Impact of a Polyester Mesh-Containing Tissue Adhesive System on Postoperative Inflammatory Biomarker Kinetics and Clinical Recovery in Instrumented Spinal Fusion

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Introduction

Polyester mesh-containing 2-octyl cyanoacrylate adhesive systems are increasingly used for skin closure in spinal surgery. Although previous studies focused on wound complications, their influence on systemic postoperative inflammatory recovery remains unclear. This study compared the clinical safety of this adhesive system with conventional dressings and evaluated its impact on postoperative inflammatory biomarker kinetics following posterior lumbar instrumented fusion.

Methods

1. Study Design and Patient Selection

Retrospective review of **224 consecutive patients** (age >18) undergoing 1–4 level posterior lumbar instrumented fusion for degenerative disease (stenosis, spondylolisthesis) between Jan 2021 – Aug 2025. Excluded: trauma/tumor/active infection, incomplete labs, systemic inflammatory disease (e.g., RA). IRB-approved (No. 2602-011-160).

2. Surgical Procedure and Wound Management

All operations by a single senior surgeon via standard midline approach with absorbable fascial/subcutaneous closure. Identical Cefazolin prophylaxis (1 h pre-incision, discontinued within 24 h post-op for all groups).

- **Conventional (n=194):** nylon sutures or staples + sterile gauze with adhesive tape; redressing every 2 days.
- **Tissue Adhesive (n=30):** polyester mesh + 2-octyl cyanoacrylate, undisturbed until drain removal (POD 5–7); mesh removed at 2 weeks.

3. Data Collection and Outcome Measures

1) Clinical Safety: demographics, surgical variables, and primary safety outcomes — SSI (CDC criteria), wound dehiscence, reoperation (I&D).

2) Biomarker Analysis — Normal Recovery cohort: to isolate the physiological dressing effect, a sub-analysis excluded patients with SSI, wound complications, or antibiotic step-up. **Final sample: n=214 (Conv 185, TA 29).**

3) Inflammatory Kinetics — measured at Post-op (T0), POD 3, POD 7:

- Standard markers: WBC, ESR, CRP.
- Albumin-corrected ratios (adjust for post-op nutritional variance/hemodilution): **CAR** = CRP/Alb, **EAR** = ESR/Alb.
- **% Change Rate:** (Value_Post-op − Value_Follow-up) / Value_Post-op × 100, quantifying recovery velocity from peak inflammation.

4. Statistical Analysis

SPSS v25.0. Continuous variables: Student's t-test or Mann–Whitney U after normality testing. Categorical: Chi-square or Fisher's exact. $P < 0.05$ considered significant.

Table 1. Baseline Demographics and Clinical Outcomes

Variable	Conventional Group (n=194)	Dermabond Group (n=30)	P-value
Demographics			
Age (years)	70.7 ± 7.3	70.1 ± 5.6	0.621
Sex (Male), n (%)	64 (33.0%)	7 (23.3%)	0.399
BMI	24.8 ± 3.5	25.1 ± 3.2	0.654
Comorbidities, n (%)			
Diabetes Mellitus	67 (34.5%)	7 (23.3%)	0.298
Hypertension	116 (59.8%)	17 (56.7%)	0.842
Osteoporosis	17 (8.8%)	3 (10.0%)	0.737
Surgical Variables			
Operation Time (min)	251.3 ± 60.3	263.9 ± 54.3	0.250
No. of Fusion Levels	2.0 ± 1.1	1.8 ± 0.8	0.378
Clinical Outcomes			
Drainage Removal Day	5.07 ± 1.53	5.34 ± 1.50	0.373
Re-operation (I&D)	6 (3.1%)	0 (0.0%)	
Readmission, n (%)	6 (3.1%)	1 (3.3%)	
Diagnosis, n (%)			0.509
Spinal Stenosis	119 (61.3%)	16 (53.3%)	
Spondylolisthesis	58 (29.9%)	12 (40.0%)	
HNP	7 (3.6%)	0 (0.0%)	
Other	10 (5.2%)	2 (6.7%)	

