Interventional procedure assessment report of off-pump minimal access mitral valve repair by artificial chordae insertion to treat mitral regurgitation

Contents

Table 1 Abbreviations

Abbreviation	Definition
ACC	American College of Cardiology
AF	Atrial fibrillation
AHA	American Heart Association
AKI	Acute kidney injury
ARF	Acute renal failure
ASE	American Society of Echocardiography
COPD	Chronic obstructive pulmonary disorder
CPB	Cardiopulmonary bypass
CVVH	Continuous veno-venous haemofiltration
EACVI	European Association of Cardiovascular Imaging
ECMO	Extracorporeal membrane oxygenation
ESC	European Society of Cardiology
IQR	Interquartile range
KM	Kaplan–Meier
LAVi	Left atrial volume index
LV	Left ventricle
LVEDVi	Left ventricular end-diastolic volume index
LVEF	Left ventricular ejection fraction
LVESD	Left ventricular end-systolic diameter
LVESVi	Left ventricular end-systolic volume index
MR	Mitral regurgitation
MRI	Magnetic resonance imaging
MV	Mitral valve
MVARC	Mitral valve academic research consortium
NYHA	New York Heart Association
PML	Posterior mitral leaflet
SD	Standard deviation
sPAP	Systolic pulmonary artery pressure
STS	Society of Thoracic Surgeons
STS-PROM	Society of Thoracic Surgeons – Predicted Risk of Mortality
TACT	Transapical artificial chordae tendineae
TIA	Transient ischaemic attack
TOE	Transoesophageal echocardiography

TOP-MINI	Transapical Off-Pump Mitral Valve Intervention with Neochord Implantation

The condition, current practice, unmet need and procedure

Information about the condition, current practice, unmet need and the procedure is available in NICE's HealthTech guidance on off-pump minimal access mitral valve repair by artificial chordae insertion to treat mitral regurgitation.

Outcome measures

The main outcomes included success endpoints, reduction in MR, functional outcomes, echocardiographic outcomes, mortality and complications. The measures used are detailed in the following paragraphs. A number of the included studies have performed additional analyses comparing endpoints among groups based on preoperative MV anatomy as follows: Type A, isolated central PML prolapse and/or flail; Type B, posterior multisegment prolapse and/or flail; Type C, anterior or bileaflet prolapse and/or flail; Type D, paracommissural prolapse and/or flail or any type of disease with the presence of significant leaflet and/or annular calcifications.

MR grade

There are several classification systems of MR based on imaging. This is usually based on echocardiography, but angiography and MRI can also be used. In the included studies, MR grade was classified based on a range of objective guidelines including ASE, AHA and ESC. Classification has 5 grades ranging from none to 1+ (mild MR), 2+, 3+ or 4+ (severe MR). A simplified 3-grade classification system is sometimes used (mild, moderate or severe).

New York Heart Association (NYHA) functional class

The NYHA functional class is used to classify heart failure according to severity of symptoms and limitation of physical activity:

- Class 1: no limitation of physical activity. Ordinary physical activity does not cause undue fatigue, breathlessness or palpitations.
- Class 2: slight limitation of physical activity. Comfortable at rest but ordinary physical activity results in undue breathlessness, fatigue or palpitations.
- Class 3: marked limitation of physical activity. Comfortable at rest but less than ordinary physical activity results in undue breathlessness, fatigue or palpitations.
- Class 4: unable to carry out any physical activity without discomfort. Symptoms at rest can be present. If any physical activity is undertaken discomfort is increased.

Echocardiographic outcomes

Some studies reported echocardiographic measurements, including linear dimensions and volumes. Other outcomes are described in the following paragraphs.

LVEF is the ratio of blood ejected during systole (stroke volume) to blood in the left ventricle at the end of diastole (end-diastolic volume). A normal range is typically between 50% and 70%. Values below 30% are considered a severe reduction.

LVEDVi is the volume of blood in the left ventricle at the end of diastole, just before the heart contracts (systole). It is indexed to adjust for a person's body surface area, enabling comparison across people of different sizes. The normal range is between 30 ml/m^2 and 79 ml/m^2.

LVESVi is the volume of blood remaining in the ventricle after the heart contracts (systole). It is indexed to adjust for a person's body surface area, enabling comparison across people of different sizes. The normal range is between 9 ml/m^2 and 31 ml/m^2.

LAVi is the volume of the left atrium at the end of systole. It is indexed to adjust for a person's body surface area, enabling comparison across people of different sizes. A normal value is 34 ml/m^2 or lower.

sPAP is the pressure in the pulmonary artery during the systolic phase. The normal range is between 18 mmHg and 25 mmHg.

MVARC endpoint definitions

Technical success (measured at exit from the catheterisation laboratory):

- absence of procedural mortality
- successful access, delivery and retrieval of the device delivery system
- successful deployment and correct positioning of the first intended device
- freedom from emergency surgery or reintervention related to the device or access procedure.

Device success (measured at 30 days and at all later post-procedural intervals):

- absence of procedural mortality or stroke
- proper placement and positioning of the device
- freedom from unplanned surgical or interventional procedures related to the device or access procedure
- continued intended safety and performance of the device, including:
  - no evidence of structural or functional failure
  - no specific device-related technical failure issues and complications
  - reduction of MR to either optimal or acceptable levels.

Procedural success (measured at 30 days):

- device success (either optimal or acceptable)
- absence of major device- or procedure-related serious adverse events, including:
  - death
  - stroke
  - life-threatening bleeding
  - major vascular complications
  - major cardiac structural complications
  - stage 2 or 3 acute kidney injury (includes new dialysis)
  - myocardial infarction or coronary ischaemia requiring percutaneous coronary intervention or coronary artery bypass graft
  - severe hypotension, heart failure, or respiratory failure requiring intravenous pressors or invasive or mechanical heart failure treatments
  - any valve-related dysfunction, migration, thrombosis, or other complication requiring surgery or repeat intervention.

Patient success (measured at 1 year):

- device success (either optimal or acceptable)
- patient returned to the preprocedural setting
- no rehospitalisations or reinterventions for the underlying condition
- improvement from baseline in symptoms
- improvement from baseline in functional status
- improvement from baseline in quality of life.

Clinical assessment tools

Most studies used a scoring system for assessing the risk of in-hospital mortality after cardiac surgery. The main scoring systems are described below.

EuroScore II

EuroScore II is a validated and commonly used risk model for assessing the perioperative risk of mortality after major cardiac surgery. It is based on patient factors, such as age, sex and comorbidities; cardiac specific factors, such as NYHA class; and procedural factors, such as urgency. It is expressed as a percentage on a scale of 0% to 100%, with lower scores indicating a lower risk.

STS score

The STS score is a risk stratification model, composed of up to 30 variables that predict short- and long-term mortality and morbidity after cardiac surgery. In general, an STS predicted risk of surgical mortality of 4% to 8% is considered intermediate risk and 8% or higher is considered high risk. Some studies report an STS-PROM MV score, which estimates the predicted risk of mortality at 30 days after isolated mitral valve repair (range 0% to 100%; a higher score indicates an increased risk).

Evidence summary

Population and studies description

This interventional procedures assessment report is based on 1,375 people from 7 prospective case series, 3 retrospective registry studies, 3 retrospective cohort studies, 2 retrospective case series and 2 case reports. Of these 1,375 people, 1,172 people had the procedure. There is likely to be substantial overlap between these patient populations. This is a rapid review of the literature, and a flow chart of the complete selection process is shown in figure 1. This assessment report

presents 17 studies as the key evidence in table 2 and table 3, and lists 9 other relevant studies in appendix B, table 5.

Naive repair population

Colli (2016) did a prospective single-centre case series to evaluate the clinical outcomes of the TOP-MINI procedure using the NeoChord DS1000 system in the early postoperative period. This study was based in Italy and included 49 people with a median age of 72 years, with 34 males (69%). Acute procedural success was defined as implantation of at least 3 neochordae with residual MR of 2+ or more. Primary efficacy outcomes were residual MR of 2+ or more, freedom from reoperation for recurrence of severe MR and clinical improvement in NYHA functional class. Safety outcomes included hospital mortality, perioperative complications, and major and minor adverse events. Patient outcomes were assessed at discharge and at 3 months post procedure.

Colli (2015) did a multicentre prospective case series to evaluate the safety and efficacy of the TOP-MINI procedure in a consecutive cohort of symptomatic people with severe mitral regurgitation (MR) due to leaflet flail or prolapse. The study was done across 2 sites in Italy and Lithuania between February 2013 and June 2014 and included 63 people with a median age of 66 years, with 42 males (67%). Early procedural success was defined as implantation of at least 2 neochordae with immediate reduction in MR to less than 2+. Primary efficacy outcomes were defined as reduction in MR to less than 2+ at the 30-day follow up, freedom from reoperation for recurrence of severe MR and clinical improvement (NYHA functional class). Safety outcomes included perioperative complications, and in-hospital and 30-day major and minor adverse events. Patient outcomes were assessed at discharge and at 30 days post procedure.

Colli (2018a) did a prospective single-centre case series to evaluate the learning curve of surgeons performing the NeoChord procedure and monitor the

performance of the procedure during the initial phase of its adoption. 112 consecutive people who had the NeoChord procedure between November 2013 and March 2016 were included in the analysis. Participants in the study had a median age of 68 years, with 82 males (73%). A composite endpoint was used based on MVARC definitions – the treatment was considered a success at 1-year follow up if the following criteria were met: (1) technical success including the placement of at least 2 neochordae and residual mitral regurgitation grade of mild or absent at the end of the procedure; (2) freedom from major adverse events such as death, stroke, mitral regurgitation grade of greater than moderate, structural or functional valvular failure and/or unplanned interventions related to the procedure or device; and (3) freedom from a decline in baseline symptoms. Patient outcomes were assessed at discharge, 1 month, 3 months, 6 months and 1 year.

Colli (2018b) did a multicentre retrospective registry study to evaluate 1-year clinical results of the procedure using the NeoChord DS1000 device in a consecutive cohort of patients. 213 people were enrolled into the NeoChord Independent International Registry between February 2013 and July 2016. All participants presented with severe mitral regurgitation due to flail/prolapse of 1 or both leaflets, and they all completed postoperative echocardiographic assessment up to 1 year. Participants included in the study had a median age of 68 years, with 153 males (72%). The primary endpoint was composed of (1) procedural success (defined as the placement of at least 2 neochordae and mild or less MR at the end of the procedure); and (2) freedom from death, stroke, MR higher than moderate, unplanned interventions related to the procedure or device, cardiac-related rehospitalisation or worsening NYHA functional class at 1 year and at each follow-up time. Patient outcomes were assessed at discharge, 1 month, 6 months and 1 year.

D’Onofrio (2022) did a single-centre, retrospective study comparing outcomes of the NeoChord procedure and conventional surgical mitral valve repair. Data from patients who had isolated mitral valve repair with the NeoChord procedure or conventional surgery from January 2010 to December 2018 were collected. After 1:1 propensity matching, 176 people were included (88 in each group), with a median age of 68 years with 77% males in the NeoChord group, and a median age of 64 years with 73% males in the conventional surgery group. The primary endpoint was overall all-cause mortality. Secondary endpoints were freedom from reoperation, freedom from moderate (2+) and severe (3+) MR and NYHA functional class in the overall population and in patients with isolated P2 prolapse (type A anatomy). Median follow up was 3.4 years in the NeoChord group, and 6.6 years in the conventional group.

D'Onofrio (2023) did a single-centre retrospective case series to evaluate clinical and echocardiographic 5-year outcomes of people who had the NeoChord procedure. All people who had the procedure from November 2013 to March 2016 were included. Indications were severe symptomatic degenerative mitral regurgitation due to leaflet prolapse/flail. 100 consecutive people were included in the analysis, with a median age of 66 years, and 73% were male. Device success was defined by the absence of procedural mortality or stroke, proper placement and positioning of the device, freedom from unplanned surgical or interventional procedures related to the device or access procedure, no evidence of structural or functional failure, no specific device-related technical failure issues and complications, and reduction of MR to either optimal or acceptable levels without significant mitral stenosis. Follow up occurred at 1 month, 3 months, 6 months, 12 months, and annually thereafter for 5 years.

Gerosa (2021) did a single-centre retrospective registry study to evaluate the midterm outcomes of people who had the NeoChord procedure. 203 consecutive people with severe symptomatic MR due to prolapse or flail of 1 or both mitral

leaflets that had the NeoChord procedure between November 2013 and June 2019 were included (78% male; median age 64 years). Clinical outcomes and the composite primary endpoint (patient success) were defined in accordance with MVARC criteria. Mitral regurgitation (MR) severity was graded as absent, mild, moderate and severe in accordance with ASE and ESC guidelines. Median follow up was 24 months, and people had clinical and echocardiographic follow up at 1 month, 3 months, 6 months, 12 months and annually thereafter for 3 years.

Kurnicka (2019) did a prospective case series to evaluate early results of the NeoChord procedure in the first group of consecutive people who had the procedure in Poland. 21 people with severe MR due to posterior leaflet prolapse (81% male; mean age 61 years, SD 12.7 years) had MV repair with the NeoChord DS1000 system between October 2014 and August 2017. 6-month echocardiographic results including MR grade and parameters of the left ventricle and left atrium geometry and function were evaluated. Patient outcomes were assessed at discharge and at 6 months post procedure.

Samalavicius (2017) did a prospective case series to describe the anaesthetic management and procedural success of people having the NeoChord procedure. 76 people (68% male; mean age 60 years, SD 13 years) who had mitral valve repair with the NeoChord system between December 2011 and December 2016 were included in the study. Perioperative safety data were collected, along with reduction in MR post procedure.

Seeburger (2014) did a multicentre prospective case series called the ‘TACT’ trial to evaluate the safety and performance of the NeoChord DS1000 system. 30 people (60% male; mean age 64 years, SD 11.9 years) across 7 centres with severe MR due to isolated posterior prolapse were included in this trial. All participants had off-pump transapical implantation of neochordae. The primary performance endpoint was the rate of people maintaining an MR grade of 2+ or

less at 30 days. The safety endpoint was major adverse events such as death, reoperation and cardiovascular events.

