A Slippery Slope: Taking a Look at Post-Operative Aneurysm Clip Slippage

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Background

- Intracranial aneurysms (IA) are commonly treated with endovascular means or surgical clipping [1-4]
- Clipping has a high success rate and has demonstrated decreased risk of late-rebleeding in ruptured aneurysms compared to coiling [1,2]
- Despite this, post-operative slippage of aneurysm clips has been described [5-11]
- Factors like closing force, blade length, and aneurysm size are thought to play a role [9, 10, 12, 13]
- Post-operative slippage of clips has been explored in series, but a cumulative review has not been published

Objective

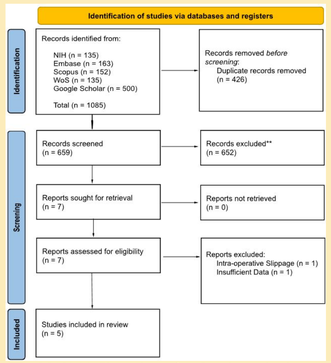
- Explore occasions of post-operative clip slippage within the recent literature and broaden the understanding of this rare phenomenon
- Identify possible commonalities in these cases and determine how best to avoid future incidents

Methods

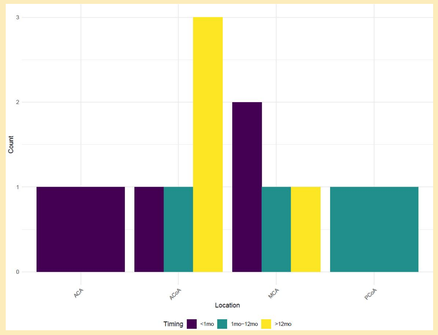
- Relevant studies identified and pulled from major databases (Pubmed, Scopus, Web of Science, Cochrane, Embase) and grey literature (Google Scholar)
- Keywords included: aneurysm, clip, slippage, and derivatives
- Abstract and full-text screening conducted through the Rayyan web-based systematic review platform
- Included articles described one or more cases of post-op clip slippage not attributed to human error within a series of at least five patients from the last 30 years
- Papers that were case reports, series with incidents of intra-operative slippage, or studies with insufficient data were excluded
- Aggregated case analysis conducted using R Studio

Results

- Five studies in total met our inclusion criteria [5-7, 10, 11]
- Total of 3374 patients followed for IA with 12 cases of slippage confirmed by imaging
- Majority of slippages were of ACoA aneurysms (n=6), followed by MCA (n=4), ACA (n=1), and PCoA (n=1)
- Aneurysm size characteristics: medium (n=4); large (n=3); small (n=2); giant (n=1); indeterminate (n=2)
- Reason for readmission: symptomatic rebleeding (n=3), clip malposition on imaging study (n=5), unknown (n=4)
- Time from initial clipping to slippage identification: <1mo (n=5); <1y (n=2); >1y (n=5)
- Aneurysm size vs duration to slippage id Cramer's V: 0.67 (P=0.47)
- Aneurysm location vs duration to slippage id Cramer's V: 0.52 (P=0.63)



PRISMA Flowchart for Study Inclusion



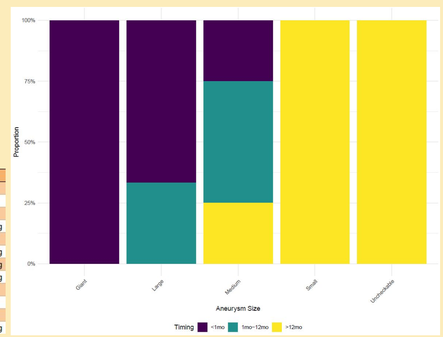
Aneurysm Location and Slippage ID Timing

Author	Year	N Patients	N Slip
Picinich	2022	100	3
Asgari	2003	727	2
Kim	2018	2364	5
Kunert	2013	119	1
Szmuda	2019	64	1

General Study Characteristics

Location	Size	Intactness	Time from original clipping	Clips Used	Readmission Reason
ACoA	Small		3 years	1	
ACoA	Small		3 years	1	
ACoA	Medium	Ruptured	1 mo	1	ICH
ACoA	Medium	Unruptured	1 day	1	Clip slippage on f/u imaging
ACoA			18 years	1	
ACoA		Ruptured	3 years		Clip slippage on f/u imaging
MCA	Medium	Ruptured	6 mo	2	Clip slippage on f/u imaging
MCA	Medium	Unruptured	1 year	1	Clip slippage on f/u imaging
MCA	Large		10 days	2	
MCA	Giant	Ruptured	25 days	2	ICH
ACA	Large	Ruptured	20 days	1	SAH
PCoA	Large	Ruptured	1 day, 3 mo	1	Clip slippage on f/u imaging

Slipped Clip Characteristics



Aneurysm Size and Slippage ID Timing

Discussion

- Data shows that post-operative clip slippage is a rare phenomenon limited to a small fraction of IA cases
- Interestingly, no posterior circulation aneurysms were noted despite the technically challenging nature of cases like basilar tip aneurysms [14]
- This could be attributed to increased precautions during the operation and small sample size
- Frequency of ACoA clip slippages are consistent with previous studies that have found increased incidence of reintervention for these aneurysms following clipping [15]
- Statistical analysis yielded no significant associations between aneurysm size or aneurysm location and slippage time frame
- The lack of published data on cases and their specifics limits the conclusions that can be reasonably drawn
- More data necessary for robust analysis, preferably with additional information on each case including clip characteristics

Conclusions

- Post-operative IA clip slippage is rare and should not be a primary deterrent when considering treatment options
- A greater number of institutional series studying clip slippage is necessary to increase understanding of the factors behind this complication and inform follow-up imaging guidelines

Future Directions

- Multi-centered studies needed for broader applicability, particularly with inclusion of clip-centric data
- Apply machine learning to investigate potential high risk factors in clip slippage when more data is available
- Determine whether clip slippage is related to high risk locations for clipping or higher aneurysm frequency locations

References