ORIGINAL RESEARCH PAPER

General Surgery

COMPARATIVE STUDY OF CONVENTIONAL INCISION AND DRAINAGE VERSUS PRIMARY CLOSURE WITH CLOSED SUCTION DRAIN IN ACUTE CUTANEOUS ABSCESSES.

KEY WORDS:

Dr Dravina Shetty Assistant Professor, Pediatric Surgery, Ltmmc sion Hospital

Dr. Pavan Dharurkar MIMER Medical College, Talegoan, Pune

Dr. Tushar Khachane Associate Professor, MIMER Medical College, Pune

ABSTRACT

An abscess is a common surgical condition [1] . It is a collection of pus that has accumulated within a tissue because of an inflammatory process in response to either infectious process or foreign material like infected needles, bullet wounds or infected wooden materials [2]. For the treatment of subcutaneous and soft tissue acute abscesses, options include percutaneous aspiration, incision and drainage without primary closure, incision and drainage with primary closure with drain. Out of these conventional incision and drainage remains the preferred choice but it leaves an ugly scar, delay wound healing and dressings are painful. In this paper we have included 75 patients with acute cutaneous abscesses for the comparison on conventional incision and drainage versus primary closure with closed suction drain for treatment of the same. The efficiency of each methods are based on the outcome parameters. The outcome parameters used in this study includes operative time, hospital stay, healing time, wound scarring and cost of treatment.

I. INTRODUCTION

An abscess is a common surgical condition [1] . It is a collection of pus that has accumulated within a tissue because of an inflammatory process in response to either infectious process or foreign material like infected needles, bullet wounds or infected wooden materials [2] . It is defensive reaction of the tissue to prevent the spread of infection to other parts of the body. The organism or foreign materials kill the local cells resulting in the release of cytokines which trigger inflammatory response and draw large number of blood cells to area and increase regional blood flow [3] . Clinically it is a painful fluctuant soft tissue mass surrounded by firm granulation tissue and erythema [4].

Predisposing factors to abscess formation include impaired host defense mechanisms, the presence of foreign bodies, tissue ischemia or necrosis, hematoma or excessive fluid accumulation in tissue. Intravenous drug use is another important risk factor with rates reported as high as 65% in this population [5] .

Trauma is also important factor for abscess formation like infected needles in case of gluteal abscesses which cause implantation of bacteria into deeper structures.

Abscesses may occur anywhere in the body and the nature of infective organisms varies with particular site of abscess formation.

Subcutaneous abscess is typically poly-microbial in nature. Staphylococcus aureus and group A beta haemolytic streptococci are most commonly involved aerobic microorganisms. Commonly isolated anaerobes include Bacteroides, Pepto-cocci, Peptostreptococci, clostridium sp., lactobacillus sp. and fusobacteria. Staphylococcus aureus is most commonly involved organism [6] .

II. MATERIAL AND METHODS

Study Area- Department of Surgery of a tertiary care Hospital.
Study Population- Patient admitted to our hospital in surgery ward with cutaneous abscess.
Study Duration- November 2018 – October 2020
Study Design- A randomized control study
Sample Size
Consecutive type of non-probability sampling was used for the selection of study subjects during study duration. All the subjects fulfilling the eligibility criteria were taken for study after informed consent. A total of 70 patients with cutaneous abscess were divided into 2 study groups as per computer generated random numbers:
Group A: Conventional incision and drainage (35 patients)
Group B: Primary closure with closed suction drain (35 patients)

Inclusion Criteria
1. All patients between 18 to 60 years old
2. Patients with acute cutaneous abscesses
3. Patients without cognitive impairment or Mental Retardation

Exclusion Criteria
1. Patients suffering from systemic diseases like tuberculosis, immunodeficiency, and patients on steroids.
2. Patient with perianal abscess.
3. Chronic Hepatic or chronic Renal illness
4. Any kind of communication problem
5. Neurotic or psychiatric disease

METHODOLOGY

Study was commenced after approval from institutional ethical committee. A total of 70 patients scheduled for surgery for Cutaneous Abscesses were enrolled in this study and allotted to respective groups as mentioned above. With due pre-anaesthetic care patients were planned and posted for surgery.

Patients in Group A were treated by conventional incision and drainage and patients in Group B were treated by primary closure with closed suction drain. In each patient detailed history and thorough clinical examination was carried out.

