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Original Research

# Functional Outcomes Following Interposition Elbow Arthroplasty Using Fascia Lata Graft for Post-Traumatic Elbow Osteoarthritis Without Ligament Reconstruction: A Minimum 3-Year Follow-Up Study



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**Purpose:** Elbow osteoarthritis is a debilitating disease for patients. Surgical options are to be considered when conservative management becomes unsatisfactory. Total elbow arthroplasty is an effective surgical option for patients older than 65 years and those with a sedentary lifestyle. Meanwhile, interposition elbow arthroplasty is suitable for young, high-demand patients. The retrospective study aimed to evaluate the surgical outcomes of interposition elbow arthroplasty for elbow osteoarthritis.

**Methods:** Eight patients who underwent interposition elbow arthroplasty from 2018 to 2020 in our center were retrospectively reviewed. Interposition elbow arthroplasty was performed using fascia lata autografts. Mayo elbow performance score; disability of arm, shoulder, and hand scores; and range of motion were evaluated and compared with that of the preoperative state.

**Results:** The mean Mayo elbow performance score significantly improved from  $53.7 \pm 14.6$  (before surgery) to  $85.6 \pm 12.1$  (after surgery). The mean disability of arm, shoulder, and hand score also significantly improved from  $93.1 \pm 11.8$  (before surgery) to  $57.5 \pm 15.9$  (after surgery). The mean arc of motion increased by  $85.8^\circ$ , from a mean before surgery value of  $6.2^\circ \pm 5.8^\circ$  to  $92.0^\circ \pm 34.0^\circ$  after surgery. Satisfaction rate was 92.5%.

**Conclusions:** Interposition elbow arthroplasty is a nonprosthetic reconstruction that respects the joint and does not burn any bridge for further total elbow arthroplasty if needed. It provides favorable surgical outcomes with high satisfaction rates among young patients with elbow osteoarthritis.

**Type of study/level of evidence:** Therapeutic IV.

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The end-stage of elbow osteoarthritis is a debilitating condition because of elbow joint destruction, causing pain, stiffness, and eventually loss of function.<sup>1</sup> The goals of treatment are to restore motion and alleviate pain.<sup>1,2</sup> Conservative management is the first treatment choice, which, oftentimes, provides excellent outcomes

in the early stage of the disease.<sup>1</sup> Surgery is considered when conservative management becomes unsatisfactory.<sup>2</sup> Total elbow arthroplasty (TEA) is an effective surgical option for patients older than 65 years with a sedentary lifestyle and lower demands on their elbow.<sup>2,3</sup> Total elbow arthroplasty is less favorable for young, high-demand patients due to the weight limitation of the prosthesis, which poses a risk of implant loosening if it is exceeded.<sup>3,4</sup>

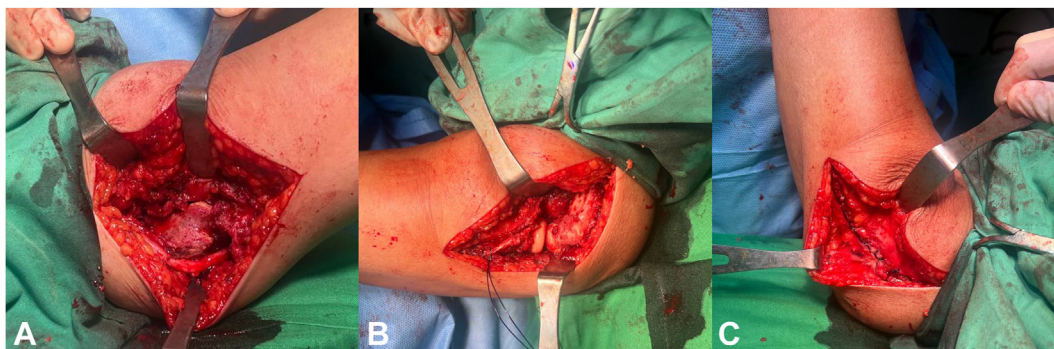
Interposition elbow arthroplasty (IEA) is a procedure to interpose soft tissues to create ulnohumeral joint space.<sup>5</sup> Studies have shown success by using fascia lata grafts, Achilles tendon allografts, dermal grafts, anconeus muscles, and gelfoam. This procedure

