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Closure of Groin Skin Incision in Children: A Comparative Study between Use of Steri-Strips and Subcuticular Absorbable Monofilament Sutures

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Abstract

Background*: Skin closure with sutures can result in a prolonged local inflammation, cellulitis, stitch abscess and ultimately ugly scars. Skin closure techniques that avoid the use of sutures have the potential to minimize these complications with possible better scar cosmetic appearance. This study aims to determine and compare the outcomes of groin skin incisions closed with steri-strips with those closed by subcuticular suturing with absorbable monofilament sutures in children.*

Methodology*: Seventy-six groin skin crease incisions following herniotomy or standard orchiopexy were randomized into two groups. The steri-strip group had their skin incisions closed with 3M™ Steri-Strips™ while the suture group had their skin incisions closed with monocryl® 4-0 in a continuous subcuticular manner. The patients were followed-up for 12 weeks. The data obtained were analysed with SPSS version 23. Categorical data were compared using the Pearson's chi-square test while continuous variables were analysed using the Mann–Whitney U test and p-values less than or equal to 0.05 was considered as statistically significant*

Results*: It took shorter mean duration (116.58±28.5 vs 277.39±5.87.07) to close the groin skin incisions with steri-strips compared with closure using subcuticular sutures (P=0.0002). The surgical site infection rate, the long-term scar cosmetic appearance and parental satisfaction were comparable between the two groups (P=0.556, 0.399 and 0.06 respectively).*

Conclusion*: It may be faster to close groin skin crease incision in children using steri-strips compared to subcuticular absorbable monofilament sutures. However, the wound infection rate, long-term scar cosmetic appearance and parental satisfaction did not differ significantly.*

Keywords*: Absorbable sutures, Children, Groin crease incisions, Scar cosmesis, Steri-strips.*

Introduction

Herniotomy and orchiopexy are the common groin surgical procedures in children.[1] Both can be performed by either laparoscopy or open surgery but the later modality is the option readily available in developing countries. This is due to paucity of trained personnel and high cost of acquiring and maintaining of laparoscopy equipments.[2] Conventional herniotomy and standard orchiopexy are performed through a groin skin crease incision averaging 2-3cm in length.[3]

Groin skin incisions for herniotomy and orchiopexy in children can be closed using several techniques but are traditionally closed using sutures.[4] Sutures used to close skin incision can be a potential source of foreign body reaction and this can culminate in unsightly scars.[5] It may also predispose to wound infections and stitch abscesses.[5] These complications may lead to ugly scars. This is important because surgical scar remains the only visible evidence of the surgeon's skill, and most times, the surgeon's efforts are judged on the final appearance of the scar.[6] For the patient, a scar may cause functional impairment and constitute cosmetic nuisance which may need revision.[7] Also, suturing of the skin is tedious and may lead to needle stick injury to the surgeons. Skin closure techniques that avoid the use of sutures have the potential to minimize these complications with possible superior scar cosmetic appearance. Reinforced 3M™ Steri-Strips™ are adhesive strips with reinforcing polyester filaments which represent an alternative to sutures for closure of simple low-tension wounds.8 It meets many of the characteristics of an ideal wound closure technique in that it is inexpensive, easy to apply, non-invasive, non-allergic, porous and comfortable to wear.[8] This study was therefore designed to compare the use of steri-strips for closure of groin skin crease incisions with subcuticular closure of such incisions using absorbable monofilament sutures in children.

Patients and Methods

This was a hospital based randomized prospective study conducted at the Paediatric surgery unit of Nnamdi Azikiwe University Teaching Hospital Nnewi , Nigeria over a period of 18 months (1st July 2018 to December 31, 2019). Ethical clearance for this study was obtained from the Health Research and Ethical Committee (HREC) of Nnamdi Azikiwe University Teaching Hospital with reference number NAUTH/CS/66/Vol.10/217/2017/130. Written informed consent was obtained from the parents/ caregivers and assent obtained from those above seven years of age for both the surgical procedure and enrolment into the study.

Children one month to 15 years with confirmed diagnoses of uncomplicated inguinal hernias, hydrocoeles and palpable undescended testes who required open surgery via the inguinal route and whose care giver gave consent were recruited into the study. Neonates were excluded because they constitute a peculiar group of patients with special surgical requirements. Patients with bleeding disorder, any form of immunosuppression and those for repeat surgery in the ipsilateral groin were also excluded.

Patients were recruited consecutively and randomised into the two groups: steri-strip group and suture group. The surgical procedures were performed by two paediatric surgeons and two senior resident doctors in paediatric surgery who were first trained on the study methods. All surgeries were done as day cases. Basic preoperative investigations including haemogram estimation were done according to institutional protocol. Patients' haemogram were at least 10g/dl before the operations were carried out. Standard preoperative fasting was observed.

