

# Frequency of Psychosomatic-Prone Myofascial Pain Syndrome in Patients with Incurable Cancer and its Association with the Armchair Sign: A Secondary Analysis of A Prospective, Multicenter, Observational Clinical Study

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## Research Article

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# Abstract

## Background

Few studies have reported psychosomatic-prone functional damage in cancer patients. Because psychosomatic diseases are pathological conditions, it is difficult to identify their degrees. The armchair sign is a test used to assess voluntary muscle relaxation. This study aimed to evaluate the frequency of psychosomatic-prone functional damage in cancer patients and its association with the armchair sign.

## Methods

This was a secondary analysis of a prospective, multicenter, observational clinical study. We evaluated the frequency of psychosomatic-prone myofascial pain syndrome (MPS) in patients with incurable cancer who were at the start of palliative care and how it is associated with the armchair sign. Moreover, we assessed the usefulness of the armchair sign for the diagnosis of psychosomatic-prone MPS.

## Results

A total of 101 patients were enrolled from March 2018 to December 2018, of whom 44 met MPS diagnostic criteria. Of these, 27 patients (61.3%) had psychosomatic-prone MPS. There was a significant association between the armchair sign and psychosomatic-prone MPS ( $p = 0.002$ ). Sensitivity and specificity were 40.7% (95% confidence interval: 18.0–63.4) and 100.0%, respectively. The area under the curve score was 0.704 (95% confidence interval: 0.553–0.855).

## Conclusions

MPS in patients with incurable cancer has a high frequency of psychosomatic pathology. The armchair sign may be useful as an ancillary test for the diagnosis of psychosomatic-prone MPS.

## Trial registration:

UMIN000031338. Registered 16 February 2018.

## Background

Psychosomatic disease is defined as any physical pathological condition with organic or functional damage that is affected by psychological factors during onset or development (1). Despite a high frequency and degree of psychological factors in cancer patients, such as psychological stress (2, 3), to our knowledge, there have not been any high-quality studies that report the frequency of psychosomatic-

prone organic or functional damage in cancer patients. Such investigations may help raise awareness of psychosomatic-prone organic or functional damage in cancer patients.

Myofascial pain syndrome (MPS) is functional damage that presents with symptoms of muscle pain. MPS is found in 31–45% of cancer patients who complain of pain (4–6). One of the reference criteria of the MPS diagnostic criteria is that pain worsens with stress (7). The relationship between low back pain, such as myofascial pain, and psychological stress has been reported in a study that identified aspects of psychological stress-induced pain exacerbation (8). Furthermore, an observational study investigated psychosomatic-prone MPS in cancer patients, which showed that 57.1% of cancer patients with MPS experienced psychological stress (6). However, the study was a single-center study on psychological stress, which carried a high risk of selection bias; treatment effects observed in single-center studies are greater than those observed in multicenter studies (9).

Because psychosomatic diseases are pathological conditions, it is difficult to identify their degrees. Approximately 50% of cancer patients have alexithymia, a characteristic typical of psychosomatic patients (10). The lack of emotional awareness in alexithymia results in patients themselves being less aware of their psychological stress (11). To be able to objectively evaluate degrees of psychosomatic disorders during physical examinations would be valuable. The armchair sign is a test to assess voluntary muscle relaxation, which, if positive, indicates insufficient relaxation.

The armchair sign is rarely reported in patients with psychosomatic disorders (12), whereas it is routinely used in psychosomatic medicine and outpatient clinics for tension headaches. It would be valuable if the armchair sign has utility as an ancillary test for psychosomatic-prone MPS. The mechanism by which unconsciously sustained muscle tension under psychological stress leads to long-lasting pain and muscle tenderness has been demonstrated in vivo (13); however, there have been no studies that have reported whether unconsciously sustained muscle tension under psychological stress is associated with voluntary muscle relaxation.

The aim of our study was to investigate the frequency of psychosomatic-prone MPS in patients with incurable cancer who are at the start of palliative care and how it is associated with the armchair sign. We also investigated the usefulness of the armchair sign for the diagnosis of psychosomatic-prone MPS.

## **Methods**

### **Study design**

This study was a secondary analysis of a multi-center, prospective observational study that investigated the prevalence of MPS and efficacy of trigger point injection in patients with incurable cancer across five institutions in Japan.

