Hand Surgery and Rehabilitation xxx (xxxx) xxx–xxx

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Original article

Arthroplasty for destroyed proximal interphalangeal joint in hand trauma surgery: Silicone hinged NeuFlex® or gliding Tactys®?

Arthroplastie des articulations interphalangiennes proximales détruites en traumatologie de la main: prothèse en silicone à charnière NeuFlex® ou à glissement Tactys®?

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ARTICLE INFO

Article history:
Received 17 May 2022
Received in revised form 25 September 2022
Accepted 26 September 2022
Available online xxx

Keywords:
Arthroplasty
Hand surgery
NeuFlex®
Proximal interphalangeal joint (PIP)
Tactys®

ABSTRACT

The treatment of proximal interphalangeal joints (PIP) after a traumatic injury has produced disappointing outcomes. The objective of this study was to evaluate the functional results of emergency hinged or gliding arthroplasty for destroyed PIP joints. A two-center retrospective study was carried out in 24 patients with open and closed trauma of the PIP joint of the fingers from 2007 to 2019. Fifteen hinged silicone implants (NeuFlex®) and nine gliding implants (Tactys®) were used. Pain on a visual analog scale (VAS), stability and total active motion (TAM), grip and pinch strength (Jamar®), QuickDASH and PRWE and satisfaction were assessed, and X-rays were performed. With a mean follow-up of 48 months, 24 patients aged 58 years on average were reviewed. Pain on VAS was 0.2/10, the TAM was 72% of the contralateral side, the QuickDASH was 15.6/100 and the PRWE was 24.5/100. PIP flexion was ≥50% of the contralateral side in 75% of patients. PIP and DIP extensor lag of 9° was significantly larger with the Tactys® than with the NeuFlex®, with no significant difference in the TAM. Three clinodactylies in fingers with the NeuFlex® and three reducible swanneck deformities in fingers with the Tactys® were noted. Three-quarters of patients were very satisfied or satisfied with the outcome. Emergency PIP arthroplasty with Tactys® seems to provide functional results that are as good as with NeuFlex®. Clinodactyly was found with NeuFlex® use. A significant PIP and IPD extensor lag of 9° and swan-neck deformities were found with Tactys® without significant functional impairment.

Mots-clés:
Arthroplastie
Articulation interphalangienne proximale
Chirurgie de la main
NeuFlex®
Tactys®

RÉSUMÉ

Les traitements de l'articulation interphalangienne proximale (IPP) traumatique ont des résultats décevants. L'objectif de cette étude était l'évaluation des résultats fonctionnels des arthroplasties à charnière ou à glissement en urgence pour les IPP traumatiques détruites. Il s'agissait d'une étude rétrospective bicentrique de 24 patients opérés de traumatismes ouverts ou fermés de l'articulation IPP des doigts longs de 2007 à 2019. Quinze prothèses à charnière en silicone (NeuFlex®) et neuf prothèses à glissement (Tactys®) ont été posées. La douleur appréciée sur une échelle visuelle analogique (EVA), la stabilité et la mobilité globale (TAM), la force de poigne au dynamomètre Jamar, les scores QuickDASH et PRWE, le score de satisfaction ont été mesurés et des radiographies ont été réalisées. Avec un recul de

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https://doi.org/10.1016/j.hansur.2022.09.006
2468-1229/

48 mois, 24 patients de 58 ans en moyenne ont été revus. L'EVA douleur était à 0,2/10, la TAM globale à 72%, le score QuickDASH de 15,6/100 et le score PRWE de 24,5/100. Une flexion de l'IPP ≥50% était objectivée chez 75% des patients. Le déficit d'extension des IPP et IPD était de 9° et significativement plus important avec les Tactys® qu'avec les NeuFlex® sans différence significative sur la TAM. Trois clinodactylies avec les NeuFlex® et 3 cols de cygne réductibles avec les Tactys® étaient relevés. 77% des patients étaient très satisfaits ou satisfaits. L'arthroplastie IPP traumatique en urgence avec la Tactys® semble apporter d'aussi bons résultats fonctionnels que la NeuFlex®. Des clinodactylies sont retrouvées avec les NeuFlex®. Un déficit d'extension significatif de l'IPP et de l'IPD de 9° et des déformations en col de cygne sont retrouvées avec les Tactys® sans retentissement fonctionnel significatif.

