

---

## Endovascular Management of Intracranial Dural Arteriovenous Fistula

Department of Diagnostic Radiology, Yonsei University College of Medicine

Dong Ik Kim, M.D.

(Korean Journal of Stroke 2004;6(1): 16~25)

---

DAVF) (dural arteriovenous fistula; (sponta  
(dura mater) neous or indirect CCF) , 가  
(shunt)

(natural history) [1].  
[1-5].

(dural sinus)  
(meningeal artery)  
(dural sinus)

1. (dural arteriovenous malforma- (perimedullary)  
tion)

2.  
1)  
(cavernous sinus)

(carotid cavernous fistula; CCF) [6-9].

[9], [10], [6].

134

TEL : 82-2-361-5842  
FAX : 82-2-393-3035  
E-mail : dikim@yumc.yonsei.ac.kr

coagulopathy

가

2) (angiogenesis)

[1].  
(neovenular channel)

Uranishi [11] basic fibroblast growth factor (bFGF), vascular endothelial growth factor (VEGF) angiogenetic growth factor 가

3. (classification)

가

1978 Djindjian, Borden[12] Cognard[13]

Davies [14]  
Cognard Borden (Table 1)

4. (Natural History)

Davies [14,15]

[13,16,17]. Davies

102	91%	33
가	가	55
23		
86%		81%

[14].

가	118	
가	6.9%	6.9%
10.4%		[15].

Duffau

가	35%	2
		[18].
		가

가

[19].

가

[18].

가

[20,21].

가

가

**Table 1.** Borden classification of dural AVF (1995)

1. Venous drainage directly into dural venous sinus or meningeal vein
2. Venous drainage into dural venous sinus with cortical venous reflux (CVR)
3. Venous drainage directly into subarachnoid veins (CVR only)

5.

