Perioperative Complications are Greater Following Posterior Fusions Versus Anterior Odontoid Screw Fixation in Geriatric Odontoid Fractures: A Propensity Matched Analysis

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INTRODUCTION:

Odontoid fractures constitute a significant percentage of all cervical fractures. Odontoid fractures follow a bimodal age distribution, being most common in individuals younger than 8 or older than 70 years old. In the case of geriatric odontoid fractures (i.e. patients over 60 years of age), the current literature demonstrates a high mortality in those managed non-operatively; however, the approaches to surgical intervention are controversial in this population. The objectives of this study were to compare the 30-day outcomes and complications in acute geriatric odontoid fractures managed with anterior odontoid screw fixation (AOS) versus posterior spinal fusion (PSF).

METHODS: Patients greater than 60 years of age with odontoid fractures managed via anterior odontoid screw fixation or posterior cervical fusion were identified in the American College of Surgeon's National Surgical Quality Improvement Database (ACS NSQIP) from January 1, 2015 – December 31, 2020. Patients underwent propensity matching between AOS and PSF cohorts controlling for sex, age category, body mass index (BMI) category, and American Society of Anesthesiologists (ASA) class. Various 30-day outcomes, surgical, and medical complications were compared between matched and unmatched cohorts. Multivariate analyses were conducted to determine independent predictors of perioperative outcomes of interest.

RESULTS:

A total of 532 patients meet inclusion criteria: 119 AOS and 415 PSF. There were baseline differences in demographic variables and medical comorbidities between the two groups prior to matching. Patients in the PSF group were more likely to be aged 60-69 years (28.7% vs. 19.3%, p=0.042) and more likely to smoke (15.2% vs. 5.0%, p=0.004) (Table 1). PSF had significantly longer operative times, on average, compared to the AOS group (169.9 +/- 61.8 mins vs. 89.5 +/- 49.5 min, p<0.001) (Table)

After propensity score matching, a total of 222 patients were included (111 AOS and 111 PSF), with similar demographic variables and medical comorbidities between groups (Table 2). In the matched cohorts, rates of readmission, reoperation, mortality, and overall medical complications were similar between groups (Table 3). Posterior fusions were associated with a significantly higher rate of non-home discharge (71.0% vs. 50.0%, p=0.011) and overall surgical complications (14.4% vs. 0.0%, p<0.001) compared to the AOS group, however (Table 3). Rates of pneumonia were higher in the AOS group compared to the PSF cohort (11.1% vs 1.1%, p=0.010).

In the entire cohort, multivariate analyses determined anterior-based approaches to fusion to be significantly associated with reoperation (RR = 2.770 [1.115-6.897]) and posterior fusions to be independently predictive of non-home discharge (RR = 1.750 [1.095-2.797]) (Table 4).

DISCUSSION AND CONCLUSION:

Anterior odontoid screw fixation yielded shorter operative times, lower rates of non-home discharge, and lower overall surgical complications in treating geriatric odontoid fractures relative to posterior spinal fusion in matched cohorts. Posterior fusion was independently predictive of non-home discharge on multivariate analysis. However, on multivariate analysis, anterior odontoid screw fixation was independently associated with unplanned reoperation. Anterior odontoid screw fixation and posterior spinal fusion have different perioperative complication profiles. Patients should be counseled appropriately on the differences in short-term perioperative outcomes between these two procedures.

