The Journal of Obstetrics and Gynecology of India (March–April 2025) 75 (Suppl 1):S348–S354
https://doi.org/10.1007/s13224-024-01999-1

ORIGINAL ARTICLE

Comparison of Three Techniques for Skin Closure in Caesarean Delivery (Absorbable Subcuticular Sutures, Non-absorbable Nylon Sutures, Surgical Staplers): A Randomized Controlled Trial

Shreya S. Kushwaha[1,2] · Seema Singhal[1] · Soniya Dhiman[1] · Sunesh Kumar[1] · Kallol K. Roy[1] · Jyoti Meena[1] · Swati Tomar[1]

Received: 29 February 2024 / Accepted: 22 May 2024 / Published online: 13 June 2024

Abstract

Background Caesarean section is associated with post-operative surgical complications such as wound disruption, induration and hematoma. It is essential to optimize surgical techniques to ensure the best possible outcomes for women undergoing caesarean section.

Methods This was a randomized controlled trial done at a tertiary care centre. A total of 300 women undergoing first caesarean section were randomly allocated to absorbable subcuticular sutures ($n=100$), non-absorbable nylon sutures ($n=100$) and surgical staplers ($n=100$) for skin closure. Post-operative wound complications, pain, cosmetic appearance, closure time, and surgeon's and patient's satisfaction were recorded post-operatively on day 3, days 7–10 and at weeks 4–6. The primary outcome was rate of wound disruption among the women in three groups at three occasions. The secondary outcomes were wound infection rate, induration, swelling, cosmetic appearance, pain, surgeon's satisfaction, patient's satisfaction and closure time.

Results Significantly more women developed wound dehiscence in the stapler group ($p=0.039$) at post-operative days 7–10 while in sub-group analysis, a similar outcome was seen between the other two groups ($p=0.999$). The patient's and surgeon's satisfaction and cosmesis were maximum with absorbable subcutaneous monocryl sutures and minimum with stapler skin closure. Pain was maximum after non-absorbable nylon sutures, while application time was minimum in staplers application.

Conclusion Present study suggests a benefit with sutures compared to surgical staplers in terms of wound dehiscence, infection, cosmesis and patient's satisfaction. Among the methods of skin closure, absorbable subcuticular monocryl and non-absorbable nylon sutures have similar outcomes with marginal benefit in absorbable subcuticular monocryl sutures.

Keywords Caesarean section · Surgical stapler · Absorbable subcuticular suture · Wound dehiscence · Non-absorbable interrupted suture

Introduction

Globally, caesarean section (CS) is a commonly performed surgery with an estimated 20 million procedure performed every year [1]. The CS rates are steadily rising worldwide and globally the rate has increased from 7.0% in 1990 to 21.0% in 2021 [2]. Similar trend has been observed in India where CS rate has increased from 17.2% to 21.5% between 2016 and 2021 [3]. With increase in CS rates, the incidence of wound complications such as wound disruption, induration, infection, seroma and hematoma is also increasing and varies from 3 to 15% in different studies [4–6]. These complications may further compromise the already challenging period of puerperium [5]. Hence, there is a need to

Shreya S Kushwaha is a Senior Resident; Seema Singhal is a Additional Professor; Soniya Dhiman is an Associate Professor; Sunesh Kumar is a Professor and Head (Former); Kallol K Roy is a Professor (Former); Jyoti Meena is an Additional Professor; Swati Tomar is an Assistant Professor.

✉ Seema Singhal
drseemasinghal@gmail.com

[1] Department of Obstetrics and Gynaecology, All India Institute of Medical Sciences, New Delhi 110029, India

[2] Present Address: Division of Maternal and Fetal Medicine, Department of Obstetrics and Gynaecology, VMMC and Safdarjung Hospital, New Delhi, India

optimize the surgical technique to decrease post-operative wound complications rate. The ideal method for skin closure should be fast, economical and simple, providing maximal aesthetics and patient contentment with minimal complications rates. Several studies have evaluated different materials and techniques for skin closure, analysing different outcome measures and follow-up intervals but yielded contradictory results regarding wound complications, cosmesis and pain [7–15]. However, obstetricians have no consensus about the most appropriate method for skin closure.

