International Surgery Journal
Muthukumar V et al. Int Surg J. 2017 Apr;4(4):1235-1243
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20171000

Original Research Article

Abdominal skin incision closure with non-absorbable sutures versus staples- a comparative study

Vamseedharan Muthukumar, Sarveswaran Venugopal*, Sureeskumar Subramaniam

Department of General Surgery, Sri Ramakrishna Hospital, Sarojini Naidu Road, New Siddhapudur, Coimbatore-641044, Tamil Nadu, India

Received: 01 March 2017
Accepted: 07 March 2017

***Correspondence:**
Dr. Sarveswaran Venugopal,
E-mail: sarvesh_59@yahoo.co.in

ABSTRACT

Background: Bacterial smartness and innovations have clearly outsmarted and drained the antibiotic discovery pipelines of pharmaceutical brains throughout the globe. Postoperative infection is a major cause of antibiotic use. The aim of the study was to compare the effects of using non-absorbable suture materials and staples for abdominal skin incision closure in terms of the occurrence rate of surgical site infections, the level of comfort experienced by patient and the cosmetic acceptability of scar by the patient.
Methods: A randomized control study conducted at the general surgical department of a tertiary hospital in Southern India. The final scores of the study in the categories of surgical site infection, pain and cosmesis were analyzed using Students t-test or Anova test.
Results: The use of staples to close skin incision in laparotomy cases reduces surgical site infection, improves the perception of cosmetic appearance of scar to the patient and adds to the comfort of patient by reducing the pain experienced by the patient. The subgroup of population who may comprehensively benefit are patients below 40 years, middle and high socio economic status population, clean and clean contaminated surgeries where incision length is more than 5cm.
Conclusions: The results of this study illustrated the fact that the use of staples in closure of skin incision in laparotomy case especially in selected subgroup of population significantly reduces the surgical site infection, hence slashing the use of antibiotics and in turn has the potential to reduce the incidence of antibiotic resistance.

Keywords: Comfort, Cosmesis, Skin closure, Staples, Sutures, Surgical site infection

INTRODUCTION

Envisage a world sans antibiotics; most routine general surgeries, hip replacements, C-sections and cancer therapies would no longer be possible devoid of significantly augmented threats. Hundreds of thousands of people would perish of infections that we once, perhaps arrogantly, thought we had crushed. Bacterial smartness and innovations have clearly outsmarted and drained the antibiotic discovery pipelines of pharmaceutical brains throughout the globe.[1,2] Postoperative infection is a major source of morbidity, mortality, and hospital costs, but it is not absolutely avoidable because certain factors such as age, drugs, systemic illness, and type of surgery cannot be altered. Any incision put must be closed, commonly using sutures or staples whether it is at a peripheral hospital or at a multi-specialty hospital located at metros. Being an essential, unavoidable step in surgeries it can be manipulated as a potential weapon to tackle the crisis and to minimize the antibiotic use. The literature is sparse on the role of skin closure technique on the rates of

infection. Here authors would like to quote Mark Ravitch: "The likelihood of wound infections has been determined by the time the last stitch is inserted in the wound".[3] Skin incision closure is as important as any action performed by the surgeon. This process though takes a less percentage of time to an operating surgeon when compared to the whole surgery; it has maximum chances of occurrences of complications to the surgeons. The surgical site infections also affect the patients in terms of cost, morbidity, duration of hospital stay, and also the long-term strength of the scar. On the other side the surgeons face pressure from the patients to have a cosmetically acceptable scar in the post-operative period through less painful and more comfortable methods of skin closure. It is also the moral responsibility of the surgeons to tackle the antibiotic crisis and at the same time to achieve cosmesis through a more comfortable method of skin closure.

The aim of the study was to compare the effects of using non-absorbable suture materials (group A) and staples (group B) for abdominal skin incision closure in terms of the occurrence rate of surgical site infections, the level of comfort experienced by patient and the cosmetic acceptability of scar by the patient.