### **Study Participants**

Patients who met the following eligibility criteria were included in the study: 1) Referred to a palliative care service (either palliative care team or unit), 2) informed of a malignancy diagnosis, 3) the malignant disease is incurable, 4) aged 20 years or older, 5) average pain numerical rating scale (NRS) over 24 hours before enrollment of 4 or higher, and 6) had complete blood count and serum biochemistry data acquired within 2 weeks of enrollment. Consecutive patients during the any 2-month period between March 2018 and December 2018 from each institution were screened, and eligible patients were enrolled in the study.

## Data Collection

Data on patient characteristics were recorded at enrollment, which included age, sex, primary cancer site, Eastern Cooperative Oncology Group performances status, anticancer treatment, and medical device use.

Data regarding MPS diagnosis of the painful sites on the posterior side of the body were collected when initiating palliative care. MPS was diagnosed on the basis of the following criteria: 1) a tender spot located with palpation, with or without referral of pain; 2) recognition of symptoms by the patient during palpation of the tender spot; and 3) at least three of the following: a) muscle stiffness or spasm, b) limited range of motion (ROM) of an associated joint, c) pain worsening with stress, and d) palpation of a taut band and/or nodule associated with the tender spot (7). The site of pain and pain NRS score for MPS were also recorded at enrollment. We defined the upper back as the region below the neck and above the costal margin, in accordance with a previous study that defined the lower back (including the buttocks) as the region below the costal margin and above the inferior gluteal folds (14). Average pain intensity was assessed using an 11-point pain NRS, which ranged from 0 (no pain) to 10 (worst possible pain) (15).

We determined the presence or absence of psychosomatic-prone MPS on the basis of criterion c above (pain worsens with stress). This was determined by palliative care physicians with more than 10 years of experience by asking patients, "Does your MPS pain worsen with stress?" Of the five institutions, two had oncology and three had psychosomatic medicine as subspecialties of the palliative care physicians.

Data for the armchair sign were also collected at the initiation of palliative care. To perform the armchair sign, a physician asked the patient to raise one of the arms forward while supporting the arm with their hand and instructed the patient, "relax your arm and tell me when it is fully relaxed." When the patient answered yes, the physician removed the supporting hand. If the arm of the patient was insufficiently relaxed, it did not fall completely. The test was considered positive (+) if the patient's arm was kept in the horizontal position, false positive ( $\pm$ ) if the patient's arm fell below the horizontal position but not completely ( $\pm$ ), and negative (-) if the patient's arm fell completely (Fig. 1).

## Statistical analysis

Data are reported as means and standard deviations, medians with interquartile ranges, or frequencies (%), as appropriate. We estimated the proportion of patients with incurable cancer who had

psychosomatic-prone MPS among all patients with MPS and calculated 95% confidence intervals (CI). Patients with incurable cancer were classified into two groups: psychosomatic-prone MPS and control (non-psychosomatic-prone MPS) groups. Unpaired *t*-tests were used to compare age and pain NRS score of MPS between the two groups. Chi-square tests were used to analyze the dependent variables of sex, Eastern Cooperative Oncology Group performances status (ECOG PS), anticancer treatment, medical devices, site of MPS, and armchair sign.

Chi-square tests were also used to analyze the association between armchair sign and presence or absence of MPS or psychosomatic-prone MPS, on the basis of whether the armchair sign was false positive ( $\pm$ ), positive (+), or negative (-). Sensitivity, specificity, positive predictive value, and negative predictive value of the armchair sign with or without psychosomatic-prone MPS were calculated, on the basis of whether the armchair sign was false positive ( $\pm$ ), positive (+), or negative (-). The receiver operating characteristic curve was calculated and the area under the curve (AUC) score was obtained. Spearman's rank correlation coefficients were calculated to assess associations between armchair sign and demographics, ECOG PS, anticancer treatment, medical devices, site of MPS, pain NRS score of MPS, and psychosomatic-prone MPS.

A value of  $p < .05$  was considered statistically significant. Statistical analyses were performed using SPSS version 25.0 and Amos version 25.0 for Macintosh (SPSS, Inc., IBM, Chicago, IL, USA).

## Results

Between March 2018 and December 2018, a total of 541 patients were referred to palliative care services at five institutions in Japan, and 101 patients met eligibility criteria. Patient characteristics are shown in **Table 1**.

