Section: General Surgery

Original Research Article

A COMPARATIVE STUDY TO ASSESS THE SURGICAL OUTCOME OF CARBUNCLE EXCISION BY CRUCIATE INCISION AND WIDE LOCAL EXCISION METHOD

Jayakumar[1], Elangovan[2], Vignesh[3]

[1]Assistant Professor, Department of General Surgery, Arunai Medical College, Tiruvannamalai, India.
[2]Assistant Professor, Department of General Surgery, Arunai Medical College, Tiruvannamalai, India.
[3]Assistant Professor, Department of General Surgery, Arunai Medical College, Tiruvannamalai, India.

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Corresponding Author:
Dr. Jayakumar,
Email: mercijayakumar@gmail.com

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ABSTRACT

Background: Skin carbuncle is a necrotizing infection of the skin and subcutaneous tissues composed of a cluster of furuncles with multiple draining sinuses. The excision of these skin lesions leads to large wound defects that require prolonged hospital stay and repeated dressings. This study compares the surgical outcomes of two different excision methods for carbuncle treatment. **Materials and Methods:** A prospective comparative study was conducted from September 2017 to April 2019 at MIMS Hospital, Calicut. Fifty-five patients with clinical diagnosis of carbuncle (<10cm maximum diameter) were enrolled and Underwent surgery based on two methods: cruciate excision method and wide excision method. Patients were followed up for 8 weeks post-surgery with wound size measurements at 2, 4, 6, and 8 weeks intervals. **Result:** The mean age was 60.26±8 years in the cruciate group and 58±12.29 years in the wide excision group. At 8 weeks, 74.07% of patients in the cruciate excision group achieved complete wound healing compared to 35.71% in the wide excision group (p=0.004). The mean wound size at 4 weeks was significantly smaller in the cruciate group (12.02±8.29 cm²) compared to wide excision (20.04±16.24 cm²) (p=0.026). **Conclusion:** Cruciate excision method demonstrated superior outcomes with faster wound healing, significant reduction in wound size, and shorter recovery time compared to wide local excision. Early diagnosis and appropriate patient selection are crucial for optimal outcomes.

INTRODUCTION

Skin carbuncle is a necrotizing infection of the skin and subcutaneous tissues composed of a cluster of furuncles with multiple draining sinuses. It is an infective gangrene of the skin and subcutaneous tissue. It will occur when a cut, wound, friction, pressure, or moisture forces the bacteria deeper into the skin or hair follicle. They are mostly found on the back of the neck, shoulders, hips and thighs, and they are especially common in middle-aged or elderly men. These debilitating skin infections commonly seen in diabetic patients. Excision of these skin lesion leads to large wound defects that require prolonged hospital stay and repeated dressings with producing pain and bleeding.[1]

Men do get carbuncle infection more often than women because of having more body hair. Carbuncles may develop anywhere in the body, but they are most common on the back and the nape of the neck. A large part of population suffering from chronic debilitating disease like diabetes adds to the issue and also the prevalence of low socioeconomic class. The emergence of community-associated methicillin-resistant S. aureus was associated with dramatically increased skin and soft tissue infection (SSTI).[3]

Carbuncle is most commonly caused by Staphylococcus aureus (MRSA &MSSA). Rare causes include skin infection with other aerobic or anaerobic microorganisms, such as Escherichia coli, Pseudomonas aeruginosa, streptococcus faecalis, Bacteroides, Lactobacillus, Peptostreptococcus or mycobacteria. Carbuncle can also develop in healthy individuals with no predisposing conditions, spontaneous infection due to community-acquired methicillin-resistant Staphylococcus aureus (CA-MRSA) may occur with greater frequency than carbuncle due to other pathogens.[4]

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Comorbid conditions present during the pre-index period made any SSTI a complicated Infection. These conditions included (a) chronic kidney disease; (b) chronic liver disease; (c) alcohol or drug abuse; (d) peripheral artery disease; (e) neuropathy; (f) diabetes; (g) obesity; and (h) compromised immune system,[5] Among all chronic debilitating diseases like diabetes & CKD are most common risk factors for carbuncle.[6]

MATERIALSANDMETHODS

Study Design and Setting

This prospective comparative study was conducted at the Department of General Surgery, MIMS Hospital, Calicut, from September 2017 to April 2019. The study protocol was approved by the institutional ethics committee, and written informed consent was obtained from all participants in their local language.

