Delayed migration due to shortening of the lower part of AFX endograft's main body in angled fusiform abdominal aortic aneurysm

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ABSTRACT

We encountered two fusiform abdominal aortic aneurysm cases with delayed AFX endograft (Endologix Inc) migration >4 years after placement. These cases showed shortening and slight angulation of the main body in the anteroposterior direction. We speculate that the potential mechanism relates to the AFX portion that is easily shortened at the bifurcation of its stent structure. This portion might contribute to delayed migration after slight angulation of the main body. Preoperative three-dimensional computed tomography should be performed from the anteroposterior and lateral views. Although the AFX is useful for narrow bifurcations, one should consider the patient's anatomy before deciding to use an AFX endograft. (J Vasc Surg Cases Innov Tech 2023;9:101311.)

Keywords: Abdominal aortic aneurysm; Delayed migration; Endoleak; Prosthetic graft; Stent structure

The Endologix AFX (Endologix, Inc) endovascular abdominal aortic aneurysm (AAA) graft systems have a unique unibody structure suitable for narrow aortic bifurcations in AAAs.[1] However, since 2017, the Food and Drug Administration has issued several safety warnings against its routine use for AAA treatment because of type III endoleaks (last updated: May 17, 2023).[2,3] We only use the AFX for almost straight AAAs with narrow bifurcations on the anteroposterior view and carefully follow-up the patients.

The AFX has a potential drawback of main body shortening because of its specific structure. The stent structure of the AFX is made of a cobalt-chromium alloy. The AFX prosthetic graft is composed of expanded polytetrafluoroethylene (ePTFE). Fixation of the outer prosthetic graft to the inner stent structure is limited at the proximal and distal ends by sutures; thus, most ePTFE grafts of the AFX main body can easily expand outward. This expansion can cause "active proximal sealing."[1,4] However, it can also generate a force that shortens the main body of the AFX. To counteract this possible drawback, the length of the stent structure should be maintained by complete fixation of all stents.

Several studies have reported the long-term outcomes compared with other non-unibody devices.[5-9] The Strata material of the ePTFE graft has a potential risk of type IIIb endoleaks; thus, it was changed to Duraply in 2014. Although the cause of adverse outcomes with the AFX is still unknown, two studies reported that large (>60 or >65 mm) AAAs tended to cause sideways displacement, producing type IIIa endoleaks.[10,11]

Although the postoperative state had been uneventful until 3 to 4 years later, we encountered two cases of delayed migration of an AFX endograft 4 and 5 years after installation. The patients provided written informed consent for the report of their case details and imaging studies and archiving of their medical records. Furthermore, we hypothesized that the specific structure of the AFX could be a potential cause of delayed migration.

CASE REPORT

Patient 1. A 68-year-old female patient underwent endovascular aortic repair (EVAR) using the main body of an AFX endograft with Duraply without an aortic cuff for a fusiform AAA with a narrow aortic bifurcation in 2017. The postoperative course was uneventful for 4 years, and the minimum AAA diameter gradually reduced. However, we noted a gradual downward migration of the main body of the AFX. Dislodging of the AFX main body from the neck was detected at the 5-year follow-up visit in 2022. The main body's length had decreased from 10.96 cm to 9.64 cm (−1.32 cm; Fig 1), causing a type Ia endoleak and recurrent AAA enlargement. Thus, we performed urgent repeat EVAR using the Endurant aorto-uni-iliac stent graft (Medtronic) and femorofemoral bypass (Fig 2). Her postoperative course was uneventful.

Patient 2. An 84-year-old male patient underwent EVAR using the main body of an AFX 2 with an aortic cuff for a fusiform AAA with a narrow aortic bifurcation in 2018. The postoperative course was uneventful, and follow-up computed tomography showed no endoleaks for >3 years. However, slipping of the main body of the AFX from the aortic cuff was detected at the 4-year follow-up visit in 2022. The main body length of the AFX

