

Silicone implant arthroplasty in Kienböck's disease

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Fifty-five patients with malacia of the carpal lunate treated by Swanson's silicone implant arthroplasty were reexamined. The follow-up period averaged 3 years. The operation had a favorable effect on pain, but the range of motion and the grip strength remained impaired. Arthrosis progressed in half the cases, and there were five dislocations of the implant and 11 cases of cystic changes of carpal bone.

In Kienböck's disease, Swanson (1970) introduced replacement of the lunate bone by a silicone rubber implant. Roca et al. (1976), Lichtman et al. (1977), Bertini et al. (1982), and Ramakrishna et al. (1982) have reported acceptable results in 59 cases treated by this technique. We report our experience in 55 patients with advanced malacia of the lunate treated by replacement with a Swanson implant.

Materials and methods

During the period from 1971 to 1982, 59 patients with necrosis of the lunate bone were treated by silicone replacement arthroplasty at our hospital. Fifty-five patients (41 males, 14 females) were re-examined 3 (0.5-11) years after the operation. Their mean age was 36 (21-66) years at the time of surgery. The right wrist was affected in 30 and the left wrist in 25 cases. The interval between the onset of symptoms and the replacement was, on an average, 3 years. Twenty-two patients reported a relevant injury of the wrist, usually hyperextension. Four patients were suspected of having a fracture of the lunate. Forty-nine patients had a strenuous job, in 35 instances demanding hewing

Table 1. The length of the ulna in relation to the radius in 55 patients with Kienböck's disease

Zero		14
Minus (mm)		37
1	15	
2	11	
3	10	
5	1	
Plus		4

or twisting. Preoperatively, 30 patients had been on a sick leave for an average of 6 months.

A microsurgical revascularization of the lunate had been attempted without success in 3 patients; and 2 patients had had an excision of the lunate. In 4 patients an arthrodesis of the other wrist had been performed because of the same disease. Only these 4 patients had a bilateral involvement.

Totally, 37/55 wrist joints showed ulna-minus and 4/55 ulna-plus variance (Table 1). Preoperatively, the radiographs of 27 patients showed mild or moderate degenerative changes in the intercarpal or radiocarpal joints. According to the classification of Lichtman et al. (1977), there were 1 case in Stage 1, 6 in Stage 2, 38 in Stage 3, and 7 cases in Stage 4, and in 3 cases adequate preoperative radiographs were not available at follow-up. Preoperatively, all the patients complained of disabling pain and weakness of the wrist, and the wrist motion was diminished.

Surgical technique. Through a transverse dorsal skin incision, the lunate was removed with rongeurs. Detachment of the volar capsule from the lunate was done with great care, avoiding damage

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to the capsule. In many cases small chips of the volar cortex were left attached to the capsule. The silicone peg extending from the implant was inserted into a drill hole in the triquetrum bone. After wound closure the wrist was supported in a splint for 6 weeks.

The follow-up examination took five parameters into account: pain, range of motion of the wrist, grip power, radiographic evaluation, and the patient's subjective evaluation of the result. Because the procedure was performed mainly for relief of pain, the presence or absence of pain was considered most important in assessing the result.

Results

One patient developed a deep-wound infection, which was treated with simple surgical drainage without removing the implant. The late result was poor. Five implants were dislocated, in 4 cases in a volar direction. Three implants had to be removed. Twelve implants were slightly volarly or dorsally subluxated (Figure 1).

The final result was subjectively rated as excellent or good by 24 patients, as fair by 28, and as poor by 3 patients. Following surgery, 28 patients continued in their previous occupation, while 22 took a less strenuous job (Table 2). The average length of the sick leave following the operation was 4 months.

Less pain at rest was experienced by 53/55 patients and 50/55 had less pain on exertion than preoperatively. Twenty patients were completely free of pain at rest (Table 3).

No patient regained normal wrist motion. The average restriction in extension compared with the uninvolved wrist was 19 degrees, in flexion 23 degrees, in radial deviation 12 degrees, and in ulnar deviation 14 degrees (Table 4), i.e., that motion was restricted by one third of normal.

The average postoperative strength of the power grip was 265 newtons in the operated hand and 382 newtons in the contralateral hand; that of the key pinch was 89 newtons and 103 newtons, respectively.

