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Ishihara, Kodai
Izawa, P. Kazuhiro
Morikawa, Takao
Hayashida, Akihiro

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Efficacy of MitraClip and continued multidisciplinary cardiac rehabilitation in preventing readmission of an older heart failure patient with severe multivalvular disease: a case report

Kodai Ishihara (PT, PhD, MSc)[a,b,c], Kazuhiro P. Izawa (PT, PhD, MSc)[b,c,*],

Takao Morikawa (MD)[d], Akihiro Hayashida (MD)[d]

[a] *Department of Rehabilitation, Sakakibara Heart Institute of Okayama, 5-1 Nakaicho 2-chome, Kita-ku, Okayama 700-0804, Japan*

[b] *Department of Public Health, Graduate School of Health Sciences, Kobe University, 10-2 Tomogaoka 7-chome, Suma-ku, Kobe 654-0142, Japan*

[c] *Cardiovascular stroke Renal Project (CRP), Kobe 654-0142, Japan*

[d] *Department of Cardiology, Sakakibara Heart Institute of Okayama, 5-1 Nakaicho 2-chome, Kita-ku, Okayama 700-0804, Japan*

Corresponding Author: Kazuhiro P. Izawa, PT, PhD, MSc

Department of Public Health, Graduate School of Health Sciences, Kobe University, 10-2 Tomogaoka 7-chome, Suma-ku, Kobe 654-0142, Japan

TEL: +81-78-796-4566; E-mail: izawapk@harbor.kobe-u.ac.jp

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Abstract

The recommendations for the treatment of heart failure patients with severe multivalvular disease are not clear. We present a successful case of an older patient with heart failure and severe multivalvular disease in whom rehospitalization was prevented by a combination of MitraClip implantation and continued multidisciplinary cardiac rehabilitation. An 85-year-old male patient presented with New York Heart Association (NYHA) class III severe mitral regurgitation (MR), severe aortic valve regurgitation (AR), and severe tricuspid valve regurgitation (TR). As first choice of treatment, surgical double valve replacement and tricuspid annuloplasty were considered. However, considering his age, pre-frailty condition, risks of surgery, and the desire of the patient, the heart team percutaneously implanted the MitraClip system. After implantation of one MitraClip (placed centrally on the A2/P2 scallops), the severity of the patient's MR decreased to mild from moderate-severe. He was followed up with multidisciplinary inpatient care and outpatient cardiac rehabilitation. At 1 year follow-up, he remained in stable condition at NYHA class I, and echocardiography at this time revealed moderate MR and TR and severe AR, and he has not required hospital readmission.

Learning objective: This case report showed that a combination of MitraClip implantation and continued multidisciplinary cardiac rehabilitation may be effective in preventing readmission in older patients with heart failure and severe multivalvular disease.

Introduction

There are few recommendations for the treatment of patients with heart failure and severe multivalvular disease because clinical trials and guidelines focus on single-valve disease [1]. Percutaneous treatment of heart failure patients with severe multivalvular disease is expected to expand with recent progress made in percutaneous procedures [1].

Implantation of the MitraClip system (Abbot Vascular, CA, USA) is an established therapy for the treatment of both degenerative and functional mitral valve regurgitation (MR) [2,3]. However, the cardiovascular outcomes assessment of the MitraClip percutaneous therapy for heart failure patients with functional mitral regurgitation (COAPT) trial excluded patients with heart failure and severe multivalvular disease [3], and thus, the effect of MitraClip implantation in older patients with heart failure and severe multivalvular disease is not clear.

Multidisciplinary outpatient cardiac rehabilitation including exercise and patient education is effective in increasing the long-term survival of heart failure patients with preserved ejection fraction or frailty and in reducing rehospitalization [4]. Thus, it is thought that a combination of MitraClip implantation and multidisciplinary cardiac rehabilitation would be effective in preventing the rehospitalization of heart failure patients

with severe multivalvular disease. We present a case of an older patient with heart failure and severe multivalvular disease in whom the combination of MitraClip implantation and continued multidisciplinary cardiac rehabilitation helped to prevent rehospitalization.

