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A Thesis for the Degree of Doctor of Philosophy

**May Cost-Effectiveness of
Robot-Assisted Mitral Valve Repair
Differ by the Medical Fee System?**

Department of Medicine
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August 2016

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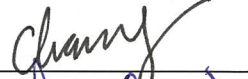
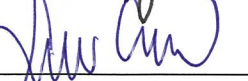
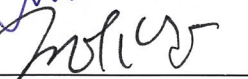
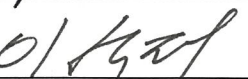
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Abstract

Introduction: The cost-effectiveness of robot-assisted surgery has been consistently debated in all related surgical fields. The cost of care of robot-assisted mitral valve repair (RMVR) is known to be more expensive than conventional mitral valve repair (CMVR) in the previous foreign studies, however, costs of specific surgeries can differ according to the different medical fee system of different countries. The author aimed to investigate the cost of RMVR under the current Korean medical fee system and compare it with the cost of CMVR.

Materials and Methods: The medical records of 38 patients who underwent RMVR (n=17) or CMVR (n=21) in the same institution from March 2010 to February 2014 were reviewed retrospectively. Information regarding cost was collected from the billing department, which was based on the hospital charges incurred by the patients.

Results: The overall surgical outcomes did not differ between the RMVR and CMVR groups. Postoperative hospital stay was shorter and postoperative complications tended to be lower in the RMVR group. Despite the significantly higher fees for procedure and surgery and anesthesia in the RMVR group, the total cost of care did not differ between groups (21,360±1,590 USD vs. 19,832±3,683 USD, P=0.12). However, the patient financial burden, per the Korean National Health Insurance Service (KNHIS) regulations, was more than double in the RMVR group compared with the CMVR group (12,368±2,305 USD vs. 5,162±1,464 USD, P<0.001).

Conclusions: The total cost of care did not differ between the RMVR and CMVR groups currently under the Korean medical fee system.

Introduction

The first surgical robot, “Arthrobot” was developed in 1983. Since then, robot technology has evolved rapidly, and robot-assisted surgery has found applications in various fields because of its minimally invasive nature and the operative advantages over endoscopic surgery.¹ Robot-assisted surgery has demonstrated favorable outcomes in the postoperative recovery stage, such as shorter hospital stays and superior cosmetic effects. However, the surgical outcomes of robot-assisted surgery are not very different from those achieved with conventional procedures.²⁻⁴ Thus, robot-assisted surgery could be considered one of the most important achievements in the field of minimally invasive surgery in this decade. In cardiac surgery, minimally invasive techniques under video-assistance have been used to harvest the internal thoracic artery since the late 1990s.⁵ Mitral valve repair using a prototype of the da Vinci system (Intuitive Surgical Inc., Sunnyvale, CA, USA) was first performed in France by Carpentier et al. in 1997,⁶ which initiated the era of robot-assisted cardiac surgery. In Korea, the Automated Endoscopic System for Optimal Positioning system (Computer Motion, Goleta, CA, USA) began to be used for cardiac surgery in 2004,⁷ and since 2008, approximately 60 cases of robot-assisted cardiac surgery are performed annually.

However, the robot system incurs high costs, which raises concerns about the cost-effectiveness of robot-assisted surgery in all robotic surgical fields. This has become a major obstacle that prevents robot-assisted surgery from being widely accepted. Research on the cost-effectiveness of robot-assisted cardiac surgery is limited. In a recent study, Mihaljevic et al. reported that, compared with conventional mitral valve repair (CMVR) performed through a complete sternotomy, a partial sternotomy, or an anterolateral thoracotomy, the total cost of care in a robot-assisted mitral valve repair (RMVR) was 20.7-32.1% higher. However, the earlier return to work in the robotic surgery group brought the actual difference

in cost down to approximately 15%.⁸

The author hypothesized that the cost-effectiveness of robot-assisted surgery may differ according to socio-medical environments or the medical fee system between countries. Therefore, the aim of this study was to verify whether RMVR under the Korean medical fee system can be cost-effective by comparing the surgical outcomes and cost of care for RMVRs and CMVRs performed in the same institution during the same period.

