A COMPARATIVE STUDY BETWEEN ADHESIVE TAPE (STERI-STRIP) VERSUS SUTURE FOR CLOSURE OF SURGICAL SITE INCISIONS

Dr. Priyank K. Katwala[1*], Dr. Sahdevsinh Chauhan[2], Dr. Amul Bhedi[3], Dr. D.B. Choksi[4]

1**----** Associate Professor, Department of Plastic Surgery, SBKSMI & RC, Sumandeep Vidyapeeth, Waghodia, Vadodara.

2---Senior Resident, Department of General Surgery, SSG Hospital, Vadodara.

3--- Professor and Head, Department of General Surgery, GMERS, Gotri Medical College, Vadodara.

4---Professor and Head, Department of General Surgery, Baroda Medical College, Vadodara.

***Corrosponding Author**:

Dr. Priyank K. Katwala

Associate Professor of Plastic Surgery, Department of Plastic and Reconstructive Surgery, SBKSMI & RC, Sumandeep Vidyapeeth and Dhiraj Hospital, Waghodia, Vadodara.

Email: pkk_108@yahoo.co.in. (M) 9925224346/ 9106814148.

Abstract:

Background: Closure of wound depends on the location, length of the wound and the age of the patient. Ideally, wound closure device should be easy to enable rapid closure, painless and provide excellent cosmetic appearance and it should be cost effective. Optimal closure technique is necessary for cosmesis and avoiding infection, scarring and adequate wound healing. Proper evasion of wound edges, minimal suture marks, adequate tensile strength and optimal approximation of skin edges should be learnt. **Materials and Methods:** The present study is a randomized study conducted at Sir Sayajirao General Hospital and Medical College, Vadodara from June 2017 to October 2018 on 100 patients with a follow up period of 1 month. Patients were evaluated postoperatively with respect to closure time, pain, cosmesis and complications like seroma, infection, wound dehiscence, etc. **Results:** Adhesive tape is better in terms of short closure time, post-operative pain and price as compare to suture material for closure of surgical site incisions but more number of randomized control trials and multicenter trials need to be undertaken with long term follow up for scar assessment.

Keywords: Adhesive tape, suture, surgical, site incisions, Steri-strips

How to cite this article: Katwala PK, Chauhan S, et al (2020): A comparative study between adhesive tape (STERI-STRIP) versus suture for closure of surgical site incisions, Ann Trop Med & Public Health; 23(S15): SP231545; DOI: http://doi.org/10.36295/ASRO.2020.231545

INTRODUCTION

The goals of wound closure are to avoid infection and to get a functional and cosmetic scar. Patients are concerned for appearance of their wounds. Importance is now shifted towards cosmetic appearance as the primary outcome measure of wound repair[1,2,3].

The wound closure material depends on the location, length of the wound and the age of the patient. The ideal wound closure device should be easy to enable rapid wound closure, painless and provide good cosmesis and be economical[4]

The scar is the only visible evidence of the surgeon skills appearance[5]. The aim of closure of any wound is healing by opposition of skin edges resulting in a cosmetically acceptable scar. The method has to be watertight and tension free. The best method of closure is one that provide adequate tensile strength to the incision, approximate the tissue in a way that normal healing can occur under optimal circumstances and remain secure in the presence of local or systemic infection. The suture material is well tolerated on a short and long term basis.[6]

Methods that must be mastered include good evasion of skin edges, minimal suture marks, adequate tensile strength along skin edges and approximation of edges of skin[7].

Suture: Sutures give better wound evasion, provide prolonged wound tensile support and close dead space[7]. The most common suture material in this technique is monofilament polyamide black (Ethilon)[7].

Adhesive Tapes: It is a non – invasive wound closure designed to treat low tension lacerations and surgical incisions without pain and without using needles[8]. Steri-Strip offer finer wound edge approximation for easy application and better outcomes[9].

Advantages of adhesive tape:

- Reinforced wound closure and reduces risk of infection
- Hypoallergenic and permits earlier staple and suture removal
- Better cosmetic outcomes than staples or sutures.
- Offers wound support and increase the tensile strength of the wound.
- Microporous material and able to promote faster healing and more patient comfort.

