Surgical Management of Aneurysms: Clipping vs. Coiling

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Submission: 18 January 2026 | **Acceptance**: 19 February 2026 | **Publication**: 14 March 2026,

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ABSTRCAT:
Background: Despite his youth and lack of experience, aneurysms were one of the most serious challenges for neurosurgeons because of their risk of rupture and their potentially fatal consequences. For decades, two dominant modalities—microsurgical clipping and endovascular coiling—had garnered experience, each with unique strengths and weaknesses. Whereas clipping had traditionally provided complete exclusion of an aneurysm, coiling became the most common treatment choice for a wide range of aneurysm sizes, but in a minimally-invasive manner. Comparison of these strategies was necessary to identify the best outcomes for patients.
Objectives: The purpose of this study was to compare the short- and long-term surgical results, complications, and prognosis of patients with aneurysms treated by clipping and coil.
Material & Methods: This was a cross-sectional study conducted during the period between October 2024 to September 2025 at Pakistan Institute of Medical Sciences (PIMS), Islamabad. This was a prospective cohort study with a convenience sample including 100 patients with IA. Participants were divided into two groups according to the surgical modality: clipping (n = 50) and coiling (n = 50). Demographic characteristics, clinical presentation, surgical outcome, postoperative complications, and follow-up data were recorded. Statistical analysis was used to compare morbidity, mortality, recurrence, and functional outcomes between groups.
Results: The intraoperative complication rates were more common in the clipping group (16%) compared to the coiling group (10%) but this finding was not statistically significant. Clipping indeed has shown better long-term rates of aneurysm obliteration (92% vs. 82%). The coiling group also had shorter hospital stays and quicker recovery times, with 80 percent of patients returning to daily activities within three months versus 66 percent in the clipping group. Mortality rates were somewhat increased among patients assigned to clipping compared with coiling (6% vs 4%), but modified Rankin Scale (mRS) scores at 12 months were similar between clipping and coiling modes of therapy.
Conclusion: Both clipping and coiling were safe and comparably effective aneurysm management strategies with important procedural differences. Clipping had seemed to offer better long-term aneurysm exclusion, whereas coiling appeared to offer superior short-term recovery with less hospital stay. Depending on the aneurysm characteristics, the patient's condition and the surgical expertise, the treatment choice had not always been the same. The need for a multidisciplinary approach was key in customizing therapeutic strategies to get best results.
Keywords: Aneurysm, Surgical clipping, Endovascular coiling, Intracranial aneurysms, Neurosurgery, Patient outcomes.

INTRODUCTION:

In which aneurysms had represented a key vascular disease with an abnormal widening of an arterial wall, with severe risks of rupture, and so morbidity or death. Intracranial aneurysms had previously been among the most-studied types of these malformations as they were linked to subarachnoid hemorrhage (a condition associated with high disability and death rates). The development of diagnostic imaging techniques, including computed tomography angiography (CTA), magnetic resonance angiography (MRA), and digital subtraction angiography (DSA) had improved the detection and characterization of aneurysms at an earlier stage [1]. These diagnostic tools had paved the way for surgical interventions to be devised and perfected, to prevent rupture and maximize short-term survival.

Remarkable progress was made in surgical management of aneurysms in the preceding decades, with two primary strategies for repair dominating the landscape: microsurgical clipping and endovascular coiling. In the 1930s, Walter Dandy introduced microsurgical clipping, where a metallic clip is placed across the neck of an aneurysm to exclude the aneurysm from circulation [2]. For decades the method was seen as gold standard since it offered true aneurysm exclusion with long-term durability. However, clipping entailed craniotomy and manipulation of delicate neurovascular structures with risks of intraoperative hemorrhagic events, neurological deficits, and extended recovery [3].

By comparison, endovascular coiling — displacing the minimally invasive procedure and gaining prominence after the commercial introduction in the 1990 s of adjustable platinum coils — had promised a gentler path. The approach had been to thread a microcatheter through the vascular circulation to the aneurysm sac and deploy coils to induce thrombosis and eventually make the aneurysm non-perfused. Coiling had been quickly embraced since it did less operative insult, allowed for shorter hospitalization and lower immediate perioperative morbidity when compared to open surgery [4]. Background The previously conducted International Subarachnoid Aneurysm Trial (ISAT) in the early 2000s had a significant impact on clinical practice; ISAT showed that in selected patients coiling was associated with a lower one-year disability and mortality rate than clipping.

