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Hand

Intramedullary Insetting of Silicone Implant for Lateral Stability in Distal Interphalangeal Joint Arthroplasty

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Summary: Silicone implant arthroplasty is an alternative surgical intervention for painful and deformed osteoarthritis of the distal interphalangeal (DIP) joints. DIP joint stability is essential for hand function; however, it carries a potential risk of postoperative joint instability. To address this concern, an intramedullary implant insetting method was used to maintain joint stability by minimum resection of the head of the middle phalanx and preserving the collateral ligament. In the new method, the length of the bone excision was limited to maintain the lateral cortical bone with the insertion of the collateral ligament, and the medullary cavity of the middle phalanx was partially removed to intentionally set the hinge part of the silicone implant in the medullary canal. Between 20 digits of the conventional approach and 23 digits of the intramedullary insetting method, there were no significant differences in patient demographics (ie, age, affected hand, and finger), and clinical characteristics (ie, active DIP joint arc, DIP joint extension loss, grip strength, visual analog scale, and Quick Disabilities of the Arms, Shoulder and Hand questionnaire score) before and over 6 months after surgery. However, postoperative joint instability was significantly lower with the intramedullary insetting method, with a significantly shorter length of bone excision of the middle phalanx. This new approach is more beneficial than the conventional approach for preventing postoperative joint instability. *(Plast Reconstr Surg Glob Open 2023; 11:e4930; doi: 10.1097/GOX.0000000000004930; Published online 13 April 2023.)*

INTRODUCTION

Arthroplasty using a silicone implant is an alternative surgical intervention for painful and deformed osteoarthritis of the distal interphalangeal (DIP) joints. It can preserve joint motion and offer good pain relief,[1–3] and affords patients satisfaction equivalent to arthrodesis.[4] However, it also involves the disadvantage of potential instability[2,5,6] and several complications, including infection, synovitis, implant breakage, implant subsidence, and recurrent deformity.[7] Postoperative lateral instability is an unfavorable condition with deterioration of hand function. We applied a modified approach to set the hinge part of the silicone implant in the medullary canal to reduce the amount of middle phalanx excision and preserve the collateral ligament to the maximum possible extent [intramedullary insetting (IMI) method]. Through our experience, we aimed to clarify the effectiveness of a new approach and compare its outcomes with those of the conventional approach.

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Surgical Technique

First, the DIP joint was opened via a dorsal approach using a long transverse skin incision just above the joint with a short longitudinal incision on both sides. The skin flap was elevated on the extensor tendon, followed by separation of the extensor tendon with V-shaped cutting. After exposing the DIP joint, osteophytes are

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removed while preserving the collateral ligaments,[2] which is very important for improving cosmetic appearance.[3] In the conventional standard method,[5] a 3- to 4-mm thick middle-phalanx head is excised with a power bone saw to match the joint space with the hinge part of the silicone implant. In the IMI method, only the joint surface of the middle phalanx was excised to maintain the lateral cortical bone with the insertion of the collateral ligament, and the medullary cavity was removed at a depth of approximately 1–2 mm using a bone rongeur to set the hinge part of the implant (Fig. 1). After implant insertion, rigid repair of the extensor tendon is vital for decreasing extension loss. When lateral instability persisted after implant insetting, plication of the lateral collateral ligament was performed before skin closure via lateral incision using an absorbable thread. [**See Video (online),** which displays the silicone implant arthroplasty of the DIP joint using the IMI method.] After the operation, the affected finger was continuously placed in a volar splint for 4 weeks in the extension position, and additional night splinting was required for 3 months (Fig. 2).

Takeaways

Question: Is there an approach for preventing lateral instability after silicone implant arthroplasty of the distal interphalangeal joint?

Findings: Intramedullary insetting of silicone implant can help maintain lateral stability with a shorter length of bone excision of the middle phalanx. This approach helps maintain joint range of motion with good pain relief as with the conventional approach.

Meaning: To prevent postoperative lateral instability, the intramedullary insetting approach can be useful.