(conjunctival injection)  
 (proptosis),  
 bruit,  
 papilledema  
 (Fig. 1),

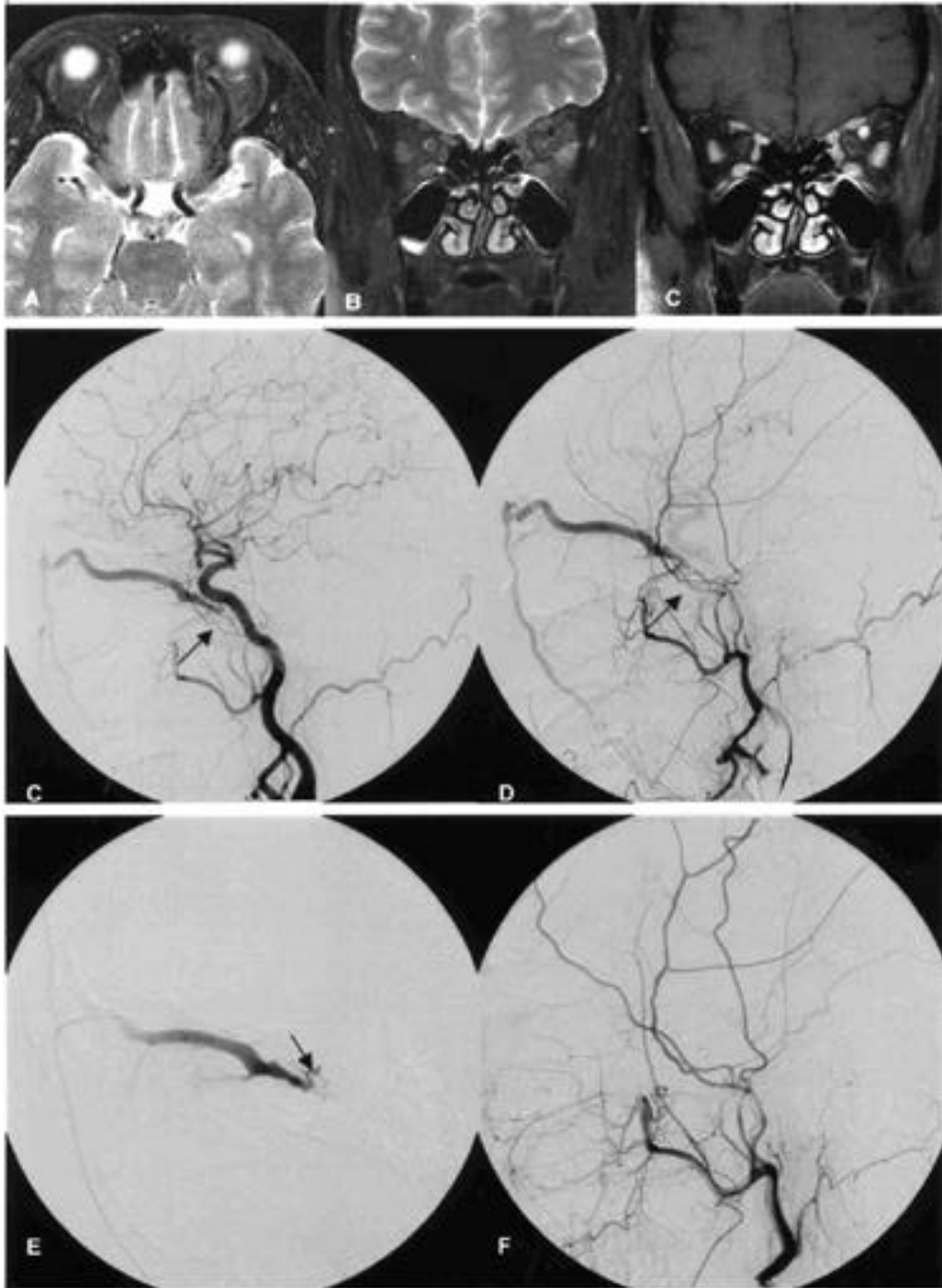


Figure 1. A-C. 39  
 C-F. (C) (D) ( )가  
 (A), coil (E, ) , (F).

5) (central retinal vein) 35 ~ 42% [4,13], 가

2) objective bruit turbulent flow 40% [22]. (Fig 2. C-F).  
bruit bruit

3) (cavernoma) (Fig. 3) 8.1% [24], 가 2 가 . (Fig. 2) 가 )

arterial steal 가 [22]. 가

ischemia) (venous 6. 1) 가 CT , CT 가 MRI가 MRI가 가 nidus CT MRI 가 가 [23]. 2) 가 가 (Fig. 3). 가 (transverse sinus) 가 torcula [23].

가 . 가

가 ,

(Fig. 1).

sylvian

(Fig

2, 3).

가 ,

가

가

가

가

가

(Fig. 2).

