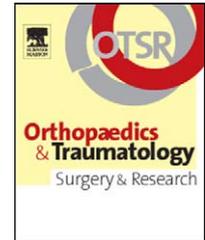




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WORKSHOPS OF THE SOO (2010, LA ROCHELLE). SYMPOSIUM: THE ARTHRITIC WRIST

The arthritic wrist. I - The degenerative wrist: Surgical treatment approaches

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Summary The primary goal in treating a degenerative wrist is to provide pain relief, while maintaining strength and mobility if possible. After failure of the recommended conservative treatment, the choice of approaches can be made from a large collection of techniques, some which are well validated. Partial wrist fusion, particularly the Watson procedure, results in a pain-free wrist in 80% of cases, with 50% of the mobility preserved, good grasping strength and stable results for at least 10 years. Proximal row carpectomy provides similar results if the cartilage on the head of the capitate is preserved and the patient is not involved in heavy manual labour. Complete denervation provides pain relief in almost 80% of cases while preserving motion and strength. This is a safe and effective option, with no age limit, that still allows other procedures to be performed in the future. Total wrist fusion also has its place in revision, and even as first-line treatment, because of the reliable outcome in terms of pain and strength, high satisfaction rates, little to no repercussions linked to the loss of mobility and fewer complications. Other techniques are now available. The partial or complete resection of a carpal bone and placement of an implant is back in vogue because of the availability of pyro-carbon. Such implants are an option in the future for localized osteoarthritis or even diffuse affections, and a useful alternative to more invasive procedures. The use of a rib cartilage graft

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to partially or completely replace a carpal bone or resurface the radius has promising results in terms of pain reduction and fusion. The role of total joint replacement must be defined relative to the classic, reliable techniques that have long-term outcome data.

Level of proof: IV.

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Introduction

No matter the aetiology of the degenerative wrist, pain is the primary reason for consultation and it is usually accompanied by reduced strength and mobility. The aetiology is predominantly post-traumatic, with sequelae from radius and scaphoid fractures (SNAC wrist), ligaments injuries (SLAC wrist) and perilunate carpal dislocations being most common. Other causes include metabolic diseases (chondrocalcinosis, hemochromatosis, gout, etc.), sequelae of inflammatory diseases and lunate osteonecrosis. Certain localized forms such as scapho-trapezio-trapezoidal (STT) or pisiform-triquetrum (PT) osteoarthritis deserve special attention.

Because the techniques, aetiology and treatment indications are heterogeneous, we did not feel it was appropriate to base this round table on a multi-centre, retrospective series of degenerative wrists. Instead, each participant discussed the technique they had experience with and reported the results.

Specific problems related to the distal radio-ulnar joint were not included.

Goals of the surgery

The primary treatment goal is to provide pain relief, while maintaining strength and mobility if possible. Many options exist to achieve this goal, ranging from conservative treatment with pain-reducing braces to total wrist fusion. Biomechanical studies have shown that procedures at the joint considerably alter load transmission and intracarpal kinematics. Thus after surgery, strength and motion will never be as they were before the surgery.

But how much range of motion is really needed? Nelson [1] showed that almost all tasks can be performed, no matter the amount of limitation. According to other authors, 5° [2] to 54° [3] of flexion and 30° [2] to 60° [3] of extension are required to perform a given task. Adams [4] showed that the perception of a restriction had a greater impact on performance than the loss itself; he also found no significant differences between a partial and total limitation. Preserving range of motion ‘‘at any price’’ is thus not a high priority objective.

Assessment of the degenerative wrist

Since the surgeon has multiple techniques at his/her disposal, the onus is to do find a compromise that will be the best choice given the circumstances, as it is impossible to offer a wrist that is simultaneously pain-free, strong and mobile. To help guide the decision, simple clinical and para-clinical tests are available. With a painful wrist that may be stiff or swollen, standard AP and lateral radiographs, and often a CT scan, are used to determine the location and

severity of joint injuries and evaluate the effects on joint space and carpal stability in the remainder of the wrist.

Accepted methods

Initial treatment with pain-relieving drugs, a brace and occasionally joint injections are always appropriate. The response or lack thereof to conservative treatment will guide the subsequent steps, particularly the choice between different surgical methods.

