Pyrolytic Carbon Arthroplasty versus Suspensionplasty for Trapezial-Metacarpal Arthritis

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Abstract

Purpose This study aims to compare outcomes after pyrolytic carbon implant hemiarthroplasty (PH) versus Thompson suspensionplasty (TS) for trapezial-metacarpal (TM) arthritis.

Patients and Methods There were 87 arthritic TM joints in 71 patients treated with PH ($n = 47$ joints, 37 patients) or TS ($n = 40$ joints, 34 patients). Patients had significantly longer follow-up in the TS group (86.9 months, 25th–75th percentile = 55.6–103.8) versus the PH group (38.4 months, 25th–75th percentile = 23.2–65.8, $p < 0.001$).

Results PH patients maintained higher final grip strength ($p = 0.03$) and apposition pinch strength ($p = 0.01$) compared with TS patients. Nelson scores were significantly higher among patients undergoing PH (mean = 50.4, standard deviation [SD] = 24.5) compared with TS (mean = 36.8, SD = 12.5, $p < 0.01$). There was a significantly higher proportion of complications ($p < 0.01$), reoperations ($p < 0.01$), and joint revision surgery ($p < 0.01$) in patients undergoing PH compared with TS. Controlling for age and sex, there was a 72.8% lower risk of complications ($p = 0.02$), 87.7% lower risk of reoperations ($p = 0.01$), and 87.2% lower risk of joint revision surgery ($p < 0.01$) among patients undergoing TS compared with PH. There was a shorter time to first complication ($p < 0.01$), reoperation ($p < 0.02$), and joint revision ($p < 0.01$) in those undergoing PH compared with TS.

Conclusion Both cohorts exhibited functional range of motion and pinch and grip strengths postoperatively, and those undergoing PH began with and maintained higher grip and pinch strength at final follow-up. Those undergoing PH had significantly increased risk of complications, reoperations, and joint revision surgery. Most complications in patients undergoing PH were related to suspected development of scapho-trapezotrapezoidal (STT) arthritis postoperatively. We thus recommend careful evaluation of possible STT arthritis when considering PH arthroplasty.

Level of Evidence Level III.

Keywords

- basal joint arthritis
- trapezial-metacarpal arthritis
- pyrolytic carbon
- Thompson suspensionplasty

Numerous surgical treatments for symptomatic trapezial-metacarpal (TM) arthritis of the thumb exist, including trapeziectomy alone,^{1–3} trapeziectomy and ligament reconstruction with or without tendon interposition,^{1,4–8} TM arthrodesis,^{3,9} arthro-

scopic resection,^{10–14} metacarpal extension osteotomy,^{15–18} and implant arthroplasty.^{19–27} While to date no surgical procedure has proven superior,^{28–32} advocates of prosthetic arthroplasty cite the potential to preserve joint biomechanics, avoid

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metacarpal subsidence, and provide immediate stability postoperatively.^{20,24,26,33}

Martinez de Aragon et al reported early results of a first-generation pyrolytic carbon hemiarthroplasty prosthesis (Pyro-HemiSphere, Integra Life Sciences, Plainsboro, NJ), a partial trapezial resurfacing implant with a press fit metacarpal stem and a proximal spherical base that articulates with a subchondral bony socket in the trapezium.¹⁹ The authors evaluated 54 TM joints in 49 patients treated with pyrocarbon hemiarthroplasty (PH) in patients with osteoarthritis, rheumatoid or other inflammatory arthritis, with an average follow-up of 1.8 years. While the overall survival rate was 80%, 15 reoperations occurred due to dislocation and/or persistent pain. Satisfaction was high at 81, and 83% of patients were either pain-free or reported only mild-to-occasional pain with repetitive activities. Grip strength recovered to 86%, key pinch to 92%, and opposition pinch to 95% of the contralateral side.