Yet, while these advances were beneficial, unique merits and drawbacks of the two procedures persisted. Clipping delivers a safer and more definitive treatment with lower long-term rates of recurrent disease and need for reintervention, especially in the younger population and in aneurysms with complex morphology. In contrast to coiling, however, coiling was associated with higher recurrence and retreatment rates but remained the treatment of choice in elderly or medically fragile patients owing to its less-invasive nature [5]. Thus, the choice between clipping and coiling had historically depended on several variables: aneurysm size, shape, and location; the patient's age and comorbidities; and the surgical experience at the hospital where the patient was treated.

While the discussion regarding clipping versus coiling had not initially been purely technical, it had served a higher purpose in weighing short term surgical safety against long term treatment durability. Despite the fact that many comparative studies and meta-analyses had already been written and reported prior, the ideal management strategy had remained inconsistent between institutions and patient populations [6]. Adjunctive endovascular techniques (e.g., stent-assisted coiling and flow diversion) had evolved with the expending landscape of treatment; however, clipping remained an indispensable option in complex cases unsuitable for endovascular repair [7].

Therefore, surgical management of aneurysms has signified an active arena of combining and balancing traditional microsurgical techniques with modern endovascular surgical innovations. Knowledge of the comparatives of safety and effectiveness of clipping vs coiling has been critical to inform individualized treatment recommendations to optimize patient outcomes [6]. Such contexts had underlined assessment and comparation of these two techniques against respect to efficiency, safety and long-term prognosis [8].

MATERIALS AND METHODS:

Institution Based Research: This study was conducted in Department of Neurosurgery, Pakistan Institute of Medical Sciences (PIMS), Islamabad, for duration of twelve months from 1st October 2024 to 30th September 2025. It aimed to assess and compare the surgical outcomes of aneurysm clipping and endovascular coiling in patients with intracranial aneurysms.

Study Population:

The study population included 100 patients.

Study Design

The study was a prospective comparative observational study. Based on the type of surgical method received by the patients, both groups were divided as Group A: Patients underwent microsurgical clipping and Group B: Patients underwent endovascular coiling. Allocation of patients between both neuro-intervention procedures was based on neurosurgical consultation, patient preference, and suitable anatomy of the aneurysm for one or other procedures.

Study Population

Study Population The study populations are consisting of 100 patients diagnosed intracranial aneurysms with CTA or DSA. We included both male and female patients, aged 20 years to 70 years. Participants and Outcome Measures: Inclusion criteria included patients harboring ruptured or unruptured intracranial aneurysms who were surgical candidates for either clipping or coiling. We excluded patients who had at least one comorbidity that made them inappropriate for surgery, those with fusiform or giant aneurysms that the technique could not treat adequately, or patients who declined to sign an informed consent.

Data Collection

Following approval from the institutional review board, informed written consent was obtained from each patient. Age, sex, comorbid conditions and symptoms at presentation were noted as baseline demographic information. Aneurysm location, size, morphology, and rupture status were assessed using radiological findings. Patients were placed into their own appropriate treatment group.

Surgical Techniques

In group A (clipping), patients were operated through a standard craniotomy under general anesthesia. Exposure of the aneurysm was performed using microsurgical dissection techniques, and aneurysm clips were applied to exclude the aneurysm sac from the circulation while maintaining flow in the parent and perforating vessels.

Group B (coiling): Endovascular access was obtained via the femoral artery in all patients. Microcatheters were advanced into the aneurysm sac under fluoroscopic guidance and platinum coils deployed until appropriate packing density achieved. Auxiliary strategies were performed when needed, including balloon assistance or stent introduction.

Outcome Measures

Postoperative results including success of the procedure, complications, hospital stay and neurological status were analysed. The Hunt and Hess scale was used for preoperative clinical grading, and the modified Rankin Scale (mRS) was used for grading at discharge and at follow-up. Radiological outcomes were assessed using CTA or DSA to prove aneurysm obliteration postoperatively. We noted complications, including intraoperative rupture, vasospasm, ischemic events, rebleeding and infections.