Table 1. Demographics, patient variables, and comorbidities prior to matching

	Anterior [n = 119]	Posterior [n = 415]	p
Sex			
Male	58 (48.7%)	216 (52.0%)	0.524
Female	61 (51.3%)	199 (48.0%)	
Age			
60-69 years	23 (19.3%)	119 (28.7%)	**0.042**
70-79 years	45 (37.8%)	157 (37.8%)	0.997
80+ years	51 (42.9%)	139 (33.5%)	0.060
BMI (kg/m²)			
Underweight	12 (10.1%)	27 (6.5%)	0.186
Normal	49 (41.2%)	150 (36.1%)	0.317
Overweight	36 (30.3%)	148 (35.7%)	0.274
Obese Class I	14 (11.8%)	60 (14.5%)	0.453
Obese Class II	6 (5.0%)	21 (5.1%)	0.994
Obese Class III	2 (1.7%)	9 (2.2%)	>0.999
Comorbidities			
Diabetes	22 (18.5%)	75 (18.1%)	0.918
Smoking	6 (5.0%)	63 (15.2%)	**0.004**
COPD	7 (5.9%)	32 (7.7%)	0.499
Ascites	0 (0.0%)	0 (0.0%)	-
Congestive Heart Failure	4 (3.4%)	6 (1.4%)	0.241
Hypertension	81 (68.1%)	288 (69.4%)	0.782
Renal Failure	0 (0.0%)	1 (0.2%)	>0.999
Dialysis	1 (0.8%)	9 (2.2%)	0.700
Chronic Steroid Use	3 (2.5%)	21 (5.1%)	0.319
Bleeding Disorder	11 (9.2%)	28 (6.7%)	0.423
Transfusion within 48 hours	0 (0.0%)	3 (0.7%)	>0.999
ASA Class			
Class 1 (No disturbance)	0 (0.0%)	0 (0.0%)	-
Class 2 (Mild disturbance)	13 (10.9%)	60 (14.5%)	0.323
Class 3 (Severe disturbance)	70 (58.8%)	266 (64.1%)	0.294
Class 4 (Life threatening)	34 (28.6%)	88 (21.2%)	0.092
Class 5 (Moribund)	2 (1.7%)	1 (0.2%)	0.126
Operative Time			
Total Time	89.5 ± 49.5	169.9 ± 61.8	**<0.001**
<60 minutes	33 (27.7%)	2 (0.5%)	**<0.001**
60-120 minutes	64 (53.8%)	92 (22.2%)	**<0.001**
120-180 minutes	17 (14.3%)	164 (39.5%)	**<0.001**
>180 minutes	5 (4.2%)	157 (37.8%)	**<0.001**

Table 3. Short-term outcome measures and complication rates after matching

	Anterior [n = 111]	Posterior [n = 111]	p
Readmission	4 (4.4 %)	5 (5.6 %)	0.734
Reoperation	9 (10.0 %)	3 (3.3 %)	0.135
Non-home discharge	45 (50.0 %)	64 (71.0 %)	**0.011**
Mortality	7 (7.8 %)	4 (4.4 %)	0.538
Length of Stay (LOS)			
Surgical Complications			
Overall	0 (0.0 %)	13 (14.4 %)	**<0.001**
Superficial surgical site infection	0 (0.0 %)	1 (1.1 %)	>0.999
Deep surgical site infection	0 (0.0 %)	0 (0.0 %)	-
Dehiscence	0 (0.0 %)	0 (0.0 %)	-
Bleeding requiring transfusion	0 (0.0 %)	12 (13.3 %)	**<0.001**
Medical Complications			
Overall	18 (20.0 %)	14 (15.5 %)	0.445
Wound Infection	0 (0.0 %)	1 (1.1 %)	>0.999
Pneumonia	10 (11.1 %)	1 (1.1 %)	**0.010**
Reintubation	9 (10.0 %)	5 (5.6 %)	0.409
Pulmonary embolism	0 (0.0 %)	0 (0.0 %)	-
Failure to wean ventilator	4 (4.4 %)	5 (5.6 %)	>0.999
Renal insufficiency	0 (0.0 %)	0 (0.0 %)	-
Renal failure	0 (0.0 %)	0 (0.0 %)	-
Urinary tract infection	1 (1.1 %)	3 (3.3 %)	0.622
Cerebrovascular accident	4 (4.4 %)	0 (0.0 %)	0.122
Cardiac arrest	2 (2.2 %)	2 (2.2 %)	>0.999
Myocardial infarction	1 (1.1 %)	1 (1.1 %)	>0.999
Deep venous thromboembolism	0 (0.0 %)	1 (1.1 %)	>0.999
Systemic sepsis	2 (2.2 %)	1 (1.1 %)	>0.999
Septic shock	0 (0.0 %)	0 (0.0 %)	-

