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The Effect of Cold Compression on the Surgical Site Post-Subdermal Contraceptive Implant Insertion to Reduce Bruising and Pain among Female Youth in Family Planning: Randomized controlled trial

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ABSTRACT

Objectives: To study the effectiveness of cold compression in reducing bruising and pain around the surgical site following subdermal contraceptive implantation among female youth.

Materials and Methods: Sixty participants aged 18–24 years who attended the family planning clinic for contraceptive implant insertion between March and July 2025 were randomly allocated into two groups. The intervention group (n = 30) received cold compression therapy combined with standard care. A cold compress was applied for 5 minutes before starting the procedure and for 20 minutes at 30 minutes, 7 hours and 18 hours after the procedure. Bruising was assessed at 7, 32, 80 and 152 hours post-procedure. The control group (n = 30) received standard nursing care. Pain was assessed using the visual analog scale (VAS) at 30 minutes, 60 minutes, 8 hours and 19 hours, with a final assessment at 32 hours, during which no cold compress was applied. Bruising and VAS scores were compared at corresponding time points.

Results: The mean size of bruising in the intervention group was significantly smaller than that in the control group at all assessed time points: 7, 32, 80, and 152 hours post-procedure ($p = 0.002$, < 0.001, < 0.001, and < 0.001, respectively). With comparable initial mean VAS scores, the intervention group also reported significantly lower pain levels than the control group post-procedure at 30 minutes, 60 minutes, 8 hours, and 19 hours ($p = 0.039$, < 0.001, 0.01, and < 0.001, respectively). However, no significant difference in pain levels was observed between the groups at 32 hours post-procedure, a time point when the intervention group did not receive cold compression.

Conclusion: This study demonstrated that cold compression for 5 minutes before inserting a

subdermal implant and for 20 minutes three times within 24 hours was more effective in reducing bruising and pain than standard care. No adverse events were reported.

Keywords: contraceptive implantation, female youth, cold compression, bruising, pain, family planning

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ผลของการประคบเย็นต่อการลดรอยช้ำและความปวดบริเวณแผลหัตถการยาฝังคุมกำเนิดของผู้รับบริการเยาวชนหญิง คลินิกวางแผนครอบครัว: การศึกษาแบบสุ่มมีกลุ่มเปรียบเทียบ

รัตติยา ชูโชติ, เนตรสุมล จตุรจรรยาเลิศ, กฤษณา พูลเพิ่ม, อุดมรัตน์ เติมกลิ่นจันทร์, สมสุข สันติเบ็ญจกุล, สุรศักดิ์ ฐานีพานิชสกุล

บทคัดย่อ

วัตถุประสงค์: *เพื่อศึกษาประสิทธิผลของการประคบเย็นต่อการลดรอยช้ำและบรรเทาความปวดบริเวณแผลหัตถการยาฝังคุมกำเนิด ของผู้รับบริการเยาวชนหญิง*

วัสดุและวิธีการ: *อาสาสมัครเยาวชนหญิง อายุ 18 – 24 ปี จำนวน 60 ราย ที่มารับบริการทำหัตถการยาฝังคุมกำเนิด คลินิกวางแผนครอบครัว ระหว่างเดือนมีนาคม – กรกฎาคม พ.ศ. 2568 สุ่มเข้ากลุ่มทดลอง 30 ราย ได้รับการประคบเย็นนาน 5 นาที ก่อนเริ่มทำหัตถการ และประคบเย็นนานครั้งละ 20 นาที 3 ครั้ง ที่เวลา 30 นาที 7 ชั่วโมง และ 18 ชั่วโมงหลังทำหัตถการ ประเมินรอยช้ำ ที่เวลา 7, 32, 80 และ 152 ชั่วโมงหลังหัตถการ ประเมินความปวดหลังการประคบเย็นแต่ละครั้งด้วย visual analog scale ที่เวลา 30 นาที 60 นาที และ 8, 19 ชั่วโมงหลังทำหัตถการ และประเมินคะแนนปวดครั้งสุดท้ายที่เวลา 32 ชั่วโมงซึ่งเป็นช่วงเวลาที่ไม่มีการประคบเย็น และกลุ่มควบคุม 30 ราย ได้รับการพยาบาลตามปกติ เปรียบเทียบรอยช้ำและความปวดที่เวลาเดียวกันในแต่ละครั้ง*