Given the paucity of evidence and to produce more robust data to guide obstetricians, the present study was designed. The objective of the present study was to compare the outcome of skin closure among absorbable subcuticular monocryl sutures, non-absorbable interrupted nylon sutures and surgical staples. Since many patients undergo caesarean delivery, even a minor decrease in post-operative wound morbidity would turn into enriched health for a significant number of women and noteworthy savings of cost and healthcare resources.

Material and Methods

The present study was a single-centre, prospective, non-blinded, randomized trial with a 1:1:1 allocation ratio, conducted in the Department of Obstetrics and Gynaecology of a tertiary care hospital in India, from January 2019 to December 2020. The trial was approved by Institutional Ethics Committee (IECPG-545/14.11.2018, RT-1/19.12.2018). Consort recommendations for reporting randomized controlled trials (RCT) were followed.

Inclusion criteria were pregnant women aged > 18 years and < 45 years with singleton viable pregnancy of more than 24 weeks undergoing emergency or elective caesarean delivery by a low transverse skin incision for any indication. Patients with previous caesarean delivery, pre-pregnancy body mass index (BMI) more than 35 kg/m^2, intrauterine foetal demise (IUD), chorioamnionitis, prolonged labour, women undergoing multiple per vaginal examinations, maternal connective tissue disease, poorly controlled diabetes, haematological malignancies or disorders, infected with Human Immunodeficiency Virus (HIV), known allergy to staplers or sutures, ongoing cancer treatment, usage of immunosuppressants, chronic steroid use and history of radiation to abdomen were excluded. The sample size was 300 patients with 100 patients in each arm for 80% power at a 5% level of significance for the primary outcome as post-operative wound dehiscence.

A total of 329 women were assessed for eligibility, out of which 11 women were excluded based on inclusion criteria and 18 women declined to participate in the study. Hence, three hundred women with viable pregnancies of more than 24 weeks undergoing caesarean delivery for any indication via a low transverse skin incision were recruited after obtaining informed written consent. The patient's demographic details and baseline characteristics were recorded. The caesarean delivery was conducted by a low transverse skin incision using either a Pfannensteil or modified Joel-Cohen technique by senior resident doctors. Abdominal preparation was performed by a standard technique using povidone-iodine solution or chlorhexidine solution in iodine-allergic patients. Perioperative antibiotic prophylaxis with a weight-based dose of intravenous cephalosporin was given within an hour of skin incision as per institutional protocol. The subcutaneous tissue of more than 2 cm was closed with a 2–0 polyglactin 910 (VICRYL) suture in interrupted fashion.

Study participants were randomized into three groups with 100 women in each one (1:1:1 allocation ratio). This randomization was performed with the help of a computer-generated scheme. Each participant was provided with an envelope with a unique identification number. This envelope was opened only at the time of rectus sheath closure by the nursing staff. In group A, skin closure was performed with subcuticular suture with a standard running 3–0 undyed monofilament poliglecaprone 25 (MONOCRYL) suture on a P-3 reverse cutting needle, started and finishing with a Z-technique at each end. In group B, for skin closure, interrupted stitches were taken with a monofilament polyamide (3–0 nylon) suture on a reverse cutting needle. For group C, Mirus™ sterile disposable metallic skin stapler was used for skin closure and was applied at an interval of 1 cm. It is a mechanical instrument designed to deliver precise rectangular-shaped stainless-steel staples for routine wound closure.