Patient Selection

Consecutive patients presenting with clinical diagnosis of carbuncle were evaluated for study enrollment. The study population comprised all patients meeting the inclusion criteria during the study period.

Inclusion Criteria:

1. Clinical diagnosis of carbuncle with maximum diameter <10cm
2. Age ≥18 years
3. Non-pregnant, non-lactating females

Exclusion Criteria:

1. Carbuncle size >10cm in maximum diameter
2. Age <18 years
3. Pregnant and lactating females
4. Patients with diabetic ketoacidosis

Sample Size and Randomization

Due to the absence of previous comparative studies on these specific surgical techniques, statistical power calculation was not feasible. Based on historical data and anticipated case load, a minimum of 50 patients was targeted for enrollment. Patients were allocated to treatment groups based on the surgical unit rotation system, ensuring unbiased distribution between methods.

Surgical Procedures

Cruciate Excision Method

The procedure involved making a single cruciate incision over the most dependent part of the carbuncle. Flaps were raised, and the collection was drained. The undersurface of the flap was thoroughly scraped using a curette, and all devitalized tissue was excised completely. An ellipse of central necrotic area was excised, leaving a central defect. The sliding lateral flaps helped cover the denuded area caused by loss of necrotic tissue. Wound packing was performed with saline-soaked gauze.

Figure 1: Carbuncle nape of neck

Figure 2: Postoperative wound status at 2nd and 4th week

Figure 3: Postoperative wound status at 6th and 8th week

Wide Local Excision Method:

This technique involved making an elliptical incision surrounding the entire carbuncle and excising the necrotic center along with surrounding cellulitis. The excision was considered adequate when the surgical margins showed healthy, completely uninflamed tissue. Large wound gaps were loosely approximated using 2-0 ethilon interrupted simple sutures, which were removed on days 10-14.

Figure 4: Carbuncle Right gluteal region and wound defect after carbuncle wide local excision

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Figure 5: Wound defect after carbuncle wide local excision

Perioperative Management

All procedures were performed under general or regional anesthesia. The surgical site was prepared with betadine and properly draped. Hemostasis was achieved in all cases, and tissue specimens were sent for microbiological culture and sensitivity testing. Empirical antibiotic therapy was initiated with cefoperazone + sulbactam intravenously and later modified based on culture results.

Diabetes management was optimized to maintain random blood sugar levels between 100-200 mg/dl using oral hypoglycemic agents or insulin as appropriate. Supportive care included maintaining lateral positioning for carbuncles on the back or neck, avoiding stress on the wound site, and correction of anemia and hypoproteinemia when present.

Follow-up and Outcome Assessment

Patients were followed up for 8 weeks post-surgery with visits scheduled at 2, 4, 6, and 8 weeks intervals. Wound size measurements were performed using transparent graph paper laid over the wound, with manual tracing and calculation of complete graph squares within the wound boundaries to produce accurate area measurements in cm^2.

Regular wound dressings were performed on alternate days after cleaning with normal saline and application of silver ointment in both groups. Complete wound healing was defined as full epithelialization without any residual defect.

Statistical Analysis

Statistical analysis was performed using IBM SPSS version 22. Quantitative variables were presented as mean ± standard deviation for normally distributed data and median with interquartile range for non-normally distributed data. Categorical variables were expressed as frequencies and percentages.

Normal distribution was assessed using visual inspection of histograms, normality Q-Q plots, and Shapiro-Wilk test ($p>0.05$ considered normal). Independent sample t-test was used for comparing normally distributed quantitative variables, while Mann-Whitney U test was employed for non-normally distributed data. Categorical variables were compared using Chi-square test or Fisher's exact test when appropriate. Statistical significance was set at $p<0.05$.

