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# Advances in Coronary Stenting: Biodegradable *vs* Metallic Stents in the Treatment of Complex Coronary Artery Disease

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## Introduction

Coronary Artery Disease (CAD) is a major cause of morbidity and mortality worldwide, and Percutaneous Coronary Intervention (PCI) has become a cornerstone of treatment for patients with obstructive coronary lesions. Stenting, which involves the placement of a scaffold in the artery to maintain vessel patency, has significantly improved outcomes in PCI procedures. While coronary stents have revolutionized the management of CAD, the choice of stent material remains an area of ongoing investigation, particularly for patients with complex coronary lesions. Conversely, metallic stents, especially Drug-Eluting Stents (DES), have been the mainstay of PCI due to their proven efficacy in reducing restenosis and improving clinical outcomes. Despite their success, metallic stents still carry the risk of long-term complications, such as late thrombosis, especially when patients fail to comply with dual antiplatelet therapy. [1]

With ongoing clinical trials and advancements in stent technology, the comparison between biodegradable and metallic stents is critical for improving treatment strategies in complex coronary artery disease. While both types of stents offer distinct advantages and drawbacks, their use in specific patient populations continues to evolve. The aim of this review is to examine the current evidence on the efficacy and safety of biodegradable versus metallic stents in treating complex coronary lesions, with particular focus on patient outcomes, restenosis rates, and long-term complications. [2]

## Description

Biodegradable stents represent a significant step forward in stent technology, offering the potential to address several limitations associated with traditional metallic stents. Made from materials like Poly-L-Lactic Acid (PLLA) or magnesium alloys, these stents provide structural support to the coronary artery during the healing phase but gradually degrade over time, ideally leaving behind no foreign material. The main theoretical advantage of biodegradable stents is the reduction in long-term adverse events such as stent thrombosis, inflammation, and the risk of late restenosis. Several early studies suggest that biodegradable stents show favorable safety profiles in terms of reducing the incidence of late thrombosis, which is a serious complication associated with metallic stents. Additionally, the possibility of normal vessel remodeling once the stent dissolves is appealing, as it may restore native endothelial function without the persistent presence of foreign material in the vessel wall. However, despite these promising features, concerns remain regarding their long-term durability and the risk of restenosis, particularly in patients with more complex coronary artery disease. [3]

Metallic stents, particularly Drug-Eluting Stents (DES), have transformed the management of coronary artery disease by significantly reducing the rates of restenosis compared to Bare-Metal Stents (BMS). DES are coated with immunosuppressive drugs, such as sirolimus or everolimus, that inhibit smooth muscle cell proliferation, a key driver of restenosis. These stents have been extensively studied in large clinical trials and have demonstrated superior outcomes in terms of reducing repeat revascularization procedures and improving clinical outcomes. The durability of metallic stents, especially in challenging lesions such as bifurcations, Chronic Total Occlusions (CTOs), or heavily calcified arteries, has made them the standard in treating complex coronary lesions. However, despite their success, DES still pose certain risks, particularly late stent thrombosis, especially in patients who do not adhere to the prescribed regimen of Dual Antiplatelet Therapy (DAPT). Moreover, the persistent presence of the stent can lead to long-term inflammatory responses and the potential for neoatherosclerosis, which could complicate patient outcomes years after implantation. [4]

A growing body of evidence comparing biodegradable and metallic stents in complex coronary lesions suggests that both types of stents have their place in clinical practice. In a variety of clinical studies, biodegradable stents have shown similar or even superior safety profiles compared to metallic stents, especially in terms of reducing stent thrombosis. However, they have also been associated with higher rates of restenosis and need for revascularization, particularly in patients with more complex or long lesions. This has led to mixed results when comparing their efficacy directly to metallic stents, which remain the gold standard in treating complex CAD. On the other hand, while metallic stents, especially DES, have well-established efficacy in reducing restenosis and improving long-term outcomes, they still come with risks that continue to be a subject of concern, such as the need for extended DAPT and the long-term risk of stent-related complications. The ongoing clinical trials, including randomized controlled trials and real-world data, are critical in determining the optimal use of biodegradable versus metallic stents, particularly for high-risk patient groups who are most prone to complications. [5]

## Conclusion

The comparison between biodegradable and metallic stents in the treatment of complex coronary artery disease is an area of intense research and clinical debate. While biodegradable stents offer the theoretical advantage of leaving no permanent foreign material in the coronary artery, their long-term durability remains a key concern. Early evidence suggests that biodegradable stents have lower rates of stent thrombosis and may promote better vessel healing compared to metallic stents. However, their higher restenosis rates in certain patient populations make them less reliable in treating highly calcified or long lesions. In contrast, metallic drug-eluting stents have well-established efficacy in reducing restenosis, particularly in complex lesions, but they still pose long-term risks such as stent thrombosis and inflammation.The future of coronary stenting likely lies in refining the indications for each type of stent. For instance, biodegradable stents may be ideal for younger patients or those with shorter lesions, where the risk of late complications is minimized. On the other hand, metallic stents remain the preferred option for high-risk patients with long, calcified lesions or complex coronary anatomy. As the technology continues to evolve, ongoing clinical trials and long-term follow-up data will be crucial in determining the optimal use of biodegradable versus metallic stents. Ultimately, the goal remains to improve clinical outcomes by minimizing complications while ensuring the best possible treatment for each individual patient.

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