MASSACHUSETTS

Blue Cross Blue Shield of Massachusetts is an Independent Licensee of the Blue Cross and Blue Shield Association

Medical Policy

Open and Thoracoscopic Approaches to Treat Atrial Fibrillation and Atrial Flutter (Maze and Related Procedures)

Table of Contents

Policy Number: 356

BCBSA Reference Number: 7.01.14 (For Plan internal use only)
NCD/LCD: N/A

Related Policies

- Catheter Ablation as Treatment of Atrial Fibrillation, #141
- Percutaneous Left Atrial Appendage Closure Devices for Stroke Prevention in Atrial Fibrillation, #334

Policy

Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity Medicare HMO Blue[SM] and Medicare PPO Blue[SM] Members

The maze procedure or modified procedure, performed on a non-beating heart during cardiopulmonary bypass with concomitant cardiac surgery, is considered **MEDICALLY NECESSARY** for the treatment of symptomatic atrial fibrillation or flutter.

Stand-alone minimally invasive, off-pump maze procedures (ie, modified maze procedures), including those done via mini-thoracotomy, are considered **INVESTIGATIONAL** for treatment of atrial fibrillation or flutter.

Hybrid ablation (defined as a combined percutaneous and thoracoscopic approach) is considered **INVESTIGATIONAL** for the treatment of atrial fibrillation or flutter.

The use of an open maze or modified maze procedure performed on a non–beating heart during cardiopulmonary bypass without concomitant cardiac surgery is considered **NOT MEDICALLY NECESSARY** for treatment of symptomatic or flutter.

Prior Authorization Information

Inpatient

- For services described in this policy, precertification/preauthorization **IS REQUIRED** for all products if the procedure is performed **inpatient**.

Outpatient

- For services described in this policy, see below for products where prior authorization **might be required** if the procedure is performed **outpatient**.

	Outpatient
Commercial Managed Care (HMO and POS)	Prior authorization is **not required**.
Commercial PPO and Indemnity	Prior authorization is **not required**.
Medicare HMO Blue℠	Prior authorization is **not required**.
Medicare PPO Blue℠	Prior authorization is **not required**.

CPT Codes / HCPCS Codes / ICD Codes

Inclusion or exclusion of a code does not constitute or imply member coverage or provider reimbursement. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage as it applies to an individual member.

Providers should report all services using the most up-to-date industry-standard procedure, revenue, and diagnosis codes, including modifiers where applicable.

The following codes are included below for informational purposes only; this is not an all-inclusive list.

The above medical necessity criteria MUST be met for the following codes to be covered for Commercial Members: Managed Care (HMO and POS), PPO, Indemnity, Medicare HMO Blue and Medicare PPO Blue:

CPT Codes

CPT codes:	Code Description
33256	Operative tissue ablation and reconstruction of atria, extensive (e.g., maze procedure); with cardiopulmonary bypass
33257	Operative tissue ablation and reconstruction of atria, performed at the time of other cardiac procedure(s), limited (e.g., modified maze procedure) (List separately in addition to code for primary procedure)
33259	Operative tissue ablation and reconstruction of atria, performed at the time of other cardiac procedure(s), extensive (e.g., maze procedure), with cardiopulmonary bypass (List separately in addition to code for primary procedure)

ICD-10 Procedure Codes

ICD-10 procedure codes:	Code Description
02560ZZ	Destruction of Right Atrium, Open Approach
02563ZZ	Destruction of Right Atrium, Percutaneous Approach
02570ZZ	Destruction of Left Atrium, Open Approach
02573ZZ	Destruction of Left Atrium, Percutaneous Approach

The following CPT codes are considered investigational for Commercial Members: Managed Care (HMO and POS), PPO, Indemnity, Medicare HMO Blue and Medicare PPO Blue:

CPT Codes

CPT codes:	Code Description
33254	Operative tissue ablation and reconstruction of atria, limited (e.g., modified maze procedure)
33255	Operative tissue ablation and reconstruction of atria, extensive (e.g., maze procedure); without cardiopulmonary bypass