Materials and Methods

Herein, 38 consecutive cases of mitral valve repair performed at Seoul National University Bundang Hospital by a single surgeon from March 2010 to February 2014 were included in the analysis. Among these, RMVR and CMVR comprised 17 and 21 cases, respectively. All RMVRs were performed using the da Vinci system, and 19 sternotomies and 2 anterolateral thoracotomies were performed during the CMVRs. Because the patient's financial burden differs markedly according to the surgical methods in the Korean National Health Insurance Service (KNHIS) system, the choice of surgical method was eventually dependent on the patient's decision. The medical records of these 38 patients were reviewed retrospectively and all clinical variables that would influence surgical outcome and cost of care were investigated. Detailed information regarding cost was collected from the billing department of our hospital, which was based on the hospital charges to the patients, not the actual cost to the hospital for the services provided. Cost of care was categorized into medical assessment, room and board, medication and injection, procedure and surgery, anesthesia, medical supplies including surgical equipment, transfusion, rehabilitation, laboratory test, radiologic examination and echocardiography. Then, the mean values of total

cost of care and each itemized cost were compared between RMVR and CMVR groups. All itemized costs but room and board were compared using the actual value of fee provided by the billing department, however, the item of room and board was compared using the adjusted value of fee, which was calculated on the assumption that all patients stayed in the cheapest room in the general ward, because it was thought that comparison with the unadjusted value of room fee, which differs remarkably according to the rating and is unrelated to the surgical outcomes, could bring about the bias in comparing the cost of care between both groups.

Looking into the Korean medical fee system briefly, it is based on the fee-for-service model, and the Ministry of Health and Welfare determines the fee for each service. According to the regulations of the KNHIS, the medical services are divided into ‘insured’ items that are covered by the KNHIS and ‘uninsured’ items that are not supported by the KNHIS. The patient covers 5-30% of the fees of the insured medical service items, but for heart surgery patients, the patient’s self-coverage portion of the fees is fixed at 5%. There is also an additional fee called the ‘selected treatment fee’, separate from the medical service fee; this is fully payable by the patient in cases where the patient selects an experienced physician in the field(s) where the patient requires examinations or surgeries. According to the KNIHS regulations, a medical service fee called the ‘robot-assisted surgery fee’ is also predetermined for all types of robot-assisted surgery, which is uninsured, and has been set at 10 million KRW (9,082 USD), regardless of the type of surgery. As the robot-assisted surgery fee includes the robotic equipment cost and the capital investment cost, the KNIHS regulations state that the patient is not liable for additional robot-related costs. In this study, the robot-assisted surgery fees were classified into the procedure and surgery fee item.

Perioperative variables and itemized costs were compared between the RMVR and CMVR groups. Continuous variables were presented as mean±standard deviation and were compared using the Student's t-test. Either the χ^2 test or the Fisher's exact test was used for categorical variables as necessary. A P value <0.05 was considered statistically significant. The analyses were carried out using IBM SPSS ver. 19.0 (IBM Co., Armonk, NY, USA).

The study design was approved from the Seoul National University Bundang Hospital Institutional Review Board, and the need for informed consent was waived (IRB number: B-1411-276-110).

Results

Surgical outcome

There was no difference in the preoperative variables between the RMVR and CMVR groups. Mitral ring annuloplasty was performed in all patients, and the mitral valve repair techniques used did not differ between the two groups. Simultaneous tricuspid annuloplasty was performed more frequently in the CMVR group. The duration of the cardiopulmonary bypass was 194.8±48.6 and 114.9±23.7 minutes ($P<0.001$) and for the aortic cross-clamp was 126.1±22.6 and 75.1±16.8 minutes ($P<0.001$) in RMVR and CMVR groups, respectively (Table 1). Postoperative intensive care unit stay was 22.9±6.3 and 33.9±16.2 hours ($P=0.008$) and hospital stay was 6.5±2.1 and 8.3±2.3 days ($P=0.02$) in the RMVR and CMVR groups, respectively. No cases of early mortality or complications such as stroke and major adverse cardiac events were reported in either group. However, the overall incidence of postoperative complications tended to be lower in the RMVR group. During the median follow-up period of 28.6 months, 1 patient was lost to follow-up in each group and 1 case of late mortality due to esophageal cancer occurred at postoperative day 46 in the CMVR group. The most recent echocardiography results showed no significant differences in the left

