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# The long-term results of proximal interphalangeal joint arthroplasty of the hand

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**Abstract**

**Introduction** Small joints replacement is a valid treatment for deforming osteoarthritis and traumatic injuries to the phalangeal joints of the hand to restore motor hand functions. Various types of implants differing in shape, biomechanics and material composition have been developed.

**The purpose of the study** was to evaluate long-term results of the proximal interphalangeal joint arthroplasty of the hand using various implants and identify their advantages.

**Material and methods** We retrospectively reviewed 78 cases of proximal interphalangeal joint replacement in 64 patients. Outcomes were assessed at 6 months and at follow-up stages with preoperative and postoperative measurements of the range of motion in the joint evaluating pain, radiographs and outcomes measures using the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire.

**Results** The range of motion in the prosthetic joint increased significantly at different follow-up periods with all types of implants. The pain syndrome decreased. Radiographs revealed 10 cases of aseptic instability in the group of constrained prostheses. The DASH assessment showed high subjective satisfaction with the treatment.

**Discussion** We could not find papers reporting PIP joint arthroplasty using SBI D.G.T. implant system. A retrospective study of RM Finger arthroplasty of the PIP joint indicated restored joint stability with AROM improvement and with low pain, although it had a high rate of complications. We recorded no complications with this implant model. Some authors would not recommend the RM Finger implant (Mathys) for PIP joint replacement. Arthroplasty of small joints of the hand with MOJE kermik-implantate showed satisfactory outcomes for 82 % of patients at a long term

**Conclusion** Arthroplasty of the PIP joint of the hand using various implant designs resulted in greater mobility of the upper limbs, a lower pain due to subjective improvement in the functionality at a long term. Although the procedures were effective with all implant designs the reliability of changes in the parameters was more evident with nonconstrained implants.

**Keywords**: proximal interphalangeal joint, joint replacement of the hand, Moje ceramics, proximal interphalangeal joint arthroplasty

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## INTRODUCTION

Fine motor skills of the hands create opportunities for learning and interactions. The hand is very important for any activity, and decreased functionality can lead to lower working capacity and physical capabilities and limitations. With present technologies, the hand function can be restored to ensure precise, strictly measured movements to control complex mechanisms [1]. The hand is a complex structure with many interconnected joints that allow versatile and very dexterous movements. The hand function is important for everyday activities. The activities such as writing, manipulating objects, grasping, opening and closing cans, turning a key would require stability and mobility at various joints of the upper limbs [2]. The normal flexion at the PIP joint ranges from 0 to 130°. In the absence of job-specific requirements for the hand the amplitude ranges between 16 and 93° in everyday life stratifying the results of treatment of arthrosis by a functional measure [3]. The treatment of deforming osteoarthritis and traumatic injuries of the phalangeal joints of the hand is aimed at maximal restoration of active movements within the functional amplitude. There is a lack of consensus regarding the optimal approach and surgical options for PIP joint disorders among the surgeons [4–6]. Maintaining or improving mobility in the joint and the grip strength is essential for the patients with an evident advantage of joint replacement over arthrodesis [7]. The decision on joint replacement or arthrodesis should be made jointly with the patient considering the patient's goals and a greater risk of complications associated with arthroplasty [8–11]. Various types of implants differing in shape, biomechanics and material composition have been developed [12–15]. The purpose was to evaluate outcomes of PIP joint replacement using various types of implants and identify the advantages.

## MATERIAL AND METHODS

A retrospective continuous study was performed at the Federal Center for Traumatology, Orthopaedics and Joint Replacement in Cheboksary (hereinafter referred to as the Center).

The study was performed in accordance with ethical principles for medical research involving human subjects stated in the 2013 Declaration of Helsinki developed by the World Medical Association, Order of the Ministry of Health of the RF dtd 19th June 2003 No. 266 on Clinical Practice Guidelines in the Russian Federation and approved by the local ethical committee of the Center (protocol No. 7 dated June 20, 2023). Eighty PIP replacement procedures were performed at the Center between 2009 and 2022 (Table 1).

