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Case Report

Redo Aortic Root Replacement for Infective Endocarditis After Prior Root Surgery: A Case Series and Discussion of Conduit Selection

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Abstract

Background: Redo surgery of the aortic root in the context of prosthetic valve endocarditis (PVE) is among the most technically demanding procedures in cardiac surgery. This case series presents six male patients who underwent redo aortic root replacement following prior root interventions, focusing on surgical strategy, microbiological findings, complications, and outcomes. **Cases**: A total of 100 patients were treated surgically for aortic valve endocarditis between 2015 and 2025; 38 underwent aortic root procedures. Six patients required redo root replacements and were included in this study. Patient data were extracted from hospital and national databases, and detailed clinical analyses were performed. Five patients underwent homograft implantation, while one patient received a bovine biological conduit. For one patient, this follow-up procedure marked the third cardiac surgery overall and the second intervention on the aortic root. **Conclusions**: All patients were male with a median age of 61 years [Interquartile range (IQR) 11.5], a median ICU (intensive care unit) stay of 3 days [IQR 1.25], and a total hospital stay of 17 days [IQR 11.5]. No in-hospital mortality or perioperative stroke was noted. Identified pathogens included Streptococcus spp., Granulicatella adiacens, Enterococcus faecalis, and Pseudomonas spp. (PCR only). The cultures remained negative in one case. All patients received six weeks of intravenous antibiotics. Redo root surgery in the setting of PVE poses high operative risks, including technical complexity and reinfection. Surgical success depended on meticulous debridement, individualized conduit selection, and appropriate preoperative planning. Homografts were favored in extensive infections due to the associated resistance to reinfection. This case series demonstrates the feasibility and safety of redoing aortic root replacement for PVE, assuming appropriate surgical and postoperative strategies are implemented, with favorable outcomes, even in high-risk patients.

Keywords: infective endocarditis; repeat aortic root replacement; aortic root conduits; homograft

1. Introduction

Surgical procedures involving the management of the aortic root are complex, particularly in patients requiring reoperation after prior root replacement for prosthetic valve endocarditis. Such clinical interventions are associated with considerable mortality and technical challenges, as previously reported [1,2,3] and further supported by recent large-scale database analyses and multicenter reviews [4,5].

Infective involvement of the aortic root often leads to annular destruction, abscess formation, or prosthesis dehiscence, necessitating radical debridement and complex reconstruction [6,7]. Depending on the extent of infection, surgical options range from standard root replacement using homografts [6,7], to alternative approaches with mechanical conduits, biological composite grafts or to more advanced techniques such as the Commando or "UFO" procedure, in cases of severe destruction of the aortic-mitral continuity, particularly in patients with root abscesses [7,8,9].

Despite advances in surgical strategies, redo root replacement remains among the most demanding procedures in cardiac surgery, and optimal conduit selection continues to be debated [6,10,11].

In this article, we present a case series of six patients, who underwent redo aortic root replacement for infective endocarditis following previous root surgery, with a focus on the surgical techniques applied, intraoperative and postoperative complications, and the resulting clinical outcomes.

2. Material and Methods

All cases included in this study were identified through the hospital's electronic information system (i.s.h.med, SAP, Walldorf, Germany) and the national quality control database (QS2, S2 Engineering, Austria). We retrospectively screened all patients admitted to our department between January 2015 and March 2025 with a diagnosis of aortic valve endocarditis, diagnosed by modified Duke criteria [12].

Surgical treatment of the aortic valve was performed in 100 patients. Of these, 38 underwent procedures involving the aortic root. Six patients required redo aortic root replacement due to prosthetic valve endocarditis following previous root surgery and comprised the cohort of this study. The remaining 62 patients underwent isolated aor-

