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# WovenEndoBridge embolization versus stent-assisted coiling for the treatment of unruptured wide-neck bifurcation intracranial aneurysms: a retrospective study

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## Abstract

**Introduction:** *Currently, endovascular coil embolization is the first line of treatment for intracranial aneurysms. Over the last decade, several new endovascular devices and techniques have been developed for wide neck aneuryms located at the bifurcation of cerebral arteries, with varying degrees of success.* **Objective:** *To compare the occlusion rates of unruptured wide-neck bifurcation intracranial aneurysms using WovenEndoBridge (WEB) device embolization versus stent-assisted coiling (SAC).* **Materials and methods:** *We performed a retrospective, longitudinal study that included adult patients treated at the National Institute of Neurology and Neurosurgery in Mexico City, between 2020 and 2022. Patients had been previously diagnosed with an unruptured saccular wide-neck bifurcation aneurysm and were assigned to either WEB embolization or SAC. Occlusion rate was assessed using imaging studies performed 90 days after the procedure was completed.* **Results**: *A total of 14 patients were included in the study. Six patients were treated with the WEB device, and eight patients were treated using SAC. No statistically significant differences were observed between the demographic characteristics of the groups. Median aspect/ratio was 1.45 (1.25-1.82) for the WEB group and 1.67 (1.166-2.11) for the SAC group, and bottleneck factor ratios were 1.35 (1.042.42) and 1.26 (1.17-1.77), respectively. Complete occlusion was observed in 6/6 patients for the WEB group and 6/8 patients for the SAC group (p = 0.308). No statistically significant differences were observed in the complication rates, 3-month modified Rankin score, and hospital length of stay between the groups.* **Conclusion:** *The WEB device is a novel treatment that carries the same safety and efficacy profile as SAC. However, more experience with the device is required to fully understand the capabilities of the WEB.*

**Keywords:** *Intracranial aneurysms. Endovascular treatment. Stent-assisted coiling. WovenEndobridge device. Wide-neck.*

## Introduction

Currently, endovascular coil embolization is the first line of treatment for ruptured and unruptured intracranial aneurysms, along with surgical clipping[1,2]. The use of slimmer, more flexible, and better-navigating catheters has led to an improvement in the treatment of aneurysms using endovascular coiling embolization[3-6]. Furthermore, the improvement of current imaging techniques has allowed for better measurements of

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aneurysm size and 3D conformation. The use of endovascular coil embolization is better suited for narrow-neck (< 4 mm) intracranial aneurysms or intracranial aneurysms with a dome-to-neck ratio < 2[7].

On the other hand, there are several cases where, due to the aneurysm location and morphology or the patient's clinical conditions, the patient might be better suited for a surgical approach treatment[8-13]. The study performed by Aydin et al. revealed that bifurcation aneurysms treated with stent-assisted coiling (SAC) using the T approach achieved a complete occlusion in 83.3% of the cases. Complications were observed in 13.7% of patients, of which 1.9% developed a lifelong disability and 1% died[14].

Over the last decade, several new endovascular devices and techniques have been developed for wide-neck aneurysms located at the bifurcation of cerebral arteries, with varying degrees of success[7]. The WovenEndoBridge (WEB) is the most common intrasaccular device currently used for unruptured wide-neck aneurysms in the anterior communicating artery (AComA), middle cerebral artery (MCA), internal carotid artery, and the tip of the basilar artery[12-15].

The WEB is a device built with nitinol threads and a platinum core suitable for aneurysm occlusion and flow diversion[15]. Literature shows that this device has an occlusion rate of 61-84.6%, a complication rate of 5.5-17%, and a mortality rate of 2%[16-19].

## Material and methods

### *Study design*

We conducted a retrospective, longitudinal, and analytical study between 2020 and 2022, involving adult patients diagnosed with unruptured intracranial wide-necked saccular aneurysms located at a bifurcation of the MCA and AComA, treated at the National Institute of Neurology and Neurosurgery. Exclusion criteria included prior treatment for the aneurysm and contraindications to dual antiplatelet therapy (DAPT).

Patients were evaluated by a multidisciplinary team and assigned to either the WEB device placement group or the SAC group based on specific criteria. The aneurysms considered for the WEB device placement had a height > 4 mm and < 4 mm for jailing. We also considered, alongside the experience of the endovascular therapist and the availability of institutional resources, particularly since the hospital is a government facility. All decisions made by the multidisciplinary team were in accordance with institutional guidelines.

