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ORIGINAL ARTICLE

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The Senami Wrist Supporter for patients with rheumatoid arthritis

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Abstract One of the wrist orthoses, the Senami Wrist Supporter (SWS), was applied to 203 rheumatoid wrists in 112 patients who had persistent wrist pain and restricted forearm rotation due to synovitis and instability at the distal radioulnar joint (DRUJ). The study was performed by sending out a questionnaire to the patients about the use of the SWS at home, and examining grip strength and forearm rotation with and without the use of the SWS. The average age of the patients was 61 years, and the average follow-up period was 18 months. The rate of compliance of wearing the SWS at home was 73% on average. It was higher in wrists of Larsen–Dale–Eek (LDE) grades 0, I, and II (normal, slight, and definite early abnormality) than in those of grades III, and IV (medium and severe destructive abnormality). Decreased pain was noted in 52% of the wrists at the time of applying the SWS. The SWS was not used in 10% of the wrists because of remission of pain at follow-up. Grip strength increased significantly ($P < 0.01$) and so did forearm rotation ($P < 0.05$) by the stabilizing effect of the SWS on the unstable DRUJ. The use of the SWS was confirmed to be an efficient measure to treat painful rheumatoid wrists with early stages of disease at the DRUJ.

Key words Rheumatoid arthritis · Wrist · Orthosis · Distal radioulnar joint · Compliance

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Introduction

In 1965, Clayton[1] stated that, "The wrist is the key joint for hand function and is also a key area for rheumatoid arthritic involvement." A stable, well-balanced, and pain-free wrist is a prerequisite for the performance of various manual tasks. In rheumatoid arthritis (RA) patients, the wrist joint is frequently affected in the early stage of the disease, and deterioration proceeds rapidly. Significant functional loss due to pain, decrease in grip strength, and restricted forearm rotation due to instability at the distal radioulnar joint (DRUJ) become apparent with the progression of the disease.

The purpose of this study was to investigate the clinical effects of our wrist orthosis, the Senami Wrist Supporter (SWS), as a local treatment of RA, and to clarify its adequacy for application to RA patients.

Materials and methods

Two hundred and thirty-nine wrists in 137 RA patients were treated with the SWS between January 1996 and November 1998. The SWS was applied to patients with wrist pain and instability at the DRUJ. Instability at the DRUJ was determined by the positive "piano key sign." The examiner stabilized the distal radius by holding the patient's wrist by key grip. With the examiner's opposite hand, the ulnar head was moved passively in the dorso-volar direction. If there was excessive mobility at the ulnar head and it did not disappear even with the forearm in the fully supinated position, the "piano key sign" was positive.

The study subjects consisted of 203 wrists (85%) in 112 patients from whom answers to a questionnaire about the use of the SWS were obtained at follow-up. There were 99 female patients and 13 male patients. The average age of the patients was 61 years, range 33–85 years. The average follow-up period after applying the SWS was 18 months, range 2–35 months. Damage to the wrists shown by

radiography was evaluated by the Larsen–Dale–Eek (LDE) method.[2] In the subjects of this study, 38 wrists were grade 0 (normal) or I (slight abnormality), 52 wrists were grade II (definite early abnormality), 62 wrists were grade III (medium destructive abnormality), and 51 wrists were grade IV (severe destructive abnormality). The SWS was not applied to grade V wrists (mutilating abnormality).

The SWS is composed of a thin elastic band 6–8 cm wide and 40–50 cm long, with a small loop attached to one end (Fig. 1). It is made of a synthetic fabric known as Powernet (Fuji Spinning Co. Ltd., Tokyo, Japan). This waterproof material has multiple pores for good ventilation and one-way elasticity. Pieces of Velcro, also known as "magic tape" (Kuraray Co. Ltd., Tokyo, Japan), are attached to the other end and the middle of the band. It is worn by passing the thumb through the loop, wrapping the wrist by pulling the band from the dorsal side to the palmar side with adequate tightness, and fastening the band on the piece of Velcro. The tightness can be adjusted by the tension of the band according to the variable circumference of the wrist.

The study was performed by sending out a questionnaire to the patients about the use of the SWS at home. The questions asked in the questionnaire are listed below.

- How often is the SWS worn at home? How many hours a day is the SWS worn?
- What are the advantages or disadvantages of the SWS? What is the reason why you wear or do not wear the SWS?
- How much are the activities of daily living (ADL) hindered by wearing the SWS?

