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Original Article

Wound Closure Using Adhesive Tapes in SRM Medical College, Potheri: A Case Study

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Abstract

Introduction: The concept of using surface adhesive tapes to close surgical wounds antedates the development of satisfactory suturing techniques. But previously available wound adhesive tapes lacked adequate adhesive properties and led to the occurrence of associated skin irritation or maceration.

Methods: A total of 30 patients who presented to Department of Surgery for elective and emergency surgical procedures were randomly selected, after getting informed consent. Wound adhesive tapes were used for skin closure. The patients were followed up in the immediate post-operative, 1 week, 4 weeks, and 3 months post-operative. Any complication such as wound gaping, wound infection, or skin irritation were noted. Cosmetic results were evaluated using modified Hollanders scale.

Results: In our study, 90% of patients were male and rest were females. Wound infection occurred in 6.7% of the patients. This is increased compared to reports from older studies which is about 3-4% wound infection in sutured wounds is about 2-11% according to available literature. Wound infection rate in our study is within this rate and is comparable to that of suture closure. There was a significant association between the incidence of wound infection and presence of diabetes mellitus (DM). 2 out of 4 patients with Type 2 DM developed wound infection. There was no association between occurrence of wound infection and age of the patient or type of incision. The relative risk of sub-optimal closure in sutured wounds is 1-8%. In our study, the rate of suboptimal closure is 6.7% which falls within this range. There is a significant association between occurrence of wound infection and final cosmetic outcome.

Conclusion: Wound adhesive tapes are effective alternatives for suture closure. Added advantages of reduced time consumption and cost of tapes compared to sutures were observed in our study.

Keywords: Adhesive tapes, Diabetes, Suture, Wound closure, Wound gaping, Wound infection

INTRODUCTION

Wound closure techniques have evolved from the earliest development of suturing materials to comprise resources that include synthetic sutures, absorbables, staples, tapes, and adhesive compounds. The engineering of sutures in the synthetic material along with standardization of traditional materials has made for superior aesthetic results. Similarly, the creation of natural glues, surgical staples, and tapes to substitute for sutures has supplemented the armamentarium of wound closure techniques. The aesthetic closure is based on knowledge of healing mechanisms and skin anatomy as well as an appreciation of suture material and closure technique. Choosing the proper materials and wound closure technique ensures optimal healing.

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The concept of using surface adhesive tapes to close surgical wounds antedates the development of satisfactory suturing techniques.[1] Since the advent of aseptic surgery enabled a safe and reliable method of wound suturing, tapes have gone into disrepute. Furthermore, previously

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available wound adhesive tapes lacked adequate adhesive properties and led to the occurrence of skin irritation or maceration.

However, various improvements have emerged recently in the composition and manufacturing methods of wound adhesive tapes to improve its adhesive properties and to reduce allergic reactions. Due to these changes, better efficacy in terms of wound healing and cosmetic outcome is observed. Various studies in the past show that the rate of complication and cosmetic outcome of wound closure using adhesive tapes is better or, at least, comparable to suture closure with added advantages such as less time consumption, cost-effectiveness and increased patient satisfaction.[2] This study was undertaken to evaluate the efficacy of adhesive tapes in the primary closure of surgical incisions.

METHODOLOGY

After getting Ethics Committee clearance, 30 Random patients who presented to the Department of General surgery for Elective procedures were enrolled in the study. Informed consent was obtained from all the patients. Wound adhesive tapes were used for skin closure after closing subcutaneous layer using Vicryl sutures. Tapes were the first applied across the wound in a perpendicular direction to the wound with about 0.5 cm gap between two tapes. Two tapes parallel to the wound were then applied, to reduce undue tension over skin. Patients were followed up in the immediate post-operative period, 1 weeks, 4 weeks, and 12-week period. Early and delayed cosmetic results were evaluated using Hollander's Cosmesis Scale.

RESULTS

Distribution of Patients According to Gender

In our study, 90% of patients were male and rest were females (Table 1).

In our study, 43.3% of patients had right sided inguinal hernia, 36.7% had left sided inguinal hernia, 13.3% had bilateral inguinal hernia, 3.3% had left para-testicular tumor, and 3.3% had umbilical hernia (Table 2).