Patients in both the WEB and SAC groups received DAPT for 10 days before the procedure, consisting of 325 mg of acetylsalicylic acid and 75 mg of clopidogrel once daily. All endovascular procedures were performed through transradial or transfemoral access. An 8 Fr distal access guide catheter was advanced to facilitate diagnostic digital subtraction angiography (DSA). Special projections measuring the aneurysm's size and characteristics, including 3D projections, were completed during the diagnostic DSA.

WEB devices were selected according to the recommended sizing guidelines provided by the manufacturer. The devices were advanced into the aneurysmal fundus using a vascular intervention access microcatheter and a microguide. Adequate device placement and changes in aneurysmal flow were confirmed using 2D projections before detaching the device.

For patients in the SAC group, the length and width of the compromised arteries were measured to select the appropriate stent size. Two microcatheters were advanced to the aneurysm site: the first microcatheter was placed distal to the aneurysm, whereas the second was positioned within the aneurysmal fundus. SAC was achieved by jailing the coils with the deployed stent. After the procedure, patients were instructed to continue DAPT for 6 months.

A cone-beam computed tomography scan was performed within the 1st month following the procedure, and DSA was conducted during the 3rd and 6th months. DSAs were obtained in a biplanar angio suite (Artis Siemens Health) using either a transradial or transfemoral approach. The DSAs were then evaluated by two experts in endovascular neurosurgery, measuring various characteristics of the treated aneurysms, including occlusion rate, height, length, neck, aspect ratio, bottleneck ratio, and the length and width of the compromised vessels and aortic arch.

Results from the web occlusion score were categorized into complete or incomplete occlusion. Patients treated with SAC were assessed using the Raymond–Roy Scale and were similarly classified into complete or incomplete occlusion.

Complications were defined as any neurological symptoms or signs of focalization that developed after the procedure or the absence of contrast passage through any major arterial vessel upon completion of the procedure.

Other outcomes analyzed during the study included hospital length of stay, mortality rate, modified Rankin score at the 3-and 6-month assessments, and intraprocedural and post-procedural complications.

### *Statistical analysis*

Results underwent descriptive statistical analysis. Variables with normal distribution were analyzed with mean and standard deviation, whereas variables without normal distribution were analyzed using median and interquartile ranges. Inferential statistics were carried out to assess statistical significance between the occlusion rates of the WEB device and SAC using the Fisher Exact Test, using $p < 0.05$ as significant. Statistical analysis was performed using the STATA software v16.1.

## Results

A total of 14 patients were included in the study. Six patients were treated with the WEB device (Fig. 1), whereas eight patients were treated with SAC (Fig. 2) from January 2020 to May 2022. Eight of the patients were male (57%). Whole patients and aneurysm characteristics are shown in table 1.

The most common aneurysm location was in the MCA bifurcation (eight cases: four in the WEB group and four in the SAC group), and the AComA (six cases: two in the WEB group and four in the SAC group).

Regarding safety and efficacy, 12 cases were completely occluded (87%). No fatalities were reported (0%). One complication involved the WEB device, which experienced partial migration during follow-up, leading to thrombosis of the parent vessel. The aneurysm was at the bifurcation of the MCA, and the partial migration caused thrombosis of the dorsal branch, resulting in motor deficits. The remaining cases had no complications. Table 2 includes outcomes of WEB devices and SAC-treated patients.

**Table 1.** Characteristics of patients treated with the WEB device and SAC

| Characteristics | WEB device (%) | SAC (%) | p |
|---|---|---|---|
| Patient characteristics | | | |
| Male sex | 5 (83) | 3 (37) | 0.12 |
| Age (years) | 61 (50-64) | 61 (60-63) | 0.59 |
| Hypertension | 3 (50) | 5 (62) | 0.52 |
| Tobacco use | 1 (16) | 2 (25) | 0.61 |
| Hyperlipidemia | 0 (0) | 1 (12) | 0.57 |
| Type 2 diabetes | 2 (33) | 2 (25) | 0.59 |
| Obesity | 1 (16) | 2 (25) | 0.62 |
| Alcohol consumption | 1 (16) | 1 (12) | 0.69 |
| Aneurysms characteristics | | | |
| Dome-neck | 6 (6-7) | 4.7 (2.5-6.2) | 0.243 |
| Width | 6 (5.1-7.5) | 3.8 (2.8-4.7) | 0.023 |
| Neck | 4.5 (3.3-5.0) | 2.3 (2.2-3.0) | 0.039 |
| Aspect ratio | 1.45 (1.25-1.82) | 1.67 (1.16-2.11) | 0.755 |
| Bottleneck | 1.35 (1.04-2.42) | 1.26 (1.17-1.77) | 1.00 |

SAC: stent-assisted coiling, WEB: WovenEndoBridge.