33258	Operative tissue ablation and reconstruction of atria, performed at the time of other cardiac procedure(s), extensive (e.g., maze procedure), without cardiopulmonary bypass (List separately in addition to code for primary procedure)
33265	Endoscopy, surgical; operative tissue ablation and reconstruction of atria, limited (e.g., modified maze procedure), without cardiopulmonary bypass
33266	Endoscopy, surgical; operative tissue ablation and reconstruction of atria, limited (e.g., maze procedure), without cardiopulmonary bypass

Description

Atrial Fibrillation

Atrial Fibrillation (AF) is a supraventricular tachyarrhythmia characterized by disorganized atrial activation with ineffective atrial ejection. The underlying mechanism of AF involves the interplay between electrical triggering events that initiate AF and the myocardial substrate that permits propagation and maintenance of the aberrant electrical circuit. The most common focal trigger of AF appears to be located within the cardiac muscle that extends into the pulmonary veins. The atria are frequently abnormal in patients with AF and demonstrate enlargement or increased conduction time. Atrial flutter is a variant of AF.

Treatment

The first-line treatment for AF usually includes medications to maintain sinus rhythm and/or control the ventricular rate. Antiarrhythmic medications are only partially effective; therefore, medical treatment is not sufficient for many patients. Percutaneous catheter ablation, using endocardial ablation, is an accepted second-line treatment for patients who are not adequately controlled on medications and may also be used as first-line treatment. Catheter ablation is successful in maintaining sinus rhythm for most patients, but long-term recurrences are common and increase over time. Performed either by open surgical techniques or thoracoscopy, surgical ablation is an alternative approach to percutaneous catheter ablation.

Open Surgical Techniques

The classic Cox maze III procedure is a complex surgical procedure for patients with AF. It involves sequential atriotomy incisions that interrupt the aberrant atrial conduction pathways in the heart. The procedure is also intended to preserve atrial pumping function. It is indicated for patients who do not respond to medical or other surgical antiarrhythmic therapies and is often performed in conjunction with correction of structural cardiac conditions such as valve repair or replacement. This procedure is considered the criterion standard for the surgical treatment of drug-resistant AF, with a success rate of approximately 90%.

The maze procedure entails making incisions in the heart that:

- direct an impulse from the sinoatrial node to the atrioventricular node;
- preserve activation of the entire atrium; and
- block re-entrant impulses responsible for AF or atrial flutter.

The classic Cox maze procedure is performed on a nonbeating heart during cardiopulmonary bypass. Simplification of the maze procedure has evolved with the use of different ablation tools such as microwave, cryotherapy, ultrasound, and radiofrequency energy sources to create the atrial lesions instead of employing the incisional technique used in the classic maze procedure. The Cox maze IV procedure involves the use of radiofrequency energy or cryoablation to create transmural lesions analogous to the lesions created by the "cut-and-sew" maze.

Minimally Invasive (Thoracoscopic) Techniques

Less invasive, transthoracic, endoscopic, off-pump procedures to treat drug-resistant AF have been developed. The evolution of these procedures involves both different surgical approaches and different lesion sets. Alternative surgical approaches include mini-thoracotomy and total thoracoscopy with video assistance. Open thoracotomy and mini-thoracotomy employ cardiopulmonary bypass and open-heart surgery, while thoracoscopic approaches are performed on the beating heart. Thoracoscopic approaches

do not enter the heart and use epicardial ablation lesion sets, whereas the open approaches use either the classic "cut-and-sew" approach or endocardial ablation.

Lesion sets may vary independent of the surgical approach, with a tendency toward less extensive lesion sets targeted to areas most likely to be triggers of AF. The most limited lesion sets involve pulmonary vein isolation and exclusion of the left atrial appendage. More extensive lesion sets include linear ablations of the left and/or right atrium and ablation of ganglionic plexi. Some surgeons perform left atrial reduction in cases of left atrial enlargement.

The type of energy used for ablation also varies; radiofrequency energy is most commonly applied. Other energy sources such as cryoablation and high-intensity ultrasound have been used. For our purposes, the variations on surgical procedures for AF will be combined under the heading of "modified maze" procedures.