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**Figure 1.** Intraoperative picture depicting two separate incisions in medial **A** and lateral **B** approach. The sleeves were repaired with running whipstitch technique through the bone tunnel (transosseous suture) at the epicondyle **C**.

necessitates immobilization of the elbow for weeks either by external fixation, splint, or sling. However, the interposed soft tissue may be subjected to the transmitted compressive force across the ulnohumeral joint that may lead to graft resorption or wear. Fortunately, this procedure permits the later IEA revision or TEA as a salvage procedure.<sup>6,7</sup> In low-resource settings within third-world countries, the resource scarcity of elbow external fixation and financial limitations necessitate an alternative approach to management. These factors compel surgeons to adapt their management strategies while striving to achieve optimal outcomes. To our knowledge, there is limited study on the functional evaluation of IEA using fascia lata grafts without external fixation. This study aimed to evaluate the surgical outcomes of IEA using fascia lata grafts without ligament reconstruction in young patients with end-stage elbow osteoarthritis without external fixation.

## Methods

### Patient selection

This is an observational study of elbow osteoarthritic patients who had undergone IEA from 2018 to 2020 in Fatmawati General Hospital, Jakarta, Indonesia. The inclusion criterion included age less than 50 years with painful and stiff elbow due to post-traumatic osteoarthritis, with a minimum follow-up of 36 months. Elbow osteoarthritis is defined as a marked narrowing of joint space with severe degenerative changes with gross destruction of the joint. Every patient was investigated thoroughly with routine blood work-up to rule out any possible systemic involvement. Patients with primary osteoarthritis (OA), those with secondary OA because of other causes and comorbidity, and those lost to follow-up were excluded. Written informed consent and ethical approval were obtained by patients and the ethical committee in our institution prior to the study. The surgical procedures for all samples were conducted by a single surgeon with over 12 years of experience in shoulder and elbow surgery.

### Surgical technique

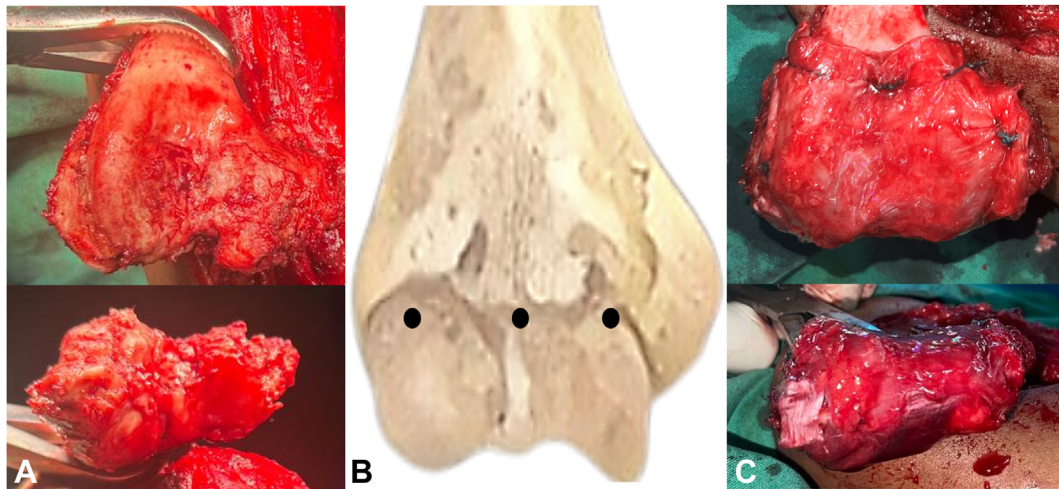
The patient was positioned supine with a pneumatic tourniquet (250 mmHg) under general anesthesia. Two separate (medial and lateral) approaches were used as the surgical approach. The ulnar nerve was meticulously isolated and mobilized to prevent iatrogenic injury from the main surgical procedure. The common flexor tendon was identified and subperiosteally detached from the medial epicondyle, creating an anterior sleeve to expose the medial column of the elbow (Fig. 1). The lateral column was exposed with the Kocher's lateral approach over the radial head, which separated