ผลการศึกษา: *ขนาดรอยช้ำในกลุ่มทดลองน้อยกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติทุกจุดเวลา ที่ 7, 32, 80 และ 152 ชั่วโมงหลังหัตถการตามลำดับ ($p = 0.002, <0.001, <0.001, <0.001$) และกลุ่มทดลองมีคะแนนความปวดน้อยกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ที่เวลา 30 นาที 60 นาที 8 และ 19 ชั่วโมง หลังทำหัตถการ ($p = 0.039, < 0.001, 0.01$ และ < 0.001) ตามลำดับ ทั้งนี้ไม่พบความแตกต่างที่เวลา 32 ชั่วโมง ซึ่งเป็นช่วงเวลาที่กลุ่มทดลองไม่ได้ประคบเย็น*

สรุป: *การประคบเย็นช่วยลดรอยช้ำและบรรเทาความปวดบริเวณแผลหัตถการยาฝังคุมกำเนิดได้เมื่อเปรียบเทียบกับกลุ่ม*

ควบคุม และไม่พบเหตุการณ์ไม่พึงประสงค์จากการประคบเย็น

***คำสำคัญ**: ยาฝังคุมกำเนิด, เยาวชนหญิง, การประคบเย็น, รอยฟกช้ำ, ความปวด, การวางแผนครอบครัว*

Introduction

Bruising and pain are common adverse events following contraceptive implant insertion. Contraceptive implants can be classified into two types according to the number of rods and duration of effectiveness: a single-rod implant, which provides protection for up to three years, and a two-rod implant, effective for up to five years. Both types are inserted subdermally under local anesthesia, typically in the inner aspect of the non-dominant arm. Although no official reports in Thailand describe the incidence of bruising after contraceptive implant insertion, informal reports, personal accounts, and widely shared images on social media indicate that post-procedural bruising is common. These images have caused fear and anxiety among some women, deterring them from undergoing the procedure, despite its high efficacy and recommendation, particularly among adolescents[1, 2, 3].

Post-insertion bruising and ecchymosis, and pain are also common after various surgical and dermatologic procedures. These physical effects may contribute to significant psychological distress in patients[4]. The cause of bruising and pain after the contraceptive implant procedure related to the main contributing factor was the injury from the trocar or applicator used during the procedure, and foreign body reaction leading to acute inflammatory responses[5, 6]. Patients should be systematically assessed to identify any underlying bleeding disorders and evaluate their risk of future bleeding before implant insertion[7].

The clinical care team in the Family Planning Clinic, King Chulalongkorn Memorial Hospital (KCMH), has recognized the critical importance of continuous quality improvement (CQI) to address complications associated with contraceptive implant procedures. Consequently, a comprehensive care protocol was developed to ensure continuity and consistency of care across all stages—pre-, intra-, and post-procedural. This protocol includes detailed wound care instructions, appropriate application of elastic compression bandages, and structured post-discharge follow-up support. To enhance patient self-care and accessibility, communication platforms such as the Line application and institutional telephone services were implemented, allowing timely advice and guidance during recovery. These measures collectively contribute to the overall enhancement of care quality and promote patient engagement in self-management. Despite these efforts, managing post-insertion bruising resulting from tissue trauma remains a clinical challenge. Notably, applying cold compresses before and after the procedure has been shown to reduce tissue injury. Studies have found that the use of ice packs or cold gel packs effectively lowers post-operative pain scores, without any associated adverse effects[8, 9].

This non-pharmacological intervention may help to reduce the extent of bruising and alleviate associated pain, thereby offering an effective adjunct to standard care practices. Continuity of patient-specific care across the pre-, intra- and post-operative phases, including post-discharge and follow-up, improves clinical outcomes[10]. These approaches can be combined with cold compresses tailored to wound type and site, ensuring safety, therapeutic effectiveness, cost-efficiency and convenience. A common method employs elastic bandaging with low-cost cold gel packs and has been shown to reduce

postoperative and procedural complications[11,12].