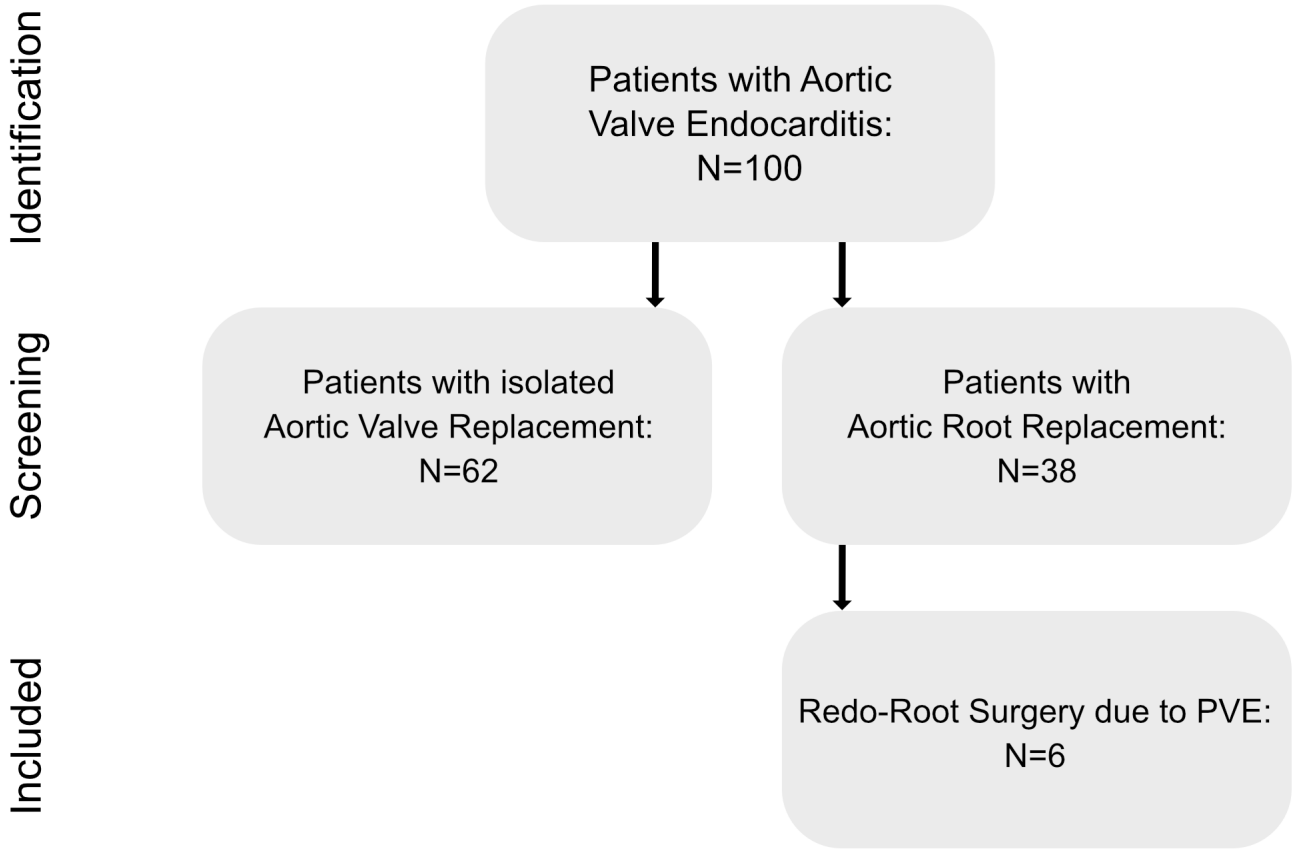


Fig. 1. Flowchart of included patients.

tic valve replacement, with or without annular patch plasty (Fig. 1).

Baseline characteristics, operative details, microbiological findings, and postoperative outcomes were obtained from electronic patient records and operative reports.

Continuous variables are presented as median with interquartile range (IQR). Due to the limited sample size, no formal statistical hypothesis testing was conducted.

This study was approved by the institutional ethics committee (EK. Number: 1176/2023).

An overview of baseline characteristics and individual patient data is provided in Tables 1,2.

Operative Technique

We apply a structured surgical protocol, prioritizing thorough preoperative planning and controlled operative execution. All patients underwent median resternotomy. Peripheral cannulation (femoral or axillary) was established prior to sternal entry to ensure immediate cardiopulmonary bypass (CPB) availability. Complete adhesiolysis was performed to expose the prosthetic root and coronary origins. Selective antegrade cerebral perfusion under moderate hypothermia was used in extensive aortic involvement, to facilitate proximal arch access. Complete surgical excision of all infected and non-viable tissue was performed in each case as a standard part of the operative protocol. Coronary buttons were reimplanted using the standard button technique. Homografts, mechanical conduits, or biological composite grafts were selected based on infection extent, conduit availability, and patient-specific factors.

Table 1. Preoperative characteristics of patients (N = 6) undergoing re-replacement of the aortic root due to infectious endocarditis.

