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Original Research Article

Post Caesarean Section Wound Healing and Factors that Affected Outcome in a Teaching Hospital in Southeast Nigeria

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Abstract: Caesarean section is the delivery of a foetus through surgical incisions in the abdominal and uterine walls. A rise in the rates has been reported, and many may be medically unnecessary but may still be associated with wound complications. Studies evaluating the post caesarean section wound complications and associated risk factors are sparse, and the few available are retrospective. The study aimed to determine the quality of wound healing after caesarean section and elicit factors that may affect outcome. ***Materials and Methods*:** The study was a prospective observational study carried out in a Teaching Hospital in South-East Nigeria. Ethical approval and informed consent were obtained. The information obtained included the socio-demographic data, the pre-, intra-, and the post-operative data including wound characteristics assessed with modified ASEPSIS wound score. Data obtained was analysed with SPSS version 29. Chi square (X^2) was used to test for significance and values < 0.05 was considered significant. Results were presented in tables, charts, and prose. ***Results*:** 134 women were delivered by caesarean section (37.6%). The mean ASEPSIS score was 4.8. Seventy-eight percent had satisfactory healing while others had various grades of wound complications. The average body mass index (BMI) was 30.3 kg/m^2 ± 6.3 kg/m^2 (SD). The mean haematocrit value was 31.7% ± 6.3% while the mean estimated blood loss was 426.45ml ±165.09 (SD). The BMI, haematocrit and blood loss were among the factors that affected outcome. ***Conclusion*:** About 22% of patients had various forms of wound challenges with associated factors elicited. Efforts at controlling these factors will improve outcome.

Keywords: Caesarean Section, Wound Complications, ASEPSIS Wound Scores.

INTRODUCTION

Caesarean section is the process of delivery of a foetus through surgical incisions made in the abdominal and uterine walls (Louis, 2018). It is clinically indicated when vaginal delivery poses a threat to the life of the mother and or the baby. The ideal rate of caesarean section globally is considered to be 10 - 15% although it varies widely within and between countries across the world (Byamugisha & Adroma, 2020), (Betrán & Wagner, 2007), (Boerma *et al*., 2018).

A rise in the rates of caesarean section has been reported, and many may be medically unnecessary but may still be associated with complications most often wound healing challenges (Harrison *et al*., 2019), (Guinto, 2012), (Ismail *et al*., 2021). It is of utmost importance that these wounds heal well but, in some cases, it is not so as wound related complications arise.

Post-operative wound complications may occur early or late during post-operative care. Early complications often include surgical site infection (SSI), wound dehiscence and haematoma among others. These also constitute the commonly occurring post caesarean section wound complications. Although SSI are the commonest and are reported in most studies, they are interrelated and often co-exist with the other complications. SSI can occur within 30 days of surgery or 90 days if an implant is left behind and can result in wound dehiscence (Gibbons *et al*., 2010), (Desvigne, 2023), (Kirkland KB, *et al*., 1973). Wound dehiscence is the separation of the edges of suture line by more than 1cm following a surgical procedure. Caesarean section particularly those with vertical abdominal wall incision is one of the most common abdominal surgeries known

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to be associated with wound dehiscence (Mowat & Bonnar, 1971). Accumulation of clotted or non-clotted blood on the outside of the blood vessel is referred to as hematoma. It is not as common as SSI or wound dehiscence but can predispose to both (Desvigne, 2023), (Kahveci *et al*., 2020).

A number of factors which could be local or systemic are known to affect wound healing. Surgical techniques, prolonged time of surgery predisposing to local infection and blood loss are among the local factors that can affect healing and these may be affected in emergency scenarios (Alfouzan *et al*., 2019), (Jido & Garba, 2012). Prominent among systemic factors that increase the risk of wound complication are obesity, co-morbid conditions and drugs (Jabbar *et al*., 2016), (Gomaa *et al*., 2021), (Opøien *et al*., 2007).

Identifying these risk factors can influence policy framework that will result in reduction of wound complication while early detection and timely treatment of complications is needed to ensure healing by primary intention. To the best of our knowledge, studies evaluating the post caesarean section wound complications and associated risk factors are sparse, and the few available ones are retrospective. The aim of the study was to determine the quality of wound healing after caesarean section and elicit factors that may affect outcome.