Case report

An 85-year-old man was admitted to our hospital with pleural effusions, New York Heart Association (NYHA) class III severe MR, severe aortic valve regurgitation (AR) and severe tricuspid valve regurgitation (TR), preserved left ventricular ejection fraction (LVEF) of 54% by disk summation method, and left ventricular end-systolic diameter (LVDs) of 38 mm. He had a clinical history of persistent atrial fibrillation, chronic kidney disease of stage G3b, Gilbert syndrome, and thoracic aortic aneurysm, which resulted in a JapanSCORE of 8.2% and a Society of Thoracic Surgeons (STS) Risk Score of 14.2%. Moreover, he had cognitive decline and was in a pre-frailty condition. He received optimal medical therapy with 1.25 mg bisoprolol, 100 mg sacubitril valsartan sodium hydrate, 1.25 mg pimobendan, 30 mg azosemide, 7.5 mg tolvaptan, and 2.25 mg warfarin potassium. As first choice of treatment, surgical double valve replacement and tricuspid annuloplasty were considered. However, considering his age, pre-frailty condition, risks of surgery, and the

desire of the patient, the heart team performed percutaneous implantation of the MitraClip system. He was then followed up with inpatient and outpatient multidisciplinary cardiac rehabilitation.

The initial result after implantation of one MitraClip (placed centrally on the A2/P2 scallops) was excellent with a reduction of his MR to mild from moderate-severe (Figure 1). By proximal isovelocity surface area method, his effective regurgitant orifice area was 0.75 cm^2, MR volume was 77 mL, and he had exercise-induced MR and exercise-induced pulmonary hypertension. The mean mitral valve gradient was 0.7 mmHg before clipping, and it increased to 1.3 mmHg after the implantation of one clip.

On postoperative day (POD) 1, a multidisciplinary cardiac rehabilitation program was started according to the guidelines of the Japanese Circulation Society [5], and he walked the ward with a physical therapist. On POD 2, he began participation in supervised exercise training by physical therapists, which included stretching exercises, 20 minutes of personalized aerobic exercise, and resistance training for 1 hour on weekdays. Aerobic exercise was performed by walking on a treadmill at an intensity of 11 to 13 on the Borg scale. Blood pressure, heart rate, and oxygen saturation were measured at each session. Resistance training consisted of half squat and heel lifting exercises with an increasing number of repetitions. In addition, he received individual counseling about his disease

condition, life guidance, nutrition education, medication guidance, and exercise instruction by a doctor, nurse, public health nurse, nutritionist, pharmacist, and physical therapist, respectively (Table 1). He was discharged to home on POD 9, and he was followed up with outpatient cardiac rehabilitation twice a week. The outpatient cardiac rehabilitation provided was similar to that during hospitalization, in which disease management such as confirmation of subjective symptoms and medication status, weight management, and blood pressure and pulse measurement was continued.

At his 1-year follow-up, the patient remained in stable condition at NYHA class I and physical function and activities of daily living were being maintained without frailty (Table 2, Supplementary Figure 1). Echocardiography at this time revealed moderate MR and TR, severe AR, a mean mitral valve gradient of 2.1 mmHg, and LVEF of 58% (Table 2), and he has not required hospital readmission.

Discussion

To our best knowledge, this is the first report to show the efficacy of a combination of MitraClip implantation and continued multidisciplinary cardiac rehabilitation on the prevention of rehospitalization in an older patient with heart failure and severe

multivalvular disease. The combination of MitraClip implantation and continued multidisciplinary cardiac rehabilitation is expected to prevent readmission of these patients.

The MR and TR in the present patient improved to mild after MitraClip implantation, which is effective in the treatment of both degenerative and functional MR [2, 3]. In addition, previous studies have reported the possibility that TR may also decrease after MitraClip implantation [6]. The severity of TR may influence worse clinical outcomes in heart failure patients with severe secondary MR [7]. Moreover, a composite outcome of death or hospitalization for heart failure and individual outcomes were reduced by MitraClip implantation compared with guideline-directed medical therapy, irrespective of baseline TR severity [7]. Therefore, MitraClip implantation may be effective in the control of MR as well as TR and clinical outcomes in heart failure patients with severe multivalvular disease.

The risk of readmission of our patient after MitraClip implantation was high because he had severe AR, a clinical history of persistent atrial fibrillation, chronic kidney disease of stage G3b, cognitive decline, and pre-frailty. Multidisciplinary cardiac rehabilitation can be an effective treatment to combat these problems. It has already been shown that multidisciplinary cardiac rehabilitation is effective in reducing the risk of rehospitalization for heart failure [4, 5]. Moreover, MitraClip implantation combined with multidisciplinary

cardiac rehabilitation begun early in the postoperative period can prevent hospitalization-associated disability because walking and resistance exercise are possible from the next day after surgery and can prevent disuse atrophy. In particular, the prevention of hospitalization-associated disability is beneficial in older heart failure patients with cognitive decline and pre-frailty as in the present patient.