Patients characteristics	
Age (years) median [IQR]	61 [12.5]
Female N (%)	0 (0)
BMI (kg/m) median [IQR]	22.2 [1.3]
Diabetes mellitus N (%)	0 (0)
CKD N (%)	0 (0)
Smoking N (%)	0 (0)
EuroSCORE II median [IQR]	8.5 [10]
Annular abscess N (%)	5 (83)
Septic embolism N (%)	4 (67)
Cerebral N (%)	1 (25)
Non cerebral N (%)	3 (75)

IQR, interquartile range; BMI, Body Mass Index; CKD, chronic kidney disease.

3. Results

Four patients initially underwent aortic root replacement for ascending aortic aneurysm with severe aortic valve insufficiency, in two of these cases, the underlying pathology was a bicuspid aortic valve. One patient required root replacement with a mechanical conduit due to type A aortic dissection (Fig. 2, Video 1).

Another patient, who underwent three cardiac surgeries in total, initially received mechanical aortic valve replacement for severe aortic stenosis, followed by prosthetic valve endocarditis (PVE). This patient required root replacement with a biological conduit, and due to reinfection, subsequently underwent redo aortic root replacement with a homograft conduit (Table 2).

All six patients were male, with a median age of 61 years (interquartile range [IQR] 11.5). Five patients received homografts during redo root replacement, and one patient received a bovine biological composite conduit.

The median intensive care unit (ICU) stay was 3 days (IQR 1.25), and the total hospital stay was 17 days (IQR 11.5). No in-hospital mortality or perioperative neurological complications occurred.

Early PVE, defined as occurring within 12 months after the initial root or valve procedure, was diagnosed in three patients. Microbiological testing identified Streptococcus spp. (n = 2), Granulicatella adiacens (n = 1), Enterococcus faecalis (n = 1), and Pseudomonas spp. (n = 1, detected by 16S rDNA PCR). In one case, the cultures remained negative.

All patients completed six weeks of intravenous antibiotic therapy. No early reinfections or reoperations were observed during the initial follow-up period.

An overview of the patients' procedures is described in Table 3 (Ref. [1,4,9]).

4. Discussion

Redo aortic root replacement for infective endocarditis remains one of the most technically challenging interventions in cardiac surgery, especially in patients with prior root replacement or complex surgical histories. As shown by Murana et al. [5], the surgery is associated with significantly higher mortality than the first root replacement, especially when endocarditis is the underlying indication. Dense adhesions, distorted anatomy, and the presence of prosthetic material in an infected field substantially increase operative risk [1,2,5]

Despite these risk factors, our series of six male patients (median age 61 years) demonstrated favorable perioperative outcomes, with no in-hospital mortality, no neurological complications, and no early reinfection during follow-up. These results compare positively to existing literature, which reports in-hospital mortality rates ranging