Materials and Methods

The study was a prospective observational study carried out in a teaching hospital in South-East Nigeria. The sample size was calculated using the formula for prevalence studies ($N = Z_{1-\alpha/2}^2 PQ/.D^2$), where N is sample size, $Z_{1-\alpha/2}^2$ is critical value at 95% confidence interval and = 1.96, P is prevalence which was obtained from a study on the prevalence of caesarean-section (Gunn *et al*., 2017) and = 7·.2%, Q = 1-P, while D is precision and = 5% giving 103. When this was added to 10% attrition value of 10 the sample size became 113.

The Medical Research Ethics Committee of the Teaching Hospital gave ethical approval for the conduct of the research while informed consent and consent for purpose of publication were obtained from the patients before data collection.

The information obtained included the socio-demographic data, the pre-operative data, the intra-operative data and the post-operative data. Post-operative wound characteristics were assessed with modified ASEPSIS (Mba *et al*., 2025) wound score, which is an acronym for Additional treatment, presence of Serous discharge, Erythema, Purulent discharge, Separation of deep tissues, Isolation of bacteria and the duration of in-patient Stay.

Data obtained was analysed with SPSS version 29. Chi square (X^2) was used to test for significance and values < 0.05 was considered significant. Results were presented in tables, charts, and prose.

Results

There was a total of 356 deliveries in the hospital within the period of this study, out of which 134 (37.6 %) women were delivered by caesarean section. One hundred and thirty-two patients that met inclusion criteria were recruited for the study. They were aged between 19 and 43 years with a median age of 32 years and mean of 31.7 ± 5.3 years (SD). The most frequently recorded age group was 35 to 39 years (Figure 1). Only 4 women representing 3.0% had comorbid condition. Majority of the women were multiparous (Table 1) with parity ranging from 0 to 4 with a median of 2.

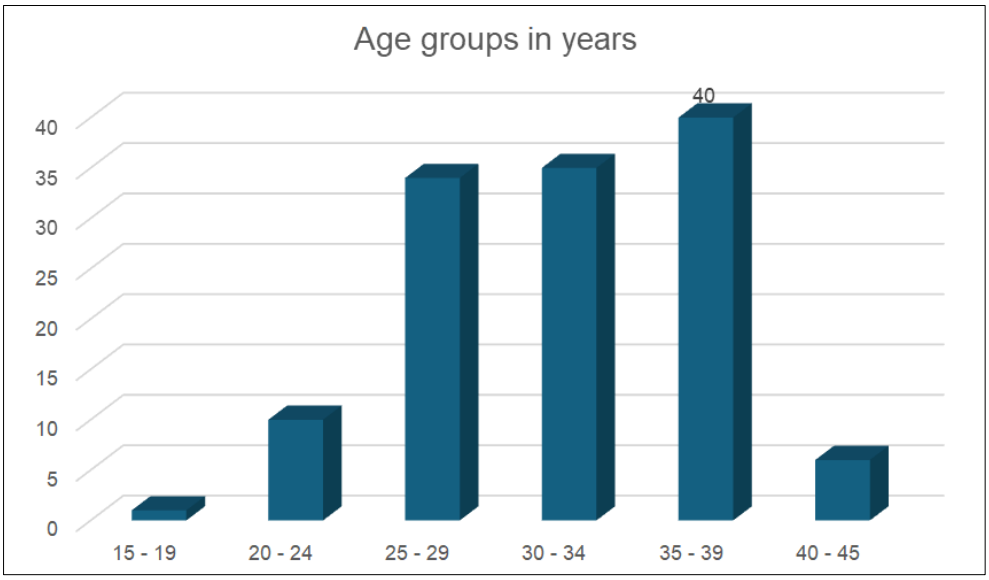

Figure 1: Age group distribution of women that had delivery by caesarean section

Table 1: Distribution of parity

Variables	Frequency	Percentages
Parity		
0	19	14.39
1	41	31.06
2 - 4	66	50.00
Missing	6	4.55

Most surgeries were carried out at gestational age of 38 to 40 weeks (Table 2). Majority of the cases were done as emergency procedures while most women were booked (Table 2)

All the women were shaved either on the eve, or the day of surgery with shaving stick (BIC^{R}). (Table 3) Two most senior categories of surgeons performed all the procedures. (Table 3)

