

## RESULTS OF EATON AND LITTLER'S LIGAMENT RECONSTRUCTION FOR INSTABILITY OF THE FIRST CARPOMETACARPAL JOINT

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*Abstract* : This study presents the cases of Eaton and Littler's ligament reconstruction for the treatment of instability of 1st CM joint resulting from early stage osteoarthritis (Group OA), trauma (Group T), and a part of generalized joint laxity (Group GJL) in 21 joints of 20 cases. Omitting six cases with less than one year follow-up, 15 joints in 14 cases were analyzed. Clinically, hypermobility pain was improved in all joints. However, eight out of 14 patients felt their joints stretched, but still had the normal range of motion. Grip power and pinch power was significantly improved ( $P < 0.01$ ,  $P < 0.05$ ). Comparing each group, only Group T revealed a significant difference between preoperative and postoperative grip power ( $P < 0.01$ ). In increase of grip power, Group T were more significantly improved than Group OA ( $P < 0.01$ ) and Group GJL ( $P < 0.05$ ). Radiographically, postoperative stages of 4 joints in 4 cases out of 8 cases which felt stretched progressed from their preoperative stages. We assumed that the newly reconstructed ligament may be strong enough to maintain the stability of 1st CM joint and ligament reconstruction is most effective in treating post-traumatic instability.

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**Key words** : Eaton and Littler's ligament reconstruction, first carpometacarpal joint

### INTRODUCTION

Instability of the 1st carpometacarpal (CM) joint seems to occur from the dysfunction of ligamentous system. It is generally accepted that most of the etiologies are idiopathic osteoarthritis in its early stage, post-traumatic ligament injury of the CM joint, and a part of generalized ligamentous laxity<sup>1,2)</sup>. However, the condition of "instability of the 1st CM joint" has no lucid definition and only its symptoms are dealt with by symptomatic treatment under the present conditions. The purpose of this study is to evaluate our results of Eaton and Littler's ligament reconstruction<sup>1)</sup> for the treatment of instability of the 1st CM joint resulting from the above three main etiologies.

### MATERIALS AND METHODS

The operations were performed on 21 joints in 20 cases, including a bilateral case (right : 8 joints, left : 13 joints). The series consisted of 7 males and 13 females ; ages ranged from 13 to

67 years (average 34.3 years). The etiologies were early stages of osteoarthritis in 11 joints of 11 cases (Group OA), trauma in 6 joints of 6 cases (Group T), and a part of generalized ligamentous laxity in 4 joints of 3 cases (Group GJL). The average age and sex by etiology were as follows: Group OA-48.6 years, 1 male, 10 females; Group T-20 years, 5 males, 1 female; and Group GJL-19.3 years, 1 male (bilateral case of Marfan syndrome), 2 females. In Group T, males outnumbered females because of trauma in a motorcycle accident. The causes of trauma were due to motorcycle accidents in 4 cases and sports injuries in 2 cases. Out of 6 cases, 5 were chronic instability and 1 was acute dislocation of 1st CM joint. All patients complained chiefly of pain around the CM joint, poorly localized to the thenar eminence, after the frequent use of their hands. Characteristics of each group were as follows: Group OA-severe pain of synovitis and two cases being false positive for Finkelstein's test and, in some cases, treated for De Quervain's disease at another hospital, Group T-marked weakness of grasping power, and Group GJL-dullness around the CM joint, difficulty in writing, etc. The joints were evaluated using Eaton and Littler's stage<sup>1)</sup>.

Out of 11 joints in Group OA, 7 cases were classified as stage III. All joints in Groups T and GJL were classified as stage I. For diagnosis, plain roentgenograms (A-P and lateral view) and stress views (the radio-lateral and the dorso-lateral direction) were used. We confirmed static instability using a stress view. The symptoms improved on injection of local anesthetic into the CM joint as differential injection study. In this study, we subjected the joints which had not obtained satisfactory results from conservative treatment for a given period, to operative treatment.

### **Surgical procedure**

We performed the operations by using a split tendon harvested from the flexor carpi radialis (FCR), reported by Eaton and Littler in 1973. As postoperative management, bulky dressing was used just after surgery and changed to thumb spica cast after the removal of sutures. Fixation period was 4 weeks postoperative and a C-wire, fixing the CM joint, was pulled out simultaneously with removal of the cast. Postoperative physiotherapy was very important and we have been guiding patients to do push-ups in their home and to compel palm flat-wrist dorsiflexion to prevent a limitation on range of motion and stiffness after the operation.

