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Irretrievable unraveled coil remaining in the vascular lumen between the cerebral aneurysm and puncture site

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●Abstract●

Objective: Unraveled coils can be removed during cerebral aneurysm embolization. However, if the unraveled coil is engaged with other indwelling coils, its retrieval is sometimes difficult. We report 2 patients in whom unraveled coils were irretrievable, and were left in the vascular lumen between the aneurysm and the puncture site, rather than being forcibly retrieved.

Methods: We stretched the unraveled coil as much as possible in the parent artery, and withdrew the catheters. The unraveled coil remained in the vascular lumen between the aneurysm and the puncture site. The tail of the unraveled coil was cut and, making a small incision at the puncture site, the remaining part was buried with ligation in the subcutaneous tissue. Systemic heparinization and antiplatelet therapy were performed after the procedure.

Results: Neither patient experienced complications attributable to the unraveled coil in the vascular lumen. Coil compaction occurred in one patient who underwent further coil embolization. The residual unraveled coil was not affected by the procedure and remained stable in the vascular lumen.

Conclusion: We consider that leaving the unraveled coils in the vascular lumen is an acceptable alternative to forcible retrieval.

●Key Words●

cerebral aneurysm, endovascular treatment, unraveled coil

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Introduction

In the course of coil embolization of intracranial aneurysms, unraveling of the coil changes its structure from spiral to that of a core wire[8)]. Most unraveled coils can be retrieved by pulling back the delivery wire in the microcatheter. Alternatively, retrieval devices such as a snare wires are available[1,3,5,8-10)], but if the distal tip of the unraveled coil is entangled with other indwelling coils, retrieval may be difficult. Herein we report 2 patients whose unraveled coils were irretrievable, and were left in the vascular lumen between the aneurysm and the puncture site, instead of being forcible retrieved. We detail our manipulations and report post-procedure management of these patients.

Case Reports

1. Case 1

This 62-year-old woman presented with subarachnoid hemorrhage (Hunt and Hess grade 2). Diagnostic angiography revealed a right internal carotid-posterior communicating artery (IC-PC) aneurysm and the patient underwent coil embolization on onset day. Using the transfemoral approach, a guiding catheter was placed in the right internal carotid artery (ICA) and a microcatheter (Tracker Excel-14; Boston Scientific, Natick, MA, USA) was advanced into the aneurysm. Heparinized saline (10-20 IU/hour) was perfused through a guiding catheter and a microcatheter without systemic heparinization. GDC-18 2D (8.0 mm × 30 cm; Boston Scientific, Natick, MA, USA) framing coil was successfully deployed into the aneurysm, which was packed with GDCs of gradually decreasing size. The 6th coil (GDC-10 Soft, 4.0 mm