the brachioradialis and extensor carpi radialis from triceps and anconeus posteriorly (Fig. 1). These muscles were then separated from distal humerus and then released to expose joint surface. Anterior and posterior sleeves were made equally in a full-thickness manner to expose the radial head. The anterior and posterior capsulectomy was performed, and the joint was inspected and freed from any heterotopic ossifications, intraarticular fibrosis, or synostosis.

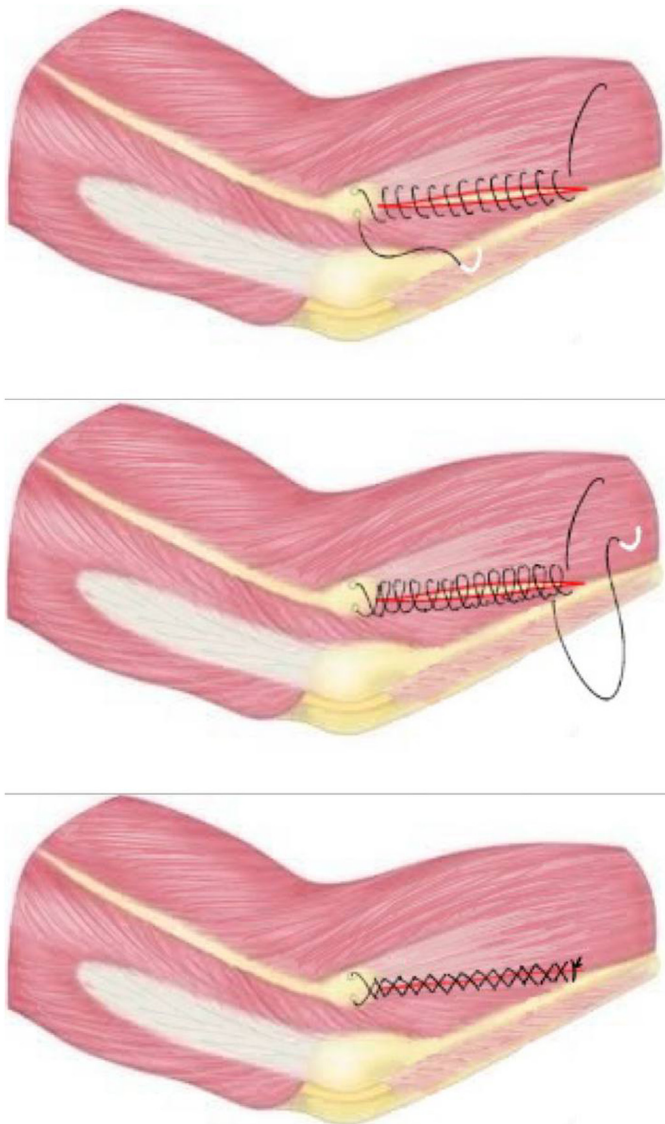
The triceps was elevated from posterodistal humerus attachment, and the joint was dislocated to further prepare the distal humerus. The distal humerus was exposed, and the articular surface was inspected (Fig. 2). We debrided both cartilage surfaces from any abnormal bone formation such as spur and, callus, and fibrous tissues until we identified the native bone at the distal humerus, at which point, we re-evaluated the alignment. We left a fibrous and cartilage surface on the olecranon side (not exposing the subchondral bone). We subjectively measured the stability after achieving a sufficient soft tissue release by evaluating the joint congruency in passive elbow flexion and extension. In all cases, we supplemented the stability by deepening and reshaping the olecranon fossa, trochlea, and coronoid fossa to ensure a congruent relationship to improve the static stability of the elbow. These procedures were performed with the combination of a rongeur and high-speed burr to ensure smooth flexion-extension motion after soft tissue interposition between the distal humerus and ulna. Adequate deepening was determined by joint stability in a full passive range of motion (ROM) without evidence of subluxation or an angled gapping that indicates incongruity.