The length of stay after MitraClip implantation is generally short without postoperative complications. Therefore, follow-up with outpatient multidisciplinary cardiac rehabilitation after MitraClip in patients at high risk for readmission and frailty is important. With aging, skeletal muscle strength and mobility usually decrease [8]. A previous study showed that the combined presence of a slower gait speed and impairment of instrumental activities of daily living was associated with a greater risk of mortality in older heart failure patients [9]. Moreover, a recent study showed that frailty was independently associated with increased mortality, complications, and non-home discharge in patients with percutaneous mitral valve repair [10]. In the present case, physical function and activities of daily living were maintained without frailty after discharge because this patient was followed up with outpatient multidisciplinary cardiac rehabilitation. In addition, by continuing multidisciplinary cardiac rehabilitation in the outpatient department, the medical staff can continue to manage disease control of the patient's heart failure. The patient's grade of MR

had worsened one year later after MitraClip implantation, but heart failure was controlled without readmission because the patient benefitted from continued outpatient multidisciplinary cardiac rehabilitation and follow-up for disease control. The performance of inpatient and outpatient multidisciplinary cardiac rehabilitation after MitraClip implantation was important in maintaining the patient's physical function and activities of daily living. Moreover, these actions combined with comprehensive disease control were factors leading to the prevention of his readmission.

This case shows that the combination of MitraClip implantation and continued multidisciplinary cardiac rehabilitation in an older patient with severe heart failure and multivalvular disease appeared to be effective in preventing readmission of the patient.

Conflicts of interest

K. I. and K.P. I. declare that there is no conflict of interest. T. M. and A. H. are speakers, consultants and proctors for Abbott Medical Japan (MitraClip) and report receiving honoraria from Abbott Medical Japan.

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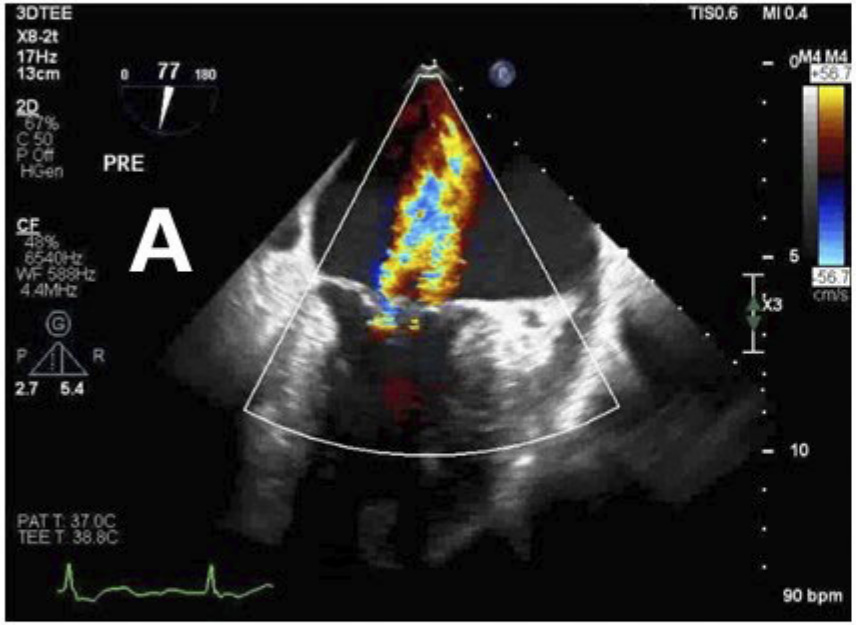
Figure legend

Fig. 1. Perioperative transesophageal echocardiography images. (A) Preoperative mitral valve regurgitation on 2-D color Doppler imaging from the commissure view. (B) Postoperative mitral valve regurgitation on 2-D color Doppler imaging from the commissure view.

