

## Asian Pacific Society of Cardiology Consensus Statements on the Use of Transcatheter Edge-to-edge Repair in the Treatment of Tricuspid and Mitral Regurgitation

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### Abstract

Since the publication of the 2021 Asian Pacific Society of Cardiology (APSC) consensus statements on the use of MitraClip for mitral regurgitation (MR), other transcatheter edge-to-edge repair (TEER) devices have been introduced for the treatment of both tricuspid regurgitation (TR) and MR. Hence, the APSC developed these consensus recommendations, with general cardiologists and internal medicine specialists practising cardiology as the intended readers, to update the recommendations on the appropriate use of TEER in patients with TR or MR. The APSC expert panel reviewed and appraised the available evidence using the GRADE system. Consensus recommendations were developed and put to an online vote. Consensus was reached when at least 80% of votes for a given recommendation were in support of 'agree' or 'neutral'. The resulting 16 statements provide guidance for clinical practitioners in the region on the evaluation and management of patients with TR or MR in the Asia-Pacific region who are being considered for TEER therapy.

## Keywords

Mitral regurgitation, tricuspid regurgitation, transcatheter edge-to-edge repair, Asia-Pacific, consensus

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Mitral regurgitation (MR) and tricuspid regurgitation (TR) represent a growing burden across the Asia-Pacific region, driven by ageing populations intersecting with rising regional cardiovascular risk factors.<sup>1,2</sup> Degenerative valve disease, AF, hypertension and metabolic comorbidities are on the increase, posing increasing risks of heart failure (HF) hospitalisations, diminished quality of life and unnecessary death. These challenges are further magnified by the heterogeneity in the healthcare infrastructure and expertise of country operators highlighting the gaps in diagnosis, referral and the ability to access complex valve care.

Surgical repair or replacement remains the standard of care for many patients with severe MR and TR, but a substantial proportion are deemed to be at high or prohibitive surgical risk. In this context, transcatheter edge-to-edge repair (TEER) has emerged as a less invasive treatment option. In 2021, the Asian Pacific Society of Cardiology (APSC) released its first consensus on MitraClip, in which 26 experts shared recommendations on its use in degenerative MR (DMR) and functional MR (FMR) in the context of the Asia-Pacific region.<sup>3</sup> Since its publication, newer mitral TEER (M-TEER) devices have been introduced, expanding treatment opportunities to anatomically complex patients. Furthermore, tricuspid TEER (T-TEER) devices have also been made available to treat severe TR. These advances have changed the treatment landscape, necessitating updated management recommendations to bring them in line with current technologies and evidence. Importantly, updates to international guidelines need to be contextualised to the local and regional environment, addressing variations in the epidemiology and distribution of diseases, access to healthcare resources, the level of Heart Team expertise and cultural considerations in the Asia-Pacific region. This

consensus aims to provide up-to-date, regionally applicable recommendations regarding the use of T-TEER and M-TEER in the management of TR and MR, respectively.

## Methods

The APSC formed a multidisciplinary expert panel to review evidence, identify practice gaps and develop consensus recommendations on the use of T-TEER and M-TEER for the Asia-Pacific region. The panel included experts in interventional cardiology, cardiothoracic surgery, imaging, electrophysiology and HF.

A literature search was conducted, prioritising Asian-centric studies while incorporating robust international evidence. Level of evidence was graded using the GRADE framework.<sup>3,4</sup> Based on this system, the levels of evidence were designated as:

1. High (authors have high confidence that the true effect is similar to the estimated effect).
2. Moderate (authors believe that the true effect is probably close to the estimated effect).
3. Low (true effect might be markedly different from the estimated effect).
4. Very low (true effect is probably markedly different from the estimated effect).

Study design, risk of bias, consistency, directness, precision and publication bias were evaluated. Consensus statements were then developed and fine-tuned over two meetings (February and May 2025).

