Results of arthrodesis with K-wire for the treatment of the first carpometacarpal joint arthrosis in postmenopausal women

Kamil Yamak¹, Huseyin Gokhan Karahan², Taskin Altay¹, Cemil Kayali¹, Fırat Ozan³

ABSTRACT

Objectives: The aim of study was to evaluate the results of arthrodesis with K-wire fixation for the treatment of Eaton stage-III arthrosis of the first carpometacarpal (CMC) joint in postmenopausal women.

Methods: Patients treated between January 2011 and January 2019 were evaluated retrospectively. Quick-DASH scores were calculated before surgery and after follow-up. Union status on direct graphy, the presence of scaphotrapeziotrapezoid joint arthritis at the end of follow-up and the development of compensatory hyperextension of the metocarpophalangeal joint were investigated. Hand grip strengths at the end of follow-up was measured.

Results: A total of 21 joints with arthrodesis in 19 patients were included in the study. Mean age was 56.6(52-72) years. Mean follow-up period was 57.7(17-90) months. In all patients, there was statistically significant improvement in the end of follow-up Quick-DASH score when compared with the presurgical score (p=0.001). Direct graphy at the end of follow-up revealed that there was non-union after arthrodesis in nine joints of eight patients (42.8%). In one patient without fusion following arthrodesis, revision surgery was performed (4.7%). There was no significant difference between the end of follow-up Quick-DASH scores of patients with and without union (p=0.84). The difference in hand grip strength in patients with fusion and non-union wasn’t statistically significant (p=0.214).

Conclusion: In our study, it was observed that k-wire arthrodesis of the first CMC joint was associated with high nonunion rates, but nonunion did not have an unfavourable effect on functional results. We believe that studies with large series are needed for a more precise result.

Key words: Arthrodesis, carpometacarpal joint arthritis, pseudoarthrosis

Introduction

The elderly population and the mean age of people are increasing all around the world [1]. First carpometacarpal (CMC) joint arthrosis is the second most common arthrosis of the hand, affecting more than half of people over the age of 70, affecting 8% to 12% of the general population, mostly postmenopausal women [2-4].
Although symptoms can be treated with conservative methods in the early period, if the symptoms do not improve and the pain becomes severe, one of the many surgical procedures described in literature may required [5-10]. Arthrodesis of the first CMC joint is recommended for patients with high activity levels, and it is also has good results in patients older than 50 years of age [11,12]. It doesn’t cause loss of strength and for those who do heavy work, it is the preferred treatment method. However, non-union after arthrodesis is a common complication and the effects of non-union on patient satisfaction and treatment results are controversial [11,13,14].

In the study, we aimed to evaluate the results of treatment with arthrodesis with Kirschner wire(K-wire) fixation on Eaton stage-III arthrosis of the first CMC joint in postmenopausal women.

**Patients and Methods**

Patients treated at our clinic for arthrosis of the first CMC joint between January 2011 and January 2019 were evaluated retrospectively. The study included postmenopausal women who had stage-III arthrosis in accordance with the Eaton-Littler classification, who were surgically treated with arthrodesis and K-wire fixation and regularly followed-up for at least 1 year.

52 joints of 47 patients who were surgically treated for the first CMC joint arthrosis were evaluated retrospectively. According to the study criteria, 21 arthrodesis of 19 patients were included in the study (Table 1).

The Eaton-Littler classification was used in the radiographic classification of the first CMC joint arthrosis. The state of union and the development of STT joint arthritis at the end of the follow-up were evaluated with direct radiography. Scaphotrapeziotrapezoid (STT) joint arthritis was evaluated according to the criteria of Crosby et al. [15]. Union after arthrodesis (fusion) was defined by the appearance of bone trabeculae along the arthrodesis area on direct graphy [9]. The clinical evaluation of disease was performed using the presurgical

**Table 1. Patients demographics.**

<table>
<thead>
<tr>
<th></th>
<th>All patients</th>
<th>Fusion</th>
<th>Non-union</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers of hands (patients)</td>
<td>21 hands (19 patients)</td>
<td>12 hands (11 patients)</td>
<td>9 hands (8 patients)</td>
</tr>
<tr>
<td>Age at time of surgery (years)</td>
<td>56.6 years (52-72)</td>
<td>58 years (52-72)</td>
<td>54.7 years (52-59)</td>
</tr>
<tr>
<td>Follow-up periods (months)</td>
<td>57.7 months (17-90)</td>
<td>55.5 months (17-90)</td>
<td>60.7 months (27-89)</td>
</tr>
</tbody>
</table>