Supplementary Fig. 1. Changes in the values of physical function measures and activities of daily living over time in the patient.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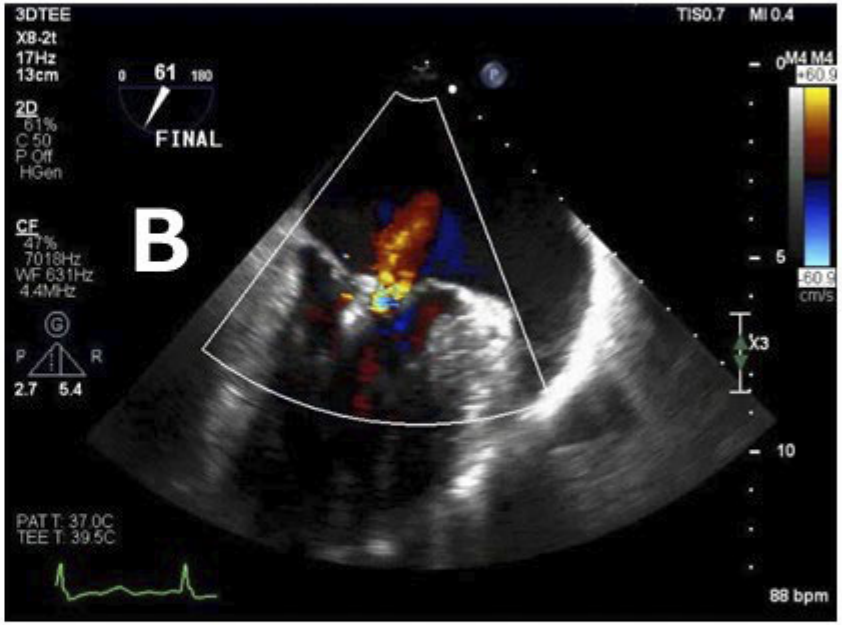
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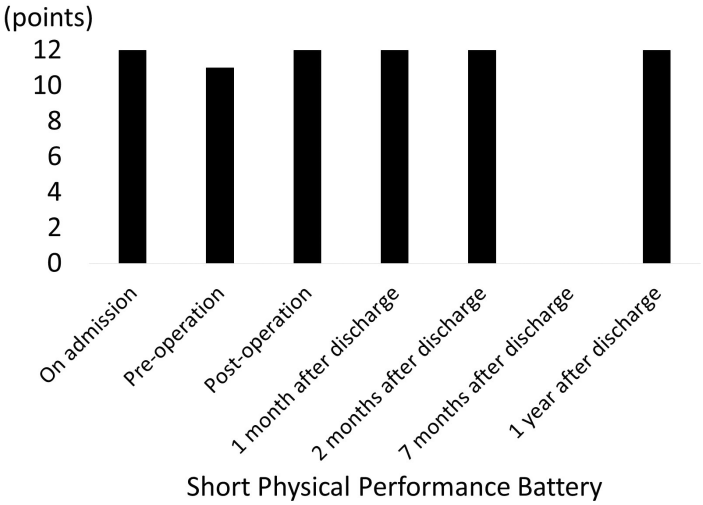
Table 1
Instructional content provided by the multidisciplinary cardiac rehabilitation staff.

Occupation	Content
Doctor	Pathologic explanation of heart failure Explanation and instructions regarding the risk of rehospitalization Explanation and instructions on the pharmacotherapy used for treatment Explanation and instruction on diet, exercise therapy, and lifestyle Provision of information to family doctors
Nurse	Patient education on self-measurement of blood pressure, pulse, and body weight Confirmation of symptoms and physical condition Confirmation and instruction on medications, diet intake, snacks, and physical activity Confirmation and instruction on bathing and toilet methods Confirmation and instruction on sleep state, stress conditions, and leisure time
Public health nurse	Looking back on one's lifestyle Life guidance about self-care Confirmation of the key person and how to go to hospital
Nutritionist	Learning about the patient’s diet at home Explanation and instruction on nutrient balance, caloric intake, sodium restriction, fat quality and quantity, luxury goods (coffee, alcohol, snacks), and eating out
Pharmacist	Explanation and instruction on medicine used for treatment Confirmation of efficacy and side effect Confirmation of the patient’s degree of understanding of the pharmacotherapy Confirmation of the management method and patient compliance
Physiotherapist	Confirmation of physical function, activities of daily living, and physical activity Explanation of the effects of the exercise therapy Instruction in the exercise method Explanation of matters requiring attention during exercise

