Impact of Positive Culture Findings on Clinical Outcomes in Primary Lumbar Fusion Surgery

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INTRODUCTION: Occult bacteria have been implicated in delayed fusion and implant failure following spinal instrumentation. These organisms reside in dermal and deeper tissue layers, potentially evading standard preoperative skin preparation and antibiotic prophylaxis. This study investigates the colonization rate of occult bacteria in patients undergoing primary instrumented lumbar fusion and its impact on fusion status and revision rates.

METHODS: This prospective cohort study included 54 patients undergoing posterior lumbar fusion with pedicle screw instrumentation at a single tertiary center (2016–2019). Inclusion criteria were ages 18-80, no prior lumbar hardware, and no active infection or immunosuppression. Intraoperative cultures were obtained from superficial skin, dermal wound edge, hypodermis, and vertebral pedicle prior to screw implantation. Control samples from sterile instruments were collected to rule out contamination. All patients received preoperative Cefazolin and standard skin antiseptics (ChloraPrep or Betadine). Samples were cultured aerobically and anaerobically for 14 days. Clinical outcomes, including fusion rates and revision surgeries, were assessed at one-year follow-up. Statistical analysis included t-tests, chi-square tests, and logistic regression, with $p \leq 0.05$ as significant.

RESULTS: A total of 525 intraoperative culture samples were collected. 33.3% of patients (18/54) were culture-positive, with an average of 3.1 positive samples per case. Culture positivity rates by tissue layer were: superficial skin (13.0%), dermal (16.7%), hypodermis (13.0%), and vertebral pedicle (20.4%). C. acnes was the most common isolate (83.3% of culture-positive cases). Male patients had a significantly higher rate of culture positivity ($p = 0.007$). Betadine-prepped patients had a higher culture positivity rate than those prepped with ChloraPrep ($p = 0.014$).

At one-year follow-up, fusion rates were similar between culture-positive and culture-negative patients, but delayed fusion occurred more frequently in culture-positive patients. By four years postoperatively, 27.8% of culture-positive patients required revision surgery, more than twice the rate of culture-negative patients (13.9%).

DISCUSSION AND CONCLUSION: Occult bacterial colonization was detected in one-third of patients undergoing primary lumbar fusion, with higher prevalence in deeper tissue layers. Culture-positive patients had delayed fusion and a higher long-term revision rate, suggesting that standard preoperative skin antisepsis and prophylaxis may not fully eliminate bacterial burden. The higher culture positivity in males and Betadine-prepped patients underscores the need for improved intraoperative antiseptic strategies. Future studies should explore targeted interventions to mitigate bacterial colonization and its impact on long-term spinal fusion outcomes.

Table 1| Secondary Surgical Interventions

	Culture-Negative Patients	Culture-Positive Patients	Total
Secondary Surgical Interventions (SSI)			
Count	36	18	54
Percentage of total	66.6%	33.3%	
Patients with SSI			
Count	5	5	10
Percentage of total	13.9%	27.8%	18.5%
Reasons for Interventions			
Screw removal	1	0	1
Segmental Fixation	3	3	6
Instrumentation Removal	0	1	1
I&D	0	1	1
Adjacent level surgery w/o instrumentation	1	0	1

Table 3. Cross tabulation of culture results in the dermal layer and deep tissue layer

$P = 0.088$	*Deep Tissue Cultures*		
	Negative	Positive	Total
Dermal Layer Cultures			
Negative			
Count	37	7	44
Percentage of total	68.5%	13.0%	81.5%
Positive			
Count	6	4	10
Percentage of total	11.1%	7.4%	18.5%
Total			
Count	43	11	54
Percentage of total	79.6%	20.4%	100.0%

Dermal layer, dermal wound-edge immediately following incision; *Deep tissue,* vertebral pedicle prior to pedicle screw insertion