The rate of compliance of wearing the SWS at home was noted with each of the LDE wrist grades.

A clinical assessment was performed of wrist pain, grip strength, and range of forearm rotation. Pain score with and without the SWS was determined in each wrist at the time of applying the SWS. A score of 0 was given to a wrist with no pain, 1 with slight pain, 2 with moderate pain, and 3 with severe pain. Differences in the scores between wrists with and without the SWS were analyzed using a paired *t*-test and the Wilcoxon signed rank test. Grip strength using a mercury dynamometer and range of supination and pronation of the forearm were measured at follow-up with and without the SWS. These data were analyzed using a paired *t*-test.

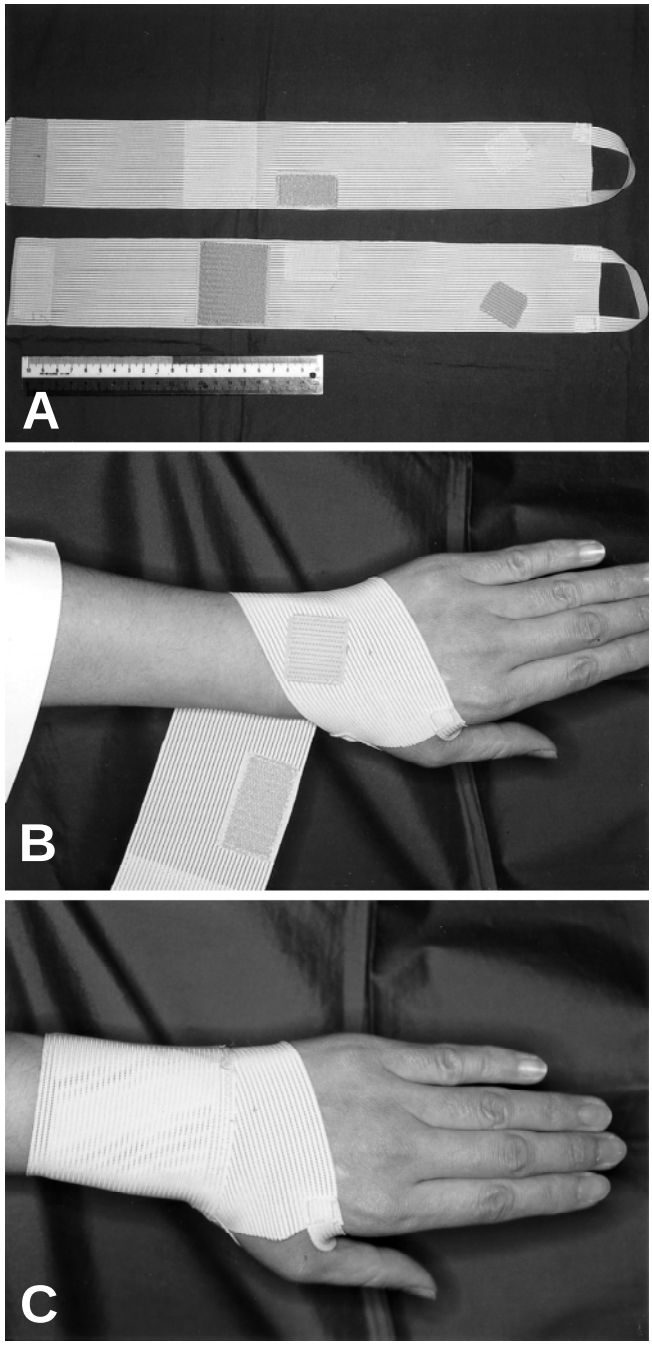

Fig. 1. The original Senami Wrist Supporter (SWS). **A** The back (*top*) and front (*bottom*) of the orthosis. **B** The wrist is wrapped by pulling the band from the dorsal side to the palmar side with adequate tension. **C** The end of the band is secured with Velcro

Results

The rate of compliance of wearing the SWS at home was 73% on average. In 28% of the wrists, the SWS was worn for more than 18 h per day. In 18% of wrists it was worn between 12 and 18 h, and in 27% it was worn for fewer than 12 h. In the remaining 27% of wrists, it was not worn at all (Fig. 2). In LDE grades 0 or I wrists, the rate of compliance was 84%. In grade II wrists it was 83%, in grade III wrists it was 77%, and in grade IV wrists it was only 52%. It was higher in grades 0, I, and II wrists than in grades III and IV wrists. The average period of wearing the SWS was 15 months, range 2–35 months, in the compliant group (n = 149), and 5 months, range 0.5–35 months, in the noncompliant group (n = 50).