Three drill holes were created on the distal humerus with a 2.5 drill bit (Fig. 2). A fascia lata graft was harvested from the middle part of the thigh and then folded to ensure adequate bulk. The width was tailored according to the width of the articular surface of the humerus, and the length should be long enough to be folded 3–4 times (15–20 cm). Horizontal mattress sutures were applied at the graft edges. The graft was fixed by 1.0 braided Ethibond Suture | Ethicon into the drilled holes (Fig. 2).

The elbow joint was then reduced. Instead of ligament reconstruction, the common flexor and extensor were repaired as sleeves from distal to proximal with running whipstitch technique in 5-mm intervals using 2.0 Ethibond Suture | Ethicon and through the bone tunnel (transosseous suture) made with 2.5-mm drill at the medial and lateral epicondyle 1 cm proximal to the cartilage–bone border in the extended axis of the humeral shaft with the same distance to the anterior and posterior joint surface in 90° elbow flexion and neutral forearm rotation. Instead of being cut, the suture was continued distally until the sleeves were fully repaired and provided additional strength (Figs. 1, 3). See Video 1 for more details, available online on the *Journal's* website at



**Figure 2.** **A** Intraoperative picture of distal humerus with arthritic changes. **B** Illustration of three drill holes created on the distal humerus with drill bit. **C** Fascia lata autograft laid across the distal humerus and secured with stitches through drill holes.



**Figure 3.** The schematic drawing of full-thickness sleeve repair.

<https://www.jhsgo.org>. The ulnar nerve was released in situ and placed back on the bed in all cases. A drain was placed before the skin closure and removed once the production was less than 30 mL, usually 2 days after surgery. The elbow was wrapped in cotton roll compression dressing with a posterior elbow splint in 90° elbow flexion and forearm neutral rotation. The splint was retained for the first 2 weeks after surgery. The patient was then encouraged to actively and passively flex the elbow in the arm sling to gain more flexion over the next 2 weeks with no extension beyond 90°. Elbow extension beyond 90° was then initiated 4 weeks after surgery. Two months after surgery, the patient was permitted to gradually increase the amount of weight lifted as tolerated. No additional medication was given besides diclofenac sodium for analgesics in the course of treatment.

#### Functional outcome measurements

The functional outcome measurement and follow-up radiologic examination were performed in the outpatient clinic by one of the authors who did not perform the surgery. The functional outcomes were assessed using a combination of tools including the Mayo elbow performance score (MEPS), which encompasses evaluations of pain, ROM, stability, and daily function components; disability of arm, shoulder, and hand (DASH) scores, consisting of both disability or symptom sections and optional high-performance sections; and ROM for flexion-extension. Patient satisfaction was determined by asking the patient whether they were “dissatisfied,” “not satisfied,” “somewhat satisfied,” “satisfied,” or “very satisfied” with the surgery. Postoperative complications were noted. Any possible complications were noted during the follow-up period.

#### Results

There were 10 patients who met the inclusion criteria. Among them, one patient was lost to follow-up, and one patient refused to participate. Eight patients with post-traumatic elbow stiffness were included in this study. The age ranged from 21 to 46 years, with a mean age of 27.8 years. The mean follow-up time was 51.75 months (range: 36–73 months). Demographic data are summarized in Table 1.