In our study, 66.6% of patients had no comorbidities and rest 33.3% had some comorbidity (Table 3).

In our study, 90% had inguinal incision, 6.7% had B/L inguinal incision, and 3.3% had ellipitical incision (Table 4).

In our study, 93.3% of patients underwent hernioplasty and 3.3% left high orchidectomy, and 3.3% underwent omphalectomy with hernioplasty (Table 5).

In our study, 30% of patients were in the age group between 36 and 45 years; 26.7% were between 55 and 65 years; 20% were between 46 and 55 years; 13.3% were more than 65 years; and 10% were <35 years (Table 6).

In our study, infection was present in 6.7% of the patients. None had wound gaping and skin irritation (Table 7).

From the Table 8, it is inferred that wound infection and diabetes and are significantly associated ($P = 0.014$). 50% of patients with diabetes had wound infection (Table 8).

Table 1: Gender distribution

Variable	Frequency	Percentage
Female	3	10.0
Male	27	90.0
Total	30	100.0

Table 2: Distribution according to diagnosis

Diagnosis	Frequency	Percentage
B/L inguinal hernia	4	13.3
Left inguinal Hernia	11	36.7
Left para testicular tumor	1	3.3
Right inguinal hernia	13	43.3
Umbilical hernia	1	3.3
Total	30	100.0

Table 3: Distribution according to co-morbidities

Co-morbidity	Frequency	Percentage
DM	2	6.7
SHT	3	10.0
Respiratary illness	1	3.3
SHT and respiratory illness	2	6.7
DM and SHT	1	3.3
DM, SHT and cardiac illness	1	3.3
No morbidity	20	66.7
Total		100.0

DM: Diabetes mellitus, SHT: Systemic hypertension

Table 4: Distribution according to type of incision

Type of incision	Frequency	Percentage
B/L inguinal incision	2	6.7
Elliptical incision	1	3.3
Inguinal incision	27	90.0
Total	30	100.0

Table 5: Distribution according to procedure

Procedure	Frequency	Percentage
Hernioplasty	28	93.3
Left high orchidectomy	1	3.3
Omphalectomy with hernioplasty	1	3.3
Total	30	100.0

Table 6: Distribution according to age

Years	*N*	Percentage
<35	3	10.0
36-45	9	30.0
46-55	6	20.0
56-65	8	26.7
>65	4	13.3
Total	30	100.0

Table 7: Distribution according to complications

Infection	Frequency	Percentage
Absent	28	93.3
Present	2	6.7
Wound gaping	0	0
Skin irritation	0	0

Table 8: Association between wound infection and diabetes

Diabetes	Infection *n* (%)		Total	Chi-square (*P* value)
	Absent	Present		
Absent	26 (100)	0 (0)	26	13.929 (0.014)
Present	2 (50)	2 (50)	4	
Total	28	2	30	

DISCUSSION

Wound and Wound Healing

Injury to any of the tissues of the body, especially that caused by physical means and with interruption of continuity is defined as a wound. Wound healing is a mechanism whereby body attempts to restore the integrity of the injured part.

Factors That Influence Wound Healing

There are several factors that may influence healing such as:

1. Site of the wound
2. Structures involved
3. Mechanism of wounding
4. Contamination
5. Loss of tissue
6. Local factors-vascular insufficiency, previous radiation, pressure
7. Systemic factors such as:
   - Malnutriron
   - Comorbidities (e.g., diabetes)
   - Medications (e.g., steroids)
   - Immune deficiency states
   - Smoking.[3]

Phases of Wound Healing

However, a clean incised wound in a healthy person will follow a set pattern of healing. This is described as taking place in four phases.