The reasons for wearing the SWS in the compliant group (n = 214) were given as a "feeling of stabilization" in 100 wrists (45%), "increased grip strength" in 53 wrists (35%), "decreased pain" in 44 wrists (21%), and "others" in 19 wrists (7%). "Others" included several psychological reasons, such as "feeling relaxed and relieved," "being

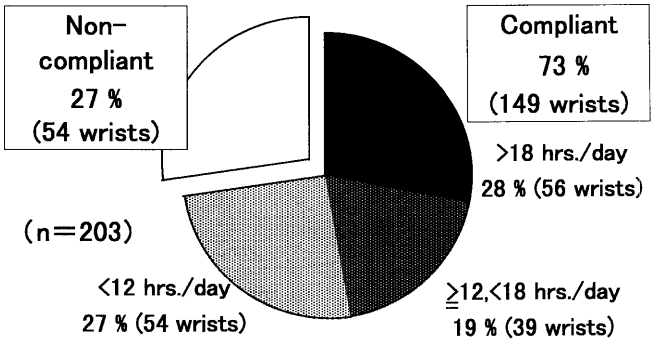

Fig. 2. The rate of compliance of wearing the SWS at home

comfortable," and "being kept warm." These are factors that support the idea that the SWS influences the patient's state mind. The reasons for not wearing the SWS in the noncompliant group (n = 54) were given as "remission of pain" in 21 wrists (39%), "no change" in 11 wrists (20%), "troublesome" in 8 wrists (15%), and "others" in 14 wrists (26%).

Regarding wrist pain (n = 184), decreased pain was noted in 96 wrists (52%) while wearing the SWS. Seventy-eight wrists (43%) showed no change, and 9 wrists (5%) showed increased pain. The average pain score decreased significantly from 1.75 without the SWS to 1.23 with the SWS ($P < 0.01$). Using the Wilcoxon signed rank test, the decrease in pain while wearing the SWS was confirmed to be significant ($P < 0.01$). The average grip power (n = 138) increased significantly from 122 mmHg without the SWS to 134 mmHg with the SWS ($P < 0.01$). Average forearm supination (n = 132) increased significantly from 79.5° without the SWS to 81.1° with the SWS ($P < 0.01$), and pronation increased significantly from 74.4° to 75.8° ($P < 0.05$).

By wearing the SWS, performing ADL (n = 185) was greatly hindered in 16 wrists (9%), somewhat hindered in 106 wrists (58%), and not hindered at all in 63 wrists (33%) compared with their condition without the SWS. In 10 of 12 wrists in which performing ADL was greatly hindered and joint damage was of LDE grade IV, wearing the SWS was discontinued within 3 months after the initial application. The main reasons for not wearing the SWS were as follows. "It is uncomfortable when it gets wet," and "It takes time and is troublesome to put on and take off this orthosis." The material of this orthosis is waterproof and easy to dry. However, many housewives who liked wearing the SWS needed a spare for kitchen work and washing only.

In 21 wrists in which the SWS was not worn because of remission of pain, 10 were of LDE grades 0, I, or II, 7 were of grade III, and 4 were of grade IV. Therefore, pain relief in the wrists was more likely in the early stages of the disease than in the advanced stages.

During the period of follow-up, 8 wrists (6%) underwent surgical treatment because of unsatisfactory relief of pain by conservative treatment. The surgical procedures included synovectomy and a Darrach procedure combined with radiolunate arthrodesis in 6 wrists and with total wrist arthrodesis in one wrist, and synovectomy and Sauvé–Kapandji's operation in one wrist. In the surgically treated wrists, 5 wrists were LDE grade IV, 2 wrists were grade III, and one wrist was grade II. Surgical treatment tended to be needed more in the advanced stages than in the early stages.