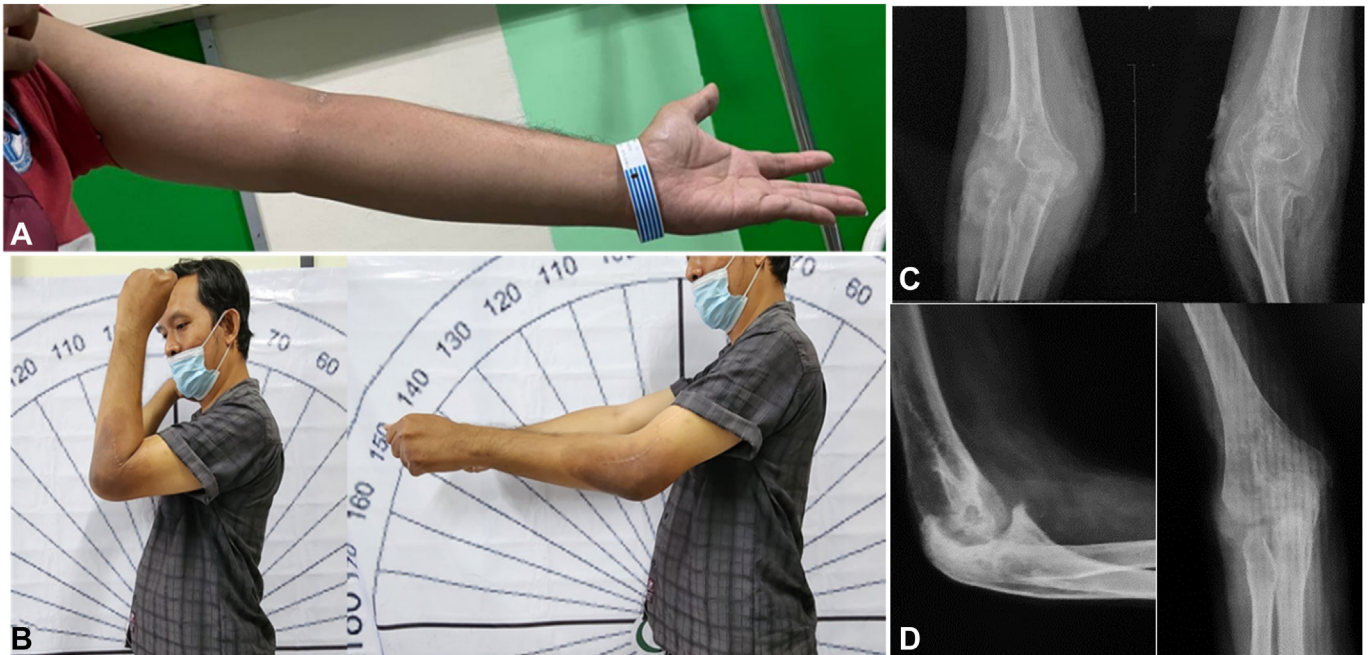
There were significant improvements in all postoperative functional scores in all subjects ( $P < .05$ ). Figure 4 represents the



**Table 1**  
Demographic Data and Functional Score in Preoperative and Postoperative

No	Age (y)	Sex	BMI	Effected Side	Hand Dominance	Follow-Up Time (mo)	Preoperative			Postoperative		
							MEPS	DASH	ROM	MEPS	DASH	ROM
1	33	Male	19.3	Right	Right	37	65	83	12	80	76	119
2	42	Male	18.4	Left	Right	61	65	92	3	100	31	121
3	22	Male	23.1	Left	Right	73	60	90	0	80	64	56
4	35	Female	20.6	Right	Right	48	55	80	0	65	70	74
5	22	Female	22.9	Left	Right	62	60	102	0	85	59	38
6	26	Female	19.7	Right	Right	37	55	85	5	95	59	129
7	22	Female	21.4	Right	Right	36	20	116	10	100	36	115
8	21	Male	19.5	Left	Right	60	50	97	6	80	65	84

BMI, body mass index; DASH, Disability of arm, shoulder, and hand; MEPS, Mayo elbow performance score; ROM, range of motion.



