Proximal row carpectomy—an adequate procedure in carpal collapse

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Abstract Proximal row carpectomy (PRC) is an established procedure in the treatment of advanced radiocarpal arthritis. The aim of this study was to evaluate the individual, functional and radiological results in relation to the initial diagnosis. Seventeen patients (15 men, two women), who had undergone PRC, were evaluated. Their average age at the time of the operation was 48 years (range 21–70 years). The most frequent diagnosis leading to PRC was scaphoid non-union advanced collapse (SNAC), which was observed in nine patients, while in three cases each the condition treated had been scapholunate advanced collapse (SLAC) and perilunate dislocation, and in two cases, Kienboeck's disease. At the time of the follow-up examination (median 65.41 months), a significant improvement in the range of movement was seen. While only four (36%) of the patients with SNAC had radiological signs of arthrosis of the radiocapitate joint, visible radiological involvement was noted in all patients who underwent PRC due to scapholunate dissociation and perilunate dislocation. The results of this study show that PRC is a good way of achieving long-term improvement of the degree of subjective freedom from symptoms and of the functional range of movement. Interruption of ligamentous structures, as in scapholunate dissociation and perilunate dislocation, seems to influence the radiological outcome.

Résumé La résection de première rangée du carpe (RPR) est une technique établie dans le traitement de l'arthrose radio-carpienne avancée. Le but de la présente étude est d'évaluer les résultats fonctionnels et radiologiques en fonction de l'état initial. Dix-sept patients (15 hommes et deux femmes) qui ont été traités par RPR ont été évalués. L'âge moyen au moment de la chirurgie était de 48 ans (de 21 à 70 ans). Le diagnostic le plus fréquent conduisant à une RPR était l'arthrose avancée sur pseudarthrose du scaphoïde (SNAC) pour neuf patients, sur instabilité scapholunaire (SLAC) pour trois patients, sur séquelle de luxation périlunaire pour trois patients et dans deux cas maladie de Kienboeck. Au moment de la révision (moyenne 65,41 mois), il y avait une amélioration significative de l'amplitude et seulement quatre des patients opérés pour SNAC avaient des signes d'arthrose radio capitale, des modifications radiologiques étaient notées chez tous les patients opérés de RPR pour instabilité scapholunaire et luxation périlunaire. Les résultats de cette étude montre que la RPR est un bon moyen d'améliorer, à long terme, les symptômes subjectifs et les amplitudes de mouvement. Les lésions ligamentaires comme dans l'instabilité scapholunaire et les luxations périlunaires semblent influencer l'évolution radiologique.

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Introduction

The proximal row carpus, as a mechanical unit, has a significant role in the transmission of force in the hand. As a sort of link between the radius and the ulnocarpal complex and the distal row carpus, it is necessary for it to adjust to the movements of the hand. If there is a break in its bony or ligamentous structure, carpal instability can result [12].

There are various injuries leading to interruptions of the stable structure. In addition to non-union following fractures of the scaphoid bone and scapholunate dissociation, necrosis and luxation of the lunate bone can also be associated with pronounced arthrosis of the wrist. The pathological changes arising from each of these conditions progress in stages [11, 19], and their treatment must be tailored to the severity of the arthrosis [16].

While there is some point to reconstruction procedures on the lunate or scaphoid bones or on the scapholunate ligament in the early stages, later on such procedures do not seem to promise any great hope of success [11]. In the presence of advanced arthritis, the only operations that can still be done are salvage procedures [10, 11].

Several treatment options are available in these circumstances, the selection depending on the pathogenesis and the severity of the arthrosis. In addition to various partial medio-carpal arthrodesis, proximal row carpectomy is a generally accepted technique used for the treatment of carpal collapse in the presence of advanced degenerative arthrosis [5, 9, 14].

The scope of this retrospective study was to evaluate the individual long-term functional/clinical and radiological results of this procedure in relation to the initial diagnosis leading to PRC.

