Scar appearance of different skin and subcutaneous tissue closure techniques in caesarean section: A randomized study

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Abstract

Objectives: To determine the role of skin and subcutaneous space closure in caesarean section on the cosmetic appearance of the scar and the patients’ satisfaction.

Study design: 153 patients undergoing caesarean section without prior abdominal delivery were included and randomly assigned in a non-blinded study to four different combinations of skin and subcutaneous tissue closure. The scar was assessed after a period of at least 4 months by a self-developed protocol and the patient was asked to complete a survey regarding her satisfaction with the scar.

Results: One hundred patients were eligible for long-term evaluation of the scar. Skin closure by either staples or intracutaneous suture in combination with closure or non-closure of the subcutaneous space has a comparable outcome in view of cosmetic outcome and patient satisfaction.

Conclusions: All four methods of skin closure seem to be a reasonable choice in caesarean section because they have comparable cosmetic outcome, do not differ with respect to the patients’ satisfaction and bear comparable costs.

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Keywords: Caesarean section; Skin closure; Staples; Cosmetic result

1. Introduction

In contemporary Obstetrics the caesarean section (CD) rate is increasing and has become a routine procedure. In an overview on evidence-based surgery for caesarean section from Berghella et al., it was demonstrated that most major steps of the operation are supported by good quality recommendations [1]. When it comes to the closure of skin and subcutaneous space, however, personal preferences and opinions diverge between the use of staples or intracutaneous suture of the skin and closure versus non-closure of the subcutaneous space. In a systematic review of the Cochrane Database, a clear lack of data on materials and techniques of skin closure following caesarean section was found [2]. Both the article from Berghella et al. and the Cochrane Database review demonstrated that there are no data available regarding long-term outcome of subcutaneous and skin closing techniques, both experienced from the woman and evaluated by a medical examiner.

Therefore, it was the purpose of our randomized study to determine the role of skin and subcutaneous space closure in caesarean section on the scar appearance and the women’s satisfaction.

2. Methods

Following approval of the local ethics committee responsible for human experimentation, women of the University Hospital of Zürich undergoing caesarean delivery were recruited for this randomized study starting in December 2003. All women undergoing caesarean delivery without prior scars from abdominal delivery were eligible if time allowed informed consent. Therefore, not only patients before labour or rupture of membranes (= elective caesarean section), but also patients after established contractions who failed to deliver vaginally (= secondary caesarean section)

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were included in the study. Exclusion criteria for participation in the study were diabetes mellitus, amniotic infection or other infection or emergency caesarean section.

The women were randomly assigned to one of the following four groups by the drawing of an opaque, sealed envelope by the nurse attending the operation:

- closure of the skin with an intracutaneous suture and closure of the subcutaneous tissue with single stitches (Group I),
- closure of the skin with an intracutaneous suture and non-closure of the subcutaneous space (Group II),
- closure of the skin with staples and closure of the subcutaneous tissue with single stitches (Group III) and
- closure of the skin with staples and non-closure of the subcutaneous space (Group IV).

The nurse informed the surgeon of the procedure to use in the closure of skin and subcutaneous tissue. All the operations were performed with a horizontal Pfannenstiel laparotomy with spinal anaesthetic. The placenta was removed with gentle cord traction and the uterus was not exteriorized for repair in all cases. After the operation was performed as previously described by our group [3] the subcutaneous space was closed with single knot stitches with Vicryl 3-0 or left unclosed, corresponding to the envelope drawn. The skin was closed either with a continuous intracutaneous suture with Vicryl 3-0 Rapid or with staples. The wound was additionally stabilized with adhesive strips and then dressed with gauze. A consultant of the Obstetric Clinic of the University Hospital of Zurich performed as assistant the operation. Neither the patient nor the attending obstetricians were blinded towards the study group.

The staples were removed on the 6th day post partum from the attending nurse while the intracutaneous suture was left in situ. All women received antibiotic prophylaxis after delivery of the baby with a single dose of a second-generation cephalosporin, were mobilized beginning on the day of the operation and received thromboprophylaxis with 5,000 IE of low-molecular weight heparin daily until the 5th day after the operation. The women’s characteristics are summarized in Table 1.

The women were invited to a follow-up examination after a minimum of 4 months postoperatively. At this time the woman was asked to complete a survey with questions concerning persisting pain of the wound area, other complaints such as pressure or pulling, the satisfaction with the cosmetic outcome in regard to color, size and overall visibility of the scar, the degree of restriction in activities due to the scar and if the she feels impaired in her appearance by the scar. Adding the points resulted in an overall score with regard to woman’s satisfaction.