### **Representative case reports**

Case 1 (Group T): Chronic instability of the 1st CM joint secondary to trauma

A 22-year-old man sprained his right thumb in a motorcycle race about a month before, but had let it alone. He visited our hospital complaining of weakness of grip strength, and instability and pain of his right thumb. Preoperative roentgenograms revealed nothing unusual in the 1st CM joint, while stress views using manual testing demonstrated instability to the dorsolateral direction in the joint (Fig. 1-a). In the opposite left thumb, lateral stress view did not show dorsal instability. A-P view showed slight laxity, but this range was smaller than that of the right thumb (Fig. 1-b). As of 33 months postoperative, he had returned to a motocross racing and grasp power had recovered from 20 kg to 50 kg, and the joint remained in stage I (Fig. 1-c).

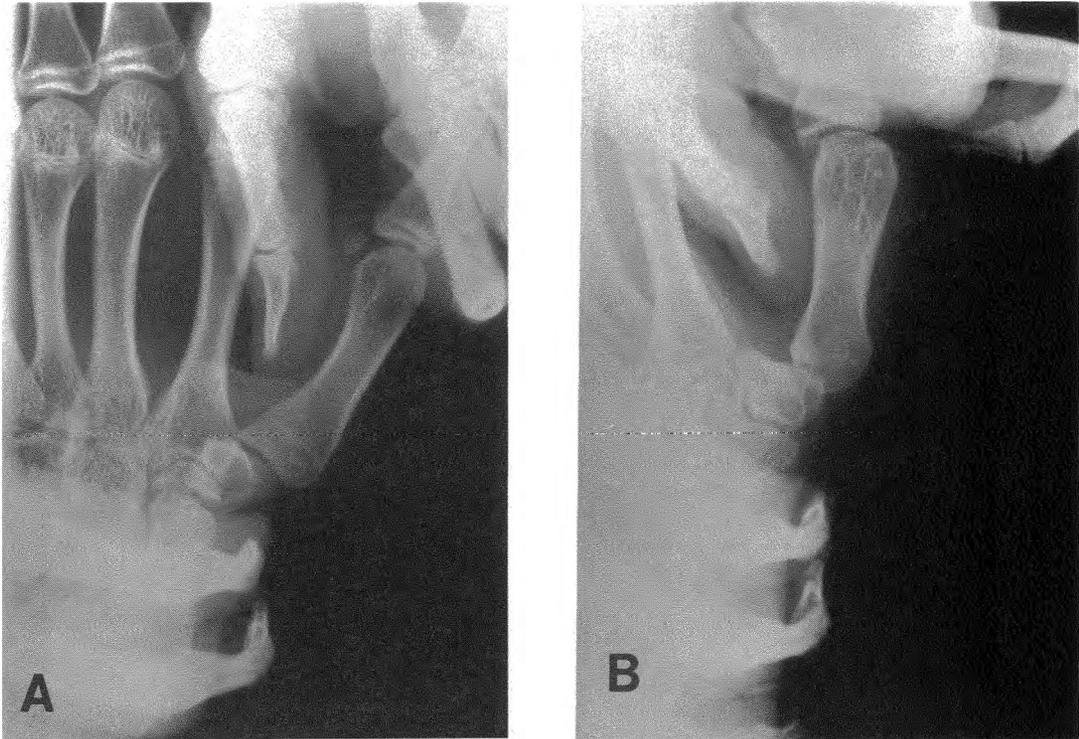


Fig. 1-a. A : Lateral stress view showed dorso-lateral instability in the right thumb.  
B : A-P stress view also showed an instability in the right thumb.

