Cardiology in the Young

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Biodegradable stents and occluders in CHD: current evidence, biomechanical constraints, and translational challenges

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Review

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Abstract

Congenital heart disease (CHD) often requires device implantation during childhood, when somatic growth and changing haemodynamics place particular demands on permanent implants. Metallic stents and nitinol occluders are effective, but their lifelong persistence can complicate repeat interventions, limit imaging surveillance, and interfere with growth-related remodelling. This review examines the rationale, current evidence, biomechanical constraints, and translational challenges of biodegradable stents and occluders in CHD. These devices aim to provide temporary mechanical support followed by controlled resorption, thereby reducing the burden of permanent foreign material and preserving future interventional options. Translation to congenital practice is, however, not straightforward, as early structural integrity must be balanced against predictable degradation, adequate endothelialisation, and compatibility with somatic growth. Experience from adult coronary bioresorbable scaffolds cannot be directly extrapolated to paediatric anatomies or timelines. Biodegradable septal occluders have accumulated more clinical experience and appear closer to routine use, whereas biodegradable vascular stents remain largely investigational and lack sufficient long-term outcome data to support broader adoption. Further long-term studies in paediatric and congenital populations are needed before biodegradable implants can be recommended as standard alternatives to permanent devices in CHD.

Introduction

CHD often requires transcatheter or surgical intervention early in life, during ongoing somatic growth. Improvements in surgical and perioperative care have increased survival, resulting in a growing population of repaired or palliated patients who require repeated interventions and lifelong follow-up.[1] Unlike adult coronary interventions, congenital implants must function in a dynamic environment shaped by growth, evolving haemodynamics, proximity to the conduction system, and long life expectancy. Stent implantation is central to interventional CHD for relieving vascular obstruction;[2] however, permanent metallic stents do not accommodate growth and may complicate future interventions and imaging surveillance. Similarly, permanent nitinol-based occluders used for atrial septal defect and patent foramen ovale closure have been associated with late complications, including erosion, thrombosis, and persistent inflammatory responses.[3,4]

These limitations have driven interest in biodegradable cardiovascular devices designed to provide temporary mechanical support during healing and remodelling, followed by controlled resorption. In paediatric CHD, minimising permanent intracardiac or intravascular implants represents a clinically relevant goal. Accordingly, biodegradable stents and occluder devices have been developed for congenital and paediatric applications.[5] Figure 1 summarises key paediatric constraints and the intended device lifecycle, highlighting the potential mismatch between required mechanical support, degradation kinetics, vascular healing, and growth across a long follow-up horizon.

Review methodology

A structured literature review was performed using PubMed, Scopus, and Web of Science to identify English-language studies on biodegradable cardiovascular devices in CHD, including

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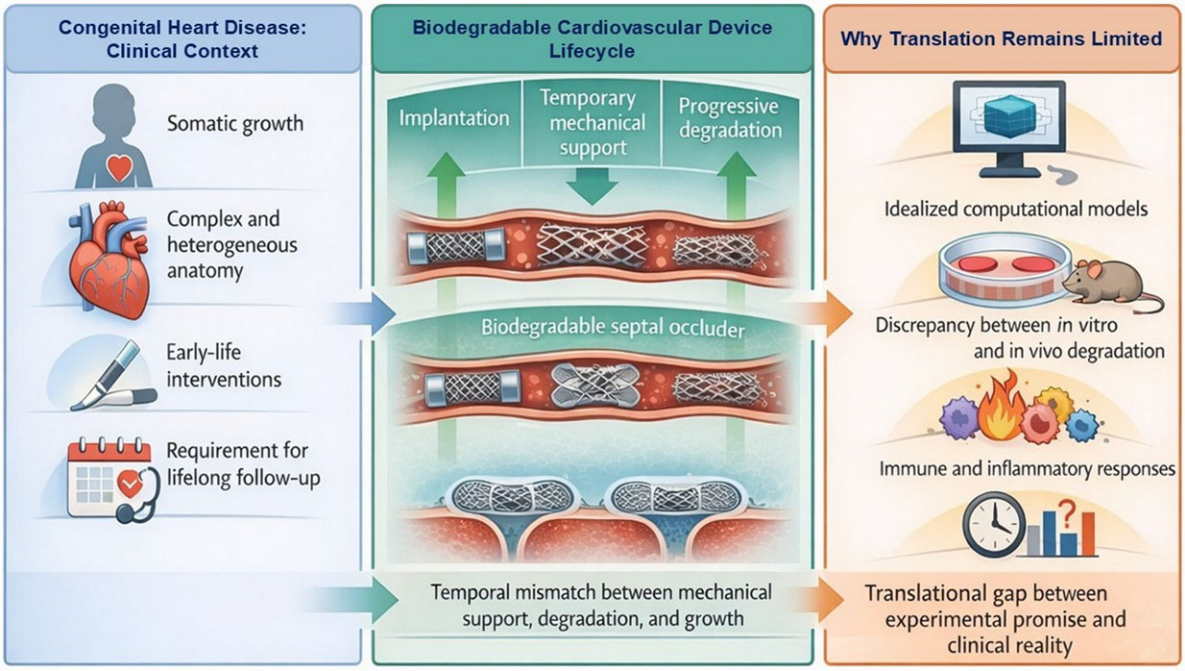