Wrobel (2019) did a prospective case series to evaluate early outcomes of a single-centre experience with transapical beating heart mitral valve repair with the NeoChord system. 37 people (78% male; mean age 62.3 years, SD 3.4 years) with severe symptomatic MR were treated with the NeoChord procedure between September 2015 and December 2018. Transapical chordal implantation was considered suitable for patients if severe MR was present due to prolapse or flail of 1 leaflet and had the potential for good coaptation without requiring a prosthetic annuloplasty. Early surgical success defined as the reduction of MR to less than moderate by implantation of at least 2 neochordae was evaluated. Standard cardiac surgery perioperative complications and those related directly to the NeoChord technique were also presented.

Zorinas (2019) did a retrospective cohort study to compare early postoperative outcomes of conventional mitral valve repair surgery with the NeoChord procedure in people with degenerative MR. 169 people who had mitral valve repair between 2011 and 2018 were included. 78 people were in the NeoChord group (67.9% male; mean age 59.5 years, SD 12.8 years) and 91 were in the conventional surgery group (57.1% male; mean age 54.2 years, SD 11.1 years). STS and EuroScore II risk scores did not differ between the groups. Performance and safety outcomes were assessed postoperatively, and at 30 days post procedure.

Re-repair population

Barbero (2025) did a retrospective cohort study to compare outcomes in people with failed MV repair having open-heart surgery versus the NeoChord procedure. 37 people were retrospectively enrolled: 22 had OHS (73% male; mean age 63.9 years, SD 8.5 years) and 15 had Neochord repair (73% male; mean age

67.5 years, SD 7.8 years). All had recurrent MV prolapse following prior annuloplasty. The primary endpoint was freedom from a composite event, defined as mitral valve reoperation or the presence of moderate or severe mitral regurgitation at 1 year.

Salizzoni (2025) did a retrospective registry study enrolling all people across 26 centres who had mitral valve re-repair for recurrent MR with the NeoChord procedure between 2014 and 2024. 72 people were retrospectively enrolled (79% male; mean age 65.1 years, SD 11.7 years). The primary endpoint was a composite outcome of cardiovascular death, recurrence of severe mitral regurgitation and reintervention because of procedural failure.

Gerosa (2021) did a retrospective case series enrolling all adults presenting with recurring severe MR after a previous surgical mitral valve repair and treated with NeoChord implantation between January 2014 and December 2018. 15 people were retrospectively enrolled (73% male; median age 61 years, IQR 53 to 72 years). The primary endpoint (patient success) was a composite of placement of at least 2 neochordae and end-procedure MR less than moderate, freedom from death, stroke, structural or functional procedure failure, procedure or device-related unplanned procedures, cardiac-related rehospitalisation, or worsening NYHA functional class at 1- and 2-year follow up.

Seguchi (2023) authored a case report on a 69-year-old female with a history of conventional mitral repair via median sternotomy who developed heart failure due to mitral regurgitation from recurrent posterior leaflet P2 prolapse. The NeoChord procedure was performed as a re-repair. MR outcomes were reported at 6-month follow up.

Blessberger (2021) authored a case report on a 57-year-old male who had undergone a minimally invasive surgical mitral valve repair 4 years earlier. TOE identified a relapse of severe mitral valve regurgitation and the NeoChord

procedure was performed as re-repair. MR outcomes were reported at 16-month follow up.

Table 2 presents study details.

Figure 1 Flow chart of study selection

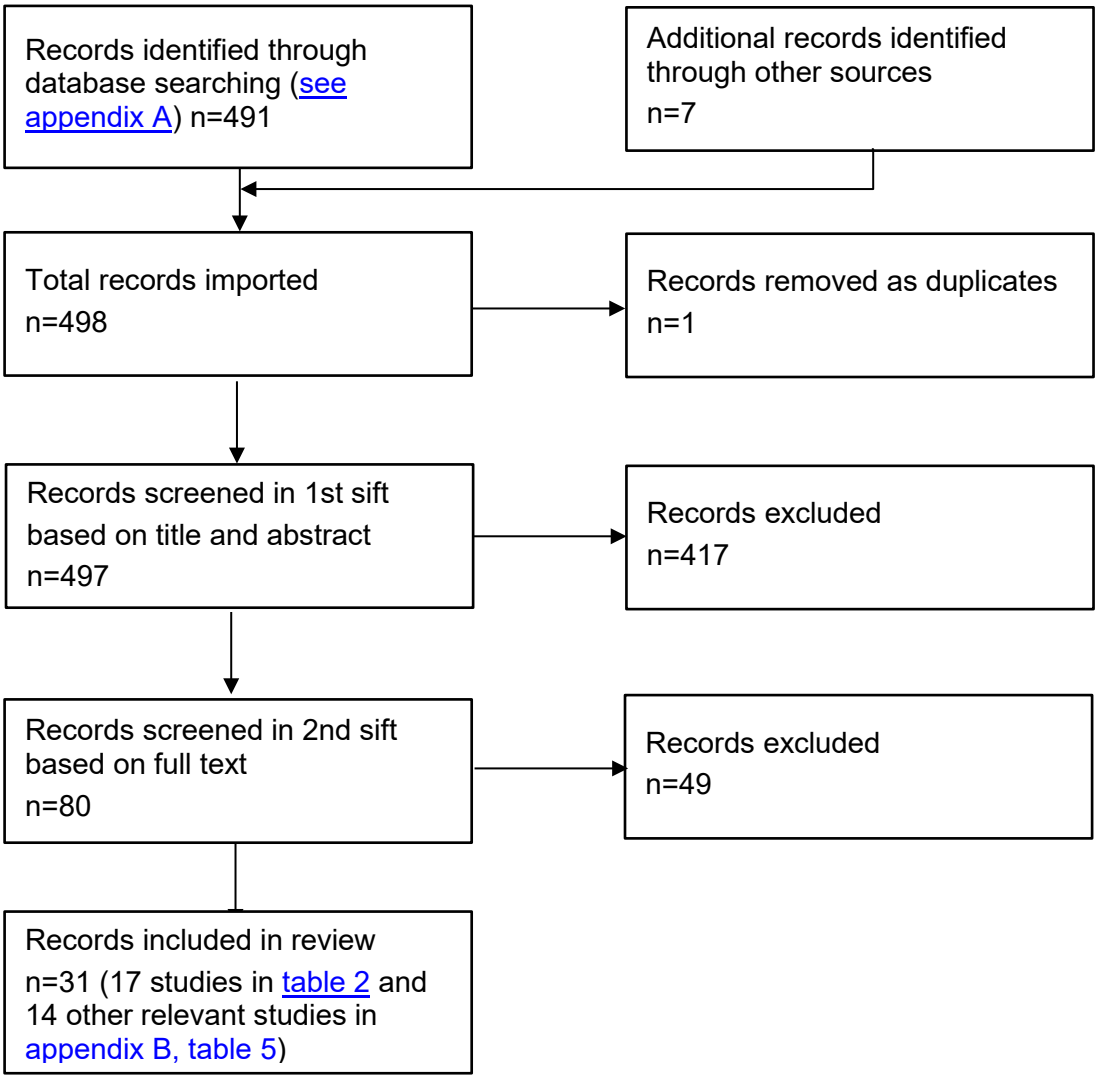

Table 2 Study details

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
1	Colli, 2018b, Italy (3 centres), Germany (2 centres), Lithuania (1 centre), Poland (1 centre)	**n=213** **Age, median (IQR)** 68 (IQR 56 to 77) **Male sex, n (%)** 153 (71.8) **EuroScore II (%), mean (SD)** 1.8 (2.5) **STS-PROM MV repair score (%), mean (SD)** 1.5 (2.1) **NYHA functional class, n (%)** 1: 14 (6.6) 2: 92 (43.2) 3: 101 (47.4) 4: 6 (2.8) **MR grade, n (%)** Severe: 213 (100) **Leaflet involvement, n (%)** PML: 193 (90.6) AML: 11 (5.2)	Retrospective registry study. February 2013 to July 2016	All enrolled people had indications for surgical MV regurgitation due to degenerative MR in accordance with current guidelines. An additional inclusion criterion was the presence of a consistent overlap of tissue to obtain a potential postoperative coaptation length of 3 mm to 5 mm. The evaluation of the potential coaptation was based on an eyeball judgement of the surgeon because of the lack of precise predefined echocardiographic measurements during the initial clinical experience. Exclusion criteria were the presence of active	Off-pump neochordae implantation with the NeoChord DS1000 device	1 year

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		AML and PML: 9 (4.2) **Leaflet prolapse, n (%)** 74 (34.7) Leaflet flail, n (%) 139 (65.3) **Mitral valve anatomical types, n (%)** A: 82 (38.5) B: 98 (46) C: 33 (15.5)		endocarditis and functional MR (Carpentier's types 1 and 3) or mixed disease		
2	Gerosa, 2021, Italy (1 centre)	**n=203** **Age, median (IQR)** 64 (54 to 74) **Male sex, n (%)** 158 (77.8) **Euroscore II, median (IQR)** 0.94 (0.61 to 1.75) **STS PROM MV repair score (%), median (IQR)** 0.60 (0.32 to 1.44) **NYHA functional class, n (%)** 3 or 4: 75 (37.0) **MR grade n (%)**	Retrospective registry study. November 2013 to June 2019	All consecutive people who had MV repair with the NeoChord procedure at University of Padua between November 2013 and June 2019 were included in the current analysis. All the included people presented with severe symptomatic DMR due to prolapse or flail of 1 or both mitral leaflets. The surgical indication was based on clinical and anatomical characteristics and the	Off-pump neochordae implantation with the NeoChord DS1000 device	3 years

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		Severe: 203 (100) **Leaflet involvement, n (%)** PML: 187 (92.1) AML: 8 (3.9) AML and PML: 8 (3.9) **Mitral valve anatomical types, n (%)** A: 106 (52.2) B: 68 (33.5) C: 16 (7.9) D: 13 (6.4)		person's personal preferences regarding treatment independently from age and surgical risk profile		
3	D'Onofrio, 2022, Italy (1 centre	**n=176** **NeoChord = 88** **Male sex, n (%)** 68 (77) Age, median (IQR): 62 (54 to 70) **Euroscore II, median (IQR):** 0.7 (0.5 to 1.0) **NYHA functional class, n (%)** 1: 33 (37.8) 2: 31 (35.4) 3: 24 (26.8)	Retrospective propensity matched cohort	Data of people who had isolated mitral valve repair with NeoChord or conventional surgery from January 2010 to December 2018 was collected. The choice between NeoChord and conventional surgery was primarily based on anatomical characteristics but also on the surgeon's and the person's preferences. People with previous cardiac	TA: Off-pump neochordae implantation with the NeoChord DS1000 device CMVR: Conventional on-pump mitral valve repair with full sternotomy	5 years

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		4: 0 **MR grade, n (%)** 3+: 88 (100) **Mitral valve anatomical types, n (%)** A: 43 (49) B: 39 (44) C: 6 (7) **Conventional surgery = 88** **Male sex, n (%)** 64 (73) **Age, median (IQR):** 61 (52.9 to 71.4) **Euroscore II, median (IQR):** 0.7 (0.6 to 1.0) **NYHA functional class, n (%)** 1: 18 (20) 2: 64 (72.9) 3: 6 (7.1) 4: 0 **MR grade, n (%)** 3+: 88 (100)		surgery, and combined operations, were excluded from the analysis. People with type D mitral valve anatomy were also excluded from this analysis		

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		Mitral valve anatomical types, n (%) A: 37 (42) B: 40 (45) C: 11 (12)				
4	Zorinas, 2019, Lithuania (1 centre)	**n=169** **Neochord = 78** **Age, mean (SD)** 59.5 (12.8) **Male sex, n (%)** 53 (67.9) **STS score (%), median (IQR)** 0.47 (0.24 to 0.74) **EuroScore II (%), median (IQR)** 0.83 (0.67 to 1.35) **NYHA functional class, n (%)** 1: 4 (5.1) 2: 45 (57.7) 3: 28 (35.9) 4: 1 (1.3) **MR grade, n (%)**	Retrospective cohort study	All candidates had indications for surgical MV repair in accordance with the current ACC/AHA and ESC/EACTS guidelines. MV pathology included single or bileaflet MV prolapse or flail, with or without chordal rupture. People with a restrictive mechanism of regurgitation, ischaemic mitral regurgitation, MV infectious lesions and people with a central regurgitation jet were excluded from the study. All people with degenerative MV disease were discussed by the heart team for eligibility to perform either CMVR surgery or	TA: Off-pump neochordae implantation with the NeoChord DS1000 device CMVR: Conventional on-pump mitral valve repair with full sternotomy	30 days

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		Severe: 78 (100) **Conventional surgery = 91** **Age, mean (SD)** 54.2 (11.1) **Male sex, n (%)** 52 (57.1) **STS score (%), median (IQR)** 0.43 (0.31 to 0.70) **EuroScore II (%), median (IQR)** 0.84 (0.67 to 1.13) **NYHA functional class, n (%)** 1: 1 (1.1) 2: 21 (23.1) 3: 68 (74.7) 4: 1 (1.1) **MR grade, n (%)** Severe: 91 (100)		a TA procedure. People with a favourable MV anatomy who agreed to a transapical procedure were selected for the TA		
5	Colli, 2018a, Italy (1 centre)	**n=112** **Age, median (IQR)** 68 (IQR 57 to 76)	Prospective case series	People presenting with severe degenerative MR with the prolapse or	Off-pump neochordae implantation	1 year

