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Research Article

COMPARATIVE OUTCOMES OF SURGICAL INCISIONS MADE WITH DIATHERMY VERSUS SCALPEL WITH LOCAL LIGNOCAINE-ADRENALINE INFILTRATION IN CLEAN AND CLEAN-CONTAMINATED SURGERY

Dr. Parikshith V[1], Dr Subhash Nadagouda[2*], Dr Akash G V[3]

[1]Senior Resident, Department of Plastic Surgery, M. S. Ramaiah Medical College, Bengaluru, Karnataka, India

[2*]Senior Resident, Department of General Surgery, GIMS Kalaburagi, Bengaluru.

[3]Senior Resident, Department of General Surgery, KIMS Bengaluru

Corresponding author: Dr. Subhash Nadagouda

Senior Resident, Department of General Surgery, GIMS Kalaburagi, Bengaluru.

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Abstract

Background: Scalpel and diathermy are widely used for surgical skin incisions. Diathermy provides simultaneous tissue division and coagulation, whereas scalpel incision combined with local lignocaine and adrenaline infiltration may provide haemostasis while avoiding thermal tissue injury. This study compared perioperative and scar-related outcomes of the two techniques in clean and clean-contaminated surgery.

Methods: A prospective comparative study was conducted at M. S. Ramaiah Group of Hospitals between August 2022 and February 2024. Adults undergoing clean or clean-contaminated surgery with an incision extending to the deep fascia were eligible. Participants were allocated alternately to diathermy or scalpel with local infiltration of 2% lignocaine with adrenaline. Incision time and incisional blood loss were recorded intraoperatively. Postoperative pain was assessed using the visual analogue scale (VAS) from postoperative day 1 to day 7, while seroma, haematoma, surgical-site infection and wound dehiscence were assessed during early follow-up. Scar size, scar thickness and Patient and Observer Scar Assessment Scale (POSAS) scores were assessed during follow-up.

Results: A total of 260 patients were analysed: 131 in the scalpel group and 129 in the diathermy group. Baseline age, height, weight and body mass index were comparable. Mean incision time

was 46.75 ± 26.19 seconds with scalpel and 49.47 ± 29.94 seconds with diathermy; the dissertation reports no statistically significant difference. Mean incisional blood loss was 15.70 ± 8.68 mL and 14.63 ± 8.04 mL, respectively, with no statistically significant difference. Mean VAS pain scores declined from 4.33 versus 4.36 on day 1 to 1.31 versus 1.30 on day 7 in the scalpel and diathermy groups, respectively, with no significant between-group difference on any recorded day. Haematoma was not observed through day 7. Seroma and surgical-site infection rates were low and did not differ significantly between groups. Mean scar size was smaller in the scalpel group at month 1 (2.83 ± 0.69 mm vs 3.01 ± 0.72 mm; P=0.040), but the difference was not significant at months 3 or 6. Hypertrophic scarring occurred in 6.9% of the scalpel group and 16.3% of the diathermy group (P=0.029). Total POSAS scores differed significantly between groups only in the 5–10 cm incision category, favouring scalpel at months 1, 3 and 6.

Conclusion: Both techniques produced comparable short-term clinical outcomes and low rates of wound complications. Diathermy showed a small numerical advantage in blood loss, while scalpel with local lignocaine-adrenaline infiltration was associated with lower early scar size and a lower incidence of hypertrophic scarring, with the clearest POSAS advantage in 5–10 cm incisions. Choice of incision technique should therefore be individualized according to the surgical context, desired haemostasis, tissue handling and cosmetic priorities.

