Long-term Outcome Up to 20 Years after STA-MCA Anastomosis and Ultimate Indirect Bypass for Moyamoya Disease

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Introduction – There are many reports about short-term (<5 years), but not long-term (>10 years) outcome after bypass surgery for moyamoya disease. However, recent reports have shown that a certain subgroup of patients may be at risk for subsequent stroke even after 10 years post-surgery. Therefore, this study was aimed to evaluate long-term (5-20 years) outcome after STA-MCA anastomosis and ultimate indirect bypass (encephalo-duro-myo-arterio-pericranial synangiosis; EDMAPS) for moyamoya disease.

Methods – This study included a total of 80 patients who were followed up for longer than 5 years after STA-MCA anastomosis and EDMAPS for moyamoya disease between 1997 and 2012. There were 30 pediatric (<18 years) and 50 adult patients. There were 22 males and 58 females. Their mean age was 30.4±19.8 years, ranging from 1 to 70 years.

Clinical diagnosis included TIA or ischemic stroke in 67 patients, hemorrhagic stroke in 10, and asymptomatic in 3.

STA-MCA single or double anastomosis was performed followed by ultimate indirect bypass (EDMAPS) through large front-temporal craniotomy onto 128 hemispheres of 80 patients. Donor tissues for EDMAPS included the dura mater, temporal muscle, STA, and frontal pericranial flap and enabled to supply surgical collaterals to the entire carotid territory. All patients were prospectively followed up at outpatient clinic for a mean of 10.8±4.2 years, ranging from 5.1 to 20 years. MRI and MRA were performed once or twice per year. Primary endpoint was ischemic and/or hemorrhagic stroke during follow-up periods. Secondary endpoint included the disease progression in carotid system of non-surgical side and posterior cerebral artery (PCA).

Results – During follow-up periods, one of 80 patients recurred hemorrhagic stroke (0.12% per patient-year). Radiological examinations demonstrated that the disease progression occurred in the carotid system of non-surgical side in one side and in the PCA in 7 sides (1.1% per side-year).

Conclusion – STA-MCA anastomosis and ultimate indirect bypass (EDMAPS) is the best choice to prevent further cerebrovascular events for longer than 10 years by widely providing surgical collaterals. However, long-term regular follow-up is essential to identify disease progression especially in the PCA.

Which Do you Prefer?		
	Advantage	Disadvantage
Indirect Bypass	• Simple & easy	• Surgical collaterals develop 2 to 3 months post-surgery • Higher incidence of peri-operative ischemic stroke • Effective in only 50% of adults
Direct Bypass	• CBF improves just after surgery • Lower incidence of peri-operative ischemic stroke • TIA quickly disappears	• Surgical training needed • Possibility of hyperperfusion

Collateral Development via Indirect Bypass Depends on The Size of Craniotomy				
	EDAS	EMS	EDAMS	EDMAPS
Craniotomy				
Donor tissue	dura, STA	temporal muscle	dura, STA, temporal muscle	dura, STA, temporal muscle, pericranium
Postop. Ext. CAG				