Patients were prepared preoperatively by giving injection tetanus toxoid and xylocaine sensitivity test (XST). Anesthesia was given depending on the site and age. e.g. local, regional, spinal, general anesthesia. Patients were given injection amoxicillin (1000mg) in combination with potassium clavulanate (200mg), 1.2gm intravenous (i.v.) before induction of anesthesia. Skin was cleaned with 10% povidone iodine solution and draped. Incision was taken at the most prominent site and abscess cavity was drained. Pus was collected in sterile syringe and sent for culture and sensitivity. The cavity was drained using a suction cannula and locculi were broken. The abscess was curetted and irrigated with

povidone iodine and hydrogen peroxide. After draining the abscess, ID of the abscess cavity was measured using a sterile suture material measuring the distance between the opposite walls of the abscess cavity.

In group A abscess was packed with ribbon gauze soaked in povidone iodine and hydrogen peroxide while in group B abscess was primarily sutured with polyamide nylon. Vertical mattress sutures were taken keeping Romovac drain of appropriate size in the cavity.

Postoperatively in both the groups injection diclofenac sodium 75mg single dose was given and then continued with tab. diclofenac sodium 50mg twice a day for 3 days and thereafter SOS to maintain analgesia. In both the groups injection amoxicillin (1000mg) in combination with potassium clavulanate (200mg) 1.2 gm i.v. given 12hrs for 2 days and then continued with Tab. for 3 more days. After the culture reports were available, as per culture sensitivity report antibiotics were changed accordingly for next five days.

In group A dressings were done daily. Cavity was cleaned with povidone iodine and hydrogen peroxide, then scraped and packed with ribbon gauze soaked with povidone iodine and hydrogen peroxide. The length of ribbon gauze was gradually made smaller depending on the size of the cavity to allow obliteration of cavity. However, in group B first dressings were done on second day and then as and when required. Suction drain was removed after the discharge from abscess cavity was minimal (less than 5ml/day) and the sutures were removed between 7th -14th day after confirming that the suture line was healthy.

In group A healing time was recorded from time of incision till the complete obliteration of abscess cavity and in group B healing time was recorded from time of incision till suture removal after confirming that skin edges were properly approximated.

As patients were operated on day of admission on emergency basis, the duration of hospital stay was calculated from day of admission till the day of discharge. On follow up at 1, 2 and 3 months recurrence was noted in both the groups. A recurrence was defined as the development of further abscess; sinus or fistula after wound was healed.

Outcome Parameters

- Operative time
- Hospital stay
- Healing time
- Wound scarring
- Cost of Treatment

RESULTS

Table 1. Distribution of Subjects as Per Study Group

Group	N	%
A (Conventional incision and drainage)	35	50.0%
B (Primary closure with closed suction drain)	35	50.0%
Total	70	100.0%

A total of 70 patients with cutaneous abscess were divided into 2 study groups of 35 each as per computer generated random numbers: Group A: Conventional incision and drainage and; Group B: Primary closure with closed suction drain.

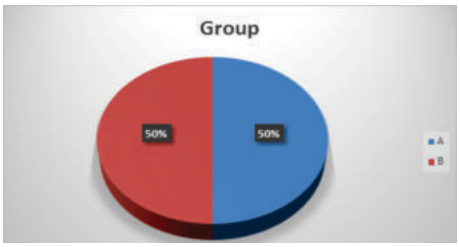


Table 2. Distribution of Subjects as Per Gender

Gender	Group		Total
	A	B	
Female	10	10	20
	28.6%	28.6%	28.6%
Male	25	25	50
	71.4%	71.4%	71.4%
Total	35	35	70
	100.0%	100.0%	100.0%
p- value - 1.0			

Out of the total 70 cases, 71.4% were males and 28.6% were females with significant difference between study groups (p-1.0).

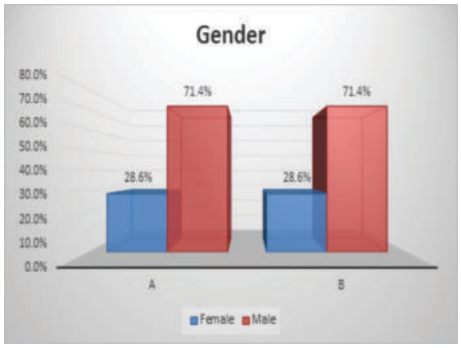


Table 3. Mean age Comparison Among Study Groups

Variables	Group	N	Mean	SD	p- value
Age (years)	A	35	38.11	11.73	0.98
	B	35	38.06	11.81	

Mean age of study cases in group A was 38.11 years while that in group B was 38.06 years respectively (p-0.98).