Each wound was covered with a sterile bandage after closure. The wound dressing was removed on third post-operative day (POD). Stapler and nylon sutures were removed on POD 7–10. A standardized physical examination of the wound was performed by the investigator at POD 3, at the time of suture removal POD 7–10 and at 4–6 weeks post-partum. Various parameters were assessed like wound dehiscence, swelling, induration, redness around wound, discharge from wound and pain. Swelling and induration were marked and measured using a scale. Post-operative pain was assessed via visual analogue scale (VAS). At post-operative weeks 4–6, additionally cosmesis was assessed via "The Patient and Observer Scar Assessment Scale" (POSAS), which is a validated scale to assess cosmesis. Also, patient's satisfaction score and surgeon's satisfaction score, rated on a scale of 1 (worst) to 5 (best) along with need for additional visits, were recorded. Among these, wound dehiscence was the primary outcome measure. The follow-up post-partum visits were planned physically or telephonically as per the patient's comfort. In case of any wound discharge from the site, the case was managed as per the treatment protocol of the hospital. The wound swab culture and sensitivity was

obtained and antibiotics were altered as per the results. The wound dressing was done for the affected cases if required.

Data analysis was carried out using SPSS IBM version 25.0 software. Continuous variables were tested for normality assumptions using the Kolmogorov–Smirnov test. Descriptive statistics such as mean, standard deviation (SD) and range values were presented for normally distributed data. A comparison of mean values was carried out either using a t-independent test or one-way ANOVA as appropriate. History-based risk factors, which were qualitative variables, were presented as frequency and percentage values. Chi-square/Fisher test was used to compare the frequency data across the categories in the appropriate situation. For all statistical tests, a probability of $p < 0.05$ was considered for statistical significance.

Results

A total of 300 women were enrolled in the study and were randomized based on skin closure techniques among the three groups including group A: absorbable subcuticular sutures (3–0 monocryl) or group B: non-absorbable interrupted sutures (3–0 nylon) or group C: surgical metallic staplers. The baseline parameters of the patients in the three groups were comparable (Table 1).

The mean age of subjects was 30.46 ± 4.22 years ranging from 20 to 42 years, whereas the mean BMI was 26.46 ± 3.22 kg/m^2 ranging from 18.03 kg/m^2 to 34.72 kg/m^2. The mean period of gestation at delivery was 37.04 ± 2.18 weeks and the mean experience of the surgeon performing skin closure was 4.21 ± 0.65 years. Out of the total 300 recruited patients, 202 (67.3%) underwent emergency CS whereas 98 (32.7%) patients underwent elective CS. Among medical co-morbidities, 25% (75/300) patients had diabetes either gestational or pre-gestational, 33/300 (11%) patients were known cases of anaemia or thrombocytopenia, and eight (2.7%) patients were using antiplatelets or anticoagulants during pregnancy. Wound disruption was assessed among the three groups at the three visits (Table 2).

None of the patient developed wound dehiscence on POD 3, while on POD 7–10, a total of 16 patients (5.6%) developed wound dehiscence. Out of these 16 patients, three (18.75%) patients were from Group A, three (18.75%) from Group B, and 10 (62.5%) were from Group C and this difference was statistically significant ($p = 0.039$). Re-suturing was performed in four (25%) of these cases; ¼ patient was from Group B and ¾ were from Group C and re-suturing was done with non-absorbable nylon suture as per the hospital protocol. The remaining 12/16 (75%) patients were healed by secondary intention which included three patients with dehiscence from Group A, two from Group B, and seven patients from Group C. Three patients (1%) had wound dehiscence on post-operative weeks 4–6 and all of them were from Group C which was a statistically significant difference ($p = 0.036$) and all were healed by secondary intention. In sub-group analysis, Group A and Group B had similar outcomes in terms of wound dehiscence on POD 7–10 and post-operative weeks 4–6 ($p = 0.999$ at both visits).

In the comparison of secondary outcomes, there was no statistically significant difference in number of patients with swelling around wound, redness around wound and wound discharge in the three groups, while a statistically significant difference was noted in patients with induration around wound at post-operative weeks 4–6 with maximum affected patients in staple group with a p value of 0.012 (Table 2).