Table 1. Preoperative and operative characteristics

	RMVR (n=17)	CMVR (n=21)	P value
Age (years)	58.5±12.3	64.8±11.4	0.11*
Male sex	11 (64.7)	9 (42.9)	0.18†
Diabetes	1 (5.9)	3 (14.3)	0.61
Hypertension	7 (41.2)	12 (57.1)	0.33†
Dyslipidemia	3 (17.6)	4 (19.0)	1.00
CRF	0 (0)	1 (4.8)	1.00
COPD	0 (0)	2 (9.5)	0.49
Atrial fibrillation	5 (29.4)	10 (47.6)	0.25†
Endocarditis	1 (5.9)	1 (4.8)	1.00
LVEF (%)	66.8±7.1	64.1±7.9	0.28*
MR grade			0.31
- Moderate	3 (17.6)	1 (4.8)	
- Severe	14 (82.4)	20 (95.2)	
Repair technique			
- Q-resection	11 (64.7)	14 (66.7)	0.90†
- T-resection	1 (5.9)	1 (4.8)	1.00
- Chordal transfer	2 (11.8)	4 (19.0)	0.67
Combined operation			
- TAP	1 (5.9)	9 (42.9)	0.01
- Maze operation	3 (17.6)	7 (33.3)	0.46

CPB time (minutes)	194.8±48.6	114.9±23.7	<0.001*
ACC time (minutes)	126.1±22.6	75.1±16.8	<0.001*

The data are presented as mean±standard deviation or number (percentage).

*Student's t-test was performed.

† χ^2 test was performed. In other cases, a Fisher's exact test was performed.

ACC, aortic cross-clamp; CMVR, conventional mitral valve repair; COPD, chronic obstructive pulmonary disease; CPB, cardiopulmonary bypass; CRF, chronic renal failure; LVEF, left ventricular ejection fraction; MR, mitral regurgitation; Q-resection, quadrangular resection; RMVR, robot-assisted mitral valve repair; TAP, tricuspid annuloplasty; T-resection, triangular resection.

ventricular ejection fraction and mitral regurgitation between the two groups (Table 2).

Cost comparison

The total cost of care was 21,360±1,590 USD and 19,832±3,683 USD in the RMVR and CMVR groups, respectively, which did not significantly differ between groups (P=0.12). In terms of itemized costs, the fees for procedure and surgery were 13,776±1,870 USD and 9,046±1,666 USD (P<0.001) and those for anesthesia were 869±127 USD and 735±176 USD (P=0.01) for the RMVR and CMVR groups, respectively. All the other medical service fees were significantly lower in the RMVR group, and the difference in fees was largest for medical supplies, which was 3,309±390 USD and 4,995±1,480 USD (P<0.001) for the RMVR and CMVR groups, respectively, followed by laboratory test, transfusion, radiologic examination, medication and injection, echocardiography, room and board, rehabilitation, and medical assessment (Table 3). The patient's financial burden, which is the sum of the uninsured fee, selected treatment fee, and 5% of the insured fee, was 12,368±2,305 USD and 5,162±1,464 USD for the RMVR and CMVR groups, respectively (P<0.001)

Discussion

In this study, despite the longer durations for cardiopulmonary bypass and aortic cross clamping, postoperative intensive care unit and hospital stays were shorter in the RMVR group. Furthermore, the rates of early mortality, postoperative complications, late mortality, and mitral valvular function at the latest follow-up echocardiography did not differ significantly between groups. Thus, RMVR can be considered equal to CMVR in terms of overall surgical outcome, which is consistent with previous comparative studies.⁹⁻¹¹ The cost comparison showed that the fees for anesthesia and procedure and surgery were higher in the RMVR group, which resulted from the longer duration of anesthesia and the specific

Table 2. Surgical outcomes

	RMVR (n=17)	CMVR (n=21)	P value
MV (hours)	5.8±4.6	7.8±6.2	0.28*
ICU stay (hours)	22.9±6.3	33.9±16.2	0.008*
Hospital stay (days)	6.5±2.1	8.3±2.3	0.02*
Early mortality	0 (0)	0 (0)	-
Complication	1 (5.9)	7 (33.3)	0.05
- Atrial fibrillation	1 (5.9)	2 (9.5)	1.00
- Bradycardia	0 (0)	3 (14.3)	0.24
- Pleural effusion	0 (0)	1 (4.8)	1.00
- Ileus	0 (0)	1 (4.8)	1.00
Late mortality	0 (0)	1 (5.0)	1.00
LVEF (%)	57.9±6.5	58.4±6.6	0.81*
MR grade			0.97†
- None	9 (52.9)	11 (52.4)	
- Mild	8 (47.1)	10 (47.6)	

The data are presented as mean±standard deviation or number (percentage).

*Student's t-test was performed.