In contrast to prosthetic arthroplasty, different methods of trapeziectomy with or without ligament reconstruction and soft tissue interposition are considered more traditional treatments for TM arthritis. Thompson described using the abductor pollicis longus (APL) to create a stabilizing intermetacarpal ligament and interposition arthroplasty, which is now referred to as “Thompson suspensionplasty” (TS).^{34–36} Purported benefits of using APL for suspensionplasty include decreased weakness in wrist flexion and torsion compared with ligament reconstruction using flexor carpi radialis and conversion of the APL tendon from a destabilizing force to a stabilizing force.^{37,38} Several authors have reported modifications of TS with successful outcomes.^{39–43}

The purpose of this study was to compare the outcomes of these two treatments for TM arthritis with regard to the range of motion (ROM), grip and pinch strength, patient-based outcomes, radiographic outcomes, and risk of complication and revision surgeries.

Patients and Methods

Patient Study Group

After institutional review board approval, a retrospective review was conducted of all patients treated by one of the authors (S.L.M.) with one of two techniques—either PH or TS—for the treatment of symptomatic TM arthritis of the thumb. With regards to PH, two different implants made by the same manufacturer (Integra Life Sciences) were used in the study period. The first generation implant—the PyroHemiSphere (PHS) prosthesis—was initially designed for use in the metacarpophalangeal (MCP) joint and represents the proximal component of this implant (→Fig. 1). The second generation implant—the NuGrip (NG) prosthesis—was specifically designed for use in the TM joint with design modifications including a collar, different implant morphology, and more size options (→Fig. 2). All patients had a minimum of 1-year overall follow-up from the initial surgery.

Evaluation and Documentation

Clinical endpoints included active radial and palmar abduction measured with a goniometer, grip strength measured

Fig. 1 The PyroHemiSphere (Integra Life Sciences, Plainsboro, NJ) implant, adapted for use in the trapezium-metacarpal joint.

with a Jamar dynamometer and opposition and apposition pinch measured with a pinch dynamometer. Apposition (lateral key) pinch is defined as pinch between the thumb and lateral side of the index finger. Opposition (terminal oppositional) pinch is defined as pinch between the tip of the thumb opposed with the tip of the index finger. We recorded the mean of three attempts for each of these parameters.

An independent survey center administered questionnaires, including a visual analog scale (VAS) for pain, a patient satisfaction with surgery, the Disabilities of the Arm, Hand, and Shoulder (DASH) and the Nelson score questionnaire. The VAS pain score was a 0 to 10 scale (with 0 representing no pain and 10 representing very severe pain) by which patients were asked to rate the severity of their postoperative pain on the day of questionnaire administration. The satisfaction score was a single question asking patients to rate their satisfaction or dissatisfaction with their surgery on a scale of 1 to 6 (with 1 representing very satisfied to 6 representing very dissatisfied). The DASH score is an established global upper-extremity-specific disability instrument used to assess various disorders of the upper extremity with scores ranging from 0 to 100, with 0 representing no disability to 100 representing maximum disability^{44,45}; the DASH has been validated for use specifically in basal joint arthritis and found to have acceptable sensitivity and correlate

Fig. 2 The NuGrip (Integra Life Sciences, Plainsboro, NJ) implant, a second generation design for use specifically in the trapezium-metacarpal joint.

with both patient satisfaction and VAS scores for pain, function, and dexterity for patients with this condition.⁴⁶ The Nelson score questionnaire is a validated disease-specific patient-based questionnaire to assess the outcome specifically of surgery for basal joint arthritis with scores ranging from 0 to 100 (with 0 representing the poorest result and 100 representing the best possible result).⁴⁷ This 10-question measure has been shown to be more sensitive than other upper extremity outcomes instruments in the setting of basal joint arthritis and is shorter to complete.

Metacarpal subsidence was radiographically measured for both PH and TS groups and was assessed by measuring the trapezium space relative to the length of the first metacarpal to standardize for X-ray magnification as previously described.⁴⁸ Further radiographic evaluation in the PH group included evaluation of subluxation or dislocation of the implant at every time point in the study period and the presence of stem osteolysis. Osteolysis was considered present when there was periprosthetic lucency > 0.5 mm surrounding the prosthesis as ≤ 0.5 mm is considered normal.¹⁹

Complications and reoperations (including joint revision) were recorded for each case. Complications were classified as minor (not requiring surgery) or major (requiring surgery). Patients were considered to have developed scaphotrapezotrapezoidal (STT) arthritis if they have both radiographic evidence of arthritis via radiograph or computed tomography

(CT) scan and tenderness to palpation at the STT joint. Radiographic abnormalities such as dislocation, prosthetic stem osteolysis, or subsidence were not considered clinical complications in asymptomatic patients not requiring an intervention such as pain medications, injections, or surgery.