The mean VAS score for pain on POD 3 was significantly more in non-absorbable interrupted nylon suture group with p value of 0.041. VAS score was comparable in all the three group at POD 7–10 and post-operative weeks 4–6 (Table 3).

The POSAS patient and observer score at post-operative weeks 4–6, surgeon and patient satisfaction score was higher in

Table 1 Baseline characteristics of patients

Characteristics	Group A ($n = 100$)	Group B ($n = 100$)	Group C ($n = 100$)	p value
Maternal age (years), (mean ± SD)	30.13 ± 4.33	30.64 ± 4.17	30.62 ± 4.18	0.62
Pre-pregnancy BMI (kg/m^2),(mean ± SD)	26.55 ± 3.27	26.53 ± 3.16	26.29 ± 3.25	0.818
Gestational age (weeks), (mean ± SD)	37.22 ± 1.90	36.87 ± 2.39	37.05 ± 2.22	0.515
Experience of person performing skin closure in years, mean ± SD	4.28 ± 0.66	4.11 ± 0.61	4.25 ± 0.68	0.153
Classification of CS (n)				
• Emergency CS	63	70	69	0.521
• Elective CS	37	30	31	
Patients with diabetes mellitus (n)	26	27	22	0.688
Anaemia/thrombocytopenia (n)	7	15	11	0.195
Antiplatelets/anticoagulants intake (n)	4	1	3	0.361

SD: standard deviation, BMI: body mass index, CS: caesarean section

Table 2 Comparison of wound outcomes in Group A, Group B and Group C

Outcome	Group A ($n=100$)	Group B ($n=100$)	Group C ($n=100$)	Total ($n=300$)	p value
Wound dehiscence					
POD-3	0	0	0	0	
POD 7–10	3 (3%)	3 (3%)	10 (10%)	16 (5.3%)	0.039*
Post-operative weeks 4–6	0	0	3 (3%)	3 (1%)	0.036*
Swelling around wound					
POD-3	1 (1%)	1 (1%)	4 (4%)	6 (2%)	0.787
POD 7–10	8 (8%)	8 (8%)	15 (15%)	31 (10.3%)	0.172
Post-operative weeks 4–6	0	0	2 (2%)	2 (0.7%)	0.110
Induration around wound					
POD-3	18 (18%)	16 (16%)	18 (18%)	52 (17.3%)	0.911
POD 7–10	33 (33%)	30 (30%)	32 (32%)	95 (31.7%)	0.898
Post-operative weeks 4–6	2 (2%)	2 (2%)	10 (10%)	14 (4.7%)	0.012*
Redness around wound					
POD-3	16 (16%)	18 (18%)	18 (18%)	52 (17.3%)	0.911
POD 7–10	33 (33%)	29 (29%)	29 (29%)	91 (30.3%)	0.777
Post-operative weeks 4–6	1 (1%)	1 (1%)	5 (5%)	7 (2.3%)	0.114
Discharge from wound					
POD-3	0	0	1 (1%)	1 (0.3%)	0.332
POD 7–10	12 (12%)	12 (12%)	18 (18%)	42 (14%)	0.369
Post-operative weeks 4–6	1 (1%)	1 (1%)	2 (2%)	4 (1.3%)	0.787