AIMS OF THE STUDY

To compare and evaluate the effectiveness of adhesive tape and suture for closure of surgical site incisions of clean and clean + contaminated wounds considering the following parameters:

The primary outcome studied is:

- Closure time
  (will be counted after taking subcutaneous suture and end up with complete incision closure of each method)
- Postoperative pain

The secondary outcome studied is:

- Potential wound complications:
  1. Seroma
  2. Surgical Site Infection (SSI) and
  3. Wound Dehiscence
- Cosmetic outcome

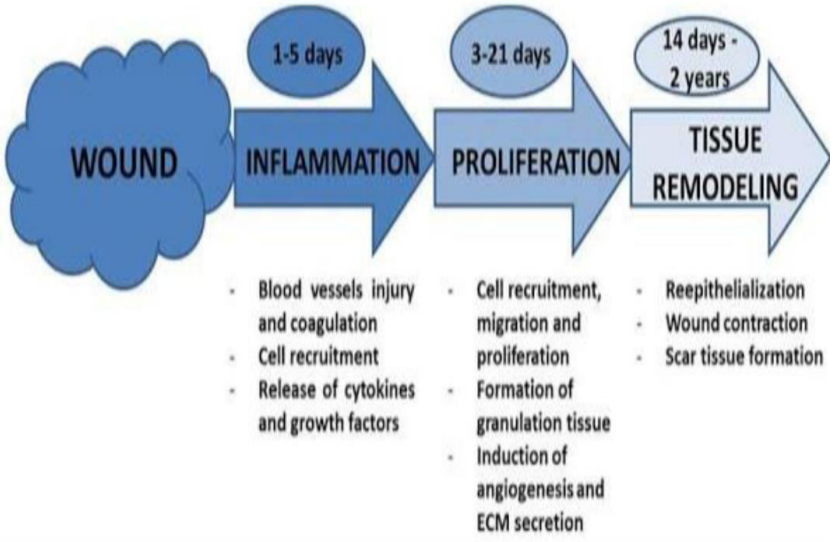
- Cost effectiveness

PHASES IN NORMAL WOUND HEALING

Most tissue in the body heal by going through the three R's:

1. Reaction
2. Regrowth and
3. Remodelling

Fig.1. Showing phases of wound healing



IMPEDIMENTS TO WOUND HEALING

INFECTION: -- Infection always impair wound healing. Wounds that have been contaminated with significant numbers of bacteria and other foreign material are at risk for developing infections, because such wounds are not easily cleansed by the natural scavenging processes of the reaction (inflammatory) phase of healing. Different types of wounds can show different clusters of signs when they are infected. Nonetheless, all infected wounds will show at least some of these signs: Fever, Pus, Abscess, Abnormal smell, cellulitis, Persistent inflammation with an exudates, Warmth and redness, Delayed healing, Continued or increasing pain, oedema and Weak, crumby granulation tissue that bleeds easily.

RE-INJURY--Re-injury can slow or stop wound healing. A new scar is weaker than the adjacent tissue, and the newest scars are the weakest.

ISCHEMIA/HYPOXIA:--Ischemia of a wound can arise from too much physical tension across the wound, ineffective oxygenation of the blood (anemia, lung problems, smoking) or reduced circulation (atherosclerosis, heart failure, kidney failure, vasoconstriction, too much pressure on the wound). Differences in the available blood supplies account, in part, for the fact that facial wound tends to heal better than foot wounds.

LOCAL SKIN TENSION:--In places where the wounded skin is under greater tension, the wound gapes more widely and heals more slowly, and the resulting scar is relatively large.

PATIENT FACTORS:

DISEASES--The most common of the problem disease is diabetes mellitus. Scar formed by diabetics have less collagen and the collagen that is laid down is more brittle than normal.

Diabetes also damages blood vessels and makes the skin more prone to ischemia. The reduced circulation is especially notable in the feet, and not wounds are notorious for not healing well in diabetic patients.

To make matter worse, diabetes leads to peripheral neuropathy. Diabetic patients lose sensation in their finger and toes, so diabetic injuries tend to go unnoticed in the extremities. Finally, diabetics have a weakened inflammatory response, and they are more susceptible than other people to developing tissue infections.