Following the completion of the survey, the scar was examined by one single non-blinded physician (I.G.) to ensure maximum uniformity in point assignment. Each criterion was awarded zero (very unsatisfied) to a maximum of four points (very satisfied). Adding the points resulted in an overall score with regard to the scar appearance (Table 2).

In a pre-trial evaluation we found that the following criterions to evaluate the scar contributed to the scar appearance and therefore were used to evaluate the scar: width, above or below level of surrounding skin surface, consistency of the scar tissue, consistency of surrounding subcutaneous tissue, deviation of scar color from skin color, adhesion between skin and deeper tissues, skin separation, scar contraction, keloid and cross hatching. The scoring system used in our study was developed from the authors. In a pre-trial evaluation we found that a difference in the point

Table 1

<table>
<thead>
<tr>
<th>Women characteristics</th>
<th>Group I (N = 25)</th>
<th>Group II (N = 24)</th>
<th>Group III (N = 26)</th>
<th>Group IV (N = 25)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother’s age (mean)</td>
<td>31.1</td>
<td>30.3</td>
<td>32.5</td>
<td>31.6</td>
<td>n.s.</td>
</tr>
<tr>
<td>Gestational age (mean)</td>
<td>37 + 3</td>
<td>38 + 0</td>
<td>37 + 1</td>
<td>37 + 6</td>
<td>n.s.</td>
</tr>
<tr>
<td>Single pregnancy</td>
<td>72%</td>
<td>91.7%</td>
<td>80.2%</td>
<td>91.6%</td>
<td>n.s.</td>
</tr>
<tr>
<td>Twin pregnancy</td>
<td>24%</td>
<td>8.3%</td>
<td>15.4%</td>
<td>4.2%</td>
<td>n.s.</td>
</tr>
<tr>
<td>Triplets</td>
<td>4%</td>
<td>0%</td>
<td>3.8%</td>
<td>4.2%</td>
<td>n.s.</td>
</tr>
<tr>
<td>Elective caesarean section</td>
<td>44%</td>
<td>79.2%</td>
<td>65.4%</td>
<td>70.8%</td>
<td>n.s.</td>
</tr>
<tr>
<td>Secondary caesarean</td>
<td>56%</td>
<td>20.8%</td>
<td>34.6%</td>
<td>29.2%</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

Elective caesarean section = caesarean section before labor or rupture of membranes; secondary caesarean section = caesarean section after established contractions who failed to deliver vaginally; n.s.: not significant.

Table 2

<table>
<thead>
<tr>
<th>Cosmetic appearance</th>
<th>Patient satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>Pain</td>
</tr>
<tr>
<td>Protrusion/indentation</td>
<td>Discomfort</td>
</tr>
<tr>
<td>Consistency of the scar</td>
<td>Other complaints</td>
</tr>
<tr>
<td>Consistency of the underlying tissue</td>
<td>Color</td>
</tr>
<tr>
<td>Adhesions</td>
<td>Overall visibility</td>
</tr>
<tr>
<td>Keloid</td>
<td>Restrictions due to the scar</td>
</tr>
<tr>
<td>Cross hatching</td>
<td>Appearance impaired</td>
</tr>
<tr>
<td>Scar contraction</td>
<td>Size of the scar</td>
</tr>
<tr>
<td>Scar separation</td>
<td></td>
</tr>
<tr>
<td>Skin colour</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>32</td>
</tr>
</tbody>
</table>

Points from 0 to 4 were assigned. Points were deducted according to the severity of complication or undesirable result. High points stand for a favorable outcome.
assignment of five or more resulted in a different subjective evaluation of the scar appearance.

Additionally, we evaluated the influence of the method of skin and subcutaneous tissue closure on the rate of wound complications after the operation and on the total operation time (from incision of the skin to the end of the skin closure). The following wound complications occurred:

- wound infection: swelling and reddening of the wound with the necessity to open the wound surgically,
- seroma: accumulation of lymphatic fluid in the wound with the necessity to drain this fluid accumulation,
- haematoma: blood or blood coagula accumulation with the necessity to open the wound surgically,
- wound disruption: a dehiscence of the skin which needed conservative treatment with patches.

