

## Comparative Study of Primary Skin Closure with Adhesive Skin Glue and Conventional Suture Material in Clean Elective Surgery

Anantha Raju G S <sup>\*1</sup>, Sundeep. A . Naik <sup>2</sup>.

<sup>\*1</sup> Assistant Professor, Department of General Surgery, SDM College of Medical Sciences and Hospital, Dharwad, Karnataka, India.

<sup>2</sup> Associate Professor, Department of General Surgery, SDM College of Medical Sciences and Hospital, Dharwad, Karnataka, India.

### ABSTRACT

**Introduction:** Wound closure techniques have evolved overtime from natural suturing materials to synthetic sutures, absorbable sutures, staples, tapes, and adhesive compounds.

A new technology is surgical adhesives, exemplified by Cyanoacrylate that could provide patients with the option of suture less skin closure. The aims and objectives of this study was to compare the time consumption, post operative pain, cosmetic appearance and complications of skin closure between the application of adhesive skin glue and conventional suturing.

**Material and Methods:** This is a comparative study in which 100 patients were studied in two groups, 50 patients in Adhesive glue group and 50 patients in Subcuticular suturing group. Informed consent was taken for the study. Same antibiotic protocol was followed: Injection Cefazolin 1gm single dose given intravenously at the time of anaesthesia. In both the groups, subcutaneous suturing was done before the closure of skin. Adhesive skin glue was applied in 3 layers over the operated wound in one group of patients, and subcuticular suturing by Nylon - Ethilon 00 was done for the other group.

**Results:** The wounds were assessed at 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup> post-operative days, 1<sup>st</sup> month and 3<sup>rd</sup> months post operatively using ASEPSIS score. Maximum number of complications such as Seroma, Erythema, Discolouration and Wound dehiscence were noted in Skin suturing group (16% -8 cases). In Adhesive glue group 8% (4 cases) of complications were observed. The wounds were assessed for Cosmesis on 7<sup>th</sup> post-operative day using Modified Hollander Cosmesis Scale and in the follow-up of 1<sup>st</sup> month and 3<sup>rd</sup> month, the Wound cosmesis was assessed by an independent observer and was scored in Visual Analogue Scale from 0 to 100. Adhesive Glue group had better cosmetic results compared to Subcuticular skin closure group.

**Conclusion:** The results from the present study show that the 2-octylcyanoacrylate adhesive glue skin closure is better than subcuticular skin closure. The use of adhesive glue takes lesser time for skin closure and results in shorter operative period. It forms a flexible, water resistant sealed skin closure and gives better cosmetic outcome. The postoperative pain is much less compared to traditional skin suturing techniques. The adhesive glue disappears naturally as incision heals and leaves no mark. It is non-irritant to skin and complications following adhesive glue application are extremely less.

**KEY WORDS:** 2-octylcyanoacrylate, Adhesive skin glue, Subcuticular suturing, Visual analogue scale, ASEPSIS score.

**Address for correspondence:** Dr. Anantha Raju G S, Assistant Professor, Department of General Surgery, SDM College of Medical Sciences and Hospital , Dharwad – 580009, Karnataka, India.

### Online Access and Article Informtaion

Quick Response code



DOI: 10.16965/ijims.2016.143

International Journal of Integrative Medical Sciences

[www.imedsciences.com](http://www.imedsciences.com)

Received: 29-07-2016

Accepted: 22-08-2016

Reviewed: 30-07-2016

Published: 31-08-2016

Source of Funding: Self

Conflicts of interest: None

## INTRODUCTION

The history of wound closure is as old as that of medicine. The recorded history of wound closure is found in Edwin Smith Surgical Papyrus, which was written in Egypt dating back to 2500 to 3000 BC [1,2]. Wound closure techniques have evolved overtime from natural suturing materials to synthetic sutures, absorbable sutures, staples, tapes, and adhesive compounds.

A new technology is surgical adhesives, exemplified by Cyanoacrylate that could provide patients with the option of suture less skin closure [3,4]. At present, 2-Octylcyanoacrylate has replaced, 2-Butylcyanoacrylate, as skin adhesive [5]. The cyanoacrylates first were synthesized in 1949 by Airdis. Coove et al and they described their adhesive properties and suggested their possible use as surgical adhesives. In the early 1960s, various surgical applications were investigated for these adhesives. Cyanoacrylates can be synthesized by reacting formaldehyde with alkyl cyanoacetate to obtain a prepolymer that by heating is depolymerized into a liquid monomer. The monomer then can be modified by altering the alkoxy carbonyl (-COOR) group of the molecule to obtain compounds of different chain lengths [6]. Upon application to living tissues (water or base), the monomer undergoes an exothermic hydroxylation reaction that results in polymerization of the adhesive. The shorter-chain derivatives tend to have a higher degree of tissue toxicity than the longer-chain derivatives [7].