Figure 1. Conceptual overview of the unique clinical context of CHD, the intended lifecycle of biodegradable cardiovascular devices, and key factors limiting clinical translation. The left panel highlights paediatric-specific considerations, including somatic growth, complex anatomy, early-life intervention, and lifelong follow-up. The central panel illustrates the shared lifecycle of biodegradable stents and septal occluders, from implantation and temporary mechanical support to progressive degradation, emphasising the temporal mismatch between device resorption, vascular healing, and growth. The right panel summarises major contributors to the translational gap, including idealised computational modelling, discrepancies between in vitro and in vivo degradation behaviour, immune and inflammatory responses, and limited long-term clinical data.

experimental, preclinical, early feasibility, clinical, and relevant regulatory reports. Studies were assessed by translational stage with focus on material properties, mechanical performance, degradation behaviour, immune response, and clinical relevance in the context of growth and long-term follow-up. Given heterogeneity in design and outcomes, a critical comparative approach was used to identify translational gaps rather than quantitative meta-analysis.

Unique clinical needs of patients with CHD

A defining challenge in CHD interventions is treatment of cardiovascular structures that continue to grow throughout childhood. Permanent metallic implants provide durable mechanical support but restrict somatic growth, frequently necessitating repeat interventions.[6,7] Biodegradable stents have therefore been proposed as temporary scaffolds that maintain vessel patency during healing and subsequently resorb to permit growth and remodelling.[2,8] This approach introduces a temporal constraint: scaffolds must preserve adequate mechanical integrity during early healing while degrading in a controlled manner. Premature loss of support may result in recoil or restenosis, whereas delayed degradation may negate the intended benefit of resorption.[2,9,10]

Congenital cardiovascular anomalies are characterised by complex morphology, heterogeneous vessel wall properties, and altered flow patterns that differ substantially from adult cardiovascular disease.[11,12] These features impose increased biomechanical demands on implanted devices, including resistance to recoil, fatigue, and deformation under pulsatile loading.[13–15] For biodegradable stents, achieving sufficient radial strength while limiting strut thickness remains challenging, as thicker struts required for mechanical support may impair deliverability and promote inflammation, neointimal hyperplasia, and restenosis, particularly in small paediatric vessels.[2,9,10,13]

Growth-related considerations differ for septal occluders. Rather than luminal constraint, long-term interaction occurs between the device framework and evolving septal geometry, particularly near the atrioventricular conduction system. Persistent intracardiac material or prolonged degradation may contribute to conduction disturbances, septal remodelling, and late arrhythmias, recognised complications of conventional metallic occluders.[3,4,16–18] Biodegradable septal occluders must maintain stable defect closure while accommodating cyclic septal motion and minimising stress on adjacent structures; excessive rigidity or prolonged persistence has been associated with conduction disturbances and arrhythmias following transcatheter closure.[3,4,19–22]

Management of CHD is further distinguished by a prolonged clinical horizon and anticipated need for repeated interventions across the lifespan.[1,6] Device-related complications, including fracture, chronic inflammation, or interference with future catheter or surgical access, may therefore have amplified long-term consequences in congenital populations.[6,7] For biodegradable stents, uncertainties remain regarding vessel integrity, remodelling, and feasibility of reintervention after complete scaffold resorption, with current evidence largely limited to preclinical and early feasibility studies.[8,23] In septal occluders, long-term concerns extend to late arrhythmias, conduction disturbances, and the impact of residual or slowly resorbing material on subsequent transseptal or left-sided procedures.[16–18,20] Although early- and mid-term results for biodegradable occluders are encouraging, systematic surveillance beyond the resorption phase remains essential.[1,3,4]

Lifelong imaging surveillance is integral to CHD care, with cardiac MRI and CT central to assessment of ventricular function and vascular patency.[1] Permanent metallic implants may generate

