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Paper # 1. Intraocular Pressure in Patients Undergoing Posterior Lumbar Fusion -- A Prospective, Randomized Trial

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Introduction: Ischemic optic neuropathy (ION) resulting in visual loss is a rare but devastating complication in spine surgery. Procedure time, blood loss, prone position and systemic factors may contribute to the risk of perioperative blindness. Elevated intraocular pressure (IOP) results in decreased perfusion and possibly ION. We evaluated the effect of head positioning on IOP in lumbar spine fusion patients.

Methods: Surgeries were performed on 52 patients at one institution. Inclusion criteria were lumbar spine fusion in patients 18-80 years old. Exclusion criteria included eye disease or injury, history of cervical stenosis, neck pain, trauma or current neoplasm. The control group had the head in neutral position with the face parallel to the level operating room table and the experimental group had the neck extended so the face had an angle of inclination of 10° with the table. All patients were managed with Gardner-Wells tongs and ten pounds of traction on a Jackson table. Using an applanation tonometer, one author made all IOP measurements in pre-operative holding, supine after anesthetic induction, prone after positioning on the table and at regular intervals throughout the case. IOP measurements were recorded with respective time points and corresponding blood pressure and CO2 values. Independent variables included age, duration of procedure, blood loss, type/amount of fluid replacement, blood pressure, PCO2, gender and head position.

Results: Data were analyzed using ANOVA for categorical risk factors and with regression analysis for continuous risk factors. Mean values for IOP measurements in the prone position were statistically significantly lower in the 10° elevated group versus the head-neutral group (p=0.0014). This difference became evident approximately 30 minutes into a case and persisted for the duration. No patient sustained visual loss or any cervical spine related complications.

Conclusion: Ten degree elevation of the head in the prone position for adult lumbar spine fusion patients resulted in statistically significantly lower IOP measurements compared to controls. As lower IOP correlates with increased optic nerve perfusion, this positioning intervention could mitigate the risk of perioperative blindness in spine surgery patients in the prone position.

Paper # 2. Posterolateral Lumbar Arthrodesis with and without Interbody Arthrodesis for L4-5 Degenerative Spondylolisthesis: A Comparative Value Analysis

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Introduction: The addition of an interbody arthrodesis (IBA) to a posterolateral arthrodesis (PLA) has become increasingly popular over the past two decades, yet the potential added value for the patient has not been carefully defined. The authors hypothesized that the addition of IBA to PLA in the setting of L4-5 degenerative spondylolisthesis (DS) will produce added value while incurring minimal additional costs.

Methods: Patients undergoing single level arthrodesis with either PLA alone or PLA+IBA for L4-5 DS from 2004-2012 were identified from our institution's prospective database. Exclusion criteria included multilevel arthrodesis, spinal stenosis requiring decompression at or above L2-3, previous L4-5 spinal fusion, spondylolisthesis of greater than 33% of the vertebral body, and use of minimally invasive surgery.

Results: 179 patients with an average follow up of 38.7 months met inclusion criteria with 68 having undergone PLA alone and 111 having undergone PLA+IBA. The study was powered to detect smaller differences than the accepted minimal clinically important differences (MCID) for each outcome measure; however, no statistical differences were noted in ODI, SF-36, or fusion rates at 6 months and at over 3 years despite the PLA cohort being significantly older with more medical comorbidities. The addition of IBA did improve lordosis/sagittal balance by 1.5 degrees when compared to the PLA cohort (p=0.04). When Costs/QALYs were calculated and normalized for length of stay (LOS), the PLA+IBA cohort demonstrated increased Costs/QALYs at every time point except the extremes of LOS (p=0.01).

Table 5. Costs/QALYs Normalized by Length of Stay

	PLA		PLA+IBA		
Length of Stay (days)	QALYs	Cost/QALYs	QALYs	Cost/QALYs	*p-value*
2	0.74	$32,053	0.74	$31,791	0.77
3	0.72	$35,530	0.71	$36,048	0.86
4	0.70	$37,819	0.70	$39,518	0.59
5	0.70	$41,357	0.68	$48,954	0.33
6	0.66	$47,230	0.55	$65,301	0.01*
7	0.67	$51,221	0.72	$50,577	0.72

Table 5: * denotes that a statistical difference was noted between cost/QALYs. The PLA + IBA incurred higher costs/ QALYs at every time point with the exception of the extremes of LOS.

Discussion/Conclusion: This single center review of open surgical treatment of L4-5 DS demonstrated that the addition of IBA to PLA added cost while not producing superior results in fusion rates, ODI, and SF-36 when compared to PLA alone. On the basis of this data we cannot recommend routine addition of IBA to PLA in patients being treatedsurgically for symptomatic DS.

Paper # 3. Retracted.

Paper #4. Effects of Intraoperative Local Steroid Utilization in a Single-Level Minimally Invasive Transforaminal Lumbar Interbody Fusion

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Introduction: Local epidural steroid application may be associated with decreased pain and narcotic utilization in the immediate

post-operative period following lumbar discectomy. However, local steroid delivery following a lumbar fusion surgery has not been well characterized. As such, the purpose of this study is to characterize the surgical outcomes and narcotic utilization following a 1- level minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF) as a function of local intra-operative depomedrol utilization.