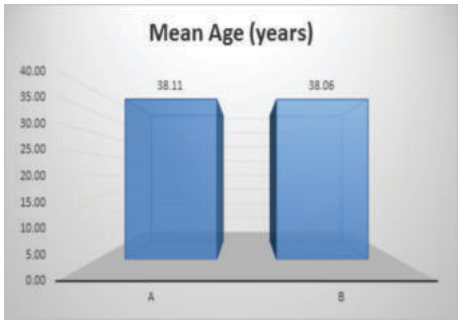


Table 4. Distribution of Study Groups as Per Site of Abscess

Site of Abscess	Group		Total
	A	B	
Abdomen	4	4	8
	11.4%	11.4%	11.4%
Axilla	9	8	17
	25.7%	22.9%	24.3%
Back	2	3	5
	5.7%	8.6%	7.1%
Breast	3	4	7
	8.6%	11.4%	10.0%
Chest	4	2	6
	11.4%	5.7%	8.6%
Gluteal region	6	6	12
	17.1%	17.1%	17.1%
Lower limb	3	4	7
	8.6%	11.4%	10.0%
Upper limb	4	4	8
	11.4%	11.4%	11.4%
Total	35	35	70
	100.0%	100.0%	100.0%
p- value - 0.949			

No difference was observed between study groups with respect to site of abscess (p-0.949).

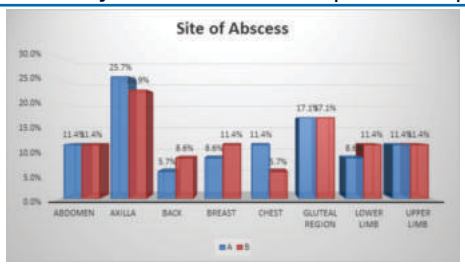


Table 5. Mean Comparison of Study Cases as Per Size of Abscess

Variables	Group	N	Mean	SD	p- value
Size of Abscess (cm)	A	35	4.48	1.38	0.91
	B	35	4.41	1.39	

Mean size of abscess in group A was 4.48 cm while that in group B was 4.41 cm respectively (p-0.91).

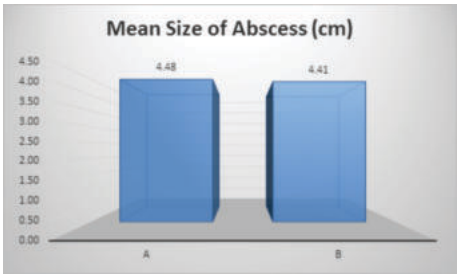


Table 6. Mean Comparison of Study Cases as Per Operative Time

Variables	Group	N	Mean	SD	p- value
Operative time (mins)	A	35	9.86	1.57	<0.01
	B	35	17.91	5.56	

Mean operative time was significantly more when we do primary closure with a closed suction drain (17.91 mins) as compared to simple incision and drainage procedure (9.86 mins).This is understandable as

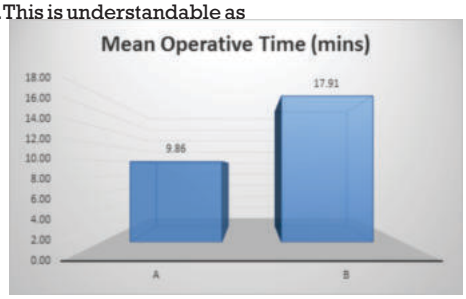


Table 7. Mean Comparison of Study Cases as Per Healing Time

Variables	Group	N	Mean	SD	p- value
Healing Time (days)	A	35	14.87	2.78	<0.01
	B	35	10.23	4.13	

Mean healing time was significantly less in cases managed by Primary closure with closed suction drain as compared to Conventional incision and drainage (10.23 vs 14.87 days; p<0.01).