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Table 1. Mechanical and degradation-related properties of materials used in biodegradable cardiovascular devices

Material	Crystallinity	Tg (°C)	Tensile strength (MPa)	Tensile modulus (GPa)	Approximate degradation time (months)	Degradation products
Polyglycolide	Semi-crystalline	35–40	60–110	5–7	4–12	Glycolic acid
Poly(L-lactide)	Semi-crystalline	60–65	60–354	2.4–7	12–36	Lactic acid
Polycaprolactone	Semi-crystalline	−65–−60	20–35	0.2–0.4	<24	Caproic acid
Polydioxanone	Semi-crystalline	−10–0	N/A	1.5	6–12	Glycolic acid and lactic acid
Poly(propylene fumarate)	Amorphous	N/A	2–30	2–3	>24	Fumaric acid derivatives
Tyrosine-derived polycarbonates	Amorphous	53–81	50–70	1–2	Very slow (in vitro)	Amide and carbonate compounds
Magnesium alloy (WE 43)	N/A	N/A	220–330	40–50	3–12	Magnesium salts
Pure Zn	N/A	N/A	120	104	Slow degradation (years-scale in vivo)	Zinc ions

imaging artefacts and complicate repeat procedures, whereas biodegradable stents may reduce long-term interference following resorption, despite reliance on radiopaque markers during deployment and follow-up.[2] Residual framework and device thickness in septal occluders may similarly affect echocardiographic windows and MRI assessment, particularly in paediatric patients requiring repeated imaging.[16–18]

Taken together, biodegradable cardiovascular devices share the goal of temporary mechanical support with reduced long-term foreign material burden, but their translational challenges differ by location and function. In CHD, biodegradable septal occluders have progressed to early clinical use with short- to mid-term safety and efficacy data,[1–4,10,24] whereas biodegradable vascular stents remain earlier in translation, with evidence largely confined to preclinical and early feasibility studies.[2,8,23]

Materials used in biodegradable cardiovascular devices

Conventional cobalt–chromium and nickel–titanium stents provide high radial strength and elastic recoil and therefore serve as mechanical benchmarks for biodegradable alternatives.[8] Their permanent nature, however, has driven the exploration of resorbable materials capable of providing temporary support.

Degradation behaviour varies substantially between in vitro and in vivo conditions and is influenced by device geometry, local haemodynamics, and host response. Most biodegradable cardiovascular devices are based on synthetic polymers or degradable metals.[2,8] Commonly used polymers include polyglycolide, poly(L-lactide), polycaprolactone, polydioxanone, and polypropylene fumarate, each with distinct mechanical and degradation profiles relevant to specific applications (Table 1). Poly(L-lactide) offers relatively high tensile strength with slower degradation, whereas polyglycolide and polydioxanone degrade more rapidly but may lose mechanical integrity earlier.[2,24] Polycaprolactone provides greater flexibility and prolonged degradation but limited radial strength when used alone.[9]

Biodegradable metallic systems have been developed to more closely replicate the mechanical behaviour of permanent stents. Magnesium alloys degrade rapidly and may lose support prematurely, whereas iron-based stents exhibit very slow corrosion and prolonged structural persistence, often exceeding the desired resorption window.[25] Zinc-based alloys have therefore emerged as an intermediate option, demonstrating more favourable and predictable degradation while maintaining acceptable biocompatibility and radiopacity in preclinical models.[23,25] A zinc-based stent developed within the PediaStent study showed promising mechanical performance and low thrombogenicity in preclinical studies, although evidence remains limited to experimental evaluation.[23] Overall, no currently available material fully combines optimal mechanics, predictable degradation, and proven long-term safety in paediatric CHD (Table 1).

Computational modelling, device design, and emerging technologies

Computational modelling plays a central role in the development and optimisation of biodegradable stents and occluder devices by enabling systematic assessment of mechanical behavior, degradation processes, and device–tissue interaction under controlled conditions. A schematic overview of the biodegradable stent development and computational evaluation workflow is provided in Supplementary Figure S1.