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		Male sex, n (%) 82 (73) **EuroScore II (%), median (IQR)** 1.25 (0.67 to 2.10) **STS score (%), median (IQR)** 0.90 (0.39 to 1.74) **NYHA functional class, n (%)** 1: 11 (10) 2: 43 (38) 3: 54 (48) 4: 4 (4) **MR grade, n (%)** Severe: 100 (100) **Leaflet involvement, n (%)** PML: 101 (90) AML: 6 (5) AML and PML: 5 (5) **Leaflet prolapse, n (%)** 48 (43) **Leaflet flail, n (%)** 64 (57)		flail of 1 or both leaflets were considered candidates for the procedure. People with an unfavourable MV anatomy or the presence of active endocarditis were excluded. The surgical indication was based on a discussion between the surgeons and cardiologists, considering operative risk profile, clinical and anatomical characteristics and the patient's personal preferences regarding the treatment course	with the NeoChord DS1000 device	

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		Mitral valve anatomical types, n (%) A: 45 (40) B: 47 (42) C: 20 (18)				
6	D'Onofrio, 2023, Italy (1 centre)	**n=100** **Age, median (IQR)** 66 (58 to 76) **Male sex, n (%)** 73 (73) **STS PROM MV repair, median % (IQR)** 1 (0.4 to 1.8) **EuroScore II** <4%: 90 (90%) 4% to 8%: 6 (6%) >8%: 4 (4%) **NYHA functional class 3 or 4:** 80% **Anatomic type, n (%)** Favourable anatomy: 81 (81)	Retrospective case series	This study included all people who had the NeoChord procedure at the Division of Cardiac Surgery of the University of Padua between November 2013 and March 2016. Inclusion criteria were based on a careful evaluation of MV anatomy. Exclusion criteria were severe LV dysfunction (LV ejection fraction <20%), LV aneurysm, apical thrombosis, and presence of associated heart disease requiring surgical correction	Off-pump neochordae implantation with the NeoChord DS1000 device	5 years

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		Unfavourable anatomy: 18 (19) **MR grade, n (%)** Severe: 100 (100) **Prolapse or flail, n (%)** Prolapse: 42 (42) Flail: 58 (58)				
7	Samalavicius, 2018, Lithuania, (1 centre)	**n=76** **Age, mean (SD)** 60 (13) **Male sex, n (%)** 52 (68) **Euroscore II (%), mean (SD)** 1.23 (1.16) **NYHA functional class, n (%)** 1: 4 (5) 2: 44 (58) 3: 27 (36) 4: 1 (1) **MR grade, n (%)** 3 or more: 51 (67) 4 or more: 25 (33)	Prospective case series	People with severe MR who were candidates for surgical MV repair and had a LVEF >25% were considered. People with functional or ischaemic MR or severe LV dysfunction, infective endocarditis, inflammatory valve disorders, leaflet perforation or heavily calcified valves were excluded from the study. All people who had MV repair using the NeoChord system from December 2011 to December 2016 were included in the study	Off-pump neochordae implantation with the NeoChord DS1000 device	Procedural results

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		Type of mitral pathology, n (%) Anterior leaflet prolapse: 3 (4) Posterior leaflet prolapse: 68 (89) Bileaflet prolapse: 5 (7)				
8	Colli, 2015, Italy (1 centre), Lithuania (1 centre)	**n=63** **Age, median (IQR)** 66 (IQR 52 to 76) **Male sex, n (%)** 42 (67) **EuroScore II (%), median (IQR)** 1 (0.7 to 2.3) **STS score (%), median (IQR)** 0.8 (0.4 to 1.7) **NYHA functional class, n (%)** 1: 3 (5) 2: 25 (40) 3: 31 (49) 4: 4 (6) **MR grade, n (%)**	Prospective case series	All people were candidates for conventional MV repair surgery, in accordance with the current guidelines. People were considered eligible for NeoChord implantation when severe MR was due to isolated prolapse or flail of the posterior, anterior or both MV leaflets. Exclusion criteria were the presence of active endocarditis or unfavourable MV anatomy	Off-pump neochordae implantation with the NeoChord DS1000 device	30 days

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		3+/4: 7 (11) 4+/4: 56 (89) **Prolapsing mitral leaflet, n (%)** PML: 56 (89) AML: 4 (6) AML and PML: 3 (5) **Leaflet involvement, n (%)** PML: 56 (89) AML: 4 (6) AML and PML: 3 (5) **Mitral valve anatomical types, n (%)** A: 22 (35) B: 27 (43) C: 14 (22)				
9	Colli, 2016, Italy (1 centre)	**n=49** **Age, median (IQR)** 72 (58 to 78) **Male sex, n (%)** 34 (69) **EuroScore II (%), median (IQR)** 1.75 (0.73 to 2.75)	Prospective case series	People selected for the NeoChord procedure presented severe degenerative MR due to posterior, anterior or both MV leaflets prolapse or flail. Exclusion criteria were the presence of active endocarditis, secondary	Off-pump neochordae implantation with the NeoChord DS1000 device	12 months

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		STS score (%), median (IQR) 1.44 (0.73 to 2.75) **NYHA functional class, n (%)** 2: 14 (28.6) 3: 32 (65.3) 4: 3 (6.1) **MR grade, n (%)** Severe (3 or 4+/4): 49 (100%) **Prolapsing mitral leaflet, n (%)** PML: 44 (89.8) AML: 4 (8.2) AML and PML: 1 (2)+/4): 49 (100%)		MR and unfavourable MV anatomy.		
10	Wrobel, 2019, Poland (1 centre)	**n=37** **Age, mean (SD)** 62.3 (13.4) **Male sex, n (%)** 29 (78) **Euroscore II, median (range):** 0.92 (0.56 to 3.73) **Leaflet pathology, n (%)**	Prospective case series	Transapical chordal implantation was considered suitable for patients if severe MR was present due to prolapse or flail of 1 leaflet and had the potential for good coaptation without	Off-pump neochordae implantation with the NeoChord DS1000 device	Procedural results

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		Posterior: 35 (95) Anterior: 2 (5) **Type of pathology, n (%)** A (Isolated central posterior leaflet prolapse): 25 (67.6) B (multiple prolapsing segments): 8 (21.6) C (commissural involvement, anterior leaflet): 4 (10.8)		requiring a prosthetic annuloplasty		
11	Seeburger, 2014, Germany (3 centres), Italy (2 centres), Denmark (1 centre), Lithuania (1 centre)	**n=30** **Age, mean (SD)** 63.5 (11.9) **Male sex, n (%)** 18 (60%) **MR grade, n (%)** 3+: 3 (10) 4+ 27 (90) **NYHA functional class, n (%)** 2: 13 (43.3) 3: 17 (56.6)	Prospective case series	People with severe MR due to isolated Carpentier type 2 prolapse of the posterior MV leaflet and no annulus dilation, with an indication for surgery confirmed in accordance with guidelines, were included in the trial. Key exclusion criteria included secondary MR, severe left ventricular dysfunction, anterior or bileaflet MV prolapse, permanent atrial fibrillation, and	Off-pump neochordae implantation with the NeoChord DS1000 device	30 days

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
				concomitant cardiac disease with an indication for surgical treatment		
12	Kurnicka, 2019, Poland (1 centre)	**n=21** **Age, mean (SD)** 60.7 (12.7) **Male sex, n (%)** 17 (81) **NYHA functional class, n (%)** 1: 6 (28.6) 2: 12 (57.1) 3: 3 (14.3) 4: 0 **Posterior leaflet flail, n (%)** 12 (57.1) **Posterior leaflet prolapse, n (%)** 9 (42.8) **Mitral valve anatomical types, n (%)** A: 12 (57.1) B: 8 (38.1)	Prospective case series	Severe MR, posterior leaflet prolapse or flail, single eccentric MR jet due to prolapse or flail, good potential for coaptation, a healthy long anterior leaflet, technical possibility to place chords. Exclusion criteria included severe LV enlargement, no tissue overlap, functional MR, multiple jets in different areas, endocarditis, significant leaflet and annulus calcifications, bileaflet prolapse, prolapse or flail of the commissural regions, leaflet perforation	Off-pump neochordae implantation with the NeoChord DS1000 device	6 months

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		C: 1 (4.8)				
13	Barbero, 2025, Italy (1 centre)	**NeoChord = 15** **Male sex, n (%)** 11 (73) **Age, mean (SD):** 67.5 (7.8) **Euroscore II %, mean (SD):** 3.4 (1.4) **Mitral valve anatomical types, n (%)** A: 9 (60) B: 4 (27) C: 2 (13) **Open surgery = 22** **Male sex, n (%)** 16 (73) **Age, mean (SD):** 63.9 (8.5) **Euroscore II %, mean (SD):** 4.3 (2.9) **Mitral valve anatomical types, n (%)** A: 8 (36) B: 10 (45) C: 4 (18)	Retrospective cohort	People with severe MV regurgitation caused by recurrent prolapse after prior MV repair were retrospectively identified. Only people with prolapse and a leaflet-to-annulus index of 1.2 or more were included. Patients with endocarditis, functional MV regurgitation, congenital malformations, Barlow disease, active clefts, dehiscence of the annuloplasty ring, and MV stenosis were excluded	NeoChord: Off-pump neochordae implantation with the NeoChord DS1000 device Open surgery: Conventional on-pump mitral valve repair with either full sternotomy or right mini thoracotomy	**Median follow up** NeoChord: 544 days Open surgery: 1,645 days

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
14	Salizzoni, 2025, 26 centres	**n=72** **Age, mean (SD)** 65.1 (11.7) **Male sex, n (%)** 57 (79) **Euroscore II %, mean (SD):** 4.2 (3.4) **Mitral valve anatomical types, n (%)** A: 53 (72) B: 16 (24) C: 3 (4) **NYHA functional class, n (%)** 2: 33 (46) 3: 22 (31) 4: 3 (4)	Retrospective multicentre registry (conference presentation)	People with recurrence of severe MR after previous surgical MV repair	Off-pump neochordae implantation with the NeoChord DS1000 device	**Median follow up** 617 days
15	Gerosa, 2021, 5 European centres	**n=15** **Age, median (IQR)** 61 (53 to 72) **Male sex, n (%)** 11 (73) **Euroscore II %, median (IQR):** 3.2 (2 to 5.5) **NYHA functional class, n (%)** 1: 3 (20) 2: 4 (27)	Retrospective case series	All adults presenting with recurrence of severe MR after a previous surgical mitral valve repair and treated with NeoChord implantation between January 2014 and December 2018 were included in the study	Off-pump neochordae implantation with the NeoChord DS1000 device	**Median follow up** 1.3 years

Study no.	First author, date Country	Characteristics of people in the study (as reported by the study)	Study design	Inclusion criteria	Intervention	Follow up
		3: 8 (53) 4: 0 **MR grade, n (%)** Severe: 15 (100%) **Type of mitral pathology, n (%)** Leaflet prolapse: 13 (87) Leaflet flail: 2 (13)				
16	Seguchi, 2023, Japan	69-year-old female with a history of conventional mitral repair via median sternotomy developed heart failure due to mitral regurgitation from recurrent posterior leaflet P2 prolapse	Case report	N/A	Off-pump neochordae implantation with the NeoChord DS1000 device	6 months
17	Blessberger, 2021, Austria	57-year-old male who had had a minimally invasive surgical mitral valve repair 4 years earlier. TOE identified a relapse of severe mitral valve regurgitation. The recurring regurgitant jet was caused by a flail leaflet due to newly ruptured native chords	Case report	N/A	Off-pump neochordae implantation with the NeoChord DS1000 device	16 months

Table 3 Study outcomes

First author, date	Efficacy outcomes	Safety outcomes
Colli, 2018b	**Early procedural success** 100% **Median procedure time, min (IQR)** 130 (117.5 to 150) **MR at discharge, n (%)** 0+: 32 (51) 1+: 22 (35) 2+: 7 (11) 3+: 1 (2) 4+: 1 (2) **MR at 30 days, n (%)** 0+: 29 (46) 1+: 16 (25) 2+: 10 (16) 3+: 7 (11) 4+: 1 (2) **NYHA class at 30 days, n (%)** 1: 55 (87) 2: 4 (6) 3: 4(6)	**Perioperative complications, n (%)** Ventricular fibrillation: 3 (5) CPB/ECMO: 1 Bleeding requiring >2 blood units: 3 (5) **Major adverse events, n (%)** Myocardial infarction: 1 Septicaemia: 2 (3%) **Minor adverse events, n (%)** Severe pericardial effusion: 2 (3) Wound dehiscence: 1 Persistent AF: 13 (21) Permanent AF: 1 PM implantation: 2 (3) **Reoperation for NeoChord procedure failure at 30 days, n (%)** New Neochordae implantation: 1 Neochordae retensioning: 2 (3) Mitral valve repair: 3 (5) Mitral valve replacement: 2 (3) **Median ICU stay, hours** 24

First author, date	Efficacy outcomes	Safety outcomes
		Median duration mechanical ventilation, hours (IQR) 3 (2 to 5) **Median hospital stay, days (IQR)** 8 (6 to 11) **Discharge location, n (%)** Home: 9 (14) Cardiac rehabilitation centre: 54 (86)
Gerosa, 2021	**Procedural success, n (%)** 200 (99%) **KM 1 year survival** 99% (SD 1%) **KM 3 year survival** 94% (SD 3%) **Operative time, min (IQR)** 120 (106 to 150) **Rate of patient success** 1 year: 91% (SD 2%) 2 year: 90% (SD 2%) 3 year: 81% (SD 4%) **Patient success by anatomy at 3 years:** Type A: 88% (SD 5%) Type B: 83% (SD 5%) Type C: 73% (SD 12%)	**Median mechanical ventilation time, hours (IQR)** 2 (1-3) **Procedural ECMO, n (%)** 4 (2) **Median hospital stay, days (IQR)** 7 (6-8) **Discharge location, n (%)** Home: 157 (77.7) Rehabilitation centre: 41 (20.3) **In-hospital death, n** 1 **TIA, n (%)** 1 **Major or extensive bleeding, n (%)** 8 (4)

