

## Carotid Artery Eversion Endarterectomy Versus Open Thromboendarterectomy and Patch Plasty

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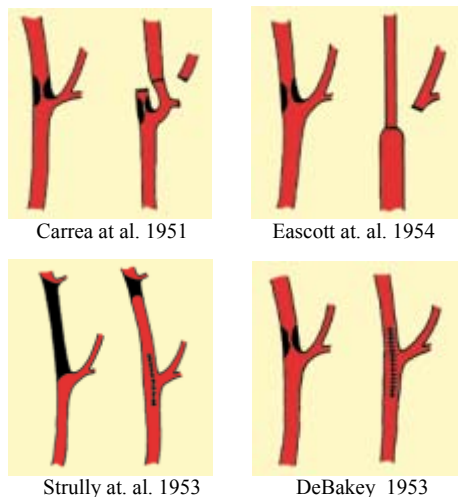
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### ABSTRACT

**Objective:** For last years we changed gradually our treatment for stenosis of the internal carotid artery (ICA) from open thromboendarterectomy and Dacron-patch plasty (TEA) to eversion endarterectomy (EEA). **Design:** retrospective study. **Methods:** We have selected 250 patients operated by EEA technique and 250 TEA techniques, between January 1996 and December 1998. These results were compared. **Results:** clamping and operation time were significantly shorter for EEA. Neurological complications included transient ischemic attacks in 1,0 % in the EEA group versus 1,3% after TEA ( $p=0,72$ ), minor strokes (0,6% vs 1,8%,  $p=0,10$ ) and major strokes in 1,5% versus 1,1% ( $p=0,59$ ). The rate of restenosis ( $>50\%$ ) was 2,4% after EEA and 10,5% after TEA. **Conclusions:** EEA of the ICA is safe procedure for carotid artery reconstruction with the additional advantages of short clamping time, possibility of the simultaneous shortening of an elongated internal carotid artery, no requirement for patch plasty and the lower risk of restenosis.

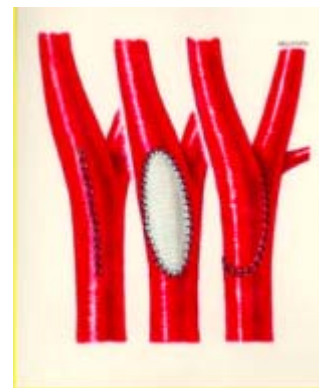
**KEYWORDS:** *internal carotid artery, eversion endarterectomy, patch lasty, stenosis*

Several prospective randomized studies (NASCET, ECST, ACAS, EVEREST and etc) have clearly defined indications for carotid endarterectomy. Different operation techniques were used for carotid reconstruction historically (Fig.1).



**Fig.1** Diagram of early operations for carotid stenosis.

Nowadays, standard surgical techniques used in practice are three: direct closure, patch plasty and eversion technique (Fig.2).



**Fig.2** Three types of carotid endarterectomy.

Some years ago mostly used technique was a longitudinal arteriotomy of the carotid bifurcation and the ICA and the open thromboendarterectomy (TEA) with or without patching. A recent prospective randomized trial showed superior results in the patch group in comparison to the direct closure regarding the perioperative permanent stroke rates as well as the incidence of late recurrent stenosis. In 1989, Kasprazak and Raithel described a modification of the original eversion technique involving oblique transection of the ICA at the carotid bulb. During recent years, several vascular surgeons have reported eversion endarterectomy (EEA) of the ICA. This technique is said to produce better or equal results using shorter clamping and operation time.

To evaluate both methods, we compared the outcome of the patients in both EEA and TEA groups retrospectively.

## MATERIALS AND METHODS

Between 01/96 and 11/98 we performed 250 operative revascularisation procedures of the ICA in 194 selected patients (patients underwent EEA). These were compared with 250 procedures in 201 selected patients undergoing revascularisation procedures between 01/96 and 11/98 at the same clinic (patients underwent TEA). All our operations are carried out under general anesthesia. An intraluminal shunt was used only on demand. This depended on the results of the intraoperative neuromonitoring, consisting of somatosensory evoked potentials; in our department an intraluminal shunt was used if the amplitude of the evoked potentials decreased below 50%.

NB All patients with intraluminal shunting were excluded from this study. Besides neurological examination the preoperative investigations included, color duplex ultrasound of the carotid artery, cerebral computed topography with application of contrast and intravenous digital subtraction angiography. All patients underwent a neurological examination in the early postoperative course. Color duplex ultrasound was used as a quality control. Patients were followed up in our vascular laboratory in 3-month intervals during the first year after operation. The follow-up investigations, besides clinical and neurological examination, color duplex ultrasound of the ICA were used. All patients received 100-mg aspirin/day indefinitely.

## SURGICAL TECHNIQUE

The TEA is performed using the technique described by Rhodes.