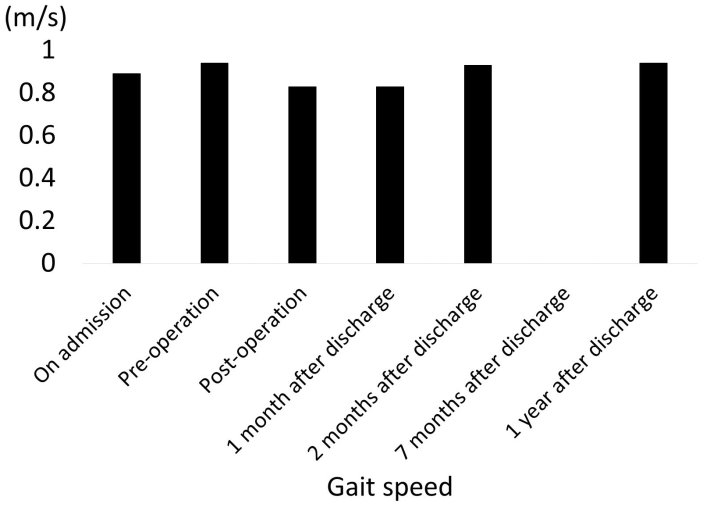
Table 2
Changes in laboratory and cardiac echocardiography data, physical function, and activities of daily living over time.

	On admission	Pre-operation	Post-operation	1 month after discharge	2 months after discharge	7 months after discharge	1 year after discharge
Laboratory data							
Hemoglobin (g/dL)	12.1	11.6	10.8	11.2	11.3	12.3	11.9
Total bilirubin (mg/dL)	3.1	1.7	–	2.3	2.1	1.9	2.3
GNRI	99.1	86.8	85.4	94.6	94.4	96.4	96.2
eGFR (mL/min/1.73 m^2)	33.3	34.3	45.2	39.7	47.0	46.4	43.9
BNP (pg/mL)	590.1	272.7	162.5	303.0	264.7	279.8	287.7
Cardiac echocardiography data							
LVEF (%)	54	66	52	56	61	64	58
Stroke volume (mL)	54	92	91	100	112	–	145
LVOT-VTI (cm)	13.9	22.6	21.4	28.1	30.1	28.1	29.2
LVDd/LVDs (mm)	62/38	58/38	55/39	57/37	58/41	56/37	61/41
Left atrial dimension (mm)	65	57	49	59	56	67	61
E/e’	13	6	16	18	12	13	17
Aortic valve regurgitation	Severe	Severe	Severe	Severe	Severe	Severe	Severe
Mitral valve regurgitation	Severe	Moderate	Mild	Mild	Mild	Mild	Moderate
Tricuspid valve regurgitation	Severe	Moderate	Mild	Moderate	Mild	Mild	Moderate
TRPG (mm)	63	25	36	27	35	24	40
Physical function							
SPPB (points)	12	11	12	12	12	–	12
Gait speed (m/s)	0.89	0.94	0.83	0.83	0.93	–	0.94
Handgrip strength (kgf)	23.9	25.2	–	24.9	25.4	–	26.0
Knee extensor muscle strength (kgf/kg)	–	–	–	–	0.41	–	0.49
6MWD (m)	–	310	–	280	310	–	300
Activities of daily living							
FIM (points)	118	123	123	123	123	122	122

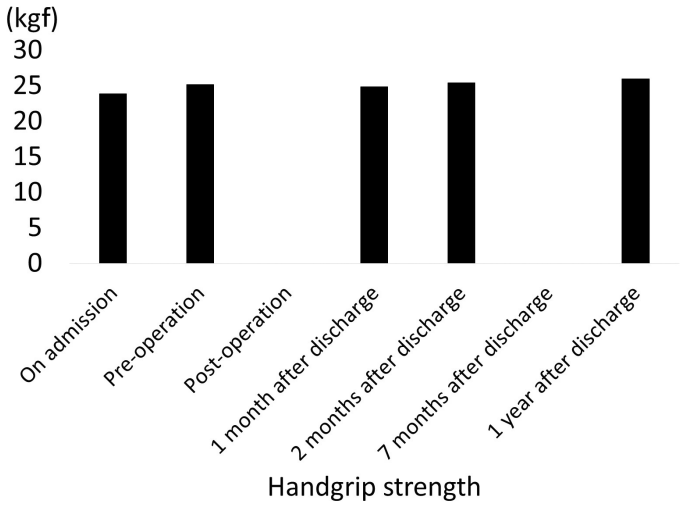
BNP, brain natriuretic peptide; eGFR, estimated glomerular filtration rate; FIM, Functional Independence Measure; GNRI, Geriatric Nutritional Risk Index; LVDd, left ventricular end-diastolic diameter; LVDs, left ventricular end-systolic diameter; LVEF, left ventricular ejection fraction; LVOT-VTI, left ventricular outflow tract velocity time integral; SPPB, Short Physical Performance Battery; TRPG, tricuspid valve regurgitation pressure gradient; 6MWD, 6-minute walk distance.