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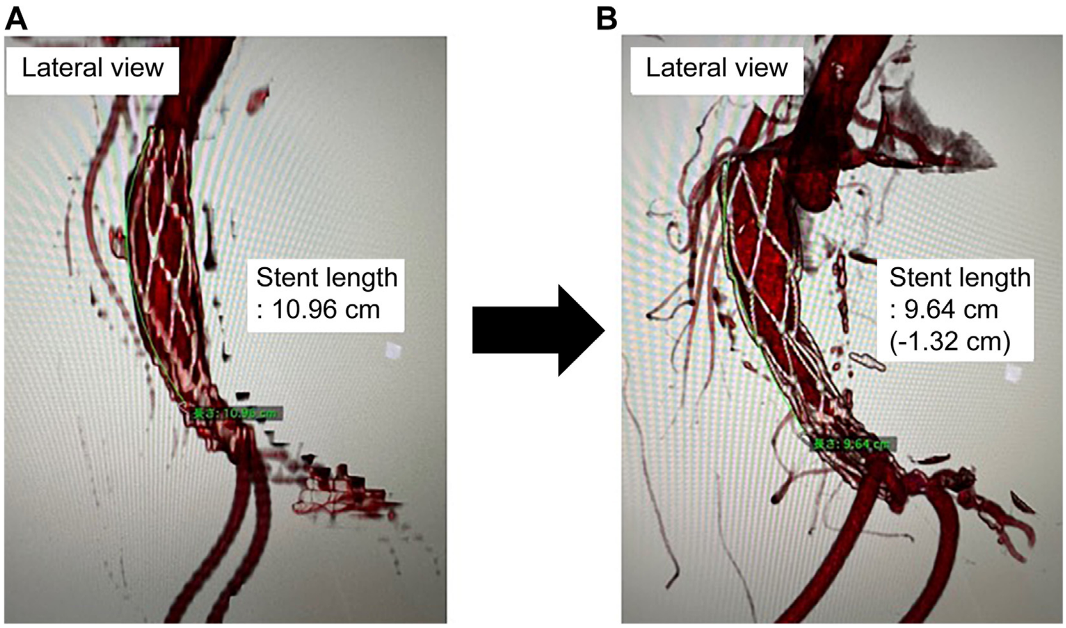

Fig 1. Three-dimensional computed tomography lateral view of patient 1. **A,** Postoperative day 3. **B,** Five years later.

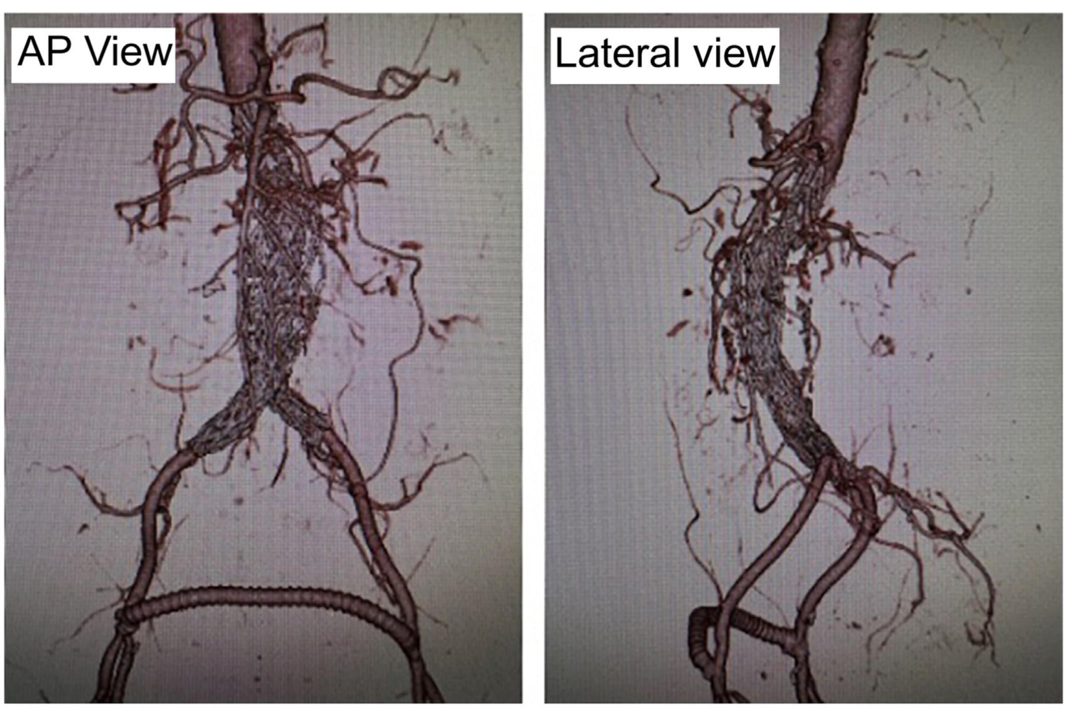

Fig 2. Postoperative three-dimensional computed tomography image of patient 1 after repeat endovascular aortic repair (EVAR). *AP,* Anteroposterior.