The equality of populations test (Kruskal–Wallis test) was used to test differences between the four groups of women. The two-sample Wilcoxon rank-sum (Mann–Whitney) test was applied to test differences between two groups of women. Differences were considered significant with \( P < 0.05 \). A power calculation (analysis of equivalence) was performed to calculate the appropriate sample size. A sample size of 25 women in each group and a difference of interest of 5 points in the scores give a power of 78% at the 5% significance level. The graphic data are presented with scatterplots and the median values. All statistical analyses were performed with STATA 9.2 Statistics/Data Analysis Software (Stata Corporation, College Station, TX).

3. Results

One hundred and fifty three from 200 women who were approached to participate were recruited over a period of 16 months between December 2003 and May 2005. Of these, 53 were lost before the long-term evaluation. The reason for this high rate of lost to follow up is predominantly the rate of occupational mobility among women included in our study. Women lost for long-term evaluation originated equally from all four groups. A total of 100 women could be followed through the long-term evaluation 4 months postoperatively (Fig. 1). The women in the four study groups were not statistically different with respect to maternal age, gestational age, rate of elective and secondary caesarean section and the number of twin and triplet pregnancies (Table 1).

Ten wound complications were found (7%), which could be attributed to the following groups:

- Group I: one wound infection.
- Group II: three wound infections and one seroma.
- Group III: one haematoma which needed surgical intervention and three wound disruptions over a short distance of the incision.

- Group IV: one haematoma with need of surgical intervention.

All of the wound infections and the seroma were opened with local anesthesia. No systemic antibiotic therapy was used. Healing after the procedure was without additional complications. The haematomas in two women developed shortly after the operation. Overall the number of wound complications did not differ significantly between the four groups.

Comparing the groups regarding scar appearance (Fig. 2) at the long-term follow-up examination 4 months post partum, none of the women used oral analgetics and only

Fig. 1. Flow chart of randomization in the study. Short-term morbidity is the occurrence of complications during the hospital stay. Long-term outcome is the evaluation after at least 4 months after the caesarean section.

Fig. 2. Scatterplot of the scar appearance score among the four groups at the examination 4 months post partum (I: skin suture, subcutaneous suture; II: skin suture, subcutaneous no suture; III: skin staples, subcutaneous suture; IV: skin staples, subcutaneous no suture).
Table 3
Comparison of patient satisfaction and scar appearance between groups (n.s.: not significant)

<table>
<thead>
<tr>
<th>Compared groups</th>
<th>Patient satisfaction</th>
<th>Scar appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I versus Group II</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>Group III versus Group IV</td>
<td>n.s.</td>
<td>$P &lt; 0.05$</td>
</tr>
<tr>
<td>Groups I and II versus Groups III and IV</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>Groups I and III versus Groups II and IV</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

one significant difference was found. When comparing groups III (staples and subcutaneous stitches) and IV (staples without subcutaneous stitches), the group without subcutaneous stitching showed a statistically significant improvement in cosmetic outcome over the group with subcutaneous stitches ($P < 0.05$) (Table 3). No significant difference was observed when all the patients with sutures were compared with all the women with staples, irrespective of the closure or non-closure of the subcutaneous tissue, or when all the women with or without closure of the subcutaneous tissue irrespective of the method of skin closure were compared (Table 3).

In the woman satisfaction score (Fig. 3) there were no differences in the above-mentioned comparisons.

Interestingly, there was a much wider spread in scores when women evaluated their own scar (6–32 points) as compared to the evaluation by the examiner (29–40 points).

The average surgery time was 27.1 min when the skin was sutured and 23.8 min when the skin was stapled, irrespective of the closure or non-closure of the subcutaneous tissue. Paradoxically, the total operation time was longer when no subcutaneous stitches were used in comparison to the use of subcutaneous stitches irrespective of the method of skin closure (26.3 min versus 24.6 min). Based upon these times, the running intracutaneous suture lengthens the average surgical time significantly by 3.3 min ($P < 0.05$) and performing a subcutaneous suture does not significantly change the total operation time.

4. Discussion

Our results on the outcome of four different skin and subcutaneous tissue closing techniques during caesarean section showed only minor differences in the scar appearance 4 months after the procedure. The only statistically significant difference (however only minute) was detected when the subcutaneous tissue was not reap proximated with sutures in comparison to the closure of the subcutaneous tissue in patients with staples. Interestingly, this judgment was not shared in the women’s evaluation. Therefore, we believe that this result is not of adequate relevance to abandon the closure of the subcutaneous tissue in order to improve the scar appearance. The satisfaction on the long-term evaluation varied widely within each group and often showed large discrepancies with the evaluation of the physician. Despite the wide ranges in patient satisfaction within the four groups, the medians and averages distributed evenly and the patients of all four groups were similarly satisfied.