METHODS

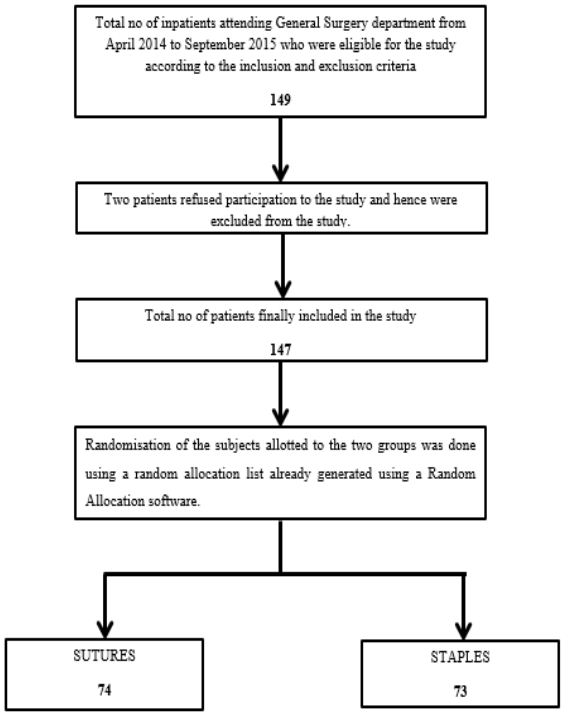
This was a randomized control study conducted at the general surgical department of a tertiary hospital in southern India over a period of 18 months. All patients undergoing elective/emergency open abdominal surgeries were included for the study. Patients undergoing elective/emergency laparoscopic abdominal surgeries, having known allergy to suture/staple material, with perceived inability to follow up the patient's course for 30 days after surgery, having active infection at or around the skin incision site, ASA-V classified patients and death of patient within the 30-day follow-up period were excluded from the study.

Statistical method

A comparison of the various characteristics like age, sex, various medical illness, nature of surgery and other variables between the populations studied under the two groups were made. The final scores of the study in the categories of surgical site infection, pain and cosmesis were analyzed using Students t-test or Anova test. The 'p' value obtained by Students t-test or Anova test using SPSS v 22.0 and Graph pad Prism V6.0 were used to determine the statistical significance of this study in the categories of surgical site infection, pain and cosmesis.

Methodology

A detailed history and routine investigations of each patient were obtained. Local skin preparation was done just before shifting the patient into the operating room either by depilatory cream or by means of clipping the hair. All patients received preoperative antibiotics (parenteral) thirty minutes prior to the surgery. The randomization of groups was done in the pre-operative room by random list already generated using a random allocation software. Intra operative skin antisepsis preparation was done using isopropyl alcohol 63% spray for all cases. Other routine aseptic precautions according to the existing standards were followed inside the operating room and during the surgery. In group A, skin was approximated using non-absorbable suture material. In group B, the skin was approximated with stainless steel staples. Dressings and other postoperative care standards were followed similarly in both groups. Patients were inspected on the 3rd postoperative day, on day of suture or staple removal and 30th day after surgery for evidence of surgical site infection. The same if present was classified as per classification given by CDC by means of scoring system. Scoring of surgical site infection was done against a total score of five. The measure of pain was based on the patients scoring on the day of suture/staple removal and on 30th day after surgery according to numerical rating scale which measured pain intensity on a continuous scale from 0 to 10. The average of score given by patients on the day of suture/staple removal and on 30th day after surgery was taken up for analysis. The cosmesis of the scar was rated on 30th day after surgery by the patient and an observer (who is unaware of the method of skin closure used) using the patient and observer scar assessment scale v2.0. The patient and observer score hence obtained were averaged to arrive at a final score out of 10. Final consort type chart is represented in Sequential Diagram 1.



Sequential Diagram 1: Study population and randomisation.