**Table 2. Results.**

<table>
<thead>
<tr>
<th></th>
<th>All patients</th>
<th>Fusion</th>
<th>Non-union</th>
<th>p * value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-operative evaluation</td>
<td>Quick dash score</td>
<td>69.5 (61.4-79.5)</td>
<td>69.7 (61.4-75)</td>
<td>69.3 (61.4-79.5)</td>
</tr>
<tr>
<td>End of follow-up evaluation</td>
<td>Quick dash score</td>
<td>8.8 (2.3-20.5)</td>
<td>5.6 (2.3-9.1)</td>
<td>13.1 (11.4-20.5)</td>
</tr>
<tr>
<td>End of follow-up</td>
<td>Hand grip strength (kg/force) (Jamar® Hydraulic Hand Dynamometer (Sammons Preston, Bolingbrook, Illinois))</td>
<td>19.9 (13-27)</td>
<td>21 (±4.03)</td>
<td>18.44 (±3.6)</td>
</tr>
<tr>
<td>Mp compensative hyperextension</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Stt arthritis</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Revision surgery</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

* P<.05 was considered statistically significant. The One-Sample Statistics test and Paired Samples Correlations were used to compare groups.
Arthrodesis of the first carpometacarpal joint in postmenopausal rural women

and end of follow-up Quick-DASH scores. At the end of follow-up, hand grip strength of both hands was measured using the Jamar® Hydraulic Hand Dynamometer (Sammons Preston, Bolingbrook, Illinois). At the end of follow-up, metacarpophalangeal (MP) joints of patients were evaluated in terms of compensatory hyperextension [16].

Arthrodesis was stabilised with two 1.4 mm K-wires that were placed in the hand’s fist position, where the distal phalanx of the thumb rests on the middle phalanx of the index finger, avoiding the penetration of the STT joint [12]. No grafts were used in any of the cases. A splint covering the thumb was applied after surgery. In the post-operative 6th week, joint movements were started after removing the K-wires in the outpatient clinic.

Figure 1. (A) Pre-operative direct radiography, (B) Early post-operative, (C) End of follow-up first CMC non-union (pseudarthrosis), (D) Pre-operative, (E) Early post-operative, (F) End of follow-up first CMC arthrodesis direct radiography with fusion.
Statistical Analysis

The data were expressed as numbers and percentages. The One-Sample Statistics test and Paired Samples Correlations were used to compare the groups. p value of <0.05 was considered statistically significant.

Results

The hospital’s local ethics committee approved the present study and informed consent was obtained from each patient.

The mean age of the 19 postmenopausal women included in the study was 56.6(52-72) years. The operation was performed on the right joint in eight patients, the left joint in nine patients and bilaterally in two patients. The mean follow-up period was 57.7(17-90) months. Mean presurgical Quick-DASH score was 69.5(61.4-79.5). Mean Quick-DASH score at the end of follow-up was 8.8(2.3-20.5)(Table 2). In all patients treated, the improvement in presurgical Quick-DASH scores when compared to the end of follow-up measurements was statistically significant(p=0.001). Direct graphy taken at the end of follow-up revealed that there was non-union at the arthrodesis line in nine joints of eight patients (42.8%) and fusion was observed at the arthrodesis line in 12 joints of 11 patients (%57.2) (Figure 1). The mean Quick-DASH score at the end of follow-up of patients with fusion after arthrodesis was 5.6 (2.3-9.1). The mean post-follow-up Quick-DASH scores of patients with non-union after arthrodesis was 13.1 (11.4-20.5), and the difference between the post-follow-up Quick-DASH scores of the two patient groups was not statistically significant (p = 0.84). Eight patients without union were satisfied with the result at the end of the follow-up, and one patient (4.7%) underwent revision arthrodesis surgery due to pain and...
Direct graphy evaluations at the end of follow-up revealed that two patients (9.5%) had stage I arthritis at their STT joint; however, the clinical and functional outcomes weren’t affected. Compensatory hyperextension of the MP joint was encountered in six patients (28.5%) (Figure 3).

All patients hand grip strength was measured in the operated extremity at the end of follow-up, and the mean value was 19.9 kg/force (11-23) (Figure 2). Mean hand grip strength of patients with fusion was 21 kg/force (±4.03). In patients with non-union, this measurement was 18.44 kg/force (±3.6). Mean grip strength of the non-operated contralateral hand was 19.4 kg/force (12-26). After arthrodesis, the difference in hand grip strength in patients with fusion and non-union wasn’t statistically significant (p=0.214).

Discussion

Arthrosis of the first CMC joint is a chronic condition with high prevalence, affecting most of the ageing population, it is expected to increase with ageing and is common affecting 16% to 25% of postmenopausal women [4,17,18]. Symptoms can be treated in the early stages without surgery and with different conservative method. Surgical treatment is required in the presence of persistent severe pain, loss of strength or significant restriction during daily-life activities. The surgical treatment of the first CMC joint arthrosis is an ongoing debate among hand surgeons [19]. These surgical treatment methods include total trapeziectomy, ligament reconstruction, metacarpal osteotomy, total joint arthroplasty, first CMC joint arthrodesis and LRTI along with trapezium excision [5-10,20].