† χ^2 test was performed. In other cases, a Fisher's exact test was performed.

CMVR, conventional mitral valve repair; ICU, intensive care unit; LVEF, left ventricular ejection fraction; MR, mitral regurgitation; MV, mechanical ventilation; RMVR, robot-assisted mitral valve repair.

Table 3. Comparison of itemized costs (monetary unit: USD)

	RMVR				CMVR				P value [*]
	Insured	Uninsured	Selected treatment	Sum	Insured	Uninsured	Selected treatment	Sum	
Medical assessment	6	0	3	9	15	0	5	20	0.03
Room & board	551	0	0	551	766	0	0	766	0.001
Medication & injection	443	39	-	481	608	110	-	718	<0.001
Anesthesia	561	0	307	869	474	0	261	735	0.01
Procedure & surgery	3,050	9,726	1,001	13,776	6,570	57	2,418	9,046	<0.001
Medical supplies	3,102	207	-	3,309	4,448	547	-	4,995	<0.001
Transfusion	110	0	-	111	373	0	-	373	0.02
Rehab	0	6	-	6	0	18	-	18	0.01
Lab	1,161	25	53	1,239	1,541	67	74	1,682	0.001
Radiologic exam	447	0	53	499	630	0	121	751	0.03
Echo	35	461	13	510	17	705	7	729	0.002
Total	9,466	10,464	1,430	21,360	15,442	1,504	2,886	19,832	0.12

The data are presented as the mean.

*P values are for comparing the sum of each itemized cost; Student's t-test was performed.

CMVR, conventional mitral valve repair; RMVR, robot-assisted mitral valve repair; USD, United States dollar.

addition of robot-assisted surgery fees to the RMVR group, respectively. On the contrary, the fees for room and board, laboratory test, radiologic examination, medication and injection, echocardiography, rehabilitation, and medical assessment were lower in the RMVR group. This seems to reflect the cost savings derived from the shorter hospital stay and lower incidence of postoperative complications in the RMVR group. The higher fees for medical supplies in the CMVR group can be explained by the KNHIS regulations regarding robot-assisted surgery fees, which is a fixed charge for all patients using a robotic system and includes the costs for the robot equipment. Therefore, no additional surgical equipment fees except cardiopulmonary bypass-related material were charged to patients in the RMVR group. The difference in the transfusion fees, which were not remarkable, seems to reflect the difference in the invasiveness of the two operative techniques. Therefore, the higher costs for procedure and surgery and anesthesia observed for the RMVR group were balanced out by the cost savings from fewer postoperative complications and shorter hospital stays. Thus, the total cost of care did not differ between the RMVR and CMVR groups. Compared with CMVR, in terms of surgical outcomes and total cost of care, RMVR is currently cost-effective in Korea. However, the patient's financial burden was more than double for the RMVR group compared with the CMVR group because the robot-assisted surgery fee is not covered by insurance according to the current KNHIS regulations, so the fee was fully charged to the patient. Therefore, in reality, in many cases, the patient burden caused by RMVR was alleviated by the patient's own private medical insurance. However, RMVR was established in Korea only 10 years ago, and the cost analysis comparing RMVR with CMVR will continue for a few years. The adjustment of the range of reimbursement for RMVR is therefore anticipated.

Government-led KNHIS allows all Koreans for an easy access to medical services with cheap insurance premiums. However, in case of critical diseases requiring advanced

technology or high costs for treatments, patients' burden increases due to limited coverage of insurance. This is the reason why private health insurance has become popular. In the United States, the benefits of social health care programs by federal and state governments are provided to a limited range of people such as low income families (Medicaid) and the elderly over 65 years and/or patients of specific diseases (Medicare). Thus, most people who are not eligible for the programs get health insurance through their employers or private insurance companies. Private insurance plans have pros and cons. Their high insurance premiums and related expenses often limit an access to medical services for light symptoms. However, patients can take high-tech treatments or extremely expensive cares with relatively low burden because they do not need to pay beyond the annual out-of-pocket maximum.

To my knowledge, comparative research on the financial burden of patients who underwent RMVR depending on different insurance systems has not been performed. This may be because medical fee systems of different countries and the policies on the deductible of insurance companies vary one another, which makes standardized comparisons difficult. This study revealed that Korean patients' financial burden may increase under some critical medical circumstances. In this situation, the function of the KNHIS as an insurance becomes limited, and an effort to resolve this issue seems to be necessary.