Surgical Techniques

The surgical approach for PH has been detailed elsewhere,²⁰ but to summarize a radially based longitudinal approach over the first dorsal compartment is utilized. The STT joint is inspected, and PH is abandoned if it is deranged. After preparing the metacarpal and using an 8 or 10 mm burr to create a socket centrally in the subchondral bone of the trapezium, a trial implant is placed in the metacarpal, and stability is assessed through a ROM. Adjustments in the depth of trapezium socket, the metacarpal base cut or trial implant size are made as necessary. The final implant is gently impacted into the metacarpal base, and a capsular closure performed with the thumb in radial abduction. A short-arm thumb spica splint was applied to maintain the TM joint in abduction and the MCP joint in flexion. Rehabilitation is initiated following 2 to 4 weeks of immobilization.

With regards to TS, the author utilized a modified technique based on Thompson's original description.³⁴⁻³⁶ Briefly, through the same radial incision used for PH arthroplasty, the trapezium was removed in its entirety. A slip of APL is isolated and released at its musculotendinous junction through a separate incision. The slip is passed from a proximal to a distal direction toward the base of the first metacarpal. A bone tunnel is drilled from the dorsum of the first metacarpal base to the center of the metacarpal articular surface and the APL is passed through this tunnel. A 2 to 3 cm incision is then made dorsally over the base of the second metacarpal and a second bone tunnel is drilled obliquely through the base of the second metacarpal angled palmarly and radially toward the base of the first metacarpal. The APL slip is passed from the base of the first metacarpal through the base of the second metacarpal within the second bone tunnel. The APL slip is tensioned and secured to the extensor carpi radialis longus tendon suspending the first metacarpal base. Postoperatively patients are casted for 4 to 6 weeks in a thumb spica and then placed into a removable splint for an additional 4 weeks. Rehabilitation is initiated under the supervision of a hand therapist at 6 to 8 weeks postoperatively.

Statistical Analysis

Separate median follow-up times were calculated for most recent clinical, radiographic, and questionnaire follow-up times. The overall follow-up was considered the time from initial surgery to most recent follow-up of any of these parameters. Within the treatment group, assessments of changes in ROM, grip, and pinch strengths were done using paired-sample *t*-tests. Comparisons of variables between treatment groups were made using independent-sample *t*-tests or chi-square (Pearson or Fisher exact tests) as appropriate. For the comparison of VAS pain scores and satisfaction scores Mann-Whitney tests were used as these two questionnaires are ordinal scales. Survival estimates for time to

Table 1 Baseline preoperative patient demographic and clinical variables by surgical procedure

Variable		PH (<i>n</i> = 47) ^a	TS (<i>n</i> = 40) ^a	<i>p</i> Value ^b
Age at surgery (y)		52.3 (11.3)	61.3 (8.2)	0.019
Gender (% female)		31/47 (66.0)	39/40 (97.5)	< 0.001
Dominant hand affected		25/47 (53.2)	20/40 (50.0)	0.767
Type of arthritis				
Osteoarthritis		38/47 (80.9)	34/40 (85.0)	0.293
Posttraumatic		5/47 (10.6)	1/40 (2.5)	
Rheumatoid arthritis/inflammatory		4/47 (8.5)	5/40 (12.5)	
Median follow-up (mo)		38.4 (26.1)	86.9 (27.8)	< 0.001
Preoperative ROM	Radial abduction (degrees)	36.5 (10.7)	32.9 (9.9)	0.151
	Palmar abduction (degrees)	38.3 (11.3)	34.0 (6.2)	0.058
Preoperative strength	Grip (kg)	22.1 (10.6)	16.2 (11.7)	0.049
	Opposition pinch (kg)	5.1 (3.7)	2.9 (2.6)	0.014
	Apposition pinch (kg)	6.3 (4.2)	3.8 (3.0)	0.013

Abbreviations: PH, pyrolytic carbon implant hemiarthroplasty; ROM, range of motion; TS, Thompson suspensionplasty.