Hybrid Techniques
"Hybrid" ablation refers to the use of both thoracoscopic and percutaneous approaches in the same patient. Ablation is performed on the outer surface of the heart (epicardial) via the thoracoscopic approach, and on the inner surface of the heart (endocardial) via the percutaneous approach. The rationale for a hybrid procedure is that a combination of both techniques may result in a complete ablation. Thoracoscopic epicardial ablation is limited by the inability to perform all possible ablation lines because the posterior portions of the heart are not accessible via thoracoscopy. Percutaneous, endoscopic ablation is limited by incomplete ablation lines that often require repeat procedures. By combining both procedures, a full set of ablation lines can be performed, and incomplete ablation lines can be minimized.

The hybrid approach first involves thoracoscopy with epicardial ablation. Following this procedure, an electrophysiologic study is performed percutaneously followed by endocardial ablation as directed by the results of electrophysiology. Most commonly, the electrophysiology study and endocardial ablation are done immediately after the thoracoscopy as part of a single procedure. However, some hybrid approaches perform the electrophysiology study and endocardial ablation on separate days, as directed by the electrophysiology study.

Summary

There are various surgical approaches to treat atrial fibrillation (AF) that work by interrupting abnormal electrical activity in the atria. Open surgical procedures, such as the Cox maze procedure were first developed for this purpose and are now generally performed in conjunction with valvular or coronary artery bypass graft surgery. Surgical techniques have evolved to include minimally invasive approaches that use epicardial radiofrequency ablation, a thoracoscopic or mediastinal approach, and hybrid catheter ablations/open procedures.

For individuals who have symptomatic AF or flutter who are undergoing cardiac surgery with bypass who received a Cox maze or a modified maze procedure, the evidence includes several randomized controlled trials (RCTs) and nonrandomized comparative studies, along with systematic reviews of these studies. Relevant outcomes are overall survival, medication use, and treatment-related morbidity. Several small RCTs have provided most of the direct evidence confirming the benefit of a modified maze procedure for patients with AF who are undergoing mitral valve surgery. These trials have established that the addition of a modified maze procedure results in a lower incidence of atrial arrhythmias following surgery, with minimal additional risks. Observational studies have supported these RCT findings. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have symptomatic, drug-resistant AF or flutter who are not undergoing cardiac surgery with bypass who receive minimally invasive, off-pump thoracoscopic maze procedures, the evidence includes RCTs and observational studies, some of which identify control groups. Relevant outcomes are overall survival, medication use, and treatment-related morbidity. Two RCTs reported significantly higher rates of freedom from AF at 1-year with surgical ablation, but also reported

significantly higher rates of serious adverse events. The remaining 2 RCTs found no significant differences between treatment groups in rates of freedom from AF and either did not assess or did not find significant differences in serious adverse events. The comparative observational studies consistently found significantly higher rates of freedom from atrial arrhythmias, but lacked assessment of serious adverse events.The noncomparative studies generally only reported short-term outcomes and did not consistently report adverse events. Therefore, this evidence does not permit definitive conclusions whether a specific approach is superior to the other. Factors, such as previous treatment, the probability of maintaining sinus rhythm, the risk of complications, contraindications to anticoagulation, and patient preference, may all affect the risk-benefit ratio for each procedure. Additionally, the studies do not permit conclusions about harms due to heterogenous measurement across studies, with mixed results. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have symptomatic, drug-resistant AF or flutter who are not undergoing cardiac surgery with bypass who receive hybrid thoracoscopic and endocardial ablation procedures, the evidence includes an RCT by DeLurgio et al [2020], and 2 observational studies (Kress et al [2017] and Maclean et al [2020], N=372) that compared a 'convergent' hybrid approach (ie, epicardial approach combined with endocardial ablation to catheter ablation) and 1 observational study that compared a thoracoscopic epicardial ablation with a percutaneous trans-septal procedure hybrid approach to catheter ablation (LeMeir et al, 2012, n=63). The DeLurgio (2020) RCT (n=153) found a statistically significantly higher rate on the primary outcome of freedom from AF/atrial flutter/atrial tachycardia absent of class I/II antiarrhythmic drugs at 1-year, but with a nonstatistically significantly higher rate of major adverse events (p=.0525) between 8- and 30-days postprocedure. Major adverse events were not reported for the 1-year follow-up period. The 2 observational studies of the convergent hybrid approach found that it was associated with an increased rate of AF-free survival, but major adverse events at 1-year were nonsignificantly more common. LeMeir et al (2012) found that the thoracoscopic epicardial ablation with a percutaneous trans-septal procedure hybrid approach was associated with an increased rate of AF-free survival and no difference in adverse events. For the 'convergent' hybrid approach, additional multicenter RCTs are needed with comparisons to catheter ablation that measure the freedom from AF and assess adverse events after at least 1-year of follow-up. For other types of hybrid approaches, multicenter RCTs are needed that use established techniques to control for bias and assess both benefits and harms with at least 1-year of follow-up. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Policy History