Partial wrist fusion

The underlying principle is to fuse the degenerated joint spaces or stabilize the wrist after excision of a carpal bone. Although a loss of motion is foreseeable with each type of fusion [5,6], functional studies have placed the amount of dysfunction due to reduced mobility into perspective. However partial wrist fusion can increase the load on the other joint spaces [7], which could lead to degeneration later on.

Partial wrist fusion can be grouped by the level in question: between the radius and first row (radioscapholunate and radiolunate fusion), within the first row (scapholunate, lunate-triquetrum), midcarpal (scapho-trapezio-trapezoidal, scaphocapitate, scapholunate-capitate, capitulate, four-corner, triquetrum-hamate or capitate-hamate) or carpometacarpal.

Among all of the partial wrist fusion options, the Watson procedure has been studied more in depth by Yann Saint-Cast (*non-published data: report of ongoing work*). Based on the observation that the radiolunate joint space remains intact in even the most severe SNAC and SLAC wrists, Watson combined scaphoid excision with a ‘‘stabilizing’’ fusion of the remainder of the wrist by fusing the four internal bones (lunate, capitate, triquetrum, hamate). Careful bone freshening and reduction of the proximal row onto the distal row must be performed before the stabilization procedure, which uses multiple K-wires instead of dedicated materials (staples, plates and screws).

A series of 68 cases that were operated on between 1989 and 1997, with 43 cases available for follow-up, was reported on by Yann Saint-Cast and Michel Le Bourg. Ninety-five percent of patients were satisfied or very satisfied. All the patients would have the procedure done again. Eighty-eight percent had good results in terms of pain relief. The range of motion was reduced by half in comparison to a normal wrist, but was relatively unchanged over time. Strength was at least 80% of the opposite side (72% of cases).

Fusion occurred in all the cases with a capitulate angle of -3° , without a significant decrease in carpal height. There was a strong statistical correlation between effective correction of the misalignment of the proximal row and clinical outcome. Over the long term, the radiolunate compartment showed signs of stress: subchondral sclerosis of the radius across the lunate, deepening of the lunate fossa and/or radi-

lunate narrowing in 14 cases (32.5%), and lunate collapse. In 10 cases (23%), ulnar-carpal impingement occurred, which was correlated with radiocarpal narrowing and the distal radio-ulnar index.

What can we expect from a Watson procedure? A pain-free, mobile wrist with good grasping strength, clinical results that are stable after more than 10 years as long as the proximal carpal row was reduced. These ideal results take into account a well-developed technique that was done at a single centre. We cannot ignore that the literature is not as optimistic: after Watson's study, a failure rate of up to 28% was reported and 36% had to be converted into total fusion, which leads to fewer good results after a failed Watson procedure [8].

Proximal row carpectomy (PRC)

This technique is performed by resecting the three bones in the proximal row except for the pisiform, which places the entire load on the capitate/hamate pair under the radius. Tang et al. [9] have shown that PRC increases the load by 3.8 times and induces translation of the capitate, which now acts as the lunate bone. Radial deviation is limited by impingement between the trapezoid and radial styloid process [10]. What can we expect from a PRC? In a single-centre series of 35 cases that had an average of 92 months follow up presented by Julien Richou [11], the average flexion/extension arc was 75°, the radial/ulnar deviation was 40°, strength was 77% of the contralateral side, pain on the VAS scale was 1.75, the satisfaction rate was 90% and the average DASH score was 32. The results were not affected by the initial diagnosis, although Kienböck's disease drags down these results in the literature. However, inflammatory arthritis and heavy manual labour are not good indications.

A procedure that is simple in principle and progression, it requires only a short immobilization period, and can easily be converted to a total wrist fusion following a failure. The drawback however is a loss of carpal height. The contact between the capitate and radius results in remodelling that manifests itself as geodes, subchondral sclerosis, narrowing of the joint space. As such, PRC can only be suggested if the head of the capitate and the lunate surface of the radius are intact.

The long-term outcome is not well known. With a follow-up of more than 9–10 years, there is no correlation between clinical and radiological findings, and the results seem stable over time [12–14].