^aAll data reported as mean (standard deviation) or count (percentage), except for the median follow-up, which is reported as median (standard deviation).

^b*p* Values represent independent samples *t*-test or chi-square test comparing PH versus TS groups.

first complication, reoperation, and revision were calculated using Kaplan–Meier survival. The association between treatment and each of these three outcomes was assessed using Cox proportional hazards regression. A 0.05 α -level was utilized to define statistical significance.

Results

Demographics

► **Table 1** summarizes baseline demographics. Within the PH group, 23 patients were treated with the PHS prosthesis versus 24 NG prostheses. Patients had an overall median follow-up time of 38.4 months (25th–75th percentile = 23.2–65.8 months) in the PH group and 86.9 months (25th–75th percentile = 55.6–103.8 months) in the TS group, which was significantly greater in

the TS group ($p < 0.001$). Both groups were similar with regard to proportion of dominant hand treated and type of arthritis, but the TH group was significantly older ($p = 0.019$), had a higher proportion of females ($p < 0.0001$), and had weaker grip ($p = 0.049$), opposition ($p = 0.014$), and apposition pinch strengths ($p = 0.013$) compared with the PH group.

Clinical Outcomes

Median clinical follow-up time, which was defined as the time when patients were physically examined in the office, was 24.2 months (25th–75th percentile = 10.3–46.1 months) in the PH group and 25.3 months (25th–75th percentile = 4.2–52.7 months) in the TH group ($p = 0.601$). ► **Table 2** summarizes preoperative and postoperative clinical values within groups. Within the PH group, there was a significant decrease in palmar

Table 2 Paired differences in pre- and postoperative values in ROM and strength within surgery groups

Variable			Preoperative ^a	Postoperative ^a	<i>p</i> Value ^b
PH (<i>n</i> = 47)	ROM	Radial abduction (degrees)	36.0 (10.2)	38.6 (10.0)	0.369
		Palmar abduction (degrees)	38.3 (11.3)	30.1 (17.4)	0.029
	Strength	Grip (kg)	23.1 (11.2)	24.4 (14.9)	0.720
		Opposition pinch (kg)	5.0 (2.5)	6.8 (9.3)	0.375
		Apposition pinch (kg)	6.6 (4.7)	8.4 (8.8)	0.358
TS (<i>n</i> = 40)	ROM	Radial abduction (degrees)	32.9 (10.2)	39.6 (9.7)	< 0.001
		Palmar abduction (degrees)	34.0 (6.2)	35.0	0.682
	Strength	Grip (kg)	14.4 (9.6)	16.9 (7.0)	0.282
		Opposition pinch (kg)	2.9 (2.6)	3.5 (3.0)	0.392
		Apposition pinch (kg)	3.8 (3.2)	4.5 (2.7)	0.339

Abbreviations: PH, pyrolytic carbon implant hemiarthroplasty; ROM, range of motion; TS, Thompson suspensionplasty.

^aData reported as mean (standard deviation).

^b*p* Values represent paired-samples *t*-test comparing PH versus TS groups.

Table 3 Postoperative clinical outcomes between surgery groups

Variable		PH (n = 47) ^a	TS (n = 40) ^a	P-value ^b
ROM	Radial abduction (degrees)	38.4 (9.8)	39.9 (9.1)	0.494
	Palmar abduction (degrees)	29.6 (17.4)	34.7 (14.4)	0.139
Strength	Grip (kg)	23.5 (14.0)	17.0 (6.7)	0.032
	Opposition pinch (kg)	6.5 (7.6)	4.0 (3.2)	0.114
	Apposition pinch (kg)	8.1 (7.6)	4.5 (2.6)	0.014
Subjective Outcomes Instruments	VAS (0–10 scale)	2.9 (2.4)	3.1 (3.0)	0.074
	Patient satisfaction (1–6 scale)	2.2 (1.9)	2.4 (2.0)	0.545
	Nelson score (0–100 scale)	50.4 (24.5)	36.8 (12.5)	0.003
	DASH score (0–100 scale)	26.7 (22.8)	24.0 (18.0)	0.606
Postoperative complication present		18/47 (38.3)	5/40 (12.5)	0.007
Minor complication		4/47 (8.5)	2/40 (5.0)	0.520
Major complication		17/47 (36.2)	4/40 (10.0)	0.004
Reoperation performed		16/47 (34.0)	4/40 (10.0)	0.008
Joint revision performed		14/47 (29.8)	3/40 (7.5)	0.009