As previously described, KNHIS regulation has classified the robot-assisted surgery fee, which includes surgery fee, surgical material cost, capital investment cost, robotic equipment cost, selected treatment fee, and hospital's profit, as an uninsured item and set it at 10 million KRW (9,082 USD), regardless of the type of surgery. On the assumption that the purchase cost of Da Vinci system should be withdrawn over 5 years and the annual maintenance cost would be added since the second year, capital investment cost per case can be calculated by dividing it by the annual number of robot-assisted surgery cases of the hospital (N=273); it was 2,716 USD and comprised about 30% of the robot-assisted surgery fee. The purchase

cost of endoscopic instrument, the robotic equipment, is about 2,000 USD and each instrument can be reused for 10 times. Four robot arms are needed in performing RMVR, therefore, 800 USD of robot equipment cost is additionally incurred per case. Thus, the surgery fee, surgical material cost, selected treatment fee, and hospital's profit are included in the remaining 5,566 USD. Considering the current surgery fee of CMVR, tricuspid annuloplasty, Maze operation, and cardiopulmonary bypass are set at 1,581, 1,370, 1,797, and 1,227 USD, respectively in Korea, RMVR should yield less hospital's profit compared to CMVR. This discrepancy stems from the arbitrary decision about the robot-assisted surgery fee at the beginning stage of robot surgery without accounting for the range and magnitude of surgeries to be applied. With more and more experiences accumulated in various fields, it is anticipated that the robot-surgery-related fee will be adjusted depending on the surgery types.

In their prospective study of early gastric cancer patients that compared laparoscopy-assisted distal gastrectomy (LADG) with robot-assisted distal gastrectomy (RADG) conducted in 2012, Park et al. did not identify any difference in either oncologic and surgical outcomes or surgical stress. However, the cost of RADG was over 3,000 € higher, which resulted in a significantly lower self-reported satisfaction level in the postoperative satisfaction survey. Therefore, they concluded that the substantially higher cost of RADG due to the robotic system expenses might not be justified.¹² Interestingly, their study conclusion contradicts ours despite having been conducted with similar subjects and a study period under the same medical environment in Korea; this contradiction maybe due to the specificity of cardiac surgery. First, unlike gastrectomy, there is no intermediately minimally invasive cardiac surgery such as thoracoscopy-assisted mitral valve repair. Anterolateral thoracotomy seems to be less invasive than sternotomy, but it is not widely performed in Korea; only 2 such cases were included in our study. As a result, RMVR had clear

advantages in terms of postoperative complications and hospital stay compared with CMVR in our study. However, there was no significant difference in RADG and LADG in Park's study. Secondly, the procedure and surgery fees for LADG presented in Park's study were remarkably lower than that for CMVR in our study (982 USD vs. 9,045 USD), which makes the high robot-assisted surgery fee appear to be more prominent. Thus, when the existing conventional surgery is minimally invasive and cheap, the cost-effectiveness of the corresponding robot-assisted surgery cannot help but be low. Whereas in the opposite situation, i.e. when conventional surgery is invasive and expensive, robot-assisted surgery seems able to be cost-effective.

In previous studies regarding the cost-effectiveness of RMVR, cost analysis was performed with the actual cost from the perspective of the hospital rather than the patient.^{8,13,14} This approach has an advantage in that it provides information that is especially useful to the medical service suppliers under a similar medical environment. However, it is not as easy to calculate the actual costs for the medical resources consumed for each individual patient, and moreover, to estimate the actual cost-effectiveness from the perspective of the patient because the hospital charges, including the hospital's profit, should be higher than the actual cost. In a specific situation when the choice of surgical method depends on the patient, the comparison of cost-effectiveness from the patient's perspective is more practical. Thus, in our study, the cost was defined as the hospital's charges to the patients. Nevertheless, while the total hospital cost, including the capital investment cost for the robot system, was significantly higher in the RMVR group in the previous 3 studies (Table 4), the total cost of care derived from hospital charges did not differ between the two groups in our study, which seems to reflect the various differences in socio-medical environments and the medical fee system between Korea and the countries where the previous studies were undertaken. For example, in the United States, insurance companies as