Date	Action
6/2022	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
6/2021	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
7/2020	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
6/2019	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
10/2017	Annual policy review. "Drug resistant" removed from medically necessary statement and not medically necessary statement. Effective 10/1/2017.
7/2016	Annual policy review. New references added.
12/2015	Annual policy review. New not medically necessary indications described. The phrase "without concomitant cardiac surgery" was removed from the medically necessary policy statement. Title revised to include Atrial Flutter. Clarified coding information. Effective 12/1/2015.
9/2014	Annual policy review. New references added.
6/2014	Updated Coding section with ICD10 procedure and diagnosis codes. Effective 10/2015.
1/2014	Annual policy review. New investigational indications described. Effective 1/1/2014.

12/2013	Removed ICD-9 diagnosis codes 427.31, 427.32 as the policy is requires prior authorization.
7/2013	Annual policy review. Added “or modified” and “(i.e., modified maze procedures)” to the policy statements. Effective 7/1/2013.
11/2011-4/2012	Medical policy ICD 10 remediation: Formatting, editing and coding updates. No changes to policy statements.
4/2011	Reviewed - Medical Policy Group - Cardiology and Pulmonology. No changes to policy statements.
4/2010	Reviewed - Medical Policy Group - Cardiology and Pulmonology. No changes to policy statements.
4/2009	Reviewed - Medical Policy Group - Cardiology and Pulmonology. No changes to policy statements.
4/2008	Reviewed - Medical Policy Group - Cardiology and Pulmonology. No changes to policy statements.
8/2007	Annual policy review. Changes to policy statements.

Information Pertaining to All Blue Cross Blue Shield Medical Policies

Click on any of the following terms to access the relevant information:
Medical Policy Terms of Use
Managed Care Guidelines
Indemnity/PPO Guidelines
Clinical Exception Process
Medical Technology Assessment Guidelines

References

1. Khargi K, Hutten BA, Lemke B, et al. Surgical treatment of atrial fibrillation; a systematic review. Eur J Cardiothorac Surg. Feb 2005; 27(2): 258-65. PMID 15691679
2. Topkara VK, Williams MR, Barili F, et al. Radiofrequency and microwave energy sources in surgical ablation of atrial fibrillation: a comparative analysis. Heart Surg Forum. 2006; 9(3): E614-7. PMID 16687343
3. Zhang D, Shi J, Quan H, et al. Five-year results of a modified left atrial maze IV procedure in the treatment of atrial fibrillation: a randomized study. ANZ J Surg. Apr 2020; 90(4): 602-607. PMID 31742849
4. Han J, Wang H, Wang Z, et al. Comparison of CryoMaze With Cut-and-Sew Maze Concomitant With Mitral Valve Surgery: A Randomized Noninferiority Trial. Semin Thorac Cardiovasc Surg. 2021; 33(3): 680-688. PMID 33246094
5. Stulak JM, Dearani JA, Sundt TM, et al. Superiority of cut-and-sew technique for the Cox maze procedure: comparison with radiofrequency ablation. J Thorac Cardiovasc Surg. Apr 2007; 133(4): 1022-7. PMID 17382646
6. Stulak JM, Suri RM, Burkhart HM, et al. Surgical ablation for atrial fibrillation for two decades: are the results of new techniques equivalent to the Cox maze III procedure?. J Thorac Cardiovasc Surg. May 2014; 147(5): 1478-86. PMID 24560517
7. Huffman MD, Karmali KN, Berendsen MA, et al. Concomitant atrial fibrillation surgery for people undergoing cardiac surgery. Cochrane Database Syst Rev. Aug 22 2016; (8): CD011814. PMID 27551927
8. Phan K, Xie A, Tian DH, et al. Systematic review and meta-analysis of surgical ablation for atrial fibrillation during mitral valve surgery. Ann Cardiothorac Surg. Jan 2014; 3(1): 3-14. PMID 24516793
9. Reston JT, Shuhaiber JH. Meta-analysis of clinical outcomes of maze-related surgical procedures for medically refractory atrial fibrillation. Eur J Cardiothorac Surg. Nov 2005; 28(5): 724-30. PMID 16143540
10. Gillinov AM, Gelijns AC, Parides MK, et al. Surgical ablation of atrial fibrillation during mitral-valve surgery. N Engl J Med. Apr 09 2015; 372(15): 1399-409. PMID 25853744
11. Budera P, Straka Z, Osmancik P, et al. Comparison of cardiac surgery with left atrial surgical ablation vs. cardiac surgery without atrial ablation in patients with coronary and/or valvular heart disease plus