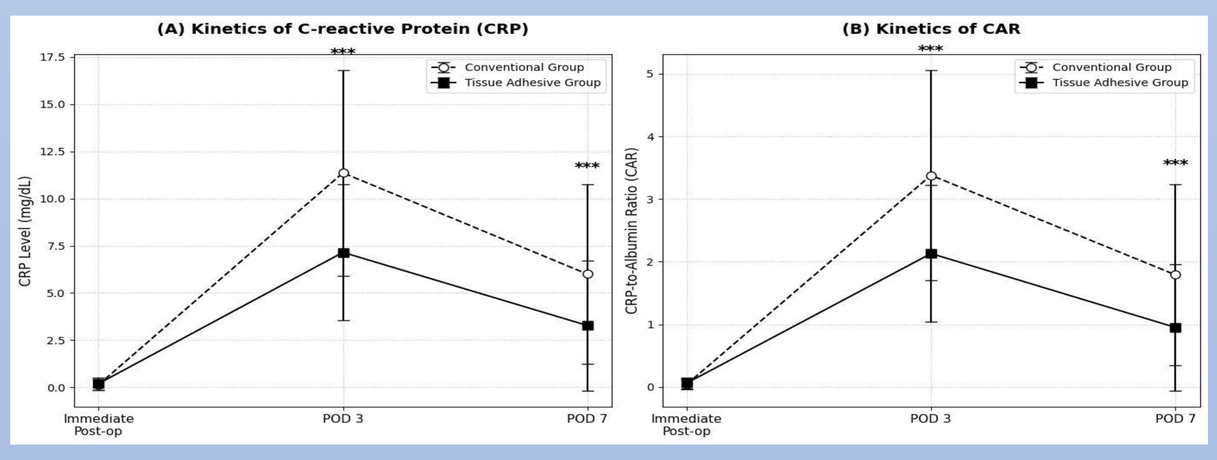

Figure 1. *Postoperative kinetics of (A) CRP and (B) CAR — adhesive group (solid) declines significantly faster (*** $P < 0.001$).*

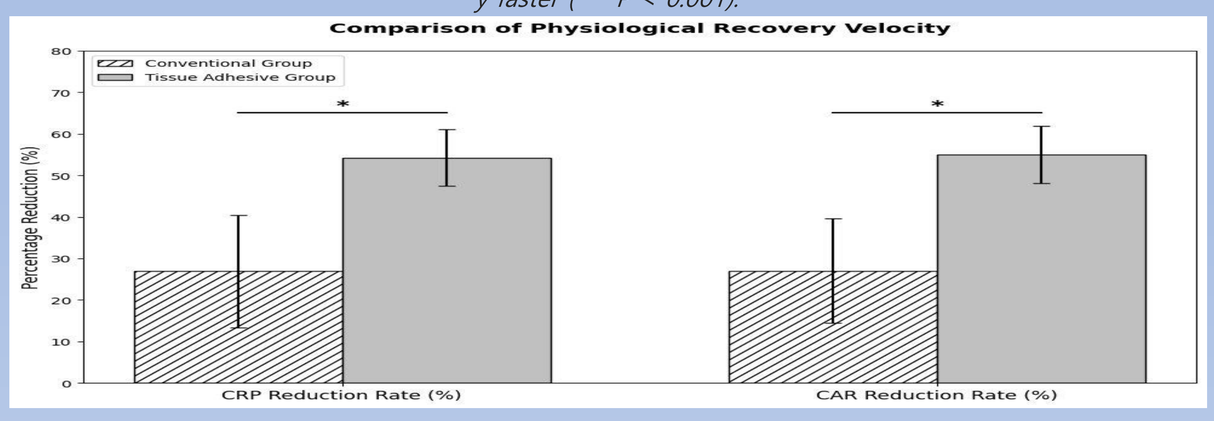

Figure 2. *Percentage reduction from peak — adhesive group ≈ 2× greater (* $P < 0.05$).*

Results

1. Baseline Comparability (Table 1)

The Conventional (n=194) and Tissue Adhesive (n=30) groups were comparable in age (70.7 vs 70.1 yr), sex, BMI (24.8 vs 25.1), comorbidities (DM, HTN, osteoporosis), operation time (251 vs 264 min), and fusion levels (all **P > 0.05**). Safety outcomes were equivalent — drainage removal (5.07 vs 5.34 d), reoperation for infection (3.1% vs 0%), and readmission (3.1% vs 3.3%)

2. Kinetics of Inflammatory Markers (Table 2, Fig. 1)

Among 214 uncomplicated patients (Conv 185, TA 29), all markers were equivalent at T0 (post-op). From POD 3 onward the **Tissue Adhesive group showed significantly lower inflammation**

- **POD 3 :** CRP 7.15 vs 11.36 (**P < 0.001**), ESR 46.0 vs 63.1 (P = 0.005), CAR 2.13 vs 3.38 (P < 0.001), EAR 13.6 vs 18.7 (P = 0.004).
- **POD 7 :** CRP 3.28 vs 6.00 (**P < 0.001**), ESR 56.8 vs 82.0 (P < 0.001), CAR 0.95 vs 1.79 (P < 0.001), EAR 16.1 vs 23.9 (P < 0.001).

WBC and Albumin did not differ at any time point.