Table 4. Previous studies analyzing the cost-effectiveness of RMVR

Article	Institution	Materials	Total hospital costs
Mihaljevic 2013 ⁸	Cleveland Clinic, Abu Dhabi, UAE; Cleveland Clinic, Ohio, USA	473 RMVRs vs. 817 CMVRs*	20.7-32.1% higher in the RMVR group (Capital investment cost included)
Kam 2010 ¹³	Epworth Hospital, Victoria, Australia	107 RMVRs vs. 40 CMVRs	18,503 USD in the RMVR group vs. 17,879 USD in the CMVR group (P=0.18) (Capital investment cost not included)
Morgan 2005 ¹⁴	Columbia Presbyterian Medical Center, New York, USA	10 RMVRs vs. 10 CMVRs	14,538 USD in the RMVR group vs. 13,894 USD in the CMVR group (P=0.54) When capital investment cost was included, cost increased by 3,444 USD in the RMVR group (P=0.004)

*CMVR included 277 complete sternotomies, 349 partial sternotomies, and 241 anterolateral thoracotomies.

CMVR, conventional mitral valve repair; RMVR, robot-assisted mitral valve repair; USD, United States dollar.

well as the government participate in the decision making of medical fee through negotiations with physicians and hospitals. Under the rule of capitalism, when insurance companies offer medical fee, physicians and hospitals may or may not take the offer and make a contract with the companies. Under this profit-pursuing system, the medical fee of the United States tends to be much higher than Korea. Such a discrepancy of medical fee system among Korea and the other countries seems to lead to the difference of cost of RMVR.

This was a retrospective study with a small patient cohort; thus, there were limitations in controlling for variables. For example, combined tricuspid annuloplasty was performed more frequently in the CMVR group, however its influence on surgical outcomes and cost of care cannot be completely ruled out. We also did not consider the fluctuation in costs when the patient was transferred from a local hospital after diagnostic examination. Moreover, even considering that our hospital is one of the representative tertiary hospitals in Korea, the nature of the hospital charges, which was the basic reference of our cost analysis, limits the results of this study to be equally applied to other institutions, especially under different medical environments. A well-controlled, multi-center, prospective study with a larger cohort of patients is necessary to better understand the cost-effectiveness of RMVR.

In conclusion, the surgical outcomes of RMVR and CMVR were not significantly different. In the RMVR group, the postoperative hospital stay was shorter and the incidence of overall postoperative complications tended to be lower. As a result, despite the significantly higher fees for procedure and surgery and anesthesia in the RMVR group, the total cost of care did not differ between the two groups. However, the patient financial burden, per the KNHIS regulations, was more than double in the RMVR group compared with the CMVR group.

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의료 수가 구조에 따라 로봇 승모판 성형술의 비용 대비 효과가 달라질 수 있는가?

연구 목적: 로봇 수술의 비용대비 효과에 관한 논란은 모든 외과 영역에서 현재까지 진행 중이다. 기존 외국의 연구에서는 로봇 승모판 성형술이 전통적 승모판 성형술에 비해 치료비가 비싸다고 보고하였으나 특정 수술의 치료비는 나라별 의료 수가 구조에 따라 달라질 수 있다. 저자는 현재 한국의 의료 수가 구조 하에서 시행한 로봇 승모판 성형술의 비용을 알아보고 이를 동일 기간에 시행한 전통적 승모판 성형술과 비교하고자 하였다.

방법: 2010년 3월부터 2014년 2월까지 단일 병원에서 로봇 승모판 성형술을 시행한 17명의 환자와 전통적 승모판 성형술을 시행한 21명의 환자를 대상으로 후향적으로 의무 기록을 분석하였다. 치료비는 환자에게 부과되는 병원비를 기준으로 하였으며 이와 관련된 정보는 병원 원무과에서 수집하였다.

결과: 양 군 간의 전반적인 수술 성적에는 차이를 보이지 않았으며 로봇 승모판 성형술 군에서 술 후 재원 기간이 더 짧았고 술 후 합병증 발생율이 낮은 경향을 보였다. 로봇 승모판 성형술 군에서 수술료 및 마취료가 훨씬 더 높았음에도

불구하고 양 군 간의 총치료비는 차이를 보이지 않았다. (21,360±1,590 USD vs. 19,832±3,683 USD, P=0.12). 하지만 한국건강보험공단의 규정에 의해 로봇 승모판 성형술 군의 환자부담금이 전통적 승모판 성형술 군에 비하여 두 배 이상 높았다. (12,368±2,305 USD vs. 5,162±1,464 USD, P<0.001).

결론: 현재 한국 의료 수가 구조 하에서 시행되고 있는 로봇 승모판 성형술은 전통적 승모판 성형술과 비교하였을 때 유의한 치료비의 차이를 보이지 않았다.