1. Hemostatic phase - occurs immediately at the onset of the wound. Bleeding phase is followed by vasoconstriction and thrombus formation. Platelets release adenosine triphosphate which causes thrombocytic aggregates to fill the wound
2. Inflammatory phase - occurs after the onset of the wound. Cytokines released from the platelets attract inflammatory cells and cause increased vascular permeability to aid their infiltration, and removal of devitalized tissues and microorganisms
3. Proliferative phase - lasts from 3rd day to 3rd week, consisting mainly of fibroblast activity resulting in neovascularization and ground substance that consists of glycosaminoglycans and proteoglycans. The initial granulation tissue formed during this phase is latter strengthened by deposition of Type 3 collagen.
4. Remodeling phase - this phase consists of maturation of collagen which involves replacement of Type 3 by Type 1 collagen, re-alignment of collagen along lines of tension, decreased wound vascularity and wound contraction.[3]

Types of Wound

The management of wound is dependent on multiple factors. This has led to the classification of wounds into two major categories - TIDY and UNTIDY wounds. Primary repair of all structures may be possible in a tidy wound, but an untidy wound requires debridement on one or several occasions before a definitive repair can be carried out. The surgeon's aim is to convert an untidy wound to a tidy wound by removing all devitalized tissue and infection.[4]

Incision

Surgical skin incisions are mostly tidy wounds. When a skin incision is planned, various factors are to be taken into account

1. Langer's lines - these lines represent the orientation of the dermal collagen fibers and an incision parallel to these lines cause a better scar
2. Anatomical structure - incisions should avoid bony prominences, crossing skin creases, and should take into consideration underlying vital structures
3. Adequate access - incision should be functionally effective for the procedure in hand
4. Cosmetic factors - any incision should be made bearing in mind the ultimate result in mind.

As far as abdominal incisions are concerned, traditionally vertical midline or para-midline incisions were used for the majority of the abdominal procedures. However, there is a current trend to utilize transverse incisions wherever possible as this minimizes post-operative complications

such as respiratory difficulty and also have a better cosmetic outcome. Mass closure of the abdominal wall is usually advocated using large bites and short steps using non-absorbable suture materials. It has been estimated that for abdominal wall closure the length of the suture material should be 4 times the length of the wound to minimize the risk of dehiscence.[5]

Wound Closure

The closure of any incision should take into account the site and the tissues involved. There is no ideal wound closure technique that would be suitable for all incisions. The correct choice of wound closure technique is important, and so is a good blood supply and a tension free closure. The type of wound healing depends on such factors:

1. Primary intention - closure simply requires an accurate approximation of wound edges. Clean uninfected wounds with good blood supply heal by primary intention
2. Secondary intention - wound is left open and heals through granulation tissue formation
3. Tertiary intention or delayed primary closure - this method is utilized when there is a high chance of wound being infected. The wound is left open and after the infective process is resolved, the wound is closed to heal by primary intention.[3]

Techniques of Wound Closure

Suture

There is an armamentarium of suture materials including non-absorbable suture materials such as - silk, linen, surgical steel, nylon, polyester, polybutester, and polypropelne and absorbable suture materials such as - catgut, chromic catgut, polygalactin, polyglyconate, polyglycolic acid, polydioxanone, and polyglycolic acid polyglycaprone. Skin closure with non-absorbable suture is an established technique and most widely used. But various other methods of skin closure have been introduced, which are less time consuming, cost effective and have a cosmetic advantage. Efficacy of different methods of skin closure is constantly being tested.

Skin Clips

Mechanical stapling devices were first used successfully by Humer Hultl in Hungary in 1908 to close stomach after resection. At present a wide range of stapling devices are available including skin staplers and staplers used for bowel anastomosis. Skin clips can be placed faster than sutures and have less predisposition to wound infection. They produce a neat scar with, with good evertion and minimal cross-hatching effect. However, skin clips are far more expensive compared to sutures and require special devices for removal.[3]

Tissue Glue

Tissue glues are available based on solution of N-butyl-2-cyanoacrylate monomer. When it is applied to a wound, it polymerized to form an adhesive bond. It is quick to use and associated with low infection rate. However, it is expensive and can be used only in specific situations where the wound is clean, dry, with near perfect hemostasis and under no tension.[3]