The statements were then put to an electronic vote until consensus was reached. Consensus was defined by  $\geq 80\%$  agree/neutral replies on a three-point scale (agree, neutral and disagree). Voting ended and the statements were considered final by August 2025. The consensus panel decided not to rate the strength of recommendation and decided instead to only report the level of consensus. Nonetheless, terminology was standardised to indicate that interventions with benefits that profoundly exceed harm are 'recommended'; 'should be considered' if benefit exceeds harm; 'may be considered' if benefit conditionally exceeds harm, depending on the clinical scenario; and 'not recommended' if harm exceeds benefit.

### Consensus Statements on Tricuspid Transcatheter Edge-to-edge Repair

**Statement 1.** If transcatheter intervention is planned, the five-grade classification of TR severity is recommended.

Level of evidence: Moderate.

Level of agreement: 100% agree, 0% neutral, 0% disagree.

**Statement 2.** In the absence of other conditions requiring cardiac surgery, T-TEER should be considered for symptomatic, severe or worse TR if the following criteria are met: New York Heart Association class II–IVa HF symptoms, pulmonary artery systolic pressure  $< 70$  mmHg and on optimised medical therapy.

Level of evidence: High.

Level of agreement: 100% agree, 0% neutral, 0% disagree.

**Statement 3:** Assessment by a multidisciplinary Heart Team is recommended in patients with clinically significant severe or worse TR; the team should include, at a minimum, a heart surgeon, echocardiologist, HF specialist and interventional cardiologist.

Level of evidence: Low.

Level of agreement: 94.6% agree, 5.4% neutral, 0% disagree.

**Statement 4.** Right-heart catheterisation should be considered in patients with severe or worse TR when the aetiology is unclear or findings are discordant, to clarify contributions of left-sided disease or pulmonary hypertension and to define haemodynamic severity.

Level of evidence: Low.

Level of agreement: 97.3% agree, 2.7% neutral, 0% disagree.

**Statement 5.** Transthoracic echocardiography is recommended for assessment of TR aetiology and severity.

Level of evidence: Low.

Level of agreement: 97.3% agree, 2.7% neutral, 0% disagree.

**Statement 6.** If TEER is being considered, transoesophageal echocardiography (TOE) is recommended to assess anatomical suitability.

Level of evidence: Low.

Level of agreement: 100% agree, 0% neutral, 0% disagree.

The American Society of Echocardiography (2017) recommended the use of four stages of severity in classifying TR echocardiographically: none/trace, mild, moderate and severe.<sup>5</sup> While this classification remains valid for most clinical scenarios, the severe classification combines patients with substantially different haemodynamic loads (which may influence treatment and predict outcomes) under one category. Hence, the panel

unanimously voted to use the five-grade system (mild, moderate, severe, massive and torrential) proposed by Hahn and Zamorano, when grading TR severity specifically in patients being considered for transcatheter interventions, to provide more precise risk stratification.<sup>6</sup>

The panel also recommended considering T-TEER in the management of carefully selected patients with severe or worse TR, based on the TRILUMINATE pivotal study. This was a prospective randomised trial that evaluated the efficacy and safety of T-TEER (using the TriClip Transcatheter Tricuspid Valve Repair system [Abbott Structural Heart]) compared with medical therapy alone in the treatment of severe TR. The study enrolled 350 patients with severe, symptomatic TR with a pulmonary artery systolic pressure of  $< 70$  mm Hg, who were receiving stable guideline-directed medical therapy (GDMT) for HF.<sup>7</sup> TRILUMINATE revealed that T-TEER significantly decreased the severity of TR, improved quality of life and reduced clinical events compared with medical therapy alone (with HF hospitalisation also reduced in the 2-year analysis).<sup>7,8</sup> Long-term follow-up also showed sustainable symptom relief, favourable survival, and low reintervention rates.<sup>9</sup> At present, the TriClip platform is the only device with randomised controlled data in this set of patients. However, non-randomised data on the PASCAL device (Edwards) are promising and the device is currently being investigated in randomised controlled trials (RCTs) (NCT04097145).<sup>10</sup> The initial experience in the Asia-Pacific region is also promising in TR reduction and symptom improvement.<sup>11</sup>

Given the availability of multiple treatment options and various factors that can affect treatment decisions and outcomes, the expert panel also encourages evaluation by a multidisciplinary Heart Team, at least a cardiac surgeon, echocardiologist, heart-failure specialist and interventional cardiologist, in patients being considered for T-TEER. Multidisciplinary team discussions should also consider shared decision-making involving the patient and caregivers.

