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A Review of the Early Outcomes of Arthroplasty of the First Carpometacarpal Joint using Pyro Carbon Spherical Implants

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Abstract

The most frequent hand joint to develop osteoarthritis is the first Carpo Meta Carpal joint (CMC). Many hand surgeons have reconsidered implant arthroplasty since it protects key structures, according to a survey. However, no implant with the ideal design and material composition exists at this time. The current study was the first to employ pyro carbon spherical implants for arthroplasty of the first CMC in patients with Eaton-Littler stage II and III osteoarthritis and to evaluate early results. From May 2010 to April 2013, a single surgeon used pyro carbon spherical implants to conduct 24 arthroplasties (23 patients (20 women, three males) with a mean age of 56 years (range 46 years to 75 years) of the first CMC (9 right hands and 15 left hands). All of the patients were unable to respond to conservative treatment. The mean Kapandji score was 8.8 of 10 (range 7 to 10) at 1.8 months postoperatively (range 4.3 months to 38.9 months), and the average pre- while postoperative visual pain scale values were 8.9 of 10 (range 8 to 10) and 1.13 of 10 (range 0 to 4), respectively. With a mean satisfaction score of 4.760.44 out 5.00, all patients were either very satisfied (scoring=5) or satisfied (score=4) with the procedure (range 4 to 5). The mean DASH (Disabilities of the Arm, Shoulder, and Hand) score after surgery was 11.2 (range 0 to 49.17). All implants were found to be stable, with no erosion of surrounding canceller's bone, according to the most recent radiographic assessments. No implant subluxations, dislocations, or revisions were found. Early findings are encouraging, indicating that this implant could be used for arthroplasty in the future. Longer-term follow-up, however, will be required to confirm these findings.

Keywords: Arthroplasty; Carpometacarpal osteoarthritis; Pyrocarbon; Spherical implant

Introduction

The thumb is considered the most essential finger of the hand, accounting for half of its workload. It allows the hand to perform the grasp and pinch functions that are required for daily activities [1]. As a result, Osteo Arthritis (OA) of the first Carpo Meta Carpal joint (CMC) is the most frequent hand joint [2]. OA of the first CMC can cause considerable pain, limited range of motion, and weakening of the thumb's function and strength [3]. Nonsurgical alternatives include activity limitation, no steroidal anti-inflammatory drugs, and corticosteroid injections as first-line treatment. If these conservative treatments fail, surgical intervention may be required.

Arthrodesis, trapeziectomy with or without Ligament Restoration and TendonIinterposition (LRTI), and silicone and ceramic implants are all common surgical techniques. Trapeziectomy with LRTI is the most preferred choice among hand surgeons, according to a survey; nonetheless, many have recently reconsidered implant arthro plasty [4]. However, no implant with a perfect design and material has yet been documented in the literature. It must be properly stable when implanted, give an adequate functional range of motion, equally distribute load over the joint, and be biocompatible and durable to be regarded an excellent implant [5]. The majority of existing implants in the literature do not meet these requirements. The pyro carbon (pyrolytic carbon) spherical implant, on the other hand, meets these characteristics as an ideal arthroplasty implant.

This implant's spherical shape gives it a distinct advantage over other implant designs. Two bone concavities are formed after implantation to cradle two-thirds of the implant, boosting its stability. To better mimic the thumb's vast range of motion, the concavities are also ball-in-socket joint articulations [6]. Compared to other implant materials, pyrocarbon has the most similar elastic modulus to cortical bone, which helps to improve biological fixation by mitigating the stress exerted by the implant at the prosthetic-bone articulation. This inhibits cancellous bone deterioration, which is a problem with many other implant materials. The biocompatibility of the pyrocarbon material has led to its usage in a variety of prostheses, including heart valves.

The pyrocarbon spherical implant is the implant of choice for arthroplasty of the first CMC in patients with Eaton-Littler stage II and III OA, in our perspective, because to its unique form and substance. To our knowledge, this is the first study to use and analyze the early results of the pyrocarbon spherical implant for CMC arthroplasty.