Of the 101 enrolled patients, 44 met diagnostic criteria for MPS. On the basis of the criteria for diagnosis of MPS with and without psychological stress, study participants were classified into the psychosomatic-prone MPS ( $n = 27$ ) or control group ( $n = 17$ ). The proportion of psychosomatic-prone MPS patients among all MPS patients was 61.3% (95% CI: 43.8–78.8). There was no significant difference in proportion of patients between the two institutions with oncologists (58.8%, 95% CI: 34.7–82.9) and the three institutions with psychosomatic physicians (63.0%, 95% CI: 44.4–81.6;  $p = 0.515$ ). **Table 2** shows the demographic and clinical characteristics of both groups.

Of the 101 enrolled patients, 100 met the enforcement for armchair sign. The armchair sign was positive (+) in 25 patients, false positive ( $\pm$ ) in 20 patients, and negative (-) in 55 patients. If the armchair sign false positive ( $\pm$ ) was negative (-), there was no significant association between armchair sign and all MPS ( $P = 0.594$ ). Similarly, in patients with an armchair sign of false positive ( $\pm$ ) or positive (+), there was no significant association between armchair sign and all MPS ( $p = 0.338$ ).

In the 44 patients with MPS, the armchair sign was positive (+) in 11 patients, false positive ( $\pm$ ) in 10 patients, and negative (-) in 23 patients. For patients who had an armchair sign of false positive ( $\pm$ ) or negative (-), there was a significant association between armchair sign and psychosomatic-prone MPS

( $p = 0.002$ ). Sensitivity, specificity, positive predictive value, and negative predictive value were 40.7% (95% CI: 18.0–63.4), 100.0%, 100.0%, and 51.5% (95% CI: 34.7–68.3), respectively. AUC score was 0.704 (95% CI: 0.553–0.855; Fig. 2). On the other hand, when false positive ( $\pm$ ) was positive (+), there was no significant association between armchair sign and psychosomatic-prone MPS ( $p = 0.052$ ). Sensitivity, specificity, positive predictive value, and negative predictive value were 59.3% (95% CI: 40.5–78.1), 70.6% (95% CI: 48.3–92.9), 76.2% (95% CI: 57.5–94.9), and 52.2% (31.4–73.0), respectively. The AUC score was 0.649 (95% CI: 0.482–0.817; Fig. 2).

**Table 3** shows the Pearson's correlations of the 44 patients with MPS between the following variables: age, sex, ECOG PS, anticancer treatment, medical devices, site of MPS, pain NRS score, psychosomatic-prone MPS, and armchair sign.

## Discussion

To the best of our knowledge, this is the first prospective, multicenter, observational study to investigate the frequency of psychosomatic-prone MPS in patients with incurable cancer and its association with the armchair sign.

The first important finding of this study was the high frequency of psychosomatic-prone MPS in patients with incurable cancer. A previous single-center study reported a frequency of 57.1% (6), which is similar to the 61.3% observed in our multicenter study. Participants included patients with incurable cancer, about half of whom were in the anticancer treatment stage and had relatively good PS of 0–2. These results were consistent with those of a previous study (6). Of the enrolled patients, the percentage of patients who met diagnostic criteria for MPS was 43.6%, which is within the range of 31–45% reported in previous studies (4–6).

The findings of this study may be useful to raise awareness of psychosomatic-prone MPS in patients with incurable cancer. MPS in patients with incurable cancer is often overlooked and is a common cause of opioid-induced delirium (16). Furthermore, medical professionals may consider pain that is exacerbated by stress as psychogenic pain. Diagnosis of MPS requires careful manual examination and is considered extremely reliable (17). Physicians' physical involvement has been reported to increase in response to patients' complaints of physical symptoms and decrease in response to psychological complaints (18).

The findings of this study will lead to increased treatment options for MPS in patients with incurable cancer. Behavioral psychosomatic approaches (e.g., biofeedback therapy, hypnosis, cognitive restructuring, and relaxation) have been recommended as psychosocial intervention for pain in cancer patients (19). Indeed, a randomized controlled trial has reported the effectiveness of biofeedback therapy for MPS in cancer patients (20).