POD: Post-operative day, (*) denotes statistically significant results

Table 3 Comparison of other secondary outcomes in Group A, Group B and Group C

	Group A ($n=100$)	Group B ($n=100$)	Group C ($n=100$)	p value
VAS score (Mean ± SD)				
POD-3	7.86 ± 0.77	8.04 ± 0.72	7.77 ± 0.80	0.041*
POD 7–10	4.38 ± 0.87	4.61 ± 0.86	4.51 ± 1.25	0.275
Post-operative weeks 4–6	1.47 ± 0.87	1.73 ± 1.00	1.49 ± 1.16	0.136
POSAS Patient's score (Mean ± SD)				
Post-operative weeks 4–6	1.64 ± 0.78	1.71 ± 0.82	2.13 ± 1.15	< 0.001*
POSAS Observer's score (Mean ± SD)				
Post-operative weeks 4–6	1.16 ± 0.46	1.23 ± 0.56	1.55 ± 0.86	< 0.001*
Surgeon's satisfaction score (Mean ± SD)	9.26 ± 0.70	7.78 ± 0.94	7.33 ± 0.86	< 0.001*
Patient's satisfaction score (Mean ± SD)	4.48 ± 0.70	4.38 ± 0.70	4.18 ± 0.90	0.022*
Time for skin closure	7.69 ± 1.08	4.91 ± 0.88	0.87 ± 0.08	< 0.001*

VAS: Visual analogue scale, SD: Standard deviation, POD: Post-operative day, POSAS: The Patient and Observer Scar Assessment Scale, (*) indicates clinically significant results

the monocryl group (group A), and cosmesis was worst in the staple group (group C). Time for skin closure was minimum in staple group (Table 3).

Discussion

The appropriate skin closure method has been a subject of research for several years and has been largely dependent

on the choice of the surgeon as per their preference and experience. Considering, the huge number of caesarean deliveries performed annually around the world, the method of wound closure technique at caesarean section is very crucial.

Wound complications including wound disruption, wound separation, hematoma formation, seroma formation, induration, swelling, discharge and need of re-suturing have been assessed in large number of studies and outcomes are variable. Majority of literature including randomized trials and latest systemic reviews concluded that the wound complications were more in the staple group when compared with the suture group and our findings are consistent with the results of these studies [8–12]. However, some authors reported comparable outcomes between closure by sutures and staples [13–15]. Another randomized control trial by Cooper et al. did not find significant difference in wound complication rate after hospital discharge in 350 women undergoing CS skin closure by suture or staple. In obese women, Mackeen et al. [10] reported significantly decreased wound complication after skin closure by suture versus staples. However, a recent meta-analysis by Han et al. has reported comparable outcomes in terms of wound infection, dehiscence or satisfaction score after skin closure by suture or stapler even in the women with BMI more than or equal to 30 kg/m^2 [14]. In the present study, we found that the wound dehiscence was significantly higher in staple group as compared to subcutaneous absorbable or non-absorbable suture skin closure at POD 7–10 and at 4–6 weeks after CS. Similar findings were also observed by other investigators.

The most frequent issue following any surgery is pain and directly related to patient satisfaction. Thus, postoperative pain management is crucial for patient recovery. However, there is plenty of published literature comparing the effect of various skin closure techniques on pain perception by various methods like VAS score, although the results were conflicting. Nayak et al. observed that women receiving staples perceived more pain at POD 7 compared with sutures [11] which is consistent with the findings in the present study. The different times of assessment and variations in analgesic protocols very well explained the inconsistent outcomes of different studies.

Cosmetic outcome after a surgery has supreme importance to patients specifically young women who underwent caesarean delivery; however, scarring can also have an impact in terms of pain and might have a negative impact on quality of life. Studies assessing skin closure techniques found varied outcomes in terms of cosmetic appearance. C et al. found the equivalent cosmetic appearance of the scar with staples and subcuticular sutures when evaluated at second and sixth month, whereas, in corroboration with our results, Feisher et al. concluded that satisfaction with the scar's appearance, and patient and physician assessments of scar cosmesis were all superior in those closed with suture [16]. Closure time has been compared by many studies and results were comparable with our findings which showed the fastest closure with staples [8, 9].

There are additional issues concerning closure technology, including cost and surgeon safety, which have not been assessed in the present study. However, previous studies have shown that absorbable subcuticular sutures were the most economical method followed by non-absorbable sutures. Although not calculated, it can be postulated that absorbable sutures might be most cost-effective by reducing the need for visit to remove for non-absorbable sutures/staples. Moreover, as wound complications arise, additional visits, readmission or re-suturing may be needed as per the condition of the wound which adds to the economic burden which is seen mostly in the staples group as wound complications are maximum in that group. An advantage of using staples in place of sutures is a reduction in the risk of needle stick injury to the surgeon and assistant.