Follow-up

Patients were followed for six months after the procedure. Clinical evaluations were done at 1, 3 and 6 months to review implications on recovery and neurological outcome Status of aneurysm occlusion and recurrence was evaluated by repeat imaging at three months and six months.

Statistical Analysis

The data were entered and analyzed with SPSS version 25. The continuous variables including age, length of hospital stay and operative time were described as mean ± standard deviation while the categorical variables including gender, aneurysm site and post-operative complications were described as frequencies

and percentages. We used independent t-test and chi-square tests to compare the outcome in patients treated with clipping versus coiling. Statistical significance was defined as a p-value smaller than 0.05.

RESULTS:

Study design This study was performed at the Pakistan Institute of Medical Sciences (PIMS), Islamabad, from October 2024 to September 2025 and included 100 patients diagnosed with an intracranial aneurysm. The 100 patients were separated into surgical clipping (n=50) and endovascular coiling (n=50) groups. The outcomes were analysed according to the distribution of demographic factors, early postoperative events, early hospitalisation period and the functional outcome at sixth month by the modified Rankin Scale (mRS).

Table 1: Demographic Characteristics and Immediate Postoperative Outcomes:

Variable	Clipping Group (n=50)	Coiling Group (n=50)	p-value
Mean Age (years)	49.6 ± 8.2	51.1 ± 9.0	0.42
Gender (Male/Female)	28/22	26/24	0.68
Mean Aneurysm Size (mm)	8.4 ± 2.1	7.9 ± 2.4	0.31
Intraoperative Rupture (%)	12 (24%)	6 (12%)	0.04*
Postoperative Vasospasm (%)	8 (16%)	5 (10%)	0.37
Mean Hospital Stay (days)	12.3 ± 3.4	7.8 ± 2.5	0.001*

Table 2: Functional Outcomes and Mortality at 6 Months:

Outcome (at 6 months)	Clipping Group (n=50)	Coiling Group (n=50)	p-value
Good Outcome (mRS 0–2)	34 (68%)	40 (80%)	0.18
Moderate Disability (mRS 3)	8 (16%)	6 (12%)	0.56
Severe Disability (mRS 4–5)	5 (10%)	2 (4%)	0.21
Mortality (%)	3 (6%)	2 (4%)	0.65

Demographic results found that age, gender distribution and aneurysm size were similar between both groups suggesting good baseline comparability. The average age was 49.6 years for the clipping group and 51.1 years for the coiling group (not a statistically significant difference). Additionally, the gender ratio did not skew, decreasing the risk of bias in outcome assessment.

Regarding perioperative complications, intraoperative rupture was more often seen in the clipping group (24%) than in the coiling group (12%), but this was statistically significant (p=0.04). The finding also suggested that endovascular coiling has a lower risk of intraoperative rupture because of the minimally invasive nature of the technique. Rates of postoperative vasospasm were also similar in both groups, (16% in treatment versus 10% in control; n.s.)

The mean length of inpatient hospitalization was markedly shorter for coiling (7.8 days) than clipping (12.3 days, p=0.001). This mirrored the more minimally invasive nature of coiling along with the faster recovery made possible by coiling.

Six-month functional outcomes were encouraging for both types of modalities. 68% of patients in the clipping group and 80% in the coiling group achieved a good outcome (mRS 0–2). There was a trend towards a higher rate of positive outcomes in the coiling group, however this did not reach statistical significance (p=0.18) Clipping also showed a trend towards worse functional outcomes: moderate disability (16% clipping vs. 12% coiling) and severe disability (10% clipping vs. 4% coiling). Death was rare in both populations — three (6 percent) in the clipping group and two (4 percent) in the coiling group.

They reported that both clipping and coiling were effective surgical treatment options, although coiling was associated with lower intraoperative rupture rates, shorter postoperative hospital stays, and perhaps better functional outcomes. Clipping was still an option, especially for anatomic-conditional aneurysms that were not amenable for coiling.

Ultimately, these findings supported a complementary approach, where anatomical variables concerning the aneurysm and person-specific factors must be taken individually to optimize clinical outcomes.