RESULTS

The study conducted at our hospital included a total of 149 patients, of which two patients refused to participate in the study. Of the final 147 patients analyzed in the study, 74 patients underwent closure of incision by non-absorbable sutures and the remaining 73 patients underwent closure of incision by staples. The study population analyses showed that majority of them were between the age group of 20-40 years (56%), females contributed to about 55% of study population. A significant share of the population was urban (60%), middle class (54%) and degree holders. About 29% of them were diabetic, 18% were hypertensive, 6% were steroid users, 12% were anaemic, 21% of them had other serious systemic illness and five patients were retroviral positive. Acute appendicitis, cholecystitis and ventral hernias were the most common diagnosis encountered in our study population. Appendicectomy, cholecystectomy and ventral hernioplasty were the commonest surgeries performed in our study population. Greater bulk of the wound incision was between 5-10cm in length (56%) and most of them were clean contaminated (49%) surgeries.

The overall analysis of the SSI scores between the methods of closure of the skin incision showed mean SSI score of 1.722±0.1044 and 1.237±0.1115 respectively in sutured and stapled wounds. The differences in the means were statistically significant with p value of 0.0018 (Figure 1). The sub group analysis showed significant SSI score mean differences in Non-steroid users, middle and high socio economic status population, incision of length between 5-10cm and clean wounds. In these sub groups the use of staples for skin incision closure reduced the SSI score significantly. In other sub groups, the difference of SSI score between the use of sutures and staples for skin incision closure was not significant. Summarised in Sequential Diagram 2 and Table 1.

Table 1: Surgical site infection associated with method of closure in other published studies.

Study	Sub group	Results
Our study	Non steroid users, Middle and high socio economic status population, incision of length between 5-10 cm and clean wounds	Staples reduce SSI
Stockley[16]	Not done	Staples increase the incidence of SSI
Tuuli[19]	Not done	
Iavazzo[10]	Not done	Staples were associated with less infection and inflammation
Roth[12]	Not done	
Lennihan[17]	Not done	
Richard[18]	Not done	
Chandrashekar[28]	Clean wounds	
Hemming[21]	Not done	Equivocal

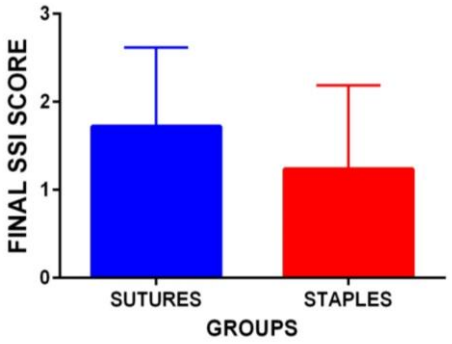


Figure 1: Final SSI score analysis between sutures and staplers.