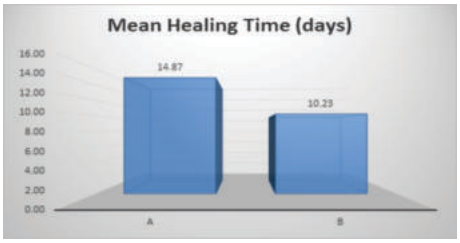


Table 8. Mean Comparison of Study Cases as Per Hospital Stay

Variables	Group	N	Mean	SD	p- value
Hospital Stay (days)	A	35	4.54	0.85	<0.01
	B	35	2.23	1.00	

Mean hospital stay was significantly less in cases managed by Primary closure with closed suction drain as compared to Conventional incision and drainage (2.23 vs 4.54 days; p<0.01).

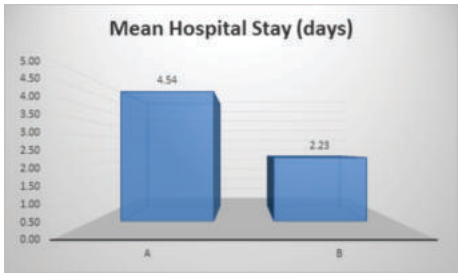


Table 9. Mean Comparison of Study Cases as Per VAS Score at Discharge

Variables	Group	N	Mean	SD	p- value
VAS Score (at discharge)	A	35	4.03	0.98	<0.01
	B	35	2.09	0.74	

Mean numeric pain rating score was significantly less in cases managed by Primary closure with closed suction drain as compared to Conventional incision and drainage (2.09 vs 4.03;p<0.01).

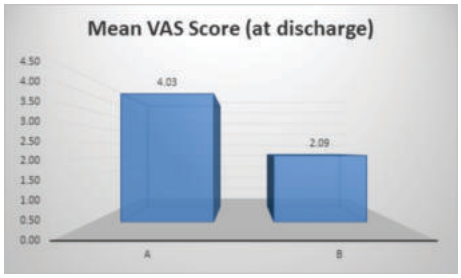


Table 10. Distribution of Study Cases as Per Presence of Wound Scarring

Wound Scarring	Group		Total
	A	B	
No	23	29	52
	65.7%	82.9%	74.3%
Yes	12	6	18
	34.3%	17.1%	25.7%
Total	35	35	70
	100.0%	100.0%	100.0%
p- value - 0.101			

Wound scarring was seen in 34.3% cases managed by Conventional incision and drainage as compared to 17.1% cases managed by Primary closure with closed suction drain. The difference was however statistically non-significant (p-0.101).

Table 11. Mean Comparison of Study Cases as Per Cost Incurred by the Cases

Variables	Group	N	Mean	SD	p- value
Cost (Rs/-)	A	35	1143.43	351.80	<0.01
	B	35	761.14	236.19	

Mean cost of the treatment incurred on the patients was significantly less in cases managed by Primary closure with closed suction drain as compared to Conventional incision and drainage (761.14/- vs 1143.43/-;p<0.01).

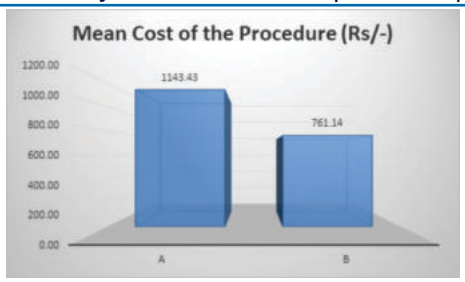
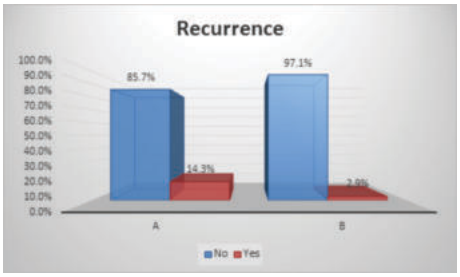


Table 12. Distribution of Study Subjects as Per Incidence of Recurrence

Recurrence	Group		Total
	A	B	
No	30	34	64
	85.7%	97.1%	91.4%
Yes	5	1	6
	14.3%	2.9%	8.6%
Total	35	35	70
	100.0%	100.0%	100.0%
p- value <0.05			

Recurrence was seen in 1 cases (2.9%) managed Primary closure with closed suction drain as compared to 5 cases (14.3%) in cases managed by Conventional incision and drainage (p<0.05).



III. DISCUSSION

For the treatment of acute cutaneous abscesses, options include percutaneous aspiration, incision and drainage without primary closure, incision and drainage with primary closure with drain. Out of these conventional incision and drainage remains the preferred choice but it leaves an ugly scar, delay wound healing and dressings are painful. Ellis (1951) first described primary closure of incision and drainage of abscess. Primary closure causes fast healing, less pain and better scar as compared to conventional method of incision and drainage [8].