METHODS AND RESULTS

We retrospectively analyzed the clinical and radiographic parameters between the two DIP joint arthroplasty groups using a SWANSON finger joint implant (Wright Medical Technology, Memphis, USA) between April 2018 and January 2022. The first 20 digits from 14 patients were treated using the conventional approach, and the last 23 digits from 13 patients were treated using the IMI method. The patients were all women who were selected to undergo arthroplasty after obtaining informed consent about the effect and complications of both arthrodesis and arthroplasty. This study was approved by our institutional review board. As clinical parameters for analysis, active DIP joint arc; DIP joint extension loss; grip strength; visual analog scale (VAS), Quick Disability of the Arm, Shoulder, and Hand (QuickDASH) score; and joint instability were evaluated preoperatively and over 6 months postoperatively. Joint instability was defined under the following conditions: the presence of over 20 degrees radial or ulnar deviation in the lateral stress test at the extension position[8,9] and the presence of patient apprehension for joint stability under pinch or grip motion. Additionally, the length of the excised head of the middle phalanx was measured by radiography. These items were statistically assessed with an unpaired *t* test for continuous variables and chi-square analysis for discrete variables, using IBM SPSS Statistics 28.0 for Windows (IBM Corp., Armonk, N.Y.). Statistical significance was set at *P* less than 0.05. As a result, patient demographics, including age, affected hand, and finger, showed no significant difference between the two procedures. There was no difference in preoperative DIP joint instability between the two procedures; however, the IMI method maintained postoperative stability relative to the conventional method ($P = 0.001$). In addition, using the IMI method, the length of the excised bone was

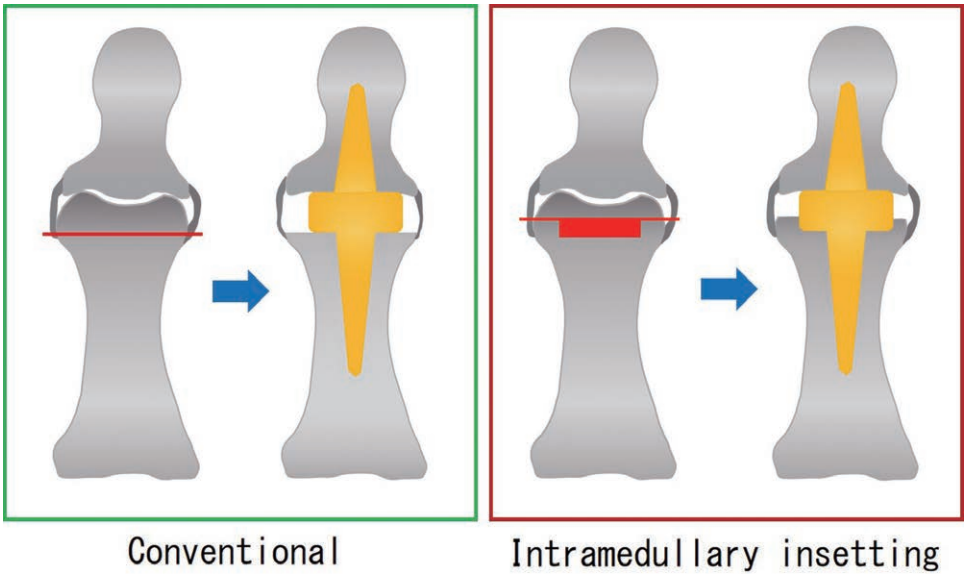

Fig. 1. Differences in bony resection using the conventional arthroplasty and the IMI method.