The surgeries were performed under general anaesthesia with the patients in supine position. Skin preparations were carried out with Savlon (chlorhexidine and cetrimide) solution and povidone iodine solution. Groin skin crease incision was made and deepened through the Camper's and Scarpa's fasciae to expose the aponeurosis of the external oblique muscle. Herniotomy, hydrocelectomy or standard orchiopexy were performed through the incision as deemed necessary depending on the diagnosis. The length of the incision was measured with sterile measuring tape. After the procedures, wounds were closed in layers with monocryl 4-0 starting with the external oblique aponeurosis, fascia of Scarpa and fascia of Camper.

The apposition of the skin was with 3M™ Steri-Strips™ Reinforced Adhesive Skin Closures ¼ inch x 4 inch (3M HealthCare, St. Paul, MN, USA. Lot Number NHRIC-8333-1546-01) for the patients in steri-strip group, while subcuticular suturing with Monocryl® 4-0 (Ethicon, Inc. Lot number LB6915) were used for patients in the suture group. The application of 3M™ Steri-Strips™ was done after the superficial fascia of Camper had been properly apposed with absorbable suture and the skin around the wound cleaned with sterile gauze soaked in normal saline and then dried with dry sterile gauze. The steri-strips were applied using the technique that was described by Katz et al.9 This method involved applying one-half of the first steri-strip on one side of the wound margin and pressed firmly in place using fingers. The skin edges were apposed as closely as possible with non-toothed forceps or the fingers. The free half of steri-strip was then pressed firmly on the other side of wound. The rest of the wound was closed with additional steri-strips placed perpendicular to the wound, parallel to each other and spaced approximately 3mm apart sequentially. The suture group had their skin closed with

Monocryl® 4-0 suture in a continuous subcuticular manner. By using a handheld stopwatch, the duration needed for skin closure was measured in seconds by a trained research assistant. The start time was when the surgeon was handed the suture or steri-strips and the stop time-when the surgeon called out "finished" after skin closure. All incision wounds were covered with a layer of gauze dressing to avoid the patients from pulling on the steri-strips and to protect the wound from the environment. Patients were placed on oral analgesics and discharged home on the day of the surgery after recovery from anaesthesia. Patients/ parents were instructed to keep the wound dressings dry and to report back to the hospital if any unusual symptoms were observed.

Wounds were reviewed for wound edge complications on the 5th post-operative day and any observed complications documented. Patients in both groups had the gauze dressings removed on the 5th post-operative day and the wounds were only dressed again if there was wound dehiscence or evidence of surgical site infection. The steri-strips were either removed or allowed to peel off. Patients that had wound edge complications had their wounds inspected and dressed as deemed appropriate. Those that had surgical site infections in addition had wound swabs taken for microscopy, culture and sensitivity and appropriate antibiotics given

Assessment of cosmetic appearance of the scar was done on the 4th and 12th post-operative weeks with the Hollander Wound Evaluation Scale (HWES) and Cosmetic Visual Analogue Scale (CVAS) by a plastic surgeon (who was blinded to the method of skin closure) and the parents respectively. The assessments by the parents were based on their satisfaction with the scar appearance using the CVAS on a scale of 1 to 10; One (1) cm represents the worst scar the parents could ever imagine while 10cm represents the finest scar possible.

Data coding, entry, cleaning and the analysis was done using International Business Machine (IBM) Statistical Package and Service Solutions (SPSS) version 23 Chicago Illinois. Bivariate analysis was done to compare the duration of skin closure, wound edge complications, scar cosmetic appearance and parental/caregivers' satisfaction between the suture group and the steri-strip group. Chi-square test analysis was done for the categorical variables while Mann-Whitney U test was done for the quantitative variable. P-values ≤ 0.05 were considered statistically significant.

Results

Ninety patients were enrolled into the study but only seventy-six patients with 76 groin skin crease incisions completed the study, 38 in each group. Overall, forty-seven (61.8%) of the groin skin crease incisions were on the right while twenty-nine (38.2%) were on the left side of the groin. The mean follow-up duration for all the patients and for each group was 12 weeks. Sixty-nine (90.8%) of the study participants were males; 35 in the steri-strip group and 34 in the suture group. Only seven (9.2%) patients were females; 3 in the steri-strip group and 4 in the suture group.

The age distribution of study participants is as shown in table 1 while indications for surgery and duration of skin incision closure are in table 2 and table 3 respectively.