Methods: A prospective, randomized, single blinded study was performed. Patients were prospectively randomized via a computer number generator into depomedrol (DEPO, 1cc - 40mg) and no depomedrol (NODEPO, 1cc - saline) cohorts. 49 patients undergoing a primary 1-level MIS-TLIF for degenerative spinal pathology were analyzed. Demographics, comorbidity, smoking, visual analogue scale (VAS) scores, Oswestry Disability Index (ODI), Short-form Health Survey (SF-12), operative levels, peri-operative variables, and narcotic utilization were compared between groups. Student's T-test and Pearson's Chi-square analysis were performed for continuous and categorical data, respectively. An alpha level of <0.05 denoted statistical significance.

Results: Of the 49 patients included, 29 (59.2%) received intra-operative depomedrol (1cc-40mg). Demographics, comorbidity burden, smoking status, and operative levels were similar between cohorts. No differences were demonstrated in the pre-operative VAS, ODI, and SF-12. Operative time, estimated blood loss (EBL), and narcotic utilization did not differ between cohorts. Length of hospitalization was greater in the NODEPO patients (50.5±21.4 vs. 41.9±14.7 hours; $p<0.05$). Post-operative VAS and ODI scores (6- and 12-week) were significantly higher in the DEPO cohort ($p<0.05$), but were equivalent at the final 6-month follow-up.

Discussion: The findings of this prospective, randomized blinded trial suggest surgical outcomes and narcotic utilization in the immediate post-operative period may be similar between DEPO and NODEPO cohorts. The DEPO patients demonstrated significantly higher post-operative VAS and ODI scores at 6- and 12-weeks.

Conclusions: Patients appear to demonstrate similar post-operative pain levels at final follow up independent of depomedrol administration following a 1-level MIS-TLIF.

Table 1. Pre- and Post-operative Characteristics for Primary 1-Level MIS TLIF with or without Depomedrol Administration †

	Depomedrol	No Depomedrol	p-value
Pre-operative SF PCS[1]	33.4±14.4	35.0±8.7	0.74
Pre-operative SF MCS[2]	49.4±12.1	56.2±8.9	0.11
Operative Time (min)	131.0±27.6	123.2±21.9	0.32
Estimated Blood Loss (cc)	61.3±33.9	57.1±26.1	0.66
Length of Hospitalization (hours)	41.9±14.7	50.6±21.4	**<0.05**
Narcotic Utilization (OME)			
Oral Morphine Equivalents ‡	114.3±46.2	109.2±43.2	0.70
Visual Analogue Scale (VAS)[3]			
Pre-operative	5.6±2.4	4.9±2.0	0.39
6-week	5.7±2.6	2.9±2.3	**<0.05**
12-week	5.6±2.5	2.9±1.7	**<0.05**
6-month	4.8±2.3	4.6±2.1	0.91
Oswestry Disability Index (ODI)[4]			
Pre-operative	42.8±21.8	38.3±15.5	0.52
6-week	48.7±22.1	30.9±9.7	**<0.05**
12-week	47.1±19.4	24.2±11.5	**<0.05**
6-month §	30.8±18.2	36.0±6.0	0.66

† MIS TLIF: Minimally Invasive Transforaminal Lumbar Interbody Fusion
‡ OME: Sum of OME values from post-operative days 0 and 1
§ Only 8 patients: 5 Depomedrol, 3 No Depomedrol
[1]SF PCS: Short-form health survey (SF-12) Physical Component Summary
[2]SF MCS: Short-form health survey (SF-12) Mental Component Summary
[3]VAS: Visual Analogue Scale Scores (Back)
[4]ODI: Oswestry Disability Index

Paper #5. The Local Application of Vancomycin in Spine Surgery Does Not Increase Vancomycin Resistance in Surgical Site Infections

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Introduction: Vancomycin placement in the surgical wound has come under recent investigation. Sweet et al. showed a significant reduction in spine surgical site infections. However, no data is available on how this novel treatment has altered bacterial resistance profiles. The aims of this study are to: analyze bacteria and resistance patterns in spine surgery infections, and determine if there is a significant association between Vancomycin placement and Vancomycin resistant bacteria.

Methods: A retrospective consecutive case series analysis was performed on all surgical site infections within an academic tertiary care spine center from 2007 - 2013. Additionally, analysis was performed on 1013 surgical cases completed from 2011-2013 with varying application of Vancomycin to determine association with Vancomycin resistant bacteria. Antibiotic resistance profiles as well as bacteria type were analyzed by epoch. Additionally, association of Vancomycin application and development of Vancomycin resistant bacteria was analyzed by Chi-square analysis.

Results: 126 bacteria were isolated from 81 surgical site infections from 2007-2013. Resistance profiles and bacteria type were analyzed. The most prevalent bacteria isolated: 2007: MSSA (36%); 2008: MSSA, MRSE (13.5%); 2009: MRSE (41.2%); 2010: MRSE (33.3%); 2011: MSSA (54.6%); 2012: MSSA (18.8%); 2013: MSSE (40%). Only two Vancomycin resistant bacteria were found: Enterococcus Faecium 2008 & 2012. Additionally, from 2011-2013 Vancomycin was placed 475 times (47%). The single patient with the Vancomycin resistant bacteria in 2012 did not receive Vancomycin in the surgical wound prior to the development of the infection. There was not a significant association found between Vancomycin application and the development of Vancomycin resistant bacteria ($p>0.05$).

Conclusion/Discussion: This study provides retrospective data that suggests that Vancomycin resistant bacteria are rare in spine surgery infections. Additionally, there has not been an increase in Vancomycin resistant surgical site infections. Lastly, there was not a significant association between Vancomycin placed intra-operatively and Vancomycin resistant bacteria. This study is an integral first step in monitoring how the application of Vancomycin will alter the bacteria, and resistance profiles in spine surgical site infections.