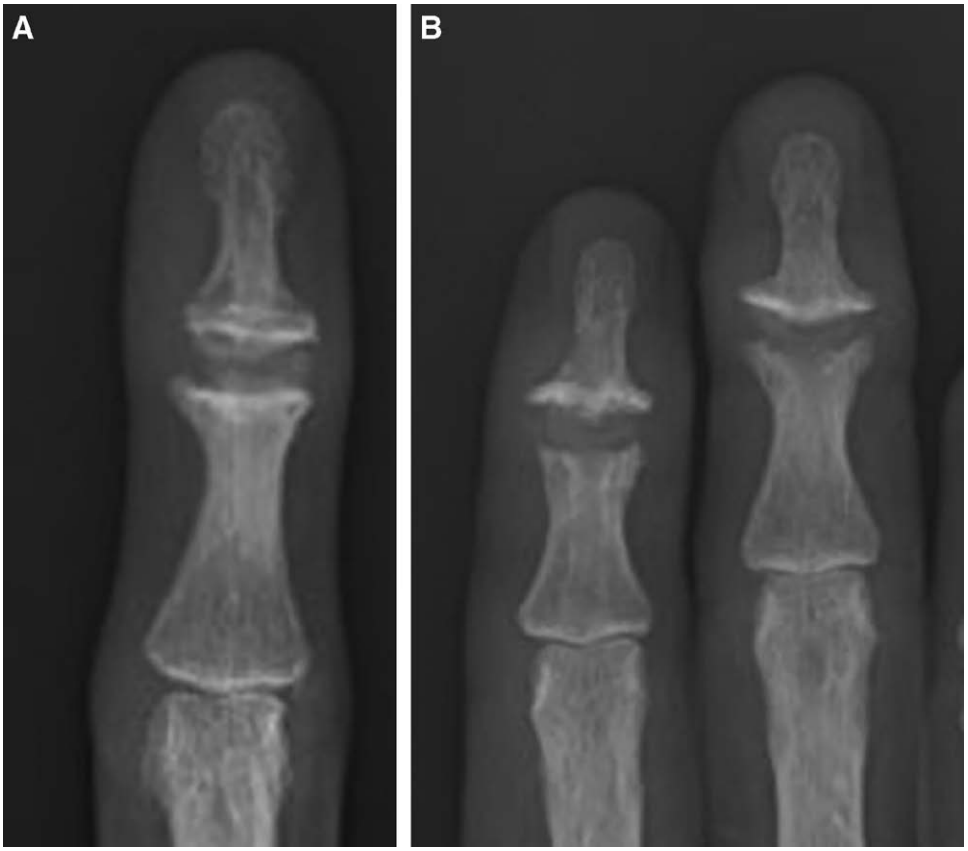

Fig. 2. Postoperative results. A, Postoperative radiograph of the right middle finger of a 56-year-old woman using the conventional approach. B, A postoperative radiograph of the right index and middle fingers of a 63-year-old woman who was treated using the IMI method.

significantly reduced ($P < 0.001$). Regarding the clinical parameters, there were no differences in the DIP joint arc and extension loss, grip strength, VAS, and QuickDASH score before and after surgery (Table 1). No severe complications were observed at 6 months after surgery.

DISCUSSION

Appropriate surgical treatment is required for patients with painful and deformed DIP joint osteoarthritis. Silicone implant arthroplasty is an alternative approach for joint motion preservation. However, Zimmerman et al[5] reported that 52% of DIP joint arthroplasty cases showed postoperative lateral instability via a standard dorsal approach; the number of cases of postoperative joint instability was significant. Additionally, joint instability is an undesirable postoperative condition that can lead to recurrent deformity and implant failure.[2,9]

It is vital to protect the collateral ligament during surgery as much as possible in silicone arthroplasty relative to surface replacement type implant arthroplasty, which retains near-normal joint congruity for support lateral stability.[8] The IMI method is the preferred approach for silicone implants to avoid damaging the collateral ligament. Our study demonstrated that 57% (13/23) of the preoperative instability was reduced to 22% (5/23) using the IMI method, while the existing 60% (12/20) increased to 70% (14/20) using the conventional approach (Table 1). The joint with severe joint deviation before surgery could not achieve complete stability, even with the IMI method.