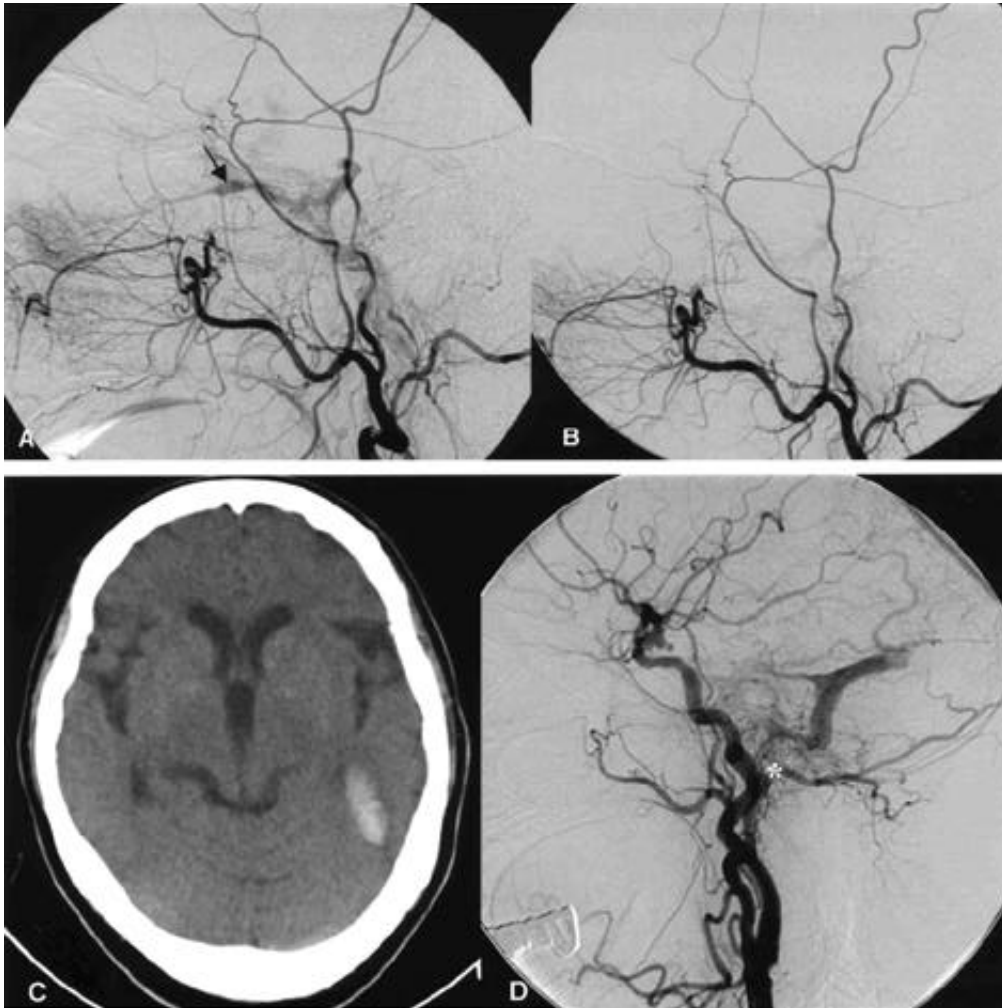


Figure 2. A-B.