had decreased from 7.5 cm to 6.2 cm (−1.3 cm), and the main body had moved slightly forward. The aortic cuff remained in the same position (Fig 3). The length between the cuff's proximal edge and bifurcation had increased (+2.42 cm). The overlap between the main body and the cuff was extremely reduced (−3 cm), and a type IIIa endoleak was detected. Thus, we performed urgent repeat EVAR, similar to that for patient 1. His postoperative course was uneventful.

DISCUSSION

Between 2010 and 2022, we encountered 52 cases of AFX used for AAAs at our institute. The AAA morphologies

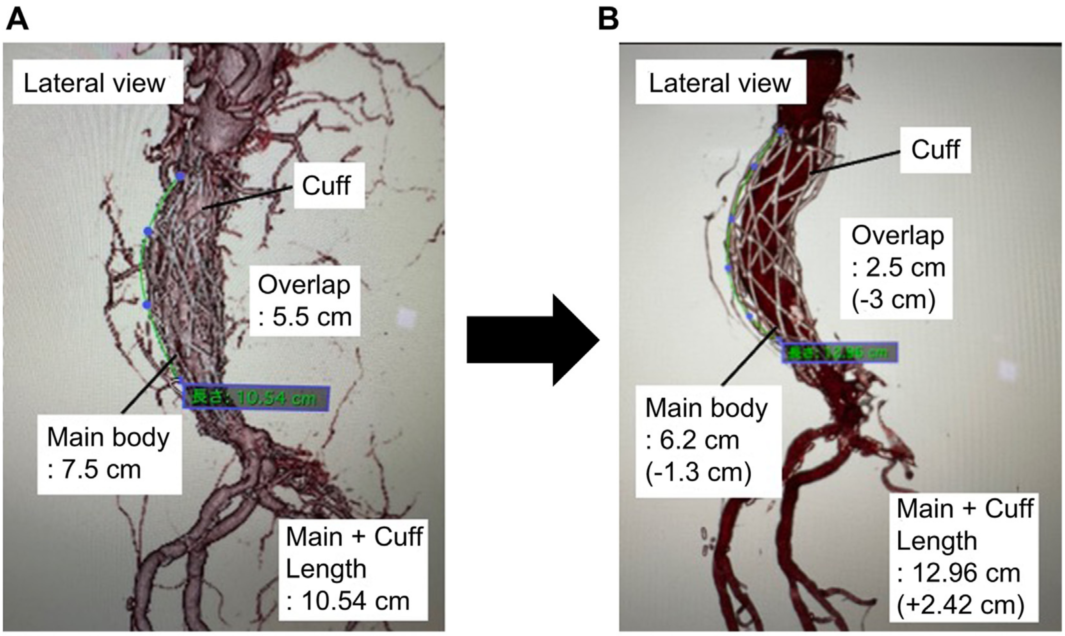

Fig 3. Three-dimensional computed tomography lateral view of patient 2. **A,** Postoperative day 3. **B,** Four years later.