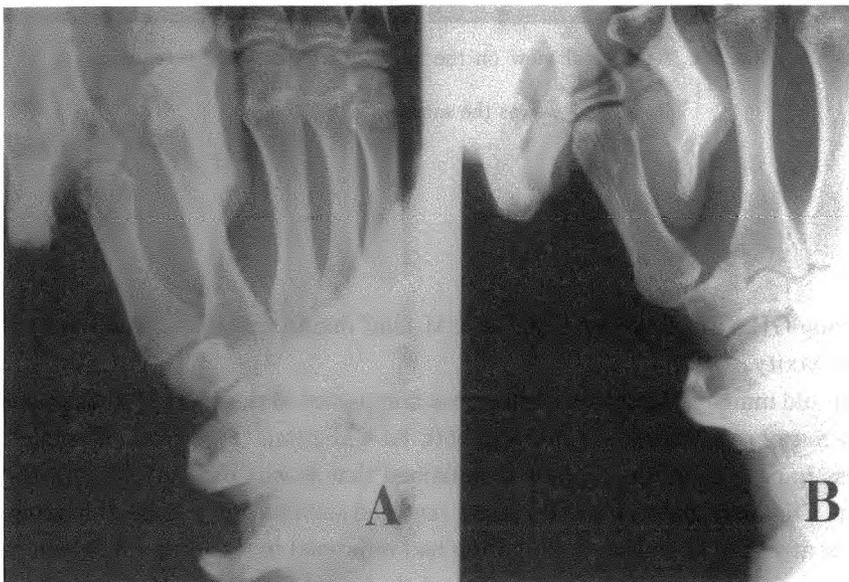


Fig. 1-b. A : In the opposite left thumb, lateral stress view did not show dorso-lateral instability.  
B : A-P stress view showed slightly laxity, but this range was smaller than that of the right thumb.



Fig. 1-c. A: Lateral view on the 33 months after surgery revealed stage I.  
B: A-P view was the same.

Case 2 (Group GJL): Instability of the 1st CM joint due to a partial symptom of generalized ligamentous laxity.

A 17-year-old man had Marfan's syndrome accompanied with generalized ligamentous laxity and a plain X-ray revealed subluxations in both 1st CM joints (Fig. 2-a). His chief complaint was dullness in case of writing and he complained that it was difficult for him to write well using a pen. Clinically, both of his CM joints revealed subluxation in case of holding a pen. As of 88 months after the operation, subluxation had improved in the left joint, which remained in stage I, and stress view showed no instability of the joint (Fig. 2-b). However, he complained of a feeling that the right joint was stretched lightly and plain roentgenogram revealed hyperextension of the MP joint and degenerative arthrosis at 86 months after operation. While instability was not found and grip power was improved, the preoperative stage I progressed to stage II (Fig. 2-c).

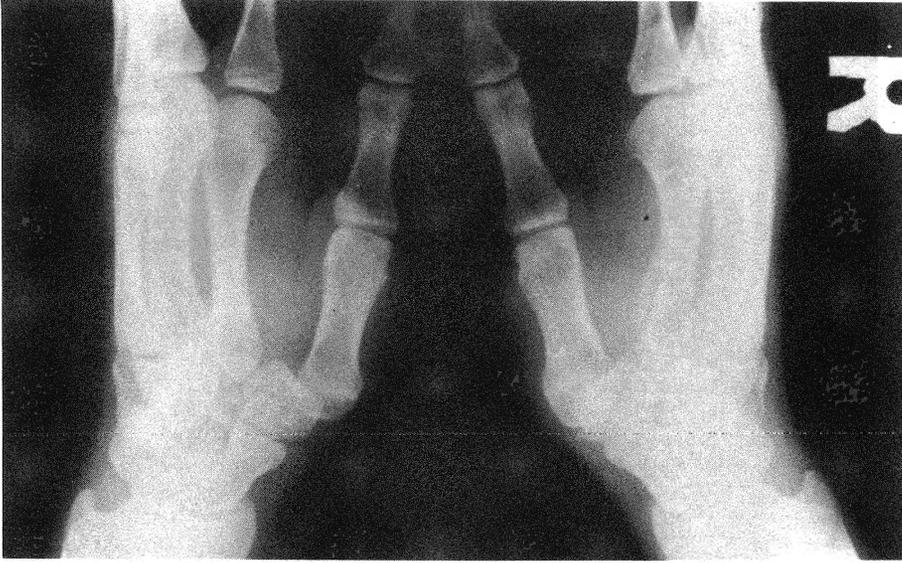


Fig. 2-a. Bilateral Carpometacarpal joint showed a static subluxation in 17-years-old-man with Marfan syndrome.