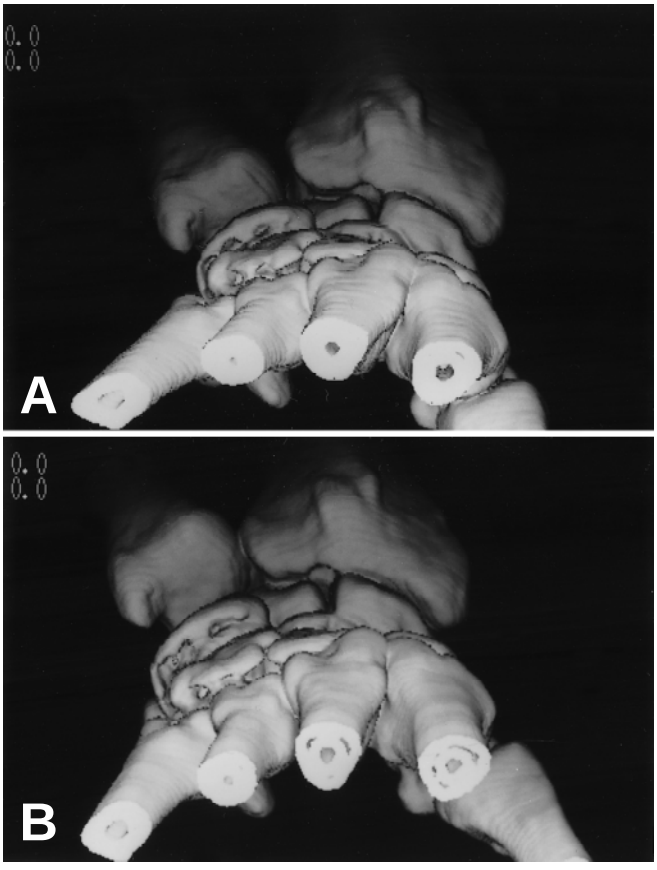

Fig. 3. Changes at the distal radioulnar joint (DRUJ) in three-dimensional computed tomograms. **A** Without the SWS; dehiscence between the radius and the ulna is noted. **B** With the SWS; good congruity at the DRUJ is shown and the range of forearm rotation is improved

Discussion

It is generally accepted that therapies for RA start with a basic program, which includes patient and family education, and progress to more aggressive therapies. Medical treatment occupies the heart of systematic general therapies. Surgical treatment and rehabilitation programs are important local therapies for RA.[3] Because it is a wrist orthosis, the SWS is included in local therapeutic measures for rheumatoid wrists in rehabilitation programs. Moreover, it is clear that the SWS was particularly effective in the early stages of disease at the DRUJ, in which the unstable ulnar head is reducible with minimal bone destruction. By wearing the SWS, dehiscence between the radius and the ulna could be corrected, and good congruity at the DRUJ was obtained (Fig. 3). However, in the advanced stages at

the DRUJ, in which the ulnar head is displaced dorsally and bone destruction is severe, favorable effects from the SWS would not be expected. To wrists in which rheumatoid synovitis and bone destruction extended not only to the DRUJ but also to the radiocarpal and midcarpal joints, a modified type of SWS was applied that totally covered the wrist and palm. The loop for the thumb was removed from the original SWS, the band was folded at an angle (Fig. 4A), and a small opening was made through both layers of fabric for the thumb (Fig. 4B). The palm and wrist proximal to the middle palmar crease were totally wrapped in the band by pulling one end of the band from the dorsal side and the other end from the palmar side. This modified SWS was efficient in some wrists, but for wrists with considerable bone destruction and instability at the radiocarpal joint, satisfactory effects could not always be obtained because the material of the SWS was too thin to completely restrict abnormal mobility. It would be better to apply a rigid orthosis that completely restricts wrist mobility in such cases.

Hämäläinen et al.,[4] in their epidemiological study during a minimum of 14 years follow-up, noted that over 90% of the wrists he observed became symptomatic at some stage of the disease, 85% showed radiographic changes, and 50%–60% remained functionally impaired. Furthermore, the DRUJ was involved in about 70% of patients. Wearing the SWS could be expected to decrease the rate of the symptomatic stage at the DRUJ and to improve function. It might also have some effect on controlling the radiographic progression of the disease.

A common occupational therapy intervention for wrist problems in patients with RA is the use of orthoses and assistive devises. The use of these treatment modalities is widespread, although there are few studies on their effectiveness. In 1988, Matsumoto et al.[5] reported the effectiveness of a wrist orthosis similar to our SWS. He applied the orthoses to 24 wrists in 16 patients who had disorders at the DRUJ due to RA, and obtained satisfactory results. Until now, there have been no other papers dealing with this type of orthosis for RA. After considering his orthosis, we modified its design and applied it to a large number of patients. We confirmed its favorable effects and clarified its indication in the systematic treatment of RA.

