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RESEARCH ARTICLE

IDEAL MECHANICAL VALVE IN INDIAN SCENARIO: A RETROSPECTIVE CASE STUDY

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Key words:-
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Abstract

Background: Mechanical valve replacement is the treatment of choice for advanced valvular heart disease. In India, the indigenously developed TTK Chitra heart valve (TTKCHV) offers a cost advantage over imported prostheses such as St. Jude Medical valve (SJMV). This study compared their short-term outcomes.

Methods: A retrospective single-center study was conducted at Grant Government Medical College, Mumbai, by analyzing hospital records from January 2021 to January 2025. A total of 134 patients undergoing isolated mitral valve replacement (MVR, n=84) or aortic valve replacement (AVR, n=50) were included; 78 received TTKCHV (48 MVR, 30 AVR) and 56 received SJMV (36 MVR, 20 AVR). Baseline demographics, valve pathology, and functional class were comparable. Clinical and echocardiographic outcomes data postoperatively and at 30 days were assessed.

Results: Both TTKCHV and SJMV groups demonstrated significant improvement in NYHA class and echocardiographic parameters postoperatively. At 30-day follow-up, there were no statistically significant differences between the two groups with respect to ejection fraction, transvalvular gradients or left ventricular dimensions. Mortality and complication rates were comparable. The cost of TTKCHV was approximately half that of SJMV, highlighting its affordability in the Indian setting.

Conclusion: TTKCHV provides short term clinical and echocardiograp hic outcomes comparable to SJMV in both MVR and AVR. Its lower cost makes it a practical and cost-effective alternative for valve replacement in India. Long-term follow-up is needed to confirm durability and late outcomes.

Introduction: -

India has 2 to 2.5 million patients of Rheumatic heart disease (RHD) [1]. Most of the patients are young and belong to low socio-economic group. At presentation in chronic RHD, the valves are damaged, leading to regurgitation or stenosis and are unsuitable for repair [2]. So prosthetic valve replacement is needed for these patients. Until 1990s, most of the artificial heart valves implanted in India were imported. TTK Chitra heart valve (TTKCHV), developed in the late 1980s at the Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram,

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(SCTIMST) Kerala, is a low-cost mechanical heart valve prosthesis [3]. The TTK Chitra Heart Valve (TTKCHV) is a tilting disc valve with monoleaflet configuration. It was developed over a period of 12 years at SCTIMST by renowned cardiac surgeon Dr M S Valiathan [4]. The tilting disc is made from ultra-high-molecular-weight polyethylene (UHMWPE), pivoted eccentrically in the metallic frame made of Cobalt-Chromium alloy. The sewing ring of polyethylene terephthalate (PET) is fitted snugly around the frame and is used to suture the valve at the intended position in the heart [5].

Bileaflet valves such as St. Jude Medical valve (SJMV) are most widely utilised, however their advantagesover themonoleaflet valve are not clearly established. TTK Chitra Heart valve (TTKCHV) being low cost is a good solution for low- and middle-income countries like India where most of the patients are dependent on social welfare schemes for their treatment because these schemes rarely cover the cost of the imported valves. This retrospective study was aimed to examine if the low cost TTK Chitra valve can offer equivalent outcomescompared to the more commonly used importedbileaflet valves like the St Jude Medical valve (SJMV).

Methods: -

The study was conducted at Grant Government Medical College and Hospital in Mumbai between January 2021 and January 2025. We performed a single-center retrospective study including all patients who underwent isolated MVR or isolated AVR with TTKCHV or SJMV. Individuals who underwent simultaneous cardiac procedures such as double valve replacement, coronary artery bypass grafting, or other procedures were excluded from the study. The study population was randomised into 2 groups based on whether SJMV or TTKCHV valve was used. The follow-up data was obtained at baseline i.e. postoperative (within 5 days of surgery) and at 30 days after surgery. Aortic valve replacement was necessary in 50 patients in total. 20 cases underwent AVR withSJMV and the remaining 30 cases were implanted withTTKCHV. Similarly, 84 patients underwent MVR, 36 patients with SJMV and 48 withTTKCHV. The surgery in the study period was done by consultant surgeons well versed with the procedures and the technique of surgery was same in both groups with the valve being secured in position by ethibondpledgeted sutures in interrupted horizontal mattress fashion. In case of MVR,TTKCHV was implanted with the larger orifice oriented posteriorly (anatomical position) whereas SJMV was implanted such as the prosthetic valve commissure was perpendicular to native valve commissure (anti-anatomical position). In case of AVR,TTKCHV was implanted with its tilting disc facing the greater curvature of the Aorta andSJMV was implanted such that the pivot of the valve was perpendicular to the interventricular septum.