In studies in which surgical treatments accepted for the arthrosis of the first CMC joint were examined in terms of pain, satisfaction and physical function, it was concluded that there was no evidence to support the superiority of any surgical procedure over another [21]. The first CMC joint arthrodesis is generally recommended for the treatment of young patients with high activity levels, but arthrodesis hasn’t been recommended in elderly patients due to the risk of developing pantrapezial arthritis [11]. In contrast, positive results after arthrodesis have been reported in patients over 50 years of age [12]. Although the indication of CMC joint arthrodesis for primary osteoarthritis in elderly patients is controversial, arthrodesis was the preferred treatment method in patients in our study in order to have a stable first metacarpal ray for patients who demand strength.

Non-union is a common complication after first CMC joint arthrodesis. In the literature, non-union rates range from 0% to 48% [9,11]. In the study by Rizzo et al, a relationship between non-union after treatment and the stage at the time of diagnosis and gender and age of the patient couldn’t be defined [9]. In the same study, no relationship was found between nonunion after arthrodesis and the type of fixation, use of additional bone grafts [9]. However, in a retrospective study by Hartigan et al. where most of the complications were nonunion, a 16% nonunion rate was reported following arthrodesis, while a lower nonunion rate (6%) was reported when plate and screw fixation was used [22]. Harston et al. investigated a new method involving CMC arthrodesis with a v-shaped osteotomy at the base of the first metacarp to provide a more stable fusion site, and the authors reported an 83% fusion.
rate at the arthrodesis line [23]. Kazmers et al. studied a modified method of arthrodesis involving a locking plate construct and reported a low non-union rate for arthrodesis (7%) [24]. Similar to the failure of fracture fixation due to changes in the bone after aging and postmenopause, fixation with K-wires in the arthrodesis line in postmenopausal women with possible osteoporosis may be considered to cause a high nonunion rate due to not provide enough biomechanical stability in our study [25]. But, Smeraglia et al. stated in their study that fusion after arthrodesis wasn’t necessary for a good outcome [13]. Furthermore, Rubino et al defined a surgical procedure aimed at creating a narrow CMC pseudoarthrosis to transform the first CMC joint from a synovial diarthrodial joint into a fibrous joint and they reported that fibrous non-union tissue could provide a satisfactory result [14]. In our study, we observed that non-union was developed in nine joints (42.8%) of the eight patients, but revision surgery was performed in only one patient (4.7%). In patients with fusion and non-union in CMC joints after arthrodesis, it was thought that the lack of difference between the QuickDASH scores at the end of follow-up and the low rate of revision surgery might be due to the non-union fibrous tissue that developed in the joint [13,14]. Smeraglia et al also reported that there was no difference between the two groups when the hand grip strength of patients who had fusion or non-union after arthrodesis was evaluated [13]. In our study, the absence of a statistical difference between the hand grip strength of patients who had fusion or non-union after arthrodesis was in accordance with the literature (p=0.214).

It is difficult to determine the optimal thumb position during arthrodesis surgery [26]. Arthrodesis may lead to loss of mobility in the related joint and cause looseness, pain and degenerative changes in the surrounding joints, resulting in compensatory hyperextension in the MP joint [16,26]. At the end of the study, six patients (28.5%) developed compensatory hyperextension in the MP joint, but this didn’t cause loss of function and revision surgery wasn’t required.

Different information is available on the incidence, clinical significance and effect on prognosis of STT arthritis that may develop after arthrodesis of the first CMC joint [8,9,11,12,16]. Rizzo et al was reported that STT joint arthritis developed at different stages in 39 hands, and in eight hands, symptomatic STT joint arthritis was encountered in their study [9]. In the study by Ishida and Ikuta, eight-year follow-up results of 21 patients were evaluated and one patient was reported to develop minimal STT joint arthritis [8]. Examination of these two studies revealed that the ages, follow-up periods, gender and arthrosiscauses of the patients included were different. In addition, there were differences in their surgical treatments and the results of a group of patients who would be considered heterogeneous were evaluated [8,9]. In our study, we observed that two patients (9.5%) developed stage I STT joint arthritis. The STT joint arthritis that developed in these patients was asymptomatic; it didn’t cause loss of function and revision surgery wasn’t required.

A weak point of our study; It can be stated that it is retrospective, the number of patients is small, different fixation methods are not used as a comparison group.

In conclusion, we observed that k-wire arthrodesis of the first CMC joint was associated with high nonunion rates, but nonunion did not have an unfavourable effect on functional outcomes, we believe that larger series studies with longer follow-up are needed for more precise results.

Conflict of interest statement
The authors have no conflicts of interest to declare.

References