A second important finding of this study was the association between armchair sign and psychosomatic-prone MPS in patients with incurable cancer, which demonstrated the clinical utility of the armchair sign

for the diagnosis of psychosomatic-prone MPS. Based on the AUC score, the accuracy of the test was close to 1 if the armchair sign false positive ( $\pm$ ) was negative (-) (21), which indicated that the test had high accuracy. In this case, specificity and positive predictive value were 100.0%, which suggested that the armchair sign of + was useful for diagnosing psychosomatic-prone MPS. The only clinical characteristic that showed a significant difference between the psychosomatic-prone MPS and control groups was the armchair sign, whereas the sensitivity and negative predictive value of the armchair sign were low, which suggested that the armchair sign of - was not reliable. Thus, our study suggests that the armchair sign is useful as an ancillary test for the diagnosis of psychosomatic-prone MPS in patients with incurable cancer.

We did not find an association between armchair sign and all MPS in patients with incurable cancer. Specifically, there was no association between sustained muscle tension and difficulty in voluntary muscle relaxation. In addition to psychological stress, MPS is associated with physical stress, such as sustained muscle tension due to positional restriction or repetitive movements (22, 23). Despite finding an association between sustained muscle tension and difficulty in voluntary muscle relaxation under psychological stress, we could not ascertain its mechanism. In patients with psychosomatic-prone functional somatic syndrome, a significant negative correlation has been shown between subjective physical tension under psychological stress and objective physiological indices (24). Constant feelings of high physical tension hinders the ability to feel sensations of relaxation (24). This unconscious sustained muscle tension under psychological stress may have resulted in insufficient voluntary muscle relaxation. In addition, alexithymia, a typical characteristic of psychosomatic patients, has been shown to be associated with MPS and is an intensifying factor of cancer pain (25, 26). One possible explanation for the positive correlation between armchair sign and NRS score in this study is that alexithymia was one of the mediating factors.

The study has several limitations. First, this study was a secondary analysis of a prospective observational study. Therefore, sample size was not calculated specifically for the aims of the study.

Second, because psychosomatic disorders are pathological conditions, it was difficult to identify its degree. Given that previous studies have not reported clear criteria (i.e., Rivers' criteria for MPS) (7), we made a comprehensive judgment based on objective assessments of medical professionals and subjective assessments of patients. In this study, there was no significant difference in diagnoses between psychosomatic physicians who are skilled in diagnosing psychosomatic disorders and oncologists who are less skilled. Third, because there have only been a few studies conducted on the armchair sign, only limited comparisons can be made with other study findings, and discussions regarding the association between the armchair sign and psychosomatic-prone MPS are limited. Finally, our study was a preliminary study.

## Conclusions

MPS in patients with incurable cancer has psychosomatic pathology with high frequency. The armchair sign may be useful as an ancillary test for the diagnosis of psychosomatic-prone MPS.

## Abbreviations

MPS  
myofascial pain syndrome  
NRS  
numerical rating scale  
ECOG PS  
Eastern Cooperative Oncology Group performances status  
ROM  
range of motion  
AUC  
area under the curve  
CI  
confidence intervals

## Declarations

### *Ethics approval and consent to participate*

This study protocol was approved by the ethical review board of each participating institution. Informed consent was not obtained in this study because usual clinical practice was observed, which included assessment and treatment. An opt-out method was used, so that patients and their families could refuse to participate in the study. The procedures performed in this study were in accordance with the Declaration of Helsinki.

### *Consent for publication*

Not applicable.

### *Availability of data and materials*

The datasets are available from the corresponding author upon reasonable request.

### *Competing interest*

The authors declare that they have no competing interests.

### *Funding*

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### *Author's contributions*

HH, HI, YM, HM, and JK were responsible for the conception and design of this study. HH wrote the article. HH, HI, YM, HM, and YH were responsible for data collection and clinical evaluations. HH and MN were responsible for data analysis. HI, YM, and HM provided advice on the structure of the manuscript. All authors have approved the final version of this manuscript.