MALNUTRITION--Specific vitamin deficiencies also lead to poor wound healing. Vitamin-A deficiency impedes the transformation of monocytes into macrophages, which can slow or halt healing. Vitamin-C deficiency leads to weak collagen, which is the basis of scurvy. Vitamin-K deficiency impairs blood clotting.

OLD AGE--As people age, they heal more slowly. In older people, scar form with less and poorer quality collagen and older adults are more likely than the young to have wound reopen.

SMOKING--Patients who smoke have poor wound healing in addition to suffering a number of other skin problems that include wrinkling, premature skin aging, higher risk of squamous cell carcinoma, psoriasis and hair loss.

WOUND CLOSURE STEPS:--Wound must be clean before they can safely seal themselves. In an attempt to close wound quickly, doctors sometimes suture together insufficiently cleansed tissues. This leads to an infection and then the dehiscence of the closure. Another problem in wound closure is the use of suture material that is too thin and subsequently breaks. In addition, sutures that are too thin or that are tie too tightly can tear through the weakened skin at the edges of the wound. Finally, if sutures, staples or tapes are removed too early, the wound edges will not have developed sufficient adhesion and the wound will reopen.

PROBLEMATIC DRUGS, SOLUTIONS AND OINTMENTS--Doxorubucin (Adriamycin) given preoperatively inhibits postoperative wound healing. Glucocorticoids (e.g.,prednisone) limit the proliferation of fibroblasts and the production of collagen, and thus steroids makes scar relatively weak. Some antiseptic solutions (e.g., 10% providone-iodine, 3% hydrogen peroxide and 0.5% chlorhexidine), haemostatic solutions (e.g., ferric subsulfate, 30% aluminium chloride, silver nitrate) slow the healing of large wounds.

Some topical ointments also slow wound healing; these include triamcinolone acetonide ointment (0.1%), Furacin and USP petrolatum. In contrast, other ointments speed wound healing; these include Neosporin ointment, Silvadene cream, Benoxyl peroxide preparations and Eucerin.

X-RAYS--Ionizing radiation damages actively dividing cells. In wounds, the regrowing epithelium, the newly growing blood vessels, and the fibroblasts that form new connective tissue that likely to be damaged by a large dose of ionizing radiation.

CDC SURGICAL WOUND CLASSIFICATION (1999)

CLASS-I / CLEAN:

Any operative wound in which there is no inflammation and without entry into respiratory, alimentary, genital or uninfected urinary tract. Operative incision wounds following non-penetrating (blunt) trauma are also included in this category.

CLASS-II / CLEAN-CONTAMINATED:

An operative wound in which the respiratory, alimentary, genital or urinary tracts are entered under controlled conditions and without unusual contamination-specifically, operations involving the biliary tract, appendix, vagina provided there is no evidence of infection or break in technique is encountered.

CLASS-III / CONTAMINATED:

Open, fresh or accidental wounds in addition, operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract and incisions in which acute, nonpurulent incision is closed in the operating room.

CLASS-IV / INFECTED:

Old wound with retained necrotic tissue and those which involve existing clinical infection or perforated viscera. This indicates that the organism causing postoperative infection was present in the operative field before the surgery.

PATIENTS AND METHODS

The present study is a randomized study conducted at Sir Sayajirao General Hospital and Baroda Medical College, Vadodara from June 2017 to October 2018 with a follow up period of 1 month.

A total of 100 consecutive patients, undergoing elective surgery, were included in the study.The patients were subjected to either Suture or Adhesive Tape randomly by odd and even type of simple randomization (odd = intervention, Even = control) for closure of surgical site incisions after taking written and informed consent to participate in the study. Purpose of the study and the methods of treatment were carefully explained to the patients individually. All patients were admitted and after clinical and physical examination all basic routine investigations were done and planned for surgery. One group had closure of their skin incisions by polyamide black suture and the study group by adhesive tape (steri-strip).

STUDY DESIGN

Single Centre, Prospective, Randomized Interventional Study

SAMPLE SIZE

As this is a time-bound study and according to the average number of patients admitted in SSG hospital, 100 patients were included. Randomization done into two groups, 50 patients in suture group and 50 patients in adhesive tape group.