Introduction

The proximal interphalangeal (PIP) joint has a range of motion of 0 to 100°. It provides 85% of the flexion arc of the fingers, while the distal interphalangeal (DIP) joint provides the other 15% [1].

In hand surgery, the treatment of traumatic injuries to the PIP joint is controversial. A destroyed PIP is defined as a fracture affecting more than 50% of the articular surface and/or subluxation greater than 30%, i.e. starting at stage III in the London [2] and/or Seno [3] classifications. Stable fractures can be treated conservatively while unstable fractures must be treated surgically [4]. Kiefhaber and Stern [5] made detailed recommendations for conservative treatment: reduce the dislocation, stabilize the fracture sufficiently to allow early mobilization, and reduce fracture–subsidence of the central hinge.

Various surgical techniques have been described in the literature. Joint-sparing techniques such as percutaneous fixation with mini-K-wires, open fracture fixation, reconstruction of the volar plate [6], dynamic external fixators for distraction such as the Ligamentotaxor® frame [7], arthroplasty by hemi-hamate graft [8] or vascularized toe graft [9]. When joint-sparing surgery is not possible, a more radical surgical treatment such as joint replacement or fusion can be proposed [4]. Immediate amputation is also an option [10].

In the literature, Swanson et al. reported the long-term results of 289 arthroplasties with a silicone hinged implant for scheduled surgery of arthritic and rheumatoid PIP joints [11]. The silicone NeuFlex® implant (DePuy, Synthes™, Saint-Priest, France) has a hinge that is preset in 30° flexion with a center of rotation to improve biomechanics [12]. The Tactys® (Stryker-Memometal™, Bruz, France) is total anatomic gliding and modular prosthesis. It has four interchangeable components: two intramedullary stems (distal, proximal) made of hydroxyapatite-coated titanium alloy, a polyethylene proximal surface and cobalt-chrome distal surface [13].

The primary aim of this study was to evaluate the long-term radiological and functional outcomes of hinged silicone or gliding arthroplasty implants in the treatment of destroyed PIP joints. We hypothesized that these two arthroplasty implants would produce comparable results and acceptable functional recovery for all patients.

Patients and methods

Patient selection

This was a retrospective study of patients treated at two French "SOS Mains" [Hand Trauma Center]. The included patients had undergone emergency primary arthroplasty for open or closed fracture of a finger PIP joint between January 2007 and January 2019 after radiographic and CT work-up. Given that these procedures were done urgently, the prosthesis chosen was determined based on which implant was available at each center. Thus, one center used the Tactys® and the other used the NeuFlex®. The Tactys® and NeuFlex® cost euro1007.71 and euro241.46 (all taxes inclusive), respectively.

The inclusion criteria were adult patients with an open or closed fracture of a finger PIP joint, destroyed PIP joint (>50% of articular surface and/or >30° subluxation), fracture of the head of the proximal phalanx (London 3 or 4 [2]) and/or base of the middle phalanx (Seno 3 or 4 [3]), treatment by emergency primary arthroplasty with a silicone hinged or gliding implant and consent provided for study participation.

Exclusion criteria were minor patients, under guardianship or trusteeship, lost to follow-up, thumb affected, conservative treatment (fracture fixation, Ligamentotaxor®), palliative treatment (arthrodesis, hemi-hamate graft, reconstruction of volar plate, vascularized or non-vascularized toe graft), pyrocarbon arthroplasty, scheduled surgery for osteoarthritis or rheumatoid arthritis.

Surgical technique (Fig. 1 and 2)

Under regional anesthesia, with a traction table and arm board, a tourniquet was inflated at the base of the limb after exsanguination. An arciform dorsal surgical approach was made and the median slip of the extensor mechanism identified. The base of the middle phalanx was detached through a midline longitudinal incision between the median slip and lateral slip without detaching the median slip. Any comminuted bone fragments were removed to prevent necrosis. An oscillating saw was used to minimally cut back the head of the proximal phalanx. The collateral ligaments were protected. The PIP was dislocated. Increasingly larger broaches were used in the medullary canal of the proximal and middle phalanges. A trial implant was positioned, and the PIP tested in flexion, extension, lateral stability and piston. The definite implant was inserted without cement. The extensor mechanism was repair either by re-insertion, longitudinal suturing or reconstruction depending on the initial tendon damage [14,15]. Fluoroscopy was used intraoperatively to confirm the implants were positioned correctly. A light compressive dressing was applied. Patients wore a static splint for 3 weeks; passive mobilization was allowed. Active mobilization was started at 3 weeks postoperative.