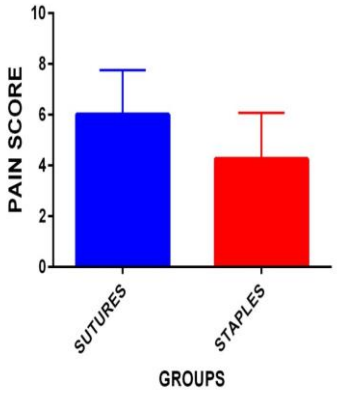


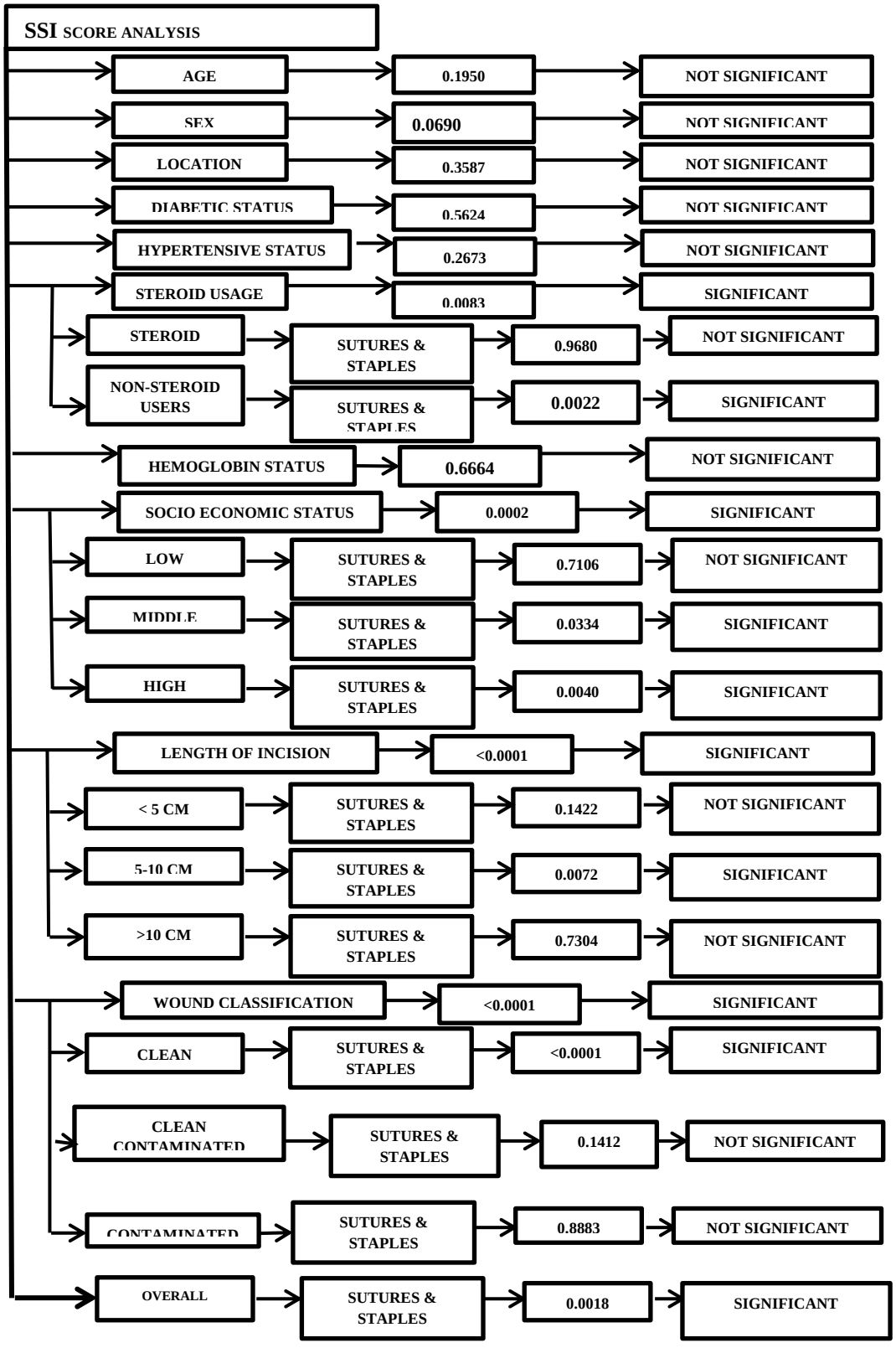
Figure 2: Pain score analysis between sutures and staples groups.

Table 2: Level of comfort associated with method of closure in other published studies.