Keywords: scalpel; diathermy; electrosurgery; lignocaine; adrenaline; surgical incision; postoperative pain; wound healing; scar; POSAS

INTRODUCTION

Surgical skin incision is a fundamental step in operative practice, and the choice of cutting technique can influence intraoperative haemostasis, operative efficiency, postoperative pain and scar formation. The conventional scalpel provides a precise mechanical cut with limited thermal injury, while diathermy uses high-frequency electrical energy to cut and/or coagulate tissue. The latter can reduce bleeding by providing haemostasis during tissue division, but concerns regarding thermal tissue injury and its potential effect on wound healing and scar quality remain relevant. [1,3,5,6,17–19]

Local infiltration with lignocaine and adrenaline is frequently used with scalpel incision. Lignocaine provides local anaesthesia, while adrenaline causes local vasoconstriction and may reduce bleeding and prolong the local anaesthetic effect. Previous studies have demonstrated reduced blood loss and operative time when vasoconstrictors are used with local anaesthetics in surgical settings. [2,10–12,24,26]

Comparative studies of scalpel and diathermy have reported inconsistent findings. Some trials and systematic reviews have reported lower blood loss, shorter operative time or reduced early postoperative pain with diathermy, whereas other work has found comparable wound infection and cosmetic outcomes. [1,3,5,6,17–19,27,29,30] Differences in incision length, operative procedure, tissue handling, use of local infiltration and postoperative assessment may contribute to variation among studies.

Scar formation is a clinically important long-term outcome. Wound healing proceeds through overlapping phases of haemostasis, inflammation, proliferation and remodelling, and scar quality can be influenced by incision technique, wound tension and patient factors. The Patient and Observer Scar Assessment Scale (POSAS) permits scar assessment from both patient and observer perspectives and therefore provides information beyond simple physical measurements. [16,20,21,31,33]

The present study was undertaken to compare scalpel incision with local lignocaine-adrenaline infiltration against diathermy in clean and clean-contaminated surgery, focusing on incision time, incisional blood loss, postoperative pain, wound complications and scar outcomes.

OBJECTIVES

- To evaluate the incision time required for each technique.
- To compare intraoperative blood loss associated with diathermy and scalpel incision with local infiltration.
- To compare postoperative pain from day 1 to day 7 using the VAS.
- To compare seroma, haematoma, surgical-site infection and wound dehiscence during early postoperative follow-up.

- To compare scar size, scar thickness and cosmetic outcomes, including POSAS scores, during follow-up.

MATERIALS AND METHODS

Study design and setting

The dissertation describes a prospective comparative study conducted at M. S. Ramaiah Group of Hospitals, Bengaluru. Participants were recruited from patients undergoing elective or emergency clean and clean-contaminated surgery. The study period was August 2022 to February 2024.

Participants and eligibility

Adults aged >18 years undergoing clean or clean-contaminated surgery with an incision extending to the deep fascia were eligible.

- Refusal to provide consent.
- Concurrent anticoagulant therapy.
- Corticosteroid therapy.
- Anaemia, hyperproteinaemia or chronic kidney disease.
- Active wound infection anywhere in the body at the time of surgery.

Sample size and allocation

The sample size was based on previously reported incision-time data from Shamim et al., with a stated 95% confidence level and 80% power, yielding a minimum of 127 participants per group. A total of 260 participants were ultimately included, comprising 131 in the scalpel group and 129 in the diathermy group.

Intervention and comparison

In the scalpel group, 2% lignocaine with adrenaline was infiltrated into the subcutaneous tissue, followed by a 45-second massage to facilitate dispersion. The skin incision was then made with a scalpel and extended to the deep fascia using the scalpel alone.

In the diathermy group, the skin incision was initiated with either a scalpel or cutting-mode diathermy at 35 W, followed by coagulation-mode diathermy (spray mode at 35 W) until the deep

fascia was reached. The dissertation defines incision time as the interval from initiation of the skin incision to reaching the deep fascia/aponeurosis with haemostasis achieved.

Outcome measures

Incisional blood loss was measured using standardized 10 × 10 cm gauze swabs. Swabs were weighed before and after use on a digital scale accurate to 1 g; each gram of weight difference was treated as 1 mL of blood. Suction was not used during the incision phase.

Postoperative pain was recorded with the VAS from postoperative day 1 through day 7. Seroma and haematoma were assessed daily during this period. Surgical-site infection was assessed during the first 7 postoperative days and was also planned for assessment at 30 days.

Scar size and scar thickness were measured with Vernier callipers. Scar quality was assessed with the POSAS, incorporating patient and observer scores. Follow-up scar assessments were reported at months 1, 3 and 6.