Wound Adhesive Tapes

The concept of using suture less techniques to close wounds dates back to about 1600 BC when linen strips were used in Egypt.[6] Although the scientific basis for selecting taped skin closure for abdominal wounds has been documented, the technique has not been widely used. This may be due to fears of a wider scar, the weaker supporting strength of the tape, and/or an increased rate of wound complications, particularly in clean-contaminated wounds.[7] The present day widely available adhesive tapes are composed of Nonwoven, rayon-backed material reinforced with Silicone coated paper liner, with cyano acrylite based adhesive which are hypoallergenic in nature. This tape has a nonwoven microporous structure with an adhesive that aggressively adheres to the underlying skin. It is strong enough to resist breakage during clinical use and elongates sufficiently to prevent blister formation. Its microporous structure permits rapid air transmission *in vitro* and results in an environment that is antithetical to bacterial growth.[8] Previous studies have shown that taped wounds had greater tensile strength than sutured wounds and that this difference was still appreciable at 150 days.[9]

Complications of Wound Adhesive Tapes

Wound infection

The review of limited amount of literature available on this topic reveals that wound infection following wound closure due to adhesive tapes is comparable or less than that of wound closure using sutures.[11] Only a small number of studies claim sutures to have lesser incidence of wound infection. A systematic review by Gkegkes *et al.* showed that there was no significant difference between wound infection rates of wound closure using sutures and tapes.[12] A similar result was observed by Lazar *et al.*,[10] Maharaj *et al.*,[13] and Webster *et al.*[1] Whereas Zempsky *et al.* concluded that adhesive strips have a lower rate of wound infection compared to sutures[2] and Conolly *et al.* reported a lower rate of infection for the taped wounds in those patients with clean-contaminated wounds.[14] In summary, adhesive tapes are a favorable alternatives to sutures, in terms of wound infection rate.

Wound dehiscence

The incidence of wound dehiscence following wound closure is comparable to suture closure in studies from the past. Zempsky *et al.*[2] showed that the incidence

of wound dehiscence with adhesive tapes was not significantly different from the incidence of wound dehiscence following suturing. Similar results were obtained in studies by Gkegkes *et al.*,[12] Lazar *et al.*[10] and Chen *et al.*[7] However, studies show advantages of sutures over adhesive tapes in certain specific situations. Uneven skin wound edge or extremely thick subcutaneous tissue may cause difficulties in skin approximation or with adhesive strips becoming less sticky, and hence may lead to a greater rate of skin wound separation in these patients. Wound dehiscence after adhesive tape closure is a more pronounced in obese patients than with suture closure.[7]

Skin Maceration and Allergic Reactions

One of the most important reasons for the avoidance of adhesive tapes is the fear of allergic reactions and skin maceration. This complication has significantly reduced following the use of acrylite based adhesives which are hypoallergenic in nature.[1,7] Skin blisters and skin maceration may occur due to undue tension over the region of skin where the tapes are applied, and hence a specific method of application of the tapes is advocated.[1,14,15]

Cosmetic Outcome

Studies from the past show that the early cosmetic outcome of wound closed by adhesive tapes is significantly better than sutured wounds and patients are more satisfied with the results of adhesive tape closure in comparison to sutured wounds. Studies by Gkegkes *et al.*, Lazar *et al.*, and Kuo *et al.* support this claim.[10,12,16] This could be due to the absence of punctuate marks of the suture needle and cross hatching. Studies by Chen *et al.*[7] and Webster *et al.*[1] show that patient satisfaction is better with adhesive tape closure even after 6 months, whereas studies by Lazar *et al.* and Rothnie *et al.* show that though initial cosmetic outcome is better with adhesive tapes, delayed cosmetic outcome is not significantly different from sutured wounds,[10,15] mainly due to scar wideneing. In summary, the cosmetic outcome of wound closure using adhesive tapes is better than or, at least, comparable with suture closure of wounds.

CONCLUSION

In summary, our study shows that wound adhesive tapes are effective alternatives for suture closure. Added advantages of reduced time consumption and cost of tapes compared to sutures were observed; in our study, though the quantification of these parameters were no taken into the study topic. Our results are comparable to results from the available literature, and we have observed a favorable outcome in terms of complication and cosmesis in wounds closed by adhesive tapes as compared to suture closure.

We acknowledge certain weaknesses of the study. Small sample size and short-term follow-up were only possible due to practical constraints. Tapes were not used in closure of tension wounds, and large incisions like midline abdominal incisions.

In summary wound, adhesive tapes are favorable substitutes for suture closure of small abdominal incisions and tension free closure. Large randomized controlled trials are required to further evaluate the efficacy of adhesive tapes.

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