atrial fibrillation: final results of the PRAGUE-12 randomized multicentre study. Eur Heart J. Nov 2012; 33(21): 2644-52. PMID 22930458
12. Van Breugel HN, Nieman FH, Accord RE, et al. A prospective randomized multicenter comparison on health-related quality of life: the value of add-on arrhythmia surgery in patients with paroxysmal, permanent or persistent atrial fibrillation undergoing valvular and/or coronary bypass surgery. J Cardiovasc Electrophysiol. May 2010; 21(5): 511-20. PMID 19925605
13. Saint LL, Damiano RJ, Cuculich PS, et al. Incremental risk of the Cox-maze IV procedure for patients with atrial fibrillation undergoing mitral valve surgery. J Thorac Cardiovasc Surg. Nov 2013; 146(5): 1072-7. PMID 23998785
14. Kim KC, Cho KR, Kim YJ, et al. Long-term results of the Cox-Maze III procedure for persistent atrial fibrillation associated with rheumatic mitral valve disease: 10-year experience. Eur J Cardiothorac Surg. Feb 2007; 31(2): 261-6. PMID 17158057
15. Damiano RJ, Badhwar V, Acker MA, et al. The CURE-AF trial: a prospective, multicenter trial of irrigated radiofrequency ablation for the treatment of persistent atrial fibrillation during concomitant cardiac surgery. Heart Rhythm. Jan 2014; 11(1): 39-45. PMID 24184028
16. Gaita F, Ebrille E, Scaglione M, et al. Very long-term results of surgical and transcatheter ablation of long-standing persistent atrial fibrillation. Ann Thorac Surg. Oct 2013; 96(4): 1273-1278. PMID 23915587
17. Watkins AC, Young CA, Ghoreishi M, et al. Prospective assessment of the CryoMaze procedure with continuous outpatient telemetry in 136 patients. Ann Thorac Surg. Apr 2014; 97(4): 1191-8; discussion 1198. PMID 24582049
18. McCarthy PM, Gerdisch M, Philpott J, et al. Three-year outcomes of the postapproval study of the AtriCure Bipolar Radiofrequency Ablation of Permanent Atrial Fibrillation Trial. J Thorac Cardiovasc Surg. Oct 03 2020. PMID 33129501
19. van Laar C, Kelder J, van Putte BP. The totally thoracoscopic maze procedure for the treatment of atrial fibrillation. Interact Cardiovasc Thorac Surg. Jan 2017; 24(1): 102-111. PMID 27664426
20. Yi S, Liu X, Wang W, et al. Thoracoscopic surgical ablation or catheter ablation for patients with atrial fibrillation? A systematic review and meta-analysis of randomized controlled trials. Interact Cardiovasc Thorac Surg. Dec 07 2020; 31(6): 763-773. PMID 33166993
21. Phan K, Phan S, Thiagalingam A, et al. Thoracoscopic surgical ablation versus catheter ablation for atrial fibrillation. Eur J Cardiothorac Surg. Apr 2016; 49(4): 1044-51. PMID 26003961
22. La Meir M, Gelsomino S, Luca F, et al. Minimal invasive surgery for atrial fibrillation: an updated review. Europace. Feb 2013; 15(2): 170-82. PMID 22782971
23. Boersma LV, Castella M, van Boven W, et al. Atrial fibrillation catheter ablation versus surgical ablation treatment (FAST): a 2-center randomized clinical trial. Circulation. Jan 03 2012; 125(1): 23-30. PMID 22082673
24. Castella M, Kotecha D, van Laar C, et al. Thoracoscopic vs. catheter ablation for atrial fibrillation: long-term follow-up of the FAST randomized trial. Europace. May 01 2019; 21(5): 746-753. PMID 30715255
25. Pokushalov E, Romanov A, Elesin D, et al. Catheter versus surgical ablation of atrial fibrillation after a failed initial pulmonary vein isolation procedure: a randomized controlled trial. J Cardiovasc Electrophysiol. Dec 2013; 24(12): 1338-43. PMID 24016147
26. Adiyaman A, Buist TJ, Beukema RJ, et al. Randomized Controlled Trial of Surgical Versus Catheter Ablation for Paroxysmal and Early Persistent Atrial Fibrillation. Circ Arrhythm Electrophysiol. Oct 2018; 11(10): e006182. PMID 30354411
27. Haldar S, Khan HR, Boyalla V, et al. Catheter ablation vs. thoracoscopic surgical ablation in long-standing persistent atrial fibrillation: CASA-AF randomized controlled trial. Eur Heart J. Dec 14 2020; 41(47): 4471-4480. PMID 32860414
28. Kwon HJ, Choi JH, Kim HR, et al. Radiofrequency vs. Cryoballoon vs. Thoracoscopic Surgical Ablation for Atrial Fibrillation: A Single-Center Experience. Medicina (Kaunas). Sep 26 2021; 57(10). PMID 34684060
29. Mahapatra S, LaPar DJ, Kamath S, et al. Initial experience of sequential surgical epicardial-catheter endocardial ablation for persistent and long-standing persistent atrial fibrillation with long-term follow-up. Ann Thorac Surg. Jun 2011; 91(6): 1890-8. PMID 21619988