Evaluation of all the patients included in the study with respect to history, physical findings, operative findings and postoperative complications in line with the predetermined objectives was done.

All the cases in both the groups were followed for a period of 1 month. The patients were followed up at one month on OPD basis or by telephonic conversations for any complications.

INCLUSION CRITERIA

Enrollment was restricted to patients at least 18 years of age with full thickness surgical site incision ≥4cm (class 1 and class 2 wounds as per CDC-Centre for Disease Control and Prevention 1999). Following surgeries were included in the study:

1. Inguinal Hernioplasty

2. Epigastric Hernia Repair

3. Pyelolithitomy/Ureterolithotomy

4. Open Cholecystectomy

5. Lumbar Sympethectomy

6. Laparotomy

7. Flap surgeries for wounds

EXCLUSION CRITERIA

Incisions located in an area of high skin tension, mucosal surface or mucocutaneous junction, areas regularly exposed to body fluids and areas with dense hair.

Patients with diabetes mellitus, current use of steroid, previous history of impaired wound healing, personal or family history of keloid or hypertrophic scar formation, immunocompromised, clotting disorder and severe anemia.

METHODOLOGY:

A total of 100 consecutive patients, undergoing elective surgery, were included in the study. Written and informed consent to participate in the study was taken and purpose of the study and the methods of treatment were carefully explained to the patients individually. One group had closure of their skin incisions by polyamide black suture and the study group by adhesive tape (steri-strip).

The type of anesthesia depends on type of surgery. All patients were given preoperative scrub with providone iodine on the operative table. A preoperative dose of injection cefotaxime 1gm was given to all patients 1 hour prior to surgery.

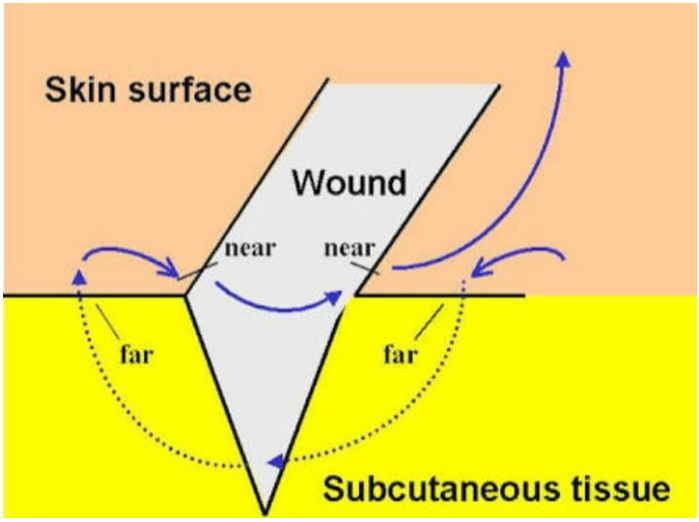
Post operatively the patients were kept nil by mouth and advised complete bed rest till the effect of anaesthesia is completely worn out, till then they are given supportive maintenance intravenous fluids. Patients were advised and encouraged to ambulate and start their activities of daily life as early as possible. Sutures and Adhesive Tapes were removed on 10th postoperative day.

WOUND CLOSURE STRATEGY

SUTURE GROUP:

For those patients in suture group, vertical mattress sutures were taken with monofilament polyamide black(2-0/3-0) with reverse cutting needle after taking sub-cutaneous sutures with polyglactin (2-0) with round body needle. Sterile occlusive dressing was applied.

Fig. 2. Showing technique of suturing



ADHESIVE TAPE GROUP[9]:

For those patients in adhesive tape group adhesive tape was applied after taking sub-cutaneous sutures with polyglactin (2-0) with round body needle. Sterile occlusive dressing was applied.

Adhesive Tape Specifications:

- Product Numbers: R1540, R1541, R1542, R1546, **R1547**, R1548, R1549.
- Width Sizes: 1/8, 1/4 or 1/2 Inch; Length Sizes: 1.5, 2, 3 or 4 Inch.
- Sterile, nonwoven and hypoallergic with Rayon-backed material reinforced with filaments.
- Brand: Steri-Strip; Manufacturer: 3M. Colour: White

We have used R1547 (1/2 inch × 4 inch) Reinforced Skin Closure Adhesive Tape in this study.