In present study, we aimed at comparing the outcomes between conventional incision and drainage versus primary closure with closed suction drain in in acute cutaneous abscesses cases in terms of: operative time, hospital stay, healing time and; need for re-procedure.

Study included a total of 70 patients with cutaneous abscess, who were divided into 2 study groups of 35 each as per computer generated random numbers: Group A: Conventional incision and drainage (I & D) and; Group B: Primary closure with closed suction drain. Out of the total 70 cases, 71.4% were males and 28.6% were females with significant difference between study groups (p-1.0). Mean age of study cases in group A was 38.11 years while that in group B was 38.06 years respectively (p-0.98). No difference was observed between study groups with respect to site of abscess and size of abscess (p>0.05).

Operation Time

Mean operative time was significantly more when we do primary closure with a closed suction drain (17.91 mins) as compared to simple incision and drainage procedure (9.86 mins).

This is understandable as in conventional incision and drainage, once the abscess cavity was drained, it was packed with ribbon gauze soaked in povidone iodine and hydrogen peroxide. On the other hand in cases managed by primary closure with a closed suction drain, once the abscess cavity was drained, abscess was primarily sutured with polyamide nylon. Vertical mattress sutures were then taken keeping Romovac drain of appropriate size in the cavity. The suturing of the wound along with drain contributes to the additional time required for the procedure.

Hospital Stay

In present study, mean hospital stay was significantly less in cases managed by Primary closure with closed suction drain as compared to Conventional incision and drainage (2.23 vs 4.54 days; p<0.01).

Beg FM et al. [9] in their study observed that hospital stay in group A (I & D) was 15.28 days as compared to group B (primary closure with drain) was 9.74 days, which was statistical significant (P<0.01). Sam Vivek G et al. [10] observed hospital stay as 13±2.1 days in group A and 7±1.2 days in group B. Hospital stay was significantly higher in group A compared to Group B. Kale A et al. [5] observed that hospital stay in Group B was shorter than in Group A (11.98 vs 17.46 days; p< 0.05). Dalvi et al. [7] in their study observed mean duration of hospital stay in group 1 as 4.48 days while in group 2 as 6.44 days with (p value = 0.0002) suggestive of mean duration of hospital stay is significantly less in group 1 i.e. primary closure group. Abraham N et al. [1] in their study observed that hospitalization was reduced by 44- days in cases managed by primary closure.

Post-op Pain

In present study, mean numeric pain rating score was significantly less in cases managed by Primary closure with closed suction drain as compared to Conventional incision and drainage (2.09 vs 4.03; p<0.01).

Beg FM et al. [9] in their study showed that the VAS score in day 1, day 3, day 5 & day 7 was 7.280±1.126, 6.520±0.8142, 4.760±0.7709 & 1.700±0.8391 respectively in group A and 5.720±1.485, 5.140±1.178, 3.340±0.9172 & 1.060±0.9127 respectively in group B. The comparison of mean in different time duration was statistically significant (p<0.01 each). Sam Vivek G et al. [10] observed significant lower VAS score in group A compared to Group B. The VAS in group A and group B at days 1,2,3,4 respectively in both the groups were 9±1.2, 6.2±1.1; 7.2±2.1, 4.2±0.9; 5.2±1.2, 3.1±1.6; 2.5±1.2, 1.2±0.7. Kale A et al. [5] observed mean VAS score as 7.5 in group A comparison to 5.62 group B (p<0.05). The score was significantly less in group B even by the end of day 7 (1.16 vs 2.94; p<0.01). In the study by Dalvi et al. [5], post-operative pain is measured quantitatively according to days of analgesic required. In group 1 mean duration of post-operative pain is 2.16 days and in group 2 mean duration of post-operative pain is 4.36 days with (p<0.01) suggestive significantly lower duration of postoperative pain in primary closure group.\

Healing Time & Cosmetic Outcome

Mean healing time was significantly less in cases managed by Primary closure with closed suction drain as compared to Conventional incision and drainage (10.23 vs 14.87 days; p<0.01). Wound scarring was seen in 34.3% cases managed by Conventional incision and drainage as compared to 17.1% cases managed by Primary closure with closed suction drain. The difference was however statistically non-significant (p-0.101).