2-Octylcyanoacrylate adhesive polymerizes through an exothermic reaction in which a small amount of heat is released. With the proper technique of applying adhesive in multiple thin layers, at least three, onto a dry wound and allowing time for polymerization between applications, heat is released slowly and the sensation of heat or pain experienced by the patient is minimized. If adhesive is applied so that large droplets of liquid are allowed to remain outspread, the patient may experience a sensation of heat or discomfort. Extra caution should be taken to avoid depositing any adhesive in the wound; the adhesive will not seep into the wound since it starts to polymerize instantaneously.

A common mistake is to inadvertently deposit the adhesive in the wound by pushing the tip of the vial into the wound and separating the wound edges [8].

Objectives of this study were to compare the time required between the application of adhesive skin glue and conventional suturing and also to compare the post operative pain, cosmetic appearance and the complications of skin closure by adhesive glue and conventional suturing.

## MATERIALS AND METHODS

Patients undergoing clean elective surgery with no focus of infection admitted in the department of General Surgery in Sri.R.L.Jalappa hospital and Research centre and attached hospitals, Kolar from December 2010 to December 2012, were included in the study. This was a comparative study in which 100 patients were studied in two groups, 50 patients in Adhesive glue group and 50 patients in Subcuticular suturing group. Every case in both the groups was investigated for any acute or chronic infections and malignancy. Written and Informed consent was taken for the study. Same antibiotic protocol was followed; Injection Cefazolin 1gm single dose, intravenously at the time of induction of anaesthesia.

In both the groups, subcutaneous suturing was done before the closure of skin. Adhesive skin glue was applied in 3 layers over the operated wound in one group of patients, and subcuticular suturing by Nylon (Ethilon 2-0) for the other group. In both the groups, the time taken for skin closure was noted and, the post-operative pain was assessed at 24hours, 72hours, 7th day, 1<sup>st</sup> month and 3<sup>rd</sup> month using Visual Analogue Scale [9-11] of 0 to 100, as rated by patients themselves. The outcome of wound was assessed at 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup> post-operative days and 1<sup>st</sup> month using ASEPSIS [12,13] score.

Any complications, if present were also observed in both the groups. On the follow-up at 1<sup>st</sup> month and 3<sup>rd</sup> month, the wound cosmesis was assessed by ward nurse, who had been trained on commenting on wound cosmesis using Visual Analog Scale of 0 to 100.

**Inclusion criteria:** Cases undergoing clean elective surgical procedure with length of

incision less than 8cms and under same antibiotic coverage.

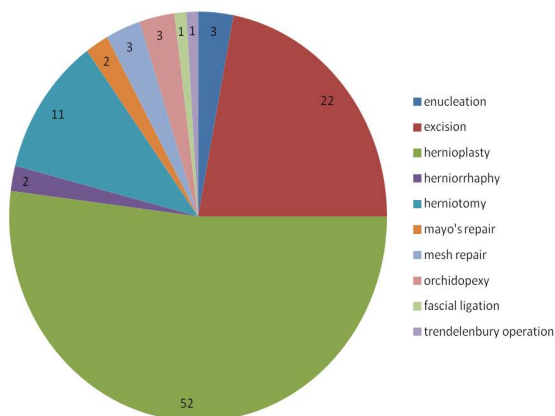
**Exclusion criteria:**

- (i) Cases not undergoing primary closure.
- (ii) Surgeries where stomas are necessary.
- (iii) Patients with systemic diseases and those not giving consent for 2-octylcyanoacrylate skin closure.
- (iv) Surgeries involving excision of malignant tumours.
- (v) Patients not coming for follow-up on or after 7<sup>th</sup> post operative days.
- (vi) Surgeries across mucocutaneous junctions like lips, oral cavity, eyes etc. where adhesive glue is contraindicated.