Intended Use:

Treatment of lacerations and surgical incisions. Steri-Strip skin closures can also be used along with sutures and staples or after their removal for supporting wound.

Contraindications:

1. Where adhesion cannot be achieved like presence of exudate, skin oils, moisture or hair.

2. Infected wounds.

3. Wounds having high tension not easily approximated with fingers or forceps.

Steps of Skin Closure Application:

1. Clean and dry skin around wound. Compound benzoin tincture (CBT) may be applied on skin up to wound edge to increase adhesion. If distention or movement is anticipated, consider using 3M™ Steri-Strip™ Elastic Skin Closures.

2. Peel back packaged tabs for Strip closures. Remove card, using sterile precautions. Bend card at end and gently remove tab.

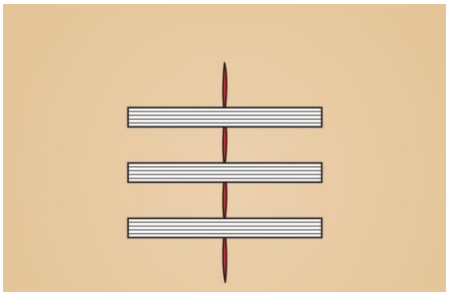
3. Hold skin edge with forceps; lift straight upward at 90 degree angle.

4. Apply half of first Steri-Strip to wound margin and press firmly in place.

5. With fingers or forceps, appose skin edges closely and Press other free half of Steri-Strip on other side of wound.

6. If edges are not apposed optimally, remove Strips and re-approximate wound.

Fig. 3. Showing steri-strips applied across the wound.



Steps of Skin Closure Removal:

1. Gently loosen ends of strips.
2. Stabilize skin with finger and remove Strip slowly towards wound, keeping close to skin surface.
3. As Strip is removed, continue moving finger tp support exposed skin. When both sides are loosened, lift strip up from center of wound.

Fig.4 FOLLOW UP ON 14TH POST-OPERATIVE DAY IN CASE OF WOUND CLOSED BY STERI-STRIPS

Removal of both sutures and adhesive tape was done 10th post-operative day.

POST OPERATIVE EVALUATION

Closure Time: Closure time was counted in seconds after taking subcutaneous sutures.

Post Operative Pain: Patients were assessed for postoperative pain using Visual Analog Scale on 1st and 3rd post operative day.

Seroma: Evaluation for seroma formation at incision site was done on the 1st and 3rdpost operative day.

Suggical Site Infection (SSI): SSI is the invasion and multiplication of microorganism such as bacteria, viruses and parasites that are normally not present within the human body.

Infection was considered present if any of the following were present:Redness 3-5 mm, Swelling, Purulent discharge, Increased skin temperature and Pain.

Evaluation for infection at incision site was done on 3rd and 10thpost operative day.

Wound Dehiscence: Wound dehiscence is the premature separation of the wound.

Cosmesis: Scar assessment was done at 4th week (28 days) follow-up, depending on width of the scar into[17]:

Poor - Scar width >/=5mm

Fair - Scar width >/=3mm but <5mm

Good - Scar width >/=2mm but <3mm

Excellent - Scar width <2mm

STATISTICAL METHODS:

P<0.05 will be considered statistically significant.

Student t test (two tailed, independent) and Chi-square test has been used to find the significance of study parameters. Statistical software: MedCalc 18.11 used for the analysis of the data and Microsoft Word and Excel used to generate graphs and tables.

RESULT AND ANALYSIS

The observations made in both groups were as follow.

Table-1. Age Distribution of patients

Age in Years	Suture (n=50)		Adhesive Tape(n=50)		Total (n=100)	
	N	%	N	%	N	%
21-30	10	20%	10	20%	20	20%
31-40	4	8%	8	16%	12	12%
41-50	7	14%	6	12%	13	13%
51-60	15	30%	15	30%	30	30%
61-70	10	20%	9	18%	19	19%
71-80	4	8%	2	4%	6	6%
Mean ± SD	50.82 ± 15.88		48.20 ± 16.04		P = 0.945	

Age ranged between 22 to 77 years in Suture group and 21 to 72 years among patients in Adhesive Tape group.