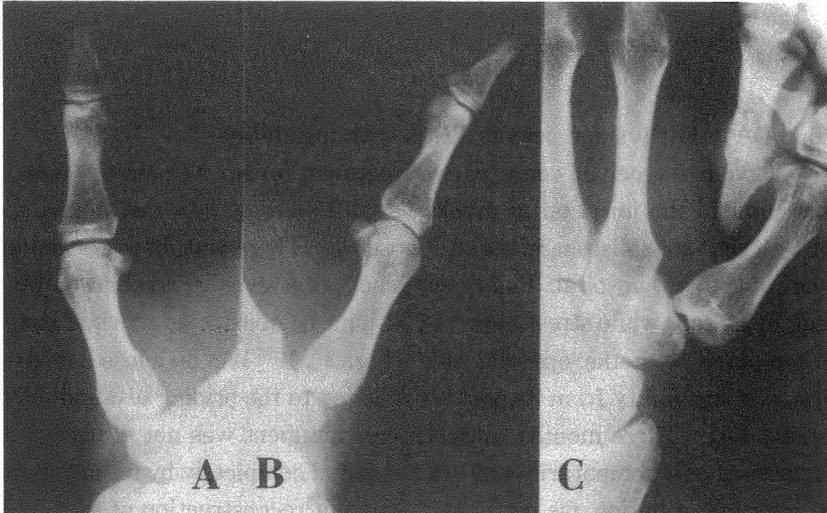


Fig. 2-b. A : A-P view on the 88 months after operation kept stage 1 and subluxation had been improved.  
B : Lateral view also kept stage 1.  
C : Stress view showed no instability of the joint.

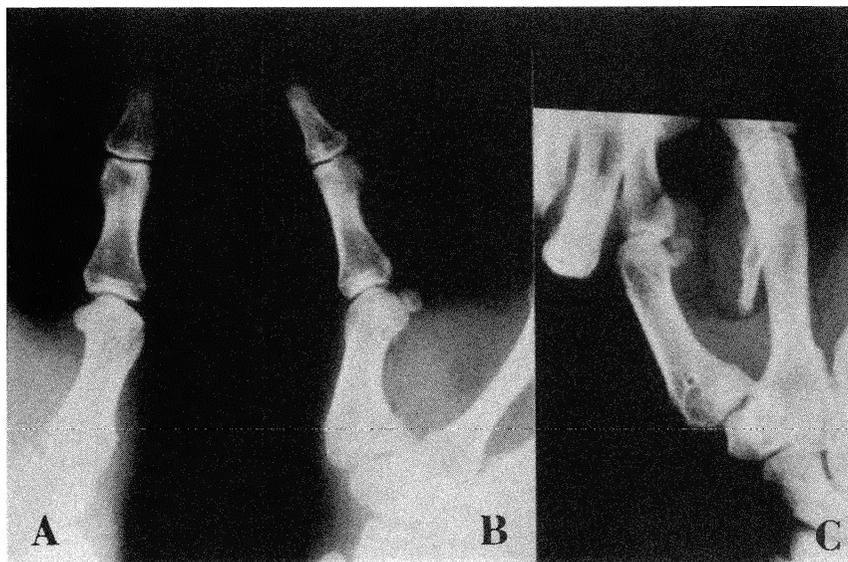


Fig. 2-c. A: A-P view on the 86 months after operation showed slightly narrowing of the left carpometacarpal joint.  
 B: Lateral view showed irregularity of joint surface and hyperextension of the Metacarpophalangeal joint.  
 C: In stress view, instability of CM joint had been improved.

#### Case 3 (Group OA) : Early stage osteoarthritis with instability.

A 47-year-old woman received conservative treatment for severe pain at the base of her left thumb. This entailed the injection of cytokines with steroids into the tendon sheath on the diagnosis of De Quervain's disease in another hospital. There was, however, no improvement at all, and she came to our hospital. Plain roentgenograms revealed no abnormality on the joint surface, being in stage I, while stress view of CM joint demonstrated marked instability in the radial side compared with the opposite side (Fig. 3-a). We diagnosed it as early stage osteoarthritis with instability from its positive reaction to the priding test and false positive to the Finkelstein's test. Three months conservative treatment was not effective. Since symptoms were improved only temporarily and not mitigated completely by using a steroid injection into the CM joint and splinting, we performed ligament reconstruction of the CM joint. As of 24 months postoperative, grasp power had increased from 33 kg to 45 kg with improvement of symptoms, the joint remained in stage I without progress of degenerative arthrosis, and the patient was satisfied with the result (Fig. 3-b).