Cold compression is an effective non-pharmacological intervention for managing wound inflammation and localised pain[13, 14], reflecting the nurse's independent professional role. It reduces pain, inflammation and bruising by decreasing nociceptor activity, constricting blood vessels, lowering tissue temperature and relaxing muscles. Cold compression is most effective within the first 24 to 48 hours after an acute injury. Applying it at 10–20 °C for 20 minutes per session[15], with 1–2 hour intervals, reduces acute inflammatory complications[13,16]. Pre-procedural application for about 5 minutes[11,12] and post-procedural application for about 20 minutes can also minimise post-procedural bruising[17]. This study demonstrated that participants who received cold compression with 5-minute application before the procedure and a 20-minute application after the procedure. The post-procedural cold compress was repeated three times at 30 minutes intervals, following the resolution of local anesthetic effects. Additional applications were incorporated into the patients' daily routine, adapted to outpatient lifestyles, at 7 hours (in the evening of the first day) and 19 hours (the following morning) post-insertion, during time periods when participants were typically at home or in a private residence. These applications remained consistent with the principles of cold compression aimed at minimizing post-procedural complications within the first 24 hours.

A review of the literature revealed no specific cold-compression protocol for wounds inflicted during contraceptive implant insertion. We adapted a standard elastic bandage, tailoring it to wound size and adding a compartment for a standard cold gel pack to provide localized compression, reduce bleeding, bruising, pain, and swelling. By integrating this with the standard care protocol for clients undergoing contraceptive implant insertion at the family planning clinic—covering pre-procedure, intra-procedure and post-procedure phases, with follow-up via telephone and LINE application—the approach aligns with clients' developmental stage and sociocultural context, serving as a guideline for nurses to optimise quality-of-care indicators, particularly post-procedural wound complications. To the best of our knowledge, no prior research has addressed this specific intervention.

Based on the aforementioned rationale and conceptual framework, we were motivated to conduct this study, titled 'The effect of cold compression on the surgical site post-subdermal contraceptive implant insertion to reduce bruising and pain among female youth in family planning'. This intervention is expected to serve as an effective strategy for caring for female youth undergoing contraceptive implant insertion, aimed at reducing post-procedural complication rates and potentially promoting implant uptake among youth. Ultimately, it may contribute to reducing the incidence of unintended teenage pregnancies in alignment with national health policy objectives.

The objectives of the present study were 1) to compare the mean bruise size around the surgical site following subdermal contraceptive implant procedures between female youth who received cold compression care and those who received standard care, and 2) to compare the mean visual analog scale (VAS) pain scores at the surgical site following subdermal contraceptive implant procedures between female youth who received cold compression care and those who received standard care.

Materials and Methods

This study is a randomized controlled trial that was conducted in the family planning clinic, outpatient department, King Chulalongkorn Memorial Hospital (KCMH), Bangkok, Thailand. The study protocol was approved by the ethical committee of the Institutional Review Board, Faculty of Medicine, Chulalongkorn University (IRB# 0548/67) and was registered in the Thai Clinical Trials Registry (TCTR20250222007), and obtained permission from the director of KCMH. The researchers collaborate with the head of the family planning clinic to request permission to conduct the study.

The participants in this study were adolescents or young women (aged 18–24 years) who attended

the family planning clinic for the insertion of subdermal contraceptive implants. Eligible women were informed about the study, and written consent was obtained after they were assessed with the pre-procedure standard care. The inclusion criteria were 18–24-year-old female adolescents who were not pregnant, were presenting to the family planning clinic for first-time insertion of subdermal contraceptive implants, had no coagulation disorders, were not on anticoagulants during this period, did not have underlying cold allergies, had no bruising or pain (VAS score = 0/100) around the surgical site, could understand and communicate in Thai, possessed a smartphone or a device for follow-up phone calls and LINE application and had access to a refrigerator or device to maintain cool temperatures. Participants were excluded if they had received preemptive analgesic medications with prolonged efficacy covering the intraoperative and postoperative periods (e.g., paracetamol or ibuprofen), exhibited allergic reactions to materials used for wound dressing or bandaging, or were unable to attend all scheduled visits as required by the study protocol. Participants were withdrawn from the study if they became pregnant during the study, had a body temperature greater than 37.5°C, developed complications intraoperatively or postoperatively, underwent an implant procedure lasting more than 5 minutes, used long-acting analgesics whose effects persisted during pain data collection, or were non-compliant with cold compress application (adherence < 75%).

Participants were allocated to the intervention and control groups using stratified block randomization with a fixed block size of four. Stratification was based on three variables: age (< 20 or ≥ 20 years), education level (< Bachelor or ≥ Bachelor), and type of contraceptive implant (1-rod or 2-rod), resulting in eight strata. In some strata, only one level of certain variables was present; for example, in the stratum of participants aged < 20 years, no individuals had an education level ≥ Bachelor. For strata with fewer than four participants, simple randomization was applied instead of block randomization.