Signs of slight radiocarpal or intercarpal arthrosis were observed in 42 patients (Table 5). Severe arthrotic changes did not occur. Thirty-four patients had carpal collapse, with the ratio of the carpal height to the length of the third metacarpal

Table 2. Type of work preoperatively and at follow-up in 55 patients

	Preoperatively	At follow-up		
		Same	Lighter	Retired ^a
Heavy	26	11	11	4
Moderate	23	12	11	0
Light	6	5	0	1

a Three patients retired for some other reason than their wrist problem.

Table 3. Pain at the follow-up examination compared to preoperative status in 55 patients

	At rest	On exertion
	Worse	2
Less	33	44
Free of pain	20	6

Table 4. Mean range of movements of the wrist (degrees) in 55 patients

	Preoperatively	At follow-up	Contralateral
	Extension	34	40
Flexion	36	40	63
Radial deviation	12	16	28
Ulnar deviation	20	23	37

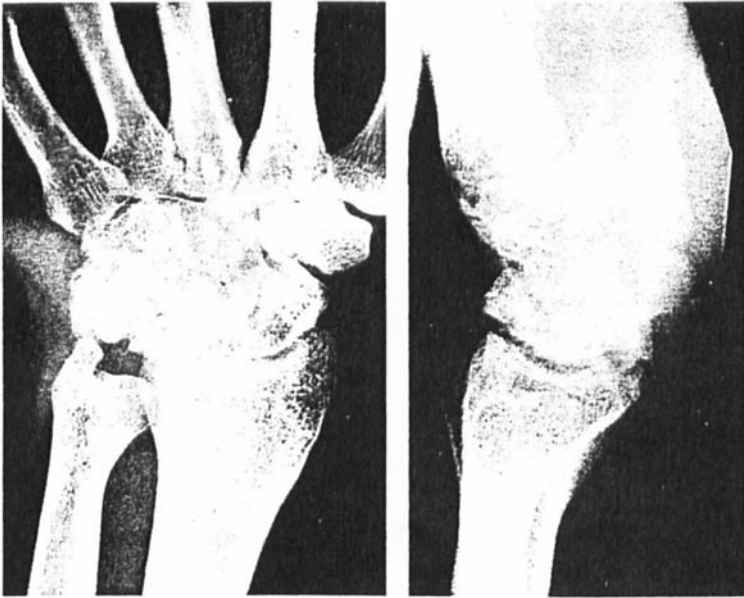
Table 5. Radiographic findings of the wrist at follow-up in 54 patients^a

	No.	Mild	Moderate	Severe
	Arthrotic changes			
Radiocarpal	32	19	3	0
Intercarpal	14	20	20	0
Cystic changes	43	6	2	3
Subluxation of the implant				12

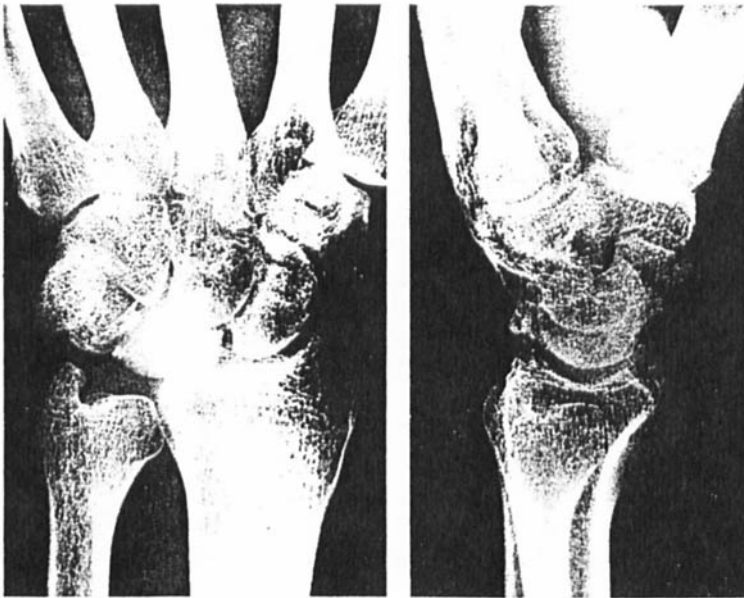
a One patient was excluded because of pregnancy.

averaging 0.46 (0.24–0.50), the normal ratio being 0.51 or more (Stark et al. 1981).