Data Collection: -

Demographic details including age at surgery, gender and socioeconomic status were collected. Clinical data regarding aetiology of valve disease, functional class (NYHA), and pulmonary artery hypertension and baseline cardiac rhythm were recorded. 2D transthoracic echocardiography reports at baseline and atfollow-up was obtained in all patients. Left ventricular ejection fraction, left ventricular dimensions (in systole and diastole), gradient across the diseased valves, left atrial size and aortic diameter were documented. Data on variables like cross-clamp time, bypass time, type of valve implanted, its size, duration of ICU stay and hospital stay were also obtained. For analysis of outcomes, we compared these parameters longitudinally at baseline i.e. post operative (within 5 days of surgery) and at 30 days after surgery. Therapeutic INR was defined as between 2.0-3.0 for AVR and 2.5 - 3.5 for MVR [9].

Results: -

Table 1: Baseline characteristics of the entire cohort

Sl.No.	TTKCHV	SJMV
Number of patients n (%)	78(58.2)	56(41.7)
MVR (n=)	48(57.1)	36(42.8)
AVR (n= 28)	30(60)	20(40)

Age at surgery (yrs.)	46.4 ±12.5	43.8 ± 12.0
Male gender (%)	45.8	46.7

A total of 134 patients were included in the study. Of them 78 patients underwent implantation with TTKCHV, 48 MVR and 30 AVR. 56 patients underwent SJMV implantation, 36 for MVR and 20 for AVR.

Table 2: Baseline characteristics of patients undergoing mitral valve replacement

Baseline characteristics	TTKCHV	SJMV	p - value
Number of patients, n (%)	48(57.1)	36(42.8)	
Age at surgery (yrs.)	42.5 ± 8.4	39.8 ± 9.5	P = 0.1719
Male gender (%)	43.1	39.8	P = 0.7628
Rheumatic heart disease(RHD) (%)	86.4	90.2	P = 0.5977
Mitralvalve prolapse(MVP) (%)	10.8	7.4	P = 0.5984
NYHA functional class III/ IV (%)	46.2/3.2	48.5/2.6	P = 0.8354 / 0.8728
Atrial fibrillation	50.2	52.8	P = 0.8146
Left atrium(LA) size (mm)	46.8 ± 7.8	48.5 ± 8.3	P = 0.3390
Ejection fraction(EF) (%)	50.4 ± 7.2	48.3 ± 8.7	P = 0.230
Mean gradient across mitral valve (mmHg)	10.5 ± 5.4	12 ± 3.5	P = 0.1502
Left ventricle end systolic dimensions (LVSD) (mm)	32.9 ± 6.3	31.8 ± 5.4	P = 0.4028
Left ventricle end diastolic dimensions (LVDD) (mm)	45.9 ± 8.9	48.8 ± 9.5	P = 0.1549

The baseline characteristics, including age at surgery, gender, cause of mitral valve disease, degree of functional impairment of the patient, preexisting atrial fibrillation, ejection fraction, mean gradient across the diseased mitral valve, left atrium dimension and left ventricle dimensions during systole and diastole were similar across both the groups. Predominantly middle age population was affected by mitral valve disease. Female were most commonly affected. The most common reason for mitral valve disease was rheumatic heart disease followed by mitral valve prolapse according to the study. Approximately 50% patients already had atrial fibrillation at the time of presentation to the hospital.

Table 3: Clinical and echocardiographic outcomes in MVR

Variable	TTKCHV	SJM	P - value
Median NYHA functional Class Baseline 30 days	 III I	 III I	
EF (%) Baseline 30 days	50.4 ± 7.2 52.1 ± 5.4	48.3 ± 8.7 50.6 ± 7.8	P = 0.230 P = 0.3008
Mean gradient across mitral valve (mmHg) Baseline 30 days	 10.5 ± 5.4 7.2 ± 3.6	 12 ± 3.5 8.4 ± 1.5	 P = 0.1502 P = 0.1657
LVSD (mm) Baseline 30 days	32.9 ± 6.3 31.4 ± 5.8	31.8 ± 5.4 30.8 ± 5.2	P = 0.4028 P = 0.6253
LVDD (mm) Baseline 30 days	45.9 ± 8.9 44.8 ± 7.2	48.8 ± 9.5 47.8 ± 8.6	P = 0.1549 P = 0.0859

Table 3 shows the outcomes after mitral valve replacement surgery compared at baseline and at 30 days post surgerywere not statistically significant irrespective of the type of valve used.