The control group consisted of participants who received standard nursing care according to the clinical practice guidelines for the management and care of clients receiving contraceptive implant procedures in family planning clinics. This guideline was developed based on the concept of the Service Procedures for Family Planning Clinics[7], integrated with the Standards for Outpatient Nursing Services[18]. This care is provided in three phases: the pre-procedural phase, the intra-procedural phase and the post-procedural phase. The standard care encompasses pre-insertion health assessment and client preparation at the pre-procedure phase. Intra-procedural care involves providing clients with standardised care and support, including the administration of local anaesthesia (1% lidocaine). The insertion site is covered with steri-strips tape, a waterproof film dressing, followed by cold compression or support using an elastic bandage. Standardised post-procedural care includes monitoring and assessing clinical signs and symptoms for a minimum of 30 minutes, followed by patient education on post-procedure self-care, insertion site management demonstration and instruction on the appropriate use of elastic bandages, including the need to keep the elastic pressure bandage dry for 3 days and avoid using the arm for strenuous activities for at least 7 days. After receiving post-procedural care instructions from the nurse provider, the researcher provided guidance and demonstrated to the participants how to use the VAS, to choose the level between 0 (no pain) to 100 (the worst pain) and how to use the standard scale L-shape ruler to measure bruising and photograph the bruise[19]. Pain intensity levels around the surgical site were assessed twice during the hospital stay: once at 30 minutes post-procedure (baseline) and again at 60 minutes post-procedure. Following discharge, pain was assessed at 8, 19 and 32 hours post-procedure. Bruising was measured and photographed at 7, 32 and 80 hours post-procedure (i.e. the evenings of postoperative days 0, 1 and 3) and again at 152 hours post-procedure (evening of day 6). Participants were instructed to record their

data in the form provided. The researcher provided ongoing follow-up care via phone calls and the LINE application, collecting data from the complications record form given to the participants in the control group until the target sample size of 30 participants was reached.

The intervention group consists of participants who received the 'guidelines for cold compress application at the insertion site of contraceptive implant procedures' in addition to the clinical practice guidelines for the management and care of clients receiving contraceptive implant procedures in family planning clinics. The researcher provided care according to the cold compress protocol for post-contraceptive implant insertion site care. This guideline was developed based on the concept of cryotherapy and literature reviews[11, 14, 20-22]. Cold compression was applied using a standard cold gel pack measuring 7 centimetres in width and 10 centimetres in length, with the surface temperature of the fabric wrapped around the gel pack monitored to ensure it remained within the target range of 10 to 15 degrees Celsius. A standard elastic bandage measuring 11 centimetres in width and 50 centimetres in length provided an optimal fit for the contraceptive implant insertion site. The protocol involves three phases: (1) Pre-procedure: applying a cold compression for 5 minutes before starting the procedure; (2) Intra-procedure: providing standard care; (3) Post-procedure: assessing pain levels 30 minutes after the procedure (once the effect of the local anaesthetic had worn off), followed by a 20-minute cold compression application. Afterwards, pain scores were reassessed 60 minutes after the procedure using VAS. After discharge, participants were instructed to continue applying the cold compress for 20 minutes at 7 (evening of day 0) and 18 (morning of day 1) hours post-procedure. Bruising was photographed at 7, 32 and 80 hours post-procedure (i.e. the evening of days 0, 1 and 3) and again at 152 hours post-procedure (evening of day 6). Pain VAS scores were assessed at specific time points. During the observational phase, the VAS scores were taken post-procedure at 30 (baseline) and 60 minutes post-procedure, and then again at 8 and 19 hours after discharge. A final pain assessment was conducted at 32 hours (evening of postoperative day 1) post-procedure, during which no cold compression was applied. Data were recorded in a form, and the researcher provided ongoing follow-up care via phone calls and the LINE application, collecting data from the complications record form given to the participants in the intervention group until the target sample size of 30 participants was reached.

Evaluation of the intervention involved assessing the VAS scores at 30 minutes, 60 minutes, 8 hours, 19 hours and 32 hours post-procedure, as well as the size of the bruise at 7, 32, 80 and 152 hours post-procedure. Bruise dimensions were assessed using a standardised L-shaped measuring ruler. The mean pain scores (VAS) and the mean size of the bruise at the site of insertion were compared between the two groups at each time point.