Table 2: Distribution of pre-operative characteristics

Gestational age (weeks)	Frequency	
28 - <34	4	3
34 - <37	7	5.3
37 - <39	45	34.09
39 - <40	18	13.63
40 - <42	46	34.85
≥42	3	2.27
Missing	9	6.81
Booking status		
Booked	104	78.79
Unbooked	27	20.45
Missing	1	0.76
Type of caesarean section		
Elective	59	44.70
Emergency	73	55.30

All the patients except 1 (99.2%) received prophylactic antibiotics in the form of ceftriaxone administered during the administration of anaesthesia. Skin preparation was done with Purit^{R} solution, which was made of Chlorhexidine gluconate 0.3%, Cetrimide 3%, and isopropyl alcohol (Saro Lifecare limited, Ibadan, Nigeria) and 70% methylated spirit in 131 patients representing 99.2% while septol solution was used in 1 (0.8%) only.

Pfannenstiel incision was the most common technique used (Table 3) the rectus sheath and skin closure were as shown in Table 3. The mean estimated blood loss was 426.4ml ± 65.0 (SD) with a range of 100ml to 1000ml and a median of 400ml.

Table 3: Distribution of pre- and intra-operative activities

Time of shaving	Frequency	Percentage
The same day	70	53
On the eve	49	37.1
On table	13	9.8
Total	132	100
Rank of surgeon		
Consultant	39	29.5
Senior registrar	93	70.5
Total	132	100
Type of anaesthesia		
Spinal	126	95
General	5	3.7
Epidural	1	0.8
Total	132	100
Type of incision		
Pfannensteil	121	91.7
Midline	10	7.6

Time of shaving	Frequency	Percentage
Missing	1	0.8
Total	132	100
Rectus closure		
Absorbable	126	95.5
Non-absorbable	6	4.5
Total	132	100
Skin closure		
Absorbable Subcuticular	113	85.6
Non-absorbable skin sutures	18	13.6
Missing	1	0.8
Total	132	100

A mixture of povidone iodine and methylated spirit was used for immediate post-operative wound dressing in all cases. Wounds were inspected for the first time from 3 to 7 days with a mean of 4.3 days ± 0.8 days (SD) and a median of 4 days.

Prophylactic antibiotics were extended for a period of 1 week post-operatively in all cases. Beyond this, antibiotic therapy was extended based of signs of infection or wound microscopy, culture and sensitivity in 16 patients representing 12.1%.

The mean ASEPSIS score was 4.8 ± 8.9 with a range of 0 to 44 and a median of 1. From the grading of the ASEPSIS scores, 104 patients representing 78.8% had satisfactory healing while others had various grades of wound healing challenges. (Figure 2)

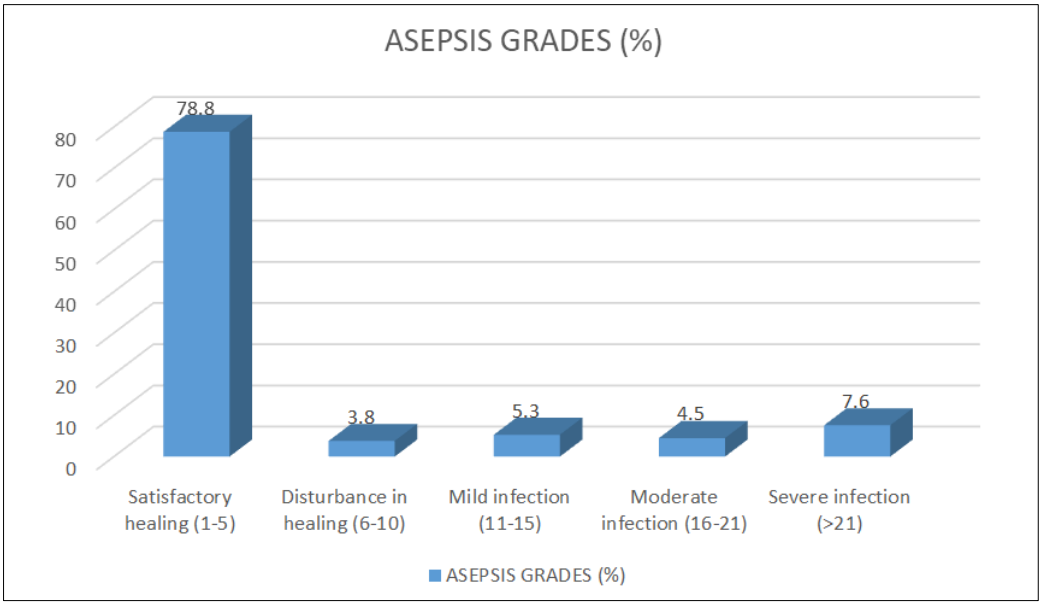

Figure 2: Distribution of outcome (ASEPSIS score grades)