Statistical analysis

Quantitative variables were summarized as mean ± standard deviation and compared using the independent Student's t-test. Categorical variables were summarized as frequency and percentage and compared using the chi-square test. Statistical significance was defined at $P<0.05$.

RESULTS

A total of 260 participants were included, with 131 (50.4%) undergoing scalpel incision with local infiltration and 129 (49.6%) undergoing diathermy incision.

Table 1: Baseline characteristics

Variable	Scalpel (n=131)	Diathermy (n=129)	P value
Age, years	52.27 ± 14.78	50.76 ± 15.66	0.425
Height, cm	167.25 ± 10.77	168.05 ± 11.21	0.557
Weight, kg	70.40 ± 13.47	70.11 ± 12.59	0.859
BMI, kg/m²	25.33 ± 6.58	25.04 ± 5.04	0.693
Male sex, n (%)	75 (57.3%)	70 (54.3%)	Not reported
Female sex, n (%)	56 (42.7%)	59 (45.7%)	Not reported

The groups were broadly comparable with respect to age, height, weight and BMI. The majority of participants were aged >60 years (29.0% in the scalpel group and 30.2% in the diathermy group).

Table 2: Incision length and incision time

Incision length	Scalpel	Diathermy	Total
1–5 cm	25 (19.1%)	28 (21.7%)	53 (20.4%)
5–10 cm	73 (55.7%)	77 (59.7%)	150 (57.7%)
10–15 cm	5 (3.8%)	9 (7.0%)	14 (5.4%)
>15 cm	28 (21.4%)	15 (11.6%)	43 (16.5%)
Total	131 (100%)	129 (100%)	260 (100%)

Incision time	Scalpel	Diathermy	Total
<20 s	15 (11.5%)	20 (15.5%)	35 (13.5%)
20–50 s	68 (51.9%)	58 (45.0%)	126 (48.5%)
>50 s	48 (36.6%)	51 (39.5%)	99 (38.1%)
Mean ± SD	46.75 ± 26.19 s	49.47 ± 29.94 s	48.10 ± 28.09 s

Most incisions were 5–10 cm long. Mean incision time was numerically shorter in the scalpel group (46.75 seconds) than in the diathermy group (49.47 seconds). The dissertation narrative describes this difference as not statistically significant. Across length categories, incision time increased with increasing incision length in both groups.

Table 3: Incisional blood loss

Outcome	Scalpel	Diathermy	Total
<20 mL, n (%)	99 (75.6%)	105 (81.4%)	204 (78.5%)
>20 mL, n (%)	32 (24.4%)	24 (18.6%)	56 (21.5%)
Mean ± SD	15.70 ± 8.68 mL	14.63 ± 8.04 mL	15.17 ± 8.37 mL

Incision length	Scalpel: mean ± SD (mL)	Diathermy: mean ± SD (mL)
1–5 cm	8.04 ± 1.03	7.06 ± 1.16
5–10 cm	12.28 ± 2.59	14.20 ± 4.97
10–15 cm	20.66 ± 8.69	14.32 ± 2.55
>15 cm	30.46 ± 4.17	31.02 ± 7.02

Mean incisional blood loss was slightly lower with diathermy than with scalpel plus local infiltration (14.63 vs 15.70 mL); the dissertation reports that this difference was not statistically significant.

Table 4: Postoperative pain

Postoperative day	Scalpel mean VAS ± SD	Diathermy mean VAS ± SD	P value
Day 1	4.33 ± 0.96	4.36 ± 0.80	0.760
Day 2	3.48 ± 1.13	3.48 ± 0.97	0.998
Day 3	2.89 ± 1.10	2.82 ± 0.95	0.617
Day 4	2.43 ± 0.96	2.40 ± 0.95	0.507
Day 5	1.91 ± 0.82	1.90 ± 0.80	0.927
Day 6	1.53 ± 0.74	1.50 ± 0.70	0.731
Day 7	1.31 ± 0.56	1.30 ± 0.52	0.874

Pain decreased progressively in both groups from postoperative day 1 to day 7. There was no statistically significant difference between groups on any recorded postoperative day.