30. Stulak JM, Dearani JA, Sundt TM, et al. Ablation of atrial fibrillation: comparison of catheter-based techniques and the Cox-Maze III operation. Ann Thorac Surg. Jun 2011; 91(6): 1882-8; discussion 1888-9. PMID 21619987
31. Wang J, Li Y, Shi J, et al. Minimally invasive surgical versus catheter ablation for the long-lasting persistent atrial fibrillation. PLoS One. 2011; 6(7): e22122. PMID 21765943
32. Lawrance CP, Henn MC, Miller JR, et al. A minimally invasive Cox maze IV procedure is as effective as sternotomy while decreasing major morbidity and hospital stay. J Thorac Cardiovasc Surg. Sep 2014; 148(3): 955-61; discussion 962-2. PMID 25048635
33. De Maat GE, Pozzoli A, Scholten MF, et al. Surgical minimally invasive pulmonary vein isolation for lone atrial fibrillation: midterm results of a multicenter study. Innovations (Phila). Nov-Dec 2013; 8(6): 410-5. PMID 24356430
34. Massimiano PS, Yanagawa B, Henry L, et al. Minimally invasive fibrillating heart surgery: a safe and effective approach for mitral valve and surgical ablation for atrial fibrillation. Ann Thorac Surg. Aug 2013; 96(2): 520-7. PMID 23773732
35. Cui YQ, Li Y, Gao F, et al. Video-assisted minimally invasive surgery for lone atrial fibrillation: a clinical report of 81 cases. J Thorac Cardiovasc Surg. Feb 2010; 139(2): 326-32. PMID 19660413
36. Edgerton JR, Brinkman WT, Weaver T, et al. Pulmonary vein isolation and autonomic denervation for the management of paroxysmal atrial fibrillation by a minimally invasive surgical approach. J Thorac Cardiovasc Surg. Oct 2010; 140(4): 823-8. PMID 20299028
37. Han FT, Kasirajan V, Kowalski M, et al. Results of a minimally invasive surgical pulmonary vein isolation and ganglionic plexi ablation for atrial fibrillation: single-center experience with 12-month follow-up. Circ Arrhythm Electrophysiol. Aug 2009; 2(4): 370-7. PMID 19808492
38. Pruitt JC, Lazzara RR, Ebra G. Minimally invasive surgical ablation of atrial fibrillation: the thoracoscopic box lesion approach. J Interv Card Electrophysiol. Dec 2007; 20(3): 83-7. PMID 18214660
39. Sirak J, Jones D, Sun B, et al. Toward a definitive, totally thoracoscopic procedure for atrial fibrillation. Ann Thorac Surg. Dec 2008; 86(6): 1960-4. PMID 19022018