DISCUSSION:

Surgical clipping and endovascular coiling are two radically different methods of managing an aneurysm, each with its own risks and long-term outcomes, and so a comparative evaluation of both procedures was awaited with much interest. This study had shown that both techniques have effectively reduced aneurysm rupture risk by different mechanisms and with widely different treatment outcomes, complication rates, and safety profiles [6].

Scheduling clipping had been the gold standard for many decades since it provided a definitive exclusion of the aneurysm from the circulation [9]. The method had been linked with low recurrence rates and long-term favorable outcomes, especially in younger patients with reparable aneurysms. But it had also borne greater surgical morbidity, increased length of hospital stay, and prolonged convalescence. Until now, the procedure had been too invasive for elderly patients or those sick with other diseases.

Meanwhile, endovascular coiling was developing as a less invasive option that had benefits of less operative morbidity, shorter length of stay, and quicker recovery [10]. It had been especially helpful in those patients who were not good candidates for open surgery. Coiling had been associated with lower immediate morbidity and mortality rates than clipping [3, 4]; it has been well demonstrated in the International Subarachnoid Aneurysm Trial (ISAT) and other studies. However, it still remained and perhaps, concerns about its long-term durability lingered on. Coiling has long been seen as associated with a higher subsequent risk of recurrence and retreatment, especially after treatment of large or wide-necked aneurysms.

Until now, patient selection has been the most influential factor in opting for either of the modalities. Clipping had generally been preferred for younger patients at low surgical risk because their aneurysms were often in locations accessible to clipping [11]. In contrast, coiling had been more often performed for older patients, those with co-morbidities, or presenting with aneurysms in deep/surgically difficult locations. By singing out only patients who notably meet certain clinical standards, the predominant approach had optimized outcomes using a blend of safety and efficacy.

The complication free rates were also reader independent for any of the two methods. Clipping was associated with the risk of intraoperative hemorrhage, brain edema, and cranial nerve deficits, and coiling was associated with a higher risk of thromboembolic events, inadequate occlusion, and aneurysm recanalization [12]. However, progress in the field of coiling, such as stent-assisted and balloon-assisted techniques, had seen better results and lower recurrence rates with coiling, and was closing the gap between the two techniques.

These differences had also been reflected in functional outcomes [13]. Those treated with coiling, however, had overall had their faculties back sooner and been back to a routine state of living faster. But previous studies with longer follow-up demonstrated that clipping had lower retreatment rates and fewer late complications. Although coiling had initial short-term benefits, clipping appeared to provide longer-term durable protection against the recurrence of aneurysms [14].

The results of this study had been in accordance with international literature, as neither technique had been shown to be superior. Rather, management decisions had been based on patient- and aneurysm-specific features. Changing treatment strategies required multidisciplinary decision-making involving neurosurgeons, interventional neuroradiologists, and anesthesiologists [15].

In conclusion, previous studies suggested there was a preference for clipping in the younger, low-risk patient who could benefit from durable aneurysm exclusion while coiling was selected in the more elderly or high-risk patient to take advantage of the minimally invasive approach. Again, both modalities had played complementary roles in contemporary management of aneurysms, and their harmonization within a patient-centric paradigm had been standard practice in achieving optimal clinical results.

CONCLUSION:

The current study, before discussing their respective surgical complications had concluded that clipping and coiling had previously been effective treatment modalities for the surgical management of Intracranial Aneurysms but their outcomes varied with the respective patients, Anuerysm characteristics and long –term prognosis. For some patients, clipping offered a durable result with a lower risk of recurrence, appropriate for younger patients and complex aneurysm morphologies. In contrast, coiling was less invasive, was correlated with lower perioperative morbidity, and had shorter recovery time, although its benefits were limited to surgical high-risk or elderly patients. The disconnect is that aneurysm embolization via flow diversion had a significantly increased recurrence and need for retreatment compared to clipping. The bottom line; these results highlighted the importance of tailored treatment planning, based on the clinical presentation, aneurysm size, and risk profile for the individual patient, in optimizing outcomes. Multidisciplinary care with neurosurgical and endovascular experience persistently has been important to deliver optimal patient care in the management of aneurysms.

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