RESULTS

Patient Demographics

A total of 55 patients were enrolled in the study, with 27 patients (49.09%) undergoing cruciate excision and 28 patients (50.91%) undergoing wide local excision. The demographic characteristics are presented in Table 1. [Table 1]

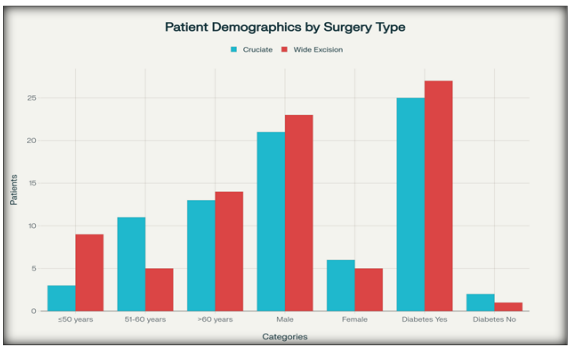

Figure 6: Patient demographics comparison between cruciate excision and wide excision groups

The mean age showed no significant difference between groups (60.26±8 vs 58±12.29 years, $p=0.425$). Male predominance was observed in both groups, accounting for 80% of the study population. Diabetes mellitus was highly prevalent, affecting 94.54% of all patients, with no significant difference between surgical groups.

The distribution of carbuncle sizes showed no significant difference between groups, with the majority of lesions measuring less than 6 cm in both groups. [Table 2]

Figure 7: Mean wound size progression over 8 weeks comparing cruciate excision and wide excision methods

Significant differences in wound size emerged starting from the 4th week post-surgery. The cruciate excision group demonstrated consistently smaller wound sizes from week 4 onwards, with statistically significant differences at 4 weeks ($p=0.026$) and 6 weeks ($p=0.015$).

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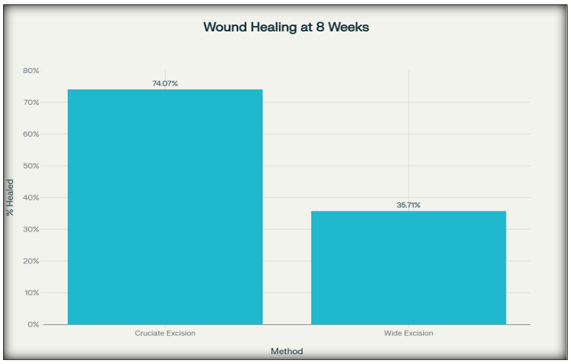

Figure 8: Comparison of wound healing rates at 8 weeks between cruciate excision and wide excision methods

The most striking difference was observed at 8 weeks, where 74.07% of patients in the cruciate excision group achieved complete wound healing compared to only 35.71% in the wide excision group (p=0.004).

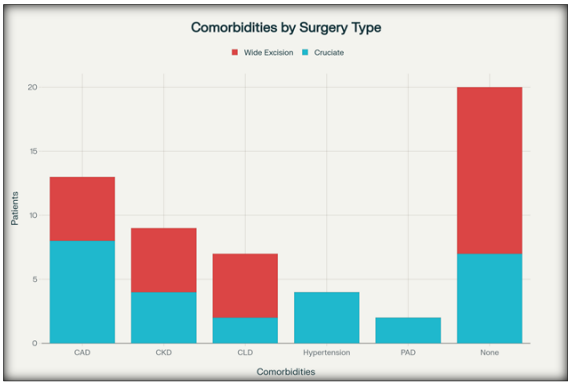

Figure 9: Distribution of comorbidities among patients in both surgical groups

Comorbidity analysis revealed that 74.08% of patients in the cruciate group and 53.58% in the wide excision group had at least one significant comorbidity, with coronary artery disease and chronic kidney disease being the most prevalent.

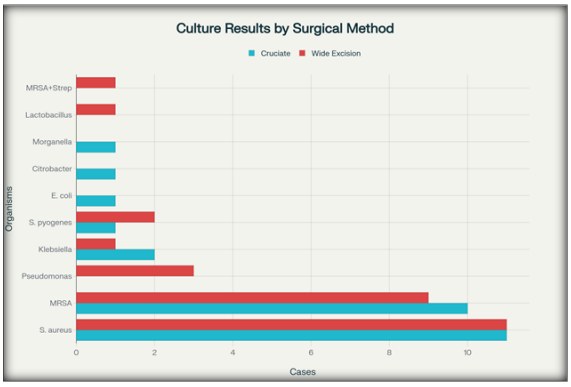

Figure 10: Microbiological culture results comparison between surgical methods

Staphylococcus aureus and MRSA were the predominant isolates in both groups, accounting for approximately 77% of positive cultures in the cruciate group and 71% in the wide excision group.