In summary, PRC results in a functional wrist within six months that is compatible with social and professional activities, as long as the cartilage on the head of the capitate is preserved and the patient does not perform heavy manual labour.

Is a Watson procedure preferable for the same indications (SNAC or SLAC I and II)? Although the load is 25% more and the contact area 60% less in the PRC than the Watson procedure [9], studies comparing both techniques have not found one to be better than the other in terms of overall results [15–22].

Complete denervation

Although this procedure only aims to eliminate pain, its use in treating the degenerative wrist is growing. Not only does it lead to pain relief in almost 80% of cases, but mobility and strength are also maintained.

Seventy-one cases in 70 patients were compiled in contributing two centres (Guillaume Bacle and Erwann Simon). The average age at review was 64 years, with an average follow-up of 73 months. There were 33 fracture sequelae (19 radius, nine scaphoid, five fracture and/or dislocation of the carpus), 25 scapholunate misalignment sequelae, seven wrists with inflammation, and six with Kienböck's disease. In almost all the cases, denervation was suggested as an isolated, first-line treatment to treat pain emanating from the radius and/or intracarpal region.

A failure, which was defined disabling, recurrent or persistent symptoms, occurred in 9 cases (13%) and required another intervention (with seven cases occurring before 2 years). This second intervention was a joint fusion in seven cases (two partial and five total), PRC in one case and neurolysis of the radial nerve in one case, with an average revision time of 31 months.

The result in terms of pain relief was good, scoring 2.3 on the VAS; there was no pain at rest in 60 cases (84.5%); pain with exertion occurred in 51 cases (72%); eight patients, all of whom performed heavy manual labour, had to change to a new job. Denervation was called a "procedure to recommend" by 80% of the patients. The average DASH score was 27.3 (range 11 to 60).

Complete denervation [23] is preferred to partial denervation in terms of efficacy and maintains or even improves range of motion [24,25]. There was no effect of aetiology or age on the results [26]. The results were maintained after one year of follow-up.

This is a safe and fairly effective option that preserves mobility, has no age limit and still allows other techniques to be performed in the future. But the risk of painful complications still exists. In the series, four cases of radial hypoesthesia/dysesthesia occurred but resolved, and there was one case of radial neuroma.

Total joint fusion

Pain relief comes at the price of mobility with this procedure. Generally suggested after the failure of one or more of the other procedures, results have improved with the use of compression plates [27] and preshaped dedicated plates.

Current total joint fusion series, despite numerous second-line procedures, found a fusion rate of 98 to 100% [27], predictable results in terms of pain relief and strength [28], a satisfaction rate of 80 to 100% [29], patients who would have liked to have had this procedure done sooner [30], few to no repercussions related to the loss of mobility and significantly fewer complications over time.

Two homogenous populations of 23 partial and 26 total wrist fusion cases (19 primary and seven secondary—after failure of partial fusion) were compared by Jacky Laulan [31]. The worst results occurred in the group who had a total joint fusion after a failed partial fusion: the VAS was 5.6 and strength was 60%. Primary total joint fusion cases were

identical to partial fusion cases in terms of pain relief and satisfaction, however strength and function were better in the former. Thus the results of total wrist fusion are weighed down by the revision of partial fusion cases. Primary total fusion produces good results with strength at 80% and no pain in 79% of cases.

In a second study of 30 total wrist fusion cases using dedicated plates, the compromised mobility was not seen as a disadvantage and repercussions related to the loss of mobility were absent or minimal in two-thirds of patients [32]. In terms of potential complications, the distal radioulnar joint must be evaluated for arthritis before the procedure and treated simultaneously [15,27,28].

In a third study reporting on 15 cases of total joint fusion for stage IIIB or IV Kienböck's disease, the fusion rate was 100%, with 14 patients satisfied or very satisfied, an average VAS of 2/10, average strength of 82%, and no real hindrance related to the lack of mobility. Thirteen of the 15 patients returned to the same job.