First author, date	Efficacy outcomes	Safety outcomes
	Type D: 57% (SD 19%), p=0.001 **MR at discharge, n (%)** Absent/trivial: 83 (42) Mild: 89 (45) Moderate: 21 (10) Severe: 5 (3) **MR at 3 years, n (%)** Absent/trivial: 60 (12) Mild: 26 (52) Moderate: 15 (30) Severe: 3 (6) **Change in echocardiographic outcomes from preoperation to discharge** LVEDVi (mL/m2): 12.8 (SD 19.6), p<0.001 LVESVi (mL/m2): -0.4 (SD 10.8), p=0.960 LVEF (%): 8.0 (SD 10.2), p<0.001 LAVi (mL/m^2): -11.6 (SD 17.3), p<0.001 sPAP (mmHg): 5.7 (SD 12.8), p<0.001 **Change in echocardiographic outcomes from discharge to 3 years** LVEDVi (mL/m^2): 5.8 (SD 14.8), p=0.138 LVESVi (mL/m^2): 5.6 (SD 14.2), p=0.150 LVEF (%): -5.1 (SD 8.0), p=0.021 LAVi (mL/m^2): 3.2 (SD 11.3), p=0.260	**Major pleural effusion, n (%)** 4 (2) **AKI stage 3, n (%)** 5 (3) **Ventricular fibrillation, n** 1 **New-onset atrial fibrillation, n** 1

First author, date	Efficacy outcomes	Safety outcomes
D'Onofrio, 2022	**Median follow up, years** NeoChord: 3.4 Conventional: 6.6 **Median surgery duration, hours (IQR)** NeoChord: 2.0 (1.8 to 2.5) Conventional: 4.0 (3.5 to 4.0) **5 year survival** NeoChord: 92.1% (95% CI 82.1 to 100) Conventional: 95.5% (95% CI 90.6 to 100), p=0.94 **5 year survival (type A anatomy)** NeoChord: 100% Conventional: 92.8% (95% CI 83.7 to 100), p=0.94 **NeoChord MR grade at discharge, n (%) p=0.084** 0 to 1+: 80 (91) 2+: 4 (5%) 3+: 4 (5%) **Conventional MR grade at discharge, n (%) p=0.084** 0 to 1+: 87 (99) 2+: 1 3+: 0 **Freedom from moderate MR at 5 years**	**30-day mortality, %** 0% **Mean ICU stay, days** 1 **Conversion to repair, n** 1 **Mean intubation time, hours (IQR)** NeoChord: 2 (1 to 3) Conventional: 7.5 (5 to 12) **Re-exploration for bleeding, n (%)** NeoChord: 0 Conventional: 4 (5) **Atrial fibrillation, n (%)** NeoChord: 5 (6) Conventional: 30 (34) **Median in-hospital stay, days (IQR)** NeoChord: 7 (6 to 8) Conventional: 8 (7 to 10) **CVVH, n** NeoChord: 0 Conventional: 1 **Wound infection, n** NeoChord: 0 Conventional: 1

First author, date	Efficacy outcomes	Safety outcomes
	NeoChord: 58% (95% CI 43 to 77) Conventional: 85% (95% CI 76 to 95), p=0.001 **Freedom from severe MR at 5 years** NeoChord: 78.1% (95% CI 65 to 93) Conventional: 90% (95% CI 82 to 98), p=0.032 **Freedom from reoperation** NeoChord: 79% (95% CI 59 to 95) Conventional: 92% (95% CI 85 to 99) **Median LVEF at discharge, % (IQR)** NeoChord: 55 (51 to 60) Conventional: 56 (51 to 61), p=0.867 **Median LVEF at follow up, % (IQR)** NeoChord: 59 (56 to 63) Conventional: 60 (55 to 64), p=0.89 **Median iLVEDV at discharge, ml/m2 (IQR)** NeoChord: 76 (59 to 87) Conventional: 50 (63 to 72), p=0.001 **Median iLVEDV at follow up, ml/m^2 (IQR)** NeoChord: 66 (66 to 72) Conventional: 62 (60 to 65), p=0.001 **>90% of patients in both groups were in NYHA class 1 or 2 at follow up**	
Zorinas, 2019	**Median duration of surgery, min (IQR)** NeoChord: 120 (110 to 146)	**Mortality, n** Neochord: 1

First author, date	Efficacy outcomes	Safety outcomes
	Conventional: 312 (280 to 361), p<0.001 **NeoChord postoperative MR, n (%)** Absent: 43 (56), p<0.001 Mild: 28 (36), p=0.007 Moderate: 4 (5), p=0.03 Severe (failed repair): 2 (3), p=0.12 **Conventional postoperative MR, n (%)** Absent: 75 (82), p<0.001 Mild: 16 (18), p=0.007 **NeoChord severe MR at 30 days, n (%)** 9 (12), p=0.001 **Conventional severe MR at 30 days, n** 0, p=0.001	Conventional: 0, p=0.277 **Mean postoperative blood loss, ml** NeoChord: 200 Conventional: 300, p=0.001 **Median time to weaning from ventilation, hours** NeoChord: 4 Conventional: 7, p<0.005 **Median length of ICU stay, hours (IQR)** NeoChord: 22 (20 to 24) Conventional: 67.5 (44 to 113), p<0.001 **Median length of hospital stay, n (IQR)** NeoChord: 8 (7 to 9) Conventional: 16 (14 to 21), p<0.001 **Conversion to full sternotomy, n** NeoChord: 1 **New atrial fibrillation, n (%)** NeoChord: 9 (12) Conventional: 23 (25), p=0.031 **Stroke, n (%)** NeoChord: 0 Conventional: 2 (2), p=0.191 **Wound infection, n** NeoChord: 0 Conventional: 1, p=0.354

First author, date	Efficacy outcomes	Safety outcomes
		Renal failure, n (%) NeoChord: 2 (3) Conventional: 14 (15), p=0.007 **New PPM within 30 days post-procedure, n (%)** NeoChord: 2 (3) Conventional: 11 (12), p=0.003 **Re-exploration, n (%)** NeoChord: 3 (4) Conventional: 3 (3), p=0.577
Colli, 2018a	**Treatment success at 1 year, % (SD)** 89 (2.9) **Procedural success, n (%)** 110 (98) **Operative time, min (IQR)** 118 (110-155) **Survival at 1 year, n (%)** 104 (96) **MR at discharge, n (%)** Trivial: 30 (31) Mild: 51 (53) Moderate: 14 (15) Severe: 1 (1) **MR at 1 year, n (%)** Trivial: 33 (39)	**Death, n (%)** 2 (2) **TIA, n (%)** 1 **Myocardial infarction, n (%)** 1 (1) **AKI, n (%)** Stage 1: 9 (8) Stage 2: 2 (2) Stage 3: 2 (2) Need for CVVH: 2 (2) **Bleeding, n (%)** Minor: 9 (8) Major: 3 (3) Extensive: 5 (4)

First author, date	Efficacy outcomes	Safety outcomes
	Mild: 36 (39) Moderate: 20 (22) Severe: 3 (3)	**Conduction disturbance, n (%)** 2 (2) **New-onset atrial fibrillation, n (%)** Paroxysmal: 25 (23) Persistent: 5 (5) **Pericardial effusion, n (%)** Minor: 7 (6) **Pleural effusion, n (%)** Minor: 68 (62) Major: 2 (2) **Wound dehiscence, n** 1 **Hospital stay, days (IQR)** 7 (6 to 9) **Discharge location, n (%)** Home: 72 (65) Rehabilitation centre: 36 (33)
D'Onofrio, 2023	**Median follow up** 5.1 years **Median operative time, min (IQR)** 123 (105 to 150) **Technical success, %** 98 **Procedural success, %**	**30-day mortality, n (%)** 2 (2) **Intraoperative complications, n (%)** ECMO: 2 (2) Conversion to conventional surgery: 2 (2) Major or extensive bleeding: 5 (5) **Early mortality, n (%)**

First author, date	Efficacy outcomes	Safety outcomes
	94 **Device success, %** 30 days: 94 1 year: 9 5 year: 78 **Patient success at 1 year, %** 92 **5 year overall survival, %** 84 (95% CI 76 to 92) No statistically significant difference (p=0.13) between FA and UA in terms of survival **MR grade at discharge, n (%)** None or trace: 30 (31) Mild: 51 (53) Moderate: 14 (15%) Severe: 1 **MR grade at 5 years, n (%)** None/trace: 5 (8) Mild: 33 (51) Moderate: 19 (30) Severe: 7 (11) **Overall cumulative incidence of severe MR recurrence, %** 1 year: 9 (95% CI 4 to 15)	2 (2) **Median ICU stay, day (IQR)** 1 (1 to 1) **Hospital stay, days (IQR)** 7 (6 to 9) **Periprocedural complications, n (%)** Reoperation for severe MR: 2 (2) TIA: 1 AKI stage 2 or 3: 4 (4) Renal replacement therapy: 2 (2) New-onset AF: 28 (28) **Early reintervention, n (%)** 3 (3)

First author, date	Efficacy outcomes	Safety outcomes
	3 years: 12 (95% CI 6 to 19) 5 years: 24 (95% CI 15 to 32) **Overall cumulative incidence of reoperation, %** 1 year: 7 (95% CI 2 to 12) 3 years: 10 (95% CI 4 to 16) 5 years: 17 (95% CI 9 to 24) Patients with FA compared with UA had a lower incidence of reintervention (5% versus 19% at 1 year; 6% versus 26% at 3 years; and 15% versus 43% at 5 years; p<0.001 **NYHA functional class at 5 years, %** 1: 78 2: 22 **Median LVEF preoperative, % (IQR)** 61 (57 to 67) **Median LVEF at discharge, % (IQR)** 57 (53 to 60), p=0.09 **Median LVEF at 5 years, % (IQR)** 59 (56 to 64), p=0.09	
Samalavicius, 2018	**Median duration of surgery, min (IQR)** 120 (115 to 145) **MR post procedure, n (%)** Trivial: 42 (56%) Grade 1+: 27 (36)	**Postoperative, n (%)** New atrial fibrillation: 9 (12) Need to inotropic support: 20 (26) **Median duration of mechanical ventilation, hours (IQR)**

First author, date	Efficacy outcomes	Safety outcomes
	Grade 2+: 4 (5) Grade >2+: 2 (3) **Procedural success, n (%)** 75 (99)	4 (2.6 to 6) **Median length of ICU stay, hours (IQR)** 22 (21 to 24) **Median length of hospital stay, days (IQR)** 8 (7 to 11) **Postoperative mortality, n** 0 **Sepsis, n** 1 **Renal failure, n (%)** 2 (3) **Re-exploration for bleeding, n (%)** 2 (3)
Colli, 2015	**Early procedural success** 100% **Median procedure time, min (IQR)** 130 (117.5 to 150) **MR at discharge, n (%)** 0+: 32 (51) 1+: 22 (35) 2+: 7 (11) 3+: 1 (2) 4+: 1 (2)	**Perioperative complications, n (%)** Ventricular fibrillation: 3 (5) CPB/ECMO: 1 Bleeding requiting more than 2 blood units: 3 (5) **Major adverse events, n (%)** Myocardial infarction: 1 Septicaemia: 2 (3%) **Minor adverse events, n (%)** Severe pericardial effusion: 2 (3) Wound dehiscence: 1

First author, date	Efficacy outcomes	Safety outcomes
	MR at 30 days, n (%) 0+: 29 (46) 1+: 16 (25) 2+: 10 (16) 3+: 7 (11) 4+: 1 (2) **NYHA class at 30 days, n (%)** 1: 55 (87) 2: 4 (6) 3: 4(6)	Persistent AF: 13 (21) Permanent AF: 1 PM implantation: 2 (3) **Reoperation for NeoChord procedure failure at 30 days, n (%)** New Neochordae implantation: 1 Neochordae retensioning: 2 (3) Mitral valve repair: 3 (5) Mitral valve replacement: 2 (3) **Median ICU stay, hours** 24 **Median duration mechanical ventilation, hours (IQR)** 3 (2 to 5) **Median hospital stay, days (IQR)** 8 (6 to 11) **Discharge location, n (%)** Home: 9 (14) Cardiac rehabilitation centre: 54 (86)
Colli, 2016	**Acute procedure success** 100% **Echocardiographic success at 3 months** 90% **Median operative time, mins (IQR)**	**Perioperative complications, n (%)** Ventricular fibrillation: 1 CPB/ECMO: 1 Bleeding requiting more than 2 blood units: 4 (8.2) **Major adverse events, n (%)**

First author, date	Efficacy outcomes	Safety outcomes
	120 (100 - 135) **Residual MR at discharge, n (%)** 0+: 22 (44.9) 1+: 14 (28.6) 2+: 11 (22.4) 3+: 2 (4.1) **Residual MR at 3 months, n (%)** 0+: 16 (33.4) 1+: 15 (31.2) 2+: 12 (25) 3+: 5 (10.4) **NYHA class at discharge, n (%)** 1: 47 (95.9) 2: 1 3: 1 **NYHA class at 3 months, n (%)** 1: 41 (85.4) 2: 2 (4.1) 3: 5 (10.4) **3 month freedom from MR 2+ by anatomical type (p=0.43)** Type A: 100 Type B: 89 ± 6% Type C: 83 ± 11%	Death: 1 Myocardial infarction: 1 Septicaemia: 1 **Minor adverse events, n (%)** Severe pericardial effusion: 3 (6.1) Deep wound dehiscence: 1 ARF: 4 (8.2) ARF needing CVVH: 1 Persistent AF: 20 (40.8) Permanent AF: 3 (6.1) **Reoperation for NeoChord procedure failure at 3 months, n (%)** 4 (8.2) **Median ICU stay, hours** 24 **Median mechanical ventilation time, hours (IQR)** 2 (0 to 3) **Median hospital stay, days (IQR)** 7 (6 to 10)