Abbreviations: DASH, Disabilities of the Arm, Hand, and Shoulder; PH, pyrolytic carbon implant hemiarthroplasty; ROM, range of motion; TS, Thompson suspensionplasty; VAS, visual analog scale.

^aData reported as mean (standard deviation) or count (percentage).

^bp Values represent independent samples t-test comparing PH versus TS groups for ROM, strength, Nelson score, and DASH score, Mann–Whitney test comparing VAS and patient satisfaction score, and Pearson chi-square for complications, reoperations, and joint revisions.

abduction (mean change = 8.1 degrees, SD = 21.5 degrees, $p = 0.03$) and within the TS group there was a significant increase in radial abduction (mean change = 6.7 degrees, SD = 9.65 degrees, $p < 0.001$) from preoperative to final postoperative values. ► **Table 3** summarizes between group comparisons. Comparing final postoperative values, those treated with PH maintained a higher grip strength ($p = 0.032$) and apposition pinch strength ($p = 0.014$) compared with TS patients.

Subjective Outcomes Instruments

Median questionnaire follow-up time was 38.4 months (25th–75th percentile = 22.1–65.8 months) in the PH group and 86.9 months (25th–75th percentile = 55.6–103.8 months) in the TS group, which was significantly greater in the TS group ($p < 0.0001$). Questionnaires were available at final follow-up for 41 of 47 patients in the PH group (87.2% follow-up) and 29 of 40 patients in the TS group (72.5% follow-up). Assessment of potential survey response bias identified that sex, age, and surgery type (PH vs. TS) were not associated with the likelihood

of questionnaire completion. Nelson scores were significantly higher in the PH group (mean = 50.4, SD = 24.5) compared with the TS group (mean = 36.8, SD = 12.5, $p = 0.003$).

Radiographic Analysis

Median radiographic follow-up time was 24.2 months (25th–75th percentile = 9.3–40.8 months) in the PH group and 26.2 months (25th–75th percentile = 3.4–26.2 months) in the TH group. ► **Table 4** summarizes radiographic measures.

Complications and Reoperations

There was a significantly higher proportion of complications ($p = 0.007$), reoperations ($p = 0.008$), and joint revision surgery ($p = 0.009$) among patients undergoing PH compared with TS (► **Table 3**). Overall, 13 patients developed suspected symptomatic STT arthritis postoperatively, and patients in the PH group were significantly more likely to undergo reoperation for suspected STT arthritis (11/47) compared with those in the TS group (2/40, $p = 0.016$).

Table 4 Radiographic outcomes between surgery groups

Variable	PH (n = 47) ^a	TS (n = 40) ^a	p Value ^b
Subluxation	2/47 (4.3)	NA	NA
Dislocation	9/47 (19.1)	NA	NA
Stem osteolysis	15/47 (31.9)	NA	NA
Metacarpal subsidence	13.2%	12.8%	0.703

Abbreviations: NA, not applicable; PH, pyrolytic carbon implant hemiarthroplasty; ROM, range of motion; TS, Thompson suspensionplasty.

^aData reported as count (percentage) except for metacarpal subsidence where data reported as percentage change in postoperative minus preoperative trapeziometacarpal ratios as percentage.

^bp Values represent chi-square test comparing PH versus TS groups for metacarpal subsidence.

Fig. 3 Kaplan-Meier survival curve in which the first complication was considered the end point.