Finite element analysis is widely used to simulate stent crimping, deployment, and in situ loading, allowing quantitative evaluation of stress, strain, elastic recoil, and radial strength.[1,2] In biodegradable stent design, relatively small changes in strut geometry or scaffold architecture have been shown to substantially influence acute mechanical performance, and simulations provide a standardised benchmark for comparison with permanent metallic stents. However, most models rely on idealised geometries and boundary conditions, limiting clinical translatability in CHD, where complex anatomy, asymmetric loading, and somatic growth

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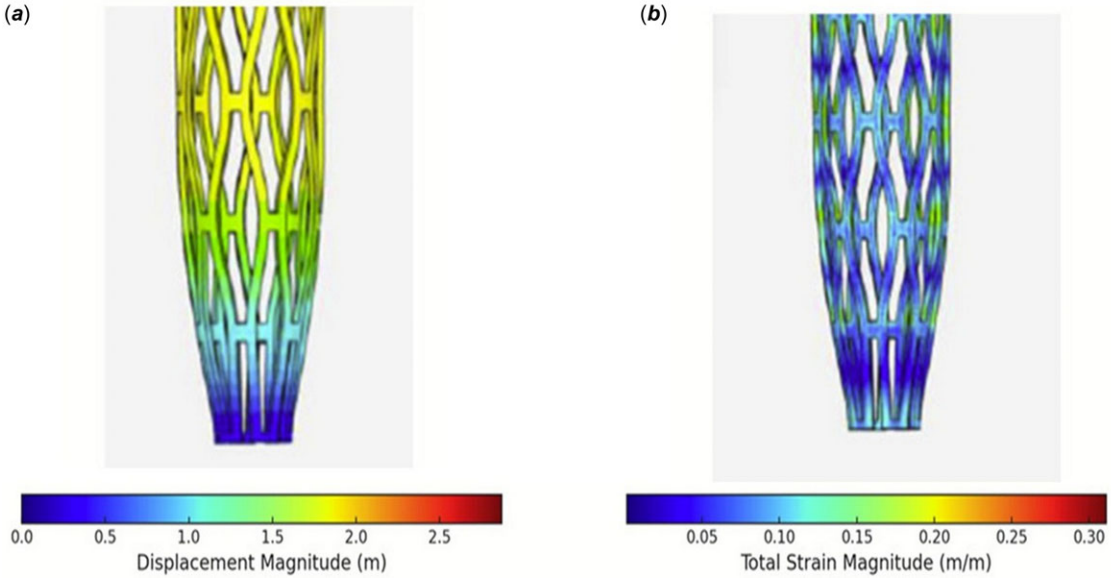


Figure 2. Representative finite element analysis (FEA) output illustrating deformation metrics during stent deployment. **(*a*)** Displacement magnitude distribution and **(*b*)** total strain magnitude distribution across the stent lattice. Colour scales indicate the magnitude range (units as shown), highlighting regions of relatively higher deformation/strain that may inform geometric refinement and mechanical optimisation.

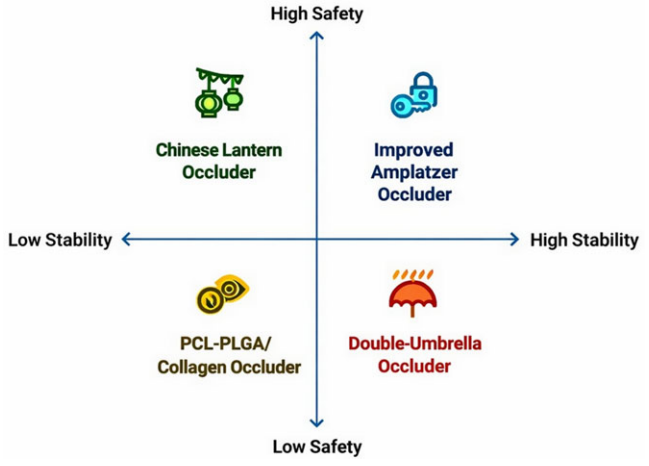


Figure 3. Schematic comparison of locking mechanisms in biodegradable occluders. The "double umbrella" design emphasises elasticity and coverage, while the "Chinese Lantern" design offers improved stability and anchoring. Both concepts aim to balance safety with retrievability, though reliability in routine paediatric use remains under investigation.

are common. Experience from coronary bioresorbable scaffolds has demonstrated that favourable computational or bench-top performance does not necessarily predict long-term clinical safety or efficacy.[9,13,26] Finite element analysis has therefore been widely applied to characterise stent expansion and mechanical behaviour under controlled conditions. Finite element analysis can visualise deployment-related deformation and identify strain concentrations within the lattice, supporting iterative design refinement (Figure 2).