Cold compress care and the evaluation of pain and bruising at designated time points were conducted in accordance with the clinical care guidelines for patients undergoing contraceptive implant procedures at the family planning clinic and were compatible with the participants' routine daily activities. This was consistent with the recommended cold compress application protocol during the first 24 hours following contraceptive implant insertion.

The sample size in this study was calculated using the G Power program, version 3.1.9.7[23]. Due to limitations in previous studies similar to this one, the sample size calculation was referenced for this study with a 5% type I error, 90% test power and a medium effect size of 0.25[24]. The final sample size reached was 60, with 30 in each group; blocks of four randomisations were used to allocating participants to the groups. Thirty participants were randomised to the control group, where they received standard nursing care, and 30 were randomised to the study group, which received the standard nursing care combined with cold compression care before and after the procedure.

Statistical analysis was performed using SPSS Version 23 (SPSS Inc., Chicago,IL. USA). Descriptive statistics such as frequency distributions, numbers, percentages, means and standard deviations were used to describe participants' characteristics. The mean bruise size and mean VAS scores of participants in the intervention and control groups were analysed using generalized estimating equations (GEEs), with statistical significance set at 0.05.

This study was conducted after consulting an independent biostatistician from the Biostatistics Excellence Center, Faculty of Medicine, Chulalongkorn University. This biostatistician provided short-term guidance regarding study design, sample size and statistical methods.

Results

Fig. 1 is a flowchart describing the participant recruitment process, randomization, intervention and outcome ascertainment in this two-arm parallel group randomized controlled trial. A total of 60 participants presenting at the family planning clinic during the study period were selected, with 30 in each group. There were no participants lost to follow-up in either group. The baseline demographic and clinical characteristics of the study participants (Table 1) indicated that the randomisation process successfully generated highly comparable control and intervention groups. The mean age of participants in both groups was 21.0 years; 70% of participants had a secondary level of education, and half of the participants used the same type of contraceptive implant. There was all presented no difference in both groups.

Table 2 shows results of the chi-square analysis, that the rate of the non-bruising (bruise size = 0 cm^2) incident in the intervention group was significantly higher than that in the control group across all evaluation time points, including at 7 ($p < 0.001$), 32 ($p < 0.001$), 80 ($p < 0.001$) and 152 ($p = 0.001$) hours post-procedure, respectively.

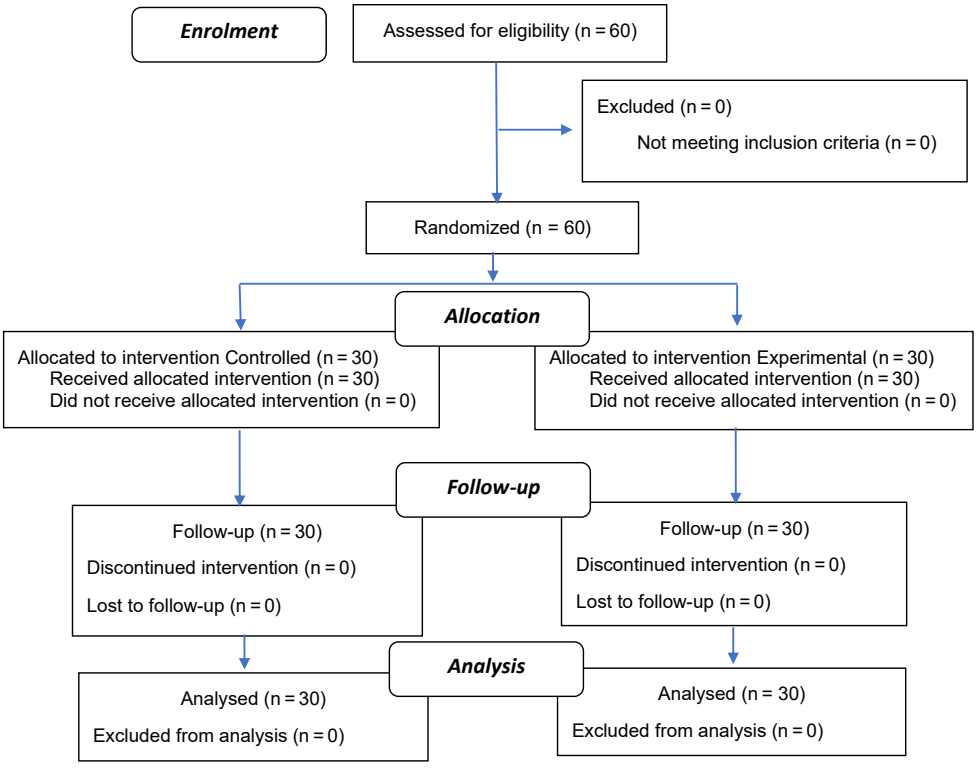

Fig. 1. The consort flowchart of randomization..