First author, date	Efficacy outcomes	Safety outcomes
Wrobel, 2019	**Median operative time, min (IQR)** 115 (65 to 175) **Post-procedure MR, n (%)** Trace to mild: 33 (90) Mild to moderate: 3 (8) Moderate 1 (2)	**Median blood loss, ml (range)** 300 (100 to 1,280) **Median ICU stay, hours (range)** 32 (22 to 100) **Median hospital stay, days (range)** 7 (4 to 17) **Surgical complications, n** 0 **Major adverse events, n** 0 **Minor adverse events, n (%)** Atrial fibrillation: 9 (24) Pleural effusion: 2 (5) Blood transfusion: 1
Seeburger, 2014	**Post-procedure MR ≤2+, n (%, 95% CI)** 26 (87, 69 to 96) **30-day MR ≤2+, n (%, 95% CI)** 17 (59, 39 to 77) 71% of these maintained MR grade ≤1+ **Acute procedural success, n (%)** 26 (87)	**Any major adverse event, n (%)** 8 (27) **Death, n (%)** 1 (3) **Reoperation for failed repair, n (%)** 6 (20) **Procedure-related blood transfusion >2 units of blood, n (%)** 5 (17)

First author, date	Efficacy outcomes	Safety outcomes
		Procedural ventilation >48 hours, n (%) 1 (3) **Stroke (transient), n (%)** 1 (3)
Kurnicka, 2019	**Procedural success, %** 100 **MR grade post procedure, %** Trivial: 43 Mild: 57 **MR grade 6 months, %** Trivial: 14 Mild: 67 Moderate: 19 **NYHA class at 6 months, %** 1: 100 **Mean LAV, ml (SD)** Preoperative: 84.5 (23.3) 6 months: 58.5 (16.6), p<0.0001 **Mean LAVi, ml/m^2 (SD)** Preoperative: 44.9 (10.6) 6 months: 31.1 (7.5), p<0.0001 **Mean LVEDD, ml (SD)** Preoperative: 55.4 (6.7) 6 months: 50.2 (5.6), p<0.0001	**Postoperative complications** 0 **Conversion to conventional surgery** 0

First author, date	Efficacy outcomes	Safety outcomes
	Mean LVESD, ml (SD) Preoperative: 37.5 (6.9) 6 months: 34.2 (4.1), p=0.005 **Mean LVEDV, ml (SD)** Preoperative: 123.9 (44.3) 6 months: 91.1 (25.3), p<0.0001 **Mean LVESV, ml (SD)** Preoperative: 59.8 (29.7) 6 months: 42.7 (11.4), p=0.006	
Barbero, 2025	**Mean duration of surgery, min (SD)** NeoChord: 146.1 (30.7) Open surgery: 310.2 (79.2), p<0.001 **NeoChord end-procedure MR, n (%)** Mild: 2 (13) Moderate: 1 **Open surgery end-procedure MR, n (%)** Mild: 2 (9), p=0.007 **NeoChord 1-year MR, n (%)** Mild: 7 (58) **Open surgery 1-year MR, n (%)** Mild: 5 (23) Moderate: 1 **1-year LVEF, % (SD)** NeoChord: 56.3 (2.9)	**Median mechanical ventilation time, hours (IQR)** NeoChord: 3 (0 to 5) Open surgery: 12 (12 to 15), p<0.0001 **Median length of ICU stay, hours (IQR)** NeoChord: 14 (0 to 17) Open surgery: 22 (20 to 30), p<0.0001 **Median length of hospital stay, days (IQR)** NeoChord: 4 (3 to 5) Open surgery: 6 (6 to 7), p<0.001 **New atrial fibrillation, n (%)** NeoChord: 1 (7) Open surgery: 7 (32) **Disabling stroke, n (%)** NeoChord: 0 Open surgery: 1

First author, date	Efficacy outcomes	Safety outcomes
	Open surgery: 56.8 (6.0) **1-year mean LVEDV, ml (SD)** NeoChord: 107.1 (21.9) Open surgery: 110.4 (26.4) **1-year mean sPAP, mmHg (SD)** NeoChord: 27.1 (4.6) Open surgery: 29.3 (5.8)	**Re-exploration for bleeding, n** NeoChord: 1 Open surgery: 1 **30-day mortality, n** NeoChord: 0 Open surgery: 0
Salizzoni, 2025	**MVARC technical success, n (%)** 72 (100) **MVARC device success, n (%)** 70 (97.2) **MVARC procedural success, n (%)** 69 (95.8) **Mean duration of surgery, min (SD)** 138.5 (61.0) **End-procedure MR, n (%)** Mild: 19 (26) Moderate: 3 (4) **Last follow-up MR, n (%)** Mild: 23 (32) Moderate: 6 (9) Severe: 2 (3) **Last follow-up mean LVEF, % (SD)** 55.8 (8.4)	**Median mechanical ventilation time, hours (IQR)** 2 (0 to 4) **Median length of ICU stay, hours (IQR)** 18 (0 to 24) **ICU not required, n (%)** 20 (28) **Median length of hospital stay, days (IQR)** 4 (4 to 5) **30-day mortality, n** 1 **New atrial fibrillation, n (%)** 3 (4) **Last-follow-up reintervention** 5 (7)

First author, date	Efficacy outcomes	Safety outcomes
	Last follow-up mean sPAP, mmHg (SD) 26.7 (8.6) **Last follow-up NYHA functional class, %** I: 93%	
Gerosa, 2021	**Procedure success, n (%)** 15 (100) **Technical success, n (%)** 15 (100) **KM 1-year patient success** 92% (SD 7%) **KM 2-year patient success** 90% (SD 10%) **Median operative time, min (IQR)** 140 (110 to 160) **MR grade discharge, n (%)** Trivial: 6 (40) Mild: 7 (47) Moderate: 2 (13) **MR grade 1 year, n (%)** Trivial: 3 (27) Mild: 6 (55) Moderate: 1 Severe: 1 **MR grade 2 year, n (%)**	**Median mechanical ventilation time, hours (IQR)** 5 (3 to 6) **Median length of ICU stay, days (IQR)** 1 (1 to 1) **Median length of hospital stay, days (IQR)** 7 (6 to 9) **Median intraoperative blood loss, mL (IQR)** 280 (163 to 328) **New atrial fibrillation, n (%)** 3 (27) **Mortality during follow up, n** 1

First author, date	Efficacy outcomes	Safety outcomes
	Trivial: 3 (50) Mild: 2 (33) Moderate: 1 **NYHA class at discharge, n (%)** 1: 14 (93) 2: 1 **NYHA class at 2 year, n (%)** 1: 5 (83) 2: 1 **Median LVEF at discharge, % (IQR)** 59.5 (55 to 60.8) **KM freedom from more than mild MR at 1 year** 92% (SD 7%) **KM freedom from more than mild MR at 2 year** 90% (SD 10%)	
Seguchi, 2023	**Operative time** 2 hours 42 minutes **MR grade discharge** Trivial **MR grade 6 months** Trivial	**Transfusion not required** **No complications**
Blessberger, 2021	**Symptom free at 16-month follow up** **MR at 16-month follow up**	**Length of hospital stay, days** 10

First author, date	Efficacy outcomes	Safety outcomes
	None	

Procedure technique

All the included studies performed the NeoChord procedure using the NeoChord DS1000 device. Technique was consistent throughout the included studies. Seeburger (2014) revised the surgical access to a posterolateral apical approach (introduced after 15 people had implants) during the study and presented both separate and combined results.

Efficacy

Composite success endpoints

Success outcomes were reported in 12 studies with varying definitions and use of MVARC criteria.

Naive repair population

In the prospective case series by Colli (2015), early procedural success was defined as implantation of at least 2 neochordae with immediate reduction in MR to less than 2+ after the procedure and was achieved in 100% of people in the study. Considering the different MV anatomical types, the 30-day procedural success rate was 95% in type A, 92% in type B and 71% in type C.

In the prospective case series by Colli (2016), acute procedural success was defined as the successful placement of a least 3 neochordae with a reduction in residual MR to less than 2+ and was achieved in 100% of people in the study. Echocardiographic success was defined as freedom from residual MR of 2+ or more. At 3-month follow up, echocardiographic success was achieved in 90% (SD 4%) of people in the study. Considering the different MV anatomy types, 3-month freedom from MR of 2+ or greater was 100% in type A, 89% (SD 6%) in type B and 83% (SD 11%) in type C. But, the difference was not statistically significant between the groups (p=0.43).

In the prospective case series by Colli (2018a), procedural success was achieved in 98% of people who had the procedure. A composite 1-year treatment success endpoint was also established based on MVARC criteria. The treatment was considered a success if the person having treatment met the following criteria at the 1-year follow up: (1) technical success including the placement of at least 2 neochordae and residual mitral regurgitation mild or less at the end of the procedure; (2) freedom from major adverse events such as death, stroke, mitral regurgitation higher than moderate, structural or functional valvular failure and/or unplanned interventions related to the procedure or device at 1 year; and (3) freedom from a decline in baseline symptoms. This endpoint was achieved in 89% (SD 3%) of patients.

In the retrospective registry study by Colli (2018b), outcome definitions were based on the MVARC guidelines. Procedural success (defined as the placement of at least 2 neochordae and mild or less MR at the end of the procedure) was achieved in 97% of people.

In the retrospective case series by D'Onofrio (2023), outcome definitions for technical, device, procedural and patient success were based on MVARC guidelines. Technical and procedural success were 98% and 94%, respectively. Device success was 94%, 92% and 78% at 30 days, 1 year and 5 years, respectively. Patient success at 1 year was 92%.

In the retrospective registry study by Gerosa (2021), patient and procedural success were defined in accordance with MVARC guidelines. Procedural success was defined as the placement of at least 2 neochordae and achievement of mild or less MR. The primary endpoint was patient success, a composite of procedural success, freedom from death, stroke, MR greater than moderate, unplanned interventions related to the procedure, cardiac-related rehospitalisation, or worsening NYHA functional class at each year of follow up.

Procedural success was achieved in 99% of people who had the procedure. The rate of people achieving the primary endpoint of patient success was 91% (SD 2%) at 1 year, 90% (SD 2%) at 2 years and 81% (SD 4%) at 3 years. Considering the different MV anatomical types, the rate of patient success at 3 years was 88% (SD 5%) for type A, 84% (SD 5%) for type B, 73% (SD 12%) for type C and 57% (SD 19%) for type D. The rate was statistically significantly different (p=0.001) between anatomical categorical types.

In the prospective case series by Kurnicka (2019), early procedural success was defined as placement of at least 2 neochordae with a significant reduction of MR (reduction of regurgitation from severe to trace or mild). This outcome was achieved in 100% of people who had the procedure. At 6-month follow up, MR remained trace or mild in 81% of people.

In the prospective case series by Samalavicius (2018), procedural success was reported in 99% of people who had the procedure. However, this outcome was not defined.

In the prospective case series by Seeburger (2014), acute procedural success was defined as the placement of at least 1 neochord and reduction in MR to 2+ or less. 87% of people who had the procedure had acute procedural success.

Re-repair population

In the retrospective registry by Salizzoni (2025), outcome definitions for technical, device and procedural success were based on MVARC guidelines. Technical and procedural success were 100% and 96%, respectively. Device success was 97%.

In the retrospective case series by Gerosa (2021), technical and procedure success were both 100%. KM patient success was 92% (SD 7%) at 1 year and 90% (SD 10%) at 2 years.

MR reduction

MR outcomes were reported in 15 studies with varying grading scales and multiple source guidelines used.

Naive repair population

In the prospective case series by Colli (2016), MR severity was graded in accordance with ASE guidelines. All people included in the study cohort had severe MR (3 or 4+) at baseline. At discharge, 45% had MR grade 0+, 29% had MR grade 1+, 22% had MR grade 2+ and 4% had MR grade 3+. At 3-month follow up, 33% had MR grade 0+, 31% had MR grade 1+, 25% had MR grade 2+ and 10% had MR grade 3+. Considering the different MV anatomical types, 3-month freedom from MR greater than 2+ was 100% in type A, 89% (SD 6%) in type B and 83% (SD 6%) 11% in type C. But, this difference was not statistically significant (p=0.43).

In the prospective case series by Colli (2015), MR severity was graded in accordance with ASE guidelines. At baseline, 11% of people included in the study had MR grade 3+ and 89% had MR grade 4+. At discharge, 51% had MR grade 0+, 35% had MR grade 1+, 11% had MR grade 2+, 2% had MR grade 3+ and 2% had MR grade 4+. At 30-day follow up, 46% had MR grade 0+, 25% had MR grade 1+, 16% had MR grade 2+, 11% had MR grade 3+ and 2% had MR grade 4+. Considering the different anatomical types at 30-day follow up, type A anatomy was associated with the best outcomes because 95% of people in this group had MR grade of 1+ or less. 46% of people with type B anatomy had MR grade of 0+, 35% had grade 1+, 15% had grade 2+ and 4% had grade 3+. 14% of people with type C anatomy had MR grade of 0+, 7% had grade 1+, 43% had grade 2+, 29% had grade 3+ and 7% had grade 4+.

In the prospective case series by Colli (2018a), residual MR was classified as absent, mild, moderate or severe. MR severity was evaluated using a

combination of semiquantitative (vena contracta width and pulmonary vein flow) and quantitative parameters (regurgitant volume) in accordance with the ASE guidelines. At baseline, all people included in the study cohort had severe MR. At discharge, 31% had no or trivial MR, 53% had mild MR, 15% had moderate MR and 1% had severe MR. At 1-year follow up, 39% had no or trivial MR, 39% had mild MR, 22% had moderate MR and 3% had severe MR.

