SCIENTIFIC ARTICLE

Pyrolytic Carbon Hemiarthroplasty in the Management of Proximal Interphalangeal Joint Arthritis

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Purpose To review clinical, subjective, and radiographic results of pyrocarbon hemiarthroplasty for proximal interphalangeal (PIP) joint arthritis.

Methods A total of 42 fingers in 38 patients underwent PIP joint hemiarthroplasty between 2005 and 2011. Preoperative diagnoses included 28 with osteoarthritis or posttraumatic arthritis and 10 with inflammatory arthritis. Average age at the time of surgery was 56 years. Digits treated included: index (10), middle (20), ring (9), and little (3). Average follow-up was 4.6 years (minimum, 2 y).

Results There was considerable improvement in patient satisfaction measures including Canadian Occupational Performance Measure for both performance and satisfaction and Disabilities of the Arm, Shoulder, and Hand and visual analog scale pain scores. There was no significant change in motion or grip and pinch strength after surgery. Four joints were revised for failure: 3 underwent arthrodesis and 1 was converted to a silicone PIP joint arthroplasty. Radiographic outcomes in surviving implants demonstrated a Sweets and Stern grade 0 in 37 implants and grade 3 in 1.

Conclusions Pyrocarbon hemiarthroplasty appears to be a viable alternative to total joint arthroplasty in the treatment of PIP joint arthritis. Clinical and patient satisfaction outcomes compared favorably with published outcomes of arthroplasty. Radiographic outcomes of PIP joint hemiarthroplasty were encouraging with respect to implant position and loosening. Compared with total joint arthroplasty, proximal hemiarthroplasty is a simple procedure that preserves more bone stock and would allow for better success of salvage options such as arthrodesis and revision arthroplasty. *(J Hand Surg Am. 2015;40(3):462–468. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Hemiarthroplasty, proximal interphalangeal joint, pyrocarbon.

PROXIMAL INTERPHALANGEAL (PIP) joint arthritis can be painful and result in deformity, diminished function, and loss of motion. Nonsurgical management includes the placement of orthosis, activity modification, topical and oral anti-inflammatory medications, and corticosteroid injections. Typical indications for surgery include failure and/or exhaustion of nonsurgical treatments. Surgical options include arthrodesis and arthroplasty.[1,2] Although arthrodesis predictably provides pain relief and is durable, it sacrifices motion.

Arthroplasty remains a desirable surgical option in the management of PIP joint arthritis. It affords pain relief and preserves PIP joint motion. Some reports have noted an incidence of substantial reoperation and the need for revision arthroplasty or arthrodesis.[3–8] Primary material options include silicone and metal–plastic or pyrocarbon designs.

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Pyrolytic carbon has been used over the past 10 to 15 years as an alternative to metal−plastic designs. Multiple authors have reported encouraging early and midterm outcomes with pyrocarbon implants for the PIP joint.[9−15] However, others have noted high rates of radiographic and clinical complications.[5−8] Because the implant does not undergo osseous integration, loosening remains a concern.[16,17]

Problems such as implant loosening or subsidence, joint instability, and premature failure can occur with total joint arthroplasty. In addition, distal component insertion can be challenging based on the architecture of the base of the middle phalanx. Therefore, the notion of a proximal hemiarthroplasty has been proposed in the treatment of PIP joint arthritis. Pyrocarbon may have advantages over metal and silicone. First, it is considered inert, which minimizes any immune mediated response.[18] In addition, its articular surface has excellent wear characteristics.[19] Finally, its elastic modulus is similar to cortical bone, so it is an excellent load-sharing implant.[20] Compared with cobalt chrome and titanium, it articulates favorably with bone and cartilage and generates markedly less cartilage wear.[19] This has been applied in the surgical management of Kienböck disease, scaphoid nonunion, and basal thumb arthritis.[21−24] The purpose of this article was to examine the outcomes of proximal hemiarthroplasty of the PIP joint using a pyrolytic carbon implant. The use of this hemiarthroplasty is considered off-label use by the Food and Drug Administration.

MATERIALS AND METHODS

Institutional review board approval was obtained at both of the authors' institutions for the collection and analysis of data. Between 2005 and 2011, 42 fingers were treated in 38 patients. All but 8 had complete up-to-date radiographic, clinical, and subjective data; the 8 with some data lacking were missing some single points of data such as preoperative distal interphalangeal joint flexion, distal interphalangeal joint extension, and 1-year postoperative pinch or grip strength measurement. These were compensated for statistically by not including their data in a specific analysis and assessing the most recent data set. In addition to clinical information, pain (visual analog score) and subjective Disabilities of Arm, Shoulder, and Hand (DASH) and Canadian Occupational Performance Measure (COPM) scores were obtained preoperatively. Whereas DASH scores are familiar outcome measures to most readers, the COPM represents an alternative occupational score that includes a performance outcome and a satisfaction measure. It includes multiple questions assessing activities of daily living and has been validated for use in both English and Swedish.[25,26] The questions are geared to assess areas of self-care, productivity, and leisure. Patients score their performance in identified problems and their satisfaction with that performance. The range of scores are from 1 to 10, with 1 being unable to do the particular task and 10 being optimal performance with the task in question or being extremely satisfied with the specific task.

Diagnoses included osteoarthritis and posttraumatic arthritis, with good coronal plane alignment and competent collateral ligaments, in 28 patients and inflammatory arthritis in 10. There were 31 women and 7 men. Average age at surgery was 56 years (range, 40−84 y). The dominant hand was treated in 25 cases. Fingers treated included: index (10), middle (20), ring (9), and little (3). Average follow-up was 4.7 years (range, 2−8 y).

Indications for PIP joint pyrolytic carbon hemiarthroplasty included angular malalignment in the coronal plane of no more than 20°, symmetric alignment of the base of the middle phalanx (ie, the base of the middle phalanx should be perpendicular to the axis of the phalanx), intact collateral ligaments, and sufficient bone stock and quality of the distal aspect of the proximal phalanx. The decision to proceed with hemiarthroplasty was based on the status of the joint and more specifically on the status of the base of the middle phalanx, primarily with respect to its architecture and symmetry. In distinction from total joint arthroplasty, one of the more important limitations of hemiarthroplasty resided in the inability to correct deformity contributed to by irregularity or asymmetric wear at the base of the middle phalanx. In addition, patients with less cartilage loss and smoother articular surface of the base of the middle phalanx would be candidates for hemiarthroplasty over total arthroplasty. Precise indications for the use of hemiarthroplasty continue to evolve based on these findings. In addition to structural concerns, general alignment of the finger and integrity of the supporting soft tissues need to be considered. Although intraoperative alternatives are discussed preoperatively with all patients, we have not had to change our plan from hemiarthroplasty to total arthroplasty based on intraoperative findings.

Surgical technique was similar for virtually all cases and was similar to previously described PIP joint surgical approaches.[27] A dorsal central tendon-splitting approach was used with care taken to protect its insertion. The PIP joint was exposed and inspected, and a preliminary assessment of the collateral ligaments