The expert panel noted that right-heart catheterisation should be considered in patients with severe or worse TR when the aetiology is not clear or findings are discordant. Right-heart catheterisation is not routinely done in patients with TR, but it is important in confirming pulmonary artery pressures and vascular resistance, which are key determinants of prognostic markers that are not reliably measured by echocardiography. Right-heart catheterisation provides important information that may clarify the contributions of left-sided disease or pulmonary hypertension and define the haemodynamic consequences of TR.

Lastly, the expert panel clarified the role of echocardiography by recommending transthoracic echocardiography for assessing TR aetiology and severity and should be ideally performed in a euvoelaemic state, on optimised medical therapy. On the other hand, TOE is required for the assessment of anatomical suitability for T-TEER. TOE offers high-resolution images of the morphology of the leaflets, coaptation gaps, and annular sizes, and multiplanar reconstruction (3D) provides greater clarity on leaflet anatomy and structural relationships.<sup>6,12</sup> Although TOE is commonly used intraprocedurally to guide leaflet grasping and clip placement, intracardiac echocardiography may be used as an adjunct if TOE is contraindicated or unable to provide sufficient information during the procedure.<sup>13</sup>

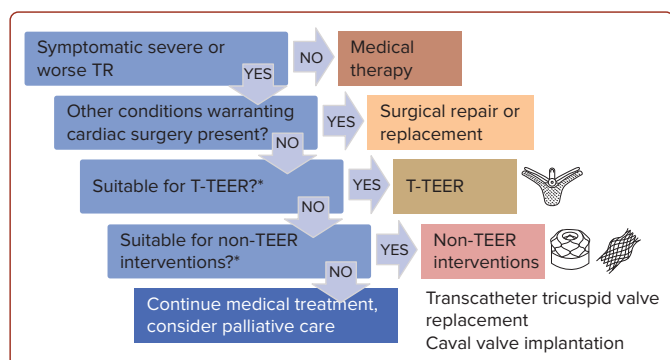
Table 1 summarises the various anatomical considerations when deciding on the appropriateness of T-TEER in the management of TR in the Asia-Pacific region. This may provide a structured, reproducible framework for Heart Teams when selecting patients and may streamline procedure

**Table 1: Anatomical Considerations in Tricuspid Transcatheter Edge-to-edge Repair**

Favourable	Complex	Unfavourable
<ul style="list-style-type: none"> <li>• Coaptation gap <math>\leq 7</math> mm</li> <li>• Anteroseptal jet location</li> <li>• Confined prolapse or flail</li> <li>• Trileaflet morphology</li> <li>• TR severity is less than torrential</li> </ul>	<ul style="list-style-type: none"> <li>• Coaptation gap <math>&gt; 7, &lt; 10</math> mm</li> <li>• Posteroseptal jet location</li> <li>• Non-trileaflet morphology</li> <li>• Incidental CIED without leaflet impingement</li> <li>• CIED-related TR (if TR reduction is likely)</li> </ul>	<ul style="list-style-type: none"> <li>• Coaptation gap <math>\geq 10</math> mm</li> <li>• Leaflet thickening, shortening or perforation</li> <li>• Dense chordae with marked leaflet tethering or immobility</li> <li>• Anteroposterior jet location or gap</li> <li>• Poor leaflet visualisation</li> <li>• CIED-related TR with significant TR reduction unlikely</li> </ul>

Level of agreement: 82.4% agree, 10.4% neutral, 5.2% disagree. CIED = cardiac implantable electronic device; TR = tricuspid regurgitation.

**Figure 1: Proposed Decision Pathway for Patients with Severe or Worse Tricuspid Regurgitation in the Asia-Pacific Region**



*\*If available. Surgical repair is also an option at any stage, if not contraindicated. The appropriate strategy should be discussed by the Heart Team. TEER = transcatheter edge-to-edge repair; TR = tricuspid regurgitation; T-TEER = tricuspid transcatheter edge-to-edge repair.*

planning.<sup>14</sup> However, a minority noted that poor leaflet visualisation, leaflet thickening and dense chordae may be classified as complex rather than unfavourable, and that the coaptation gap cut-off for unfavourable anatomy may need to be lowered from  $>10$  mm to  $>8.5$  mm (with the complex range being between 7 mm and 8.5 mm).