Table 4. Logistic regressions identifying independent risk factors for various 30-day complications

	Risk Ratio [95% C.I.]	P
Readmission		
Comorbidities		
COPD	8.982 [2.980 – 27.067]	<0.001
Hypertension	6.720 [1.786 – 25.123]	0.005
Reoperation		
Approach		
Anterior-based	2.770 [1.115 – 6.897]	0.028
ASA Class		
II	0.017 [0.001 – 0.714]	0.017
Non-home Discharge		
Approach		
Posterior-based	1.750 [1.095 – 2.797]	0.019
Sex		
Female	1.503 [1.020 – 2.217]	0.039
Age		
80+ years-old	3.806 [2.502 – 5.791]	<0.001
Mortality		
Comorbidities		
COPD	6.295 [1.565 – 25.316]	0.010
Age		
80+ years-old	4.943 [1.577 – 15.491]	0.006
Surgical Complications		
Comorbidities		
Hypertension	2.753 [1.140 – 6.652]	0.024
Operative Time		
Over 180 minutes	2.449 [1.262 – 4.751]	0.008
Medical Complications		
Comorbidities		
COPD	2.802 [1.161 – 6.762]	0.022
ASA Class		
II	0.062 [0.004 – 0.885]	0.040
Age		
80+ years-old	1.999 [1.117 – 3.577]	0.020

Table 2. Demographics, patient variables, and comorbidities after matching

	Anterior [n = 111]	Posterior [n = 111]	p
Sex			
Male	49 (54.4 %)	49 (54.4 %)	>0.999
Female	62 (68.8 %)	62 (68.8 %)	
Age			
60-69 years	17 (18.9 %)	17 (18.9 %)	>0.999
70-79 years	43 (47.7 %)	43 (47.7 %)	>0.999
80+ years	51 (56.6 %)	51 (56.6 %)	>0.999
BMI (kg/m²)			
Underweight	6 (6.7 %)	6 (6.7 %)	>0.999
Normal	49 (54.4 %)	49 (54.4 %)	>0.999
Overweight	41 (45.5 %)	41 (45.5 %)	>0.999
Obese Class I	14 (15.5 %)	14 (15.5 %)	>0.999
Obese Class II	1 (1.1 %)	1 (1.1 %)	>0.999
Obese Class III	0 (0.0 %)	0 (0.0 %)	-
Comorbidities			
Diabetes	12 (13.3 %)	12 (13.3 %)	>0.999
Smoking	1 (1.1 %)	1 (1.1 %)	>0.999
COPD	1 (1.1 %)	1 (1.1 %)	>0.999
Ascites	0 (0.0 %)	0 (0.0 %)	-
Congestive Heart Failure	0 (0.0 %)	0 (0.0 %)	-
Hypertension	78 (86.6 %)	78 (86.6 %)	>0.999
Renal Failure	0 (0.0 %)	0 (0.0 %)	-
Dialysis	0 (0.0 %)	0 (0.0 %)	-
Chronic Steroid Use	1 (1.1 %)	1 (1.1 %)	>0.999
Bleeding Disorder	2 (2.2 %)	2 (2.2 %)	>0.999
Transfusion within 48 hours	0 (0.0 %)	0 (0.0 %)	-
ASA Class			
Class 1 (No disturbance)	0 (0.0 %)	0 (0.0 %)	-
Class 2 (Mild disturbance)	8 (8.9 %)	8 (8.9 %)	>0.999
Class 3 (Severe disturbance)	84 (93.2 %)	84 (93.2 %)	>0.999
Class 4 (Life threatening)	19 (21.1 %)	19 (21.1 %)	>0.999
Class 5 (Moribund)	0 (0.0 %)	0 (0.0 %)	-