Pyrocarbon Spherical Implant

All of the patients had failed conservative treatment, which included activity limitation, no steroidal anti-inflammatory drugs, and at least two corticosteroid injections. A positive grind test, chronic soreness in the first CMC region, dorsal-radial prominence (subluxation) of the base of the first metacarpal bone, restricted range of motion, and pinch strength were all included in the study [7]. Patients with rheumatoid arthritis, osteoporosis, scaphotrapezial arthritis, or displacement at the base of the first metacarpal bone were all excluded. Patients may have benefited more from other arthroplasty procedures with these problems, according to the senior author, albeit this was not confirmed. Although one patient received arthroplasty utilizing the authors' procedure, he was not included in the analysis because he had several upper limb nerve compressions.

Patients thumb function and mobility was measured clinically at their most recent follow-up appointment, and a Kapandji score was calculated to quantify thumb opposition. After that, a questionnaire packet was distributed. Pre and postoperatively, the package included

a visual pain scale (0=no pain to 10=worst possible pain), a five-point likert scale for satisfaction (1=very dissatisfied, 2=dissatisfied, 3=neutral, 4=satisfied, 5=very satisfied), and the DASH questionnaire (Disabilities of the arm, shoulder, and hand). A simple radiograph was also taken and analyzed. For all quantitative data, the mean, range, and SD were determined [8].

Surgical Technique

The procedure was conducted under general anesthesia with a tourniquet by a single surgeon. The patients requested that three cases be done under intravenous regional anesthetic (Bier block). At the time of anesthetic induction, all patients received an intravenous prophylactic antibiotic. A longitudinal incision was made from the radial styloid process to 1.5 cm distal to the base of the metacarpal bone, covering the extensor pollicis brevis and abductor pollicis longus tendons. Throughout the surgery, the superficial radial nerve branches were identified and safeguarded. A fascia was opened between the extensor pollicis brevis and the abductor pollicis longus. The radial artery's deep branch was found, released, and protected by a vascular loop. To expose the joint, the capsular periosteal flaps were raised [9]. Using 2 mm of the first metacarpal base and the distal surface of the trapezium were removed with a sagittal saw, resulting in a 4 mm gap. Because it allowed for greater sight of the trapezium for resection, the metacarpal base was removed first, followed by the distal trapezium. The flexor carpi radialis tendon was carefully preserved as it passed through the trapezium's groove. Around the joint, a Rongeur bone cutter was utilised to remove thicker soft tissues and osteophytes.

The implant size was then put flat against the trapezium's distal surface, and the correct implant size was chosen from the five options. When two implant sizes were available, the smaller one was chosen. A spherical bur was then used on the two resected surfaces to create a cup in the centre, which was subsequently polished with the suitable broach (raspatory). When the implants were [10] put perpendicular to the cups, the cups were prepared so that a cortical rim of bone was preserved and one-third of the implant size could fit inside each cup. Two-thirds of the implant was cradled by the cups, one-third by the trapezium, and one-third by the metacarpal bone. The implant can then be inserted into position by using an implant retriever and/or finger pressure.

With the thumb abducted at the CMC and flexed at the metatarsophalangeal joint, the capsule was closed with 2.0 permanent sutures (undyed TiCron, Covidien, USA). 4.0 dissolvable sutures were used to close the subcutaneous tissue and skin. To keep the thumb abducted and the metacarpophalangeal joint flexible, a dorsal plaster splint was used. The procedure was then followed by a radiographic assessment in the operating room.

The patient was placed in a cast one week after surgery, with the interphalangeal joint free for five weeks. As a precaution, the patient was referred to a hand therapist after week 6 and told to avoid hard pinching and extreme opposition (opposing the thumb to the base of the fifth digit) for another four weeks. All other movements were permitted on a case-by-case basis.

Conclusion

The spherical-shaped pyro carbon implant is the implant of choice for conducting arthroplasty of the first CMC in patients with Eaton-Littler stage II and III OA due to its biocompatibility and the extensive range of motion of the first CMC. Early results are encouraging and support the use of this implant in arthroplasty. Longer-term follow-up, however, will be required to confirm these findings.

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