Data collection

The variables of interest are listed in Appendix 2. All angles were measured with a goniometer by an independent observer (IR).

Statistical analysis

Qualitative variables were summarized by their counts (n) and share (%), while quantitative variables were summarized by their

Fig. 1. Surgical technique for arthroplasty with a NeuFlex® silicone implant through a dorsal approach. Surgical approach: after resection of the comminuted bone fragments and PIP joint dislocation, minimal resection of the proximal phalanx head perpendicular to its axis was done with an oscillating saw (A). View of the medullary canal in the proximal phalanx in which progressively larger broaches are inserted (B). Implanting the chosen NeuFlex® prosthesis (C). Final AP view of the finger (D).

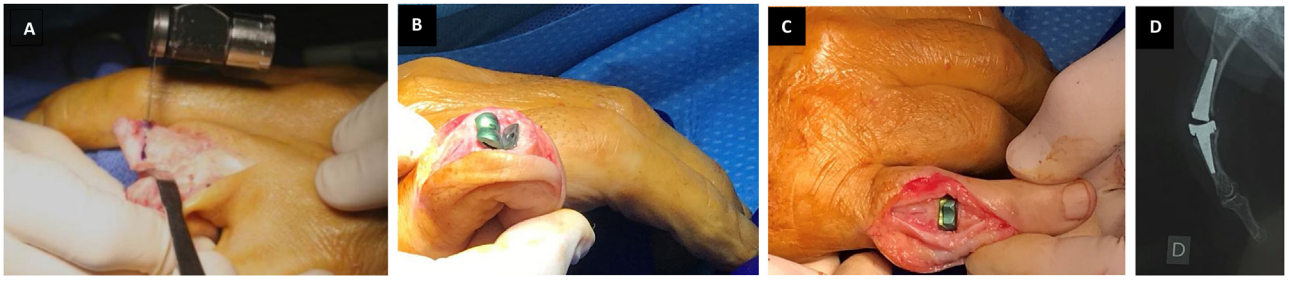

Fig. 2. Surgical technique for arthroplasty with a Tactys® implant through a dorsal approach. Surgical approach: after resection of the comminuted bone fragments and PIP joint dislocation, minimal resection of the proximal phalanx head perpendicular to its axis was done with an oscillating saw (A). The trial Tactys® implant is inserted and the finger tested in flexion (B).Testing in extension of the trial Tactys® implant (C). Final AP view of the finger (D).

mean and SD values. A descriptive statistical analysis was done for both groups: silicone hinged arthroplasty and gliding arthroplasty. Potential differences between mean and SD values were determined with Student's *t* test for quantitative variables. The analysis was done using SPSS PASW Statistics 18 software (SPSS, Inc., Chicago, Illinois).

Results

Over the 12-year study period, 32 patients underwent arthroplasty for a destroyed PIP joint at the two participating centers. Eight patients (25%) were lost to follow-up (Fig. 3). The remaining 24 patients were included in the study: 6 women (25%)

Table 1
Demographic, clinical and radiological data for our case series.