Singer AJ et al. [2] conducted a systematic review on Primary closure of cutaneous abscesses. The time to healing after primary closure (7.8 days; 7.3-8.3) was significantly shorter than that after secondary closure (15.0 days; 14.3-15.7]. Beg

FM et al. [9] in a similar study observed wound healing days in conventional I & D group as 14.46 days as compared to 9.20 days in primary closure group, which was statistical significant (p<0.01). They also observed that primary closure provides more satisfactory cosmetic results. Sam Vivek G et al. [10] in their study also observed that wound healing significantly (p<0.01) faster in group B (9±1.2) compared to group A (11±2.4). Singh A et al. [8] also observed wound healing was significantly faster in incision and drainage with primary closure (9.18±0.941days) as compared to conventional method of incision and drainage (16.66±1.944 days) (p<0.05). Kale A et al. [5] observed that wound healing in Group B was faster than in Group A (11.0 vs 16.56 days; p< 0.05). Dubey V et al. [3] in their study observed healing time in Group A (I & D with primary closure and use of a closed suction drain) patients was less than that of Group B patients (I & D). Raj MRM et al. [6] also observed lesser time to heal and better scar in primary closure than the open group.

Cost of Treatment

Mean cost of the treatment incurred on the patients was significantly less in cases managed by Primary closure with closed suction drain as compared to Conventional incision and drainage (761.14/- vs 1143.43/-; p<0.01).

Cost of increased duration of hospital stay and cost of daily dressing resulted in increased cost of treatment in conventional incision and drainage group.

Recurrence

Recurrence was seen in 1 case (2.9%) managed Primary closure with closed suction drain as compared to 5 cases (14.3%) in cases managed by Conventional incision and drainage (p<0.05).

CONCLUSION

Study concluded that on comparing the two methods of treatment for acute cutaneous abscess, the primary closure with closed suction technique was superior to the conventional technique in terms of duration of healing, post-op pain, length of hospitalization, success rate and cosmetic results. Overall cost of the procedure was also lower with primary closure technique. We thus recommend primary closure with closed suction as the choice of treatment for acute cutaneous abscesses