The Federation of Obstetric and Gynaecological Societies of India (FOGSI) Consensus Statement for Caesarean Section, 2014 suggested the use of any absorbable or non-absorbable suture or staples or vertical mattress for skin closure keeping in mind the diverse practices in our country [17]. However, the guidelines from developed countries have suggested use of sutures rather than staples for skin closure after CS (18).

Overall, despite numerous investigations to assess the most optimal closure technique, there has been no definitive evidence to support the superiority of one technique over others. The current study represents an important contribution to the growing literature showing the efficacy of suture closure over staplers in terms of lower wound complications. It has many strengths, including the randomized design, good sample size, use of internationally developed and validated assessment tools for subjective outcomes such as pain and cosmetic appearance that have enhanced reliability and validity. Being single centric, it ensures the uniformity of care and also inclusion of emergency cases increased its generalizability. Although this was controlled by randomization and exclusion of patients based on factors known to affect wound healing, still there could be unmeasured variables that confounded the results. Many surgeons performed the procedures, which could have affected the internal validity of the study results although this was also largely controlled for by evaluating the experience of the surgeon performing skin closure which was found to be comparable among the three groups. Nowadays, numerous surgeons are the reality at most healthcare centres, thereby enhancing the external validity of the study.

The main limitation of our study was exclusion of women with BMI more than 35, which might confound the primary

outcome, and the conclusions may not apply to morbidly obese women. Similarly, a short follow-up of 6 weeks limited the cosmetic assessment of scars, which is better assessed at 6 months due to completion of scar remodelling. Hence, for cosmesis evaluation, a follow-up till 1 year would have been more reliable.

Our study suggests a benefit with sutures in terms of decreased wound dehiscence, wound infection (discharge along with swelling, redness, induration), cosmetic results and patient satisfaction. However, no major effect on the pain score was seen. Staplers have the only benefit of lesser application time. Among the two methods of suture closure, a marginal benefit in absorbable subcuticular monocryl suture group was seen. Hence, our study represents an important contribution to the growing literature showing the efficacy of suture closure in reducing wound complications.

Acknowledgements The authors would like to thank the whole staff for their help in the acquisition and management of data, reading and in paper reviewing. This study received no external funding.

Author Contributions Shreya S Kushwaha was involved in patient enrolment, acquisition of data, analysis and interpretation of data. Seema Singhal helped in analysis and interpretation of data, drafting of the article and revision for important intellectual content. Soniya Dhiman assisted in contributions to concept and design and implementation of study and data interpretation. Swati Tomar helped in contributions to concept and design and implementation of study and data interpretation. Jyoti Meena helped in contributions to concept and design and revision of article. Kallol K Roy was involved in contributions to concept and design and revision of article. Sunesh Kumar assisted in contributions to concept and design and revision of article. All authors have read and agreed to this version of the manuscript.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Ethics Committee. (IECPG-545/14.11.2018, RT-1/19.12.2018).

Informed Consent Informed consent was taken from all the enrolled patients of the study.