가

(A),

sigmoid sinus

69

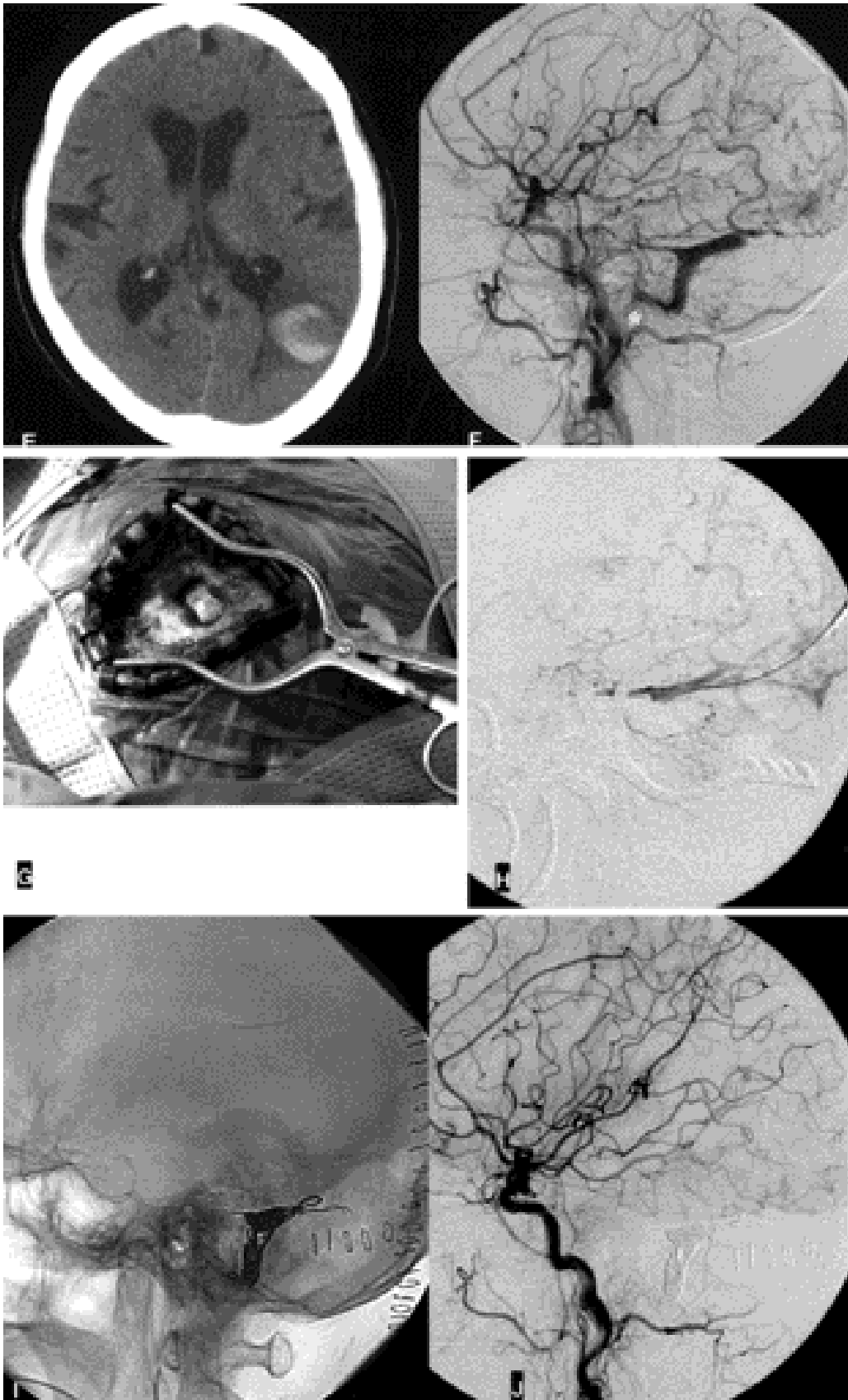
