Loading of the lunate in patients with Kienböck’s disease and a negative ulnar variance provide the rationale for a radial shortening osteotomy. This osteotomy decreases forces transmitted from the radius to the lunate. We retrospectively reviewed 12 patients with Kienböck’s disease who had 13 radial shortening osteotomies to ascertain whether the reported short- and medium-term results endured in the long term. We evaluated nine osteotomies in nine of the 12 patients with a minimum of 16 years followup (average, 22 years; range, 16–31 years). Three patients died and one was lost to followup. For the nine patients, the range of motion was impaired compared with the normal side. Grip strength was on average 90% of the unaffected side. The average visual analog scale score for pain was 2.4 and the average Disabilities of the Arm, Shoulder, and Hand score was 14 at latest followup. In eight patients, the Lichtman classification of Kienböck’s disease did not change at followup, but in three patients there was radiographic progression of the disease, which occurred during the first 10 years postoperatively. The medium- and long-term results therefore were comparable. We recommend radial shortening in stable wrists (Stage 3A or less) with a negative ulnar variance. The radius should be shortened to the level of the ulna, normally 4 to 6 mm, after which stable (plate) fixation should be performed under compression.

Surgical options for treating Kienböck’s disease include resection arthroplasty of the lunate (with or without tendon interposition), denervation surgery, prosthetic replacement, revascularization, and fusions. The success rates for these surgical interventions range from 55% to 88% after followups of 3 to 11 years. These rates are not entirely satisfactory compared with the natural history of untreated Kienböck’s disease. Beckenbaugh et al described the natural history of Kienböck’s disease and reported nine patients with only mild pain and one patient with no pain after a followup of 9 months to 27 years. Kristensen et al also reported 77% of patients free of pain during normal activity after a followup of 18 years. Saffar and Gentaz reported the 10- to 30-year results of nonoperative treatment in 80 construction workers in whom change of occupation was rare even if radiographic evidence of progressive destruction and decrease of mobility of 50% was present.

In 1935, Hultén postulated Kienböck’s disease occurred because of stress overloading on the lunate. Decompressing the lunate was considered the most logical treatment for relieving this stress load. In 1982, Palmer et al described a method to measure the ulnar variance. Two years later, al Ekenstam et al showed that, in the neutral axis, 80% of the loading is on the radius while only 20% is on the ulna. According to this theory, distal radius shortening might be the treatment of choice for a negative ulnar variance of Kienböck’s disease. Almquist and Burns reported, 5 to 10 years after radial shortening, 11 of 12 patients were satisfied with their treatment, showed functional improvement, and returned to their normal activities. Eiken and Niechajev reported, 2 to 7 years after radial shortening, six of eight patients had pain relief and could resume the same work as before the onset of symptoms. Marti et al reported, 1 to 5 years after radial short-
MATERIALS AND METHODS
From 1974 to 1987, we performed 13 distal radius shortening osteotomies in 12 patients to treat Kienböck’s disease in the presence of a negative ulnar variance. The indication for surgery was long-lasting pain complaints and loss of function in the presence of Kienböck’s disease. The average age at the time of the osteotomy was 31 years (range, 20–44 years). The dominant hand was affected and treated in four patients (Table 1). Of the initial 12 patients, two patients (three osteotomies) died during followup and one was lost to followup but was free of complaints during his last regular visit 16 years postoperatively. The remaining nine patients (five men, four women; nine osteotomies) were followed a minimum of 16 years (average, 22 years; range, 16–31 years) (Table 1).

The surgical technique was described in 1981 by Marti et al. A standard dorsal approach to the distal radius was used. First, we made a 4- to 6-mm hole with a 3.5-mm dynamic compression plate temporarily fixed to the distal part. We performed a transverse osteotomy in the metaphyseal bone and removed a 3-mm-thick slice of radius (normally total amount of resection 4–6 mm). The thickness of the slice was determined using preoperative radiographs. Our aim was to achieve a neutral wrist. The definitive fixation was performed under compression (AO compression device) to optimize bone healing. Postoperative treatment consisted of 4 weeks of plaster immobilization.

The patients were asked to score their pain and satisfaction at the time of followup on a 10-cm visual analog scale (VAS). The scale was graded from 0 to 10 cm, with 0 cm indicating high satisfaction and no pain. We also obtained Disabilities of the Arm, Shoulder, and Hand (DASH) scores (0 points = no complaints; 100 points = worst possible outcome) for all patients. In addition, patients were asked if they had returned to their previous occupation. Visual analog and DASH scores were obtained by giving the patients a standardized questionnaire which they returned to us after filling them out.

Clinical followup consisted of measuring the range of motion of both wrists and grip strength in kilograms for both hands with a Jamar-meter (Therapeutic Instruments®, Clifton, NJ). Grip strength was measured three times after instructions were given to the patient (DH); the highest of the three values was documented. Complications occurring during the followup period also were noted and documented.

