

# Comparative Study of Repeat Revascularization Surgery for Moyamoya Patients After Previous Indirect or Direct Bypass

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## Introduction

To compare and contrast the clinical and radiological outcome of MMD patients with previous indirect or direct bypasses.

## Methods

Single institution, retrospective analysis of a prospective MMD database.

## Results

From 1991-2014, 1244 revascularization bypass (1107 direct, 137 indirect) were performed in 765 patients, of whom 57 were repeat revascularizations (38 had previous indirect and 19 had previous direct bypass). When the initial revascularization was performed at Stanford, the rate of repeat revascularization was 4% (5/137) and 1% (12/1107) for indirect and direct bypass respectively (p=0.03).

Comparing the cohorts with previous indirect or direct bypass, the patients were slightly younger (mean age 23years (range 5-49) versus 30years (range 5-60), and less females (61%,(23/38) vs 84%,(16/19) (p = 0.08). In the patients with previous indirect bypasses that needed repeat revascularizations, the majority of the first operations were performed at outside institutions (91%, 51/56).

In both cohorts (indirect vs direct), the mean duration between initial bypass procedures and repeat revascularization was similar (49months vs 47months). The indication for repeat revascularization due to TIAs was similar in both groups (66% vs 63%). One case of acute graft occlusion was encountered in the previous direct bypass group and was revised within 1week postop.

**Table 1. Comparison of repeat revascularization cases between cohorts with initial indirect or direct bypasses**

	Previous Indirect	Previous Direct	p-value
Number of patients	38	19	
Female: Male	23F: 15M	16F: 3M	0.08
Age (mean)	23 yrs	30 yrs	
Age (range)	5-49 yrs	5-60 yrs	
Pediatric cases (< 18 yrs)	16	5	0.24
Adult cases (> 18 yrs)	22	14	
No. of repeat revascularizations	56	20	
Location of previous revascularization			< 0.001
Stanford	5	12	
Outside institution	51	8	
Duration between 2 surgeries (Mean)	48.8 mos	47.4 mos	
Duration between 2 surgeries (Median)	36 mos	30 mos	
Duration between 2 surgeries (Range)	3-264 mos	0.2-200 mos	
Indications for repeat revascularization			0.60
TIAs	25	12	
TIA and choreiform movement	1	1	
Developmental delay, seizure	3		
Ischemic stroke	7	2	
Hemorrhagic stroke	2	2	
Graft occlusion		1	
Radiological-persistent poor reserve and steal		1	
Types of repeat revascularization			< 0.001
Parietal branch STA-MCA bypass	26	0	
Frontal branch STA-MCA bypass	2	9	
OA-MCA bypass	4	2	
Saphenous vein-mca bypass	1	0	
EMS	4	3	
EDAS	6	1	
EDAMS	4	0	
Omental graft	8	5	
Burr holes	1	0	
Duration of follow up			
Mean (years)	4.8	4.7	
Range (years)	0-16	0.5-21	
Follow up outcomes			0.81
Well, no TIAs/strokes	29	14	
Occasional TIAs	7	3	
Died	2	1	

## Results

Over 50% of repeat revascularizations performed in both groups were achieved by direct bypass methods, but the major difference was that the repeat bypass for the previous direct group was to augment another vascular territory. Furthermore, the parietal STA branch could be used in repeat revascularization of the hemisphere in 46%(26/56) for those with previous indirect surgeries, compared to none with previous direct surgeries (p<0.001).

With similar mean follow-up of nearly 5 years in both groups, over 80% of patients in both groups are well and free from stroke/TIA symptoms with excellent radiological results (angiogram, perfusion study, MRI brain).

## Conclusions

1. Indirect bypass has a higher rate of repeat revascularization than direct bypass.
2. Over 50% of repeat revascularization were achieved with direct procedures.

## Learning Objectives

By the conclusion of this session, participants should be able to:

- 1) understand the indications for repeat revascularizations for moyamoya disease.
- 2) discuss the difference in treatment options for repeat revascularizations, the pros and cons of each technique.
- 3) compare and contrast the difference in repeat revascularization after initial direct or indirect bypass.

## References

Pandey P, Steinberg GK. Outcome of repeat