Table 1

PIP replacement procedures performed with different implants as reported in 2009–2022

| Year | Implant modification | | | Total |
|---|---|---|---|---|
| | SBI D.G.T. PIP joint implant | RM Finger (Mathys) | Moje ACAMO PIP | |
| 2009 | 2 | | | 2 |
| 2010 | 6 | | | 6 |
| 2011 | 12 | | | 12 |
| 2012 | 8 | | | 8 |
| 2013 | 7 | | | 7 |
| 2014 | 14 | 3 | | 17 |
| 2015 | 1 | 2 | | 3 |
| 2016 | | 2 | | 2 |
| 2017 | | 3 | 5 | 8 |
| 2018 | | | 2 | 2 |
| 2019 | | | 4 | 4 |
| 2020 | | | 3 | 3 |
| 2021 | | | 4 | 4 |
| 2022 | | | 2 | 2 |
| Total | 50 | 10 | 20 | 80 |

Different modifications of implants used at different periods were associated with the changed range on the medical market. A total of 66 patients underwent the p;rocedure with 31 female (47 %) and 35 male (53 %) patients. The mean age of patients was 47.1 years (CI = 95 %; SD = 12.7, range, 25 to 83). Inclusion criteria included idiopathic and post-traumatic arthrosis; post-traumatic defects of the digital joints; degenerative and post-infectious arthrosis; bone ankylosis; initial stages of rheumatoid arthritis and psoriasis. The endoprostheses were implanted through the dorsal median transtendon surgical approach. Flexion and extension with active and passive amplitude could be performed at 2 to 3 weeks. More than half of the PIP joint replacements were performed on the right side on the third finger (Table 2).

Table 2

Location of PIP joint implants

| Hand | Finger | | | | |
|---|---|---|---|---|---|
| | I | II | III | IV | V |
| Right-sided | — | 12 | 25 | 10 | — |
| Left-sided | — | 6 | 9 | 16 | 2 |
| Total | — | 18 | 34 | 26 | 2 |

The following types of implants were used for joint replacements:

– constrained implants with the lateral stability being ensured by the design of the implant – SBI D.G.T. PIP joint implant (Fig. 1) and RM Finger (Mathys) (Fig. 2); 50 and 10 implants were used, respectively;

– Moje ACAMO PIP implants, an unconstrained endoprosthesis made of zirconium ceramics (Fig. 3); A total of 20 implants were used.

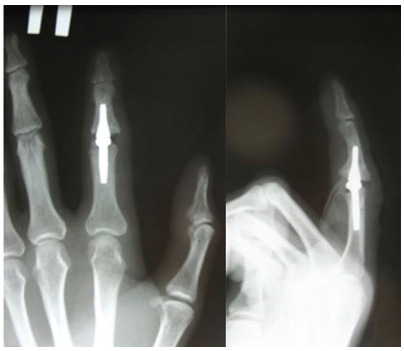
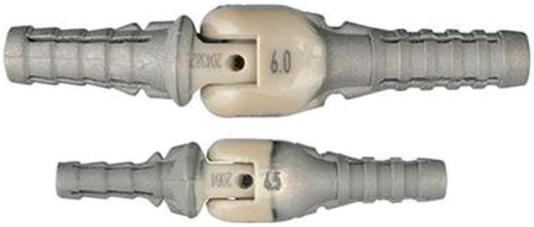


**Fig. 1** Constrained SBI D.G.T. PIP joint implant



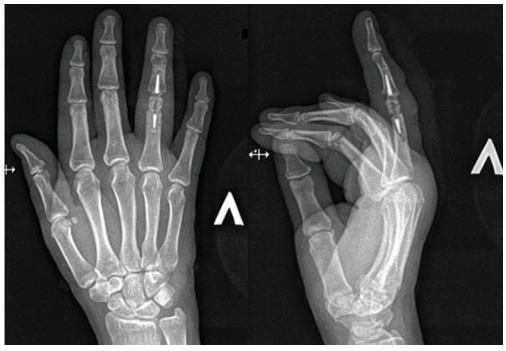
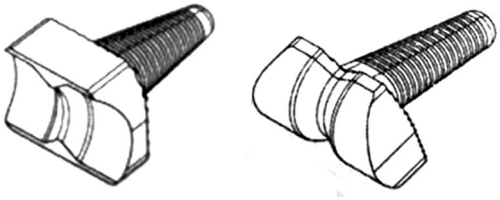