Table 1. The Baseline characteristics of the study participants.

Characteristics	Control (n = 30)	Intervention (n = 30)	Total (n = 60)
Age (years), mean ± SD	21.0 ± 2.0	21.0 ± 2.0	21.0 ± 2.0
Education level, n (%)			
Secondary	21 (70.0)	21 (70.0)	42 (70.0)
≥ Bachelor	9 (30.0)	9 (30.0)	18 (30.0)
No Underlying disease, n (%)	30 (100.0)	30 (100.0)	60 (100.0)
Type of contraceptive implant, n (%)			
1 rod	15 (50.0)	15 (50.0)	30 (50.0)
2 rods	15 (50.0)	15 (50.0)	30 (50.0)
History of contraceptive use, n (%)			
Never used	2 (6.7)	3 (10.0)	5 (8.3)
Previously used	28 (93.3)	27 (90.0)	55 (91.7)
Number of methods, n (%)			
1 method	11 (36.7)	15 (50.0)	26 (43.3)
2 methods	13 (43.3)	11 (36.7)	24 (40.0)
3 methods	6 (20.0)	4 (13.3)	10 (16.7)
Methods previously used, n (%)			
Combine oral contraceptives (COCs)	11 (36.7)	8 (26.7)	19 (31.7)
Injectable contraceptives	2 (6.7)	7 (23.3)	9 (15.0)
Emergency contraceptive pills (ECPs)	14 (46.7)	9 (30.0)	23 (38.3)
Condom	26 (86.7)	22 (73.3)	48 (80.0)
Intrauterine devices (IUD)	0 (0.0)	1 (3.3)	1 (1.7)

SD: standard deviation

Table 2. Comparison of the non-bruising (bruise size = 0 cm^2) incidence in the participants between groups at the time point post procedure.

Time point post procedure	Control (n = 30)	Intervention (n = 30)	X^2	dt	p value
7 hours	4 (13.33%)	27 (90%)	35.31	1	< 0.001
32 hours	1 (3.33%)	23 (76.67%)	33.61	1	< 0.001
80 hours	0 (0%)	13 (43.33)	16.60	1	< 0.001
152 hours	0 (0%)	10 (33.33)	12.00	1	0.001

Table 3 shows that according to the GEE analysis, the intervention group demonstrated significant efficacy of cold compression in preventing and reducing the size of bruises, with statistically significant differences observed at all assessed time points, including at 7 hours (mean difference = 2.97, $p < 0.002$), 32 hours (mean difference = 4.10, $p < 0.001$), 80 hours (mean difference = 9.64, $p < 0.001$) and 152 hours (mean difference = 12.52, $p < 0.001$) post procedure, respectively.

Table 3. Comparison of mean size of bruise (cm^2) between groups at the time point post procedure.

Time points post procedure	Control (n = 30) mean (SE)	Study (n = 30) mean (SE)	mean difference (95% CI)	p value
7 hours	3.00 (0.98)	0.03 (0.02)	2.97 (1.05, 4.89)	0.002
32 hours	4.19 (0.99)	0.09 (0.04)	4.10 (2.16, 6.03)	< 0.001
80 hours	10.00 (1.29)	0.36 (0.08)	9.64 (7.10, 12.18)	< 0.001
152 hours	12.91 (1.72)	0.39 (0.09)	12.52 (9.14, 15.90)	< 0.001

SE: standard error, CI: confidence interval

Table 4 shows results of the GEE analysis, demonstrating that the intervention group receiving cold compression therapy reported significantly lower pain scores compared to the control group at the 30-minute (mean difference = 2.37, p = 0.039), 1-hour (mean difference = 10.83, p < 0.001), 8-hour (mean difference = 10.17, p = 0.01) and 19-hour (mean difference = 9.99, p < 0.001) time point. There was no statistically significant difference in pain scores between the groups at 32 hours (mean difference = 6.57, p = 0.103).