Biodegradable devices undergo progressive material degradation, prompting the development of computational models that simulate time-dependent loss of mass, stiffness, and load-bearing capacity during healing and remodelling.[3] In polymer-based systems, degradation models incorporate hydrolytic chain scission and molecular weight reduction, whereas in biodegradable metals, they are based on corrosion-driven material loss.[4,27] To address these competing requirements, multiple locking and anchoring concepts have been proposed for biodegradable septal occluders, each reflecting different trade-offs between elasticity, stability, and degradation behaviour. As schematically shown in Figure 3, these models aim to capture the evolution of mechanical integrity as degradation progresses, although most assume spatially uniform material loss and incompletely represent heterogeneous corrosion, inflammatory response, or patient-specific hemodynamics. Experimental–computational comparisons suggest that such simplifications may underestimate localised mechanical failure and adverse tissue reactions, particularly in biodegradable metallic systems.[10,27,28]

Computer-aided design enables parametric generation and iterative optimisation of stent and occluder geometries, facilitating evaluation of key design variables such as strut thickness, cell configuration, and connector orientation. When combined with finite element analysis, these workflows support balancing flexibility, radial strength, and deliverability. Advanced optimisation strategies, including multi-objective and genetic algorithms, have been applied to identify mechanically favourable configurations, although their relevance in CHD remains constrained by limited incorporation of growth-adaptive conditions and long-term biological response.[5]

Patient-specific computational modelling, based on three-dimensional reconstructions from CT or MRI, allows virtual device deployment within individualised anatomies and provides insight into expansion behaviour, wall apposition, and local stress distribution.[6] At present, such approaches remain largely exploratory, with limited validation against procedural outcomes or long-term follow-up in congenital populations, restricting their role as routine clinical decision-support tools.[6,24]

Emerging technologies further expand these modelling frameworks. Poly(p-dioxanone) has attracted interest because of favourable biocompatibility and predictable degradation, while shape-memory polymers and additive manufacturing techniques, including 3D and 4D printing, have been proposed to improve

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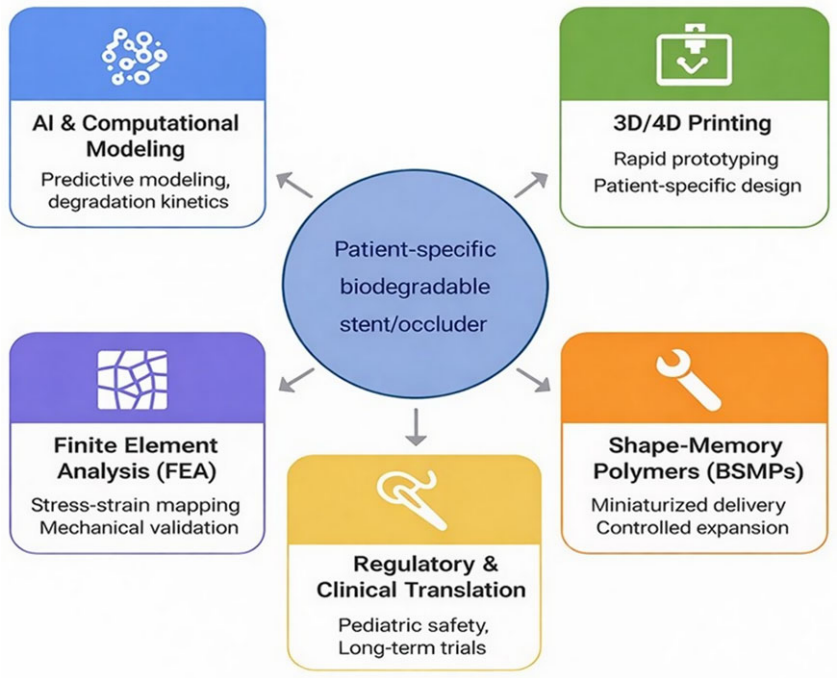


Figure 4. Future perspectives for biodegradable cardiovascular devices. Integration of 3D/4D printing, shape-memory polymers, artificial intelligent-driven computational modelling, and finite element simulations may enable patient-specific, resorbable stents and occluders with optimized performance and predictable degradation profiles.