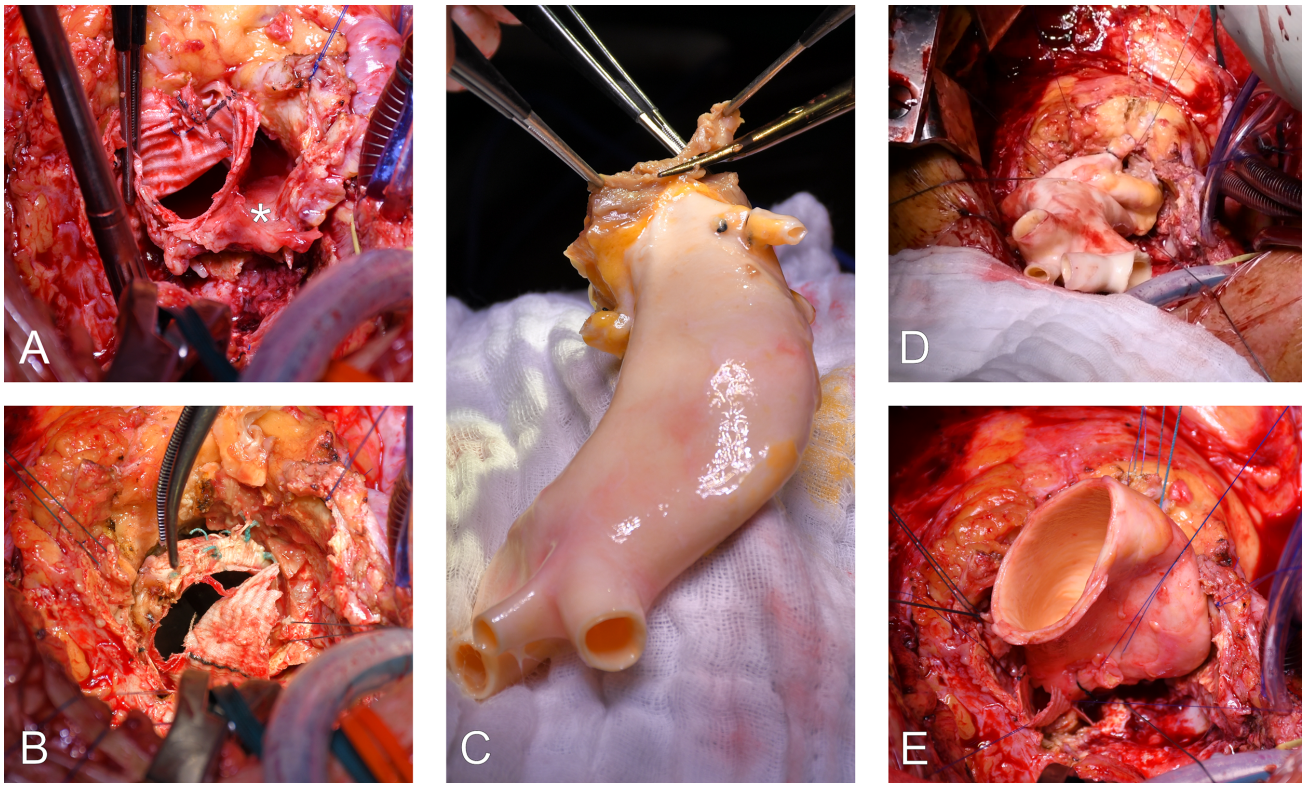
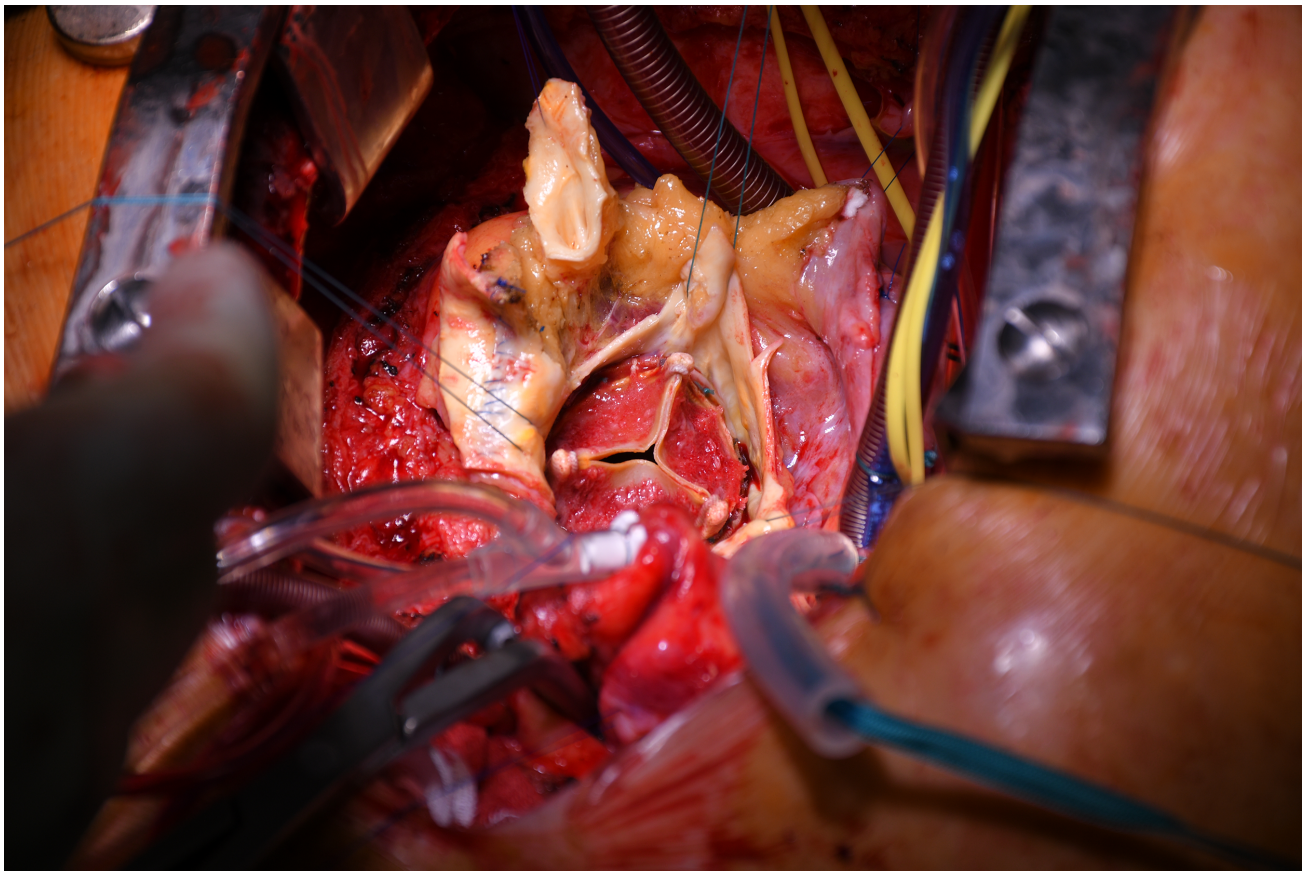