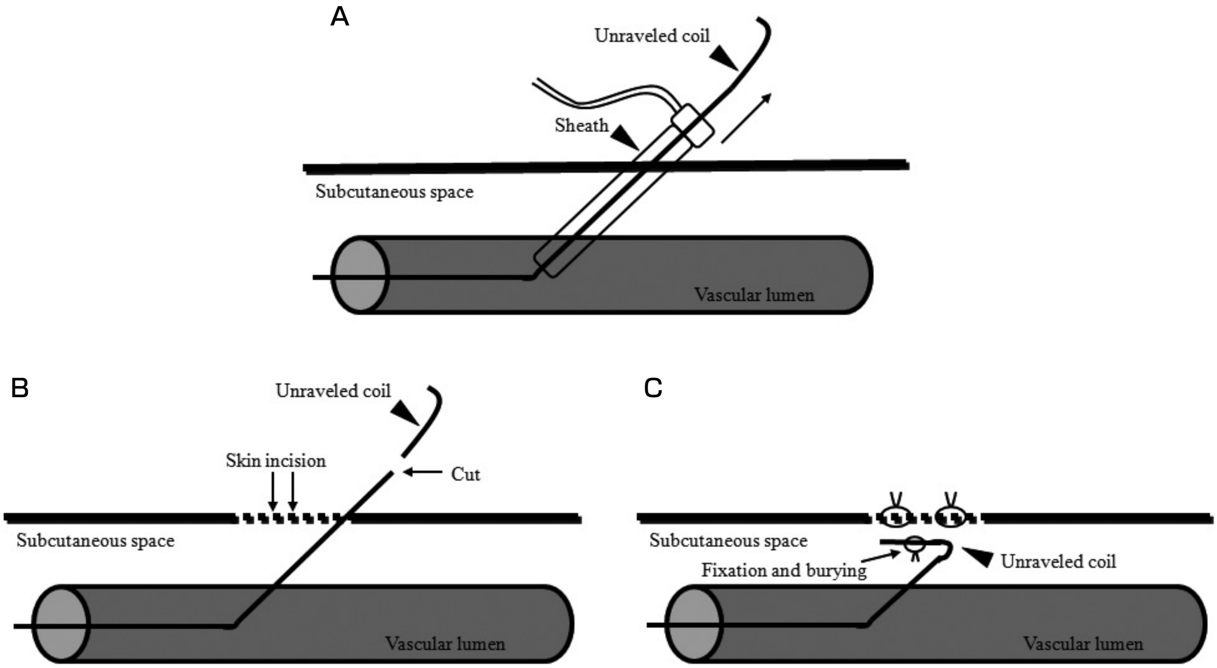

Fig. 1 Schematic representation of our procedure to address unraveled coils at the puncture site. The micro- and guiding catheters are removed under direct fluoroscopic observation and the unraveled coil is left in the vascular lumen (**A**). The unraveled coil is manually compressed, a small skin incision is made at the puncture site, and the portion of the coil protruding from the puncture site is cut (**B**: arrow). The tail of the unraveled coil is ligated to subcutaneous tissue and buried in the puncture site (**C**).

×8.0 cm) unraveled during positioning. At first we pulled back the delivery wire in an attempt to retrieve the unraveled GDC. However, the unraveled part extended as far as the proximal ICA and the distal tip of the coil could not be detached from other coils deployed in the aneurysm. Pulling back the unraveled coil with the microcatheter shifted the coil mass toward the ICA. We abandoned retrieval of the unraveled coil, and stretching it as much as possible in the femoral artery without cutting it. We then withdrew the catheters under direct fluoroscopic observation. After removal of the sheath, the unraveled GDC was left in the vascular lumen between the aneurysm and the puncture site. We applied manual compression, then cut the part of the coil protruding from the puncture site to a length of about 2.0 cm. The tail of the unraveled GDC was ligated to the subcutaneous tissue through a small skin incision and buried at the puncture site (**Fig. 1**). The patient awoke from general anesthesia without neurological deficits. Persistent systemic heparinization was performed for 72 hrs after the procedure; the activated clotting time (ACT) was maintained at 200-250 sec. In addition, the patient received aspirin (100mg/day) for 6 months starting from the postoperative day 1.

Post-operative computed tomography (CT) showed neither hemorrhagic nor thromboembolic complications. On skull radiographs obtained on the 3rd postoperative day, the unraveled coil in the vascular lumen showed no interval changes in configuration (**Fig. 2**). The patient was discharged without any deficits. CT and cerebral angiograms obtained 6 months later showed neither new ischemic lesions nor aneurysmal recanalization.

2. Case 2

This 69-year-old woman presented with oculomotor nerve palsy. Head MRA disclosed a left IC-PC aneurysm and she underwent coil embolization. As her aortic arch and common carotid artery were highly tortuous we chose direct left common carotid puncture rather than the transfemoral approach. Heparinized saline (10-20 IU/hour) was perfused through the catheters without systemic heparinization. GDC-18 2D (10 mm×30 cm) framing coil was successfully deployed and the aneurysm was packed with GDCs of gradually decreasing size. The 8th GDC-10 Soft coil (4.0 mm ×8.0 cm) failed to enter the aneurysm, unraveling during withdrawal. Its distal tip was entangled with the indwelling GDC mass and, during the retrieval attempt, became extended as far as the proximal ICA. Therefore, after removal of the guiding and microcatheters, the unraveled GDC was left in