3. Change Rates of Inflammatory Markers (Table 3, Fig. 2)

The Tissue Adhesive group achieved a **2 times greater reduction** from the peak inflammatory response: CRP−**54.2% vs 26.9%** (P = 0.040) and CAR −**55.0% vs −27.0%** (P = 0.027). ESR, EAR, WBC, and WAR change rates did not differ (P > 0.05).

Table 2. Comparisons of Inflammatory Markers in Normal Recovery Group

Variable	Conventional Group (n=185)	Dermabond Group (n=29)	P-value
WBC (x10³/μL)			
Post-op	10.66 ± 3.48	11.14 ± 3.68	0.515
1st F/U	8.25 ± 2.56	8.51 ± 2.57	0.622
2nd F/U	6.47 ± 2.04	6.38 ± 1.64	0.803
ESR (mm/hr)			
Post-op	8.26 ± 12.46	9.76 ± 15.87	0.629
1st F/U	63.06 ± 35.81	46.03 ± 27.53	0.005*
2nd F/U	82.03 ± 30.64	56.76 ± 29.56	<0.001*
CRP (mg/dL)			
Post-op	0.14 ± 0.29	0.20 ± 0.32	0.343
1st F/U	11.36 ± 5.44	7.15 ± 3.60	<0.001*
2nd F/U	6.00 ± 4.76	3.28 ± 3.45	<0.001*
Albumin (g/dL)			
Post-op	3.46 ± 0.33	3.43 ± 0.38	0.657
1st F/U	3.42 ± 0.42	3.39 ± 0.30	0.686
2nd F/U	3.44 ± 0.34	3.47 ± 0.31	0.632
Ratios			
CRP / Albumin Ratio (1st F/U)	3.38 ± 1.68	2.13 ± 1.09	<0.001*
CRP / Albumin Ratio (2nd F/U)	1.79 ± 1.44	0.95 ± 1.01	<0.001*
ESR / Albumin Ratio (1st F/U)	18.66 ± 11.11	13.59 ± 7.91	0.004*
ESR / Albumin Ratio (2nd F/U)	23.88 ± 8.92	16.12 ± 8.06	<0.001*

Table 3. Percentage Change Rates of Inflammatory Markers

Variable	Conventional Group (n=185)	Dermabond Group (n=29)	P-value
CRP Change (%)	-26.9 ± 184.1	-54.2 ± 36.6	0.040*
CAR Change (%)	-27.0 ± 171.8	-55.0 ± 36.9	0.027*
ESR Change (%)	+114.9 ± 493.9	+62.4 ± 139.6	0.413
EAR Change (%)	+112.2 ± 471.3	+60.9 ± 146.6	0.366
WBC Change (%)	-17.8 ± 26.9	-22.7 ± 16.8	0.542
WAR Change (%)	-18.6 ± 28.1	-24.4 ± 16.6	0.593

Discussion

Wound complication and infection rates were comparable between groups, establishing **clinical safety**. In the Normal Recovery cohort, the Tissue Adhesive group showed **significantly lower CRP and CAR at POD 3 and POD 7 (P < 0.001)** with **faster CRP normalization (54.2% vs 26.9%, P = 0.040).** Suggesting the closure system modulates the early systemic inflammatory response.

Three mechanisms likely drive this accelerated recovery: (1) **antimicrobial seal** 2-octyl cyanoacrylate has intrinsic bactericidal activity against Gram-positive organisms and creates a hermetic barrier; (2) **no dressing-related irritation** eliminating repetitive tape removal removes a source of mechanical/allergic cutaneous inflammation; (3) **tension redistribution** by the polyester mesh reduces local ischemia and limits systemic propagation of inflammation.

CAR and EAR were included as **albumin-corrected supplementary indices** to control for post-op nutritional and fluid variance. CAR has been validated as an independent predictor of SSI after lumbar fusion. Concordant reductions across CRP, CAR, and EAR confirm that the accelerated recovery is robust across multiple inflammatory indices.

Clinical implication : By accelerating return to physiological baseline, the adhesive system aligns with **Enhanced Recovery After Surgery (ERAS)** principles. reframing wound closure from a passive endpoint into a modifiable lever for optimizing the early postoperative course.

Limitations : retrospective single-center design; smaller Tissue Adhesive cohort (n=30); early post-op window only. Prospective RCTs and longer-term follow-up are needed to confirm impact on fusion rates and clinical outcomes.

Conclusion

In conclusion, the use of Dermabond Prineo in instrumented spinal fusion is associated with a more rapid and effective reduction in postoperative CRP and CAR levels compared to conventional closure techniques. These results suggest that the tissue adhesive system contributes to accelerating the restoration of physiological homeostasis beyond simple wound closure. Therefore, spinal surgeons may consider this system not merely as a dressing tool, but as a component of an Enhanced Recovery After Surgery (ERAS) strategy to minimize the postoperative physiological burden.

References

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