Table 4: Baseline characteristics of patients undergoing aortic valve replacement

Variable	TTKCHV	SJMV	p - value
Number of patients, n (%)	30(60)	20(40)	
Age at surgery (yrs.)	52.8 ± 7.8	50.8 ± 10.5	P = 0.4435
Male gender (%)	64.5	72	P = 0.5829
Calcified/degenerative (%)	55.2	48.6	P = 0.6504
Bicuspid aortic valve (%)	15.3	25.4	P = 0.3805
RHD	24.9	23.8	0.9301

(%)			
NYHA III/ IV	62.8 / 35.5	60.4 / 34.9	P = 0.8655 / 0.9656
EF (%)	50.1 ± 9.7	53.6 ± 10.2	P = 0.2267
Mean aortic valve gradient (mmHg)	50.7 ± 17.8	55.8 ± 22.0	P = 0.3712
Aortic diameter (mm)	31.6 ± 6.4	34.5 ± 5.4	P = 0.2597
LV systolic dimension (mm)	36.2 ± 8.6	38.7 ± 9.4	P = 0.3368
LV diastolic dimension (mm)	58.2±12.4	58.5±12.8	P=0.944

The baseline characteristics including age at surgery, gender, cause of aortic valve disease, degree of functional impairment, ejection fraction, mean gradient across the diseased aortic valve, diameter of aorta and left ventricle dimensions during systole and diastole were similar across both the groups. Aortic valve disease predominantly affected middle aged people more commonly a decade older than mitral valve affection in the study population. Male were the most commonly affected gender. The most common reason for isolated aortic valve disease was degenerative aortic valve disease. It was followed almost equally by bicuspid aortic valve and rheumatic heart disease in our study.

Table 5: Clinical and echocardiographic outcomes in AVR

Variable	**TTKCHV**	**SJMV**	**p - value**
NYHA functional class (Median) Baseline 30 days	 II I	 II I	
EF (%) Baseline 30 days	 50.1 ± 9.7 52 ± 8.6	 53.6 ± 10.2 54.6 ± 9.4	 P = 0.2267 P = 0.3180
Mean gradient across aortic valve (mmHg) Baseline 30 days	 50.7 ± 17.8 20.4 ± 5.8	 55.8 ± 22.0 22.8 ± 8.4	 P = 0.3712 P = 0.2372
LVSD (mm) Baseline 30 days	 36.2 ± 8.6 35.4 ± 7.8	 38.7 ± 9.4 37.8 ± 8.4	 P = 0.3368 P = 0.3065
LVDD (mm) Baseline 30 days	 58.2±12.4 57.8 ± 8.2	 58.5±12.8 58.2 ± 11.4	 P = 0.944 P = 0.8858

Table 5 shows there was no statistically significant difference observed in the outcomes of aortic valve replacement surgery irrespective of the type of the valve is used.

Table 6 : Cost comparision of TTKCHV and SJMV

Variable	TTKCHV	SJMV
Cost	Rs 18,000 - 20,000 /-	Rs 45,000 - 55, 000 /-

TTKCHV cost around Rs 18,000 - 20000/- in 2016 in India whereas the imported mechanical valves like SJMV cost around Rs 45,000 - 55,000/- in the same time [6, 7]. In current times, the cost for both the valves have almost doubled.

Discussion: -

Valvular heart disease is a major cause of cardiovascular morbidity and mortality worldwide and an enormous burden on healthcare resources. Rheumatic heart disease is most common etiology of valvular heart disease in developing countries like India. At the time of presentation the valves involved are unsuitable for repair, so valve replacement is the only option available. In our study, the patients undergoing valve replacement were mostly of middle age group 40 - 50 years.In India, mitral valve replacements are more common than aortic valve replacements, the reverse of what is seen in developed nations as RHD affects the mitral valve preferentially compared to degenerative valvular disease more commonly affecting aortic valve.

Due to higher prevalence of valvular heart disease and need for valve replacement in this resource limited setting, this study was done to compare theaffordability and performance of the valves used for valve replacement surgery. The two most commonly used mechanical valves at our centre are TTKCHV and SJMV.In our study, the median NYHA functional class improved from NYHA III to NYHA I at 30 day follow-up for both group of valves in case of MVR and from NYHA II to NYHA I for both groups in case of AVR. There was not much improvement in EF in both groups for both AVR and MVR at 30 days post surgery. The mean gradient across the valves also showssignificant improvement at 30 days follow-up in both mitral and aortic positions but there were no significant differences across both the groups. Our study shows comparable results to various other studies done to compare outcomes of both the valves [8 -11]. There was no incidence of mortality, thromboembolic or bleeding complication or stuck mechanical valve during the period of the study in both the groups. The results of this study indicate that performance of St. Jude Medical valve and TTK Chitra Heart valve are comparable in terms of clinical benefits, adverse events and early mortality in both aortic and mitral positions in the short term. The TTKCHV offers equivalent results at almost half the cost of imported mechanical valves like the St Jude Mechanical heart valve making cardiac surgery available to a large number of patients in this resource-limited country [8-11].

