted to compare the results of heel spur treatment with corticosteroid injections and conservative treatments in patients with heel spurs. The results of the present study showed that the majority of patients with heel spurs were women in the age range of 30 to 50 years, which was by most of the available articles, for example, in the study of Lapidus and Guidotti, 76% of patients were between the ages of 40 and 70 years. were located [20]. In the study of Karbasi and banadaki, the average age of patients with heel spurs was 42 years, with an age range of 28 to 65 years [21]. A study in 2014 showed that heel spurs are more common in older women and men [22]. Aging, reduced body water (especially in the plantar fascia), decreased tissue elasticity, arthritic changes, and repetitive stress leading to microtears at the heel bone junction are contributing factors to heel pain. Prolonged standing and obesity, particularly in women, increase the risk of developing heel spurs [23]. These findings highlight gender and age as significant risk factors for heel spurs.

In Fakharian and Kalher's study, the number of women with painful heels was 2.74 times that of men [24]. While most studies suggest that heel spurs are more common in women [25, 26], some sources, such as Campbell's Orthopedic Textbook, report a higher prevalence in men [27, 28]. Contompasis stated that the heel spur is caused by the inward protrusion of the heel bone as a result of inflammation and shortening of the sole, which increases mostly in women due to prolonged standing or obesity [29]. women and obese people are more prone to developing heel spurs and wearing ill-fitting shoes can irritate the heel spur and increase inflammation [30, 31]. Also, the results of other studies show that high weight, sudden weight gain, and age are among the underlying factors of this disease, and added that women are more exposed to heel spurs, and this disease is seen more in women than in men [32, 33].

The results showed that the prevalence of heel spurs was higher in people with high weight. Snook and Chrisman found that half of heel pain patients were overweight [34]. In the Karbasi and banadaki study, it was found that 70% of patients with heel spurs are overweight in terms of obesity [21]. Singh et al. reported a significant relationship between BMI and the prevalence of heel spurs [35]. Researchers have found that heel spurs are also associated with obesity [36, 37]. High weight, long runs, uncomfortable shoes and hard shoe soles, frequent and long-standing motionless, flat soles or shallow feet or the presence of other abnormalities in the feet, the tissue under the heel not being soft enough, especially in people Due to the loss of foot fat, frequent pressure on the foot, foot injury, and diabetes are the causes of heel spurs in the elderly. This finding underscores the importance of weight management and obesity prevention in managing and preventing heel spurs.

The results showed that corticosteroid injection had better results than conservative treatments in heel spurs. According to the research, corticosteroid injection is more effective than other medical treatments, however, after 36 months of cortisone injection, its effect is completely lost [38]. This finding suggests that corticosteroid injections can be an effective short-term treatment option, but for long-term results, they should be combined with other therapies such as stretching exercises and weight management.