### RESULTS

Omitting cases with less than one year follow-up, we investigated 15 joints in 14 cases (Table 2). Follow-up periods ranged from 12 to 88 months (average 34.3 months). Preoperative symptoms and joint instability were improved in all patients. The instability was corrected in all. Eight patients felt their operated joints stretched in palm flat test, but were none the worse

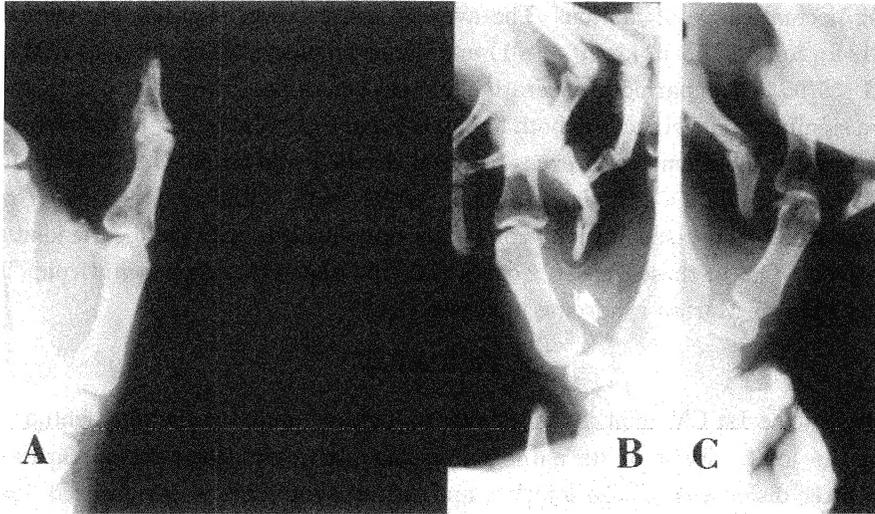


Fig. 3-a. A : Plain lateral view showed no abnormality of the Carpo-metaphalangeal joint in her left thumb.  
 B : In stress roentgenogram on the A-P view, instability to the radiolateral side compared the opposite side (C:) was observed.

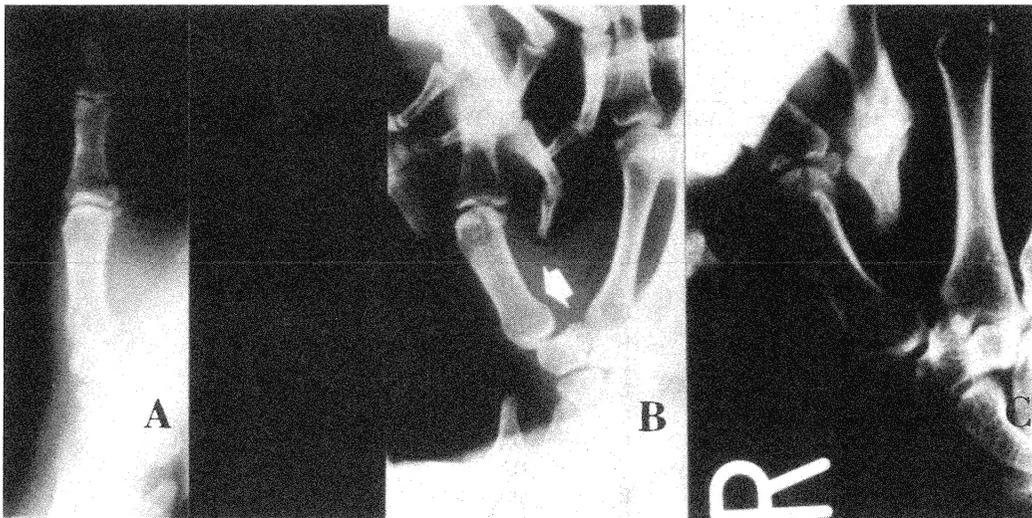


Fig. 3-b. A : Plain roentgenogram revealed no abnormality and kept stage 1.  
 B : Preoperative stress view  
 C : In postoperative stress view on 24 months after operation, instability compared that of preoperative stress view was improved.

for getting normal range of motion. The average grasp power significantly increased from 18.93 10.12 kg to 32.27 15.03 kg ( $P < 0.01$ ) and the pinch power was from 2.19 1.03 kg to 3.36 1.07 kg ( $P < 0.05$ ). Comparing preoperative and postoperative grip power one in each group, there were significant differences in both Group OA and GJL (Table 3). In the increase of grip power, there were significant differences between Group T and Group OA ( $P < 0.01$ ) or Group GJL ( $P < 0.05$ ) (Table 4). Clinically, good results were obtained for each group, while radiographic stage progressed in 4 joints of 4 cases out of 8 cases with feeling the joint stretched postoperatively. Out of these 4 cases, 2 cases were in Group OA, one was in Group T and one was a right joint of Marfan syndrome in Group GJL.