The body mass index had statistically significant effect on ASEPSIS scores. The linear-to-linear association and correlation between the two were 0.003 and 0.002 respectively. The relationship between class of BMI and the ASEPSIS score were also statistically significant (P = 0.002) similar to relationship between the class of BMI and ASEPSIS score grades. The haematocrit value had significant effect on the ASEPSIS score (P < .001) while there was statistically significant association between degree of anaemia and ASEPSIS categories, and overall outcome.

A higher percentage of wound complication particularly severe infection were associated with emergency caesarean section. However, the association between the type of surgery (elective or emergency) and the ASEPSIS score category and outcome was not statistically significant. The time of shaving had some association with ASEPSIS score category and outcome. The percentage of severe wound infection was slightly higher in those that were shaved on the eve of surgery than those shaved on the day of surgery or on- table but the association was not statistically significant. Majority of our patients had surgery under spinal anaesthesia. There was a statistically significant relationship between the type of anaesthesia and the ASEPSIS wound score, thus outcome. Blood loss had statistically significant association on ASEPSIS score grades and outcome. There was also a statistically significant association between the post-operative days of first wound

inspection and ASEPSIS wound score grades, and outcome. There was a higher percentage of severe wound infection in those wounds that were first opened for inspection after 5 days. The type of wound dressing following the first post-operative wound inspection had statistically significant effect on ASEPSIS wound score grades and overall outcome. Closed dressing after first wound inspection was associated with higher percentage of all categories of wound healing challenges ranging from healing disturbances to severe infection than open dressing. The presence and type of wound dehiscence directly influenced the ASEPSIS wound score grades, and this relationship was statistically significant. Superficial dehiscence contributed to all the grades more substantially than deep dehiscence.

There was no statistically significant association between age, parity, gestational age, co-morbidity, booking status, the type of surgery (elective or emergency), and the rank of the surgeon, and the ASEPSIS score category and outcome.

DISCUSSION

The primary outcome measure in this study was to determine the quality of wound healing using modified ASEPSIS (Mba *et al*., 2025) wound score and elicit factors influencing outcome. Seventy-eight percent of patients had satisfactory healing, while others had various grades of wound infections. The body mass index, degree of anaemia, type of anaesthesia, blood loss, post-operative days of first dressing removal or wound inspection, and the type of wound dressing following the first post-operative wound inspection had statistically significant effect on ASEPSIS scores, and the overall outcome.

In this study, a caesarean section rate of 37.6% was recorded. This is similar to findings in various parts of southern Nigeria (Agboeze *et al*., 2013), (Njoku & Njoku, 2019), (Ezechi *et al*., 2002) It is, however, higher than the rates reported in parts of northern Nigeria. (Chama *et al*., 2000), (Jido & Garba, 2012) It is important to note that the caesarean section rates vary widely between population and hospital-based studies. This has been demonstrated in this study as a population-based study in this environment showed a caesarean section rate of 7.2%.(Gunn *et al.,* 2017) However, the high rate in the study is understandable and can be explained by the fact that the hospital is located at the center of the city and thus a referral center for the peripheral health facilities within and around the city.