In the study of Crawford and his colleagues, the short-term effect of corticosteroid injection in the patient group was compared with local anesthetic in the treatment of heel spurs in the control group. In addition, the effect of anesthesia was also investigated. The study was conducted on 106 patients and the results were evaluated with the help of VAS at intervals of 1, 3, and 6 months. The results of the study were that corticosteroid injection reduces pain in the short term, but heel anesthesia before injection has no effect on the treatment [38]. In another study published in 2007, asteroid injection and iontophoresis with asteroids were considered effective in the treatment of plantar fasciitis in the short term [39]. In a study conducted by Stahl et al., who examined steroid injection in epicondylitis, there was a significant reduction in the pain intensity of patients six weeks after injection, but pain recurrence was reported after three months to one year [40]. In the meantime, some studies have shown the beneficial effects of corticosteroid injection in the long term, which can be referred to a study in Turkey that showed the beneficial effects of corticosteroid injection up to one year after injection by ultrasound [41]. In a systematic review to compare medical shoes and corticosteroid injections in the treatment of plantar fasciitis, it was shown that the effects of corticosteroids are short-term, but besides reducing pain, medical shoes are more effective than corticosteroids in improving performance, as well as the pain caused by injections. Reduces the acceptability of corticosteroids [42]. In another study, where 60 patients were treated with shockwave and corticosteroid injection in two groups, it was shown that both treatments were effective in improving symptoms, but no significant difference was observed between them, and because of the lower cost, corticosteroids were recognized as the preferred treatment. became [43]. In a study conducted by Porter et al., 132 patients were divided into two groups treated with a shock wave and corticosteroid injection. The pain was evaluated on the VAS scale and the tenderness of the algometer, and the results were recorded 3 and 12 months after the start of the intervention and showed that the reduction of pain in the corticosteroid injection group was higher and also the reduction of tenderness in the heel area in the local injection group during three months after treatment was higher than loe Energy E.S.W.T [44]. In the study by Frater et al., the results showed that out of 24 patients, 8 of whom had bilateral involvement, after the injection, the pain was completely or almost completely gone in 20 legs, the other 12 legs were the ones that had a short recovery. They had a period of 4 to 5 weeks or did not recover at all [45]. But in a study conducted by Benedit et al. in the United States, 101 patients with heel spurs with an average age of 46 years were examined, these researchers stated that the majority of patients completed the exercise techniques with satisfaction and only A small number will require other treatment methods [46]. Also, Benedict and his colleagues in another study in the United States designed a clinical trial study with a two-year follow-up of 66 patients to investigate two different exercise methods in the treatment of heel spurs. These researchers reported that the methods during which the Achilles tendon is stretched are more effective than other treatment methods. The results of this study showed that 92% of all patients were satisfied with their treatment method and 77% of them had no problems or limitations in performing stretching techniques. These researchers concluded that the stretching of the plantar sheath is a much more effective and less expensive method compared to other treatment methods. A corticosteroid injection can have complications such as skin depigmentation, infection, atrophy of the fat layer of the heel, or even rupture of the plantar fascia [47]. Indian physicians reported a case where the patient developed central serous chorioretinopathy (a rare ocular complication of steroid therapy) after a topical injection of triamcinolone to treat plantar fasciitis [48]. Some studies have shown that cortisone injections may weaken tendons and cartilage. This is why many doctors do not recommend cortisone injections more than 3 times a year. A cortisone injection is an effective method and a good treatment option. However, this method may be overused or, in some cases, cortisone injections may not be a suitable treatment option. Injections should only be used to treat inflammation; Not to treat pain. Also, the number of injections should be limited, especially in young people with healthy joints and tendons that may be damaged by repeated injections [49].

## Conclusion

Results demonstrated that both local corticosteroid injections and conservative treatments are effective in managing heel spur symptoms. so, both methods can be considered viable options for patients. Also, the findings showed a significant association between treatment outcomes and patient gender. Women were more likely to experience positive outcomes with both treatment methods, whereas male patients reported lower satisfaction overall. This underscores the importance of considering

gender as a factor in treatment decisions for heel spur patients. Corticosteroid injections are recommended as the preferred option due to higher patient satisfaction. However, orthopedic specialists may offer both treatment approaches based on individual patient preferences and needs. Further research into gender-related differences in treatment outcomes could help develop more targeted and effective therapies, particularly for male patients. Adopting a patient-centered approach that considers individual characteristics can enhance care and improve outcomes for individuals with heel spurs.

#### Limitations of the study

Limitations of this study include the small sample size and the limited number of patients in both groups. These factors can limit the study and potentially increase statistical analysis errors. It is suggested that future studies include a larger number of patients to compare two treatment options - corticosteroid injection and conservative treatment - so that results can be more effectively compared. Another limitation of the study was the unavailability of standardized questionnaires for evaluating the effectiveness of the implemented treatments on patients. Consequently, the investigators were compelled to utilize a researcher-developed checklist. We recommend that future studies employ validated questionnaires to assess treatment efficacy in patients. This study included only eight male participants, resulting in an imbalanced gender distribution that represents a significant limitation. Future research should prioritize achieving more representative gender ratios in study population. Another significant limitation of this study is the failure to assess the long-term and sustained effects of corticosteroids in the months and years following the injection of these drugs. Therefore, other researchers are advised to consider this assessment in future studies. Additionally, this study was conducted at Jiroft University of Medical Sciences and included patients referred to Imam Khomeini Hospital (RA) in Jiroft. Therefore, caution should be taken when generalizing the findings.