Patient	Age (years)	Sex	Accident	Mechanism	Follow-up (months)	Finger	Dominant side	P1 head (London)	P2 base (Seno)	Implant
1	46	M	Domestic	Crush	18	D3	Yes	–	4	Tactys®
2	71	F	Domestic	Fall	42	D4	Yes	4	–	Tactys®
3	56	M	Domestic	Hedge trimmer	42	D2	No	–	4	Tactys®
4	58	M	Work	Circular saw	42	D2	Yes	3	4	Tactys®
5	70	F	Domestic	Sickle	18	D3	No	–	4	Tactys®
6	76	M	Domestic	Fall	18	D5	Yes	–	4	Tactys®
7	30	F	Domestic	Fall	18	D4	Yes	–	4	Tactys®
8	57	M	Domestic	Fall	18	D5	No	3	–	NeuFlex®
9	47	M	Domestic	Wood splitter	72	D5	No	3	–	NeuFlex®
10	65	M	Domestic	Fall	84	D3	Yes	–	4	NeuFlex®
11	64	M	Domestic	Saw	108	D4	No	4	–	NeuFlex®
12	58	M	Domestic	Circular saw	114	D5	No	4	–	NeuFlex®
13	76	M	Domestic	Fall	66	D2	Yes	4	–	NeuFlex®
14	34	M	Domestic	Planer	26	D3	Yes	4	–	NeuFlex®
15	75	M	Domestic	Traction	57	D4	Yes	3	–	NeuFlex®
16	50	M	Domestic	Saw	44	D3	Yes	4	4	NeuFlex®
17	69	M	Domestic	Circular saw	10	D4	No	4	–	NeuFlex®
18	67	M	Domestic	Balloon	24	D4	No	4	–	NeuFlex®
19	42	M	Domestic	Fall	12	D2	Yes	4	–	NeuFlex®
20	60	F	Work	Breaker plow	24	D4	No	–	3	NeuFlex®
21	60	M	Work	Fall	24	D5	No	4	–	NeuFlex®
22	51	M	Work	Circular saw	6	D3	Yes	–	4	NeuFlex®
23	59	M	Work	Circular saw	22	D4	No	4	–	NeuFlex®
24	55	F	Domestic	Hedge trimmer	15	D2	No	4	–	NeuFlex®

P1: proximal phalanx; *P2*: middle phalanx; *London*: classification by London [2]; *Seno*: classification by Seno et al. [3].

Table 2
Functional outcomes in our case series (Student's test).

Variables	Total (n = 24)		Hinged (n = 15) NeuFlex®		Gliding (n = 9) Tactys®			
	μ	SD	μ	SD	μ	SD	p	95% CI
Age (years)	58	14.2	59	11.4	57	14.4	0.681	
Follow-up (months)	48	36.1	58	35.5	36	18.9	0.428	
Amplitude (degrees)								
MCP								
Flex	84	15.4	83	16.2	90	0.0	0.196	
Ext	+6	11.4	**+3**	**6.1**	**+15**	**11.7**	**0.03**	4.55; 19.57
ROM	92	19.4	86	19.8	105	11.7	0.15	
PIP								
Flex	57	27.9	57	27.4	56	15.3	0.909	
Ext	−9	18.2	**−5**	**12.7**	**−22**	**16.1**	**0.007**	−29.85; −5.2
ROM	46	23.4	52	26.3	33	11.0	0.56	
DIP								
Flex	36	17.8	37	17.2	30	10.3	0.286	
Ext	-9	13.5	**−12**	**13.4**	**0**	**0**	**0.018**	2.17; 20.88
ROM	27	15.2	25	17.5	30	10.3	0.485	
Overall								
TAM (%)	71	19.0	69	19.6	76.3	6.4	0.296	
ROM	159	48.0	156	50.1	168	14.0	0.470	
Pain on VAS (/10)	0.18	0.7	0.33	1.0	0.75	0.3	0.332	
QuickDASH (/100)	15.6	12.4	17	12.7	12	6.7	0.282	
PRWE (/100)	24.4	16.3	25	11.9	23	16.8	0.751	

VAS: visual analog scale, Ext: extension, Flex: flexion, DIP: distal interphalangeal joint, PIP: proximal interphalangeal joint, MCP: metacarpophalangeal joint, TAM: total active motion, QuickDASH: quick version of the Disabilities of the Arm, Shoulder and Hand; PRWE: Patient Rated Wrist Questionnaire; ROM: range of motion.

and 18 men (75%) with a mean age of 58 ± 12 years. A work-related accident caused the injury in 25% of cases. The ring finger was affected the most (33%). The head of the proximal phalanx was fractured in 58%, the base of the middle phalanx in 33% and combined lesions were present in 8% (Table 1). The NeuFlex® was used in 15 patients and the Tactys® in 9 patients.