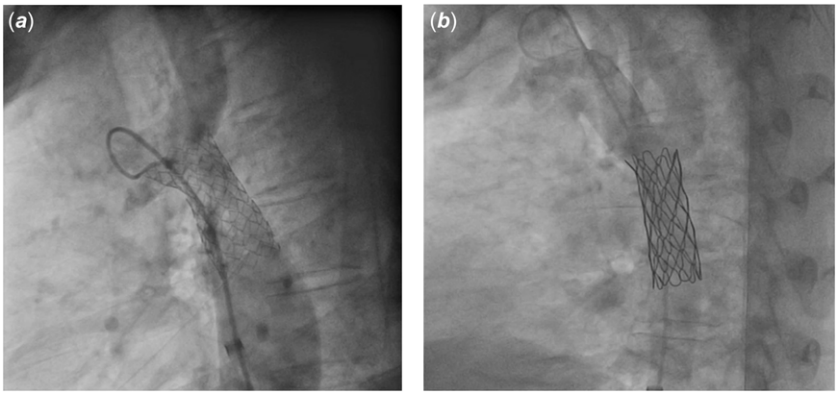


Figure 5. Conventional stents used for aortic coarctation in paediatric patients. Fluoroscopic images of **(*a*)** Andra Stent (Andramed GmbH, Reutlingen, Germany) implanted in a 13-year-old patient and **(*b*)** Cheatham–Platinum Stent (NuMED Inc., Hopkinton, NY, USA) implanted in a 10-year-old patient.

deployability, anchoring, and patient-specific design.[29–34] Artificial intelligence–based methods can accelerate exploration of design spaces, predict degradation behaviour, and support iterative geometry optimisation.[7] The conceptual integration of computational modelling, advanced materials, patient-specific design, and data-driven optimisation strategies is summarised in Figure 4, highlighting potential future pathways for biodegradable cardiovascular device development. However, reliable clinical translation remains challenging, particularly in CHD, where complex anatomy, evolving haemodynamics, and ongoing growth must be accommodated. Integration of computational modelling, advanced materials, and data-driven approaches is therefore likely to remain a key focus of future device development.

Immune response and host–device interactions in biodegradable cardiovascular implants

Host immune response is a critical determinant of outcomes in biodegradable cardiovascular implants. Unlike permanent metallic devices, progressive degradation results in sustained exposure to degradation products, generating a time-dependent immune response.[35–37] Excessive inflammation may impair endothelialisation and promote thrombosis or restenosis, particularly in paediatric patients with small vessels and altered flow patterns.[38,39] Degradation by-products from polymer- or metal-based systems can further modulate local inflammatory signalling, with material-specific profiles observed for magnesium, iron, and zinc alloys.[36,37] In congenital populations, developmental immune differences and prolonged exposure during growth underscore the need for paediatric-specific evaluation of immune compatibility.[35,36]

Biodegradable stents in CHD

Stents are widely used in CHD to treat vascular stenoses such as pulmonary artery branch stenosis and aortic coarctation.[11,12] Compared with balloon angioplasty alone, metallic stents provide more durable lumen expansion but may induce vessel injury, inflammation, and neointimal proliferation, contributing to restenosis.[13–15] Although drug-eluting stents reduce proliferative

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Table 2. Representative biodegradable stent platforms evaluated for congenital and paediatric cardiovascular interventions, summarising target anatomy, evidence level, key dimensions, and reported resorption and mechanical performance metrics

Device	Target anatomy	Study model/evidence level	Strut type (mm)	Diameter (mm)	Resorption time (months)	Radial strength (ATM)
Poly L-lactic acid -based polymer (ELIXIR MEDICAL)	Coronary / vascular models	Bench testing and animal studies/preclinical	N/A	3–6	12	N/A
Polylactic-co-glycolic acid/ polyglycolide-co-ε-caprolactone (480 BIOMEDICAL)	Vascular models	Bench testing and animal studies/preclinical	N/A	3–6	12–18	0.9
Zinc alloy (PEDIA STENT LLC ZeBRa STENT)	Paediatric vascular segments	Animal studies/preclinical	0.14–0.16	3–5	>2 years	Variable
PLLA (TREMEDICS ILLUSİCOR)	Congenital vascular lesions	Early feasibility testing/ limited clinical experience	0.065–0.30	1.5 –20	22–44	1–1.1

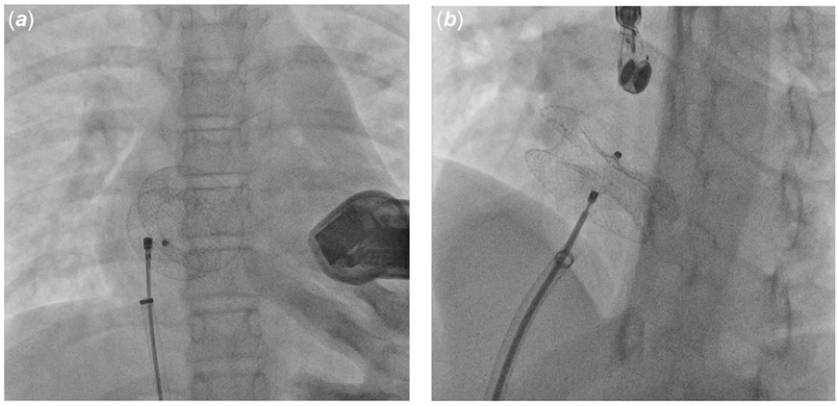


Figure 6. Conventional occluders used for atrial septal defect closure in paediatric patients. **(*a*)** Ceraflex septal occluder (Lifetech Scientific Corporation, Shenzhen, China) implanted in a 4-year-old patient and **(*b*)** Amplatzer septal occluder (AGA Medical Corporation, Golden Valley, MN, USA) implanted in a 5-year-old patient for atrial septal defect closure.