Overall, 11 patients developed subluxation or dislocation of the pyrocarbon prosthesis postoperatively (2 of which were asymptomatic), but patients in the PH group were not significantly more likely to undergo reoperation for postoperative instability (3/47) compared with those in the TS group (0/40). Controlling for age and sex, there was a 72.8% lower risk of complications ($p = 0.005$), 87.7% lower risk of reoperations ($p = 0.002$), and 87.2% lower risk of joint revision surgery ($p = 0.001$) for patients undergoing TS compared with PH. Kaplan-Meier analysis revealed a shorter time to first complication ($p = 0.015$), reoperation ($p = 0.011$), and joint revision ($p = 0.009$) in patients undergoing PH compared with TS (► **Figs. 3–5**). A variety of joint revision procedures were performed. Of the 11 PH revisions performed for suspected STT arthritis, 8 were performed by removing the implant and converting to TS with total trapeziectomy with or without partial proximal trapezoid resection, and 3 were performed by revising to a larger implant, proximal resection of the

trapezium and trapezoid and AlloDerm (LifeCell Corporation, San Antonio, TX) interposition in the STT joint. Of the three PH revisions performed for instability, one was performed by repositioning of the implant and stabilization of the TM joint with a capsular imbrication, and APL advancement, and two were performed with deepening of the trapezial socket, capsular imbrication, and APL advancement. In the TH group, two patients were revised for suspected STT arthritis with a partial proximal trapezoid resection and AlloDerm interposition, and one patient was revised for postoperative metacarpal subsidence and weakness to PH because she preferred the result she had with prior PH on the contralateral thumb.

Discussion

While pyrocarbon has been extensively studied in hand and wrist small joint arthroplasty,^{49–59} there has been less published data for pyrocarbon basal joint arthroplasty. Pyrolytic

Fig. 4 Kaplan-Meier survival curve in which reoperation was considered the end point.

Fig. 5 Kaplan-Meier survival curve in which joint revision was considered the end point.

carbon offers the theoretical benefit of having a modulus of elasticity similar to cortical bone, which may theoretically help prevent implant subsidence and better replicate the normal joint biomechanics. Martinez de Aragon et al reported on the early results of the first-generation pyrolytic carbon hemiarthroplasty PHS prosthesis.¹⁹ While they noted high patient satisfaction and pain relief, recovery of strength and ROM, and low rates of metacarpal subsidence or implant loosening, there were high complication and revision rates in the early-term results, due primarily to instability of the implant and persistent pain. Other pyrolytic carbon prostheses for use in the basal joint have had mixed results.^{59–63}

Since Thompson's initial description,³⁴ there have been numerous reports of successful use of TS or a modification. Soejima et al reported on a series of 21 thumbs treated with TS, and at 33 months postoperatively patients had significant pain reduction, 56 degrees of both radial and palmar abduction, and 16-kg and 4-kg of grip and pinch strength, respectively.⁴² Kochevar et al reported outcomes of 25 thumbs treated with TS with a minimum of 4-year follow-up.⁴³ High levels of satisfaction and pain relief were noted, and an average increase in grip, key pinch, and tip pinch strength of 14, 12, and 6%, respectively.

With respect to comparison analyses, a recent prospective cohort study of trapeziectomy alone versus trapeziectomy and pyrocarbon implant interposition by Colegate-Stone et al assessed outcomes in 38 consecutive patients with primary TM joint arthritis.⁶³ Patients were evaluated with the Quick Disabilities of the Arm, Shoulder, and Hand score (QuickDASH) and a VAS, and objective measures included grip strength measurements. They found no significant difference in QuickDASH and pain between groups at 6 or 12 months postoperatively but a higher complication rate in the pyrocarbon group was seen, seven of which sustained significant complications.

The current study found no differences in changes in ROM, grip strength, or pinch strength between the PH and TS groups. However, the PH group started out with higher preoperative grip

and pinch strengths, and maintained significantly higher grip strength and apposition pinch strengths compared with TS patients at final follow-up. This may be in part because the PH group was also younger and had a higher proportion of male patients. There were no significant differences in VAS pain scores, satisfaction scores, and the DASH score between surgery cohorts, but there was approximately a 14-point average higher Nelson score in patients undergoing PH compared with TS. The Nelson score is a disease-specific instrument for thumb basal joint arthritis with higher sensitivity compared with other upper extremity outcomes instruments,⁴⁷ and higher scores may indicate improved functional outcome.