**RESULTS**

The present study was done to compare the efficacy between Subcuticular skin suturing and Adhesive glue skin closure in clean elective surgeries. A total of 100 patients were recruited in the study from December 2010 to December 2012. The patients were randomly included in either Subcuticular Skin Suturing group or Adhesive Glue group. None of the patients experienced hypersensitivity reaction and toxicity to Cyanoacrylate glue. In the present study there were 68 male and 32 female cases. There were 36 males out of 50 cases in adhesive glue group, which constitutes 72% of total number of cases and there were 14 females out of 50 cases in adhesive glue group, which constitutes of 28% of total. In suturing group there were 32 males out of 50 cases, which constitutes of 64% of total and there were 18 female cases out of 50

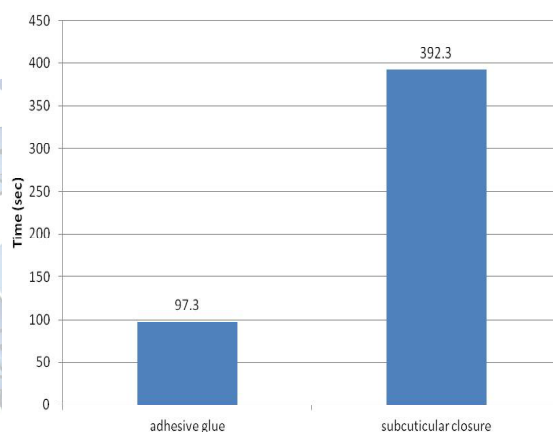
**Fig. 1:** Types of surgeries in the study population.



cases, which constitutes of 36% of total. The diagnosis and nature of surgeries were variable in each case in each group. The Fig. 1 shows the surgeries done in each group. All cases were clean elective surgeries.

The time taken for skin closure was measured using a stopwatch and entered in unit of seconds. The mean time taken for skin closure in adhesive glue was 97.3seconds ±47.1 and that of subcuticular suturing was 392.3seconds±70.3. This difference was of great statistical significance with p value of <.001 confidence. The Graph 1 depicts the mean time of skin closure.

**Graph 1:** Mean time taken for skin closure in study group.



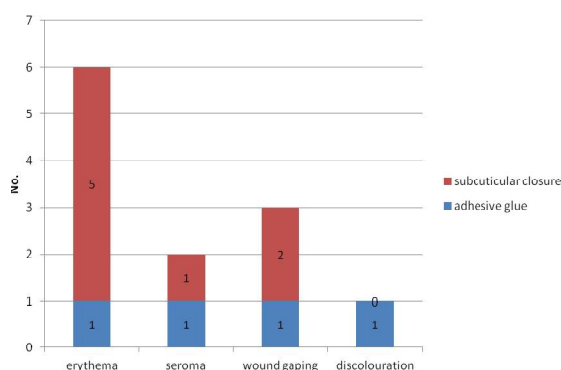
The Post-operative pain was measured in both the groups using Visual Analog Scale by patients themselves. Visual Analog Scale (VAS) is calibrated from 0 to 100. 0 is marked for being no pain and 100 being sense of worst pain. The pain score was observed at 24hours, 72hours, 7<sup>th</sup> day, 1month and 3months. (Table 1)

**Table 1:** Comparison of Post Operative Pain - VAS Score.

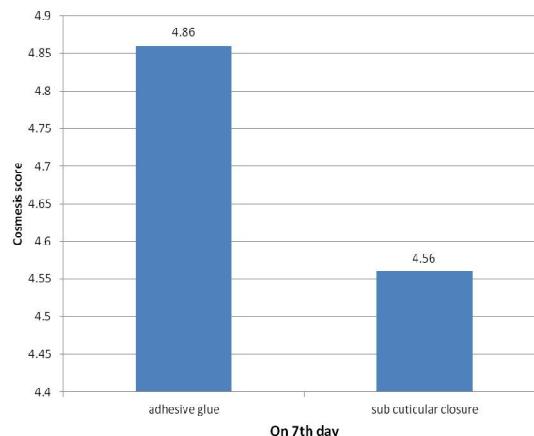
Time		N	Mean	Std Dev	t value	p value	degree of freedom
24hrs	Adhesive glue	50	28.7	8.85	-5.99	<0.001	86
	Subcuticular closure	50	37.8	6.07			
72 hrs	Adhesive glue	50	17.2	6.56	-4.97	<0.001	92
	Subcuticular closure	50	24.7	8.42			
7 days	Adhesive glue	50	12.2	4.97	-1.12	0.268	70
	Subcuticular closure	50	14	10.3			
1 month	Adhesive glue	50	2.6	3.53	-4.52	<0.001	97
	Subcuticular closure	50	5.8	3.55			
3 month	Adhesive glue	50	0.6	1.64	-0.25	0.801	89
	Subcuticular closure	50	0.7	2.26			