Sex Distribution: Out of 100 patients 43 male patients in Suture group and 42 male patients in Adhesive Tape group. There was no significant difference in the male sex in both the groups(**P=0.913**). Out of 100 patients 7 female patients in Suture group and 8 female patients in Adhesive Tape group. There was no significant difference in the female sex in both the groups (**P=0.796**).

Surgery wise Distribution: Out of 50 patients in suture group 34 patients (68%) are of Inguinal Hernioplasty, 3 patients (6%) are of Epigastric Hernia Repair, 6 patients (12%) are of Pyelolithotomy/ Ureterolithotomy, 4 patients (8%) are of Open Cholecystectomy, 1 patient (2%) of Lumbar Sympethectomy and 2 patients (4%) are of Laparotomy.

Out of 50 patients in Adhesive Tape group 36 patients (72%) are of Inguinal Hernioplasty, 4 patients (8%) are of Epigastric Hernia Repair, 5 patients (10%) are of Pyelolithotomy/ Ureterolithotomy, 4 patients (8%) are of Open Cholecystectomy and 2 patients (4%) are of Laparotomy.

OUTCOME ASSESSMENT

Closure Time:

The mean closure time in Suture group was 434.22 ± 40.74 seconds while that in Adhesive Tape group was 152.20 ± 23.93 seconds. The difference in closure time in both the group is statistically significant (**P = <0.0001**).

Table-2. Post Operative Pain (VAS Scale)

Day	Suture(n=50)	Adhesive Tape(n=50)	P Value
1	6.7 ± 0.88	6.13 ± 0.77	P = 0.0002
3	2.7 ± 0.97	2.1 ± 0.49	P = < 0.0001

Seroma Formation: Seroma was not there in either group on Day 1 but on Day 3 seroma was there in 6 (12%) patients in Suture Group and in 5 (10%) patients in Adhesive Tape Group. The difference between two group is statistically not significant (**P=0.763**).

Table-3. Surgical Site Infection (SSI)

SSI	Suture(n=50)		Adhesive Tape(n=50)		Total(n=100)		P Value
	N	%	N	%	N	%	
Day-3	0	0%	0	0%	0	0%	---
Day-10	4	8%	3	6%	7	7%	P = 0.705

Wound Dehiscence:

Wound dehiscence was not noted in either group during study period in the present study.

Table-4. Scar Assessment

Scar Assesment	Suture(n=50)		Adhesive Tape(n=50)		Total(n=100)		P Value
	N	%	N	%	N	%	
Excellent(scar width <2mm)	3	6%	4	8%	7	7%	P = 0.705
Good(scar width <3mm)	30	60%	37	74%	67	67%	P = 0.392
Fair(scar width <5mm)	17	34%	9	18%	26	26%	P = 0.116
Poor(scar width >5mm)	0	0%	0	0%	0	0%	---

Cost Effectiveness: The price of pre-strile pack of polyamide black (2-0) with reverse cutting needle is almost 3 times more than that for 3M Steri Strip ½ inch× 4 inch (6 Strips) pack.

DISCUSSION:

The present study was carried out at S.S.G. Hospital and Medical College, Baroda, between June 2017 to October 2018 with a follow up period of 1 month. A total of 100 patients were included in the present study, which were divided by by odd and even type of simple randomization(Even = intervention, odd = control) method in Suture group and in Adhesive Tape group with 50 patients in each group. Statistical analyses were made using student t test, chi square test and paired t test. The results were analyzed and compared to various other studies done in this field.

Age Distribution:

IM Anuar Ramdhan et al[11]found that Mean age group in Suture group was 18.77 ± 4.82 years while in Adhesive Tape group was 19.66 ± 4.19 years with P = 0.384, which was not statistically significant.

In this present study age ranged between 22 to 77 years in Suture group and 21 to 72 years among patients in Adhesive Tape group. The Mean age of presentation in Suture group was 50.82±15.88 years and in Adhesive Tape group was 48.20±16.04 years. There was no significant statistical difference in the age in both the groups.(**P=0.945**).

Closure Time:

Mohammad K. et al[10] found that Mean closure time in Suture group was 2.32 ± 1.20 minutes while in Adhesive Tape group was 1.09 ± 0.82 minutes with P = <0.05, which was statistically significant.