Additionally, *Figure 1* proposes a simplified decision pathway for patients with severe or worse TR in the Asia-Pacific region, taking into consideration the limited access to devices in this region.<sup>15</sup> The pathway highlights the importance of optimised background medical therapy and the preference for surgical valve repair if there are other indications for heart surgery. Given the availability of randomised controlled evidence and long-term follow-up data supporting the use of T-TEER, this strategy is preferred whenever transcatheter valve intervention is being considered.<sup>7,9</sup>

**Updated Consensus Statements on Mitral Transcatheter Edge-to-edge Repair**

**Statement 7.** Both symptomatic and asymptomatic patients with  $\geq 3+$  DMR, who meet the indications for surgery but are considered high risk by the Heart Team, should be considered for M-TEER.  
Level of evidence: Moderate.  
Level of agreement: 86.5% agree, 8.1% neutral, 5.4% disagree.

**Statement 8.** M-TEER should be considered for symptomatic high-risk  $\geq 3+$  DMR patients with or without reduced left ventricular (LV) ejection fraction (LVEF).  
Level of evidence: High.  
Level of agreement: 94.6% agree, 5.4% neutral, 0% disagree.

**Statement 9.** M-TEER may be considered for asymptomatic patients with high-risk  $\geq 3+$  DMR, with: reduced LVEF ( $\leq 60\%$ ) and/or LV dilatation (LV end-systolic diameter  $\geq 40$  mm), new-onset AF or pulmonary hypertension (systolic pulmonary arterial pressure  $\geq 50$  mmHg).  
Level of evidence: Low.  
Level of agreement: 75.7% agree, 21.6% neutral, 2.7% disagree.

**Statement 10.** M-TEER should be considered for ( $\geq 3+$ ) symptomatic ventricular FMR patients who are already receiving optimised GDMT, including cardiac resynchronisation therapy when indicated.  
Level of evidence: High.  
Level of agreement: 94.6% agree, 5.4% neutral, 0% disagree.

**Statement 11.** For ischaemic FMR ( $\geq 3+$ ), coronary anatomy and ischaemia evaluation should be performed before M-TEER consideration. If percutaneous coronary intervention is performed, staged M-TEER therapy should be considered for severe symptomatic FMR.  
Level of evidence: Moderate.  
Level of agreement: 97.3% agree, 2.7% neutral, 0% disagree.

**Statement 12.** Ventricular FMR patients should be monitored regularly (e.g. every 3–6 months) and referred early to the Heart Team (including a TEER specialist, HF specialist, echocardiologist and surgeon) for potential M-TEER.  
Level of evidence: Low.  
Level of agreement: 97.3% agree, 2.7% neutral, 0% disagree.

**Statement 13.** Symptomatic patients with  $\geq 3+$  ventricular FMR should be assessed by the Heart Team for potential M-TEER.  
Level of evidence: High.  
Level of agreement: 94.6% agree, 5.4% neutral, 0% disagree.

**Statement 14.** Ventricular FMR patients who do not meet the eligibility criteria for M-TEER (e.g. asymptomatic patients, those with MR severity of  $\leq 2+$ , and those with less-optimised GDMT) should be closely monitored. These patients should be considered for M-TEER.  
Level of evidence: Moderate.  
Level of agreement: 97.3% agree, 2.7% neutral, 0% disagree.

**Statement 15.** Patients with symptomatic atrial FMR should be evaluated by the Heart Team (including an electrophysiologist and HF specialist) and, if treatment has already been optimised, M-TEER may be considered.  
Level of evidence: Moderate.  
Level of agreement: 94.6% agree, 5.4% neutral, 0% disagree.