The outcome of wound was assessed at 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup> post-operative days and 1 month postoperatively using ASEPSIS score. Wound was scored from 0 to 10, according to the proportion of wound involved and presence of serous collection, erythematous changes, purulent exudates, and separation of deep tissues. Table - 2 shows the ASEPSIS Score on 3<sup>rd</sup> day, 5<sup>th</sup> day, 7<sup>th</sup> day and 1<sup>st</sup> month in both groups. The overall complication rates in both the groups are shown in Graph 2. Maximum numbers of complications were noted in Subcuticular suturing group. Patients in both the groups were followed up at 7 days, 1<sup>st</sup> month, and 3<sup>rd</sup> month and the wound was assessed for Cosmesis on 7<sup>th</sup> post-operative day using Modified Hollander Cosmesis Scale [14] which has 6 clinical variables as step-off borders, edge inversion, contour irregularities, excess inflammation, wound margin separation, and good overall appearance. A total cosmetic score was derived by adding the scores of variables. A score of 1 was given to each variable if not present in the wound, so a score of 5 and 6 was considered as optimal while less than 5 as sub-optimal. Any complications/infections, if present were also observed in both the groups. On the 1<sup>st</sup> month and 3<sup>rd</sup> month Wound Cosmesis was assessed by independent observer and wound scoring was done using Visual Analog Scale of 0 to 100. Wound Cosmesis Score was assessed at 7th post-operative day using Modified Hollander Cosmesis Scale. Subcuticular suturing group had a maximum score of 6 in 5 patients and a minimum of 2 in 3 patients, with a mean of 4.56 on the scale. In Adhesive glue group maximum score was 6 in 6 patients and minimum is 2 in 1 patient with a mean of 4.86 on the scale. These early results were more in favour of Adhesive glue. (Graph 3)

**Graph 2:** Distribution of complications in study group.



**Graph 3:** Mean Modified Hollander cosmesis scale.

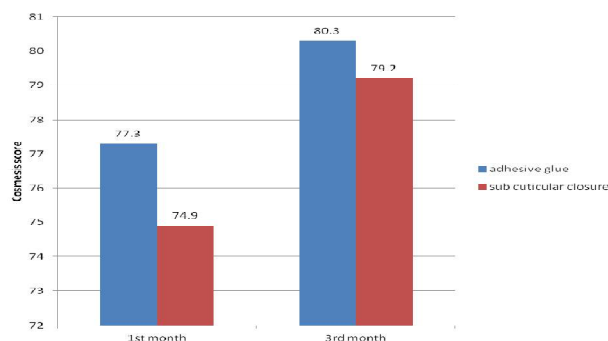


**Table 2:** Wound ASEPSIS score.

Wound asepsis	N	Mean	Std dev	max	degree of freedom	t value	p value
<b>3rd day</b>							
Adhesive glue	50	10.6	2.18	20	66	-1.67	0.099
Sub cuticular closure	50	11.9	5.04	30			
<b>5th day</b>							
Adhesive glue	50	1.18	4.27	20	62	-1.58	0.12
Sub cuticular closure	50	3.9	11.4	60			
<b>7th day</b>							
Adhesive glue	50	0.5	2.53	15	54	-1.75	0.085
Sub cuticular closure	50	3.3	11	60			
<b>1st month</b>							
Adhesive glue	50	0.2	1.41	10	73	-1.38	0.173
Sub cuticular closure	50	0.8	2.74	10			

Further, in the follow-up of 1<sup>st</sup> month and 3<sup>rd</sup> month, the Wound Cosmesis was assessed by an independent observer and was scored in a Visual Analogue Scale from 0 to 100. (Graph 4)

**Graph 4:** Mean wound cosmesis VAS score.



## DISCUSSION

In a study conducted by Matin.S.F<sup>15</sup>, 50 patient's wounds were closed with Octylcyanoacrylate and 42 patient's wounds with Subcuticular suturing. In Octylcyanoacrylate skin closure group, mean age was 52.5years and that of Subcuticular skin Suturing group it was 51.24 years. In the present study, the mean age in