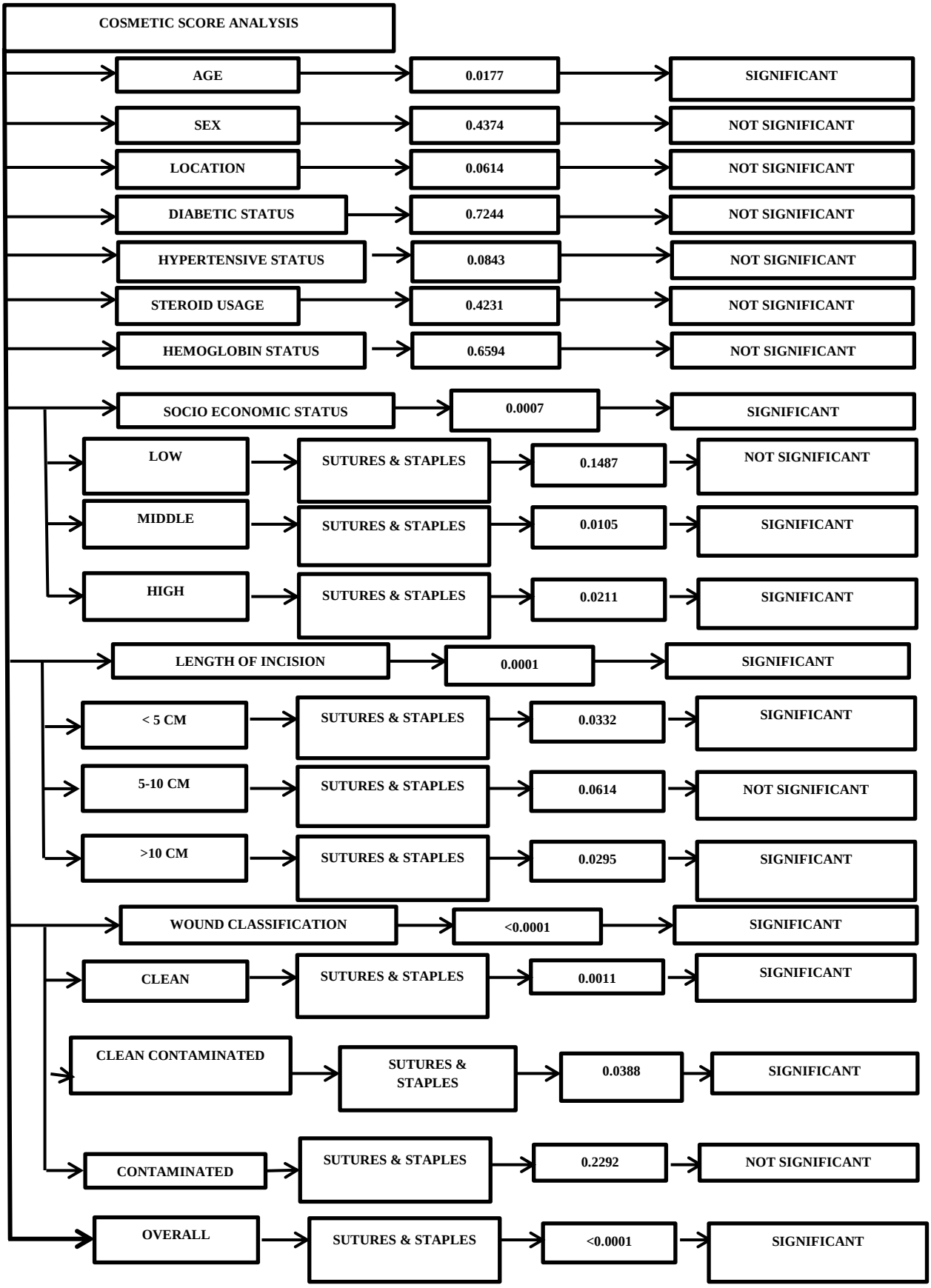
Study	Sub group	Results
Our study	Incision of length less than 5cm, between 5-10 cm, more than 10 cm and clean and clean contaminated wounds	Staples reduce pain
Chandrashekar[28]	Clean wounds	
Chavan[29]	Not done	
Karbhari[30]	Not done	
Stockley[16]	Not done	Staples were associated with increased pain
Eldrup[7]	Not done	
Slade[9]	Not done	
Iavazzo[10]	Not done	

The level of comfort or in other words the pain experienced by the patient in the form of pain score analysis between the two methods of skin incision closure showed mean score of 6.014±0.2032 and 4.260±0.2128 respectively in sutured and stapled wounds. The differences in the means were statistically significant with p value of <0.0001 (Figure 2). The sub group analysis showed significant pain score mean differences in incision of length less than 5cm, between 5-10cm,