Materials and methods

All patients who underwent proximal row carpectomy (PRC) in our department from 1991 to 1999 were originally enrolled in the study. Of the total of 23 patients treated by this technique during the period specified, six who had congenital multiple arthrogryposis or infantile cerebral palsy (ICP) were excluded, as they were not comparable or evaluable, so that altogether 17 patients (100%) were eligible to be followed up for the study, two of whom were women and the remaining 15, men. Their average age at the time of the operation was 48 years (range 21–70 years. The time since operation was between 34 and 141 months (median 65.41 months). The most frequent diagnosis that had led to the decision that PRC was indicated was scaphoid non-union advanced collapse Grade II (SNAC), which was observed in nine patients, while the condition treated had been scapholunate dissociation Grade II (SLAC) and perilunate dislocation in three cases each, and Kienboeck's disease in two cases (Table 1).

In 11 cases (65%), the operation was performed on the dominant side. In all patients a dorsal approach by way of the third or fourth extensor tendon was used with a tourniquet on the upper arm. The extensor retinaculum was split longitudinally and the joint capsule opened, after which the capitate bone and the lunate fossa were inspected. We were looking for intact and unaltered

cartilage, without which PRC cannot be considered to be indicated. After removal of the pathologically altered proximal row, followed by radiological monitoring with image intensification, we placed a purse string suture to close the joint capsule and also closed the extensor retinaculum. All patients had the treated forearm immobilised in a plaster cast for 4 weeks after surgery, followed by physiotherapy for an average of 2 months. In none of our patients was resection of the styloid process of the radius performed in association with the operation described above.

In addition to a standardised clinical examination to determine the active range of motion, the grip strength on both the affected and the contralateral side was ascertained by means of a Jamar dynamometer. Patients' subjective assessment of how successful the operation had been and their level of satisfaction with the result of the operation as experienced in daily life were documented by the patients themselves with the aid of a questionnaire, with four possible answers to choose from for each question (very well satisfied, improved, satisfied, not satisfied).

The DASH (disabilities of the arm, shoulder and hand) questionnaire [8] and a modified Mayo Wrist Score [3] were used for evaluation of the quality of life and of the pooled results. The radiological results at the time of the follow-up examination were compared with the preoperative X-rays. Standard anteroposterior and lateral exposures were prepared for this purpose. Wilcoxon's signed ranks test for dependent spot tests was used for the statistical analysis, as was a regressions analysis. Differences were regarded as significant at $P < 0.05$. The study was approved by the appropriate ethics committee and has therefore been performed in accordance with the ethical standards laid down in the 1975 Declaration of Helsinki. All persons gave their informed consent prior their inclusion in the study.

Results

Complications

Complications, such as impaired wound healing, infections or sensitive restrictions, arose neither in the perioperative nor in the postoperative course. In one patient, radiocapitate arthrosis made a complete wrist arthrodesis necessary 59 months after PRC. The results recorded in this patient were not included in the evaluation of the clinical and functional investigation.

Clinical examination

At the time of the follow-up examination, wrist movement was found to be significantly improved in all planes, with the

Table 1 Data of patients [SLAC scapholunate advanced collapse, SNAC scaphoid non-union advanced collapse, KD Kienboeck's disease, PL perilunate dislocation, AROM active range of motion (degrees), ex/flex extension/flexion, rad/uln radial adduction/ulnar adduction, Arthritis radiological alteration in the radiocapital joint, M male, F female, R right, L left, Y yes, N no]