Fig. 2. Implantation of an aortic homograft after mechanical conduit for infective endocarditis. (A) Removal of the prosthesis and * extensive annular abscess cavity. (B) Explantation of the mechanical aortic valve prosthesis. (C) Preparation and sizing of the aortic homograft. (D,E) Suturing and positioning of the aortic homograft.



Video 1. Extended Aortic Root Replacement. Video associated with this article can be found, in the online version, at https://doi.org/10.31083/HSF56235.

from 10% [2] to 22.2% [13]. Murana et al. [5] reported a 12% in-hospital mortality across 16,627 patients in a literature review, and 9.6% in their single-center series of 344 redo root procedures. Our results support that, even in complex redo cases, acceptable outcomes are achievable through meticulous surgical technique and individualized conduit selection.

The microbiological spectrum in our cohort included fastidious organisms such as Granulicatella adiacens and Pseudomonas spp., both known for increased diagnostic complexity and higher complication rates [8,14]. Their presence underlines the importance of aggressive surgical debridement and extended antimicrobial therapy to optimize infection control.

Intravenous antibiotic therapy is the cornerstone of treatment for prosthetic endocarditis, typically requiring a prolonged course of at least six weeks with pathogen-specific regimens such as anti-staphylococcal penicillins (or vancomycin for methicillin-resistant strains) often combined with gentamicin and rifampin for staphylococcal infections [15]. Outpatient parenteral antibiotic therapy (OPAT) has been shown to be a safe and effective option for selected, stable patients, reducing hospital stays and maintaining low mortality and relapse rates when careful monitoring is ensured [16,17]. Recent studies also support the possibility of switching to oral antibiotics after initial intravenous therapy in stabilized patients, with similar outcomes to continued IV treatment in certain cases [18,19,20].

Appropriate conduit selection remains critical in redo root replacement, balancing infection control, durability, and patient-specific factors. In our series, homografts were used in five patients, consistent with their recognized advantages in complex endocarditis, including reduced susceptibility to reinfection, favorable hemodynamics, and optimal integration in infected fields [2,21]. Pocar et al. [13] reported that homograft root replacement in destructive prosthetic valve endocarditis achieves near 90% operative survival and acceptable mid-term outcomes, supporting its role as a preferred option in extensive cases, despite concerns about long-term durability in younger patients.

In one patient, a bovine biological composite conduit was implanted following a prior David-Procedure. Biological valved conduits offer practical advantages, particularly in avoiding anticoagulation. However, they are associated with structural valve degeneration [21,22].

Mechanical valved conduits, although offering superior durability, remain controversial in the setting of active endocarditis due to concerns regarding reinfection risk [23]. Preventza et al. [1] reported acceptable outcomes with mechanical conduits in selected cases, though caution is warr-

Table 2. Summary of case reports for the six patients undergoing redo aortic root replacement.

Pat. No.	Age	Initial procedure	Early PVE (<12 M)	Pathogen	Reoperation	Outcome
1	47	Bio Bentall Procedure *	yes	Pseudomonas spp. (PCR)	Homograft	Full recovery without major complications+
2	61	Type A dissection repair with mechanical valved conduit **	no	Streptococcus pneumoniae	Homograft and bypass to the right coronary artery	Full recovery without major complications+
3	64	First surgery: Mechanical AVR *** Second surgery: Bio Bentall Procedure ****	yes	Streptococcus mitis	Homograft	Full recovery without major complications+
4	41	Bio Bentall Procedure *****	no	No pathogen detected	Homograft	Full recovery without major complications+
5	73	David Procedure ******	yes	Granulicatella adiacens	Bio integral conduit	Full recovery without major complications+
6	61	Bio Bentall Procedure *	no	Enterococcus faecalis	Homograft	Full recovery without major complications+

+Major bleeding, major adverse cardiac events, major adverse neurological events.