**Fig. 2** Constrained RM Finger implants (Mathys)



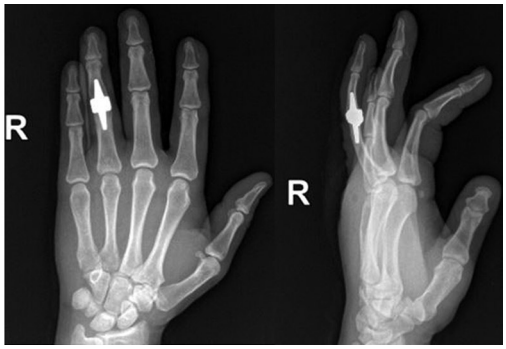



**Fig. 3** Non-constrained Moje ACAMO PIP implant

Short- (at 6 months of surgery) and long-term results (at the follow-up stage, 1 year or more after surgery) were assessed using objective criteria (preoperative and postoperative measurement of ROM with a protractor, assessment of pain on the VAS scale and radiological examination), and subjective criteria using DASH score, to assess the extent of disability of the arm, shoulder and hand from 0 meaning no disability and a good function to 100 points indicating severe disability.

Statistical analysis was produced using the package of the Microsoft Excel 2007 program. Normal distribution of the variables was confirmed graphically in MS Excel with the data represented in the form of the arithmetic mean (M) and standard error (m). The minimum, maximum, median, mode were identified in the absence of normality. The Fisher's exact test was used to assess the statistical significance of differences in the groups calculated with the Graf Pad program. Differences were considered statistically significant at $p<0.05$.

## RESULTS

Long-term results of 78 cases of replaced PIP joints using constrained and unconstrained implants were retrospectively reviewed in 64 patients. Two patients (two arthroplasty cases) with replaced PIP joint using SBI D.G.T. implant were unavailable for the follow-up due to changed contact information. Follow-up period for patients with the SBI D.G.T PIP joint implant was 8–14 years, 6–9 years for RM Finger (Mathys), 6-month-to-6-year period for Moje ACAMO PIP. Assessment of the range of motion in the prosthetic joint at various periods of observation showed a statistically significant increase in the parameter for the three types of implants ($0.00001 \leqslant p \geqslant 0.04475$) (Table 3).

Table 3

ROM in the PIP joint at stages of treatment, °

| Type of implant | ROM at stages of treatment, ° | | | |
|---|---|---|---|---|
| | | pre-op | at 6 mo | at the follow-up stage |
| SBI D.G.T. PIP joint implant | *M* ± *m* | 9.6 ± 14.0 | 16.3 ± 18.7 | 17.2 ± 19.9 |
| | *p* | – | 0.04475* | 0.02944* |
| RM Finger (Mathys) | *M* ± *m* | 16.5 ± 14.2 | 44.0 ± 30.3 | 46.5 ± 31.5 |
| | *p* | – | 0.02214* | 0.01651* |
| Moje ACAMO PIP | *M* ± *m* | 7.8 ± 9.2 | 42.8 ± 26.6 | 48.0 ± 30.0 |
| | *p* | – | 0.00001* | 0.00001* |

* as compared to pre-op value

There was no optimistic increase in ROM as compared to preoperative measurements. Postoperative ROM either remained at the same level or increased with no maximum ROM to be achieved at the follow-up stage. In our series, the unconstrained Moje ACAMO PIP ceramic implant showed restored the best ROM regained in the joint postoperatively (up to an average of 48°). All patients reported a decrease in pain after surgery (Table 4).