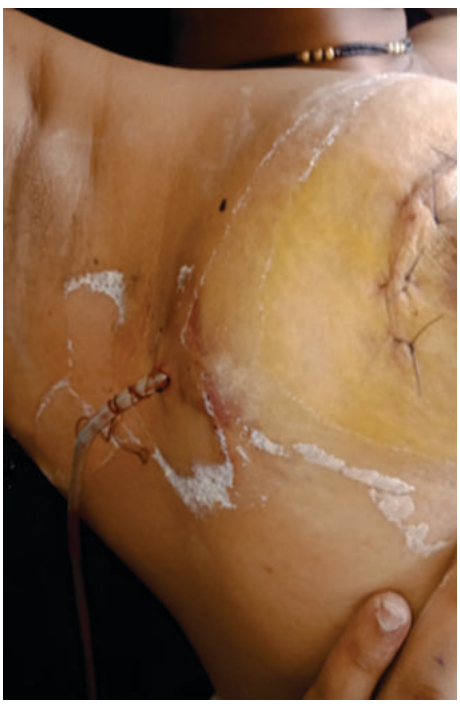


Fig. 1 Postoperative Drain Kept in Breast

Fig. 2 Primary Closure with Closed Suction Drain in Thigh Abscess

Fig 3 Picture Showing Conventional Incision and Drainage

REFERENCES

1. Townsend CM. Surgical Infections and Choice of Antibiotics. Sabiston Textbook of Surgery: the biological basis of modern surgical practice. Saunders Elsevier, Philadelphia; 2007:299-327.
2. Edino ST, Ihezue CH, Obekpa PO. Outcome of primary closure of incised acute soft tissue abscesses. Niger Postgrad Med J. 2001;8:32-6.
3. Lamont P. Surgical Infection. In: Williams NS, Bulstrode C, O'connell P. Bailey and Love's Short Practice of Surgery, 26th Ed. CRC, London; 2013:53-55.
4. Thomas W. Basic surgical skills and anastomosis. In: Williams NS, Bulstrode C, O'connell P. Bailey and Love's Short Practice of Surgery, 26th Ed. CRC, London; 2013;53-55.
5. Ruiz LP, Strain EC, John G. The substance abuse handbook. Wolters Kluwer Health/Lippincott Williams and Wilkins Philadelphia; 2007:373.
6. Efem DE. Breast abscesses in Nigeria; Lactational versus non-lactational breast. JR Coll Surg Edin. 1995;40:25-27.
7. Bhishagratna KK. English Translation of Sushruta Samhita (ca 600B.C.) Calcutta Bose; 1916.
8. Ellis M. Incision and Primary suture of Abscesses of the Anal region. Proc R Soc Med. 1960;53:652-3
9. Yousef H, Alhajj M, Sharma S. Anatomy, Skin (Integument), Epidermis. [Updated 2020 Jul 27]. In: StatPearls [Internet]. Treasure Island (FL): Stat Pearls Publishing; 2021 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470464/.
10. Fenner J, Silverberg NB. Skin diseases associated with atopic dermatitis. Clin Dermatol. 2018 Sep - Oct;36(5):631-640.
11. O'Connell RL, Rusby JE. Anatomy relevant to conservative mastectomy. Gland Surg. 2015 Dec;4(6):476-83.
12. Andersson T, Ertürk Bergdahl G, Saleh K, Magnúsdóttir H, Stødkilde K, Andersen CBF, Lundqvist K, Jensen A, Brüggemann H, Lood R. Common skin bacteria protect their host from oxidative stress through secreted antioxidant RoxP. Sci Rep. 2019 Mar 05;9(1):3596.
13. Losquadro WD. Anatomy of the Skin and the Pathogenesis of Nonmelanoma Skin Cancer. Facial Plast Surg Clin North Am. 2017 Aug;25(3):283-289.
14. Slominski AT, Manna PR, Tuckey RC. On the role of skin in the regulation of local and systemic steroidogenic activities. Steroids. 2015 Nov;103:72-88.
15. Hall BK. Germ layers, the neural crest and emergent organization in development and evolution. Genesis. 2018 Jun;56(6-7):e23103.
16. Denkler KA, Denkler C. The Direction of Optimal Skin Incisions Derived from Striae Distensae. Plast Reconstr Surg. 2015 Jul;136(1):120e-121e.