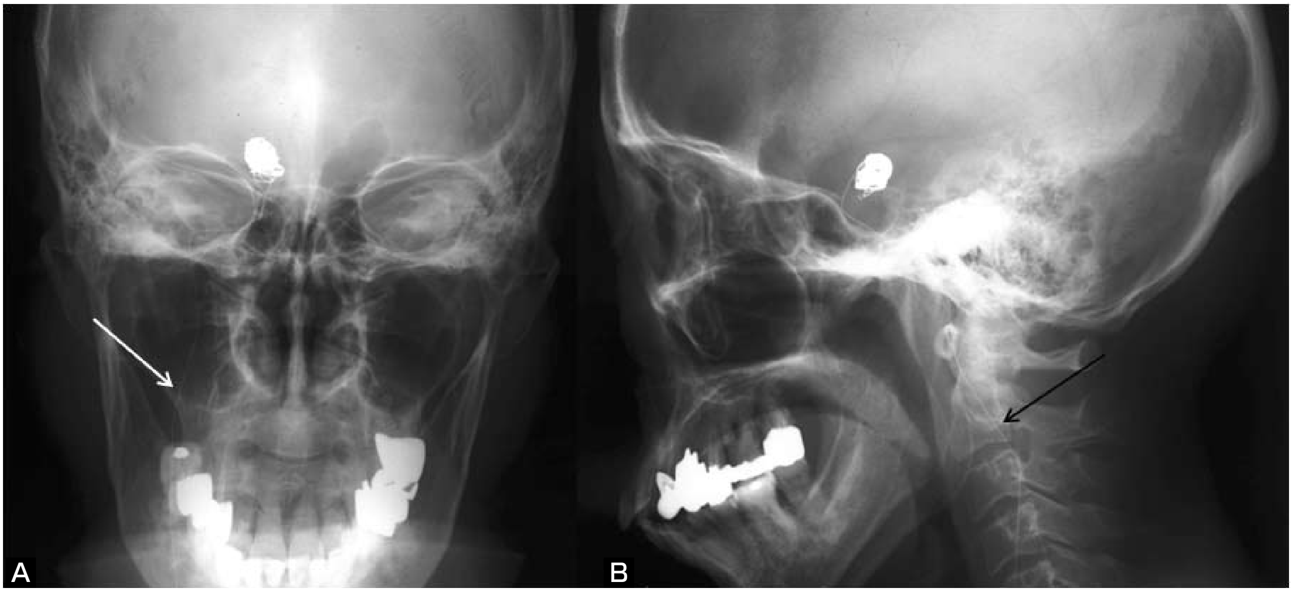

Fig. 2 Case 1
Skull radiographs (**A**: anterior-posterior view **B**: lateral view). The unraveled GDC is left in the right internal carotid artery (arrows).