Table 4

Pain assessed with VAS, scores

| Type of implant | VAS score | | |
|---|---|---|---|
| | | pre-op | at the follow-up stage |
| SBI D.G.T. PIP joint implant | *M* ± *m* | 6.0 ± 1.9 | 0.4 ± 0.6 |
| | *p* | – | 0.00000* |
| RM Finger (Mathys) | *M* ± *m* | 6.5 ± 2.2 | 0.4 ± 0.5 |
| | *p* | – | 0.00001* |
| Moje ACAMO PIP | *M* ± *m* | 4.9 ± 1.9 | 0.6 ± 0.8 |
| | *p* | – | 0.00000* |

* as compared to pre-op value

Radiological assessment of endoprosthetic results showed no evidence of lateral instability with the Moje ACAMO PIP ceramic non-constrained implant (Fig. 4).

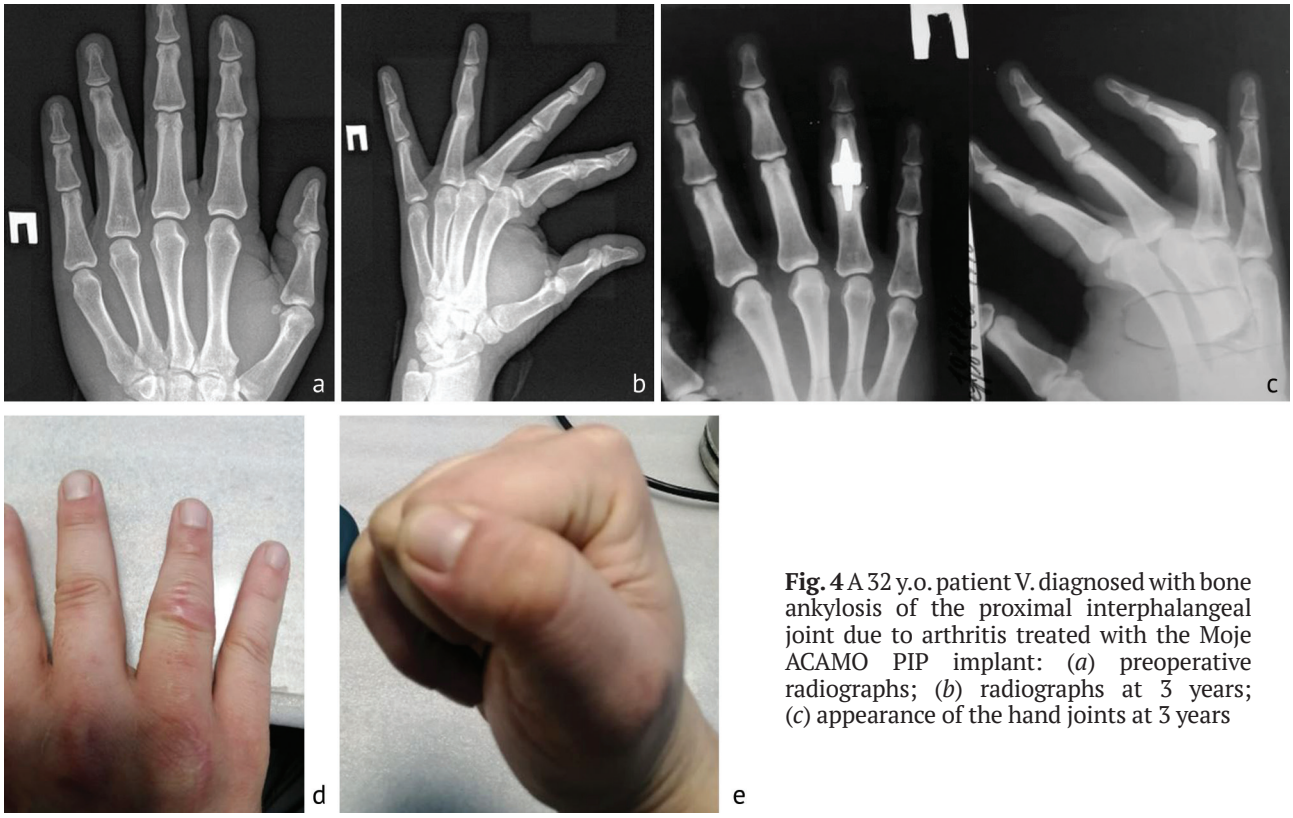



**Fig. 4** A 32 y.o. patient V. diagnosed with bone ankylosis of the proximal interphalangeal joint due to arthritis treated with the Moje ACAMO PIP implant: (*a*) preoperative radiographs; (*b*) radiographs at 3 years; (*c*) appearance of the hand joints at 3 years

Radiological examination demonstrated 10 cases of aseptic instability of the SBI D.G.T. PIP joint implant, including 5 cases of unstable implant at 3 years with 2 due to periprosthetic joint fracture (Fig. 5).