## DISCUSSION

Instability of the 1st CM joint is mainly due to tears or laxity of the ligamentous structure protecting the joint. Most of its pathogenesis may be early stage osteoarthritis, trauma, especially after dislocation of the joint<sup>3-6</sup>, and partial symptoms of generalized ligamentous laxity<sup>1,2</sup>. There is, however, no clear definition of "instability of the 1st CM joint." Because the 1st CM joint has a wide range of motion<sup>7-10</sup>, it does not always correspond with clinical symptoms. This is because it originally has laxity to some degree and is not the load bearing joint. In this study, symptoms of the thumb resulting from hypermobility are named "instability of the 1st CM joint." The conservative treatment, splinting the affected part and keeping it

Table 1. Operated cases

CASE	SEX	AGE	SIDE	ETIOLOGY	STAGE(PRE)	FOLLOW-UP
1	M	21	R	T	1	66 mon.
2	M	22	L	T	1	70
3	M	21	R	T	1	39
4	M	17	R	GJL(Marfan)	1	86
5	M	17	L	GJL(Marfan)	1	88
6	F	23	L	GJL	1	34
7	F	47	L	OA	1	24
8	F	23	L	T	1	18
9	F	55	L	OA	3	21
10	F	52	L	OA	1	14
11	M	67	L	OA	2	14
12	F	42	L	OA	2	13
13	F	43	L	OA	2	12
14	F	40	R	OA	1	12
15	F	29	R	OA	1	12
16	F	23	L	GJL	1	6
17	F	49	R	OA	1	6
18	F	58	L	OA	2	4
19	F	53	R	OA	1	4
20	M	13	L	T	1	4
21	M	17	L	T	1	2

T ; Trauma

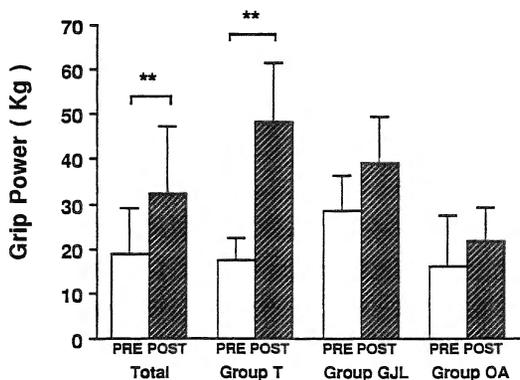
GJL ; General Joint Laxity

OA ; Osteoarthritis

Table 2. Analysed Cases \* Progressed cases

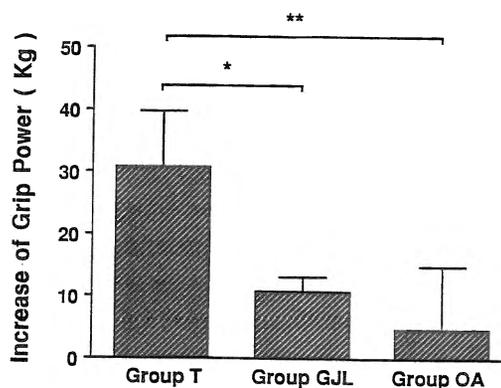
CASE	PAIN	FEELING of Stiffness	GRIP POWER		PINCH POWER		STAGE	
			Pre.	Post.	Pre.	Post.	Pre.	Post
1	F	+	20 kg	63 kg			1	2*
2	F	-	20	50			1	1
3	F	-	20	49			1	1
4	F	+	33	45			1	2*
5	F	-	33	45			1	1
6	F	-	5	23			1	1
7	F	-	19	27	0.8 kg	2.1 kg	1	1
8	F	+	22	26	2.0	2.0	1	1
9	F	+	10	31	0.8	2.1	3	3
10	F	+	21	14	3.4	4.1	1	2*
11	F	-	33	37	3.0	4.1	2	2
12	F	+	5	20	3.0	3.1	2	3*
13	F	-	5	17	2.5	4.8	1	1
14	F	+	10	15	3.0	3.7	1	1
15	F	+	28	22	1.2	4.2	1	1
F; Free		Mean	18.93	32.27	2.19	3.36 kg		
		SD	10.12	15.03	1.03	1.07 kg		
			(P<0.01)		(P<0.05)			

Table 3. Comparison of preoperative grip power with postoperative one in each group



(\*\*P<0.01) there are significant differences between preoperative and postoperative grip powers in whole case, especially Group T.