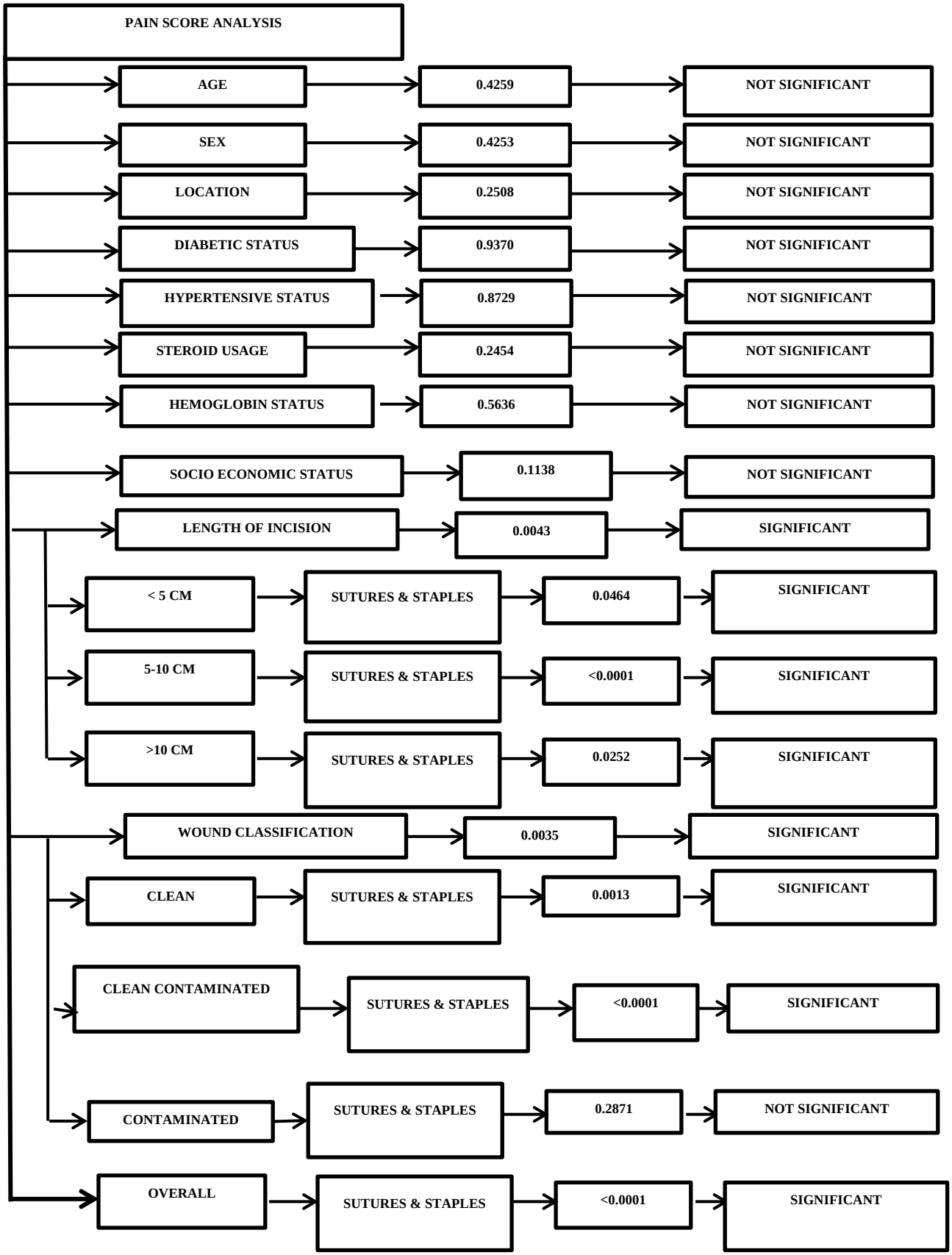
more than 10cm and clean and clean contaminated use of sutures and staples for skin incision closure was not significant. Summarized in Sequential Diagram 3 and Table 2.