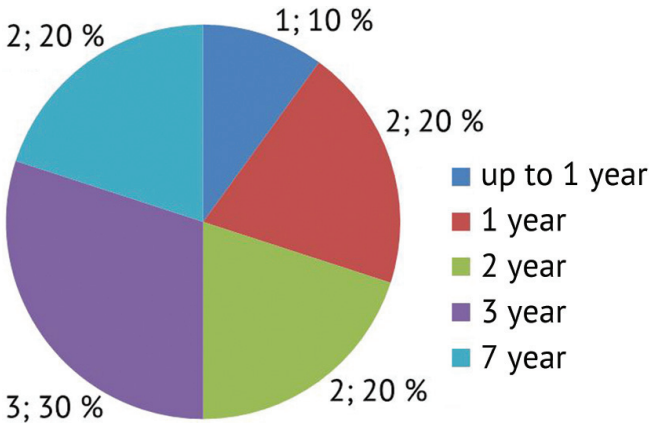



**Fig. 5** Cases of aseptic instability of SBI D.G.T. PIP joint implant developed at various follow-up periods

No infectious complications were noted in the three groups throughout the observation period. The DASH score was measure in 64 patients at a long term (Table 5). Two patients with the SBI D.G.T. PIP joint implant were unavailable follow-up due to changed contact details. Patients with unconstrained Moje ACAMO PIP ceramic implant demonstrated the best score of 14.2. The maximum ROM achieved (on average 48°) at the follow-up stage was also observed in patients with unconstrained implantation.

Table 5

Outcomes of PIP joint replacement assessed on the DASH (The Disabilities of the Arm, Shoulder and Hand) scale

| Type of implant | Postoperative DASH score | | |
|---|---|---|---|
| | | pre-op | at the follow-up stage |
| SBI D.G.T. PIP joint implant | *M* ± *m* | 29.7 ± 1.3 | 19.5 ± 3.7 |
| | *p* | – | 0.00000* |
| RM Finger (Mathys) | *M* ± *m* | 29.6 ± 1.7 | 17.4 ± 6.2 |
| | *p* | – | 0.00015* |
| Moje ACAMO PIP | *M* ± *m* | 30.3 ± 1.3 | 14.2 ± 5.0 |
| | *p* | – | 0.00000* |

* as compared to pre-op value

The effectiveness of the operation was statistically confirmed ($p < 0.05$) for all types of implants. The changes in the three parameters (p value) was more evident in the group of Moje ACAMO PIP implants as compared to other implant models with a greater ROM and subjective criteria measured with the DASH score.

## DISCUSSION

Normal biomechanics of the joint is essential for a full functional range of motion. The implant is aimed at restoring the center of rotation of the joint maintaining the anatomical distances between the muscles and tendons of the finger [16–18]. Understanding the anatomy, biomechanics, physiology of the hand and its components is the key to success in the comprehensive restoration of the function and improvement of the quality of life [3, 19, 20]. Despite advances in materials and new implant designs proximal interphalangeal joint replacement remains an unsolved biomechanical problem, [21, 22]. The goals of the operation are to reduce pain, increase range of motion, restore the biological axis of the fingers and improve the function [23, 24]. Various surgical approaches depending on the needs and experience of the surgeon are used to replace the proximal interphalangeal joint of the hand, [25, 26]. We normally use dorsal access in our practice. Literature review showed no statistical differences in postoperative range of motion, complication rates, or the number of revision surgeries between palmar and dorsal approaches in proximal interphalangeal joint arthroplasty [27, 28]. The operations were performed under general anesthesia with use of a tourniquet. Advantages of local anesthesia with the procedures have been reported in recent publications without the use of a tourniquet and can be used in the future [29–32]. No scientific papers describing the results of clinical use of the SBI D.G.T. PIP joint implant could be found. The search was performed with use of GoogleScholar, PubMed, eLIBRARY, PubMedCentral in Russian and English using the keywords “replacement of the proximal interphalangeal joint”, “arthrodesis of the proximal interphalangeal joint”, “osteoarthritis of the proximal interphalangeal joint”. There were no papers reporting SBI D.G.T. PIP joint implant. In our series, patients reported an improvement from preoperative 29.7 ± 1.3 DASH score to postoperative 19.5 ± 3.7 DASH score. Radiological examination indicated to 10 cases of aseptic instability of the implant of the 50 identified with poor outcomes registered in 20 %.