**Table 2.** Outcomes of WEB device and SAC-treated patients

| Outcomes evaluated | WEB device (%) | SAC (%) | p |
|---|---|---|---|
| Complete occlusion | 6 (100) | 6 (75) | 0.308 |
| Complications | 1 (16) | 0 (0) | 0.429 |
| mRs 0-1 at 3 months | 5 (83) | 8 (100) | 0.429 |
| Length of hospital stay (days) | 3 (2-4) | 3 (3-3) | 1.00 |

SAC: stent-assisted coiling, WEB: WovenEndoBridge.

## Discussion

Wide-necked bifurcation intracranial aneurysms have always proven a challenge for interventional neuroradiology. While most aneurysms undergo open surgical clipping, many are now treated using endovascular approaches, thanks partly due to the availability of new technologies such as SAC or intrasaccular devices.

The safety and efficacy of these new technologies have been demonstrated by recent studies. The prospective WEBCAST and WEBCAST 2 studies were performed in Europe, whereas the WEB-intrasaccular therapy study took place in the United States. All studies confirmed the safety and efficacy of the device[16,20,21]. In addition, several early experiences and systematic reviews have continued to add information regarding the effectiveness of the WEB device[22].

The review by Laurent Pierot[22] compared the safety profiles of different endovascular techniques, including primary coiling, SAC, flow diverters, and the WEB device. The study found a lower mortality rate and similar occlusion and morbidity rates between the WEB device and the other techniques. Furthermore, no statistically significant differences were observed in secondary outcomes. These findings correlate with those observed in the studies by Kabbasch et al.[23,24] and Kashkoush et al.[25] On the contrary, the paper published


**Figure 1.** Digital subtraction angiography demonstrating the treatment of an anterior communicating artery aneurysm. **A:** initial angiogram shows the aneurysm. **B:** WovenEndobridge device deployment within the aneurysm sac. **C:** follow-up angiogram confirming complete occlusion of the aneurysm.

