



Quantifying Strength of Commonly Employed Peripheral Nerve and Epidural Catheter Securement Methods

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Introduction

- Epidural and peripheral nerve blocks provide effective postoperative analgesia for a variety of surgical procedures.
- Peripheral nerve catheters are associated with improved pain control with lower opioid requirements and higher patient satisfaction scores compared with single shot nerve blocks¹.
- Reliable securement prevents premature or accidental dislodgement of nerve catheters.
- Several commercial adhesives are commonly utilized as adjuncts to decrease the incidence of catheter migration at the skin:
 - 2-octyl cyanoacrylate (Dermabond)
 - Gum mastic, styrax, alcohol, and methyl salicylate (Mastisol)
 - Reinforced skin-closure strips (Steri-strips)
- Our goal is to evaluate the effectiveness of several types of dressings and methods for securement in an in-vitro model by quantifying the force in Newtons required for catheter dislodgement using a force gauge.

Materials and Methods

- Regional and obstetric anesthesiologists from several academic institutions were polled on peripheral nerve and epidural catheter securement methods utilized in their practice, with the following most popular variations:
 - transparent film dressing (Tegaderm) + 2-octyl cyanoacrylate (CA) + gum mastic, styrax, alcohol, and methyl salicylate (GM) + reinforced skin closure strips (SS) in cross-hatch pattern
 - transparent film dressing + GM adhesive + SS flush to skin
- These were compared against a control securement method: transparent film dressing only
- Catheters were inserted through a silicone and foam model and secured at depth of 10cm using each method.
- With the distal end of the catheter fixed to a force gauge, steady traction was applied at a 45-degree angle until force-to-failure was achieved.
- Force-to-failure: force applied in Newtons until catheter migration of at least 1cm at the skin, or complete dislodgement of catheter from the model.
- Ten measurements were collected for each securement method.
- Data was analyzed by 1-way ANOVA and Tukey's Honestly Significant Difference (HSD) test, each using an alpha value of 0.05.
- Statistical analysis was performed in Python 3 using SciPy version 1.11.4.



Figure 1: Securement of catheter with various methods. **A:** Tegaderm only. **B:** Tegaderm + CA + GM + SS in a cross-hatch pattern, **C:** Tegaderm + GM + SS flush on “skin.”

Results

- Force to catheter failure was significantly lower in the Tegaderm only control group compared with the Tegaderm + CA + GM + SS group ($p < 0.001$), as well as compared with the Tegaderm dressing + GM + SS group ($p < 0.001$).
- Significantly less force was also required to dislodge catheters in the Tegaderm + GM + SS group compared with the group with CA adhesive added ($p = 0.002$).

Securement Method	Samples	Force-to-Failure, Newtons (mean [95% CI])	One-way ANOVA
Group A	10	8.52 [8.23 – 8.81]	F > 37.82 p < 0.001
Group B	10	14.51 [13.20 – 15.82]	
Group C	10	11.91 [10.93 – 12.89]	

Table 1: Mean force-to-failure in Newtons for three securement method groups. **Group A:** Tegaderm only, **Group B:** Tegaderm + CA + GM + SS in a cross-hatch pattern, **Group C:** Tegaderm + GM + SS flush on “skin.”

Pair	Difference [95% CI]	p-value
Group A vs Group B	-5.99 [-7.70 – -4.28]	< 0.001
Group A vs Group C	-3.39 [-5.10 – -1.68]	< 0.001
Group B vs Group C	2.60 [0.89 – 4.31]	0.002

Table 2: Pairwise comparison of mean force-to-failure in Newtons for three securement method groups. **Group A:** Tegaderm only, **Group B:** Tegaderm + CA + GM + SS in a cross-hatch pattern, **Group C:** Tegaderm + GM + SS flush on “skin.”

Discussion

- Premature dislodgement may place patients at increased risk for adverse outcomes:
 - potential epidural hematoma development in the setting of recent anticoagulation administration²
 - infection at an exposed catheter insertion site³
 - lower patient satisfaction
- 2-octyl cyanoacrylate glue has been found to improve maintenance of catheter-to-nerve apposition when compared with gum mastic-based liquid adhesive⁴, as well as decrease the incidence of peri-catheter leakage compared with fixation with skin-closure strips⁵.
- From our literature search, there is little quantitative evidence to suggest the combination of several commonly used adhesives is superior in preventing migration at the skin, or if a more elaborate application of adhesive strips offers better catheter securement than straightforward applications.

Conclusion

- Our results suggest that using a combination of skin adhesives significantly increases the strength needed for catheter dislodgement.

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