Bone lengthening of the radius with temporary external wrist fixation for mild radial club hand
Takehiko Takagi, Atsuhito Seki, Shinichiro Takayama
Department of Orthopaedic Surgery, National Center for Child Health and Development

Introduction
The goals in the treatment of radial club hand are to correct the wrist deformity, to maintain the corrected position, to provide wrist-like mobility and to preserve the maximal forearm longitudinal growth capacity as well as to achieve an acceptable cosmetic result. However, in fact, it is difficult to acquire alignment as well as mobility. We developed an approach that tries to solve the problem of radial club hand by a combination of bone lengthening of the radius and temporary external fixation between ulna and metacarpals to support the radial side of wrist for avoiding loss of correction.

MATERIALS AND METHODS
Patients
Five radial club hands have been treated with the new method: radius lengthening with external fixation to support the radial side. All hands were Bayne type I (short distal radius) or II (hypoplastic radius). No limited range of elbow motions in all cases. The age of the patients at the time of operation was from 21 to 55 months (mean, 36.0 months). There were three boys and two girls. Pollicization has been done for absent thumb in two cases one year after the wrist treatment. The follow-up period was from 25 to 55 months (mean, 38.4 months). All affected hands were classified as type II and one as type I in the categories defined by Bayne (Table I).

Surgical Procedure

Figure 1. Zig-zag incision was made along the radial side of the wrist.

Figure 2. Care was taken to avoid damage to the sensory branches of the radial nerve. (Blue tape retracted the sensory branch of the radial nerve.)

Figure 3. The thick fasciae around brachioradialis and radial wrist extensors were exposed to release the distal end of radius and radial side of wrist.

Figure 4. The radius was fixed with an external fixator for bone lengthening (M55 BL2001, ME system, Tokyo, Japan) and cut with K-wires and an osteotome at the distal metaphysis.

Figure 5. The wrist was fixed from the ulnar side with an external fixator (Orthofix MS51, Orthofix Orthopedics, Lewisville, TX, USA) in the neutral position of the wrist with a slight distraction. The radius was fixed with an external fixator for bone lengthening.

Figure 6. Postoperative X-ray (Day 5).

Figure 7. Postoperative X-ray at the final follow-up, 55 months after surgery.

RESULTS
The preoperative and postoperative clinical parameters are shown in Table I. Healing index of the radius was from 72.2 to 298.9 day/cm (mean, 176.8 day/cm). The radial/ulnar flexion was 84.0±14.0 degrees before surgery and 37.0±13.0 degrees at the time of the final follow-up. All cases were able to bring an object to mouth. No patient had postoperative complications such as infection and nerve palsies.

Table I.

<table>
<thead>
<tr>
<th>Follow-up period (mo)</th>
<th>Pre-Radial flexion</th>
<th>Pre-Ulnar flexion</th>
<th>Post-Radial flexion</th>
<th>Post-Ulnar flexion</th>
<th>Extended length of the radius(mm)</th>
<th>External fixator duration (days)</th>
<th>Healing index (day/cm)</th>
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<td>0</td>
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<td>30</td>
<td>110</td>
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<td>80</td>
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DISCUSSION
Centralization of artroplasty is the preferable procedure in the treatment of radial clubhand deformity. The goals in the centralization are to correct the wrist deformity, to maintain the corrected position as well as to achieve an acceptable cosmetic result. However, there is a problem of mobility loss of the wrist because the distal ulna is placed in the carpal defect and stabilized with a smooth Kirschner wire.

Vilikki developed a vascularized transplantation of the second metatarsophalangeal joint after some distraction with good results in a 10-year follow-up period. However, there remain problems of excision of talus bones and joint and difficulty of the procedure.

We have developed radius lengthening to support the radial side of the wrist in the mild case of radial club hand, Bayne type I and type II. Correction loss is avoided during the growth in the present method because the lengthening bone includes the growth plate. In addition, good range of motion may also be acquired due to temporary distraction of the wrist using an external fixation without the growth plate damage. It is important to include growth plate of the radius and distraction of the wrist to avoid correction loss of radial club hand.

In the present series, all cases have shown ADL improvement with better range of motion despite poor healing index. Although centralization, radialization, or Vilikki's technique is still recommended in the case with severe (Bayne type III or IV) radial club hand with poor or missing radius, our novel technique can be performed for the cases with mild (Bayne type I or II) radial club hand with mild radius deficiency including growth plate. More experience and clearly a longer follow-up period is still needed for final evaluation of the method.

REFERENCES