Table 4. Comparison of pain visual analog scale (VAS) scores between groups at the time point post procedure.

Time point post procedure	Control (n = 30) mean (SE)	Intervention (n = 30) mean (SE)	mean difference (95% CI)	p value
30 minutes	4.43 (0.83)	*2.07 (0.79)	2.37 (0.12, 4.62)	0.039
1 hours	10.83 (1.00)	**0.00 (0.00)	10.83 (8.87, 12.80)	< 0.001
8 hours	19.53 (3.53)	**9.37 (1.74)	10.17 (2.46, 17.87)	0.01
19 hours	13.80 (2.28)	**3.81 (1.31)	9.99 (4.48, 15.14)	< 0.001
32 hours	15.93 (3.17)	***9.37 (2.47)	6.57 (-1.32, 14.45)	0.103

SE: standard error, CI: confidence interval, VAS: visual analogue scale (0 = no pain, 100 = the worst pain)

* mean VAS after the procedure and received a cold compress for 5 minutes before starting the procedure

** mean of VAS after receiving a 20-minute cold compress

Discussion

Contraceptive implants, classified as long-acting reversible contraceptives (LARCs), are widely recognized for their high safety and effectiveness and have been promoted as a key strategy to prevent unintended pregnancy among female youth[2, 3]. Nevertheless, concerns remain regarding side effects, such as menstrual irregularities, dizziness, and mood changes, as well as procedural complications, including pain and bruising. Although complications at the implant insertion site are typically minor and self-limiting, they can influence user satisfaction, acceptance, and continuation[25]. Among adolescents, concerns regarding bruising and pain have been associated with reluctance to initiate use. Bruising may adversely affect body image, further impacting the overall user experience[26]. In addition, post-procedural pain following implant insertion may increase patient anxiety, which can in turn amplify pain perception[27], resulting in physical and emotional discomfort.

Therefore, healthcare providers should develop appropriate measures to prevent or alleviate local complications. Cold compression has been recognised as an effective method to relieve pain and reduce bruising following implant insertion. Pharmacokinetic

evidence indicates that contraceptive implants release hormones consistently and continuously, independent of temperature or local environmental conditions at the insertion site[28]. Furthermore, cold compression is a low-cost intervention that can be easily applied in clinical practice to mitigate adverse local symptoms after implant insertion.

This study demonstrated that participants who received cold compression with 5-minute application before the procedure and a 20-minute application after the procedure. The post-procedural cold compress was repeated three times at 30 minutes, 7 hours, and 19 hours following the procedure had a lower incidence of bruising compared with the control group. Specifically, the proportion of participants with no bruising (bruise site = 0 cm^2) was significantly higher in the intervention group, and bruise sizes at 7, 32, 80 and 152 hours were significantly smaller in the intervention group than in the control group. These effects are attributed to local cooling at the implant site, which lowers skin and subcutaneous tissue temperature, inducing vasoconstriction as an initial response. Subsequently, the sympathetic nervous system reflexively stimulates α-receptors, causing further vasoconstriction, reduced blood flow and decreased delivery of oxygen and nutrients, thereby slowing cellular metabolism in the area. Reduced local circulation is a key mechanism by which cold application decreases swelling and bruising[29].

These findings were consistent with those of previous research on the use of cold compresses in minor procedures. Participants receiving standard care developed significantly larger bruises at 48 and 72 hours following subcutaneous anticoagulant injection compared with those who received a cold compress either 5 minutes before or after the injection[30]. Cold compress applied for 5 minutes prior to the injection also significantly reduced the incidence of bruising[20]. Furthermore, meta-analyses have confirmed that cold compress application for 2–5 minutes, either before or after subcutaneous injection, effectively reduces bruising without serious adverse effects[21, 31].