Sequential diagram 2: Summary of SSI score analysis.



Sequential diagram 3: Summary of cosmesis score analysis.



Sequential diagram 4: Summary of pain score analysis.

The cosmetic score analysis between the methods of closure of the skin incision showed mean cosmesis score of 6.203±0.1539 and 5.205±0.1891 respectively in sutured and stapled wounds. The differences in the means were statistically significant with p value of <0.0001 (Figure 3). This study observed that the wounds closed with staplers were cosmetically superior when compared to non-absorbable sutures. The sub group analysis showed significant cosmesis score mean differences in younger age group, middle and high socio economic status population, length of incision less than 5cm, more than 10cm, clean and clean contaminated wounds. In these sub groups the use of staples for skin incision closure resulted in a cosmetically superior scar with better patient acceptance. In other sub groups, the difference of pain score between the use of sutures and staples for skin incision closure was not significant. Summarised in Sequential Diagram 4 and Table 3.

Table 3: Cosmesis of scar associated with method of closure in other published studies.

Study	Sub group	Results
Our study	Younger age group, middle and high socio economic status population, length of incision less than 5 cm, more than 10 cm, clean and clean contaminated wounds	Staples associated with cosmetically superior scar
Stockley[16]	Not done	
Lubowski[8]	Not done	
Simcock[31]	Not done	
Lennihan[17]	Not done	
Richard[18]	Not done	
Chandrashekar[28]	Clean wounds	
Chavan[29]	Not done	
Karbhari[30]	Not done	
Meiring[6]	Not done	Equivocal
Iavazzo[10]	Not done	

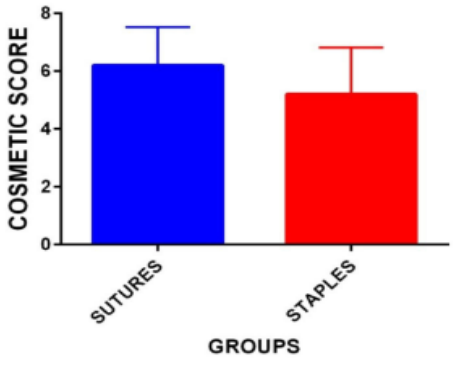


Figure 3: Cosmesis score analysis between sutures and staples.

DISCUSSION

There was a general consensus regarding the time saved by using staple for wound closure. All the reviewed articles echoed the fact that stapling of wound was quicker and time saving when compared to conventional wound/skin closure methods.[4-13] The mean time saving of 80% was possible with stapling devices and was 2.7 times faster than conventional methods.[6,11]

Most of the articles reviewed were also having an overall similar view when comparing the cost of using staples against conventional methods. Staple were indeed more expensive than using conventional closure methods.[5,11,13] One of the studies had given the difference to be about 4 times.[14] A study opined that the extra cost of staples can be overcome provided the disposable instruments are reused until empty.[15]

Discomfort/pain/patient satisfaction was another factor that was intended to be compared in this study. There was an overall agreement in the fact that staples were associated with more pain and discomfort to patients.[7,9,10,16] A meta-analysis which compared most of randomized control trials made a strong statement in need to incorporate more objective methods for assessment of cosmetic and patient satisfaction in further studies.[10]

Except the fact that staples were faster, costlier and painful, none of the other factors compared here below have a clear consensus and the views of one group of study differed significantly from the other beyond comparison.