In the retrospective registry study by Colli (2018b), postoperative MR was assessed with transthoracic echocardiography independently by each centre's investigators in accordance with ASE criteria. All people included in the study cohort had severe MR at baseline. At discharge, 41% had absent or trace MR, 45% had mild MR, 12% had moderate MR and 2% had severe MR. At 1-year follow up, 31% had absent or trace MR, 44% had mild MR, 17% had moderate MR and 8% had severe MR. Considering the different anatomical types at discharge, type A anatomy was associated with the best outcomes because 95% of people in this group had MR grade of absent or trace or mild. 35% of people with type B anatomy had MR grade of absent or trace, 51% mild, 13% moderate and 1% severe. 23% of people with type C anatomy had MR grade of absent or trace, 40% mild, 30% moderate and 7% severe. At 1-year follow up, a similar trend was observed with type A anatomy associated with improved MR grade outcomes compared with types B and C.

In the retrospective propensity-matched cohort study by D'Onofrio (2022), the severity of mitral valve regurgitation was graded as mild (1+), moderate (2+) and severe (3+) in accordance with the ASE guidelines. All people included in the study had severe MR at baseline. People having the NeoChord procedure showed worse freedom from moderate MR (2+ or more) at 5-year follow up compared with conventional surgery: 58% (95% CI 43% to 77%) and 84.6% (95% CI 76% to 95%) in the NeoChord and conventional groupsm respectively (p=0.001). Freedom from severe MR at 5-year follow up was also lower in the

NeoChord group than in the conventional group: 78% (95% CI 65% to 93%) and 90% (95% CI 82% to 98%) for the NeoChord and conventional groups, respectively (p=0.032).

In the retrospective case series by D'Onofrio (2023), MR severity was graded as absent or trace (0), mild (1+), moderate (2+) and severe (3+) in accordance with the ASE criteria. All people included in the study cohort had severe MR at baseline. At discharge, 31% had absent or trace MR, 53% had mild MR, 14% had moderate MR and 1% had severe MR. At 5-year follow up, 8% had absent or trace MR, 51% had mild MR, 30% had moderate MR and 11% had severe MR. Overall cumulative incidence of severe MR recurrence was 9% (95% CI 4% to 15%) at 1 year, 12% (95% CI 6% to 19%) at 3 years and 24% (95% CI 15% to 33%) at 5 years. People with favourable anatomy (type A and B) compared with unfavourable anatomy (types B and C) had a lower incidence of severe MR recurrence over the same period with 6% compared with 22% at 1 year; 8% compared with 33% at 3 years; and 15% compared with 63% at 5 years (p=0.001).

In the retrospective registry study by Gerosa (2021), MR severity was graded as absent or trivial, mild, moderate and severe in accordance with ASE and ESC guidelines. All people included in the study cohort had severe MR at baseline. At discharge, 42% had absent or trivial MR, 45% had mild MR, 10% had moderate MR and 3% had severe MR. At 3-year follow up, 12% had absent or trivial MR, 52% had mild MR, 30% had moderate MR and 6% had severe MR. Considering the different MV anatomical types, freedom from MR recurrence of moderate or higher was 88% (SD 5%) in type A, 8% (SD 4%) in type B, 73% (SD 12%) in type C and 48% (SD 18%) in type D (p=0.001).

In the prospective case series by Kurnicka (2019), MR severity was graded as absent, mild, moderate and severe in accordance with ASE and ESC guidelines.

Baseline MR data was not reported. Postoperatively, 43% had trace MR and 57% had mild MR. At 6-month follow up, 14% had trace MR, 67% had mild MR and 19% had moderate MR.

In the prospective case series by Samalavicius (2018), MR severity was graded in accordance with AHA/ACC and ESC guidelines. At baseline, 67% of people had MR grade 3+ and 33% had MR grade 4+. After the procedure, 56% of people had trivial MR, 36% had grade 1+ MR, 5% had grade 2+ MR and 3% had higher than grade 2+ MR.

In the prospective case series by Seeburger (2014), MR severity was graded in accordance with AHA/ACC guidelines. At baseline, 10% of people in the study had MR grade 3+ and 90% had MR grade 4+. Post procedure, 87% (95% CI 70% to 96%) had MR grade of 2+ or less. At the 30-day follow up, 59% (95% CI 39% to 77%) had an MR grade of 2+ or less, with 71% of these people maintaining an MR grade of 1+ or less.

In the prospective case series by Wrobel (2019), MR severity was described in accordance with the EACVI recommendations for the assessment of native valvular regurgitation. Post procedure, 90% of people in the study had trace or mild MR, 8% had mild or moderate MR and 2% had moderate MR.

In the retrospective cohort study by Zorinas (2019), source guidelines for the description of MR severity were not reported. All people included in the study had severe MR at baseline. Post procedure, 100% of people in the conventional surgery group had MR grade absent or mild, compared with 92% in the NeoChord procedure group. At 30-day follow up, 0 patients in the conventional surgery had MR grade severe, compared with 8% in the NeoChord procedure group (p=0.001).

Re-repair population

In the retrospective cohort by Barbero (2025), baseline MR data was not reported. Postoperatively, 13% had mild MR and 1 person had moderate MR in the NeoChord group, and 9% had mild MR in the open-heart surgery group. In the NeoChord group 58% had mild MR at 1-year follow up. In the open-heart surgery group 23% had mild MR at 1-year follow up, and 1 person had moderate MR.

In the retrospective registry study by Salizzoni (2025), baseline MR was not reported. Postoperatively, 26% of people had mild MR and 4% had moderate MR. At last follow up, 32% of people had mild, 9% had moderate and 3% had severe MR.

In the retrospective case series by Gerosa (2021) source guidelines for the description of MR severity were not reported. All people included in the study had severe MR at baseline. At discharge, 6 (40%) of people had trivial MR, 7 (47%) had mild MR and 2 (13%) had moderate MR. At 1-year follow up, 3 (27%) of people had trivial MR, 6 (55%) had mild MR, 1 person had moderate MR and 1 person had severe MR.

In the case report by Seguchi (2023), MR at baseline was graded as severe. MR at discharge and 6-month follow up was graded as trivial. In the case report by Blessberger (2021), MR was graded as 0 at 16-month follow up.

NYHA functional class

NYHA functional outcomes were reported in 7 studies. All studies showed a durable improvement from baseline after the NeoChord procedure.

Naive repair population

In the prospective case series by Colli (2016), 6% of people were NYHA class 1, 58% class 2, 36% class 3 and 1% class 4 at baseline. All successfully treated

people showed an improvement in NYHA functional class at 3 months; 85% were in NYHA class 1, 4% in class 2 and 10% in class 3. Considering NYHA functional class across the different MV anatomical types at 3-month follow up, 100% of type A were in class 1, 96% of type B were in class 1, and 67% of type C were in class 1.

In the prospective case series by Colli (2015), 5% were NYHA class 1, 40% NYHA class 2, 49% in NYHA class 3 and 6% in NYHA class 4 at baseline. Clinical improvement was observed in all successfully treated people. At the 30-day follow up, 87% were in NYHA class 1, 6% in NYHA class 2 and 6% in NYHA class 3. Considering NYHA functional class across the different MV anatomical types at 30-day follow up, 100% of type A were in class 1, 88% of type B were in class 1 and 71% of type C were in class 1.

In the propensity-matched study by D'Onofrio (2022), significant improvement in NYHA functional class with respect to baseline was seen in both groups ($p<0.001$) with more than 90% of people in NYHA class 1 and 2 at follow up.

The retrospective case series by D'Onofrio (2023) reported 7% of people as NYHA class 1 at baseline, 38% in class 2 and 52% class 3. At discharge, the proportion of people in NYHA class 1 increased to 99%, decreasing to 78% at the 5 year follow up.

The prospective case series by Kurnicka (2019) reported 29% of people were NYHA class 1 at baseline, 57% in class 2 and 14% in class 3. At 6-month follow up, all people in the study were NYHA class 1.

Re-repair population

The retrospective registry study by Salizzoni (2025) reported 46% of people were NYHA class 2 at baseline, 31% in class 3 and 4% in class 4. At maximum follow up, 93% of people were NYHA class 1.

The retrospective case series by Gerosa (2021) reported 3 people (20%) were NYHA class 1 at baseline, 4 (27%) in class 2, and 8 (53%) in class 3. At discharge, 14 (93%) of people were class 1, and 1 person was class 2. At 2-year follow up, 5 (83%) people were in class 1 and 1 person was in class 2.

Survival

Survival was reported in 5 studies. Length of follow up for this outcome ranged from 3 months to 5 years.

Naive repair population

Colli (2016) estimated overall survival using the KM method. Overall survival at 3 months was 97% (SD 2%); no p-value was reported. In Colli (2018b), overall survival at 1 year was reported as 98%, with 4 high-risk people dying during the study. In D'Onofrio (2022), overall all-cause mortality was similar between the NeoChord and conventional surgery groups. KM analysis showed 5-year survival of 92% (95% CI 82% to 100%) and 96% (95% CI 91% to 100%) in the NeoChord and conventional surgery groups, respectively. In people with type A anatomy, survival was 100% in the NeoChord group and 93% (95% CI 84% to 100%) in the conventional surgery group. In D'Onofrio (2023), KM analysis estimated overall survival at 5 years of 84% (95% CI 76% to 92%). There was no statistically significant difference in terms of survival (p=0.13) between favourable anatomy (types A and B) and unfavourable anatomy (types B and C). Gerosa (2021) reported a KM survival estimate of 99% (SD 1%) at 1 and 2 years and 94% (SD 3%) at 3 years. All deaths were cardiovascular, and all deceased people were elderly with multiple severe comorbidities.

Reintervention

Reintervention was reported in 6 studies. Reasons for reintervention were new neochordae implantation, re-tensioning, recurrent severe MR and failed repair.

Naive repair population

Colli (2016) reported 4 cases (8%) of reoperation for NeoChord procedure failure at 3 months. One person had a further NeoChord procedure, and 3 had mitral valve replacement. Colli (2015) reported 8 cases (13%) of reoperation for NeoChord procedure failure at 30 days. One person required new neochordae implantation, 2 required neochordae re-tensioning, 3 had conventional mitral valve repair and 2 had mitral valve replacement. Colli (2018a) reported 4 cases (4%) of reintervention due to recurrent MR at 1-year follow up. Colli (2018b) reported 7 people (4%) with severe MR at 6-month follow up had conventional MV reintervention. D'Onofrio (2022) reported that 5-year freedom from reoperation in the NeoChord group was 79% (95% CI 66% to 95%) and 92% (95% CI 85% to 99%) in the conventional surgery group (p=0.022). But, in anatomical type A patients, the difference in freedom from reoperation between NeoChord and conventional surgery groups was not statistically significant. During a median follow up of 3.4 years, 11 people in the NeoChord group had the reoperation; of these, 4 were re-repair, 6 were replacements and 1 was a further NeoChord procedure. In D'Onofrio (2023) the overall cumulative incidence of reoperation was 17% (95% CI 9% to 24%) at 5 years. People with favourable anatomy (types A and B) had a lower incidence of reintervention at 5 years than people with unfavourable anatomy (types B and C); 15% compared with 43%, respectively (p=0.001). Gerosa (2021) reported 13 (6%) people required reoperation for recurrent MR at 3 years. Seeburger (2014) reported 6 (20%) cases of reoperation due to failed repair. Salizonni (2025) reported 5 (7%) cases of reintervention.

Echocardiographic outcomes

LVEF

Naive repair population

D'Onofrio (2022) reported a median LVEF of 55% (IQR 59% to 68%) at discharge after the NeoChord procedure, a reduction from a median of 64% (IQR 59% to 68%) at baseline. This increased to 59% (IQR 55.5% to 62.5%) after a median follow up of 3.4 years. D'Onofrio (2023) showed similar results, with an initial reduction at discharge from median 61% (IQR 57% to 67%) to 57% (IQR 53% to 60%). Median LVEF at 5-year follow up was 59% (IQR 56% to 64%) (p=0.09). Kurnicka (2019) did not report a statistically significant change between LVEF at baseline compared with 6-month follow up.

Re-repair population

Barbero (2025) reported 1-year mean LVEF of 56.3% (SD 2.9) in the NeoChord group and 56.8% (SD 6.0) in the open-heart surgery group. Salizzoni (2025) reported a mean LVEF at last follow up of 55.8% (SD 8.4), which is a slight reduction from baseline LVEF of 57.1% (SD 3.4). Gerosa (2021) reported a median LVEF at discharge of 59.5% (IQR 55% to 60.8%).

LVEDV

Naive population

D'Onofrio (2022) reported median LVEDVi at discharge 76 ml/m^2 (IQR 58.5 ml/m^2 to 86.5 ml/m^2), a reduction from 82 ml/m^2 (IQR 67.3 ml/m^2 to 95 ml/m^2) at baseline. This further reduced to 66 ml/m^2 (IQR 66 ml/m^2 to 72 ml/m^2) at median follow up of 3.4 years. D'Onofrio (2023) reported a reduction from 82 ml/m^2 (IQR 70 ml/m^2 to 79 ml/m^2) at baseline to 68 ml/m^2 at discharge, with a further reduction of 6 ml/m^2 at 5-year follow up. Kurnicka (2019) reported a statistically significant reduction in LVEDV from 123.9 ml (SD 44.3) at baseline to 91.1 ml (SD 25.3) at 6-month follow up (p<0.0001).

Re-repair population

Barbero (2025) reported a 1-year mean LVEDV of 107.1 ml (SD 21.9) in the NeoChord group and 110.4 ml (SD 26.4) in the open-heart surgery group. This is a reduction from baseline LVEDV in both groups.

LVESV

Naive repair population

D'Onofrio (2023) reported a reduction from 33 ml/m^2 (IQR 25 ml/m^2 to 39 ml/m^2) at baseline to 29 ml/m^2 (IQR 24 ml/m^2 to 37 ml/m^2) at discharge, with a further reduction of 4 ml/m^2 at 5-year follow up. Kurnicka (2019) reported a statistically significant reduction in LVESV from 59.8 ml (SD 29.7) at baseline to 42.7 ml (SD 11.4) at 6-month follow up (p=0.006).