Adhesive glue group is  $38.3 \pm 19.9$  years and in Subcuticular suturing group it is  $40.7 \pm 20.1$  years. Nevertheless, this marginal difference in the age between the two categories are statistically not significant ( $p > 0.547$ ) as patients are randomly selected. It is observed from the present study that the sex ratio (Male: Female ratio) in Adhesive glue group is 1:0.38 and that in Subcuticular suturing group it is 1:0.56, whereas the respective values in Matin.S.F study were 1:0.85 and 1:0.7824. It may be seen here that the male to female ratio in the present study is much lower in both Adhesive glue group and Subcuticular suturing group compared to Matin.S.F. study. The difference in sex population was not thought to have any effect on the results, as all the patients were randomly selected healthy individuals.

In one of the first published studies evaluating Octylcyanoarylate, Quin.J. et al [16], performed a prospective randomized controlled trial comparing Octylcyanoarylate and sutures. One hundred and thirty patients were enrolled. Use of the skin adhesive was found to be significantly faster in this setting (220seconds versus 744seconds;  $p < 0.001$ ). In Matin.S.F. study, the mean time taken for skin closure in Adhesive glue group is faster than Subcuticular suturing group (150 seconds versus 360 seconds). In the present study, the mean time taken for skin closure in Adhesive Glue is much faster than Subcuticular suturing Group (97.3seconds versus 392.3 seconds) which is of great significance with  $p < .0001$ .

In both the groups, the post-operative pain is assessed at 24hours, 72hours, 7th day, 1 month and 3 months using Visual Analogue Scale of 0 to 100, as rated by patients' themselves. The present study shows significant less postoperative pain in Adhesive glue group. The earlier studies by Zempsky.W.T., et al. [17], Arunachalam.P, et al. [18], and Quinn.J.,et al., have compared the post-operative pain using Visual Analogue Scale of 0 to 100 and have shown less post-operative pain in Adhesive glue group. In the present study there is significant less pain in Adhesive glue group up to first 72 hours following surgery.

The outcome of wounds is assessed at 3rd, 5th, 7th post-operative days, 1 month and 3 months

post op using ASEPSIS score. Maximum number of complications are noted in Subcuticular suturing group (16% - 8 cases). In Adhesive glue group 8% (4 cases) of the patients developed complications. Seroma developed in 1 patient, Discolouration was seen in 1 patient, Erythema was found in 1 patient and 1 patient had Wound dehiscence. In Subcuticular suturing group, 1 patient developed seroma, Erythema formed in 5 patients and 2 cases of wound dehiscence were observed. Earlier published studies by Singer.A.J., et al. [19], shows that the infection rates at the end of 1week after surgery were similar and fewer cases of erythema were seen in Adhesive glue group. But Wound dehiscence rate is 1.6% in Adhesive glue group and 0.9% in Suturing group. In the present study wound dehiscence is seen in 2% (1 case) in Adhesive glue group and 4% (2cases) in Subcuticular suturing group. Toriumi.D.M., et al. [20], in their study, evaluated the wound at 1st week and had didn't observe any complications. Our complications are in the initial part of the study in Adhesive glue group wherein excess of glue is used in the wound which led to seroma formation and wound separation. Patients in both the groups were followed up at 7<sup>th</sup> day, 1<sup>st</sup> month, and 3<sup>rd</sup> month. The wound is assessed for cosmesis on 7th post-operative day using Modified Hollander Cosmesis Scale. Further, in the follow-up of 1<sup>st</sup> month and 3<sup>rd</sup> month, the Wound cosmesis is assessed by an independent observer and was scored in a Visual Analogue Scale from 0 to 100.

The study conducted by Toriumi.D.M., et al., observed wounds on 7<sup>th</sup> day using Modified Hollander Cosmesis Scale and later by Visual Analog Scale and revealed the equivalent results with Modified Hollander Cosmesis Scale. In a study done by Jallali.N. et al. [21], they compared the wound with Modified Hollander Cosmesis Scale and later by Visual Analog Scale which showed no significant difference in cosmesis with both the scores. In the present study, the early results on 7<sup>th</sup> day is in favour of Adhesive glue group and later follow up at 1<sup>st</sup> month and 3<sup>rd</sup> month shows less significant difference between both the groups.