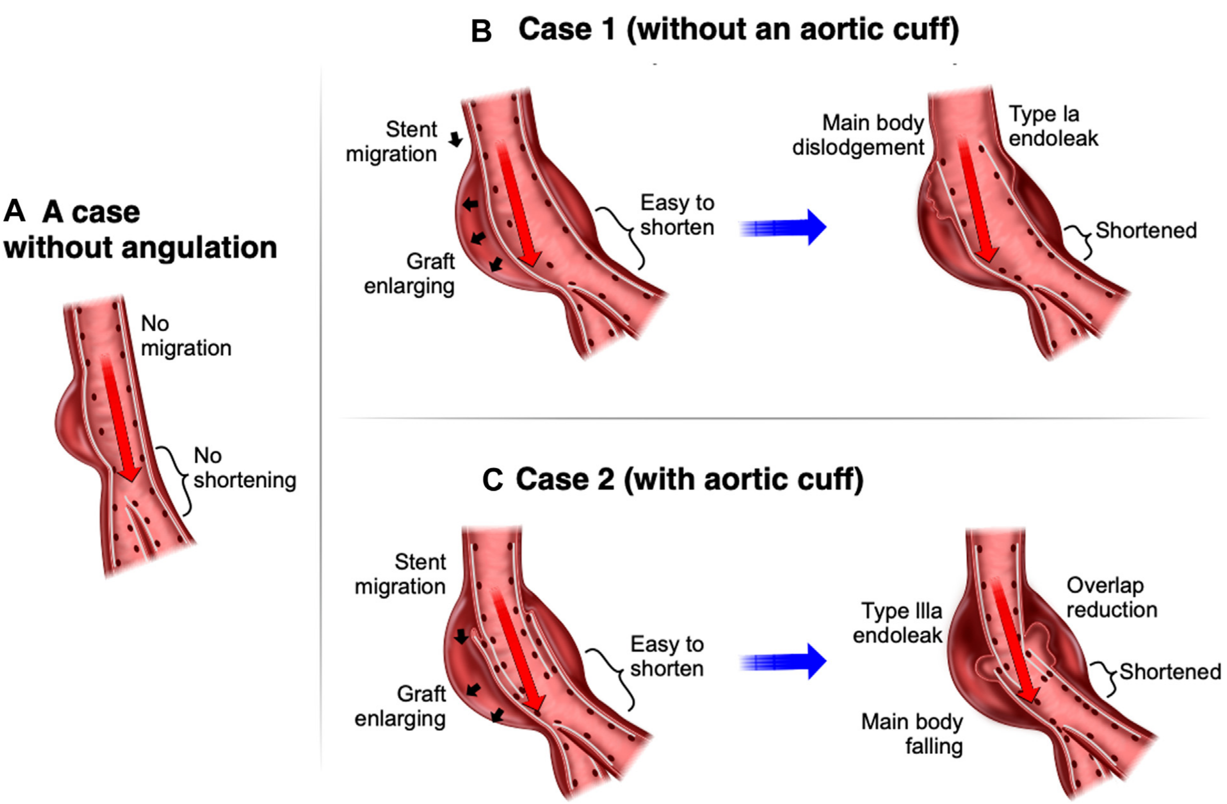

Fig 4. Potential mechanisms of delayed AFX migration in abdominal aortic aneurysms (AAAs). **A,** A case without angulation. **B,** Patient 1 (without an aortic cuff). **C,** Patient 2 (with an aortic cuff). *Black dots* indicate stent structures; *white line,* expanded polytetrafluoroethylene (ePTFE) graft; and *red arrows,* blood flow direction.

were fusiform for 36, saccular-shaped for 12, and local dissection or pseudoaneurysm for 4. The delayed migration rate was 5.6% (2 of 36) for the fusiform AAAs and 0% (0 of 16) for the saccular-shaped AAAs, local dissections, and pseudoaneurysms. Furthermore, we investigated the morphologic differences between the cases of delayed migration and no migration of fusiform AAAs.

We focused on the shape of the main body of the AFX after its placement. In the cases without migration, the main body was almost straight. In contrast, in the cases with delayed migration, it was angulated by >30° in the anteroposterior direction. The neck angulation was not associated with delayed migration. Three cases had neck angulation >30°. However, these cases showed no migration, and the main body was almost straight. We hypothesized that the slight angulation of the main body in the anteroposterior direction in the fusiform AAAs is important for delayed migration. A large fusiform AAA (>60 or >65 mm) that provides space for migration could also play a vital role, as previously reported.[10,11] Saccular or locally dissected AAAs with no movement space showed no migration in our series and might be more suitable for AFX use.

We obtained a stent structure without a prosthetic graft from Endologix. The stent's main body between the upper first and fourth sections was fixed together; thus, the upper and middle parts of the main body could not be shortened. However, the fourth portion and the portions for the bilateral common iliac arteries were not fixed because of hip joint movement; thus, the lower part of the main body could easily shorten (Supplementary Video, online only). The degree of this shortening could change depending on the patient's anatomy or stent structure variations. We speculate that this portion might have played a pivotal role in the shortening of the main body of the AFX, as observed in our migration cases.