References

1. Berghella V, Mackeen AD, Jauniaux ERM. Cesarean delivery. In: Gabbe's Obstetrics: Normal and problem pregnancies. 8th ed. Amsterdam: Elsevier; 2021.
2. Angolile CM, Max BL, Mushemba J, et al. Global increased cesarean section rates and public health implications: a call to action. Health Sci Rep. 2023;6(5): e1274. https://doi.org/10.1002/hsr2.1274.
3. Neethi Mohan V, Shirisha P, Vaidyanathan G, et al. Variations in the prevalence of caesarean section deliveries in India between 2016 and 2021—an analysis of Tamil Nadu and Chhattisgarh. BMC Pregnancy Childbirth. 2023;23(1):622. https://doi.org/10.1186/s12884-023-05928-4.
4. Grabarz A, Ghesquière L, Debarge V, et al. Cesarean section complications according to degree of emergency during labour. Eur J Obstet Gynecol Reprod Biol. 2021;256:320–5. https://doi.org/10.1016/j.ejogrb.2020.11.047.
5. Carbonnel M, Brot D, Benedetti C, et al. Risks factors for wound complications after cesarean section. J Gynecol Obstet Hum Reprod. 2021;50(7): 101987. https://doi.org/10.1016/j.jogoh.2020.101987.
6. Narice BF, Almeida JR, Farrell T, et al. Impact of changing gloves during cesarean section on postoperative infective complications: a systematic review and meta-analysis. Acta Obstet Gynecol Scand. 2021;100(9):1581–94. https://doi.org/10.1111/aogs.14161.
7. Poprzeczny AJ, Grivell RM, Louise J, et al. Skin and subcutaneous fascia closure at caesarean section to reduce wound complications: the closure randomised trial. BMC Pregnancy Childbirth. 2020;20(1):606. https://doi.org/10.1186/s12884-020-03305-z.
8. Zaman S, Mohamedahmed AYY, Peterknecht E, et al. Sutures versus clips for skin closure following caesarean section: a systematic review, meta-analysis and trial sequential analysis of randomised controlled trials. Langenbecks Arch Surg. 2022;407(1):37–50. https://doi.org/10.1007/s00423-021-02239-0.
9. Huang Y, Yin X, Wei J, Li S. Comparison of the effect of skin closure materials on skin closure during cesarean delivery. PLoS ONE. 2022;17(6): e0270337. https://doi.org/10.1371/journal.pone.0270337.
10. Mackeen AD, Sullivan MV, Schuster M, et al. Suture compared with staples for skin closure after cesarean delivery: a systematic review and meta-analysis. Obstet Gynecol. 2022;140(2):293–303. https://doi.org/10.1097/AOG.0000000000004872.
11. Nayak GB, Saha PK, Bagga R, et al. Wound complication among different skin closure techniques in the emergency cesarean section: a randomized control trial. Obstet Gynecol Sci. 2020;63(1):27–34. https://doi.org/10.5468/ogs.2020.63.1.27.
12 Jijon-Knupp R, Sanchez-Ramos L, Kaunitz A. Sutures versus staples for skin closure after cesarean delivery. Does the type of suture matter? A direct and indirect comparison meta-analysis. Am J Obstet Gynecol. 2018;18(1):S521-1.
13. Madsen AM, Dow ML, Lohse CM, et al. Absorbable subcuticular staples versus suture for caesarean section closure: a randomised clinical trial. BJOG. 2019;126(4):502–10. https://doi.org/10.1111/1471-0528.15532.
14. Han D, Feng L, Xu L, et al. Staples versus subcuticular suture for cesarean skin closure in obese women: a systematic review and meta-analysis. J Gynecol Obstet Hum Reprod. 2022;51(8):102420. https://doi.org/10.1016/j.jogoh.2022.102420.
15. Cooper SM, Blanchard CT, Szychowski JM, et al. Does time of wound complication after Cesarean delivery differ by type of skin closure? Am J Perinatol. 2019;36(9):981–4. https://doi.org/10.1055/s-0038-1675767.
16. Fleisher J, Khalifeh A, Pettker C, et al. Patient satisfaction and cosmetic outcome in a randomized study of cesarean skin closure. J Matern Fetal Neonatal Med. 2019;32(22):3830–5. https://doi.org/10.1080/14767058.2018.1474870.
17. Biniwale P, Gupte S, Ganguli I, Mane S, Shitut P, Akolekar R, et al. Consesus Statement Cesarean Section. FOGSI; 2014. Accessed on 15 March 2024. https://www.fogsi.org/wp-content/uploads/2015/11/fogsi_gcpr_ceserean_section.pdf
18. Caesarean birth. London: National institute for health and care excellence (NICE); 2023 Sep 6. PMID: 33877751.