Conclusion: -

This retrospective single-center analysis demonstrates that the indigenously developed TTK Chitra heart valve provides short-term clinical outcomes equivalent to the St. Jude Medical valve in both aortic and mitral valve replacement. Improvements in functional class, echocardiographic parameters, and postoperative recovery were comparable across groups, with no significant differences in mortality or early complication rates. Importantly, the substantially lower cost of the TTK Chitra prosthesis represents a crucial advantage in the Indian healthcare context, where affordability and accessibility remain significant considerations. By offering performance on par with internationally established prostheses at nearly half the cost, TTK Chitra emerges as a viable and sustainable alternativefor patients in low- and middle-income countries like India where most of the patients are non affordingand are dependent on government welfare schemes for their treatment because the cost of imported valves does not fit in the government approved schemes.

Limitations: -

This study has some limitations. First, its retrospective and single-center design may limit the generalizability of the findings to broader patient populations. Second, the follow-up period was restricted to 30 days, precluding evaluation of long-term valve durability, anticoagulation-related complications, thromboembolic or hemorrhagic events, and reoperation rates. Finally, although cost differences between the two valve types was highlighted, a

comprehensive socioeconomic analysis, including long-term treatment-related expenses and quality-of-life outcomes, was beyond the scope of this study.

Statement and Declaration: -

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Conflicts of Interests: -
None

References: -

1. ET HealthWorld. Over 2.5 million people in India suffer from RHD: survey [Internet]. ETHealthworld.com. PTI; 2016 [cited 2025 Aug 24]. Available from: https://health.economictimes.indiatimes.com/news/industry/over-2-5-million-people-in-india-suffer-from-rhd/51862557
2. Javed N, Pineda R, Itare V, Ashraf S, Kamalakkannan G. Rheumatic Valve Disease Presenting as Mitral Stenosis and Regurgitation. Cureus. 2025 Jun 24;17(6): e86671. doi: 10.7759/cureus.86671.
3. Varma PK, Kumar RK, Bhuvaneshwar GS, Krishna N. Evaluation of TTK Chitra heart valve prosthesis in pediatric patients. Indian J Thorac Cardiovasc Surg. 2023 Jan;39(1):37-41. doi: 10.1007/s12055-022-01440-0.
4. Rajashekar, P. Development of Mechanical Heart Valves - An Inspiring Tale. Journal of the Practice of Cardiovascular Sciences 1(3): p 289-293, Sep–Dec 2015. | DOI: 10.4103/2395-5414.177309
5. TTK Healthcare Heartvalve Division [Internet]. TTK Healthcare Heartvalve Division. 2015. Available from: https://www.ttkchitraheartvalves.com/products.php
6. Ministry of Science & Technology. Low-cost Sree Chitra valve facilitating the Government's commitment to inclusive healthcare for all Posted On: 01 MAR 2024 3:26PM by. PIB Delhi. 2024 Mar 1;
7. Low-Cost Heart Valve for Inclusive Healthcare. Science India Bureau. 2024 May 19;
8. Dr. Anupama Rao, Dr. Padma S, Dr. Anurag Vidhale and Dr. PK Dash. Hemodynamic results of TTK-Chitra valve in aortic position in patients undergoing aortic valve replacement for aortic stenosis. Int. J. Surg. Sci. 2020;4(4):237-240. DOI: https://doi.org/10.33545/surgery.2020.v4.i4d.566
9. Kaushik R, Mani A, Ganapathi S, Pillai VV, Jayakumar K. Clinical outcomes of bileaflet St. Jude Medical and tilting disc TTK Chitra mechanical heart valve prosthesis: A comparative study. Journal of Cardiac Surgery. 2022 Aug;37(8):2367-74.
10. Nagarajan M, Muralidharan S, Chandrasekar P. The TTK chitra heart valve—A single centre experience with midterm results. Indian Journal of Thoracic and Cardiovascular Surgery. 2000 Dec; 16:8.
11. Muralidharan S, Muthubaskeran V, Chandrasekar P. Ten years outcome of Chitra heart valves. Indian Journal of Thoracic and Cardiovascular Surgery. 2011 Jan; 27:24-7.