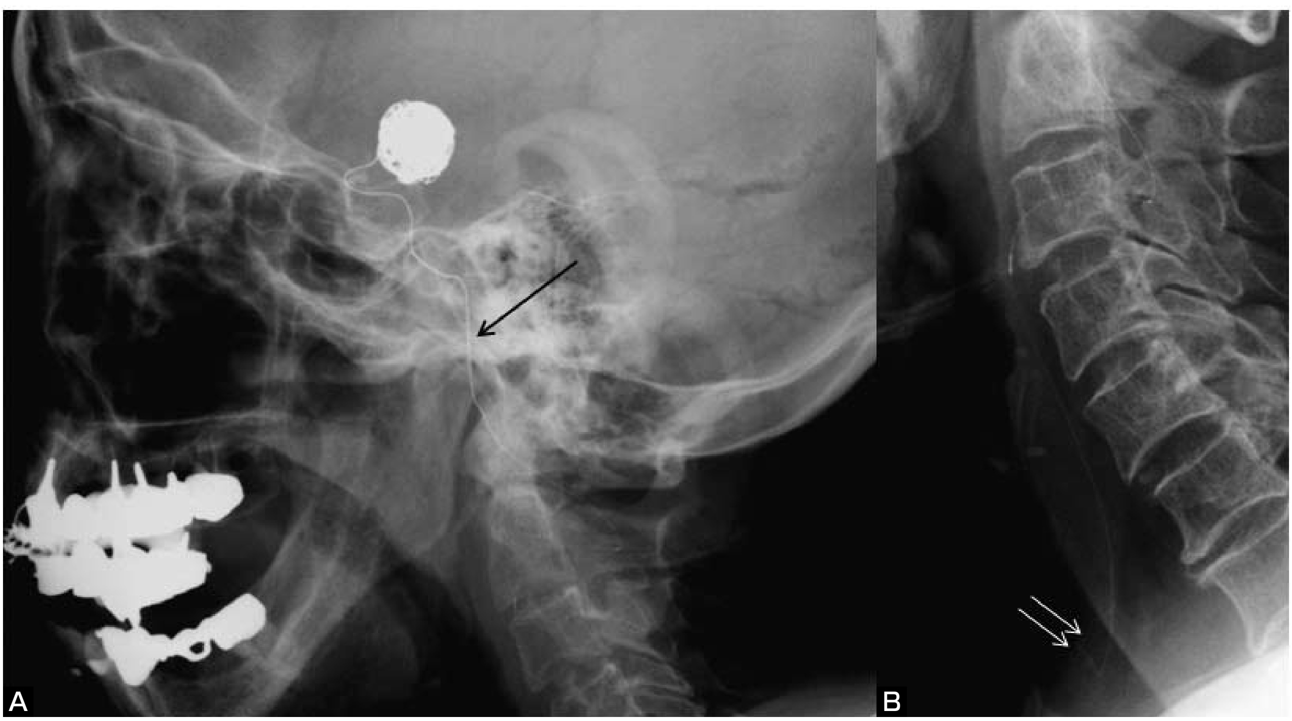

Fig. 3 Case 2
Skull (**A**) and cervical spine radiographs (**B**). The unraveled GDC is left in the left internal carotid artery (**A**: arrow). The tail of the cut GDC is buried with ligation to the subcutaneous space of the 7th cervical level (**B**: double arrows).

the vascular lumen between the aneurysm and the puncture site. After manual compression, its tail was cut and the residual coil portion was ligated to the subcutaneous space of the neck. Systemic heparinization (ACT 200-250 sec) and aspirin (100mg/day) were administered after the procedure. Skull radiographs on the 3rd postoperative day showed no changes in the GDC left between the aneurysm and the neck (**Fig. 3**). The patient was discharged without neurological deficits except for oculomotor paralysis, which improved in 3 months. However, as follow-up angiography performed 6 months post operation showed coil compaction in the aneurysm, the patient underwent further GDC embolization via the transcarotid approach. The unraveled GDC remained stable without shifting in the vascular lumen, and it did not affect the subsequent procedure.

Discussion

Coil unraveling or fracturing reportedly occurs in fewer than 2% of patients undergoing endovascular treatment for intracranial aneurysms[8]. Unraveled coils can be retrieved by pulling back the delivery wire or microcatheter, or by using a snare wire or other devices[1,3,5,8-10]. However, retrieval of unraveled coils may result in intimal injury or aneurysmal rupture[3]. Moreover, if the distal tip of the unraveled coil is entangled with an indwelling coil mass, forcible retrieval may shift the coil mass from the aneurysm to the parent artery. Alternatively, the unraveled coil may be detached in the parent artery. For our patients, we decided against forceful retrieval and left the coils in the vascular lumen between the aneurysm and the puncture site.

Various techniques were reported to manage stretched coils in the parent artery. In a patient undergoing endovascular treatment for a carotid cavernous fistula, Gupta et al[2] left an irretrievable coil in the arterial tree after cutting it at the level of the femoral sheath. Sedat et al[6] buried an unraveled coil in the subcutaneous part of the neck. They delivered anticoagulation and antiplatelet therapy after the procedure to prevent thromboembolic complications. We performed 72 hrs systemic heparinization and 6-month antiplatelet therapy after the procedure.

If a part of the unraveled coil remains in the parent artery it may be moved distally by the blood flow and become entangled in the parent artery, increasing the risk of thromboembolic complications. Therefore, we ligated the tail of the unraveled coil that protruded from the vascular lumen to the subcutaneous tissue and tethered it to prevent any bending. Post-operative skull radiographs showed no changes in the unraveled coils in the vascular lumen and neither patient experienced local pain or inflammation. In case 2, the unraveled coil in the parent artery remained stable inside the vascular lumen during the subsequent coil embolization procedure. Nakahara et al[4] reported that 1.8 Fr non-detachable balloon system, which was left in the parent artery, was covered by fibrous tissue during long-term anticoagulant therapy. The caliber of unraveled coil is less than 1.8 Fr system. We believe that unraveled coils left in the vascular lumen will be covered by endothelial cells proliferating during the administration of post-procedure medications.

Recently, coil unraveling has decreased owing to the development of a stretch resistant (SR) coil which provides safer endovascular treatment[7]. Should SR coil unraveling occur, it can be difficult to stretch the coil intentionally and the coil mass may come out of the parent artery. As an alternative solution, the use of an intracranial stent can be used to trap the unraveled coil in the parent artery.

Conclusion

The retrieval of coils that unravel during aneurysm embolization is sometimes difficult. However, we found that burying and tethering the proximal end of the coil in the subcutaneous space at the puncture site is an acceptable alternative rather than forceful retrieval of the coils. Post-procedure anticoagulation and antiplatelet therapy are necessary to prevent thromboembolic complications.

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