J.P. Rijnja et al. performed a retrospective study of the RM Finger arthroplasty (Mathys) and concluded that proximal interphalangeal joint arthroplasty could restore joint stability, improve range of motion and pain with a high complication rate [33]. There were no complications in our

series with the use of this model of implant. A. Middleton et al. did not recommend the RM Finger implant (Mathys) for replacement of the proximal interphalangeal joint, in cases of rheumatoid arthritis, in particular [34]. M.I. Muradov et al. reported 82 % of satisfactory long-term results with replacmeent of small joints of the hand using MOJE kermik-implantate were with the range of motion increased in the prosthetic joint from preoperative 16º to 59º at 6 months and 73º at 1 year [35]. The best results in our series were obtained with ceramic implants with the range of motion restored in the joint to 48.0 ± 30.0º at the follow-up. The advantages of the study include comparative assessment of the replacements depending on the type of implant used. A limitation of the study included a small number of observations, which requires further study of the problem with the possibility of applying the results in clinical practice.

## CONCLUSION

Long-term results of replacement of the proximal interphalangeal joint of the hand using various types of implants showed improvement in the mobility of the upper limb, pain and the appearance of the segment due to subjective functional improvement. Non-constrained implants anatomically imitate the articular surfaces of the finger joints with the loading provided by the finger's ligamentous apparatus. Non-constrained ceramic implants having optimal biocompatibility with the bone facilitated maintaining or increasing the range of motion in the interphalangeal joint. No case of joint instability was identified with their use. Although effective procedure was statistically confirmed with all types of implants ($p < 0.05$) the reliability of changes ($p$) was more pronounced for all parameters with use of non-constrained Moje ACAMO PIP implants as compared to constrained types.

***Conflict of interest*** *The authors declare that there is no conflict of interest.*

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***Ethical review*** *The study received a favourable opinion from the relevant research ethics committee (Abstract of minutes № 7 dtd 20.06.2023).*

***Informed consent*** *is not required.*

## REFERENCES

1. Nikolaenko A.N. *Bionic approach to hand joint arthroplasty: Author's abstract Doct. Diss*. Samara; 2019:46. Available at: https://www.samsmu.ru/files/referats/2019/nikolaenko/avtoreferat.PDF. Accessed Sept 06, 2023. (In Russ.)
2. Kapandji A.I. *Functional anatomy: Volume 1: Upper limb*. (6th ed.). Paris: Maloine; 2005:198-341.
3. Pang EQ, Yao J. Anatomy and Biomechanics of the Finger Proximal Interphalangeal Joint. *Hand Clin*. 2018;34(2):121-126. doi: 10.1016/j.hcl.2017.12.002
4. Hidajat NN, Arsa W, Chaidir MR, et al. Soft tissue interpositional arthroplasty as a treatment of proximal interphalangeal joint arthritis in resource-limited health care facility: A case report. *Int J Surg Case Rep*. 2022;99:107700. doi: 10.1016/j.ijscr.2022.107700
5. Milone MT, Klifto CS, Hacquebord JH. Prosthetic Arthroplasty of Proximal Interphalangeal Joints for Treatment of Osteoarthritis and Posttraumatic Arthritis: Systematic Review and Meta-Analysis Comparing the Three Ulnar Digits With the Index Finger. *Hand* (N Y). 2019;14(5):658-663. doi: 10.1177/1558944718791186
6. Griffart A, Agneray H, Loubersac T, et al. Arthroplasty of the proximal interphalangeal joint with the Tactys® modular prosthesis: Results in case of index finger and clinodactyly. *Hand Surg Rehabil*. 2019;38(3):179-185. doi: 10.1016/j.hansur.2019.03.001
7. Harris CA, Shauver MJ, Yuan F, et al. Understanding Patient Preferences in Proximal Interphalangeal Joint Surgery for Osteoarthritis: A Conjoint Analysis. *J Hand Surg Am*. 2018;43(7):615-624.e4. doi: 10.1016/j.jhsa.2018.03.001