**Table 2: Anatomical Considerations for Mitral Transcatheter Edge-to-edge Repair Use**

Favourable	Complex	Unfavourable
<ul style="list-style-type: none"> <li>• Pathology in segment 2</li> <li>• Valve area &gt;4.0 cm<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Valve area 3–4.0 cm<sup>2</sup></li> <li>• Non-central pathology</li> <li>• Posterior leaflet length &lt;7.0 mm</li> <li>• Barlow’s syndrome</li> <li>• Mitral valve cleft</li> <li>• Severe mitral annular calcification</li> <li>• Severely calcified leaflets</li> <li>• Prior annuloplasty</li> <li>• Rheumatic pathology</li> <li>• Small LA or very large LA</li> <li>• Thickened or lipomatous inter-atrial septum</li> <li>• PFO, or prior surgical or device interatrial closure</li> <li>• Multiple MR jets</li> </ul>	<ul style="list-style-type: none"> <li>• Leaflet perforation</li> <li>• Moderate-to-severe mitral stenosis (valve area ≤2.0 cm<sup>2</sup>)</li> <li>• Left atrial thrombus</li> <li>• Left atrial appendage thrombus</li> <li>• Active infective endocarditis</li> </ul>

LA = left atrium; MR = mitral regurgitation; PFO = patent foramen ovale.

**Statement 16.** Patients with less common scenarios of MR should be evaluated by the Heart Team on a per-patient basis to determine whether M-TEER use would be feasible and beneficial for them. Enrolment into clinical trials or registries should be considered. Level of evidence: Low. Level of agreement: 97.3% agree, 2.7% neutral, 0% disagree.

Evidence supporting the use of M-TEER in MR is rapidly evolving with the introduction of various devices such as MitraClip, PASCAL and DragonFly (Valgen MedTech), as well as the clinical evidence supporting their use.

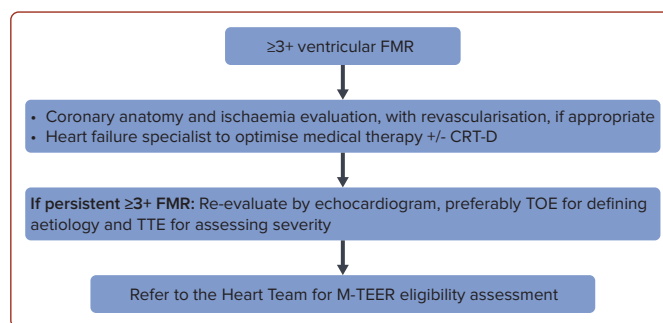
Since the publication of the COAPT and MITRA-FR trials in 2018, two other trials have been published to establish the role of M-TEER in ventricular FMR.<sup>16,17</sup> RESHAPE-HF2 was a large RCT that compared MitraClip plus GDMT versus GDMT alone in 505 patients with symptomatic HF and moderate-to-severe or severe secondary MR.<sup>18</sup> The study found that the primary endpoint of cardiovascular death or HF hospitalisation at 2 years was significantly lower in the MitraClip group and this was driven by a reduction in HF hospitalisations. Importantly, patients who received the MitraClip therapy had significantly better symptomatic improvement and quality of life compared with medical therapy only. RESHAPE-HF2, together with COAPT and MITRA-FR, cover a broad range of patients with ventricular FMR of varying MR severity and LV dimensions, giving greater clarity on who may derive the most benefit from M-TEER in addition to GDMT.<sup>16–18</sup>

On the other hand, the MATTERHORN study compared MitraClip with mitral surgery in 210 patients with symptomatic severe secondary MR despite GDMT. The study showed that at 1 year, MitraClip was non-inferior to surgery for the composite of death, HF hospitalisation, reintervention, or residual MR. Surgery achieved more complete MR elimination, but TEER had fewer early complications and faster recovery.<sup>19</sup>

For the PASCAL system, the CLASP IID study provides compelling RCT data comparing this device against MitraClip in prohibitive risk patients with significant symptomatic DMR. The study found that in this subset of patients, the PASCAL system was non-inferior to MitraClip and that at 1 year, PASCAL was associated with comparable clinical outcomes, MR reduction and symptom improvement compared with MitraClip.<sup>20</sup>