Patient no.	Age	Sex	Diagnosis	Dominant side	Operated side	Date of operation	Dash Score	Mayo Wrist Score	Jamar operated wrist ^a	Jamar contralateral wrist ^a	AROM ex/flex preoperative	AROM ex/flex postoperative	AROM rad/uln preoperative	AROM rad/uln postoperative	Arthritis
1.	66	F	KD	R	R	15.06.96	20.7	75	11.9	17.4	60	50	40	40	Y
2.	24	M	SNAC	R	L	09.03.98	5.2	90	28.1	37.9	75	100	30	40	N
3.	56	M	SNAC	L	L	03.07.98	61.2	55	23.7	29.1	70	65	30	30	N
4.	52	F	KD	R	R	28.04.99	50.0	95	4.3	3.5	0	110	0	50	N
5.	31	M	SNAC	R	R	12.07.96	40.7	90	32.5	35.6	45	90	25	40	N
6.	50	M	SNAC	R	R	16.04.96	16.4	75	27.0	29.4	50	80	20	35	N
7.	46	M	PL	R	R	22.12.99	17.2	80	16.3	29.9	0	45	0	30	Y
8.	46	M	PL	R	L	03.12.99	14.2	80	16.0	31.0	95	60	50	30	Y
9. ^b	48	M	SNAC	R	R	16.06.97	19.0	50	18.6	26.0	0	0	0	0	Y
10.	60	M	SNAC	R	R	19.12.94	16.4	95	23.1	54.0	40	65	20	25	Y
11.	60	M	SLAC	R	L	190.8.99	20.7	80	16.6	23.8	45	90	15	45	Y
12.	70	M	SLAC	R	R	09.05.97	33.9	65	12.3	18.4	45	45	15	25	Y
13.	31	M	SLAC	R	R	01.10.94	20.7	70	27.9	40.1	45	80	15	20	Y
14.	41	M	SNAC	R	L	07.05.98	60.3	75	18.0	23.2	15	130	5	50	Y
15.	21	M	SNAC	L	R	26.01.96	43.0	70	31.4	36.8	110	110	40	35	N
16.	47	M	SNAC	R	L	12.11.98	22.4	70	18.1	29.8	75	80	40	55	N
17.	57	M	PL	R	L	25.01.91	8.9	85	15.4	30.5	0	40	0	15	N

^a Mean of ten repetitions with Jamar dynamometer (kg)^b Patient received total arthrodesis of the wrist

exception of radial adduction (Table 2). The grip strength reached 72% of the contralateral side (20 vs 28 kg).

Pain/function

Of the 16 PRC-treated patients left in the trial at the time of the follow-up examination, five were completely free of all symptoms, ten reported pain on heavy physical stress, and one patient complained of symptoms during everyday activities; none reported pain at rest. In terms of the subjective result, six patients were very well satisfied, nine were satisfied and one was not satisfied with the outcome of the operation. Almost all patients were able to go back to their former occupation after the operation; only one patient, a bricklayer, was forced to change his job because of the nature of the work. When the DASH questionnaire was evaluated, the resulting score was 27.7 (± 17.3) points, while the average Mayo Wrist Score was 74.4 (± 10.7) points.

Radiological results

In all patients who underwent PRC due to scapholunate dissociation or perilunate dislocation, arthrosis of the radiocapitate articulation was demonstrable on X-ray examination. There was no correlation, however, between the presence or severity of the radiocapitate arthrosis and any of the other points investigated AROM, pain, etc.).

Discussion

There are various possible causes of degenerative arthritis of the radiocarpal joint. For example, non-union of scaphoid fractures and scapholunate dissociation are associated with marked arthrosis of the wrist, as also are necrosis and luxation of the lunate bone. Other treatment options besides PRC and various partial arthrosis techniques are total arthrodesis of the wrist and joint plasties [13]. Selection of the most suitable surgical technique depends on the one hand on the objective findings, and on the other on the ideas and personal requirements of the patients. Arthro-