8. Vitale MA, Fruth KM, Rizzo M, et al. Prosthetic Arthroplasty Versus Arthrodesis for Osteoarthritis and Posttraumatic Arthritis of the Index Finger Proximal Interphalangeal Joint. *J Hand Surg Am*. 2015;40(10):1937-48. doi: 10.1016/j.jhsa.2015.05.021
9. Helder O, Marks M, Schweizer A, et al. Complications after surface replacing and silicone PIP arthroplasty: an analysis of 703 implants. *Arch Orthop Trauma Surg*. 2021;141(1):173-181. doi: 10.1007/s00402-020-03663-5
10. Aversano FJ, Calfee RP. Salvaging a Failed Proximal Interphalangeal Joint Implant. *Hand Clin*. 2018;34(2):217-227. doi: 10.1016/j.hcl.2017.12.011
11. Regas I, Pluvy I, Leroy M, et al. Arthroplasty for destroyed proximal interphalangeal joint in hand trauma surgery: Silicone hinged NeuFlex® or gliding Tactys®? *Hand Surg Rehabil*. 2022;41(6):681-687. doi: 10.1016/j.hansur.2022.09.006
12. Wilder FV, Barrett JP, Farina EJ. Joint-specific prevalence of osteoarthritis of the hand. *Osteoarthritis Cartilage*. 2006;14(9):953-7. doi: 10.1016/j.joca.2006.04.013
13. Yamamoto M, Malay S, Fujihara Y, et al. A Systematic Review of Different Implants and Approaches for Proximal Interphalangeal Joint Arthroplasty. *Plast Reconstr Surg*. 2017;139(5):1139e-1151e. doi: 10.1097/PRS.0000000000003260
14. Yamamoto M, Chung KC. Implant Arthroplasty: Selection of Exposure and Implant. *Hand Clin*. 2018;34(2):195-205. doi: 10.1016/j.hcl.2017.12.009
15. Kulkarni K, Sheikh N, Aujla R, et al. Outcomes of Unconstrained Proximal Interphalangeal Joint Arthroplasty: A Systematic Review. *J Hand Surg Asian Pac Vol*. 2022;27(2):300-312. doi: 10.1142/S2424835522500266
16. Jonsson H. Age related prevalence of hand osteoarthritis diagnosed by photography (HOASCORE). *BMC Musculoskelet Disord*. 2017;18(1):508. doi: 10.1186/s12891-017-1870-0
17. Hong SW, Yoon J, Kim YJ, Gong HS. Novel implant design of the proximal interphalangeal joint using an optimized rolling contact joint mechanism. *J Orthop Surg Res*. 2019;14(1):212. doi: 10.1186/s13018-019-1234-6
18. Hunag YC, Chang CM, Huang SF, et al. Development and Biomechanical Evaluation of an Anatomical 3D Printing Modularized Proximal Inter-Phalangeal Joint Implant Based on the Computed Tomography Image Reconstructions. *Int J Bioprint*. 2022;8(3):579. doi: 10.18063/ijb.v8i3.579
19. Hourston G, Begum R, Sarker S, Chojnowski A. Outcomes of Multiple Digit Proximal Interphalangeal Joint Swanson Arthroplasty Done at a Single Operation. *J Hand Surg Asian Pac Vol*. 2022;27(2):280-284. doi: 10.1142/S2424835522500345
20. Uchiyama S, Cooney WP 3rd, Linscheid RL, et al. Kinematics of the proximal interphalangeal joint of the finger after surface replacement. *J Hand Surg Am*. 2000;25(2):305-12. doi: 10.1067/jhsu.2000.jhsu25a0305
21. Zhu AF, Rahgozar P, Chung KC. Advances in Proximal Interphalangeal Joint Arthroplasty: Biomechanics and Biomaterials. *Hand Clin*. 2018;34(2):185-194. doi: 10.1016/j.hcl.2017.12.008