The incision is closed by a prosthetic patch using continuous sutures 6/0 polypropylene sutures with a Dacron patch. To allow proper eversion during EEA the posterior wall of the ICA also has to be free from adhesions to the surrounding tissue. Preparation starts at the cranial level of the ICA. After systematic administration of heparin, early clamping of the ICA prevents embolisation during the complete preparation of the bifurcation. Then preparation is continued cranially beyond the crossing of the ICA with the hypoglossal nerve and caudally until the common carotid artery is well exposed. After clamping of the vessels the ICA is divided obliquely at the carotid bifurcation. Following eversion of the adventitial and outer medial layers of the ICA over the atheromatous core the plaque is removed. Any residual debris is removed by fine forceps, until the remnant intimal layer is connected firmly to the arterial wall. Routine tacking sutures for the end point are not necessary. The external and the common carotid artery are disobliterated as in the standard procedure. The re-implantation of the ICA in to the carotid bifurcation is carried out with continuous 6/0 polypropylene sutures. Elongation of the ICA causing kinking is corrected by the longitudinal incision of the CCA and more proximal implantation or excision of the redundant ICA. Before finishing the suture the ICA is dilated to prevent spasm and to control the

intimal endpoint again. The operation is finished by the reversal of the heparin, drain placement and wound closure.

## RESULTS

The mean age of the patients in both groups was 68.5 years (range 47-88 y). Characteristics of the clamping and operation time, restenosis and reoperation rate was following (see *Tab.1*).

	EEA	TEA
Mean clamping time (min)	24±7	36±11
Mean operation time (min)	51±12	64±12
Early restenosis > 50%	2,4%	10,5%
Reoperation	0,75%	2,6%

**Tab.1** *Intra- and postoperative characteristics after EEA and TEA*

Statistics of early complications postoperatively during the first year was following (see *Tab.2*).

Complications	EEA	TEA	p value
TIA (%)	1,0	1,3	0,72
Minor Stroke (%)	0,6	1,8	0,10
Major stroke (%)	1,5	1,1	0,59
Neural lesions (%):			
Hypoglossal nerve	3,3	2,6	0,34
Facial nerve	11,2	9,3	0,37
Laryngeal recurrent nerve	2,3	2,1	0,84
Bleeding (%)	1,5	2,1	0,48
Infection (%)	0,6	0,5	0,84
Early thrombosis (%)	1,0	0,8	0,69
Cardiac instability (%)	2,3	2,8	0,59
Pneumonia (%)	1,0	1,3	0,72
Fatality rate (%)	1,0	1,8	0,33

**Tab.2** *Distribution of the cerebrovascular symptoms and other complications after EEA and TEA*

## DISCUSSION AND CONCLUSIONS

The main advantage of the Eversion endarterectomy technique is:

\* reduced time of clamping and operation due to the reconstruction without patch plasty, which has its own problems and risks

\* the lower risk of restenosis resulting from the long and oblique anastomosis

\* More favorable flow dynamics due to stretching of the ICA and avoidance of a perianastomotic hypercompliant zone at the end of the patch.

\* the simultaneous correction of an elongated ICA-necessary in up to 55% of the cases

The change of the operative technique from the open TEA and Dacron-patch closure to the EEA did not increase our rate of complications, even in comparison to the literature.

In conclusion, EEA of the ICA is safe procedure with the additional advantages of short clamping time, the possibility to shorten an elongated ICA, and avoidance of prosthetic patches. The level of these results may serve as a gold standard, which will have to be reached by new techniques such as angioplasty or stenting.

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## Преимущества эверсионной эндартерэктомии сонной артерии в сравнении с открытой эндартерэктомией с применением заплаты

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### РЕЗЮМЕ

В последние годы, при стенозе внутренней каротидной артерии, чаще стали использовать эверсионную эндартерэктомию вместо открытой тромбэндартерэктомии с применением дакроновой заплаты. Сопоставлены 250 случаев эверсионной эндартерэктомии с 250 случаями операций с применением дакроновой заплаты в период 1996 – 1998 гг. Длительность операции существенно уменьшилась при эверсионной эндартерэктомии. Число неврологических осложнений также уменьшилось - транзиторные ишемические атаки с 1.3% до 1.0% ( $p=0,72$ ), малый инсульт (0.6% vs. 1.8%,  $p=0,10$ ) и инсульт (1,5% vs 1,1%,  $p=0,59$ ). Количество рестенозов (>50%) при эверсионной эндартерэктомии составило 2,4% против 10,5% при операциях с применением дакроновой заплаты. Таким образом эверсионная эндартерэктомия при стенозе внутренней каротидной артерии - безопасный метод лечения, который дает возможность уменьшить время пережатия, не требует применения дакроновой заплаты и уменьшает риск рестенозов.

**КЛЮЧЕВЫЕ СЛОВА:** внутренняя сонная артерия, эверсионная эндартерэктомия заплата, стеноз