Another important factor was the blood flow direction. If the main body is straight, the blood flow could directly hit the bifurcation of the AFX, causing minimal prosthetic graft dilatation. Therefore, shortening of the main body might not have occurred. However, if the main body is slightly angulated in the anteroposterior direction, the blood could flow into the lower part of the anterior wall of the main body, causing local dilation of the prosthetic graft. This pulsatile local dilatation of the graft could cause main body shortening and delayed migration or, in the worst case, the complete closure or collapse of the stent because its lower part can easily shorten owing to the specific stent structure, as stated. A similar phenomenon was observed even with placement of an aortic cuff. Fig 4 shows the potential mechanisms underlying the delayed migration of AFX.

This flexible portion of the AFX structure is not present in other non-unibody EVAR devices. This distinctive phenomenon might be one of the mechanisms that worsens the long-term outcomes with the AFX endograft. Furthermore, both the anteroposterior and the lateral views should be reviewed during preoperative EVAR planning. If a slight angulation of the main body of the AFX is predicted preoperatively, the use of the AFX should be avoided.

CONCLUSIONS

We encountered two cases of delayed AFX migration due to main body shortening. The flexible lower part of the stent's main body and the force of the blood flow that hits the lower anterior wall could have played pivotal roles in the delayed migration. If a slight angulation of the main body of the AFX is predicted preoperatively in the anteroposterior direction, AFX use should be avoided. Although the AFX endograft is useful for narrow bifurcations, its use should be carefully considered according to the patient's anatomy.

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DISCLOSURES

None.

REFERENCES

1. Diethrich EB. Novel sealing concept in the endologix AFX unibody stent-graft. J Cardiovasc Surg 2014;55:93-102.
2. US Food and Drug Administration. Type III endoleaks associated with endovascular graft systems — letters to health care providers, https://public4.pagefreezer.com/content/FDA/16-06-2022T13:39/https://www.fda.gov/medical-devices/letters-health-care-providers/type-iii-endoleaks-associated-endovascular-graft-systems-letter-health-care-providers. Date issued. Accessed September 28, 2017.
3. US Food and Drug Administration. Update on Endologix AFX endovascular AAA graft systems and risk of type III endoleak: FDA safety communication, https://www.fda.gov/medical-devices/safety-communications/update-endologix-afx-endovascular-aaa-graft-systems-and-risk-type-iii-endoleak-fda-safety. Date issued. Accessed May 17, 2023.
4. Melas N, Stavridis K, Saratzis A, Lazarides J, Gitas C, Saratzis N. Active proximal sealing in the endovascular repair of abdominal aortic aneurysms: early results with a new stent-graft. J Endovasc Therapy 2015;22:174-8.
5. Goodney P, Mao J, Columbo J, et al. Use of linked registry claims data for long term surveillance of devices after endovascular abdominal aortic aneurysm repair: observational surveillance study. BMJ 2022;379:e071452.
6. Kwolek CJ, Ouriel K, Stucky FS, Pons PJ, Wilson SE, Kujath SW. Five-year results of the LEOPARD trial of commercially available endografts. J Vasc Surg 2023;78:324-32.e2.
7. Prentice HA, Paxton EW, Harris JE, et al. Risk for surgical interventions following endovascular aneurysm repair with endologix AFX or AFX2 endovascular AAA systems compared with other devices. J Vasc Surg 2023;78:333-43.e4.
8. Secemsky EA, Song Y, Sun T, et al. Comparison of unibody and non-unibody endografts for abdominal aortic aneurysm repair in Medicare beneficiaries: the SAFE-AAA study. Circulation 2023;147:1264-76.
9. Hoshina K, Suhara M, Miyahara K, et al. Midterm outcomes of AFX2 endografts used in combination with aortic cuffs. J Vasc Surg 2023;77:424-31.
10. İşcan HZ, Karahan M, Akkaya BB, et al. Long-term results of endovascular intervention with unibody bifurcation endograft for elective abdominal aortic aneurysm management. Rev Cardiovasc Med 2021;22:453-9.
11. Lemmon GW, Motaganahalli RL, Chang T, et al. Failure mode analysis of the Endologix endograft. J Vasc Surg 2016;64:571-6.

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