PIPR™
Proximal Interphalangeal Replacement

Clinical Data Summary

Natural Function
Treatments for end-stage PIP joint arthritis

Treatments for proximal interphalangeal (PIP) joint arthritis include arthrodesis and arthroplasty. While arthrodesis can work well, many patients prefer the retention of some movement to none at all; when there is concomitant disease of neighbouring joints, PIP fusion can result in increased stiffness of the whole finger and consequently reduced function [1-2]. The alternative, PIP arthroplasty, has been in use since the 1960s. However, early and current designs, including silicone single-piece and surface replacement devices, have been prone to high rates of complications including implant fracture [3,4], loosening and migration [4,5,6,7,8], failure to relieve pain [4,5], and failure to maintain or improve function and range of motion (ROM) [3,4,5,7,8,9].

Principles of the PIPR™

The goal of PIP arthroplasty is to restore a pain free, stable and strong grip with an acceptable ROM. Successful outcomes can be achieved with a well-fixed arthroplasty, accurately placed within the joint and with soft tissues intact. The device itself should provide an accurate match for the shape and size of the native joint. Its articulation should be based on a thorough understanding of the natural function of the PIP joint and work with the soft tissue envelope to achieve the greatest degree of stability and mobility possible for a given patient.

The PIPR™ was developed between 2002 and 2006 and is the result of in-depth study of the anatomy, soft tissues and biomechanics of the PIP joint [1] and novel research into its bony morphology [10]. The PIPR™ features an anatomical bearing design, provided in proportions and a size range appropriate for all PIP joints of the hand and for the entire population. The patented design includes an exterior profile that minimises bone resection, uniquely preserving functioning collateral ligaments, and is provided with advanced instrumentation to ensure fit and assist ligament balancing for optimum function. The conforming bearing maintains lateral and dorsal-palmar stability throughout the unrestricted flexion. It also permits the physiological rotation associated with the torsion of the head of the proximal phalanx during flexion-extension [10]. With proven materials and press-fit cementless fixation, the device features all elements essential for implant longevity and is supported by a well-designed, accurate and repeatable surgical technique.

Clinical experience

The PIPR™ was first used in January 2006 at the Wrightington Hospital, UK, and to date more than 700 have been implanted worldwide. The PIPR™ has been demonstrated to improve pain, function and range of movement.

Throughout an extended series followed up at the Wrightington, good outcomes have been maintained [11,12,13,14]. The series now includes data for 100 PIPR™ devices implanted in 50 patients that were available for review at mean 47 months (range 24-77) [13,14]. Seventy-five percent of patients were female. Seventy-four percent were treated for osteoarthritis, 23% for rheumatoid arthritis and 3% for psoriatic arthritis.

Functional outcomes

Of the patients who had fully completed the pain scores (48 of 50 patients), 86% were completely free of pain at rest; the remainder noted a significant reduction in pain. Of the implants with complete pre- and postoperative data on ROM (61 of 100 implants), 72% had a preoperative ROM of greater than 20° and had a statistically significant improvement in ROM postoperatively. There was a significant improvement in grip strength for all patients with data on grip strength (52 of 56 hands). There was also a significant improvement in all scores for patients with complete pre- and postoperative outcome scores (66 of 100 implants). When considering each whole hand, there was a significant improvement in both Michigan Hand Outcomes Questionnaire (MHIQ) and the Patient Evaluation Measure (PEM) scores.

Survivorship

From the same series of 100 PIPR™ implants, Kaplan-Meier survivorship at 6 years 5 months is 85%, with no difference in survival between osteoarthritis and rheumatoid arthritis subgroups. Reasons for revision included stiffness (5 implants), ulnar deviation (4 implants), swan neck deformity (3 implants) and one component dissociation very early in the series. Likelihood of recurrence of component dissociation has since been resolved with the implant now supplied factory assembled. There were no cases of infection. No implant had progressive loosening and none had lost their initial position at latest follow-up. Removal of the PIPR™ when required enabled successful conversion to silastic joint, arthrodesis or another PIPR™.
Summary

The PIPR™ has been in use since 2006 with over 700 implanted worldwide.

In a published series of 100 implants followed up for a minimum of 2 years, maximum 6 years 5 months \[13,14\], the PIPR™ was shown to achieve:

- good pain relief,
- improvement in grip strength and function,
- for many, improvement in ROM, and
- survivorship of 85% at maximum 6 years 5 months postoperatively.
1. Morphological measurements of the proximal interphalangeal joint

The morphology of the proximal interphalangeal joint was determined using a photographic technique. The head of the proximal phalanx, viewed end on, has a complex trapezoid appearance characteristic for each named digit. The asymmetric condyles diverge from one another and are separated by an intercondylar groove that increases in depth from the dorsal to the palmar surface. Sagittal sections of the head of the proximal phalanx are not circular, but, sections taken in the plane of maximum dimensions of the condyle are circular with a radius of curvature of approximately one half of the height of the condyles. The articular surface of the base of the middle phalanx is not circular in outline in either the sagittal or coronal plane. In coronal sections the articular surface is biconcave convex with a prominent median ridge separating the two adjacent concave articular surfaces. The implications of this varied morphology on implant design are discussed.

2. MatOrtho Proximal Interphalangeal Joint Arthroplasty: Minimum Two-Year Follow-up

Introduction: The MatOrtho proximal interphalangeal replacement (PIPR) is a cementless cobalt-chromium metal-on-polyethylene mobile bearing surface replacement arthroplasty. It permits preservation of the collateral ligament attachments so that joint stability is not compromised. The aim of this study is to report the outcome and complications from the MatOrtho PIPR at a minimum of 2 years of follow-up from a single centre.

Materials and Methods: A retrospective case review was performed on all MatOrtho PIP joint replacements performed with a minimum of 2-year follow-up. Patient demographics, diagnosis, implant revision and other surgeries were recorded. Subjective and objective outcomes were evaluated at latest follow-up including pain scores, range of motion and radiographic assessment.

Results: 109 implants were inserted in 56 patients. Nine implants (6 patients) were lost to follow-up. Of the remaining 100 implants 75 were female, the average age at time of surgery was 64 years and the principal diagnosis was osteoarthritis in 77% of joints. The average follow-up was 46 months. The revision rate was 12%. The reasons for revision were soft tissue failure in 6 patients, stiffness in 5 patients and implant failure in 1 patient. Eight joints were revised to the NeuFlex (silicone rubber) prosthesis, 3 were converted to an arthrodesis and 1 had exchange of the MatOrtho prosthesis. Twenty-four joints (24%) required soft tissue release. There was no infection. There was a significant improvement in pain scores, with 62 out of 72 joints being pain free at rest. There was an improvement in functional scores post operatively but no improvement in range of motion. Nine percent showed some radiological periprosthetic lucency but no clinical loosening was observed.

Conclusion: The survival of the MatOrtho PIP joint arthroplasty was 88% at a minimum of 2 years follow-up. Patients can be advised that the procedure achieves good pain relief, improvement in functional scores but does not improve range of motion.
References