At a mean follow-up of 48 ± 36 months, pain on a visual analog scale (VAS) was 0.2 ± 0.7/10, overall finger mobility based on the total active motion (TAM) was 72% ± 22%, total flexion of the MCP, PIP and DIP joints was 159° ± 48°, grip strength was 27.8 ± 9 kg/F and pinch strength was 5.3 ± 6 kg/F, which was 71% and 44% of the contralateral side, respectively. The mean QuickDASH was 15.6 ± 15/100 and the PRWE was 24.4 ± 23/100 (Table 2). All patients described their PIP joint as stable in the frontal and sagittal planes, although clinical laxity was found in two patients who had received a silicone implant.

No postoperative infection occurred. No secondary amputation was needed. One patient developed Type II complex regional pain syndrome. Three patients had no PIP movement, but the overall TAM was 155°,150° and 65°; they did not want to undergo another surgery (secondary tenolysis). Three patients who received NeuFlex® implants developed ulnar clinodactyly of 5°, 30° and 45° with TAM of 79%, 66% and 84% and QuickDASH of 5/100, 0/100 and 16/100, respectively. Three patients who received Tactys® implants had a reducible swan-neck deformity with no functional impairment (Fig. 3).

The PIP and DIP extensor lag was significantly greater in fingers receiving the Tactys® than the NeuFlex® ($p = 0.007$; 95%CI [−29.85; −5.2] and $p = 0.018$; 95%CI [−29.85; −5.2]) with no significant difference in the PIP or DIP flexion or range of motion. This PIP and DIP extensor lag was accompanied by greater hyperextension of the metacarpophalangeal (MCP) joint in the Tactys® group than the NeuFlex® group ($p = 0.03$ 95%CI [4.55; 19.57]). PIP flexion ≥50% was found in 75% of patients with no significant difference between groups. The TAM with the Tactys® appeared better than with the NeuFlex® but this difference was not statistically significant (Table 2).

On follow-up radiographs, one implant had subluxed by less than 30% with implant fracture seen at 2 years postoperative (NeuFlex®) but no clinical impairment (TAM 91%, QuickDASH 9, PRWE 18).

No dislocation, implant loosening, central subsidence or secondary ossification was found. No surgical revision was needed. At the final review, 77% of patients were satisfied or very satisfied with their care.

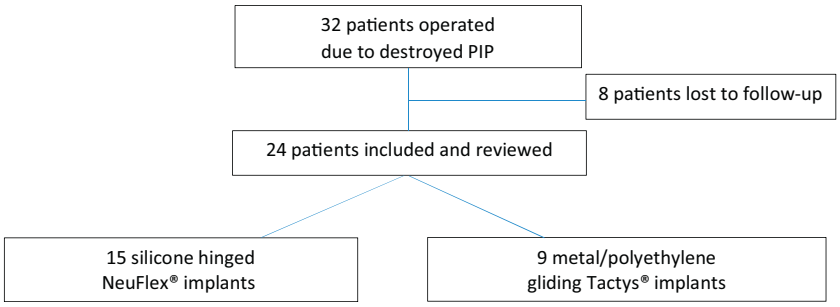

Fig. 3. Study flow chart.

Discussion

Our study is the first to compare these two types of implants for emergency arthroplasty of destroyed PIP joints.

Limitations

This study was retrospective and multicentered. The 25% loss to follow-up rate is lower than in the literature based on a systematic review finding more than 30% loss to follow-up for traumatic PIP injuries [12]. Our case series is relatively small given the low frequency of this type of injury and the challenges of doing postoperative follow-up in the context of the COVID-19 pandemic [13].

Associated soft tissue lesions can be confounding factors when evaluating the functional outcomes. We were unable to compile a detailed list of all the lesions associated with these destroyed PIP joints, thus unable to account for this bias.

There is also a measurement bias for the TAM because the angles at rest were not measured. Thus, it is difficult to describe the extensor lag objectively. The extensor lag was measured during active finger extension.

Outcomes

The functional outcomes in our case series are comparable to the literature with hinged implants for acutely destroyed PIP or post-traumatic PIP arthritis (Table 3). But up to now, no article has compared the results of the hinged silicone NeuFlex® implant with Tactys® implants in urgent severe finger fracture cases.