Elective caesarean section is the most common major surgical procedure in western countries. The safety of the procedure has dramatically improved because of the experience with less traumatic operation procedures and the routine administration of antibiotics [4]. The more the caesarean section becomes an elective rather than an emergency procedure, functional and cosmetic aspects gain increasing importance. Surprisingly, in the literature there is a clear lack of evidence on how the skin should be closed after caesarean section in terms of long-term morbidity and scar appearance. The Cochrane Review of “Techniques and materials for skin closure in caesarean section”, updated in August 2005, [2] found only one study done by Frishman et al. comparing staples and subcuticular suture to be sufficiently randomized. In this randomized study, staples and absorbable subc ticular sutures following caesarean delivery in 50 women were compared [5]. The authors report a longer operation time, but less postoperative pain if the incision was closed with a subcuticular suture. No long-term outcome is reported. Therefore, the Cochrane review concludes that there is a lack of evidence on the best method of skin closure after caesarean section and calls for more studies concentrating on minimizing scarring, infec tion, long-term morbidity and scar appearance. The same conclusion was drawn in a recent review by Berghella et al. on evidence-based surgery for caesarean delivery [1]. The authors recommended, based on a recently published meta-analysis which reviewed six randomized trials on subcutaneous suture in obstetric patients, closure of the subcutaneous tissue when thickness is $\geq 2$ cm, but concluded that the available studies on subcutaneous tissue closure are generally of poor quality and therefore do not allow for evidence-based recommendations as to the best method [6]. A recent prospective randomized controlled trial demonstrated no significant change in the incidence of overall wound complications independent from the closure or non-closure of the subcutaneous tissues in women with 3 cm or...
more subcutaneous fat [7]. The latter study was not performed with obstetric, but with elderly gynaecological patients, who had longer operation times. Therefore, these results may not be applicable to caesarean sections.

None of these studies examined the scar appearance of the wound. Based upon our experience, the wound still undergoes major changes during the first 3 months and the final result cannot be evaluated before this time point. An objective evaluation of the “scar appearance” is a priori difficult, because scar appearance is a complex impression of the overall aspect of the scar. No single parameter alone, such as protrusion or adhesion of the scar, describes the complex impression of the scar appearance. In a pre-trial evaluation we found that all the parameters we used in our study contributed to the cosmetic appearance of the scar and that a difference in the point assignment of 5 resulted in a difference in the subjective evaluation of the scar appearance. It is a weakness of our study that we cannot prove that the parameters used in our study are independent predictors of the scar appearance. It is also possible that adding the points of the different parameters and generating a sum-score minimizes differences that could be important in the scar appearance. However, an analysis of each criterion separately between the four groups gave no statistically significant differences and was in concordance with the sum score. The major determinant in the cosmetic appearance of the scar is presumably the method of skin closure, but no significant difference was found if the skin was stapled or if a continuous intracutaneous suture was performed, irrespective of the closure or non-closure of the subcutaneous tissue.

This study not only compared different methods of skin closure during caesarean section, but also closure or non-closure of the subcutaneous tissues, since both skin and subcutaneous repair determine the final scar appearance. We performed a four arm 1-1-1-1 randomized, non-blinded study which included 152 participants. This number is not enough to evaluate short-term morbidity with respect to the method of skin closure, which was not the aim of our study. The gross distribution of postoperative complications in our study did not differ in number between the stapled and the sutured group.

With the rising cost of health care, the financial aspect is important when choosing between materials that provide a similar outcome. At the University Hospital of Zurich the one-way skin stapler ULC35 from Tyco was used at a cost of 9.87 Swiss Francs (CHFr). For the subcuticular suture a Vicryl rapid 3/0, FS-1, 45cm from Ethicon-Johnson & Johnson was used, at a cost of 5.67 CHFr. The additional surgery time spent for sutures was 3.4 min with intracutaneous sutures and did not significantly differ with subcutaneous sutures. Therefore, our considerations at the University hospital of Zurich speak in favor of a running intracutaneous suture, because this method does not necessitate a clinical visit to remove the stitches and only minimally prolongs the time of the operation.

In conclusion, our study confirms that the four different methods of skin and subcutaneous tissue closure used in our study group give a comparable scar appearance and achieve similar patient satisfaction. Our results are not generalizable to women with emergency caesarean section, mothers with diabetes mellitus, amnion infection or any other infection and to medical institutions using different techniques of skin closure in caesarean section than the four methods used in our study.

References