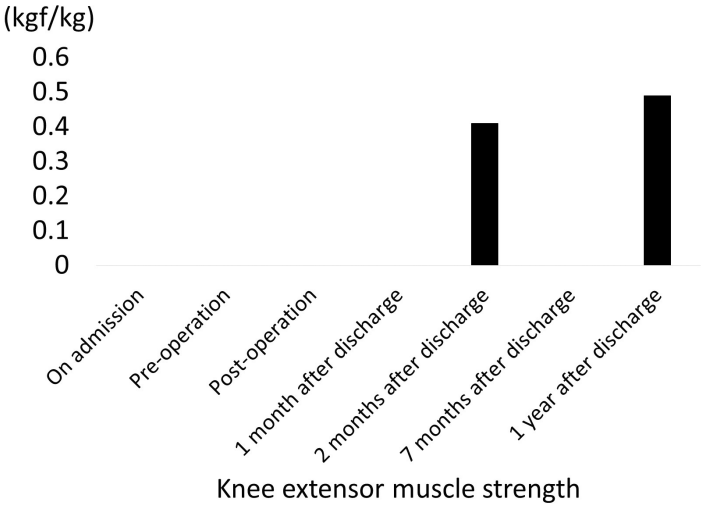
Short Physical Performance Battery



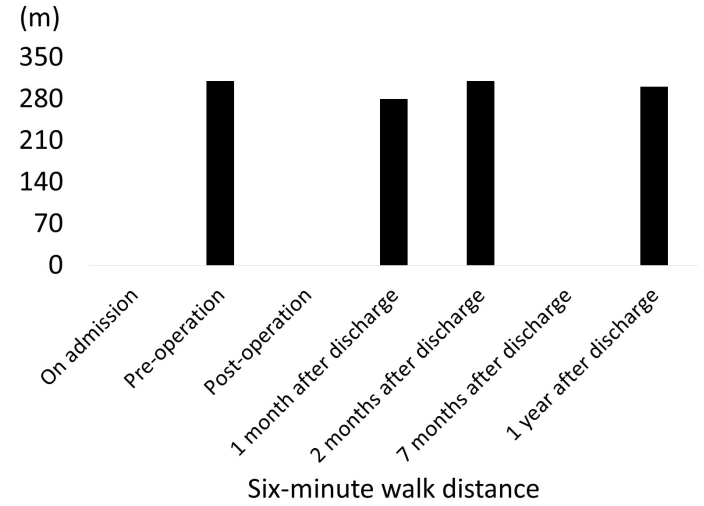
Gait speed



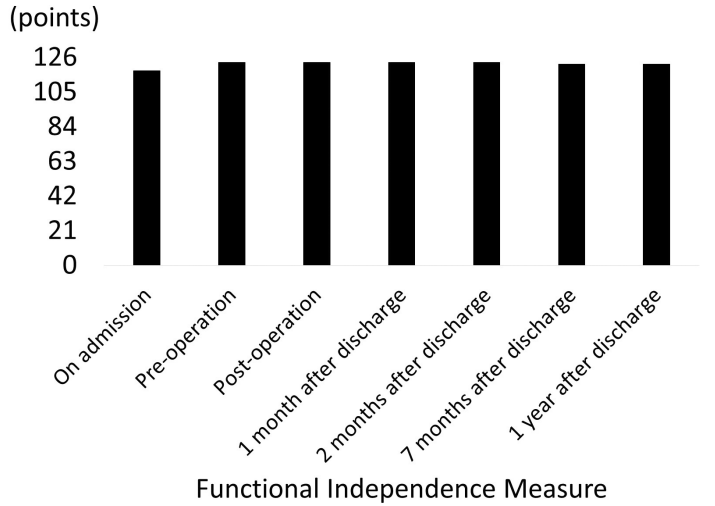
Handgrip strength



Knee extensor muscle strength



Six-minute walk distance



Functional Independence Measure