Table 5: Wound complications

Outcome	Day	Scalpel	Diathermy	P value
Seroma	1	1 (0.8%)	5 (3.9%)	0.118
Seroma	2	1 (0.8%)	3 (2.3%)	0.368
Seroma	3	0 (0%)	3 (2.3%)	0.120
Seroma	4	0 (0%)	3 (2.3%)	0.120
Seroma	5	0 (0%)	1 (0.8%)	0.496
Seroma	6	1 (0.8%)	3 (2.3%)	0.368
Seroma	7	0 (0%)	0 (0%)	1.000
SSI	1	0 (0%)	0 (0%)	1.000
SSI	2	1 (0.8%)	1 (0.8%)	1.000
SSI	3	0 (0%)	2 (1.6%)	0.245
SSI	4	1 (0.8%)	0 (0%)	1.000
SSI	5	1 (0.8%)	1 (0.8%)	1.000
SSI	6	0 (0%)	0 (0%)	1.000
SSI	7	0 (0%)	0 (0%)	1.000
Haematoma	1–7	0	0	1.000
Wound dehiscence	1–6	0	0	1.000
Wound dehiscence	7	0 (0%)	1 (0.8%)	0.312

Seroma was observed more frequently in the diathermy group on several early postoperative days, but none of the daily comparisons reached statistical significance. No haematoma was

recorded through day 7. Wound dehiscence was rare, with one event in the diathermy group on day 7. The dissertation reports no significant difference in wound complications between groups.

Table 6: Scar size and thickness

Time point	Scalpel mean ± SD	Diathermy mean ± SD	P value
Scar size, month 1	2.83 ± 0.69 mm	3.01 ± 0.72 mm	0.040
Scar size, month 3	2.11 ± 0.62 mm	2.23 ± 0.69 mm	0.145
Scar size, month 6	1.56 ± 0.62 mm	1.67 ± 0.71 mm	0.199
Scar thickness, month 1	0.88 ± 0.08 mm	0.88 ± 0.09 mm	0.842
Scar thickness, month 3	0.67 ± 0.12 mm	0.66 ± 0.11 mm	0.407

Mean scar size was significantly smaller in the scalpel group at month 1, but this difference was not statistically significant at months 3 and 6. Scar thickness did not differ significantly between groups at months 1 or 3.

Table 7: Keloid and hypertrophic scarring

Scar outcome	Scalpel	Diathermy	P value
Keloid absent	130 (99.2%)	124 (96.1%)	0.118
Keloid present	1 (0.8%)	5 (3.9%)	0.118
Hypertrophic scar absent	122 (93.1%)	108 (83.7%)	0.029
Hypertrophic scar present	9 (6.9%)	21 (16.3%)	0.029

Keloid formation was uncommon and did not differ significantly between groups. Hypertrophic scarring was significantly less frequent in the scalpel group than in the diathermy group (6.9% vs 16.3%; P=0.029).

Table 8: POSAS outcomes

Incision length	Group	Month 1	Month 3	Month 6	P value (M1/M3/M6)
1–5 cm	Scalpel	9.44 ± 1.39	8.44 ± 1.92	7.80 ± 2.77	0.780 / 0.986 / 0.388
1–5 cm	Diathermy	9.32 ± 1.66	8.43 ± 2.75	7.11 ± 3.00	—
5–10 cm	Scalpel	9.05 ± 1.84	7.86 ± 2.46	7.21 ± 2.90	0.0017 / 0.0002 / 0.0155
5–10 cm	Diathermy	10.05 ± 1.97	9.38 ± 2.43	8.32 ± 2.70	—
10–15 cm	Scalpel	8.80 ± 2.05	8.00 ± 3.32	8.00 ± 3.54	0.908 / 0.565 / 0.658
10–15 cm	Diathermy	8.89 ± 0.78	8.89 ± 2.32	8.78 ± 2.82	—
>15 cm	Scalpel	9.36 ± 1.77	8.18 ± 2.51	6.79 ± 2.78	0.221 / 0.540 / 0.288
>15 cm	Diathermy	10.13 ± 2.26	8.67 ± 2.38	7.67 ± 2.06	—

Total POSAS scores generally decreased over time in both groups. The only incision-length category showing statistically significant between-group differences at all three time points was 5–10 cm, with lower scores in the scalpel group. No significant between-group differences were reported for 1–5 cm, 10–15 cm or >15 cm incisions.