(B). C-D. 1 6

가

(D).

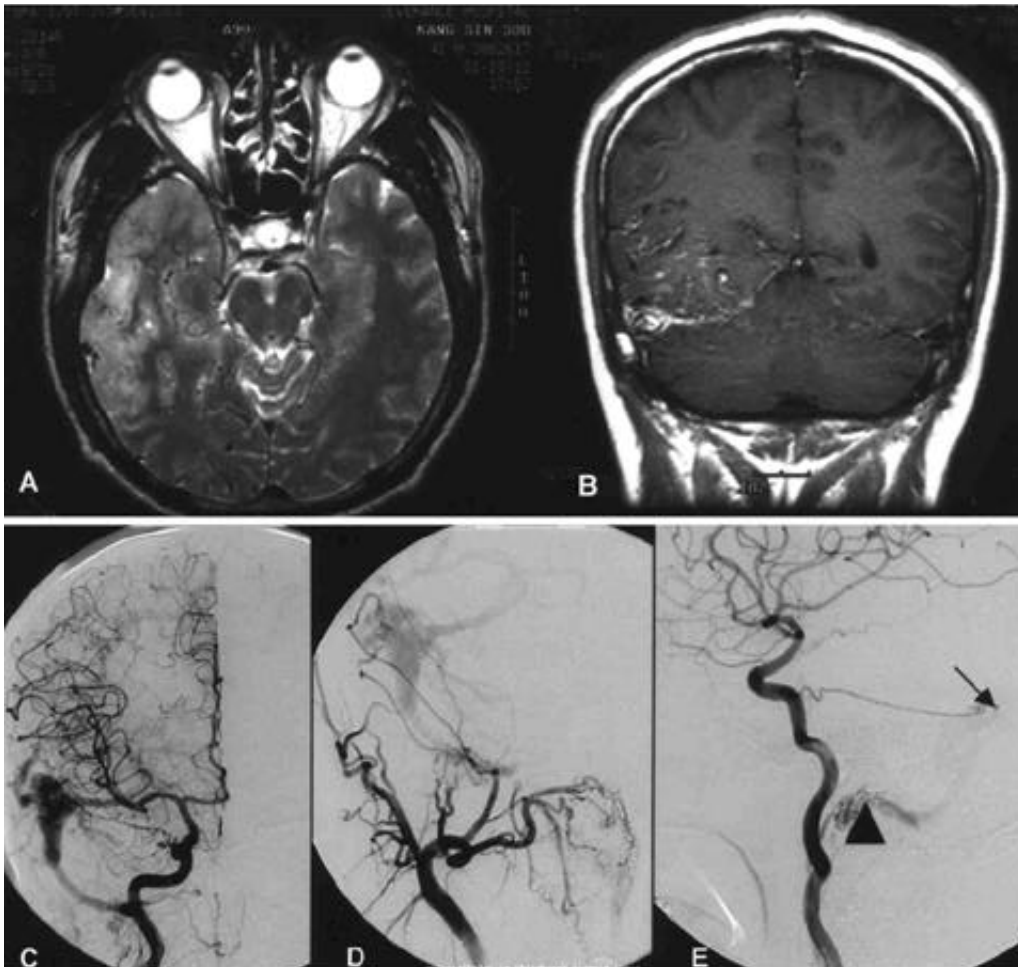
CT(C)