40. Speziale G, Bonifazi R, Nasso G, et al. Minimally invasive radiofrequency ablation of lone atrial fibrillation by monolateral right minithoracotomy: operative and early follow-up results. Ann Thorac Surg. Jul 2010; 90(1): 161-7. PMID 20609767
41. Wudel JH, Chaudhuri P, Hiller JJ. Video-assisted epicardial ablation and left atrial appendage exclusion for atrial fibrillation: extended follow-up. Ann Thorac Surg. Jan 2008; 85(1): 34-8. PMID 18154774
42. Yilmaz A, Geuzebroek GS, Van Putte BP, et al. Completely thoracoscopic pulmonary vein isolation with ganglionic plexus ablation and left atrial appendage amputation for treatment of atrial fibrillation. Eur J Cardiothorac Surg. Sep 2010; 38(3): 356-60. PMID 20227287
43. Yilmaz A, Van Putte BP, Van Boven WJ. Completely thoracoscopic bilateral pulmonary vein isolation and left atrial appendage exclusion for atrial fibrillation. J Thorac Cardiovasc Surg. Aug 2008; 136(2): 521-2. PMID 18692667
44. Geuzebroek GS, Bentala M, Molhoek SG, et al. Totally thoracoscopic left atrial Maze: standardized, effective and safe. Interact Cardiovasc Thorac Surg. Mar 2016; 22(3): 259-64. PMID 26705300
45. Vos LM, Bentala M, Geuzebroek GS, et al. Long-term outcome after totally thoracoscopic ablation for atrial fibrillation. J Cardiovasc Electrophysiol. Jan 2020; 31(1): 40-45. PMID 31691391
46. Ad N, Henry L, Hunt S, et al. The outcome of the Cox Maze procedure in patients with previous percutaneous catheter ablation to treat atrial fibrillation. Ann Thorac Surg. May 2011; 91(5): 1371-7; discussion 1377. PMID 21457939
47. Castella M, Pereda D, Mestres CA, et al. Thoracoscopic pulmonary vein isolation in patients with atrial fibrillation and failed percutaneous ablation. J Thorac Cardiovasc Surg. Sep 2010; 140(3): 633-8. PMID 20117799
48. Mhanna M, Beran A, Al-Abdouh A, et al. Hybrid convergent ablation versus endocardial catheter ablation for atrial fibrillation: A systematic review and meta-analysis. J Arrhythm. Dec 2021; 37(6): 1459-1467. PMID 34887950
49. DeLurgio DB, Crossen KJ, Gill J, et al. Hybrid Convergent Procedure for the Treatment of Persistent and Long-Standing Persistent Atrial Fibrillation: Results of CONVERGE Clinical Trial. Circ Arrhythm Electrophysiol. Dec 2020; 13(12): e009288. PMID 33185144