Table1: Patient Demographics and Baseline Characteristics

Characteristic	Cruciate Excision (n=27)	Wide Excision (n=28)	P-value
Age (years)			
Mean ± SD	60.26 ± 8.0	58.0 ± 12.29	0.425
Age Groups			0.07
≤50 years	3 (11.11%)	9 (32.14%)	
51-60 years	11 (40.74%)	5 (17.85%)	
>60 years	13 (48.14%)	14 (50.0%)	
Gender			0.686
Male	21 (77.77%)	23 (82.14%)	
Female	6 (22.22%)	5 (17.85%)	
Diabetes Mellitus			0.531
Yes	25 (92.59%)	27 (96.42%)	
No	2 (7.41%)	1 (3.57%)	

Table 2: Carbuncle Size Distribution

Size (cm)	Cruciate Excision (n=27)	Wide Excision (n=28)	P-value
<6	14 (51.85%)	17 (60.71%)	0.401
6-9	11 (40.74%)	7 (25.0%)	
>9	2 (7.41%)	4 (14.28%)	

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Primary Outcomes: Wound Size and Healing

Table 3: Wound Size Progression Over Time

Time Period	Cruciate Excision	Wide Excision	P-value
Initial Size (cm²)	25.59 ± 2.14	36.04 ± 2.32	0.464
2 weeks (cm²)	24.26 ± 16.82	34.04 ± 27.08	0.115
4 weeks (cm²)	12.02 ± 8.29	20.04 ± 16.24	**0.026**
6 weeks (cm²)	6.59 ± 4.02 (n=23)	11.94 ± 9.36 (n=25)	**0.015**
8 weeks (cm²)	5.36 ± 2.36 (n=7)	7.44 ± 4.97 (n=18)	0.302

Note: Reduced sample sizes at 6 and 8 weeks due to complete wound healing

Table 4: Wound Healing Status

Time Point	Healing Status	Cruciate Excision (n=27)	Wide Excision (n=28)	P-value
6 weeks	Healed	4 (14.81%)	3 (10.71%)	0.648
	Not Healed	23 (85.18%)	25 (89.28%)	
8 weeks	Healed	20 (74.07%)	10 (35.71%)	**0.004**
	Not Healed	7 (25.92%)	18 (64.28%)	

Secondary Outcomes: Comorbidities and Microbiological Profile

Table 5: Comorbidity Distribution

Comorbidity	Cruciate Excision (n=27)	Wide Excision (n=28)
Coronary Artery Disease	8 (29.62%)	5 (17.85%)
Chronic Kidney Disease	4 (14.81%)	5 (17.85%)
Chronic Liver Disease	2 (7.41%)	5 (17.85%)
Hypertension	4 (14.81%)	0 (0%)
Peripheral Arterial Disease	2 (7.41%)	0 (0%)
None	7 (25.92%)	13 (46.42%)

Table 6: Microbiological Culture Results

Organism	Cruciate Excision (n=27)	Wide Excision (n=28)
Staphylococcus aureus	11 (40.74%)	11 (39.28%)
MRSA	10 (37.03%)	9 (32.14%)
Pseudomonas aeruginosa	0 (0%)	3 (10.71%)
Klebsiellapneumoniae	2 (7.41%)	1 (3.57%)
Streptococcus pyogenes	1 (3.70%)	2 (7.14%)
Escherichia coli	1 (3.70%)	0 (0%)
Citrobacter species	1 (3.70%)	0 (0%)
Morganellamorganii	1 (3.70%)	0 (0%)
Lactobacillus	0 (0%)	1 (3.57%)
MRSA + Strep. agalactiae	0 (0%)	1 (3.57%)

DISCUSSION

This comparative study demonstrates superior surgical outcomes for carbuncle excision using the cruciate incision method compared to wide local excision. The results provide compelling evidence for reconsidering the traditional approach to carbuncle management.

The demographic profile of our study population aligns with established epidemiological patterns, showing male predominance (80%) and significant prevalence of diabetes mellitus (94.54%). The mean age of approximately 59 years in both groups reflects the typical patient population affected by carbuncles, where decreased immune response, poor personal hygiene, and associated comorbidities contribute to increased susceptibility.