responses, the persistence of a permanent metallic scaffold and the need for prolonged antiplatelet therapy remain important limitations in paediatric patients.[40] Conventional metallic stents used for aortic coarctation, shown in Figure 5, therefore serve as the mechanical benchmark for biodegradable scaffold evaluation.

Biodegradable stents were developed to provide temporary vascular support during healing, followed by resorption that may permit subsequent growth and remodelling.[8] Polymer-based biodegradable stents have been extensively assessed in preclinical models and degrade primarily through hydrolysis; however, limited radial strength and radiolucency remain key challenges, often requiring thicker struts and radiopaque markers.[2,8,24] Metal-based biodegradable stents, particularly zinc-based systems, more closely approximate the mechanical properties of conventional metallic stents, but evidence in paediatric CHD is largely restricted to preclinical and early feasibility studies.[23,25] An o4n congenital and paediatric settings is provided in Table 2.[11–18,26–29,40]

Biodegradable septal occluders in CHD

Transcatheter occlusion devices are widely used for closure of atrial septal defect and patent foramen ovale. Conventional nitinol-based occluders provide reliable defect closure but remain permanently implanted near the atrioventricular conduction system, raising concerns regarding long-term intracardiac foreign material burden and conduction-related complications. Representative examples of commonly used metallic occluders are shown in Figure 6, illustrating the clinical reference devices that have motivated the development of biodegradable alternatives.

Partially and fully biodegradable septal occluders have therefore been developed to achieve stable defect closure during early healing while allowing gradual resorption over time. These devices typically combine a structural framework and sealing membrane with radiopaque markers and dedicated locking mechanisms, requiring careful balance between deliverability, anchoring stability, cyclic septal motion, and controlled loss of mechanical integrity during degradation.

Preclinical studies have demonstrated the technical feasibility of biodegradable septal occluders but have also reported device-related thrombus formation, inflammatory response, and incomplete endothelialisation. As a result, clinical evidence remains largely limited to early feasibility experience, and biodegradable devices evaluated for septal defect closure are summarised in Table 3.[4,19–22,30,41–57]

Clinical translation has been most advanced for septal occluders. A fully biodegradable polydioxanone ventricular septal defect occluder demonstrated effective closure and favourable degradation in preclinical models, with high procedural success reported in early paediatric series.[2,10,58] In a randomised trial including 108 patients, closure efficacy at 24 months was comparable to nitinol devices, while persistent conduction block occurred less frequently with the biodegradable occluder (0/54 vs 6/54).[24] Similarly, a fully biodegradable poly(L-lactic acid) atrial septal defect occluder achieved non-inferior closure rates with comparable adverse events in early human and randomised multicentre studies, while eliminating permanent intracardiac metal.[1,4]

In contrast, biodegradable stents, despite encouraging preclinical results, have not yet achieved comparable clinical translation in

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Table 3. Biodegradable occluder concepts investigated for septal defects and PFO, summarising degradability, material composition, design features, and available preclinical/clinical evidence

Device	Degradability	Main material composition	Design characteristics	Reported findings	Study model/ evidence
BioSTAR occluder	Partially	MP35N alloy framework with porcine intestinal collagen membrane	Umbrella-type, double-disc design	Feasible implantation and defect closure reported; collagen component resorbs over time	Clinical experience
Double BioDisk occluder	Partially	Nitinol rings with platinum coil and porcine submucosal membrane	Double-disc, self-expanding design	Adequate positioning and retrieval reported	Animal studies
Carag bioresorbable septal occluder	Partially	Polyester arms with PLGA monofilaments and PEEK connectors	Self-centering, retrievable configuration	Stable positioning and redeployment reported	Animal studies
Double-Umbrella occluder	Fully	PCL/PLC polymer framework	Double-umbrella structure	Effective defect coverage without device dislocation reported	Animal studies
Chinese lantern occluder	Fully	PLC/PCL polymer skeleton	Lantern-shaped expandable design	Repositioning and retrieval feasible in experimental setting	Animal studies
PCL–PLGA/ Collagen occluder	Fully	PCL skeleton with PLGA–collagen composite membrane	Double-disc configuration	Comparable sealing capacity to conventional devices in experimental models	Animal studies
Improved amplatzer occluder	Fully	PPDO monofilament framework with PLA fabric and radiopaque markers	Modified double-disc design	Successful deployment reported in preclinical evaluation	Animal studies
Totally biodegradable PLA-based occluder	Fully	PLLA skeleton with PDLLA discs	Locking mechanism allowing retrieval	Stable defect closure reported in experimental models	Animal studies
Fully degradable PLLA occluders	Fully	PLLA double-umbrella framework with PET/PLLA locking system	Double-umbrella structure	Complete degradation with maintained closure observed	Animal studies