**Figure 4.** A preoperative clinical picture of patient with extension contracture without any apparent movement **A** and postoperative flexion-extension position **B** achieving functional range of motion ( $10^{\circ}$ – $110^{\circ}$ ). **C** Preoperative and **D** postoperative radiographs at the 2-year follow-up.

clinical picture of one patient who had an extension contracture without any apparent movement before surgery and gained functional elbow movement after surgery until the last follow-up (61 months). The mean MEPS improved by 31.9 points, from  $53.7 \pm 14.6$  before surgery to  $85.6 \pm 12.1$  after surgery. The lowest gain in MEPS was 10 points, whereas the greatest was 80 points. The preoperative mean DASH score was  $93.1 \pm 11.8$ , and the postoperative mean score was  $57.5 \pm 15.9$ . The lowest DASH improvements were seven points, whereas the greatest improvements were 80 points. The mean ROM increased by  $85.8^{\circ}$  from a mean before surgery value of  $6.2^{\circ} \pm 5.8^{\circ}$  to  $92.0^{\circ} \pm 34.0^{\circ}$  after surgery. The smallest ROM difference was  $38^{\circ}$ , whereas the largest was  $124^{\circ}$  (Table 2). All participants of the study verbally expressed satisfaction with the operation.

During the early postoperative period, there was a transient ulnar nerve paresthesia in two patients that subsided in approximately 6 and 8 weeks. Three patients complained of some difficulty in lifting weights, but none experienced pain. Among them, one patient underwent box-loop technique ligament reconstruction surgery because of moderate instability, whereas the others demonstrated favorable and adequate stability, albeit with mild instability, obviating the need for further surgery. Muscle strengthening exercise was prescribed to improve the muscle

**Table 2**  
Functional Outcome Measurements of Elbow Interposition Arthroplasty

Parameters	Preoperative	Postoperative	Mean Difference
MEPS	$53.7 \pm 14.6$	$85.6 \pm 12.1$	$31.9 \pm 21.9$
DASH	$93.1 \pm 11.8$	$57.5 \pm 15.9$	$35.6 \pm 24.9$
ROM ( $^{\circ}$ )	$6.2^{\circ} \pm 5.8^{\circ}$	$92.0^{\circ} \pm 34.0^{\circ}$	$85.8^{\circ} \pm 32.7^{\circ}$

DASH, Disability of arm, shoulder, and hand; MEPS, Mayo elbow performance score; ROM, range of motion.

strength across the elbow. No patients converted to TEA during the follow-up time. Other complications such as donor site morbidity, wound complications, or infections were not found.

## Discussion

Post-traumatic OA in young adults is scarce and yields a particular treatment challenge.<sup>8–10</sup> Mild OA may benefit from nonsurgical treatments by analgesic and activity modification to reduce stress across the elbow joint. In the advanced stage of OA or a failed nonsurgical treatment, surgery should be considered to restore elbow function and pain management. Total elbow arthroplasty is one of the surgical options particularly in patients

with pain throughout the elbow arc of motion with radiographic evidence of degenerative joint changes. In the elderly population, TEA can be considered the first-line treatment. The TEA's high mechanical failure rate particularly in active populations necessitates the patient to strictly adhere to weight restriction. Hence, in young populations, TEA is saved for the last salvaging procedure.<sup>8,9</sup>

Resection arthroplasty, fusion, and IEA are other alternative options to TEA in the young and active population. This approach uses soft tissue autografts (fascia lata and dermis) or allografts (eg, Achilles tendon and dermis) to resurface the elbow articular surface by introducing a thick cushion between the bones. Contrary to TEA, IEA gives a larger weight capability for the elbow. However, there is still a risk of graft wear or absorption. Thus, IEA is indicated for painful loss of motion in young or active patients, particularly patients who want to avoid the weight restrictions of TEA.<sup>8,9</sup>