plasty is still not a safe alternative, and because of this and also because of the revision rate associated with the operation, it can only be regarded as a second-line therapy [1, 4]. Total wrist arthrodesis also does not always seem to be a good policy. Nagy and Bchler [13] have shown in a comparable patient population that both PRC and partial mediocarpal arthrodesis seem to be superior to total arthrodesis. While the residual pain level was virtually identical after all three procedures, the movement-conserving operations yield better clinical and functional results and also involve fewer complications. PRC has proved to have an extremely low postoperative complication rate, as confirmed both by studies in the literature [5, 9, 14] and by our study. In PRC, we have a procedure that not only has few complications and is technically simple to perform but also improves the symptoms and achieves mobility of the wrist. As in the study of carpectomy published by Imbriglia et al. [9], our study also had a positive influence on the range of movement except for the radial deviation, with good evolution of strength. The observation of a persisting restriction of the radial mobility has been reported in other studies [2, 17]. One explanation for this might be that the radial adduction takes place mainly between the proximal and distal rows, while ulnar deviation is initiated both intercarpally and radiocarpally [21]. Various authors therefore recommend that styloidectomy be combined with PRC to avoid radial impingement. However, this combined procedure also does not seem to yield any improvement in mobility, since, as shown by Imbriglia et al. [9] by three-dimensional computed tomogram reconstruction, the trapezium is sited palmar to the tip of the radial styloid. In our opinion, therefore, in removal of the styloid process is generally not indicated. In addition, potential harm to the radiocapital ligament can be avoided allowing better stabilisation of the capitate bone in the lunate fossa, thus preventing ulnar translocation [7].

Besides clinically objective parameters, the patient's subjective evaluation is of importance for the assessment of an operative procedure. Various authors have shown that 80% of patients report attenuation of their symptoms and a good level of satisfaction after PRC [6, 18].

Table 2 Mobility of the wrist, measured before surgery and at the time of the follow-up (AROM active range of movement, ND no data ascertained)

	Extension ^a	Flexion ^a	AROM ^a (sagittal plane)	Ulnar adduction ^a	Radial adduction ^a	AROM ^a (Frontal plane)	Grip strength ^b
Preoperative	20.00 $\pm$ 12.6	31.47 $\pm$ 17.4	51.47 $\pm$ 26.6	15.59 $\pm$ 9.7	8.53 $\pm$ 5.6	24.12 $\pm$ 12.6	ND
Postoperative	35.00 $\pm$ 11.6	41.76 $\pm$ 16.5	76.76 $\pm$ 25.9	23.53 $\pm$ 8.9	10.88 $\pm$ 7.9	34.41 $\pm$ 11.6	72.65 $\pm$ 13.19
Significance (<i>P</i> value)	0.004*	0.035*	0.009*	0.005*	0.277	0.020*	

*Significant, Wilcoxon signed ranks test

^a Mean $\pm$ SD (degrees)

^b Mean $\pm$ SD (percentage of contralateral, untreated side) measured by Jamar dynamometer

In our patient population, the proportion who were satisfied was similar. The personal evaluation of the severity of pain and of the result by the patients are also influenced by other factors, so that a purely subjective evaluation does not allow any unequivocal statement about the quality of life. The questionnaires administered in the course of the study for evaluation of the results confirm this suspicion and show that the well-being and even the postoperative quality of life after PRC are not at all inferior to that after partial wrist arthrodesis. Partial arthrodesis gave rather poorer results, with a DASH score of 39 [16]. Most authors recommend carpectomy only for patients who have no advanced degenerative involvement of the proximal capitate bone or of the lunate fossa [6, 20]. However, with this proviso, it seems that when the cartilage is initially intact radiological changes in the newly developed radio-capitate joint have little influence on the functional result or the symptoms [14, 18].

To our knowledge, this is the first series that has showed a certain relationship between the diagnosis and the presence of arthrosis in the radiocapitate joint. We assume that trauma with initially damaged ligament structures is associated with worse radiological results. This is maybe due to a reduced intrinsic and extrinsic stabilisation. But in the light of the small number of patients enrolled in our study, this can just be seen as a trend without statistical relevance.

Despite a high proportion of radiological changes between radius and capitate, we like other authors were unable to find any correlation between arthrosis and the functional parameters measured or the preoperative diagnosis [2, 15].

We are of the opinion that PRC is a reliable and low-risk procedure for the treatment of arthrosis of the wrist. In addition to a number of other operative procedures, it is a possible way of achieving good functional results and a subjectively satisfactory outcome in the long-term.

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