However, evidence on bruise management following contraceptive implant insertion remains limited. Accordingly, this study adapted cold compression protocols from patients receiving subcutaneous heparin injections, in which cold compression was applied for 5 minutes before the procedure[11, 12] and for 20 minutes afterward[17]. The extended duration in our protocol aimed to further reduce local inflammation and bruising, as contraceptive implant insertion causes slightly more tissue trauma than a standard subcutaneous injection. In addition, because the implanted device acts as a foreign object that may trigger an inflammatory response, two additional post-procedural cold compression sessions were applied. General recommendations suggest 2–3 cold compression sessions per day, 20 minutes each, with gel packs at a surface temperature of 10–20 °C for post-injury or post-procedural care[16]. In this study, the protocol was adapted to be practical and compatible with participants' daily routines. Similar postoperative studies in cesarean delivery applied a single 20-minute cold gel pack session 2 hours after surgery without changing the pack, and no adverse events were reported[8].

This study found that participants who received cold compresses according to the cold compress protocol for post-contraceptive implant insertion site care reported significantly lower pain levels than those in the control group at 30 minutes and at 1, 8 and 19 hours after contraceptive implant insertion, with VAS scores evaluated after the administration of the cold compress. This result can be explained by the gate control theory of pain proposed in 1965[5], which posits that pain signals are transmitted through small-diameter nerve fibres (A-delta and C fibres) to the dorsal horn of the spinal cord. At this site, substantia gelatinosa (SG) cells modulate a 'gate' that regulates the transmission of pain impulses to transmission cells (T-cells) and subsequently to the brain. Cold stimulation activates large-diameter fibres (A-beta and A-alpha), which stimulate SG cells to close the gate, thereby inhibiting pain transmission. In addition, cold compression reduces local blood flow, slows tissue

metabolism, decreases muscle tension and may activate central opioid receptors, all of which result in reduced pain perception. These findings are consistent with those of prior studies. Karadağ et al reported that participants who received cold compresses experienced significantly lesser pain than those who received manual pressure following subcutaneous anticoagulant injection[22]. Similarly, a systematic review demonstrated that cold application before or after subcutaneous injection significantly reduces pain intensity[12]. Moreover, Wongcharoen and Inta found that combining cold gel packs with standard care resulted in lower pain scores during and after needle insertion compared to standard care alone[32].

However, by 32 hours post-procedure during which no applied cold compression, pain scores were not significantly different between the intervention and control groups. It may be explained by the natural resolution of acute tissue inflammation and the fact that cold compresses were applied only during the first 24 hours after the procedure. Similar patterns have been observed in other surgical settings, such as Caesarean delivery, where cold gel packs effectively reduced early postoperative pain but had minimal effect beyond 24 hours[8]. These results suggest that cold compresses provide short-term analgesic benefits, highlighting the importance of early application after the procedure, while additional pain management strategies may be necessary for later time points.

We acknowledge that the bruise size and VAS were low in both groups, which likely reflects the effectiveness of the standard nursing care provided to the control group, including careful pre-, intra-, and post-procedural monitoring, VAS assessment, bruising measurement, and ongoing follow-up, similar to the intervention group. Despite the overall low scores, statistical analysis showed a significant reduction in pain and bruising in the intervention group, indicating the additional benefit of the cold compress protocol beyond standard care.

In this study, participants received care following the management and care of clients receiving contraceptive implant procedures in family planning clinics guidelines, which encompass pre-, intra- and post-procedural support, side effect monitoring and self-care instruction provision via the LINE official account after discharge. Continuous follow-up through youth-appropriate communication channels has been shown to enhance post-insertion self-care, reduce anxiety, increase satisfaction and allow for safe management of minor adverse events without requiring a return visit[10, 33, 34].

This randomized controlled trial demonstrated notable strengths, including the absence of adverse events and participant dropout, underscoring the feasibility and safety of the intervention. Nonetheless, several limitations should be considered. The unblinded design may have introduced bias in participants' reporting of bruising and pain, and the requirement for repeated cold compression applications could have influenced adherence to the intervention protocol. While bruising incidence and size were systematically monitored, the evaluation of color changes over time was limited, as participant-submitted smartphone images via the LINE application introduced variability in image quality and color consistency, thereby reducing the precision of outcome assessment. Future studies employing blinded designs, standardized image capture methods, and streamlined intervention protocols are warranted to validate these findings and enhance their generalizability.

Conclusion

Application of a cold compress at the contraceptive implant insertion site, involving a 5-minute pre-procedure and 20-minute post-procedure application, with additional post-procedural compresses at 30 minutes, 7 hours, and 19 hours, was an effective, non-technology innovation for reducing pain and bruising. In this study, participants who received care according to the cold compress protocol reported significantly lower pain levels and smaller bruises compared with the control group. No adverse events were reported.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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