In all, total joint fusion provides a high rate of satisfaction and effective pain relief in most of the patients [29]. There was little to no functional disability and good adaptation [32,33]. The pain relief parameter was more important than the range of motion parameter [19,34]. The success rate is higher if the procedure is proposed early on, as the results are more predictable. Total joint fusion cannot completely rescue the early failure of a palliative procedure [35]. If the wrist injury (and/or context) has a poor prognosis and the functional requirements are high, total joint fusion provides a reliable outcome [28] and very often allows the patient to return to the same job.

Innovative techniques

Resection with implant interposition

The partial resection of a carpal bone and placement of an implant, such as a movable and free spacer, is not a new approach. But the availability of new materials has brought this technique back to the forefront, as the goal is to maintain the overall mechanics of the wrist joint. A new line of pyrocarbon implants consisting of a graphite nucleus and thin layer of pyrolytic carbon was introduced in the 2000s. These polished implants glide easily, which makes them very resistant to wear.

A summary of Philippe Bellemère's experience in different situations is provided here: APSI implant for necrosis of the proximal pole after scaphoid fracture, with or without SNAC I or even II osteoarthritis [36]; RCPI implant to resurface the capitate after PRC when the cartilage on the head of the capitate is involved; midcarpal implant in a case of arthritis with necrosis of the head of the capitate as an alternative to partial capitulunate fusion; radiocarpal and midcarpal implants in wrists with multiple injuries where fusion is not desired.

Such implants are an option in the future for localized osteoarthritis or even diffuse affections, a useful alternative to more invasive procedures and a fallback solution in case of failure of other procedures (partial or total joint fusion, etc.). However, this research approach must be validated with larger series and longer follow-up.

Rib cartilage grafting

Rib cartilage grafting an interesting choice for the partial or total replacement of a carpal bone or resurfacing of the radius. Laurent Obert reported on work done at the Besançon centre in three main indications: peri-scaphoid arthritis with resection of the proximal scaphoid and rib osteocartilage autograft [37], sequelae of radius fractures with radiocarpal osteoarthritis [38] and Kienböck's disease. The results are promising in terms of pain reduction and fusion.

Role of prostheses

With the mobility outcome not being an end in itself, is it justified to propose a total joint replacement to an active patient who performs manual labour, or after failure of other techniques? Recourse to total joint replacement should be done carefully because of the significant joint loads during activities of daily living (>200N) [39]. A series of 10 cases reported by Laurent Obert (Dijon, Besançon; *non-published data: report of ongoing work*) had the following average results after a 4 month follow-up: flexion: 30°, extension: 35.5°, radial deviation: 18°, ulnar deviation: 19°, grasping strength: 21.6. The role of total joint replacement must be defined relative to classic, reliable techniques that have long-term outcome data.

Localized forms

Scapho-trapezio-trapezoidal (STT) osteoarthritis

The possibility of STT arthritis should be considered when a patient presents with FCR tendinitis, synovial cyst of the pulse groove, or pain that is proximal to the trapezoid-metacarpal area and mostly anterior. Often bilateral and tolerated for a long time, STT arthritis affects as many women as men. Structures around the STT such as the trapezoid-metacarpal area and the carpal bones (radioscaphoid narrowing and/or destabilization of the carpus?) should also be investigated. This form of osteoarthritis often occurs in the context of chondrocalcinosis.

Surgical treatment consists of resecting the distal scaphoid, with or without interposition (tendon, pyrocarbon) and can be done by arthroscopy. This trend toward resection-interposition avoids problems related to STT fusion; the other option requires a graft, makes fusion challenging and overloads the radioscaphoid compartment.

Pisiform-triquetrum osteoarthritis

Often missed, this possibility should be considered when a patient presents with pain anterior and medial to the heel of the hand or more generally with *chronic pain on the ulnar side of the wrist*. This condition can have a primary (middle-aged patients, no trauma, often bilateral, arthritic background) or secondary (microtrauma or trauma to the pisiform and/or triquetrum, pisiform instability) origin [40,41]. The examination seeks to identify pain upon tapping and movement of the pisiform (grinding test). FUC

tendinitis, synovial cysts and ulnar dysesthesia can occur concurrently. The diagnosis is made based on lateral radiographs with the forearm supinated 20–30°, an axial view of the carpal tunnel or preferably a CT scan and can be confirmed with X-ray guided injection. Treatment involves excision of the pisiform.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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