With respect to cosmetics there were certain studies that out favored staples in view of higher incidence of inflammation and spreading of the healing scar.[16] Few studies went ahead to say that cosmetic results were good as if not better than conventional methods.[6,10] Other studies favored the use of staples for better cosmetic results.[8,17,18] A study was more specific in giving verdict in the form of conventional methods were more cosmetically acceptable for transverse wounds and staples had more or less equal cosmesis in vertical wounds.[8]

With respect to infection/inflammation, few of the studies indicated an increased incidence associated with staple and a few studies contradicted the studies with an opinion that staples were associated with less infection and inflammation.[10,1216-19] However, some studies could not find any significant differences.[7,20] In contaminated surgical procedure, one of the study pointed that skin staples could provide an alternate method of skin closure.[18] There was also a meta-analysis favoring use of staples in evaluated types of surgeries in reducing wound infection.[10] Finally a meta-analysis comparing the use of staples verses suture for surgical procedures went to support staples theoretically as it reduced the operative time and reduction in the operative time has the potential

to reduce tissue handling and associated tissue injury. Hence has the potential to improve the patient outcome. But the study failed to prove the same.[21] A study on pig model demonstrated that stapled wounds are substantially narrower and are associated with less inflammation than sutured wounds.[12]

A few more observations that were striking when we reviewed the literature are also mentioned here.

In laparotomies, regarding the method of skin closure in midline vertical laparotomies there is a consensus in using staple and in transverse laparotomies there is only an overall agreement in using staples as a method of skin closure.[22] Another study echoed that staples are clearly considered a suitable method for vertical abdominal wounds.[8] A different study gave its verdict that there was no clear benefit from the use of staples in closure of abdominal wounds.[5] A RCT gave its view as the use of conventional methods of suturing was not validated to reduce the incidence of wound complications after open gastrointestinal surgery.[23]

In caesarean surgery, two studies were of the opinion that staples are preferred by women after caesarean delivery.[24,25] The other review article contradicted them by associating the staple use with high risk of wound complication in obstetric surgeries.[19] In other settings, study comparing the effect of modality of wound closure after total knee replacement demonstrated significantly fewer complications with staple use.[26] In a study involving paediatric population it was concluded that staples should be used for closure of scalp wounds more extensively.[13] With respect to closure of scalp wounds staple were safer to use and needle stick injury to operator is less likely.[20] Other study stated, the staple method of closure is safe comparable and effective in the emergency department settings.[11] The higher expense will be taken care with other advantages offered by staples. A study in varicose vein surgery also favored staple closure in aspects of wound sepsis and keloid formation.[17] There were also warning bells rung by an article stating staples are quicker but may increase complications on use.[27]

Limitations

Period of study; Sample size; Confounding variables.

CONCLUSION

The results of this study illustrated the fact that the use of staples in closure of skin incision in laparotomy case especially in selected subgroup of population significantly reduces the surgical site infection, hence slashing the use of antibiotics and in turn has the potential to reduce the incidence of antibiotic resistance contributing significantly to alleviate this paramount public health threat. The use of staples to close skin incision in laparotomy cases also improves the perception of cosmetic appearance of scar to the patient and significantly reduces the level of discomfort and adds to the comfort of patient by reducing the pain experienced by the patient.

Though the sub group of patient who may benefit by the use of staples to close skin incision in laparotomy cases on single benchmark may vary, the subgroup of population who may comprehensively benefit from reduction of surgical site infection, pain and cosmetic improvement in the appearance of scar are younger age group of patients below 40 years, middle and high socio economic status population, clean and clean contaminated surgeries where incision length is more than 5cm.

The results of this study could improve the understanding of importance of method of skin closure in reduction of surgical site infection, pain and cosmetic improvement in the appearance of post-operative scar. This study also could help in revolution of an essential step for comprehensive wound care, developing policy regarding skin closure methods and primordial prevention intervention which could lead to reduction in incidence and severity of surgical site infection, invariably reducing the antibiotic resistance burden in the community and in addition improve the cosmetic façade of the scar and level of comfort experienced by the patient.

Present study in future can provide a strong platform and valuable resources for further researchers who traverse their path into similar kind of studies with more refined objectives and precise targets, as the literatures are sparse on such topics. In future further studies done along similar notions will throw more clarity towards the use of staples and other complex methods to improve the outcome of postoperative wounds.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Muthukumar V, Venugopal S, Subramaniam S. Abdominal skin incision closure with non-absorbable sutures versus staples- a comparative study. Int Surg J 2017;4:1235-43.