The functional outcomes following IEA such as ROM and outcome scores are improved; however, these results are inferior to those of TEA in the short-term follow-up.<sup>8</sup> In our study, all patients showed a significant outcome improvement measured from MEPS, DASH scores, and ROM of flexion and extension of the elbow. Nolla et al<sup>9</sup> reported on 13 cases of post-traumatic arthritis that underwent IEA and hinged external fixation. Postoperative ROM significantly improved. Larson and Morrey<sup>3</sup> reported 38 cases of IEA with Achilles tendon allograft with a mean of 6 years of follow-up. There was an improvement in the mean MEPS (41–65 points) and the mean flexion-extension arc (51°–97°).<sup>3</sup> Cheng and Morrey<sup>4</sup> showed significant improvement in functional score after IEA with fascia lata autograft. The MEPS increased from 34 before surgery to 70 after surgery.<sup>6</sup> The ROM also increased from 60° before surgery to 85° after surgery. In these studies, authors used external fixator to distract the elbow for 3–4 weeks after the operation.<sup>5</sup>

We did not use an external fixator device, which may be good for stability by not distracting the joint. Iyidobi et al<sup>10</sup> applied a dorsal splint for 6 weeks after the operation and obtained significant MEPS and ROM improvement after 24 weeks. The MEPS improved from 42.51 to 81.24, and the ROM from 16.4°–97.2°.<sup>10</sup> Fernandez-Palazzi et al<sup>11</sup> performed 12 IEA, with 10 using fascia lata, one using skin graft, and one using gelfoam material, and reported that postoperative ROM ranged from 30° to 150°. Two patients achieved total ROM >120°, whereas four patients had ROM <60°. In this study, the arm was immobilized by an arm sling.<sup>11</sup>

As the sole shoulder and elbow surgeon at the third referral hospital, coupled with a prevailing community reliance on bone-setter treatment, authors often encountered cases burdened with neglected conditions, ultimately resulting in end-stage arthritic changes that necessitated referral. Our study suggested a favorable result of using fascia lata grafts with better increment in ROM than previously reported, further supporting the application of splint for postoperative stability. This will reduce the risk of pin-track infection, a subsequent external fixator removal procedure, and excess cost. Furthermore, we decided to use a splint instead of a hinged external fixator because the elbow was found stable after the reshaping procedure.

In other studies, the IEA procedure is followed by a hinged external fixator as a protective stabilizer device while permitting early postoperative elbow mobilization.<sup>2,5,9,12</sup> However, it necessitates future removal and has a risk of infection. Laubscher et al<sup>2</sup> study on hinged external application following IEA in 17 cases showed pin-related infection in eight cases. Cheung et al<sup>13</sup> reported that infections following elbow external fixation in 100 patients included local erythema and nonpurulent pin site in 15% of patients and purulent pin site drainage, fixator malalignment, pin loosening, and deep infection in 10% of patients.<sup>13</sup> Nerve irritation is another

reported pin-associated complication. Transient radial nerve irritation was reported following elbow external fixator application. Fortunately, none has ended with a permanent deficit.<sup>14</sup>

The necessity of reconstructing elbow ligaments for stability preservation is a subject of ongoing debate. Without collateral ligament reconstruction, advocates for ligament reconstruction argue that recurrent instability may arise after achieving functional ROM. Conversely, opponents of ligament reconstruction contend that it complicates surgical procedures and could prolong motion restriction during recovery. Furthermore, the potential nonanatomic ligament reconstruction poses risks such as restricted elbow motion and increased pressure on articular surfaces, leading to arthritis.<sup>15</sup>