Intraosseous cysts in the carpal bones were noted in 11 cases. The cyst size ranged from 2 to 22 millimeters and were mostly located in the capitate and hamate bones. The mean follow-up time of these patients was 3 (1–9) years. In the most advanced bilateral case, arthrodesis of the wrist, due to pain, swelling, and limitation of movement, was performed. Histologic and elemental analysis revealed foreign-body reaction in the cysts and synovium. The size of the implant was slightly reduced, and silicone was detected in the cysts by electron-probe microanalysis (Telaranta et al. 1983).



A



B

Figure 1. Malacia of the lunate bone of an 18-year-old man.
A. Preoperative. Ulna-minus variance is 3 mm.
B. Two years after silicone implant arthroplasty. The implant is slightly volarly subluxated. The patient has no symptoms.

Discussion

Kienböck (1910) concluded that an injury, possibly a perilunar subluxation of the wrist, interferes with the circulation of the lunate with subsequent necrosis of the bone and secondary fractures and compression. Occasional bilateral cases and the frequent absence of significant trauma raise objections to this theory (Marek 1957). Many authors disregard trauma in the etiology of malacia of the lunate (Hultén 1928, Persson 1950, Antuna-Zapico 1981). A step formation at the distal radioulnar joint in connection with ulna-minus variance may be an etiologic factor of malacia of the lunate (Müller 1920, Hultén 1928, Persson 1950, Marek 1957, Nahigian et al. 1970).

In our study, 22/55 patients reported a substantial injury of the wrist. We consider it possible that in many cases a hyperextension injury played some etiologic role. The work of about two thirds of our patients was strenuous. Totally, 37/55 patients showed an ulna-minus variance; however, it was less than 3 mm in 26 cases.

Many methods of treatment have been advocated in Kienböck's disease. Good results have been reported by excising the lunate (Dornan 1949, Marek 1957, Einola et al. 1979, Gillespie 1961), but this treatment has also been criticized (Ståhl 1947, Therkelsen & Andersen 1949, Persson 1950). A dorsal flap (Nahigian et al. 1970) or tendon interposition arthroplasty (Ueba et al. 1972, Ishiguro et al. 1978, Hastings et al. 1983) has tended to diminish carpal collapse. Danis (1951), Agerholm & Goodfellow (1963), Renard et al (1970), Aderhold & Aderhold (1972), and Barber & Goodfellow (1974) used an acrylic prosthesis. Previously, Lippman & McDermott (1949) used a vitallium device in 1 case. Lengthening of the ulna or shortening of the radius have been advocated by many authors (Armistead et al. 1982, Eiken & Niechajev 1980, Narakas & Neff 1970, Persson 1950, Tajima & Kutsumi 1981).

It has been suggested that the lunate should be retained as long as it has not collapsed, fragmented, or become badly misshapen (Ståhl 1947).

We use this policy and perform radial shortening in Stage 1 and 2 if there is ulna-minus variance. Armistead et al. (1982) considered implant arthroplasty to be definitely indicated only if the distal articular surface of the lunate is fragmented, if an extra-articular procedure has failed, or if there are contraindications to niveau operations.

On the contrary, Lichtman et al. (1977) emphasized silicone implant arthroplasty in the early stages of the disease. The technical details of arthroplasty are important: too large a prosthesis will be forced out of position by pressure from the capitate; too small an implant may slip out of position; careful preservation of the volar wrist ligaments and tight closure of the dorsal capsule are necessary. Occasional dislocation of the prosthesis, as well as the inevitable dissociation of the proximal carpal bones that follows implantation of the prosthesis, tempered the early enthusiasm for silicone replacement arthroplasty. In 4/55 of our patients, we had a volar dislocation because of poor preservation of the volar ligaments in the early period of the series. Confirming previous reports, the result in our series was favorable with respect to pain. The result did not correlate with radiographic changes of the wrist, although advanced arthrosis was associated with symptoms. The alloplasty yielded good results even when the lunate was severely collapsed. Almost all the patients returned to their previous or to a somewhat less strenuous occupation.

Wear of the implants was observed in some cases, but the exact size of the implant is difficult to evaluate radiographically. Migration of silicone particles and formation of foreign-body cysts are, furthermore, unsolved problems. According to Swanson (personal communication 1985), the risk factors in cystic formation are the oversize and malposition of the implant, carpal instability, and excessive motion and daily activity of the wrist. In some instances an association between the cysts and silicone particles has been demonstrated (Telaranta et al. 1983, Ekfors et al. 1984). Long-term follow-up investigations are necessary to elucidate this problem.

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