Thus, comparing the criteria of Time taken for Skin closure, the Post operative pain, the Cosmetic

appearance between Adhesive glue group and Subcuticular suturing group in the present study with earlier studies prove that Adhesive glue, Octylcyanoacrylate skin closure is significantly better than the subcuticular skin closure.

## CONCLUSION

The results from the present study show that the 2-octylcyanoacrylate adhesive glue skin closure is better than subcuticular skin closure. The concept of a surgical tissue adhesive for superficial skin closure is an attractive alternative to the use of sutures. The use of adhesive glue takes lesser time for skin closure and results in shorter operative period. It forms a flexible, water resistant sealed skin closure and gives better cosmetic outcome.

Application of adhesive glue needs no bandaging and allows the patient to have shower anytime after surgery. The postoperative pain is much less compared to traditional skin suturing techniques. The adhesive glue disappears naturally as incision heals and leaves no mark. Patient is also exempted from the pain of suture removal. It is non-irritant to skin and complications following adhesive glue application are extremely less. Therefore it can be concluded that 2- Octylcyanoacrylate can be used safely in surgical skin closure in clean elective surgeries.

## REFERENCES

- [1]. Moy RL, Waldman B, Hein DW. A review of sutures and suturing techniques. *J Dermatol Surg Oncol* 1992;18:785-95.
- [2]. Lober CW, Fenske NA. Suture materials for closing the skin and subcutaneous tissues. *Aesthetic Plast Surg* 1986;10:245-7.
- [3]. Singer AJ, Thode HC Jr. A review of the literature on Octyl cyanoacrylate tissue adhesive. *Am J Surg*. 2004;187(2):238-48.
- [4]. Blondeel NV, Murphey JW, Debrosse D, Nix JC, Puls LE, Theodore N, et al. Closure of long surgical incisions with a new formulation of 2-octylcyanoacrylate tissue adhesive versus commercially available methods. *Am J Surg*.2004;188(3):307-17.
- [5]. Osmond MH, Quinn JV, Sutcliffe T, Jarmuske M, Klassen TP. A randomized, clinical trial comparing butylcyanoacrylate with octylcyanoacrylate in the management of selected pediatric facial lacerations. *Acad Emerg Med*. 1999 Mar;6(3):171-7.
- [6]. Nitsch A, Pabyk A, Honig JF, Verheggen R, Merten HA. Cellular, histomorphologic, and clinical characteristics of a new octyl-2-cyanoacrylate skin adhesive. *Aesthetic Plast Surg*. 2005 Jan-Feb;29(1):53-8. Epub 2005 Mar 11.
- [7]. Chigira M, Akimoto M. Use of a skin adhesive (octyl-2-cyanoacrylate) and the optimum reinforcing combination for suturing wounds. *Scand J Plast Reconstr Surg Hand Surg*. 2005;39(6):334-8.
- [8]. Dragu A, Unglaub F, Schwarz S, Beier JP, Kneser U. Foreign body reaction after usage of tissue adhesives for skin closure: a case report and review of the literature. *Arch Orthop Trauma Surg*. 2009 Feb;129(2):167-9.
- [9]. McCarthy M, Chang CH, Pickard AS, Hurder A G, Price DD, Jonasson O, et al. Visual Analogue Scales for Assessing Surgical Pain. *J Am Med Ass*. 2005;201(5):245-52.
- [10]. Ong KS, Seymour RA. Pain measurement in humans. *J Ryl Coll Surg*. 2004;2(1):15-27.
- [11]. Martin McCarthy Jr, PhD, Chih-Hung Chang, PhD, A Simon Pickard, PhD, Anita Giobbie-Hurder, MS, Donald D Price, PhD, Olga Jonasson, MD, FACS, et al. Visual Analog Scales for Assessing Surgical Pain. *J Am Coll Surgeons* . 2005:201:245-252.
- [12]. Wilson AP, Weavill C, Burridge J, Kelsey MC. The use of the wound scoring method ASEPSIS in postoperative wound surveillance. *J Hosp Infec*.1990;16(4):297-309.
- [13]. Quinn.J, Wells.G, Sutcliffe.T, Jarmuske.M, Maw.J, Stiell.I, et al. Tissue adhesive versus suture wound repair at 1 year: randomized clinical trial correlating early, 3-month, and 1-year cosmetic outcome. *Ann Emerg Med*. 1998;32(6):645-9.
- [14]. Naki MM, Api O, Acioglu HC, Ozkan S, Kars B, Comparative study of a barbed suture, poliglecaprone and stapler in Pfannenstiel incisions performed for benign gynecological procedures: a randomized trial. *Acta Obstet Gynecol Scand*. 2010 Nov;89(11):1473-7.
- [15]. Matin.S.F. Prospective Randomized Trial of Skin Adhesive versus Sutures for closure of 217 laparoscopic port-site incisions. *J Am Coll Surgeons*. 2003;196(6): 845-53.
- [16]. Quinn J, Wells G, Sutcliffe T, Jarmuske M, Maw J, Stiell I, et al. A randomized trial comparing octylcyanoacrylate tissue adhesive and sutures in the management of lacerations. *J Am Med Ass*.1997;277(19):1527-30.
- [17]. Zempsky WT, Parrotti D, Grem C, Nicholas J. Randomized Controlled Comparison of Cosmetic Outcomes of Simple Facial Lacerations closed with Steri Strip Skin Closures or Dermabond tissue Adhesive. *Pediatr Emerg Care* . 2004;20(8):519-24.
- [18]. Arunachalam P, King P.A, Oxford J, A Prospective comparison of tissue glue versus sutures for circumcision. *Ped Surg Inter*. 2003;19(1-2):18-9.
- [19]. Singer.A.J, Church.A.L, Forrestal.K, Werblud.M, Valentine.S.M and Hollander.J.E. Comparison of