Fingers that received the Tactys® had a larger PIP and DIP extensor lag than fingers that received the NeuFlex®. Fingers receiving the Tactys® appeared to have better TAM, but this difference was not significant. We suggest that MCP hyperextension compensates for the postoperative extensor lag in the DIP and PIP in the fingers receiving the Tactys®, which would explain the lack of impact on the fingers' overall range of motion, pain on VAS, QuickDASH and PRWE.

The lack of mobility and limited PIP joint motion postoperatively in three of our patients can be explained by post-traumatic and postoperative adhesions [14]. Some authors proposed revision surgery with secondary tenolysis or substituting a less bulky implant [14].

Fingers receiving the NeuFlex® appeared to be more inclined to develop clinodactyly that caused minimal functional impairment in three of our patients. This deformity can be explained by the deformability of the silicone and resection of the collateral PIP ligaments in the surgical technique. PIP clinodactyly with the Tactys® implant has been reported in only 3% to 9% of cases [14,16]. Some authors have described surgical revision with the Tactys® for correction of index clinodactyly, with correction maintained at 2.6 years postoperative [17].

Implant fracture was discovered at 2 years postoperative in a finger with a NeuFlex® implant with no functional impairment (range of motion 205°, QuickDASH 9). Implant fractures have been documented in 10% to 17% of cases for the NeuFlex® implants [18–21].

Three patients in our case series had a reducible swan-neck deformity. This deformity can be explained by lesions of the volar plate, either because of the initial trauma that destroyed the PIP articular surface or because of intraoperative damage. Athlani et al. [14] recommend not weaking the volar plate and not reattaching the median slip if PIP passive flexion is constrained during intraoperative joint testing due to tenodesis. This deformity has been documented in 18% of cases with Tactys® [14] and 7.7% with the NeuFlex® [22] without need for revision surgery.

Surgical approach

All the implants in our case series were inserted through a dorsal longitudinal transtendinous surgical approach. Both participating centers favored the transtendinous dorsal approach without median slip detachment for silicone implants due to the ease of exposing the joint, compared to other surgical approaches [24]. But there is a risk of secondary joint stiffness due to adhesions of the extensor mechanism responsible for extensor lag [27].

Bodmer et al. [28] reported better functional outcomes and fewer complications with a transtendinous surgical approach compared to a volar approach and Chamay approach, with 2 years' follow-up.

Table 3
Review of literature for traumatic (emergency) or post-traumatic (>6 months after injury event) proximal interphalangeal arthroplasty.

Authors	Traumatic/ Post-traumatic	Implant	Surgical approach	N	Age (years)	Follow-up (months)	Pain VAS (/10)	QuickDASH (/100)	PRWE (/100)	PIP ROM (degrees)	Grip strength (%)	Revisions (%)	Complications
Cesari and Alnot [23]	Posttraumatic	Silicone Swanson®	Dorsal	13	36	64	NR	NR	NR	33	NR	4 (24)	3 implant changes 1 tenolysis
Mathoulin et al. [24]	Posttraumatic	Silicone Sutter®	Dorsal	21	38	46	NR	NR	NR	65	60	8 (38)	5 tenolysis 1 arthrodesis 2 implant fractures
Hage et al. [25]	Posttraumatic	Silicone Swanson®	Lateral	16	34	48	7.3	NR	NR	47	NR	2 (13)	1 arthrodesis 1 amputation
Nunley et al. [26]	Posttraumatic	Pyrocarbon	Dorsal	7	40	17	4	35	NR	30	63	2 (29)	1 amputation 1 revision
Obert et al. [10]	Traumatic	Silicone NeuFlex®	Dorsal	10	47	32	NR	NR	NR	41.8	NR	0	1 CRPS 2 clinodactyly 2 instability 3 implant fractures
Laurent et al. [21]	Traumatic	Silicone NeuFlex®	Dorsal	13	57.7	32	1.1	24	NR	48.8	NR	0	1 CRPS 2 clinodactyly 1 implant fracture
Current study	Traumatic	NeuFlex® Tactys®	Dorsal	24	58	48	0.2	15.6	24.4	52 33	24.5 30.5	0	3 clinodactyly 1 implant fracture 1 CRPS

VAS: visual analog scale; PIP: proximal interphalangeal; ROM: range of motion; NR: not recorded; QuickDASH: quick version of the Disabilities of the Arm, Shoulder and Hand; PRWE: Patient Rated Wrist Questionnaire; TAM: total active motion; CRPS: complex regional pain syndrome; [10]: publication of some of our case series results with the silicone implant at a shorter follow-up.

