



### Background

Although incomplete occlusion and recurrence of intracranial aneurysms following coil embolization is a well-known problem, the factors that influence and predict recurrence are still debated.

### Objective

The present study sought to identify the patient, aneurysm, and procedural factors that are associated with and can be used to predict recurrence following coil embolization.

### Methods

This is a retrospective review of 375 patients with 394 aneurysms treated with coil embolization. Atypical aneurysms and those that were previously treated were excluded. Univariate statistical tests were employed to select variables for incorporation into a multivariate logistic regression model of aneurysm recurrence after coiling.

### Results

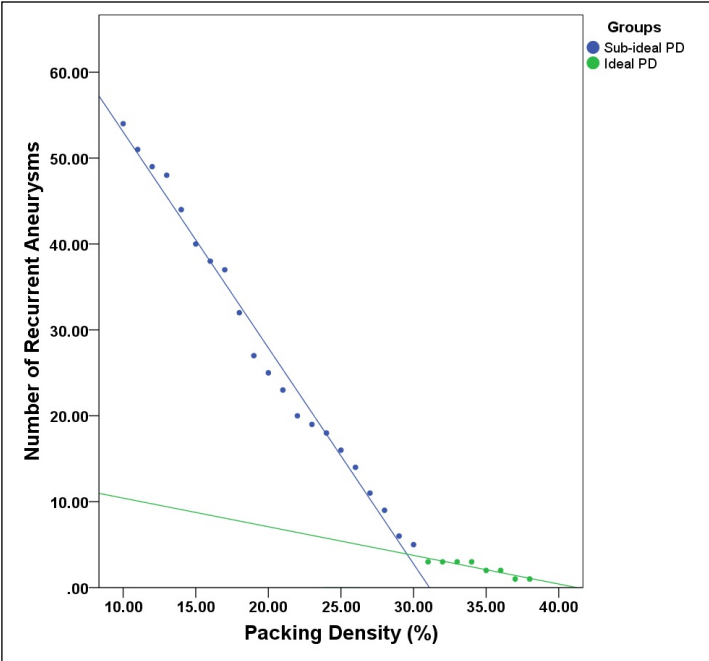
Packing density (PD;  $p=0.039$ ) and incomplete aneurysm occlusion ( $p<0.001$ ) following treatment were significantly associated with recurrence on multivariate analysis. Upon further investigation, we identified a PD of 30% as being an optimal cut-off with only a 6% recurrence rate for aneurysms over 30% PD compared to 34% for aneurysms under 30% PD. We also observed that PD exhibits a significant linear decrease as aneurysm volumes exceed 200 mm<sup>3</sup>. Stent assistance did not protect again recurrence in this series ( $p=0.363$ ).

### Conclusions

Our results suggest that predictive factors for recurrence include PD and incomplete aneurysm occlusion and that a PD greater than 30% is the optimal PD for preventing recurrence and is particularly difficult to acheive for large aneurysms (>200mm<sup>3</sup>). Knowledge of these key determinants of recurrence should be useful to both prevent and predict aneurysm recurrence after coil embolization. These findings should be further validated in a prospective study.

Table 4. Multivariable Logistic Regression Analysis of Covariates Predicting Recurrence on Follow-up Angiography for Coiled Aneurysms*			
Variable	Odds Ratio	95% Confidence Interval	P value
Aneurysm dome average diameter	0.69	(0.41 – 1.17)	0.165
Aneurysm volume	1.00	(0.99 – 1.01)	0.352
Aneurysm neck average diameter	1.26	(0.89 – 1.81)	0.194
Coil volume	1.02	(0.99 – 1.04)	0.171
Coil coating	0.98	(0.23 – 4.23)	0.976
Packing density (%)	0.001	(<0.01 – 0.686)	0.039
Initial MRRC†			
I	–	–	–
II	1.95	(0.31 – 12.21)	0.476
IIIa	5.02	(0.91 – 27.79)	0.064
IIIb	126.19	(20.44 – 779.06)	<0.001

\* A multivariable logistic regression model utilizing all factors found as significant on univariate analysis.  
†MRRC, as a multivalued categorical variable is shown as odds ratios compared to MRRC Class I as a reference value.  
MRRC: Modified Raymond-Roy Classification



A plot of number of recurrent aneurysms at initial follow-up above individual PD thresholds. There is an average decrease of 2.4 recurrences (4% rate of recurrence) per percent PD for sub-optimal (<30%) PD. For optimal PD (>30%, these is a markedly different linear relationship with an average of 0.29 recurrences (0.5% rate of recurrence) per percent of PD.