- patient satisfaction and practitioner satisfaction with wound appearance after traumatic wound repair. *Acad Emerg Med* 1997;(4):133-137.
- [20]. Toriumi.D.M, O'Grady.K., Desai.D., Bagal.A. Use of Octyl-2-Cyanoacrylate for skin closure in facial plastic surgery. *Plast Reconstr Surg.* 1998;102(6):2209-19.
- [21]. Jallali N, Haji A, Watson CJ. A prospective randomized trial comparing 2- octyl cyanoacrylate to conventional suturing in closure of laparoscopic cholecystectomy incisions. *J Laparoendosc Adv A.* 2004;14(4):209-11.
- [22].Cardo DM, Falk PS, Mayhall CG. Validation of surgical wound classification in the operating room. *Infect Control Hosp Epidemiol.* 1993 May;14(5):255-9.
- [23]. Kiritsy CP, Lynch AB, Lynch SE. Role of growth factors in cutaneous wound healing: a review. *Crit Rev Oral Biol Med.* 1993;4(5):729-60.
- [24]. Martin P, Hopkinson-Woolley J, McCluskey J Growth factors and cutaneous wound repair. *Prog Growth Factor Res.* 1992 ; 4 (1) : 25-44.
- [25].Grazul-Bilska AT, Johnson ML, Bilski JJ, Redmer DA, Reynolds LP. Wound healing: the role of growth factors. *Drugs Today (Barc).* 2003 Oct;39(10):787-800.
- [26].Christian LM, Graham JE, Padgett DA, Glaser R, Kiecolt - Glaser JK. Stress and wound healing. *Neuroimmunomodulation.* 2006;13(5-6):337-46.
- [27].Glat PM, Longaker MT. Wound healing. In: Aston SJ, Beasley RW, Thorne CHM, eds. *Grabb and Smith's Plastic Surgery.* 1997: chap 1.
- [28].Tanenbaum M. Skin and tissue techniques. In: McCord CD Jr, Tanenbaum M, Nunery WR, eds. *Oculoplastic Surgery.* 3<sup>rd</sup> ed.1995:3-4.
- [29].Vegas O, Vanbuskirk J, Richardson S, Parfitt D, Helmreich D. Effects of psychological stress and housing conditions on the delay of wound healing. *Psicothema.* 2012 Nov;24(4):581-6.
- [30]. Stadelmann, WK, Digenis, AG, Tobin GR. Physiology and healing dynamics of chronic cutaneous wounds. *Am J Surg.*1998 ;176 (2A Suppl):26-38.

**How to cite this article:**

Anantha Raju G S, Sundeep. A . Naik. Comparative Study of Primary Skin Closure with Adhesive Skin Glue and Conventional Suture Material in Clean Elective Surgery. *Int J Intg Med Sci* 2016;3(8):384-390. **DOI:** 10.16965/ijims.2016.143