In contrast, the IMI method has the potential to reduce the joint arc owing to the partial migration of the hinge part of the implant into the medullary canal. However, joint stability of the DIP joint is essential for hand function; thus, some loss of the joint arc is acceptable when considering joint stability. In the DIP joint, a small range of motion enhances the quality of daily activities,[10] whereas a large range of motion is required in the proximal interphalangeal joint. Additionally, because the joint space is narrow, the IMI method involves the potential risk of joint ankylosis in the long term.

CONCLUSIONS

The IMI method is a simple procedure for preserving the collateral ligament, which involves intentionally embedding part of the hinge of a silicone implant into the medullary canal. Our data show that the IMI method is more effective than the conventional approach in

Table 1. Patient Demographics and Clinical Outcomes

Characteristic	Conventional	IMI	*P*
No.	20	23	
Age (y)	58.9±11.1	57.2±6.8	0.558
Hand			0.172
Rt	12	9	
Lt	8	14	
Finger			0.458
Index	3	7	
Middle	6	6	
Ring	3	5	
Little	8	5	
Length of excised bone (mm)	3.5±0.7	2.8±0.7	<0.001
Follow-up (mo)	13.2±9.3	9.4±7.4	0.146
Before surgery			
DIP arc (°)	31.7±12.4	36.0±11.8	0.251
DIP extension loss (°)	24.4±12.7	18.4±11.3	0.112
Grip (kg)	14.0±5.0	16.6±5.8	0.146
VAS (/100)	51.1±32.6	48.0±29.8	0.762
QuickDASH (/100)	30.2±25.6	30.9±24.5	0.933
DIP instability			0.818
No	8	10	
Yes	12	13	
After surgery			
DIP arc (degrees)	24.6±7.3	23.5±7.2	0.628
DIP extension loss (degrees)	16.4±7.8	12.3±5.8	0.068
Grip (kg)	14.2±4.9	17.4±6.7	0.098
VAS (/100)	8.4±12.6	7.8±13.1	0.880
QuickDASH (/100)	10.2±10.3	12.3±8.5	0.520
DIP instability			0.001
No	6	18	
Yes	14	5	

IMI: intramedullary insetting.
Notation for continuous variables: Mean ± SD.

achieving joint stability after surgery. It involves the potential risk of decreasing the joint arc; however, this limitation is acceptable compared with the advantage of attaining joint stability.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Snow JW, Boyes JG, Jr, Greider JL, Jr. Implant arthroplasty of the distal interphalangeal joint of the finger for osteoarthritis. *Plast Reconstr Surg.* 1977;60:558–560.
2. Culver JE, Fleegler EJ. Osteoarthritis of the distal interphalangeal joint. *Hand Clin.* 1987;3:385–403.
3. Swanson AB, Swanson GD. Osteoarthritis in the hand. *J Hand Surg Am.* 1983;8:669–675.
4. Neukom L, Marks M, Hensler S, et al. Silicone arthroplasty versus screw arthrodesis in distal interphalangeal joint osteoarthritis. *J Hand Surg Eur Vol.* 2020;45:615–621.
5. Zimmerman NB, Suhey PV, Clark GL, et al. Silicone interpositional arthroplasty of the distal interphalangeal joint. *J Hand Surg Am.* 1989;14:882–887.
6. Wilgis EF. Distal interphalangeal joint silicone interpositional arthroplasty of the hand. *Clin Orthop Relat Res.* 1997:38–41.
7. Satteson ES, Langford MA, Li Z. The management of complications of small joint arthrodesis and arthroplasty. *Hand Clin.* 2015;31:243–266.
8. Minamikawa Y, Imaeda T, Amadio PC, et al. Lateral stability of proximal interphalangeal joint replacement. *J Hand Surg Am.* 1994;19:1050–1054.
9. Drayton P, Morgan BW, Davies MC, et al. A biomechanical study of the effects of simulated ulnar deviation on silicone finger joint implant failure. *J Hand Surg Eur Vol.* 2016;41:944–947.
10. Sierakowski A, Zweifel C, Sirotakova M, et al. Joint replacement in 131 painful osteoarthritic and post-traumatic distal interphalangeal joints. *J Hand Surg Eur Vol.* 2012;37:304–309.