LAVi

Naive repair population

D'Onofrio (2023) reported a reduction from 55 ml/m^2 (IQR 42 ml/m^2 to 56 ml/m^2) at baseline to 45 ml/m^2 (IQR 35 ml/m^2 to 57 ml/m^2) at discharge, with a further reduction of 2 ml/m^2 at 5-year follow up. Kurnicka (2019) reported a statistically significant reduction in LAVi from 44.9 ml/m^2 (SD 10.6) at baseline to 31.1 ml (SD 7.5) at 6-month follow up (p<0.0001).

sPAP

Naive repair population

D'Onofrio (2023) reported a reduction from 33 mmHg (IQR 26 to 41) at baseline to 29 mmHg (IQR 24 to 39) at discharge, with a further reduction of 4 mmHg at 5-year follow up.

Re-repair population

Barbero (2025) reported a 1-year mean sPAP of 27.1 mmHg (SD 4.6) in the NeoChord group, and 29.3 mmHg (SD 5.8) in the open-heart surgery group. This is a reduction from baseline sPAP of 34.3 mmHg (SD 8.6) in the NeoChord group and 40.8 mmHg (SD 15.7) in the open-heart surgery group. Salizzoni (2025) reported a mean sPAP of 26.7 mmHg (SD 8.4) at last follow up.

Operative time

Operative time was reported in 14 studies. Median operative time ranged from 115 minutes to 130 minutes across these studies for the NeoChord procedure.

Naive repair population

In D'Onofrio (2022) median operative time was 2.0 hours (IQR 1.8 to 2.5) for the NeoChord procedure, and 4.0 hours (IQR 3.5 to 4.0) for conventional surgery. Similar operative times were reported in Zorinas (2019), with median operative time reported as 120 minutes (IQR 110 to 146) for the NeoChord procedure, and 312 minutes (IQR 280 to 361) for conventional surgery.

Re-repair population

Barbero (2025) reported a mean duration of surgery of 146 minutes (SD 31) in the NeoChord group and 310 minutes (SD 79) in the open-heart surgery group. Salizzoni (2025) reported a mean duration of surgery of 139 minutes (SD 61). Gerosa (2021) reported a mean operative time of 140 minutes (IQR 110 to 160). The case study by Seguchi (2023) reported an operative time of 162 minutes.

Length of hospital stay

Length of hospital stay was reported in 14 studies. Median hospital stay ranged from 4 to 8 days across these studies for the NeoChord procedure.

Naive repair population

In Zorinas (2019), median hospital stay was 8 days (IQR 7 to 9) for the NeoChord procedure and 16 days (IQR 14 to 21) for conventional surgery.

Re-repair population

In Barbero (2025), median length of hospital stay was 4 days (IQR 3 to 5) in the NeoChord group, and 6 days (IQR 6 to 7) in the open-heart surgery group. In Gerosa (2021), median length of hospital stay was 7 days (IQR 6 to 9).

Safety

In-hospital and 30-day deaths

Early deaths occurred in 7 of the included studies. No procedural deaths occurred in any study. The primary reason for in-hospital death was cardiovascular dysfunction, other reasons included postcardiotomy syndrome with concomitant sepsis and multi-organ failure, and bleeding-related tamponade. People who died after the procedure were considered high surgical risk, with multiple comorbidities. In-hospital deaths ranged from 1% to 2% across all studies, and D'Onofrio (2023) reported a 30-day mortality of 2% for the NeoChord procedure.

Major adverse events

Cardiovascular or cerebrovascular

Major cardiovascular or cerebrovascular adverse events, such as myocardial infarction and stroke, were reported at a rate of 2% or less at follow up in all 12 studies.

Septicaemia

In Colli (2015), 2 (3%) of people in the study developed septicaemia after the procedure, similar rates were reported in Colli (2016) and Samalavicius (2018). Seeburger (2014) reported 0 septicaemia occurrences. This outcome was not reported in the remaining studies.

Major or extensive bleeding

Bleeding was reported in 7 of the included studies. The proportion of people who experienced major or extensive bleeding ranged from 3% to 5% across all studies. Colli (2016) reported 8% of people had intraoperative bleeding requiring at least 2 units of blood; however, none needed surgical revision for bleeding. In Samalavicius (2018), 3% of people who had the procedure required re-exploration for bleeding. Zorinas (2019) reported that postoperative blood loss in the NeoChord procedure group was statistically significantly lower than in the conventional surgery group, with 200 ml compared with 300 ml, respectively (p=0.001).

Minor adverse events

Kidney injury

8% of people in Colli (2016) developed acute renal failure, one of whom required CVVH. 12% of people in Colli (2018a) developed AKI, the majority of which was stage 1. However, 2 people developed stage 3 AKI and required CVVH. Four more studies reported the rate of post-procedure kidney injury between 3% and 7%. Notably, Zorinas (2019) reported the proportion of renal failure of the NeoChord procedure compared with conventional surgery as 3% and 15%, respectively (p=0.007).

Atrial fibrillation

New-onset AF post procedure was reported in 7 studies. AF can be paroxysmal (intermittent) or permanent. The proportions of people developing AF after the procedure ranged from 12% in Samalavicius (2018) to 28% in D'Onofrio (2023). In Colli (2018b), 19% of people developed paroxysmal AF, and 3% developed persistent AF. In D'Onofrio (2022), 6% of people who had the NeoChord procedure developed AF, and 34% of people who had conventional surgery developed AF. Similar results were reported in Zorinas (2019), with 12% of people who had the NeoChord procedure developing AF compared with 25% in the conventional surgery group (p=0.031).

Pleural or pericardial effusion

Pericardial effusion was reported in 4 studies and was categorised as minor or major. The proportion of people who had major pericardial effusion varied between 1% in Colli (2018b) and 6% in Colli (2016). Colli (2018a) reported that 6% of people in the study experienced minor pleural effusion.

Pleural effusion was reported in 4 studies and was also categorised as minor or major. Colli (2018a) reported 62% of people who had the procedure experienced minor pleural effusion, and 2% major pleural effusion. Similar results were reported in Colli (2018b), with 40% of people experiencing minor pleural effusion and 1% major. Gerosa (2021) and Wrobel (2019) reported rates of major pleural effusion of 2% and 5%, respectively.

Anecdotal and theoretical adverse events

Expert advice was sought from consultants who were nominated or ratified by their professional society or royal college. They were asked if they knew of any other adverse events for this procedure that they had heard about (anecdotal), which were not reported in the literature. They were also asked if they thought

there were other adverse events that might possibly occur, even if they had never happened (theoretical).

They listed the following anecdotal adverse events:

- cardiac arrythmias or conduction disturbances
- infection.

They listed the following theoretical adverse events:

- heart failure
- emergency surgery.

Five professional expert questionnaires for this procedure were submitted. Full details of what the professional experts said about the procedure are in the specialist advice questionnaires for this procedure.

Validity and generalisability

- Sample sizes were small across all studies because of the limited use of this procedure in clinical practice and novelty of the NeoChord DS1000 device. The largest sample size was 213 in Colli (2018b), while the smallest was 21 in Kurnicka (2019). These smaller studies lack statistical power and are not generalisable.
- None of the included studies were done in the UK or contained UK data. Study centres were in Italy, Lithuania, Germany, Poland and Denmark. This limits generalisability to the UK context.
- Follow up ranged from 30 days to 5 years across all studies, providing some insight into long-term outcomes. However, more robust long-term studies are needed to assess the durability of artificial chordae implanted with the NeoChord procedure. Long-term outcomes are particularly important for this procedure.

- The potential for bias is very high because all the studies are non-randomised and observational, and many are retrospective case series.
- Patient selection bias is likely across all studies because people had anatomical screening before the NeoChord procedure.
- Key evidence gaps remain in long-term outcomes beyond 5 years, quality-of-life outcomes and patient-reported outcomes focusing on different subgroups. A larger number of patients and longer follow up are needed to assess the definitive value of this therapeutic approach.
- In the comparative studies, people who had the NeoChord procedure were strictly followed up through clinical and echocardiographic assessment at scheduled timepoints. However, many people who had conventional surgery were followed up by their referral cardiologist. So, the possible underestimation of valve-related adverse events in the conventional surgery population cannot be excluded.
- The determination of the exact positioning, length adjustment and neochordae tensioning depends exclusively on the ability and training of the operator and echocardiographer. Variation in experience and skill across the operators in the studies could introduce bias to the results.
- Study endpoints were not consistent across the studies and often contained composite outcomes based to varying degrees on MVARC criteria. This limits comparison of efficacy outcomes across the studies.
- Different criteria were used to grade residual MR across the studies, limiting comparison of results across the studies.
- Measurement and interpretation of MR is operator dependent, and therefore is a potential source of bias.
- There is likely substantial overlap in the populations of some of the included studies. There is a high potential for selection bias.

- Many authors of the included studies have potential financial conflicts of interest with the manufacturer of this device (NeoChord, Inc.), including providing consulting services, receiving travel grants and proctoring.

Ongoing trials

NCT02803957 Randomized Trial of the NeoChord DS1000 System Versus Open Surgical Repair (ReChord) is a multicentre, open-label trial to assess the safety and effectiveness of the NeoChord DS1000 device in people with degenerative mitral valve disease receiving a mitral valve repair without cardiopulmonary bypass (treatment group) when compared with people having mitral valve repair using standard surgical techniques with cardiopulmonary bypass (control group). Sponsor: NeoChord, USA. Estimated completion: July 2027.

NCT04190602 Multicentre Post-Market Observational Registry of the NeoChord Artificial Chordae Delivery System (AcChord) is an observational, single-arm, multicentre post-market registry. The objective of this study is to evaluate the 5-year outcomes of participants with degenerative mitral valve disease treated with the NeoChord DS1000 in a post-market setting. Sponsor: NeoChord, USA. Estimated completion: December 2027.

Related NICE guidance

Interventional procedures

Percutaneous mitral valve leaflet repair for mitral regurgitation (2019) NICE interventional procedures guidance [HTG513, formerly IPG649]. (Recommendation: standard arrangements)

Percutaneous mitral valve annuloplasty (2010) NICE interventional procedures guidance [HTG225, formerly IPG352]. (Recommendation: research only)

Thoracoscopically assisted mitral valve surgery (2007) NICE interventional procedures guidance [HTG157, formerly IPG245]. (Recommendation: standard arrangements)

NICE guidelines

Heart valve disease presenting in adults: investigation and management (2021) NICE guideline NG208.

Professional societies

- Society for Cardiothoracic Surgery in Great Britain and Ireland
- British Cardiovascular Intervention Society
- British Society for Heart Failure
- British Cardiovascular Society
- British Society for Echocardiography
- Royal College of Surgeons of England
- Royal College of Physicians London
- Royal College of Physicians of Edinburgh
- Royal College of Surgeons of Edinburgh
- Royal College of Physicians and Surgeons of Glasgow
- NHS England
- NHS Scotland.

Company engagement

NICE asked companies that manufacture a device potentially relevant to this procedure for information on it. NICE received 1 completed submission. This was considered by the interventional procedures technical team and any relevant points have been taken into consideration when preparing this assessment report.

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Appendix A: Methods and literature search strategy

NICE has identified studies and reviews relevant to beating heart mitral valve repair by artificial chordae insertion for mitral regurgitation from the medical literature.

Search strategy design and peer review

This search report is informed by the Preferred Reporting Items for Systematic reviews and Meta-Analyses literature search extension (PRISMA-S).

A NICE information specialist ran the literature searches on 06 May 2025 and updated them on 13 October 2025. See the search strategy history for the full search strategy for each database. Relevant published studies identified during consultation or resolution that are published after this date may also be considered for inclusion.

The principal search strategy was developed in MEDLINE ALL (Ovid interface). It was adapted for use in each of the databases listed in table 4a, taking into account the database's size, search functionality and subject coverage. The MEDLINE ALL strategy was quality assured by a NICE senior information specialist. All translated search strategies were peer reviewed to ensure their accuracy. The quality assurance and peer review procedures were adapted from the Peer Review of Electronic Search Strategies (PRESS) 2015 evidence-based checklist.

Review management

The search results were managed in EPPI-Reviewer version 5 (EPPI-R5). Duplicates were removed in EPPI-R5 using a 2-step process. First, automated deduplication was done using a high-value algorithm. Second, manual

deduplication was used to assess low-probability matches. All decisions about inclusion, exclusion and deduplication were recorded and stored.

Limits and restrictions

The CENTRAL and Embase database searches removed trial registry records and conference material.

English language limits were applied to the search when possible in the database.

The limit to remove animal studies in the searches is standard NICE practice, which has been adapted from Dickersin K, Scherer R, Lefebvre C (1994) Systematic Reviews: Identifying relevant studies for systematic reviews. BMJ 309(6964): 1286.

Main search

Table 4a Main search results

Database	Date searched	Database platform	Database segment or version	Number of results downloaded
Cochrane Central Register of Controlled Trials (CENTRAL)	06/05/2025	Wiley	Issue 4 of 12, April 2025	5
Cochrane Database of Systematic Reviews (CDSR)	06/05/2025	Wiley	Issue 5 of 12, May 2025	0
Embase	06/05/2025	Ovid	1974 to 2025 May 02	413
INAHTA International HTA Database	06/05/2025	https://database.inahta.org/	-	2
MEDLINE ALL	06/05/2025	Ovid	1946 to April 23, 2025	447

Update search

Table 4b Update search results

Database	Date searched	Database platform	Database segment or version	Number of results downloaded
Cochrane Central Register of Controlled Trials (CENTRAL)	13/10/2025	Wiley	Issue 10 of 12, April 2025	0
Cochrane Database of Systematic Reviews (CDSR)	13/10/2025	Wiley	Issue 09 of 12, May 2025	0
Embase	13/10/2025	Ovid	1974 to 2025 Oct 12	8
INAHTA International HTA Database	13/10/2025	https://database.inahta.org/	-	0
MEDLINE ALL	13/10/2025	Ovid	1946 to October 10, 2025	11

Search strategy history

For the updated searches there was no change to the strategy apart from the date limit [from May 2025 to October 2025] and the additional removal of clinical trial registration records from Embase.