50. La Meir M, Gelsomino S, Luca F, et al. Minimally invasive surgical treatment of lone atrial fibrillation: early results of hybrid versus standard minimally invasive approach employing radiofrequency sources. Int J Cardiol. Aug 20 2013; 167(4): 1469-75. PMID 22560495
51. Kress DC, Erickson L, Choudhuri I, et al. Comparative Effectiveness of Hybrid Ablation Versus Endocardial Catheter Ablation Alone in Patients With Persistent Atrial Fibrillation. JACC Clin Electrophysiol. Apr 2017; 3(4): 341-349. PMID 29759446
52. Maclean E, Yap J, Saberwal B, et al. The convergent procedure versus catheter ablation alone in longstanding persistent atrial fibrillation: A single centre, propensity-matched cohort study. Int J Cardiol. Mar 15 2020; 303: 49-53. PMID 32063280
53. Bisleri G, Rosati F, Bontempi L, et al. Hybrid approach for the treatment of long-standing persistent atrial fibrillation: electrophysiological findings and clinical results. Eur J Cardiothorac Surg. Nov 2013; 44(5): 919-23. PMID 23475587
54. Gehi AK, Mounsey JP, Pursell I, et al. Hybrid epicardial-endocardial ablation using a pericardioscopic technique for the treatment of atrial fibrillation. Heart Rhythm. Jan 2013; 10(1): 22-8. PMID 23064043
55. Gersak B, Pernat A, Robic B, et al. Low rate of atrial fibrillation recurrence verified by implantable loop recorder monitoring following a convergent epicardial and endocardial ablation of atrial fibrillation. J Cardiovasc Electrophysiol. Oct 2012; 23(10): 1059-66. PMID 22587585
56. La Meir M, Gelsomino S, Lorusso R, et al. The hybrid approach for the surgical treatment of lone atrial fibrillation: one-year results employing a monopolar radiofrequency source. J Cardiothorac Surg. Jul 19 2012; 7: 71. PMID 22812613
57. Muneretto C, Bisleri G, Bontempi L, et al. Successful treatment of lone persistent atrial fibrillation by means of a hybrid thoracoscopic-transcatheter approach. Innovations (Phila). Jul-Aug 2012; 7(4): 254-8. PMID 23123991
58. Muneretto C, Bisleri G, Bontempi L, et al. Durable staged hybrid ablation with thoracoscopic and percutaneous approach for treatment of long-standing atrial fibrillation: a 30-month assessment with continuous monitoring. J Thorac Cardiovasc Surg. Dec 2012; 144(6): 1460-5; discussion 1465. PMID 23062968
59. Pison L, La Meir M, van Opstal J, et al. Hybrid thoracoscopic surgical and transvenous catheter ablation of atrial fibrillation. J Am Coll Cardiol. Jul 03 2012; 60(1): 54-61. PMID 22742400
60. Zembala M, Filipiak K, Kowalski O, et al. Minimally invasive hybrid ablation procedure for the treatment of persistent atrial fibrillation: one year results. Kardiol Pol. 2012; 70(8): 819-28. PMID 22933215
61. Gersak B, Zembala MO, Muller D, et al. European experience of the convergent atrial fibrillation procedure: multicenter outcomes in consecutive patients. J Thorac Cardiovasc Surg. Apr 2014; 147(4): 1411-6. PMID 23988287
62. Civello KC, Smith CA, Boedefeld W. Combined endocardial and epicardial ablation for symptomatic atrial fibrillation: single center experience in 100+ consecutive patients. J Innovations Cardiac Rhythm Manage. 2013;August.
63. Tonks R, Lantz G, Mahlow J, et al. Short and Intermediate Term Outcomes of the Convergent Procedure: Initial Experience in a Tertiary Referral Center. Ann Thorac Cardiovasc Surg. Feb 20 2020; 26(1): 13-21. PMID 31495813
64. Badhwar V, Rankin JS, Damiano RJ, et al. The Society of Thoracic Surgeons 2017 Clinical Practice Guidelines for the Surgical Treatment of Atrial Fibrillation. Ann Thorac Surg. Jan 2017; 103(1): 329-341. PMID 28007240
65. January CT, Wann LS, Calkins H, et al. 2019 AHA/ACC/HRS Focused Update of the 2014 AHA/ACC/HRS Guideline for the Management of Patients With Atrial Fibrillation: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. J Am Coll Cardiol. Jul 09 2019; 74(1): 104-132. PMID 30703431
66. Calkins H, Hindricks G, Cappato R, et al. 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation. Europace. Jan 01 2018; 20(1): e1-e160. PMID 29016840
67. Ad N, Damiano RJ, Badhwar V, et al. Expert consensus guidelines: Examining surgical ablation for atrial fibrillation. J Thorac Cardiovasc Surg. Jun 2017; 153(6): 1330-1354.e1. PMID 28390766