DISCUSSION

This study compared scalpel incision preceded by local lignocaine–adrenaline infiltration with diathermy in 260 adults undergoing clean and clean-contaminated surgery. The principal findings were that the two approaches produced similar incision times and incisional blood loss, similar postoperative pain trajectories and low rates of early wound complications. The most notable difference was in scar outcomes, particularly the lower incidence of hypertrophic scarring with scalpel incision and the significantly better total POSAS scores for 5–10 cm incisions.

Diathermy had a small numerical advantage in mean incisional blood loss, 14.63 mL compared with 15.70 mL with scalpel plus local infiltration. This difference was not statistically significant. The small between-group difference suggests that adrenaline infiltration can provide effective haemostasis during scalpel incision. This observation is biologically plausible because adrenaline-induced vasoconstriction reduces local blood flow, while lignocaine provides local anaesthesia. Previous studies have also reported haemostatic benefits from local anaesthetic–adrenaline infiltration. [2,10–12,24]

Postoperative pain decreased steadily from day 1 to day 7, with nearly overlapping VAS trajectories.

Early wound complications were uncommon. Seroma was numerically more frequent in the diathermy group on several days, but daily comparisons were not statistically significant. No haematoma occurred through day 7, and wound dehiscence was rare. These findings are consistent with comparative literature reporting that, when appropriately performed, diathermy does not necessarily result in higher rates of wound infection or other early wound complications. [5,6,17–19,27,29,30]

Scar outcomes provide the clearest signal favouring scalpel incision in this dataset. Scar size was smaller with scalpel at month 1, although the difference was no longer significant by months 3 and 6. More importantly, hypertrophic scarring occurred in 6.9% of scalpel incisions versus 16.3% of diathermy incisions (P=0.029). This may be compatible with the theoretical concern that thermal injury can increase local tissue injury and inflammatory response, although the present study was not designed to establish mechanism. [16,20,21]

The POSAS analysis adds patient- and observer-oriented assessment of scar quality. Both groups generally improved over time. In the 5–10 cm incision category, total POSAS scores were significantly lower in the scalpel group at months 1, 3 and 6. In the other incision-length categories, between-group differences were not statistically significant. Because the 5–10 cm category comprised the largest proportion of the study population, this finding may be clinically relevant, but it should be interpreted cautiously because subgroup sample sizes were unequal and the study was single-centre.

Overall, the findings support the use of either technique in clean and clean-contaminated surgery, with technique selection guided by operative requirements. Diathermy retains the practical advantage of simultaneous tissue division and coagulation and may be attractive when immediate haemostasis is a priority. Scalpel incision with local lignocaine–adrenaline infiltration provides a simple alternative with comparable measured blood loss and wound outcomes and may be particularly attractive when avoidance of thermal tissue injury or optimization of scar appearance is important.

5.1 Strengths and limitations

- Prospective comparative data with a relatively balanced group size (131 versus 129 participants).
- Objective measurement of incisional blood loss using pre- and post-use gauze weights.
- Assessment of both short-term wound outcomes and longer-term scar outcomes.
- Use of POSAS, incorporating patient and observer assessment of scar quality.
- Single-centre design limits generalizability.
- Scar follow-up was limited to six months.

CONCLUSION

In this prospective comparative study of 260 adults undergoing clean and clean-contaminated surgery, scalpel incision with local lignocaine adrenaline infiltration and diathermy produced broadly comparable perioperative and early postoperative outcomes. Mean incisional blood loss was slightly lower with diathermy but without a statistically significant difference. Postoperative

pain trajectories, seroma, haematoma, surgical-site infection and wound dehiscence were also comparable. Scalpel incision was associated with a smaller mean scar size at month 1 and a significantly lower incidence of hypertrophic scarring. Total POSAS scores significantly favoured scalpel for 5–10 cm incisions at months 1, 3 and 6. The choice between techniques should therefore be individualized, balancing haemostatic requirements, tissue handling, equipment availability and cosmetic priorities.

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