### Confounders in the study

The study had several potential confounding factors that may have influenced the treatment outcomes. The gender imbalance with predominantly female participants could have affected results due to biological and biomechanical differences. The age distribution skewed toward middle-aged patients may have introduced bias as healing capacity varies with age. Variations in BMI and obesity levels could have impacted treatment response due to differing mechanical loads on the plantar fascia. Prior treatments and adherence to conservative therapies were not accounted for, potentially affecting outcome comparisons. Injection technique variability without imaging guidance might have led to inconsistent drug delivery. The reliance on subjective pain assessment without functional measures limited comprehensive evaluation. The short follow-up duration prevented the assessment of long-term efficacy and recurrence rates. The small sample size, particularly the limited number of male participants, reduced statistical power. The retrospective design introduced selection bias as treatment allocation was non-randomized. The lack of adjustment for baseline characteristics in the analysis may have obscured true treatment effects.

#### Future perspectives and clinical implications

Future studies should prioritize investigating gender-specific treatment responses, as the current results demonstrated significantly better outcomes in female patients compared to males. This suggests potential biological or biomechanical differences that warrant further exploration through prospective trials with balanced gender representation. Additionally, longer-term follow-up studies are needed to properly evaluate the durability of treatment effects, particularly for corticosteroid injections which showed promising short-term results but require assessment of potential late complications and recurrence rates. From a clinical perspective, these results suggest that treatment selection should consider patient gender as a potentially important factor, while also accounting for individual preferences and risk factors. The moderate success rates of both treatment approaches indicate that combination therapies incorporating corticosteroid injections for immediate relief followed by conservative measures like physical therapy and weight management may offer optimal outcomes.

Clinicians should be particularly attentive to weight management in overweight patients, as BMI appeared to influence treatment response in subgroup analyses. The study also underscores the need for more standardized outcome measures in future research, incorporating both pain scales and functional assessments to provide a more comprehensive evaluation of treatment efficacy. Improved injection techniques using imaging guidance and investigation of potential biomarkers for treatment response could further refine therapeutic approaches. These advancements would help develop more personalized treatment algorithms that consider demographic factors, lifestyle characteristics, and individual biological responses. For clinical practice, the results support a patient-centered approach that balances the rapid pain relief offered by corticosteroid injections with the potentially more sustainable benefits of conservative treatments. This should involve shared decision-making discussions that address patient preferences, treatment goals, and risk factors. The gender disparity in outcomes particularly suggests that male patients may require

alternative or more aggressive treatment strategies, warranting further investigation into potentially more effective approaches for this population.

**Abbreviations**

| | |
|---|---|
| NSAIDs | Non-Steroidal Anti-Inflammatory Drugs |
| BMI | Body Mass Index |
| VAS | Visual Analog Scale |
| BID | Bis In Die (Twice a day) |
| E.S.W.T | Extracorporeal Shock Wave Therapy |

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**Author contributions**
S.H. conceived the original idea and designed the project. H.H. participated in the design and executed the experiments. AOS, RR, S.D, and KH discussed the results and strategy. SD, RR, and HH wrote the manuscript. All authors reviewed, edited, and approved the final manuscript.

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**Data availability**
The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Declarations

**Ethics approval and consent to participate**
Written informed consent was obtained from all participants before starting the study. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1975 Helsinki Declaration and its later amendments or comparable ethical standards. In order to comply with the ethical considerations in this research, the information of the participants was kept confidential and other people were not able to access this information. The names and surnames of the participants were not used for data collection, and data collection was done after obtaining the code of ethics from Jiroft University of Medical Sciences. This article reports the results of a research project approved by Jiroft University of Medical Sciences with the code of ethics IR.JMU.REC.1402.035.

**Consent for publication**
Not applicable.

**Competing interests**
The authors declare no competing interests.

**Disclosure**
During the preparation of this work, the authors used ChatGPT in order to check the grammar and improve readability. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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