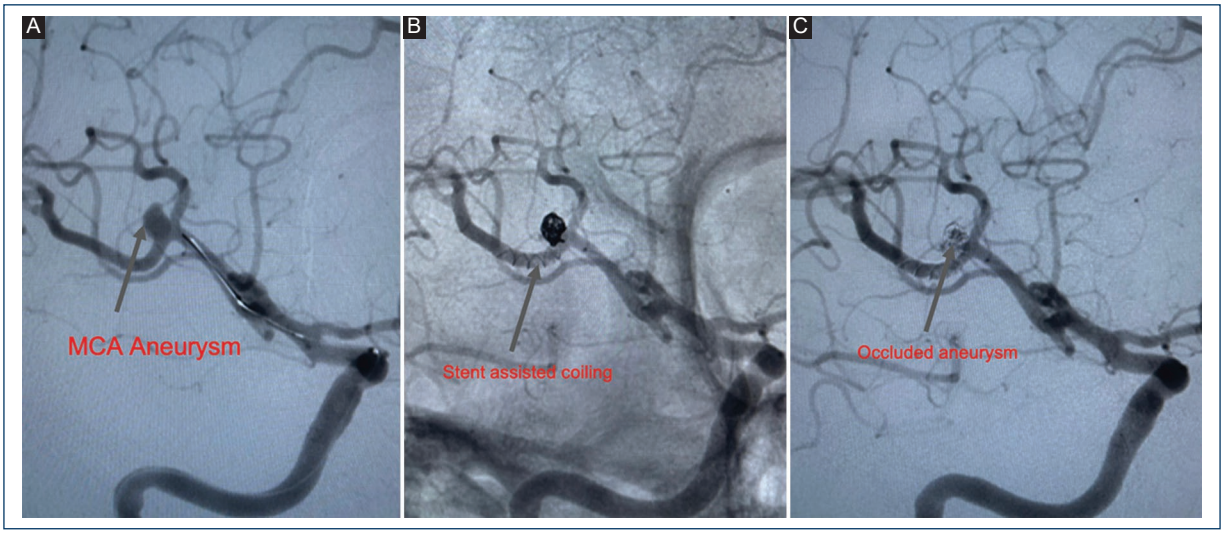


**Figure 2.** Digital subtraction angiography illustrating the endovascular treatment of a middle cerebral artery (MCA) aneurysm. **A:** initial angiogram shows an MCA aneurysm. **B:** stent-assisted coiling procedure. **C:** follow-up angiogram confirming complete occlusion of the aneurysm.

by El Naamani et al.[26], mentions that the WEB-device-treated patients had a higher occlusion rate in the 6-month assessment. Overall, most of the studies affirm that the WEB device is comparable to SAC in terms of safety and efficacy.

The WEB device may well replace SAC and other coiling techniques in the future. However, the costs of the device and the training should decrease significantly first to become a first-line treatment in places with limited resources. This includes subsidized healthcare systems and underfunded systems.

In addition, time considerations should be considered when deciding on an endovascular treatment for unruptured aneurysms. While the use of SAC can confirm an immediate occlusion of the aneurysm, the use of intrasaccular devices requires at least a follow-up for 3 months to confirm successful occlusion[12,15].

In contrast, the SAC requires a longer use of DAPT than the WEB device. At least 6 months of anti-aggregation therapy must be completed after SAC to effectively reduce post-treatment thrombotic complications[12]. This carries an inherent risk of unintended bleeding, yet most of the patients who present this complication suffer from minor episodes, as was the case in our study.

We consider that the WEB device deployment technique requires a lower number of repetitions to achieve procedure mastery than SAC. More specifically, the jailing technique for SAC involves a higher-level

complexity that requires a higher number of cases to completely develop. The use of a technique that requires a lower number of cases to learn implies a lower exposure to radiation during training, hence becoming a safer technique.

A future approach to treating wide-necked bifurcation intracranial aneurysms with intrasaccular devices such as the WEB system faces several limitations. One of the primary challenges is the high cost of the device, which restricts its widespread adoption, particularly in health-care systems with limited resources or those reliant on public funding. In addition, the requirement for specialized training in its deployment remains a barrier, as widespread proficiency among interventional neuroradiologists has yet to be achieved. Another limitation is the necessity for follow-up imaging to confirm aneurysm occlusion, unlike SAC, which provides immediate confirmation. This follow-up requirement may lead to delays in treatment adjustments if needed. Furthermore, while the WEB device reduces the need for DAPT, its long-term durability and effectiveness compared to SAC or flow diverters require further investigation through larger, long-term studies.

Moreover, the small sample size in this study limits the generalizability of the results. The findings, while promising, should be viewed as preliminary, and larger studies with higher statistical power are necessary to confirm these results and provide a more robust comparison between treatment approaches. Overcoming these limitations will be essential for intrasaccular devices to become a standard first-line treatment in the future.

## Conclusion

In our institution, intracranial wide-neck aneurysms located at the AComA and MCA bifurcation demonstrated a high occlusion rate and a low complication rate, regardless of the device used for endovascular therapy. No statistically significant differences were observed between the WEB and SAC groups. Both techniques offer distinct advantages, and an individualized approach should guide the choice of technique used.

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## Conflicts of interest

The authors declare no conflicts of interest.

## Ethical considerations

**Protection of human subjects and animals.** The authors declare that this study was carried out according to the guidelines stated by the Helsinki Declaration and the Mexican General Law of Health. This study was assessed as a class I study under the National Regulations for Research in Healthcare. The research protocol was approved by the IRB of the National Institute of Neurology and Neurosurgery under Resolution #115/22.

**Confidentiality, informed consent, and ethical approval.** The authors have obtained approval from the Ethics Committee for the analysis of routinely obtained and anonymized clinical data; therefore, individual informed consent was not required. Relevant ethical recommendations have been followed.

**Declaration on the use of artificial intelligence.** The authors declare that no generative artificial intelligence was used in the writing or creation of the content of this manuscript.

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