In contrast, the DragonFly device is supported by the DRAGONFLY-DMR

**Figure 2: Assessment and Initial Management of Patients with ≥3+ Ventricular Functional Mitral Regurgitation**



CRT-D = CRT defibrillator; FMR = functional mitral regurgitation; M-TEER = mitral transcatheter edge-to-edge repair; TOE = transoesophageal echocardiogram; TTE = transthoracic echocardiogram.

trial, a prospective, single-arm, multicentre study, which included 120 patients. The trial demonstrated the safety and efficacy of the device in treating DMR with 87.5% clinical success rate (defined as freedom from all-cause mortality, mitral valve reintervention, and MR severity >2+ at 1-year follow-up).<sup>21</sup>

While the emerging clinical data on the various M-TEER devices have strengthened the role of M-TEER in MR treatment and have expanded the choice of devices, none has resulted in any substantial change in the past recommendations. While the clinical evidence for the newer M-TEER devices focuses on DMR, the expert panel found no reason to avoid their use in ventricular FMR. Figure 2 outlines the assessment and initial management of patients with ≥3 ventricular FMRs. This algorithm underscores the importance of optimising initial treatments before considering M-TEER as well as the need for a comprehensive multidisciplinary assessment to ensure that M-TEER is offered only to patients likely to derive sustained benefit while avoiding futile interventions in those with prohibitive anatomy or untreated underlying disease. Some experts also noted that, even in some patients, such as those with advanced age, M-TEER may be considered even if the high-risk criteria are not met. Table 2 summarises the various anatomical considerations when deciding on the appropriateness of M-TEER in the management of TR in the Asia-Pacific region.

**Limitations and Conclusions**

The authors note that the consensus panel meetings ended in May 2025 and the voting and statements were finalised in early August 2025.

Hence, recent relevant publications such as the 2025 European Society of Cardiology/European Association for Cardio-Thoracic Surgery guidelines for the management of valvular heart disease, published on 29 August 2025, were not considered nor discussed in the development of these consensus statements.<sup>22</sup>

The 16 statements presented in this paper aim to guide clinicians based on the most updated evidence and collective expert opinion from the Asia-Pacific region. These recommendations build on prior APSC guidance and incorporate the latest trial evidence, device platforms and regional practice considerations. However, given the varied clinical situations, healthcare resources and level of expertise present in the region, these recommendations should not replace, but rather augment, clinical judgement. The management of TR and MR should be individualised, taking into account the patient's clinical characteristics as well as patient and caregiver concerns and preferences. Clinicians should also be aware of the challenges that may limit the applicability of these consensus recommendations in their centre, such as the access to specific interventions and technologies, availability of resources, including the competency level of clinical staff, accepted local standards of care, cultural factors and one's own experience and expertise. Nonetheless, these consensus statements might help create and improve protocols and pathways for the management of TR and MR in centres across the Asia-Pacific region to best benefit patients.

Across both MR and TR, general cardiologists play a central role in early identification, optimisation of medical therapy and referral to experienced

valve centres before advanced ventricular dysfunction or end-organ damage occurs. On-going follow-up through serial echocardiography, biomarker monitoring and HF management remain critical after intervention.

Looking forward, the expansion of regional registries, structured referral networks and collaborative training programs will be key to ensuring equitable access and standardisation of care across the Asia-Pacific. By integrating international trial evidence with regional realities, these consensus statements aim to provide cardiologists with a clear, practical framework to guide timely referral, patient selection and collaborative management, ultimately improving outcomes for patients with valvular heart disease. □

### Clinical Perspective

- Transcatheter edge-to-edge repair provides the greatest benefit in carefully selected patients with severe mitral or tricuspid regurgitation or who remain symptomatic despite optimised guideline-directed medical therapy. Hence, patients should be carefully assessed for eligibility and procedural planning.
- Heart-team evaluation is essential. Shared decision-making guided by a multidisciplinary Heart Team improves safety, appropriateness and long-term outcomes.
- Structured long-term follow-up is vital in ensuring sustained mitral or tricuspid regurgitation reduction and maximising the long-term clinical benefit demonstrated in clinical trials.

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