Age distribution	**Group**		χ^2	**P-value**
	Steri-strip N=38(%)	**Suture N=38(%)**		
1month- 1year	12(31.6)	10(26.3)	3.122	0.210
2-5years	10(26.3)	18(47.4)		
>5years	16(42.1)	10(26.3)		

Table 1: Age distribution of study participants

Diagnoses	**Methods of skin closure**		χ^2	**P-value**
	Steri-strips n=38(%)	**Sutures n=38(%)**		
Hydrocoele	14(36.8)	13(34.2)	0.114	0.945
Inguinal hernia	18(47.4)	18(47.4)		
Undescended Testis	6(15.8)	7(18.4)		

Table 2: Indications for the surgeries

	Groups		T	P-value
	Steri-strip (n=38)	Suture (n=38)		
Mean length of incisions (in cm)	2.92±0.32	3.12±0.33	0.215	0.531
Mean duration of skin closure (in seconds)	116.58±28.54	277.39±58.07	-14.316	0.0002
Mean speed of skin closure (cm/seconds)	0.025±0.001	0.011±0.003	4.359	0.001

Table 3: Mean length of groin skin incisions and the mean duration of skin closure

Superficial surgical site infection was the only complication seen in three (3.8%) groin skin incision wounds as shown in Table 4. Culture of swabs from the infected wounds yielded Staphylococcus aureus in two wounds and Echerichia coli in one of the wounds. None of the patients in the steri-strip group reported any allergic reaction to the steri-strips.

Wound edge complication	Group		χ^2	P value
	Steri-strip n=38(%)	Suture n=38(%)		
None	36(94.74)	37(97.37)	0.347*	0.556
Superficial SSI	2(5.26)	1(2.63)		

SSI= Surgical site infection, *Pearson Chi square tests

Table 4: Wound edge complications

The mean Hollander wound score and CVAS at four weeks and twelve weeks post-surgery are shown in Table 5. Mann-Whitney U test showed that the differences in the scores between the two methods of skin incision closure were only significant at 4 weeks post-surgery (Table 6).

Method of skin closure		Hollander wound score		CVAS	
		At 4 weeks	At 12 weeks	At 4 weeks	At 12 weeks
Sutures	Mean	5.18 ± 0.652	5.79 ± 0.413	7.76±1.218	9.00±0.771
	Range	4 – 6	5 – 6	5-10	7-10
Steri-strips	Mean	4.97± 0.788	5.68 ± 0.525	7.16 ± 1.197	7.16 ± 1.197
	Range	4 – 6	4 – 6	5-9	6-10

Table 5: Hollander wound score and CVAS at 4weeks and 12 weeks post-operation

	Group		U	P-value
	Steri-strip (n=38)	Suture (n=38)		
	Mean Rank	Mean Rank		
Hollander wound score at 4weeks	35.67	45.33	614.50	0.041
Hollander wound score at 12weeks	36.89	40.11	661.00	0.399
CVAS at 4 weeks	38.54	43.46	533.50	0.074
CVAS at 12 weeks	33.62	39.38	536.50	0.06

CVAS =Cosmetic Visual Analogue Score. U = Mann-Whitney U

Table 6: Mann-Whitney U of Hollander wound score and CVAS of wounds

Discussion

The main goal of all wound closure techniques is to approximate the wound edges without interfering with the process of wound healing.[10] Proper closure of skin incision is essential for good cosmetic and functional result. Apart from cosmetically good scars, it is also necessary that the skin closure technique should be technically easy, speedy and acceptable.[10,11] The creation of steri-strips to substitute for sutures has added to the armamentarium of wound closure techniques.

The age distributions, sex distributions and indications for groin surgeries in the steri-strip group and the suture group were similar. These findings allow for proper comparison to be made between the two groups. The lower number of female subjects is due to higher prevalence of surgical conditions requiring groin operation in male children than in females. Hernias, hydrocoeles and palpable undescended testes were the indications for groin surgeries in this study because they are the most common surgical conditions encountered in the paediatric day case groin surgeries in Nigeria.

The mean groin skin incision length in this study compares favourably with the known length of skin incision for standard herniotomy that averages 2-3 centimeters.[12] Although this study included patients who had orchiopexy, only patients with palpable undescended testes were included. The groin dissections were not extensive and long skin incisions were therefore not required. Despite comparable skin incision length between the two groups, the mean duration of skin closure was shorter for the steri-strip group compared with suture group. This finding suggests that steri-strips are quicker and easier to apply compared with subcuticular suturing with absorbable monofilament sutures. This result is in agreement with the systematic review by Gkegkes et al.[13] who found steri-strips to be faster and easier to apply compared to subcuticular suturing. Despite this observed advantage, the use of steri-strips requires strict haemostasis and good apposition of subcutaneous layers.[5] In some instances, the time spent in achieving these may erode the difference observed in the speed of skin

closure using steri-strips. This may explain why O'Leary et al.[14] in their study found no difference in the entire duration of surgery in a comparative study of use of steri-strips versus monofilament sutures for closure of collar skin incisions for thyroid and parathyroid surgeries. The use of steri-strips for skin closure however limits use of needle during surgery and may help reduce the risk of needle stick injury to the surgeons.