Radiographically, both groups had roughly a 13% metacarpal subsidence, in line with previously published reports for TS.⁴³ This contradicts the notion that PH has less metacarpal subsidence compared with trapeziectomy and soft-tissue reconstruction. However, that since the metacarpal base is resected and trapezial space is deepened for this implant, the method of measurement of metacarpal subsidence utilized may not be the most appropriate.⁴⁸ There were several noteworthy radiographic abnormalities in the PH group, including a 19% rate of dislocation, and a 32% rate of stem osteolysis, although many of these abnormalities were clinically asymptomatic.

Significantly higher proportions of complications, reoperations, and joint revision surgery were observed in patients undergoing PH compared with TS. Controlling for age and sex, there was a 72.8% lower risk of complications, 87.7% lower risk of reoperations, and 87.2% lower risk of joint revision surgery for patients undergoing TS compared with PH. The most common complication requiring revision was development of symptomatic STT arthritis ($n = 11$ requiring revision), followed by postoperative instability ($n = 3$ requiring revision), the latter being the most common reason for failure in the previous analysis by Martinez de Aragon et al.¹⁹ Patients in the PH group were significantly more likely to undergo joint revision specifically for suspected development of STT

arthritis than those in the TS group. Given these findings, special consideration should be given when using this prosthesis to screening patients for signs of early STT arthritis with advanced imaging such as a CT scan. The risks of postoperative complications and possible eventual revision to complete trapeziectomy and/or implant revision must be discussed with patients preoperatively, although a recent study suggests that the results of salvage trapeziectomy following prosthetic arthroplasty may be equivalent to primary trapeziectomy.⁶⁴ In fact, in the present cohort of the 14 patients in the PH group undergoing joint revisions, 8 were performed by salvage to TH and 6 were performed by either resizing/repositioning the implant or deepening the trapezial socket with satisfactory final results.

The current study has several limitations, including its retrospective nature, a potential timing bias on the results as the TS group had a greater length of follow-up than the PH group, and a lack of analysis of multiple time points throughout the study period. Furthermore, the two groups were not equivalent with regard to age, gender, or preoperative grip and pinch strengths. Selection bias was present in the surgical decision to utilize TS versus PH; specifically within this series, pyrocarbon arthroplasty was reserved for younger, more active patients. Despite this difference, the study still allows for an evaluation of complication rates and functional outcomes. Additional strengths of the current study include a relatively large sample size compared with similar studies and detailed analysis of objective and subjective patient-based endpoints.

In summary, the present investigation showed that both PH and TS resulted in generally good clinical and functional outcomes, with PH having superior Nelson scores to TS and also maintaining higher grip and apposition pinch scores at final follow-up. The PH cohort also, however, had significantly higher risks of complication, reoperation, and joint revision compared with TS. While pyrolytic carbon hemiarthroplasty has generally been reserved for the younger and more active patient interested in preserving grip and pinch strength, the indications of PH should be very carefully considered on a patient-specific basis in light of the higher complication rate, and a careful assessment of the STT joint should be performed in any patient interested in this form of thumb arthroplasty to minimize complications and need for further surgical intervention. Future research should compare complication, reoperation, and revision rates of pyrolytic carbon hemiarthroplasty to alternative procedures, such as trapeziometacarpal joint fusion, which may similarly provide better grip and pinch strength compared with trapeziectomy and suspensionplasty.

Note

The investigation was performed in its entirety at the Mayo Clinic, Rochester, MN. Written informed consent was obtained from all patients whose data were included in the study. The research protocol was approved in advance by the institutional review board at the medical center where the investigation was performed.

Conflict of Interest

Dr. Moran is a consultant for Integra Life Sciences. No other authors have any conflicts of interest relevant to this article. The authors received no financial support for the research, authorship, and/or publication of this article.

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