17. Schlader ZJ, Vargas NT. Regulation of Body Temperature by Autonomic and Behavioral Thermoeffectors. Exerc Sport Sci Rev. 2019 Apr;47(2):116-126.
18. Iizaka S. Skin hydration and lifestyle-related factors in community-dwelling older people. Arch Gerontol Geriatr. 2017 Sep;72:121-126.
19. Stecco C, Pirri C, Fede C, Fan C, Giordani F, Stecco L, Foti C, De Caro R. Dermatome and fasciatome. Clin Anat. 2019 Oct;32(7):896-902.
20. Iheanacho F, Vellipuram AR. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Sep 29, 2020. Physiology, Mechanoreceptors.
21. Murphrey MB, Agarwal S, Zito PM. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Sep 2, 2020. Anatomy, Hair.
22. National Hospital Ambulatory Medical Care Survey: 2013 Emergency Department Summary Tables. Found at https://www.cdc.gov/nchs/data/ahcd/nhamcs_emergency/2013_ed_web_tables.pdf. Accessed April 29, 2017.
23. Pallin DJ, Egan DJ, Pelletier AJ, et al. Increased US emergency department visits for skin and soft tissue infections, and changes in antibiotic choices, during the emergence of community-associated methicillin-resistant Staphylococcus aureus. Ann Emerg Med 2008;51:291-298.
24. Stevens DL, Bisno AL, Chambers HF, et al; Infectious Diseases Society of America. Practice guidelines for the diagnosis and management of skin and soft tissue infections: 2014 update by the Infectious Diseases Society of America. Clin Infect Dis 2014;59:e10-e52.
25. Hammond SP, Baden LR. Management of skin and soft-tissue infection — polling results. N Engl J Med 2008;359:e20.
26. Kelly EW, Magilner D. Chapter 152. Soft Tissue Infections. In: Tintinalli JE, et al. eds. Tintinalli's Emergency Medicine: A Comprehensive Study Guide. 8th ed. New York: McGraw-Hill Education; 2016.
27. Lopez MA, Cruz AT, Kowalkowski MA, et al. Trends in resource utilization for hospitalized children with skin and soft tissue infections. Pediatrics 2013;131:e718-725.
28. Darmstadt GL. Oral antibiotic therapy for uncomplicated bacterial skin infections in children. Pediatr Infect Dis J 1997;16:227-240.
29. Taira BR, Singer AJ, Thode HC Jr, et al. National epidemiology of cutaneous abscesses: 1996 to 2005. Am J Emerg Med 2009;27:289-292.
30. Fridkin SK, Hageman JC, Morrison M, et al. Methicillin-resistant Staphylococcus aureus disease in three communities. N Engl J Med 2005;352:1436-1444.
31. Moran GJ, Krishnadasan A, Gorwitz RJ, et al. Methicillin-resistant S. aureus infections among patients in the emergency department. N Engl J Med 2006;355:666-674.
32. Magilner D, Byerly MM, Cline DM. The prevalence of community-acquired methicillin-resistant Staphylococcus aureus (CA-MRSA) in skin abscesses presenting to the pediatric emergency department. N C Med J 2008;69:351-354.
33. Marin JR, Bilker W, Lautenbach E, et al. Reliability of clinical examinations for pediatric skin and soft-tissue infections. Pediatrics 2010;126:925-930.
34. Gordon RJ, Lowy FD. Bacterial infections in drug users. N Engl J Med 2005;353:1945-1954.
35. Tayal VS, Hasan N, Norton HJ, et al. The effect of soft-tissue ultrasound on the management of cellulitis in the emergency department. Acad Emerg Med 2006;13:384-388.
36. Squire BT, Fox JC, Anderson C. ABSCESS: Applied bedside sonography for convenient evaluation of superficial soft tissue infections. Acad Emerg Med 2005;12:601-606.
37. Iverson K, Haritos D, Thomas R, et al. The effect of bedside ultrasound on diagnosis and management of soft tissue infections in a pediatric ED. Am J Emerg Med 2012;30:1347-1351.
38. Marin JR, Dean AJ, Bilker WB, et al. Emergency ultrasound-assisted examination of skin and soft tissue infections in the pediatric emergency department. Acad Emerg Med 2013;20:545-553.
39. Schmitz GR. How do you treat an abscess in the era of increased community-associated methicillin-resistant Staphylococcus aureus (MRSA)? J Emerg Med 2011;41:276-281.
40. American College of Emergency Medicine. [press release] Choosing Wisely: Five things physicians and patients should question. Dallas, TX: American College of Emergency Medicine; 2013. Available at: http://www.choosingwisely.org/societies/american-college-of-emergency-physicians/. Accessed Dec. 5, 2015.
41. Schmitz G, Goodwin T, Singer A, et al. The treatment of cutaneous abscesses: Comparison of emergency medicine providers' practice patterns. West J Emerg Med 2013;14:23-28.
42. Duong M, Markwell S, Peter J, et al. Randomized, controlled trial of antibiotics in the management of community-acquired skin abscesses in the pediatric patient. Ann Emerg Med 2010;55:401-407.
43. Hankin A, Everett WW. Are antibiotics necessary after incision and drainage of a cutaneous abscess? Ann Emerg Med 2007;50:49-51.
44. Llera JL, Levy RC. Treatment of cutaneous abscess: A double-blind clinical study. Ann Emerg Med 1985;14:15-19.
45. Rajendran PM, Young D, Maurer T, et al. Randomized, double-blind, placebo-controlled trial of cephalexin for treatment of uncomplicated skin abscesses in a population at risk for community-acquired methicillin-resistant Staphylococcus aureus infection. Antimicrob Agents Chemother 2007;51:4044-4048.
46. Lee MC, Rios AM, Aten MF, et al. Management and outcome of children with skin and soft tissue abscesses caused by community-acquired methicillin-resistant Staphylococcus aureus. Pediatr Infect Dis J 2004;23:123-127.
47. Talan DA, Mower WR, Krishnadasan A, et al. Trimethoprim-sulfamethoxazole versus placebo for uncomplicated skin abscesses. N Engl J Med 2016;374:823.
48. Wilson W, Taubert KA, Gewitz M, et al. Prevention of infective endocarditis: Guidelines from the American Heart Association: A guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Inter-disciplinary Working Group. Circulation 2007;116:1736-1754.
49. Fitch MT, Manthey DE, McGinnis HD, et al. Videos in clinical medicine. Abscess incision and drainage. N Engl J Med 2007;357:e20.
50. Singer AJ, Richman PB, Kowalska A, et al. Comparison of patient and practitioner assessments of pain from commonly performed emergency department procedures. Ann Emerg Med 1999;33:652-658.