The most significant finding of this study is the dramatically improved healing rate at 8 weeks in the cruciate excision group (74.07% vs 35.71%, p=0.004). This represents more than a two-fold improvement in complete wound healing, which translates to substantial clinical benefits including reduced healthcare costs, decreased patient morbidity, and improved quality of life. The superior healing rate can be attributed to several factors inherent to the cruciate excision technique.

The preservation of viable tissue flaps in the cruciate method provides better wound coverage and promotes faster epithelialization. Unlike wide excision, which creates large tissue defects requiring healing by secondary intention, the cruciate technique allows for partial primary closure through flap advancement. This mechanism reduces the exposed wound surface area and accelerates the healing process.

Wound size analysis revealed statistically significant differences beginning at 4 weeks post-surgery, with the cruciate group maintaining consistently smaller wound dimensions. The progressive reduction in wound size was more pronounced in the cruciate group, with mean wound sizes of 12.02±8.29 cm² versus 20.04±16.24 cm² at 4 weeks (p=0.026). This pattern continued at 6 weeks, where the difference became even more pronounced (6.59±4.02 cm² vs 11.94±9.36 cm², p=0.015).

The microbiological profile confirmed Staphylococcus aureus and MRSA as the predominant pathogens, consistent with published literature. Interestingly, Pseudomonas aeruginosa was isolated exclusively in the wide excision group

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(10.71%), which may reflect the larger wound surface area and prolonged healing time associated with this technique, potentially predisposing to secondary bacterial colonization.

Comorbidity analysis revealed a higher burden of associated conditions in the cruciate excision group, yet this group still demonstrated superior outcomes. This finding strengthens the evidence for the cruciate technique's effectiveness, as it achieved better results despite potentially more challenging patient characteristics.

The study has several limitations that warrant consideration. The non-randomized allocation of patients to treatment groups, though based on surgical unit rotation to minimize bias, may have introduced selection bias. The relatively small sample size, while adequate for detecting significant differences, limits the generalizability of findings. Additionally, the single-center design may not reflect outcomes in different healthcare settings or populations.

Future research should focus on randomized controlled trials with larger sample sizes to validate these findings. Long-term follow-up studies examining recurrence rates, functional outcomes, and patient satisfaction would provide additional valuable insights. Cost-effectiveness analyses comparing the two techniques would further inform clinical decision-making and healthcare policy.

The implications of this study extend beyond surgical technique selection. The demonstrated superiority of cruciate excision challenges the traditional preference for wide excision and suggests that tissue-preserving approaches may be more beneficial for patient outcomes. This paradigm shift could influence surgical training curricula and clinical practice guidelines.

CONCLUSION

This comparative study provides robust evidence supporting the superiority of cruciate excision over wide local excision for carbuncle management. The cruciate excision method demonstrated significantly higher wound healing rates at 8 weeks (74.07% vs 35.71%, p=0.004), faster reduction in wound size, and shorter recovery times. These findings suggest that cruciate excision should be considered the preferred surgical technique for carbuncle management in appropriately selected patients.

The success of the cruciate excision method appears to stem from its tissue-preserving approach, which allows for better wound coverage through flap advancement while achieving adequate debridement and drainage. This technique offers the dual advantage of effective infection control and optimal wound healing conditions.

Early diagnosis and appropriate patient selection remain crucial factors for optimal outcomes regardless of the surgical technique employed. Factors such as carbuncle size, location, patient comorbidities, and overall health status should guide treatment decisions. The high prevalence of diabetes mellitus in the study population (94.54%) emphasizes the importance of optimal glycemic control in the perioperative period.

These findings have significant implications for clinical practice, suggesting that surgeons should consider cruciate excision as the first-line surgical approach for carbuncle management. The superior outcomes demonstrated in this study, including faster healing, reduced wound size, and earlier recovery, support a shift toward tissue-preserving surgical techniques in carbuncle management.

Future research should focus on validating these findings through randomized controlled trials and investigating long-term outcomes including recurrence rates and functional results. Cost-effectiveness analyses would further strengthen the evidence base for adopting cruciate excision as the standard of care for carbuncle treatment.

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