MEDLINE ALL search strategy

1 mitral valve insufficiency/ 27504

2 Mitral Valve Prolapse/ 5400

3 (Mitral adj4 (prolapse* or disease* or regurgitat* or insufficien* or rupture* or incompetence or floppy or click-murmur)).tw. 34296

4 or/1-3 46050

5 (beating heart adj5 repair*).tw. 131

6 (artificial adj4 (chord* or neo-chord*)).tw. 406

7 (implant* adj4 (chord* or neo-chord*)).tw. 179

8 or/5-7 603

9 4 and 8 432

10 NeoChord.tw. 132

11 (HARPOON and (mitral or "beating heart" or "repair system")).tw. 16

12 10 or 11 142

13 9 or 12 527

14 limit 13 to english language 484

15 animals/ not humans/ 5307231

16 14 not 15 447

Embase search strategy

1 mitral valve regurgitation/ 60107

2 Mitral Valve Prolapse/ 10727

3 (Mitral adj4 (prolapse* or disease* or regurgitat* or insufficien* or rupture* or incompetence or floppy or click-murmur)).tw. 52495

4 or/1-3 79506

5 (beating heart adj5 repair*).tw. 198

6 (artificial adj4 (chord* or neo-chord*)).tw. 574

7 (implant* adj4 (chord* or neo-chord*)).tw. 309

8 or/5-7 894

9 4 and 8 605

10 NeoChord.tw,dv. 249

11 (HARPOON and (mitral or "beating heart" or "repair system")).tw. 23

12 10 or 11 265

13 9 or 12 775

14 limit 13 to english language 735

15 Nonhuman/ not Human/ 5683074

16 14 not 15 684

17 (conference abstract* or conference review or conference paper or conference proceeding).db,pt,su. 6252247

18 16 not 17 413

Cochrane Library (CDSR and CENTRAL) search strategy

#1 MeSH descriptor: [Mitral Valve Insufficiency] explode all trees 605

#2 MeSH descriptor: [Mitral Valve Prolapse] explode all trees 59

#3 (Mitral near/4 (prolapse* or disease* or regurgitat* or insufficien* or rupture* or incompetence or floppy or click-murmur)) 1696

#4 {or #1-#3} 1696

#5 (beating heart near/5 repair*) 4

#6 (artificial near/4 (chord* or neo-chord*)) 5

#7 (implant* near/4 (chord* or neo-chord*)) 4

#8 {or #5-#7} 10

#9 #4 and #8 7

#10 NeoChord 5

#11 (HARPOON and (mitral or "beating heart" or "repair system")) 0

#12 #10 or #11 5

#13 #9 or #12 10

#14 "conference":pt or (clinicaltrials or trialsearch):so 824537

#15 #13 not #14 5

INAHTA HTA Database search strategy

#1. "Mitral Valve Insufficiency"[mh] 43

#2. "Mitral Valve prolapse"[mh] 1

#3. (Mitral and (prolapse* or disease* or regurgitat* or insufficien* or rupture* or incompetence or floppy or click-murmur)) 40

#4. #1 or #2 or #3 56

#5. ((beating heart) and repair*) 0

#6. (artificial AND (chord* or neo-chord*)) 0

#7. (implant* AND (chord* or neo-chord*)) 0

#8. #5 or #6 or #7 0

#9. NeoChord 2

#10. (HARPOON and (mitral or "beating heart" or "repair system")) 0

#11. #9 or #10 2

#12. #4 and #8 0

#13. #11 or #12 2

Inclusion criteria

The following inclusion criteria were applied to the abstracts identified by the literature search.

- Publication type: clinical studies were included with emphasis on identifying good quality studies. Abstracts were excluded if they did not report clinical outcomes. Reviews, editorials, and laboratory or animal studies, were also excluded and so were conference abstracts, because of the difficulty of appraising study methodology, unless they reported specific adverse events not available in the published literature.
- People with mitral regurgitation
- Intervention or test: NeoChord DS1000 System.
- Outcome: articles were retrieved if the abstract contained information relevant to the safety, efficacy, or both.

If selection criteria could not be determined from the abstracts the full paper was retrieved.

Potentially relevant studies not included in the main evidence summary are listed in Appendix B: Other relevant studies.

Find out more about how NICE selects the evidence for the committee.

Appendix B: Other relevant studies

Other potentially relevant studies that were not included in the main evidence summary (tables 2 and 3) are listed in table 5 below.

Table 5 Additional studies identified

Study	Number of people and follow up	Direction of conclusions	Reason study was not included in main evidence summary
Brown A, Jefferson HL, Fatehi Hassanabad A, Noss C, Webb N, Fedak PW, Kent WD, Adams C. (2023) Echocardiographic and clinical outcomes following beating heart NeoChord DS1000 mitral valve repair: a single centre case series. Frontiers in Cardiovascular Medicine.10:1160979.	Prospective case series n=10 Follow up: 6 weeks	All patients had severe chronic MR and normal left ventricular function. At 1 month follow up echocardiography, MR was graded from trivial to moderate and left ventricular inner diameter dimensions decreased from an average of 5.4 ± 0.4 cm to 4.6 ± 0.3 cm. The early surgical outcomes suggest this approach is	Larger and more relevant studies included in the summary of the key evidence.

		feasible, safe, and effective in reducing MR.	
Colli A, Besola L, Bizzotto E, Fiocco A, Denas G, Bellu R, Pradegan N, Nadali M, Gregio A, Pittarello D, Gerosa G. (2019) Mechanisms of recurrent regurgitation after transapical off-pump mitral valve repair with neochord implantation. European Journal of Cardio-Thoracic Surgery. 56(3):479-87.	Retrospective case series n=52	Possible mechanisms of recurrent MR were identified as: patient selection (17%), technical issues (29%), progression of baseline disease (15%), left ventricle reverse remodelling (2%), excessive over-tensioning (36%) and posterior mitral leaflet curling (31%). The mechanisms of recurrent MR after the NeoChord procedure can be used to formulate prevention strategies.	Studies with more relevant outcomes included in the summary of key evidence.
Gonçalves-Teixeira P, Costa S, Martins D, Neves P, Ribeiro J. (2021) Transapical off-pump mitral valve repair with NeoChord™ implantation: An early single-center Portuguese experience. Revista portuguesa de cardiologia. 40(12):933-41.	Prospective case series n=18 Median follow up: 194 days	Successful repair, defined by none, trace or mild mitral regurgitation, by implantation of two to four neochordae,was achieved in all 18 patients. No major complications arose intra-procedurally In selected patients, minimally invasive mitral	Larger and more relevant studies included in the summary of the key evidence.

		valve repair using the NeoChord system is safe, effective and reproducible.	
Manzan E, Azzolina D, Gregori D, Bizzotto E, Colli A, Gerosa G. (2021) Combining echocardiographic and anatomic variables to predict outcomes of mitral valve repair with the NeoChord procedure. Annals of cardiothoracic surgery. 10(1):122.	Prospective case series n=91 Follow up: 2 years	A nomogram was developed to predict the probability of mild or less MR at follow up. NeoChord mitral valve repair prediction tool would be helpful in clinical decision-making and in the identification of patients who may benefit from a ringless mitral valve repair using the NeoChord procedure.	Studies with more relevant outcomes included in the summary of key evidence.
Gammie JS, Bartus K, Gackowski A, D'Ambra MN, Szymanski P, Bilewska A, Kusmierczyk M, Kapelak B, Rzucidlo-Resil J, Moat N, Duncan A. (2018) Beating-heart mitral valve repair using a novel ePTFE cordal implantation device: a prospective trial. Journal of the American College of Cardiology. 71(1):25-36.	Prospective multicentre case series n=30 Follow up: 6 months	At 1 month, MR was mild or less in 89% and was moderate in 11%. At 6 months, MR was mild or less in 85 %, moderate in 8%, and severe in 8%. MVRS ePTFE cordal implantation can reduce the invasiveness and morbidity of conventional MV surgery. The device's safety	Harpoon system used, device has been discontinued. Studies with NeoChord DS1000 included in the summary of key evidence.

		profile is promising.	
Gammie JS, Wilson P, Bartus K, Gackowski A, Hung J, D'Ambra MN, Kolsut P, Bittle GJ, Szymanski P, Sadowski J, Kapelak B. (2016) Transapical beating-heart mitral valve repair with an expanded polytetrafluoroethylene cordal implantation device: initial clinical experience. Circulation. 134(3):189-97.	Prospective feasibility trial n=11 Mean follow up: 186 days	Eleven patients with posterior leaflet prolapse and severe MR were treated with 100% procedural success. Immediate postprocedural mean MR grade was trace. At 1 month, the mean MR grade was mild with significant decreases in end-diastolic volume This MV repair technique demonstrates a significant reduction in MR with favourable left ventricular and left atrial reverse remodelling. This approach has the potential to decrease invasiveness and surgical morbidity	Harpoon system used, device has been discontinued. Studies with NeoChord DS1000 included in the summary of key evidence
Gammie JS, Bartus K, Gackowski A, Szymanski P, Bilewska A, Kusmierczyk M, Kapelak B, Rzucidlo-Resil J, Duncan A, Yadav R, Livesey S. (2021) Safety and performance of a novel transventricular beating heart mitral valve repair system: 1-year	Prospective multicentre case-series n=62 Follow up: 1 year	95% of people achieved technical success. At 1 year, 98% of the patients with HARPOON cords were in New York Heart Association class 1 or 2, and mitral regurgitation was none/trace in	Harpoon system used, device has been discontinued. Studies with NeoChord DS1000 included in the summary of key evidence.

outcomes. European Journal of Cardio-Thoracic Surgery. 59(1):199-206.		52%, mild in 23%, moderate in 23% and severe in 2%.	
Vairo A, Gaiero L, Marro M, Russo C, Bolognesi M, Soro P, Gallone G, Fioravanti F, Desalvo P, D'Ascenzo F, Alunni G. (2023) New echocardiographic parameters predicting successful trans-ventricular beating-heart mitral valve repair with neochordae at 3 years: Monocentric retrospective study. Journal of Clinical Medicine. 12(5):1748.	Retrospective case series n=72 Median follow up: 34 months	At follow up, MR > moderate was found in 24.6% of people. Annular dysfunction parameters were the best predictors of procedural success: 3D early-systolic annulus area, 3D early-systolic annulus circumference, and 3D annulus area fractional change.	Studies with more relevant outcomes included in the summary of key evidence.
Wang S, Meng X, Hu S, Sievert H, Xie Y, Hu X, Sun Y, Luo Z, Zhou H, Zhang G, Pan X. (2022) Initial experiences of transapical beating-heart mitral valve repair with a novel artificial chordal implantation device. Journal of Cardiac Surgery. 37(5):1242-9.	Prospective feasibility trial n=10 Follow up: 1 year	MR reduced from severe to none or trace in five patients, and mild in five patients before discharge. The safety and efficacy endpoint were achieved in all patients at 1-month follow-up. At 1-year follow-up, six patients had mild MR, three patients had moderate MR, one patient had recurrence of severe MR and had surgical repair.	Mitralstitch system used, device not used in the UK. Studies with NeoChord DS1000 included in the summary of key evidence.
Stanley M, Sellke F. (2023). Neurocognitive decline in cardiac surgery patients: What	Expert review	N/A	Submitted by company for committee information.

do we know?. The Journal of thoracic and cardiovascular surgery, 166(2), 543-552.			Does not report outcomes on the procedure being evaluated in this guidance.
Yu C, Arjomandi Rad A., He H, Yang Y, Maessen J, Sardari Nia P. (2025). The impact of recurrent mitral regurgitation after surgical or transcatheter mitral valve repair: a comprehensive review and a meta-analysis. Interdisciplinary CardioVascular and Thoracic Surgery, 40(6), ivaf109.	Meta-analysis n=960 Follow up ranged from 1-10 years in included studies	Results show that in research involving secondary MR, patients with recurrent MR are more likely to undergo reoperation, experience cardiovascular death, be readmitted, have heart failure and be classified as NYHA functional class 3 or 4	Outcomes for the procedure being evaluated in this guidance not reported.
Rogers J, Dong T, Kota R, Chan J, Mohamed S, Ciulli F, Angelini G, Fudulu D. (2025). Reoperative mitral valve surgery in the UK: 20-year trends and early outcomes. International Journal of Cardiology, 133602.	Retrospective cohort study Primary mitral valve surgery: n=47,213 Reoperative repair: n=1239	Compared with primary mitral valve surgery, reoperative procedures had higher mortality, greater need for dialysis, more cerebrovascular events, more returns to theatre for bleeding and longer hospital stays.	Submitted by company for committee information. Does not look at the procedure being evaluated in this guidance.
Manzan E, Azzolina D, Gregori D, Bizzotto E, Colli A, Gerosa G. (2020). Combining echocardiographic and anatomic variables to predict outcomes of mitral valve repair with the NeoChord	Retrospective prognostic model development study n=91	Key echocardiographic and anatomical factors such as the leaflet-to-annulus index, pulmonary artery pressure, left ventricle size, flail	Submitted by company for committee information. Does not report outcomes of interest for the procedure being evaluated

procedure. Annals of cardiothoracic surgery, 10(1), 122.		width, annular dimensions and calcification were identified as important predictors of success.	in this guidance.
Budra M, Janusauskas V, Drasutiene A, Zorinas A, Zakarkaite, Lipnevicius A, Rucinskas K. (2022). Midterm results of transventricular mitral valve repair. Single-center experience. The Journal of Thoracic and Cardiovascular Surgery, 164(6), 1820-1828.	Prospective cohort study n=88 Median follow up: 42 months	About one-third of patients developed significant recurrent mitral regurgitation and one-fifth required repeat surgery. Durability was good in simpler anatomies (types A and B) but poor in complex pathology (type C).	Submitted by company for committee information. Results align with evidence already included in assessment report.