Some authors described using a volar surgical approach to release the A3 pulley, volar plate, and collateral ligaments with good results [29,30]. Lautenbach et al. [31] reported good survival of silicone implants when using a volar approach, with only one revision (3%) over an 8-year follow-up period. This surgical approach allows for earlier and more intense active rehabilitation [32].Yamamoto et al. [33] did a systematic literature review and found a lower revision rate through the volar approach (6% with 41 months follow-up) than with resurfacing implants through a dorsal approach (18% with 51 months follow-up).

Implant selection

The Tactys® is a valid and reliable alternative to conventional implants for scheduled surgery of post-traumatic or degenerative osteoarthritis [16]. It provides significant improvement in the functional outcomes in terms of pain, QuickDASH and PRWE, pinch and grip strength ($p < 0.001$) [15] and postoperative PIP range of motion of 58° on average at 2 years' postoperative ($p < 0.05$) [14].

Silicone implants are another valid and reliable alternative [33]. Surgical revisions after resurfacing implants mainly consist of conversion to silicone implants (23%) and arthrodesis (14%) [33]. But this silicone implant is associated with more lateral laxity than resurfacing implants [34].

Some authors have compared pyrocarbon implants with two other types of arthroplasty systems; the revision rate was 11% with silicone arthroplasty implants versus 27% for titanium/chrome-cobalt implants and 39% with pyrocarbon implants [35]. While pyrocarbon implants can provide good long-term results [36], some authors recommend against their use [37] given the poor functional outcomes and high complication rate when treating PIP arthritis [35,38].

Patient age

Patients under 60 years of age had worse postoperative results than older patients with worse joint mobility ($p < 0.01$), more frequent implant dislocation ($p = 0.04$) and more surgical revisions (OR 2.07 $p < 0.01$) [39]. The revision rate at 8 years' follow-up was reduced after silicone arthroplasty for post-traumatic PIP compared to other arthroplasty systems in those under 60 years of age ($p = 0.03$) [39].

Alternatives

PIP arthrodesis can be proposed as a first-line procedure in cases of a defect in more than 40% of the surface or a comminuted fracture, or as a secondary procedure in cases of persistent post-arthroplasty pain or chronic instability [4]. In cases of post-traumatic arthritis of the index finger, arthroplasty has 4.3 times more complications than immediate arthrodesis with comparable functional outcomes in terms of pain and patient satisfaction in the two groups [40].

Conclusion

Emergency PIP arthroplasty with Tactys® or NeuFlex® implants appears to provide similar functional outcomes. Patients must be informed of potential complications such as clinodactyly with NeuFlex® implants, swan-neck deformity and significant PIP and DIP extensor lag with the Tactys® implants with no significant functional impairment. Emergency arthroplasty for severe PIP fracture is an alternative treatment to arthrodesis and amputation in case of a large bone defect. In our case series, it provided useful PIP flexion≥ 50% in 75% of patients.

Conflict of interest

Laurent Obert has conflicts of interest with FX Solutions, Zimmer, Medartis, Evolutis, Wright Medical.
Philippe Bellemère has conflicts of interest with Wright-Medical Tornier and Stryker.
The other authors have no conflicts of interest to declare.

Funding

This work did not receive any grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval

This study conformed with the standards of the institutional review board and with the 1964 declaration of Helsinki and its subsequent amendments.

Human rights

The authors declare that the work described here did not involve experimentation on humans or animals.

Informed consent of patients

The authors declare that this report does not contain any personal information that could lead to the identification of the patient(s) and/or volunteers.

Author contributions

IR collected data, wrote and corrected the manuscript.
PB and LO corrected the manuscript and provided critical perspective.
FL, ML and IP operated patients, contributed to the design and review of the manuscript.

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