* Bio Bentall Procedure = Bio Conduit Edwards INSPIRIS RESILIA™ (Edwards Lifesciences, Irvine, USA), Hemashield Graft (Getinge, Sweden).

** Mechanical Valved Conduit = Cabosil (Sorin Group, Saluggia, Italy).

*** Mechanical Aortic Valve Replacement = SJM bileaflet valve 2011 (St. Jude Medical, St. Paul, USA).

**** Bio Bentall Procedure = Biointegral Surgical Inc. (Ottawa, Canada).

***** N.a. (Medical records not available).

****** David Procedure = Unigraft (Aortic root graft by Vascutek/Terumo, Inchinnan, Scotland, UK).

Table 3. Comparative summary of individual surgical procedures.

Criteria	Homograft	Mechanical conduit	Biological composite graft
Infection Resistance	Lower reinfection risk reported (0% [1] to 5.4% [9])	Comparable outcomes to homografts [4]	Similar to homografts/mechanical conduit [4]
Mortality (Early/Long-term)	10-year survival 35 ± 5.4% [9]	Similar survival to homografts [4]	Comparable survival to others [4]
Reoperation Risk	Valve degeneration and reinfection 14% [9], 2.9% [1]	Low (durable structure) [4]	Moderate, similar to homografts [4]
Anticoagulation	Not required	Lifelong required (bleeding risk)	Not required
Availability/Technical Use	Limited availability; preferred in root abscess	Widely available, flexible application	Readily available

anted when extensive infection persists. Moreover, increased reinfection rates with mechanical conduits in infected fields, reinforcing the preference for biological alternatives in active PVE have been reported, nevertheless, recent meta-analyses indicate that mechanical valved conduits may provide superior long-term durability, with significantly lower rates of late mortality and reintervention compared to bioprosthetic conduits, highlighting the importance of patient selection [22,23].

In scenarios involving extensive destruction of the aortic root, intervalvular fibrous body, or aorto-mitral continuity, radical surgical approaches such as the Commando or "UFO" procedure become necessary to achieve complete debridement and anatomical reconstruction [9,24]. Vojacek et al. [9] described satisfactory early outcomes with these complex techniques, although they are associated with significant operative risk and should be reserved for cases with severe structural involvement. In our institution we have good experiences with this procedure. In the described cases, patients did not present with indications for such approaches. Standard redo root replacement with homograft and biological conduit proved sufficient to manage observed pathology.

Our study is limited by the small sample size, reflecting the rarity and complexity of redo root replacement for PVE, short-term follow-up, and single-center design, which may introduce selection bias favoring operable patients. Nevertheless, our results highlight the feasibility of redo aortic root replacement for prosthetic valve endocarditis when performed in experienced centers using tailored surgical strategies. Larger multicenter studies with extended follow-up are required to further define optimal conduit selection and long-term outcomes in this challenging patient population.

5. Conclusion

Redo aortic root replacement for prosthetic valve endocarditis after prior root surgery is feasible with acceptable early outcomes. In our series, no in-hospital mortality or neurological complications occurred. Homografts demonstrated satisfactory infection control, particularly in patients with extensive annular destruction or reinfection. Larger studies with long-term follow-up are required to confirm durability and guide conduit selection.

Availability of Data and Materials

Due to institutional and ethical restrictions, the data analyzed during this study are not publicly available but may be obtained from the corresponding author upon reasonable request.

Author Contributions

PB, IR, AH, and GS contributed to the conception and design of the work, data interpretation, and writing of the manuscript. OM was responsible for data acquisition and manuscript writing. AZ and JG provided overall supervision, contributed to surgical decision-making, and critically revised the manuscript for important intellectual content. PS contributed to data analysis and manuscript editing as the corresponding author. All authors read and approved the final version of the manuscript. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Ethics Committee of the Johannes Kepler University Linz, Austria (Ek. Number: 1176/2023; date of approval: Oct. 2023). Written informed consent was not required due to the retrospective design and anonymized nature of the data, as confirmed by the Ethics Committee.

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Conflict of Interest

The authors declare no conflict of interest.

Declaration of AI and AI-Assisted Technologies in the Writing Process

The authors used AI-assisted language tools (ChatGPT (Pro 2025)) during manuscript preparation to improve linguistic clarity. All content was reviewed and approved by the authors, who take full responsibility for its accuracy and integrity.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/HSF56235.

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