Majority of the women were young adults with peak age group of 35 to 39 years and least age group of ≤ 19 years. This finding is in keeping with the report by Dhakal-Rai *et al*., (Dhakal-Rai *et al*., 2022) of an association between higher maternal age and increasing caesarean section rates. It however contrasts with findings by Maskey *et al*., (Maskey & Bajracharya, 2019) where the peak age group of 25 to 29 was reported. Generally, the childbearing age of women starts from menarche to menopause, commonly between the ages of 15 to 44 years with decreasing fertility (ACOG, 2014) but despite this, the chances of caesarean section tend to increase with increasing maternal age. There are conflicting reports of effects of age on caesarean section rates, but the body of evidence favour strong relationship between the two. Adewuyi *et al*., (Adewuyi *et al*., 2019) reported that maternal age greater than or equal to 35 years was significantly associated with higher prevalence of caesarean section. Manyeh *et al*., (Manyeh *et al*., 2018) in Ghana noted that women older than 34 years were three times more likely to have caesarean deliveries than those younger than 20 years. They reported the highest caesarean rate among 35 - 39 age group. Both reports were corroborated by what was recorded in this study. In a population-based study in Denmark, Rydahl *et al*., (Rydahl *et al*., 2019) reported a strong association between advancing maternal age and increased rate of caesarean section although the relationship could not be explained by the demographic features neither could it be explained by presence or absence of co-morbities. In Japan, Yoshioka-Maeda *et al*., (Yoshioka-Maeda *et al*., 2016) reported increased risk of caesarean section in mothers older than 35 years. On the contrary, Alshammari *et al*., (Alshammari *et al*., 2023) found no significant relationship between age and caesarean section rates among women in Saudi Arabia.

Most caesarean sections in this study were carried out at a gestational age of 38 and above. Nigar *et al*., (Nigar *et al*., 2019) made similar observation as majority of their patients were operated at gestational age of 37 weeks or greater. The gestational age at which decision to operate is taken may be influenced by indication for the caesarean section. In this study, previous caesarean sections predominantly determined the elective surgeries done at 38 weeks. In the comparison of various gestational age patterns in caesarean section, Delnord *et al*., (Delnord *et al*., 2014) observed an increase in caesarean section rate at 38 weeks in many countries and this was attributed to a rise in elective caesarean sections. In this study, gestational age has no association with the occurrence or severity of wound complications. This finding is similar to report by Jabbar *et al*., (Jabbar *et al*., 2016) in Karachi Pakistan. In contrast, surgical site infection was 4 time more likely to occur in preterm gestation age mothers than at term as reported in Ethiopia by Mamo *et al.*, (Mamo *et al.,* 2017).

Most of the pregnant women who had caesarean section were booked as against a little more than 20% that were un-booked. This is similar to findings by some studies in Nigeria. (Ismail *et al*., 2021), (Ajah *et al*., 2016) In contrast, Bello *et al*., (Bello *et al*., 2015) in Ibadan and Nigar et al (Nigar *et al*., 2019) in India reported higher rate of un-booked cases of caesarean deliveries than booked cases. The rate of booked versus un-booked case may reflect the awareness and health seeking behaviour of the population studied. It may also

reflect the location and the capacity of the facility where the study was carried out in terms of receiving and managing cases with complication from peripheral facilities.

Prophylactic antibiotics were given to most of the patients prior to surgery as a routine. This is because caesarean section wound is a clean contaminated wound for which prophylactic antibiotics are recommended. Body of evidence is in favour of prophylactic antibiotics prior to any caesarean section. Dahlke *et al*., (Dahlke *et al*., 2013) in an updated review of evidence-based surgery for caesarean delivery recommended a dose of prophylactic antibiotics prior to caesarean section. Razavi *et al*., (Razavi *et al*., 2005) reported statistically significant correlation between the administration of prophylactic antibiotics and the incidence of SSI. In Kuwait, Alfouzan *et al*., (Alfouzan *et al*., 2019) reported that women who were not given prophylactic antibiotics had SSI more often than those who were given. In a related report, Salim *et al.,* (Salim *et al.,* 2011) found that prophylactic antibiotics reduced infectious morbidity following caesarean delivery. In our series, antibiotics were extended beyond recommended single dose prophylaxis. It is important to note that in WHO global guidelines for the prevention of SSI, (WHO, 2018) prolongation of antibiotics was strongly discouraged. This was based on evidence that such prolongation had no benefit coupled with possible adverse drug reaction and the risk of antimicrobial resistance (AMR).

Alcohol based chlorhexidine cetrimide solution was used for pre-operative skin preparation in all our patients in line with WHO (WHO, 2021) and NICE (NICE, 2021) recommendations of alcohol-based chlorhexidine solution as a standard solution for pre-operative skin preparation during caesarean section based on evidence that the solution reduces the risk of SSI.