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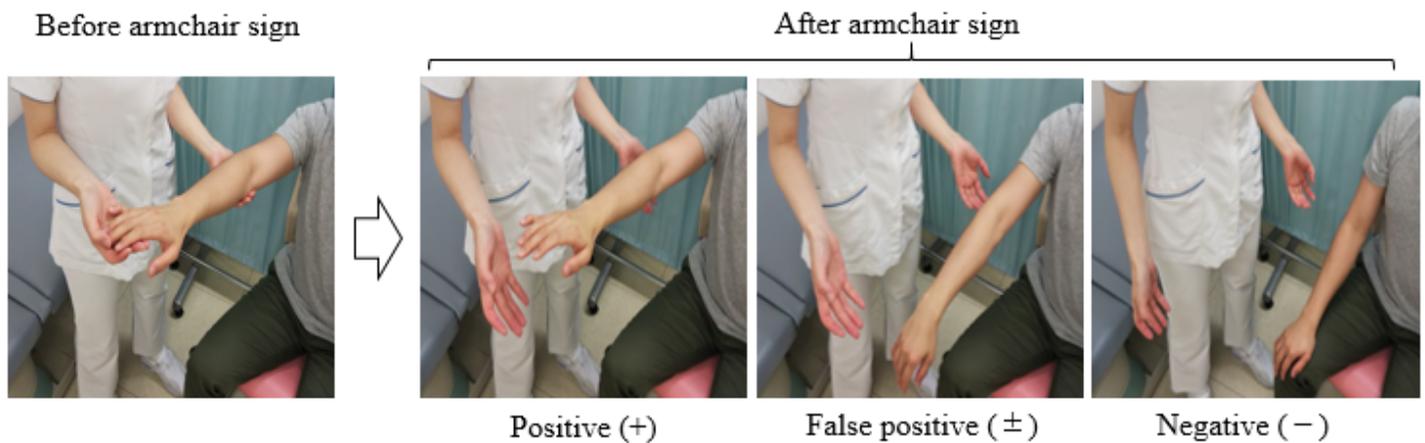
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## Tables

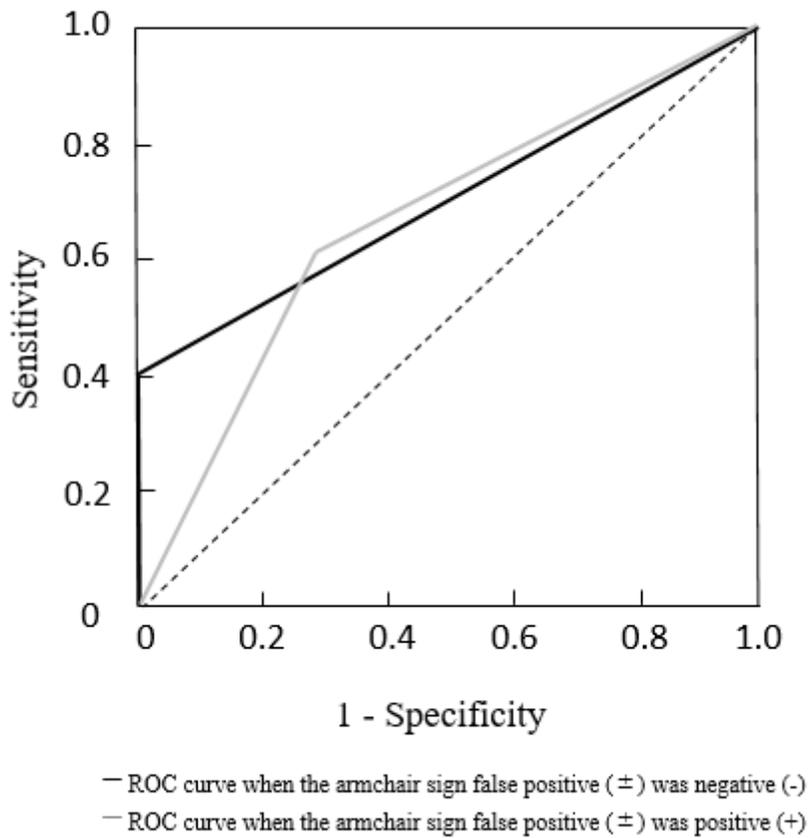
Due to technical limitations, table 1, table 2 and table 3 are only available as a download in the Supplemental Files section.

## Figures



**Figure 1**

Evaluation of the armchair sign



**Figure 2**

Receiver operating characteristic curve of the armchair sign with or without psychosomatic-prone myofascial pain syndrome ROC, receiver operating characteristic

## Supplementary Files

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