We used preoperative and the most recent postoperative radiographs to rate the severity of the Kienböck’s disease using the criteria described by Lichtman and Degnan (Table 2) and the carpal height index according to Youm et al. For two patients, no preoperative radiographs were preserved. All radiographs were viewed by two of us (EEJR, DH).

RESULTS
The subjective outcome measures for the long-term outcome showed an average VAS score for pain of 2.4 (range,

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<table>
<thead>
<tr>
<th>TABLE 1. Patient Characteristics and Followup</th>
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<td><strong>Gender</strong></td>
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*One patient (two osteotomies) died 21.2 and 23.7 years postoperatively; †One patient was lost to followup 16 years postoperatively and no DASH was obtained; ‡One patient died 18.1 years postoperatively; NA = no followup available—last available radiographs were used; Max = maximum

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Our aim was to determine whether the radiologic long-term results of a radial shortening osteotomy for Kienböck’s disease in patients with a negative ulnar variance were identical to the short- and medium-term results.

This is a retrospective study with a limited number of patients describing the long-term results of patients seen at a recent followup. We could not collect data and perform a complete followup for all the patients for the average followup of 22 years. Therefore, the data might not be generalizable.

Although early results in patients with Kienböck’s disease may be good, the disease may not necessarily be resolved permanently because secondary osteoarthritic changes are likely to occur in these patients. However, we found our long-term results similar to the medium-term results reported earlier and the medium-term results reported by others. All radiographic deteriorations occurred during the first 10 years postoperatively and remained completely stable afterward.

Our findings showed an average DASH score of 14, indicating a good outcome for our patients overall. Only three patients had slight radiographic deterioration without major clinical implications. Two patients radiologically progressed to Stage 3B disease during the first 10 years; this radiologic deterioration was not equal to a bad outcome, as these patients had a DASH score of 0 and 34 at followup.

One patient had a poor clinical outcome (DASH score = 68). We performed a radial shortening osteotomy in this 20-year-old patient who had Stage 3B Kienböck’s disease. Despite no radiographic progression, the clinical situation did not improve much (Fig 1). Joint leveling surgery of the wrist is not advised in patients with advanced stages of Kienböck’s disease (Stages 3B and 4). Although one patient in our small series is not sufficient to support this statement, we did not perform any joint leveling procedures in patients with Stage 3B disease or worse.

Although the success of radial shortening osteotomies in patients with Stage 3A disease is also considered doubtful, all of our patients with preoperative Stage 3A deformities responded well to treatment.

Our data support the hypothesis of af Ekenstam that stabilization of Kienböck’s disease occurs after unloading the lunate by radial shortening. Some patients had radiographic evidence of deterioration; however, the deterioration stopped after 10 years of followup. A negative ulnar variance is an etiologic factor of Kienböck’s disease, and the concept of joint leveling procedures is widely accepted. Although the same biomechanical solution is pro-

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**TABLE 2. Classification of Kienböck’s Disease by Lichtman and Degnan**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
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<tr>
<td>1</td>
<td>Radiographs are normal except for the possibility of linear or compression fracture.</td>
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<tr>
<td>2</td>
<td>Disease in this stage is still localized to the lunate. The size, shape, anatomic relationship, and kinematics of the carpal bones are not substantially altered. The lunate has definite increased density relative to the carpal bones. Late in this stage, some height may be lost on the radial side of the lunate.</td>
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<tr>
<td>3A</td>
<td>The lunate has collapsed in the frontal plane and elongated in the sagittal plane. The capitate begins to migrate proximally. The kinematics of the proximal row are altered minimally.</td>
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<tr>
<td>3B</td>
<td>Further deterioration of Stage 3A disease. The lunate has collapsed with fixed scaphoid rotation and other secondary derangements.</td>
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<tr>
<td>4</td>
<td>All the findings of Stage 3 are present, in addition to generalized carpal degeneration.</td>
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</tbody>
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vided by ulnar lengthening, several studies report better outcome and less complications for radial shortening.\textsuperscript{3,11,13,19}

As for every type of osteotomy, nonunion is a well-documented complication. However, nonunion did not occur in our series. We believe the use of fixation under compression lowers the rate of nonunions.

Our data suggest the long-term results after distal radius shortening osteotomy for Kienböck’s disease in patients with a negative ulna variance gives long-lasting pain relief. The deformity seems to stabilize after 10 years, but some complaints of occasional pain remain.

\textbf{Fig 1A–D.} (A) An anteroposterior radiograph from a 20-year-old woman shows Lichtman Stage 3B Kienböck’s disease on the right (dominant) wrist. (B) The lateral radiograph of the same patient shows a ventral collapse of the lunate. The negative ulnar variance is visible. (C) The anteroposterior and (D) lateral radiographs 20 years after the radial shortening osteotomy show she still had a Stage 3B deformity; her DASH score was 68.

\textbf{References}