Patients in this study showed overall satisfaction with the surgery. The satisfaction rate in this study is 92.5%, with 75% of patients reporting “very satisfied.” This result is higher than the 62% satisfactory rate of IEA reported by Cheng and Morrey<sup>4</sup> in 13 patients, with a mean follow-up of 5.2 years. Complications of IEA have been reported in several studies with longer follow-up. Laubscher et al<sup>2</sup> reported 18 consecutive cases of IEA with a mean follow-up of 54 months, of which seven cases were revised. In a systematic review by Lanzerath et al,<sup>16</sup> with a mean follow-up period of 61 months, as much as 20.9% of IEA patients required revision surgery, which includes eight cases of conversion to TEA, two graft removal, two arthrodesis, and one revision IEA.

In our study, three patients developed postoperative instability. This complication might arise because the ligamentous repair was not performed as part of the IEA procedure. Stability was attained through the congruence between the reshaped olecranon and trochlear, facilitated by the creation of soft tissue sleeves at the medial and lateral aspects. These sleeves were then meticulously repaired to their origins using bone tunnels and sutures, including the reattachment of the flexor and extensor mass. Previous studies had reported postoperative instability following IEA. Nolla et al<sup>9</sup> had four of 13 patients (30.8%) with severe instability after IEA procedure. However, Larson and Morrey<sup>3</sup> found that the postoperative instability in their study always occurred in patients with preoperative instability. Therefore, they claimed that IEA does not destabilize the joint if the technique is performed carefully, and the stability assurance may or may not need an external fixator.<sup>3</sup>

Two cases presented with numbness and tingling sensation over the ulnar nerve distribution during the early postoperative period in this study. There was no motor impairment, and the symptoms subsided at 6 and 8 weeks. Ulnar nerve paresthesia following IEA is uncommon, although the ulnar nerve is usually at risk after the manipulation and mobilization of the joint after a prior prolonged immobilization. In a systematic review of 67 cases, only two cases were reported to have ulnar nerve problems, of which only one required a nerve transposition procedure, whereas in another case, the paresthesia was only transient in the early postoperative period.<sup>16</sup>

The recurrence of elbow stiffness may complicate in the long-term follow-up. The graft used in IEA will eventually resorb over time and render the elbow to become stiff again.<sup>17</sup> Hence, revision surgery or conversion to TEA is warranted. Our study had eight patients with a mean follow-up time of 51.75 months (range: 36–73 months), and within the follow-up time, none had to convert to TEA or required revision surgery. A study by Cheng and Morrey<sup>4</sup> on IEA using fascia lata graft showed a revision rate of 31%, whereas four of 13 patients had to convert to TEA. Two of them had a follow-up time of 1 year or less.<sup>5</sup> Meanwhile, Ersen et al<sup>17</sup> reported that of the five patients who underwent IEA with Achilles tendon grafts with a follow-up time of 87.6 months, none had to convert to TEA. Moreover, Larson and Morrey<sup>3</sup> reported that a minimum revision rate (16%) occurred in cases using Achilles

tendon grafts. Explaining a better revision rate, Morrey<sup>3</sup> hypothesized that Achilles tendon grafts may be able to retain longer.<sup>3</sup> Although this hypothesis is still yet to be confirmed, our study has shown that fascia lata grafts may have longer durability than previously reported.

The small sample size and the retrospective nature are major limitations of this study. The small size of the sample perhaps renders the extrapolation to the wider population. Further studies involving larger study samples, longer follow-ups, and direct comparisons among the graft choices as well as the postoperative immobilization options are needed.

Interposition elbow arthroplasty is a nonprosthetic reconstruction that respects the joint and does not burn any bridge for further TEA if needed. Executing meticulous IEA without ligamentous reconstruction, accompanied by a simple splint and sling, followed by our postoperative protocol, yielded favorable surgical outcomes with high satisfaction rates among young patients with elbow osteoarthritis.

### Conflicts of Interest

No benefits in any form have been received or will be received related directly to this article.

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