The purpose of orthotic treatment is to reduce pain due to inflammation and instability by providing rest and stability for the affected joint. The prevention of progression to a nonfunctional deformity of the joint was expected. The ideal orthosis for rheumatoid hands and wrists should be functional and aesthetically pleasing, as well as light, thin, inconspicuous, and durable. Also, such orthoses should be easy to put on and take off for patients who have some disorder in the other hand. To date, most wrist orthoses have been made of plastic with belts or elastic fabric and with a preshaped aluminum strip on the palmar side.[6–10] They had the merit of resting the affected wrist by immobilization until the acute condition had improved. However, they tended to restrict finger motion, and were not ideal for the activities of daily living. Orthoses made of leather are soft and comfortable and keep the wrist warm.

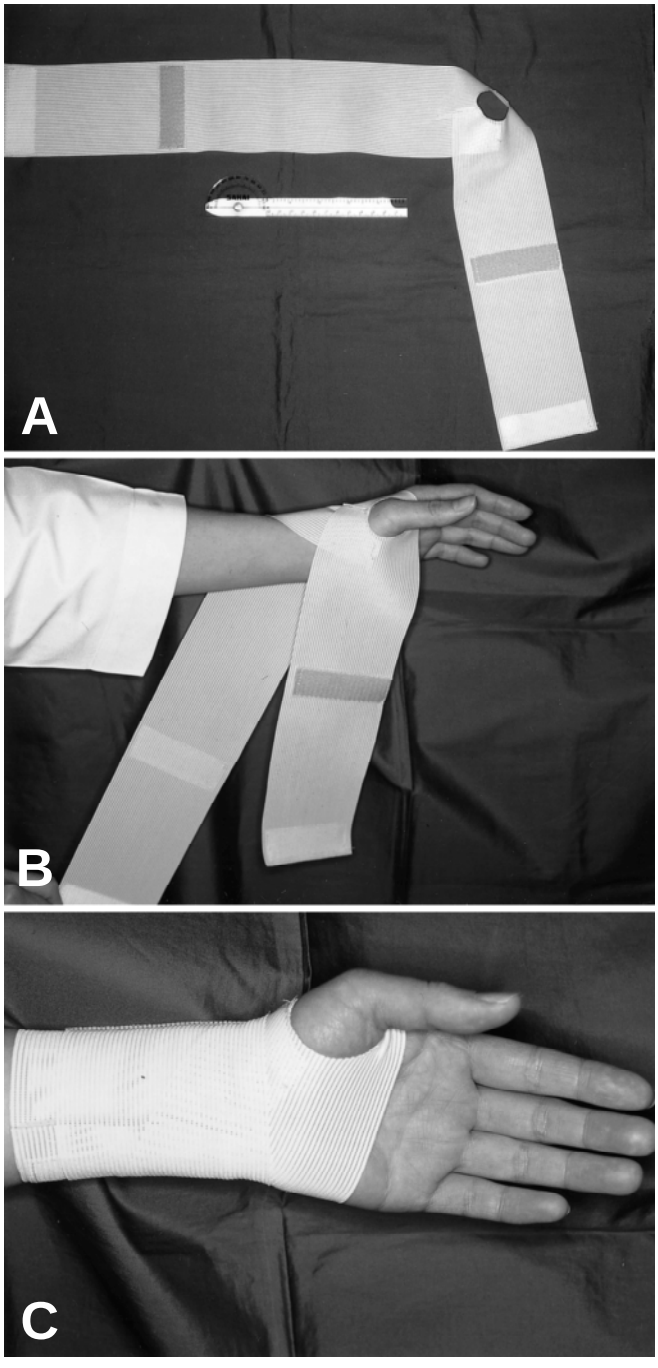

Fig. 4. Modified SWS. **A** A small opening for the thumb is made in the folded band. **B** The wrist and palm are wrapped in the band by pulling one end from the dorsal side and the other from the palmar side. **C** Both ends of the band are secured with Velcro

However, they are not washable and tended to become dirty easily.

The SWS appears to be an ideal orthosis in terms of its materials and design. The remarkable features of its material are that it is thin, elastic, light, skin-colored, waterproof, and synthetic, with small pores for good ventilation. The design is very simple and it is easy to put on and take off. It did not hinder the mobility of the wrist at all, and

the patients could regulate the tightness of the band in accordance with the degree of swelling at the wrist joint.

In conclusion, the use of the SWS was confirmed to be an effective way to treat painful rheumatoid wrists in the early stages of RA at the DRUJ.

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