The rate of SSI in this study is much higher than the rates in many studies in the country and around the world, (Agboeze *et al*., 2013), (Njoku & Njoku, 2019), (Jido & Garba, 2012), (Gomaa *et al.,* 2021). (Opøien *et al*., 2007) but lower than what was recorded by Jabbar *et al*., (Jabbar *et al*., 2016) in Karachi, Pakistan. The wide variations in the rates of SSI can be explained by the lack of uniformity in the definitions and criteria for diagnosis of SSI as has been recognized by Saeed *et al*., (Saeed *et al*., 2017) in their protocol for a systematic review and meta-analysis on incidence of surgical site infection following caesarean section. While we used modified ASEPSIS wound score (Mba *et al*.,), most other similar studies did not use any standard scoring system for their data collection.

We also recorded 3.8% disturbance in healing. This has not been recorded in related literature to the best of our knowledge except in studies that use ASEPSIS wound score for data collection. It corresponds to the effects that are observed when there is critical colonization. This is a concept that represents the presence of actively multiplying pathogenic micro-organisms in amounts capable of impairing wound healing but not enough to elicit host response as in wound infection. (White & Cutting, 2006), (Obrien, 2008).

Majority of the subjects were either overweight or obese and this negatively affected outcome as BMI was significantly associated with wound complications. This finding is consistent with several studies that have identified obesity as an independent risk factor for SSI. (Jabbar *et al*., 2016), (Opøien *et al*., 2007), (Gomaa *et al*., 2021). This may be explained by the association between obesity increased soft tissue thickness, subcutaneous fat and chronic inflammation all of which impair wound healing response.

Majority of the subjects had anaemia which had statistically significant effect on wound healing. This is in line with studies by Mamo *et al*., (Mamo *et al*., 2017) and Gomaa *et al*., (Gomaa *et al.,* 2021) but contrasts that of Jido *et al*., (Jido & Garba, 2012) Anaemia has been shown to reduce oxygen carrying capacity of blood and thus supply to the wound area, and as well hinder immune response. (Gomaa *et al*., 2021).

Majority of the women had their surgery under spinal anesthesia. There was a statistically significant association between the type of anesthesia and the ASEPSIS wound score with general anaesthesia being associated with higher percentage of severe infection. This finding aligns with other similar studies. (Ayala *et al.,* 2021) Reduction in post-operative respiratory complication may explain frequent utilization of regional anaesthesia (Mashamba, 2021) but the reason for the positive association with SSI remains unclear. There may not be a causal relationship but probably a bias towards the use of general anaesthesia in patients with the likelihood of challenges.

In this study, blood loss had significant association with wound complication. This finding aligns with that of Jido *et al*., (Jido & Garba, 2012) in Kano where more blood loss was recorded among patients who had SSI compared to the group that did not. Re-dosing of prophylactic antibiotics has been recommended following loss of more than 1500ml of blood to reduce the risk of wound complications. (Kilic *et al*., 2021).

We found a statistically significant association between the post-operative days of first wound inspection and ASEPSIS wound score grades, and outcome. This is in line with findings in similar studies (Wadhwa & Wadhwa, 2021), (Ahmed *et al*., 2020), (Zhang *et al*., 2020) However, in comparing dressing removal between 24 hours and 48 hours, Kilic *et al*., (Kilic *et al*., 2021) reported that dressing removal at 48

hours had lower ASEPSIS wound score than removal at 24 hours, implying lower wound complications. From the foregoing, it can be deduced that wound dressing removal between 2 to 5 days is superior to removing it earlier or later.

CONCLUSION

Counselling of women of childbearing age and potential mothers on the need for maintenance of appropriate weight for height is recommended. Pregnant women should be advised against high carbohydrate consumption during pregnancy especially third trimester as BMI had significant effect on outcome.

Antenatal services in the hospital should incorporate the services of dieticians for a strong emphasis on balanced diet in course of pregnancy. Emphasis on adherence to supplementation with routine drugs should be made during ANC talks. These are to combat anaemia which was very prevalent in this study.

There is need to minimize intraoperative blood loss. This can be achieved through good surgical techniques that involves meticulous dissection and prompt, and adequate haemostasis.

The postoperative wound care protocol needs little modification. The first dressing removal should be between the 2nd and 5th post-operative days, and wound should be left open subsequently except in situations where there are challenges with the wound. In such situations, dressing agents should be determined by the state of the wound.

The extension of prophylactic antibiotic to the post-operative period is not evidence based and may need to be stopped. The practice may be due to fear of infection based on peculiarities of our environment in which case it should be subjected to randomised clinical trial.

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