vein of Labbe



**Figure 2. E-J.** 3 sigmoid sinus (E), burr-hole (G), (H), coil (I), (J).

3) , 가  
 (1) ( ) 가  
 (2) 가  
 polyvinyl alcohol  
 (PVA) N-butyl 2-cyanoacrylate (NBCA) 가  
 가  
 가 skeletonization 가  
 NBCA , aqueous  
 가 diamox, mannitol lasix 가



**Figure 3. A-B.** dementia 42 edema (A) venous engorgement (B)가 . C-E. (C, E) (D) , sigmoid sinus ( ) trans-verse sinus( ) 가 (E), vein of Labbe (C, D).

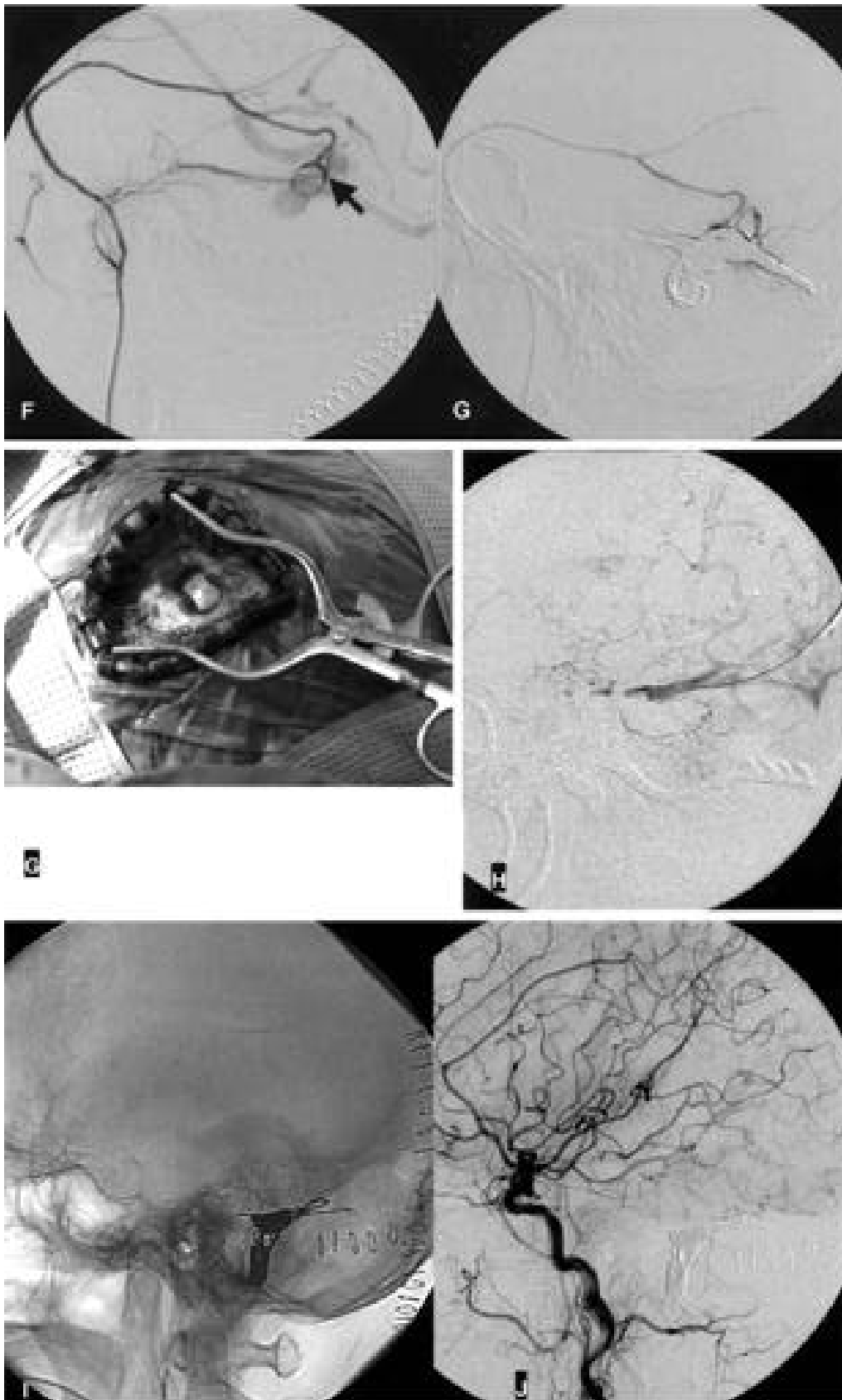


Figure 3. F-G. (F) transverse sinus ( ) , (G) cross sigmoid transverse sinus coil (H, I), 1 (J). H-J. edema , .



(3) 가 stereotaxic radiosurgery가 [31].

가

7.

가

가 guidewire 가 가

가

4 ~ 33%, 0 ~ 4% (4)

4 ~ 5%, [25, 26].

가 가 가

70-88% [25, 26].

가 가 가

4) 가 가 가

가 가 가 (Fig. 2), [4,12,27-30].

skeletonization

20 가

가 15% 가

REFERENCES

1. A. Berenstein, P. Lasjaunias and K.G. ter Brugge, Dural arteriovenous shunts. Surgical neuroangiography II, Springer Verlag, Berlin 2003.
2. P. Lasjaunias, Angioarchitecture and natural history of dural arteriovenous shunts. *Intervent. Neuroradiol* 1997;3;313-317.
3. M.A. Davies, J. Saleh, K.G. ter Brugge, R. Willinsky and M.C. Wallace, The natural history and management of intracranial dural arteriovenous fistulae. Part I: benign lesions. *Intervent. Neuroradiol* 1997;3;295-302.
4. M.A. Davies, K.G. ter Brugge, R. Willinsky and M.C. Wallace, The natural history and management of intracranial dural arteriovenous fistulae. Part II: aggressive lesions. *Intervent. Neuroradiol* 1997;3;303-311.
5. M. VanDijk, K. ter Brugge, R.A. Willinsky and C. Wallace, The clinical course of cranial dural AV-fistulas with long-term persistent cortical venous reflux. *Stroke* 2002;33;1233-1236.
6. R. Djindjian and J.J. Merland. *Superselective arteriography of the external carotid artery*, Springer, Berlin/Heidelberg/New York (1978).
7. O.W. Houser, H.L. Baker, A.L. Rhoton and H.