ASD = atrial septal defect; PFO = patent foramen ovale; PCL = polycaprolactone; PLLA = poly(L-lactide); PDLLA = poly(D,L-lactide); PLGA = poly(lactic-co-glycolic acid); PPDO = poly(p-dioxanone); PET = polyethylene terephthalate; PEEK = polyether ether ketone; PLC = poly(L-lactide-co-caprolactone).

congenital populations, and long-term outcomes following complete scaffold resorption remain insufficiently defined.[3,5,6,8,15,23]

Translational lessons from coronary bioresorbable scaffolds and drug-eluting stents

Experience with coronary polymeric bioresorbable scaffolds, particularly the ABSORB platform, has highlighted important safety limitations relevant to congenital applications. Large randomised trials demonstrated higher rates of target lesion failure and device thrombosis compared with cobalt–chromium drug-eluting stents, with adverse events clustering before complete scaffold resorption.[13,25,26] Similar safety concerns led to early termination of the COMPARE-ABSORB trial in high-risk populations.[13,25]

In contrast, newer thin-strut biodegradable-polymer drug-eluting stents have shown favourable mid- to long-term outcomes with low thrombosis rates, underscoring the importance of strut minimisation, predictable degradation, and optimised implantation technique.[13,14,25] These coronary data emphasise that long-term follow-up beyond complete resorption is essential. Although biodegradable septal occluders in CHD demonstrate encouraging early- and mid-term safety, continued surveillance is required to detect late arrhythmias, conduction abnormalities, and delayed device-related events.[1,2,4,10–12,24,29]

Clinical translation, regulatory challenges, and limitations

Clinical translation of biodegradable cardiovascular devices is currently limited. No fully biodegradable occluder has achieved widespread regulatory approval, and biodegradable stents continue to face challenges related to predictable degradation and long-term safety.[33,59] Paediatric-specific regulatory requirements further complicate development, as devices must be evaluated in the context of growth, evolving anatomy, and prolonged follow-up. In addition, the lack of standardised biodegradation testing and robust in vitro–in vivo correlation frameworks remains a major barrier to regulatory acceptance and future clinical trials.

Despite their conceptual advantages, biodegradable stents and occluders face limitations that restrict wider adoption in CHD. Lower radial strength compared with permanent alloys often necessitates thicker struts, impairing deliverability and increasing inflammation, delayed endothelialisation, and restenosis risk.[2,9,10] Additional challenges include the need for larger, customised geometries, radiolucency requiring markers[2], variable degradation kinetics, and limited long-term clinical data.

Clinical practice implications and future directions

Current evidence indicates that biodegradable septal occluders for atrial septal defect and perimembranous ventricular septal defect achieve closure efficacy and short- to mid-term safety comparable

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to metal devices, with potential advantages in reducing persistent conduction block and avoiding lifelong intracardiac metal.[1–4,10–12,24–29] Biodegradable vascular scaffolds appear technically feasible and acutely safe in paediatric stenoses, but available data remain limited by small cohorts and short follow-up. Future studies should focus on long-term outcomes beyond complete resorption, growth compatibility, and multicentre registries to capture rare but clinically relevant events.[1,6,23,25,26]

Conclusion

Biodegradable stents and occluders offer a potential alternative to permanent implants in CHD, particularly in paediatric patients with ongoing growth and long life expectancy. Current evidence indicates that biodegradable septal occluders achieve closure efficacy and short- to mid-term safety comparable to metal devices, with possible reductions in long-term foreign-body burden and conduction-related complications. In contrast, biodegradable stents remain largely limited to preclinical and early feasibility studies, with ongoing challenges related to mechanical strength, degradation control, and vascular remodelling. Progress will require paediatric-specific design and robust long-term clinical evaluation before broader clinical adoption can be considered.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S1047951126111974.

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