The infection rate in this study is comparable to the rate of surgical site infection following inguinal herniotomies with and without prophylactic antibiotics in Nigeria.[15] The finding of Staphylococcus aureus as the most common cause of surgical site infection is in line with a previous study done in Nigeria that found Staphylococcus species as the common culture isolates in infected groin wounds following day case herniotomies in Nigeria.[15] No adverse or allergic reaction due to steri-strips use was observed in this study like in the other previous studies indicating that it is safe.[14, 16-18]

The scar cosmetic appearance in this study was evaluated at two different levels. At four weeks, the wounds closed with sutures had a better scar cosmetic appearance compared with those closed with steri-strips and this finding is similar to the findings by van de Kar et al.[17] It however contrast with other previous studies that reported equivalent and in some cases superior scar cosmetic appearance for the skin incisions closed with steri-strips compared with those closed with subcuticular sutures at short term follow-up.[13, 18] None of these previous studies was done in groin skin crease incision closure in children and since wound tension and healing varies in different regions of the body, what was observed in these studies may not apply in this present study. The observed difference in the Hollander wound score at four weeks post-operation may be ascribed to minor distraction of the skin incision wounds due to movement of the lower limbs. This movement although not enough to disrupt the steri-strips, may have caused the wound edges to widen with resultant larger scars. This is not applicable to skin incisions closed with absorbable monofilament sutures as the sutures are better adapted to withstand wound tension for a longer period.[17]

The comparable cosmetic appearance of scars of groin skin crease incisions closed with steri-strips and those closed with subcuticular sutures at 12 weeks assessment of the scars agrees with studies by Lazar et al.[18] and systematic review and meta-analysis by Gkegkes et al.[13] The authors found no difference in scar cosmetic appearance between the skin incisions closed with steri-strips and those closed with subcuticular absorbable sutures. It however differs with findings by O'Leary et al.[14] who observed skin incisions closed with steri-strips to have had a better scar cosmetic outcome. However, the scar assessment in the study by O'leary and colleagues was done by the surgeon who performed the surgeries and that may have introduced bias towards a particular method of skin closure.

As scars mature with time, the dynamic changes in collagen may have caused the observed differences at four weeks to disappear leading to similar scar cosmetic appearance at twelve weeks post-surgery.[19] Previous studies have also shown that early cosmetic outcome correlates poorly with eventual long term scar appearance.[19, 20] This is because, during the early period of wound healing, inflammatory responses and dynamic changes in collagen maturation are still in process.[20] Although the final scar assessments in this study were done at twelve weeks instead of after one year when the scars must have fully matured, results from a previous study showed that the scar cosmetic appearance at twelve weeks correlated well with scar cosmetic outcome at one year.[19] The authors were of the opinion that significant wound remodeling does not occur after three months. At three months, the wound tensile strength is approximately 80% of the original and since wounds never attain 100% tensile strength of their pre-injury state, it is unlikely that significant changes will occur thereafter. The scar cosmetic outlook at twelve weeks therefore is a good indicator of long-term scar cosmetic appearance.[19]

Parental/caregiver's satisfaction in this study was overwhelmingly positive and comparable between the two groups. This shows that both skin incision closure methods were acceptable to the parents/caregivers. Parental opinion is important because they represent the patient who is going to live with the scar. This finding is in consonance with that from a previous studies done by van de Gevel et al.[21] and systematic review and meta-analysis by Gkegkes et al.[13] This is not surprising as both methods of skin incision closure share similar attributes including not having the need for suture removal and leaving no stitch marks on the skin.

Conclusion

This study has shown that although it may be faster to close groin skin crease incisions in children with steri-strips compared with subcuticular suturing with absorbable monofilament sutures, there might be no difference in the risk of surgical site infection and in long term scar cosmetic appearance between groin skin crease incisions closed with steri-strips and those closed by subcuticular suturing with absorbable monofilament sutures in children. A large multicenter randomized controlled trial needs to be carried out to corroborate the findings of this study because a subtle difference between the two methods of groin skin incision closure may become more obvious with larger sample size. Also, a future study assessing the cost difference may be necessary.

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