

# The Evolution of Endovascular Treatment of Carotid Cavernous Fistulas: A Single Institution Experience

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## Introduction

The endovascular treatment of carotid cavernous fistulas (CCFs) has evolved to include both transarterial and transvenous embolization using detachable balloons, coils, and liquid embolic agents. The present series comprises our 16-year institutional experience in the endovascular treatment of CCF.

## Methods

We reviewed our prospectively-maintained database for patients evaluated for endovascular treatment for CCF between 12/1995-3/2012. Relevant clinical and demographic data were extracted for 96 patients from medical records, operative notes, and radiographic reports.

Table 1: Direct CCF

dCCF (n=40)	Overall	%
Patients Treated	38	95
Mean Treatment Sessions	1.7	
Transarterial	26	68
Transvenous	2	5
Combined	10	26
Detachable Balloons	18	47
Carotid Occlusion	15	39

Table 2: Direct CCF Treatment

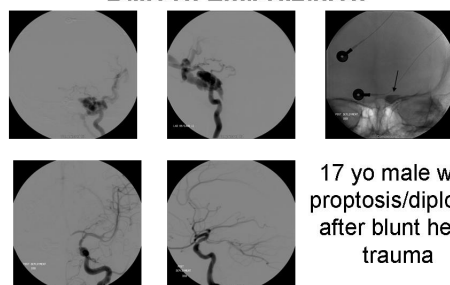
dCCF (n=40)	12/95-3/04	%	3/04-present	%	Overall	%
Patients Treated	22	57	16	42	38	95
Mean Treatment Sessions	1.82		1.56		1.7	
Transarterial	18	82	8	50	26	68
Transvenous	1	5	1	6	2	5
Combined	3	14	7	44	10	26
Detachable Balloons	18	82	0	0	18	47
Carotid Occlusion	10	45	5	31	15	39

## Results

### Direct CCF

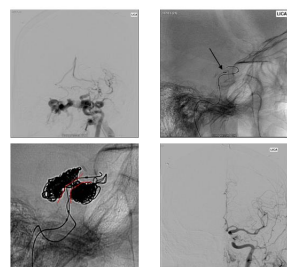
Of 40 patients with direct CCF, 38 were successfully treated using endovascular techniques (95%), with an 8% morbidity and 3% mortality. From 12/1995 to 3/2004, detachable balloons were used in 18/22 direct CCF cases. The internal carotid artery was occluded in 45% of these cases. In the later era, coil embolization, with and without adjunctive balloon remodeling/stent assistance, became first line therapy. Carotid occlusion was necessary in 5/16 patients (31%). Residual fistula was seen in 7 of the treated patients (18%), with follow-up residual in 3 patients (8%).

### dCCF: Transarterial Detachable Balloon Embolization



17 yo male with proptosis/diplopia after blunt head trauma

### dCCF: Transarterial Balloon-Assisted Coil Embolization



84 yo female with acute onset proptosis/diplopia.

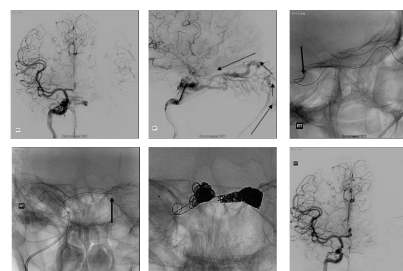
### Indirect CCF

Of the 56 patients with indirect CCF, 46 were successfully treated using endovascular techniques (82%), with transvenous embolization as first-line treatment. The overall morbidity was 8% and mortality was 0%. Venous approaches included transfemoral access via the inferior petrosal sinus or facial vein, as well as cutdown or percutaneous access to the ophthalmic veins. Of the treated patients, 11 (24%) exhibited residual fistula following initial treatment, with 10 (22%) exhibiting residual on angiographic follow-up angiogram.

Table 3: Indirect CCF

iCCF (n=56)	Overall	%
Patients Treated	46	82
Mean Treatment Sessions	1.4	
Transarterial	6	13
Transvenous	36	78
Combined	4	9

### iCCF: Transfemoral Facial Vein



77 yo male with several weeks of conjunctival injection/diplopia, ophthalmoparesis

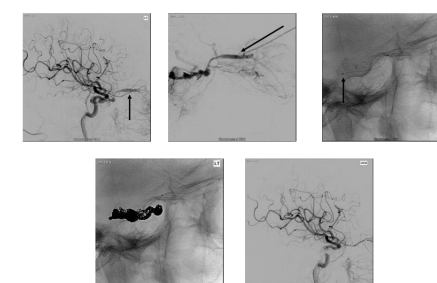
## Conclusions

Advances in endovascular technology have inspired an evolution in the treatment of CCF. For direct CCF, coil embolization with adjunctive stent/balloon assistance has evolved as first-line treatment. For indirect CCF, improvements in venous access have facilitated treatment of lesions with restricted venous outflow.

## Learning Objectives

By the conclusion of this session, participants should be able to: 1) Understand the anatomy and pathogenesis of both direct and indirect CCFs, 2) Describe the current options for endovascular treatment of each of these classes of fistula, and 3) Appreciate how advances in endovascular techniques have led to an evolution in treatment of CCF.

### iCCF: Percutaneous Puncture SOV



80 yo female with two weeks of proptosis/chemosis.