In present study the mean closure time in Suture group was 434.22 ± 40.74 seconds while that in Adhesive Tape group was 152.20 ± 23.93 seconds. The difference in closure time in both the group is statistically significant (P = <0.0001).

Post Operative Pain (VAS Scale):

Mohammad K. et al[10] found that the post operative pain score in Suture group was 3.65 ± 1.82 while in Adhesive Tape group was 2.32 ± 1.20 with P = >0.05, which was statistically not significant.

In the present study the post operative pain score in Suture group was 6.7 ± 0.88 while in Adhesive Tape group was 6.13 ± 0.77 with P = 0.0002, which was statistically significant.

Seroma:

Mohammad K. et al[10] found that the post operative seroma formation was occurred in 2 patients in Suture group while in Adhesive Tape group it was occurred in 1 patient with P = 0.563, which was statistically not significant.

In present study it was found that the post operative seroma formation was occurred in 6 patients in Suture group while in Adhesive Tape group it was occurred in 5 patient with P = 0.763, which was also statistically not significant.

Surgical Site Infection:

Mohammad K. et al[10] found that the post operative wound infection was occurred in 1 patients in Suture group while in Adhesive Tape group it was occurred in 1 patient with P = 1.000, which was statistically not significant.

In present study it was found that the post operative wound infection was occurred in 4 patients in Suture group while in Adhesive Tape group it was occurred in 3 patient with P = 0.705, which was also statistically not significant.

Wound Dehiscence:

Mohammad K. et al[10] found that the post operative wound dehiscence was occurred in 1 (4%) patients in Adhesive Tape group.

In present study there was no wound dehiscence was noted in either group during study period.

Scar Assessment:

Excellent scar was found there in 3 (6%) patients in Suture Group and in 4 (8%) patients in Adhesive Tape Group. The difference between two group is statistically not significant (**P=0.705**).

Good scar was found there in 30 (60%) patients in Suture Group and in 37 (74%) patients in Adhesive Tape Group. The difference between two group is statistically not significant (**P=0.392**).

Fair scar was found there in 17 (34%) patients in Suture Group and in 9 (18%) patients in Adhesive Tape Group. The difference between two group is statistically not significant (**P=0.116**).

Poor scar was not found in either group during study period.

CONCLUSION

The present study comparing suture and adhesive tape for closure of surgical site incisions came out with the following conclusions:

- ✓ There is a difference in closure time was noted which was 434.22 ± 40.74 with suture and 152.20 ± 23.92 with adhesive tape which is lesser with adhesive tape with P value of <0.0001 which is strongly significant.
- ✓ The post operative pain is lesser with adhesive tape on first (P=0.0002) and third (P=<0.0001) postoperative days and it helps in patients to ambulate faster and get discharged faster than with suture and it is statistically significant.
- ✓ Complications like Seroma and Wound Infection were seen which are comparable in both the groups and statistically not significant.
- ✓ Scar assessment was done at 1 month follow up in both the groups which are comparable and statistically not significant.
- ✓ Adhesive tape is cheaper as compare to suture material in compare to cost.

Adhesive tape is better in terms of short closure time, post-operative pain and price as compare to suture material for closure of surgical site incisions but more number of randomized control trials and multicenter trials need to be undertaken with long term follow up for scar assessment.

BIBLIOGRAPHY:

1. Rutherford WH. Spence R. Infection in wounds sutured in the accident and emergency department. Ann Emerg Med. 1980; 9:350-
2. Dire DJ, Coppola M, Dwyer DA. Lorette JJ, Karr JL. Prospective evaluation of topical antibiotics for preventing infections in uncomplicated soft-tissue wounds repaired in the ED. AcadEmerg Med. 1995.
3. Wood PB. Wound infection in undressed sutured wounds of the hand. Br J Surg. 1971; 58: 543-5.
4. Singer AJ, Hollander JE, Quinn JV Evaluation and management of traumatic lacerations. N Engl J Med 1997; 337: 1142-1148.
5. Brig BM Nagpal, Maj Gaura Kumar, Maj GS Nagi, WgCdr Pradeep Singh (Retd). Sutureless closure of operative skin wounds. 2004; 60: 131- 133.
6. Peter C Richards, M.D., Charles M. Baith, M.D., Joaquin S. Aldrete, M.D. A randomised prospective study of 571 patients comparing continuous Vs interrupted suture techniques. From department of surgery, university of Albama. 1982. file: H:\s2-files\ annsurg. gif.
7. Ronald L. May, Alexander Lee, Alicia Zalka. Commonly used suturing techniques in skin surgery. American family physician, 1991, Vol 44: 1625- 1634.
8. Kuo F, Lee D, Roger GS.3 M Announces the addition of the steri-strips surgical skin closure to its family. Reuter –com. htm.
9. 3M™ Steri-Strip™Adhesive Skin Closures PRODUCT CATALOG - go.3M.com/SS-Brochure
10. Raad S. AL-SaffarMBChB, CABS Mohammad K. AL-ShibaniMBChB - A COMPARISON OF THREE METHODS OF SKIN CLOSURE BY USING SUBCUTICULAR VICRYL SUTURE, METALLIC SKIN STAPLER AND A STERI-STRIP ADHESIVE TAPES - Kufa Med. Journal 2008. Vol. 11. No.1
11. IM AnuarRamdhan, MBBS, W Zulmi, MS Orth, AN Hidayah*, MD, MJM Kamel*, MBBS, MSM Fadhil*, MD, M Anwar Hau*, M Med Orth-COMPARATIVE STUDY BETWEEN COAPTIVE FILM VERSUS SUTURE FOR WOUND CLOSURE AFTER LONG BONE FRACTURE FIXATION-Malaysian Orthopaedic Journal 2013 Vol 7 No.1
12. ZempskyWT(1), Parrotti D, Grem C, Nichols J.- RANDOMIZED CONTROLLED COMPARISON OF COSMETIC OUTCOMES OF SIMPLE FACIALLACERATIONS CLOSED WITH STERI STRIP SKIN CLOSURES OR DERMABOND TISSUE ADHESIVE. - PediatrEmerg Care. 2004 Aug;20(8):519-24.
13. Kerrigan CL(1), Homa K. - EVALUATION OF A NEW WOUND CLOSURE DEVICE FOR LINEAR SURGICAL INCISIONS: 3MSTERI-STRIP S SURGICAL SKIN CLOSURE VERSUS SUBCUTICULAR CLOSURE. - PlastReconstr Surg. 2010 Jan;125(1):186-94. doi: 10.1097/PRS.0b013e3181c2a492.
14. TakayamaS(1), Yamamoto T(1), Tsuchiya C(1), Noguchi H(1), Sato J(1), Ishii Y(2). - COMPARING STERI-STRIP AND SURGICAL STAPLE WOUND CLOSURES AFTER PRIMARY TOTAL KNEE ARTHROPLASTIES. - Eur J OrthopSurgTraumatol. 2017 Jan;27(1):113-118. doi:10.1007/s00590-016-1848-x. Epub 2016 Sep 6.

15. Lazar HL(1), McCann J, Fitzgerald CA, Cabral HJ. - ADHESIVE STRIPS VERSUS SUBCUTICULAR SUTURE FOR MEDIANSTERNOTOMY WOUND CLOSURE. - J Card Surg. 2011 Jul;26(4):344-7. doi: 10.1111/j.1540-8191.2011.01257.x. Epub2011 May 9.
16. Davis M(1), Nakhdjevani A, Lidder S. - SUTURE/STERI-STRIP COMBINATION FOR THE MANAGEMENT OF LACERATIONS IN THIN-SKINNED INDIVIDUALS. - J Emerg Med. 2011 Mar;40(3):322-3. doi: 10.1016/j.jemermed.2010.05.077. Epub 2010 Sep 29.
17. Sujan Narayan Agrawal - A COMPARATIVE STUDY OF USE OF ADHESIVE GLUE VERSUS SKIN STAPLERS FOR CLOSURE OF SKIN INCISIONS. INTERNATIONAL JOURNAL OF RECENT TRENDS IN SCIENCE AND TECHNOLOGY. - March 2016; 18(2): 346-348 http://www.statperson.com(accessed 16 March 2016).