- Okazaki, Intracranial dural arteriovenous malformations. *Radiology* 1972;1105;55-64.
8. M.Y. Chaudhary, V.P. Sachved, S.H. Cho, I. Weitzner, S. Puljic and Y.P. Huang, Dural arteriovenous malformation of the major venous sinuses: an acquired lesion. *Am. J Neuroradiol* 1982;3;3-19.
  9. A. Watanabe, Y. Takahara, Y. Ibuchi and K. Mizukami, Two cases of dural arteriovenous malformation occurring after intracranial surgery. *Neuroradiology* 1984;26;375-380.
  10. S. Bitoh, H. Hasegawa, M. Fujiwara and M. Nakata, Traumatic arteriovenous fistula between the middle meningeal artery and cortical vein. *Surg. Neurol.*1980: 14;355-358.
  11. R. Uranishi, H. Nakase and T. Sakaki, Expression of angiogenic growth factors in dural arteriovenous fistula. *J Neurosurg* 1999;91;781-786.
  12. J. Borden, J.K. Wu and W. Shucart, A proposed classification for spinal and cranial dural arteriovenous fistulous malformations and implications for treatment. *J Neurosurg* 1995;82;166-179.
  13. C. Cognard, Y.P. Gobin, L. Pierot, A.L. Bailly, E. Houdart, A. Casasco, J. Chiras and J.J. Merland, Cerebral dural arteriovenous fistulas: clinical and angiographic correlation with a revised classification of venous drainage. *Radiology* 1995;194;671-680.
  14. M.A. Davies, J. Saleh, K.G. ter Brugge, R. Willinsky and M.C. Wallace, The natural history and management of intracranial dural arteriovenous fistulae. Part I: benign lesions. *Intervent. Neuroradiol* 1997;3;295-302.
  15. M.A. Davies, K.G. ter Brugge, R. Willinsky and M.C. Wallace, The natural history and management of intracranial dural arteriovenous fistulae. Part II: aggressive lesions. *Intervent. Neuroradiol* 1997;3;303-311.
  16. M. Femand, D. Reizine, J.P. Melki, M.C. Riche and J.J. Merland, Long term follow-up of 43 pure dural arteriovenous fistulae (AVF) of the lateral sinus. *Neuroradiology* 1987;29;348-353.
  17. I. Awad, J. Little, W.P. Akrawi and J. Ahl, Intracranial dural arteriovenous malformations: factors predisposing to an aggressive neurological course. *J Neurosurg* 1990;72;839-850.
  18. H. Duffau, M. Lopes, V. Janosevic, J.P. Sichez, T. Faillot, L. Capelle, M. Ismail, A. Bitar, F. Arthus and D. Fohanno, Early rebleeding from intracranial dural arteriovenous fistulas. *J Neurosurg* 1999;90;78-84.
  19. C. Cognard, E. Houdart, A. Casasco, J. Gabrillargues, J. Chiras and J.J. Merland, Long-term changes in intracranial dural arteriovenous fistulae leading to worsening in the type of venous drainage. *Neuroradiology* 1997;39;59-66.
  20. J Satomi, M vanDijk, K ter Brugge, RA Willinsky and C. Wallace, Benign cranial dural arteriovenous fistulas: natural history and proposed management. *J Neurosurg* 2002;97;767-770.
  21. P.S. Olutola, M. Eliam, M. Molot and A. Talalla, Spontaneous regression of a dural arteriovenous malformation. *Neurosurgery* 1983;12;687-690.
  22. P. Lasjaunias, C. Ming, K. ter Brugge, A. Tolia, M. Hurth and M. Bernstein, Neurological manifestations of intracranial dural arteriovenous malformations. *J Neurosurg* 1986;64;724-730.
  23. R. Willinsky, M. Goyal, K. ter Brugge and W. Montanera, Tortuous, engorged pial veins in intracranial dural arteriovenous fistulas: correlations with presentation, location and MR findings in 122 patients. *Am. J Neuroradiol* 1999;20;1031-1032.
  24. M. VanDijk, K. ter Brugge, R.A. Willinsky and C. Wallace, Multiplicity of dural arteriovenous fistulas. *J Neurosurg* 2002;96;76-78.
  25. F. Urtasun, A. Biondi, A. Casaco, E. Houdart, N. Caputo, A. Aymard and J.J. Merland, Cerebral dural arteriovenous fistulas: percutaneous transvenous embolization. *Radiology* 1996;199;209-217.
  26. D. Roy and J. Raymond, The role of transvenous embolization in the treatment of intracranial dural arteriovenous fistulas. *Neurosurgery* 1997;40;1133-1144.
  27. G.M. Malik, J.E. Pearce, J.L. Ausman and B. Mehta, Dural arteriovenous malformations and intracranial hemorrhage. *Neurosurgery* 1984;15;332-339.
  28. T.M. Sundt and D.G. Piepgras, The surgical approach to arteriovenous malformations of the lateral and sigmoid aural sinuses. *J Neurosurg* 1983;59;32-39.
  29. C. Lucas, J. Zabramski, R. Spetzler and R. Jacobowitz, Treatment of intracranial dural arteriovenous malformations: a meta-analysis from the English language literature. *Neurosurgery* 1997;40;1119-1132.
  30. M. Collice, G. D 'Aliberti, O. Arena, C. Solaini, R. Fontana and G. Talamonti, Surgical treatment of intracranial dural arteriovenous fistulae: role of venous drainage. *Neurosurgery* 2000;47;56-67.
  31. W.Y. Guo, D.H.C. Pan, H.M. Wu, W.Y. Chung, C.Y. Shiau, L.W. Wang, H.J. Chiou, M.Y. Yen and M.M.H. Teng, Radiosurgery as a treatment alternative for dural arteriovenous fistulas of the cavernous sinus. *Am. J. Neuroradiol.* 1998;19;1081-1087.