22. Matter-Parrat V. Proximal interphalangeal joint prosthetic arthroplasty. *Hand Surg Rehabil*. 2023;42(3):184-193. doi: 10.1016/j.hansur.2023.02.001
23. Louvion E, Santos C, Samuel D. Rehabilitation after proximal interphalangeal joint replacement: A structured review of the literature. *Hand Surg Rehabil*. 2022;41(1):14-21. doi: 10.1016/j.hansur.2021.09.007
24. Sharma S, Ong J, Putti A. Proximal Interphalangeal Joint Arthroplasty Using the Wide-Awake Local Anesthesia No Tourniquet Technique. *Hand* (N Y). 2023;18(4):612-615. doi: 10.1177/15589447211063545
25. Renfree KJ. Surgical approaches for proximal interphalangeal joint arthroplasty. *Bone Joint J*. 2022;104-B(12):1329-1333. doi: 10.1302/0301-620X.104B12.BJJ-2022-0946
26. Bodmer E, Marks M, Hensler S, et al. Comparison of outcomes of three surgical approaches for proximal interphalangeal joint arthroplasty using a surface-replacing implant. *J Hand Surg Eur Vol*. 2020;45(6):608-614. doi: 10.1177/1753193419891382
27. Tranchida GV, Allen ST, Moen SM, et al. Comparison of Volar and Dorsal Approach for PIP Arthroplasty. *Hand* (N Y). 2021;16(3):348-353. doi: 10.1177/1558944719861718
28. Duncan SFM, Smith AA, Renfree KJ, et al. Results of the Volar Approach in Proximal Interphalangeal Joint Arthroplasty. *J Hand Surg Asian Pac Vol*. 2018;23(1):26-32. doi: 10.1142/S2424835518500042
29. Khudr J, Hughes L, Younis F. The what, why and when of wide awake local anaesthesia no tourniquet surgery. *Br J Hosp Med* (Lond). 2022;83(1):1-10. doi: 10.12968/hmed.2021.0383
30. Lalonde DH. Ten Questions About Wide Awake Local Anaesthesia No Tourniquet (WALANT) Surgery. *J Hand Surg Asian Pac Vol*. 2022;27(2):219-225. doi: 10.1142/S2424835522300031
31. Gunasagaran J, Sean ES, Shivdas S, et al. Perceived comfort during minor hand surgeries with wide awake local anaesthesia no tourniquet (WALANT) versus local anaesthesia (LA)/tourniquet. *J Orthop Surg* (Hong Kong). 2017;25(3):2309499017739499. doi: 10.1177/2309499017739499

32. Lalonde DH. Latest Advances in Wide Awake Hand Surgery. Hand Clin. 2019;35(1):1-6. doi: 10.1016/j.hcl.2018.08.002
33. Rijnja JP, Kouwenberg PPGM, Ray S, Walbeehm ET. Robert Mathys Finger prosthesis of the proximal interphalangeal joint: a retrospective case series of 19 joints in 17 patients. *Arch Orthop Trauma Surg*. 2017;137(8):1155-1160. doi: 10.1007/s00402-017-2725-8
34. Middleton A, Lakshmipathy R, Irwin LR. Failures of the RM finger prosthesis joint replacement system. *J Hand Surg Eur Vol*. 2011;36(7):599-604. doi: 10.1177/1753193411406798
35. Muradov MI, Baitinger VF, Kamolov FF, et al. Assessment of the remote results of endoprosthesis replacement of joints of fingers of the hand. *Issues of Reconstructive and Plastic Surgery*. 2016;(1):33-40. (In Russ.) doi: 10.17223/1814147/56/5

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