Table 4. Comparison for each group in increase of the grip power



(\*P<0.05, \*\*P<0.01) there are significant differences between Group T and Group OA or GJL.

rested, administering anti-inflammatory drugs, and injecting local anesthetic with steroid into the joint, should be taken for this disease in principle. However, failure to achieve full pain relief or recurrence of pain and subluxation after this treatment may be indications for operative treatment<sup>11</sup>.

Ligament systems<sup>1,2,7-9</sup> supporting the 1st CM joint have been reported and there are controversies on the question of which ligaments contribute to the joint stability. Eaton et

al<sup>1,10-12</sup>). described that the volar ligament anatomically holds the key to joint stability and recommended volar reconstruction with the FCR for the treatment. In contrast, Pagalidis et al<sup>13</sup>). reported that joint instability was caused by cutting off not the volar ligament but the first intermetacarpal ligament and Biddulph et al. (1985)<sup>2</sup>) presented that the dorsal reconstruction with the ECRL was effective subsequent to the report of Pagalidis et al. Brunelli<sup>14</sup>) which also reported that the ligament reconstruction between the 1st and 2nd metacarpal bones was effective using an abductor pollicis longus tendon. We have not found the differences between both for effectiveness, but believe that both the volar ligament and the 1st intermetacarpal ligaments are able to be reconstructed with the harvested FCR tendon by this method, even if the ECRL is not used.

Besides the above authors, several authors<sup>15-19</sup>) had reported various ligament reconstructions to stabilize the 1st CM joint and most authors had reported good clinical results. However, most reports presented little more than clinical results of ligament reconstruction and there has been no report to investigate statistically the operative results for each etiology. Of course using Eaton and Littler's ligament reconstruction, we obtained clinically satisfactory results for whatever etiologies the instability of this joint were caused by, just as Eaton and his colleagues<sup>20</sup>). It goes without saying that the main reason was due to this procedure being performed for the treatment of Stage I or II. In our results about grip power, there were significant differences between Group T and Group OA or Group GJL. It was true that there were significant differences in grip power, but it is impossible to evaluate thumb function entirely using grip power alone. However, this statistical result shows that this ligament reconstruction was the most effective for the posttraumatic instability among their etiologies, and this study will support the previous reports<sup>1,10-12,20,21</sup>). Radiographically, postoperative stages of 4 patients progressively worsened from their preoperative stages. The reasons for these results were deemed to be as follows : in a joint of Group T, damage of articular cartilage could not be observed sufficiently at surgery ; In two joints of Group OA, damage of the cartilage was widely found under direct visualization, although preoperative stages were I and II ; in a joint of Group GJL, one of bilateral case in the representative Case 2, tension of the ligament was too strong, which was deduced from the absence of degenerative arthrosis in the contra-lateral reconstructed joint. From this, the primarily recommended indications for the reconstruction are deemed to be Eaton's stage I and II, while other methods seem to be better for the joints in which damage of the cartilage has reached the subchondral region or stiffness has already occurred<sup>20</sup>). However, it was very difficult to know exactly the condition of damaged cartilage at the operation because CM joint was saddle joint. In our cases, 8 of 14 patients complained of feeling their joint stretched, though range of motion of the joint was normal. This gave us the impression that the reconstructed ligaments were enough to maintain the stability of the 1st CM joint, and therefore, we now consider that it is not necessary for 4 weeks postoperative fixation across the 1st CM joint using a C-wire pinning. Eaton by himself<sup>11,12</sup>) also after his first report, changed the contents concerning postoperative management. He recommended that a Kirchner wire be used for transfixation of the MP joint in 20 degree fixation. He claimed this was important in maintaining opposition thumb position during cast application and immobilization. Fixation with a Kirchner wire across the TMT joint was rarely used. We also agree with his opinion from our experiences. If the newly

reconstructed ligament will be sutured in extensive tension, or postoperative immobilization will be too long or strong, joint stiffness will be conversely progressive and osteoarthrosis may occur in earlier stages than in the case of a non-operative course.

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