J Surg Med. 2026;10(1):1-6.
https://doi.org/10.28982/josam.8495

JOSAM

Research article
https://jsurgmed.com/

Journal of Surgery and Medicine

e-ISSN: 2602-2079

FDMA-based kite flap reconstruction for post-burn first web space contractures: A retrospective study

Cenk Melikoğlu

Department of Plastic Surgery, Ekol Hospitals, Izmir, Turkey

ORCID of the author(s)

CM: https://orcid.org/0000-0002-6944-721X

Abstract

Background/Aim: Post-burn first web space contractures significantly impair thumb abduction and overall hand function. This study aimed to evaluate the short- to mid-term clinical outcomes of a first dorsal metacarpal artery (FDMA)–based kite flap following complete release of post-burn first web space contractures.

Methods: This retrospective case series included five patients with post-burn first web space contracture. In all cases, complete release of the contracture was performed, followed by reconstruction of the resulting defect using an FDMA-based kite flap. In one patient, a concomitant fifth-finger flexion contracture was corrected with a cross-finger flap during the same session. The primary outcome measure was first web space opening, assessed preoperatively and postoperatively using a goniometer in a standardized clinical position.

Results: The mean preoperative first web space opening was 70.0 (3.5), which increased to 90.0 (0.0) postoperatively, corresponding to a mean improvement of 20.0 (3.5). Follow-up ranged from 5 to 7 months. In all patients, the achieved web space opening was preserved throughout follow-up, and no residual or recurrent contracture was observed.

Conclusion: Reconstruction of post-burn first web space contractures using an FDMA-based kite flap after adequate release provides reliable restoration and maintenance of web space opening in the short to mid-term. This technique represents a stable and functional reconstructive option in selected patients when a true soft tissue defect is present after contracture release.

Keywords: first web space; burn contracture; first dorsal metacarpal artery; kite flap; web space opening

Corresponding Author
Cenk Melikoğlu
Department of Plastic Surgery, Ekol Hospitals, Izmir, Turkey
E-mail: cenkmelikoglu@gmail.com

Ethics Committee Approval
Written informed consent was obtained from all patients for surgical treatment and the use of clinical photographs. Ethics committee approval was obtained before study initiation.
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

Financial Disclosure
The authors declared that this study has received no financial support.

Published
2026 January 8

How to cite: Melikoglu C. FDMA-based kite flap reconstruction for post-burn first web space contractures: A retrospective study. J Surg Med. 2026;10(1):1-6.

Introduction

The first web space, defined as the interval between the thumb and the index finger, constitutes a central functional unit of the hand. Adequate opening of this space permits palmar abduction of the thumb, which determines grip span and enables effective performance of power grip, key pinch, and precision pinch. Limitation of the first web space therefore causes a disproportionate decline in overall hand function relative to the apparent local deformity. Early hand surgery literature emphasized that thumb adduction contracture should not be regarded as an isolated cosmetic or regional problem, but as a condition with broad biomechanical and functional consequences [1].

Littler's work established that restriction of thumb abduction alters grasp geometry and reduces efficiency across nearly all grip patterns [1]. When the thumb cannot abduct sufficiently, its relationship to the index and remaining fingers is disrupted, resulting in compromised object acquisition, reduced grip stability, and impaired fine motor control. Herrick and Lister further demonstrated that preservation and reconstruction of the first web space are critical not only for primary hand function but also for the success of secondary procedures such as opponensplasty and tendon transfers, which rely on an adequately positioned and mobile thumb [2].

Clinically, patients with first web space contracture often report a subjective "loss of hand strength", which commonly reflects mechanical disadvantage rather than true muscular weakness. When thumb positioning is constrained by web space narrowing, force transmission during grasp becomes inefficient and functional performance deteriorates. Sandzen emphasized that the first web space should be considered a three-dimensional functional volume rather than a simple angular measurement [3]. Within this framework, durable reconstruction should address not only widening but also restoration of depth, contour, and tissue compliance.

Post-burn contractures of the first web space are particularly challenging. Burn scars are characterized by disorganized collagen deposition and prolonged remodeling, leading to progressive contractile forces that may persist long after epithelial healing. Due to thin skin coverage, limited subcutaneous tissue, and exposure to multidirectional tensile stresses, the first web space is especially vulnerable to secondary contracture formation after burns. Bhattacharya noted that burn-related first web space contractures frequently extend beyond superficial skin involvement to include deeper structures such as fascia, tendon sheaths, and intrinsic muscle compartments [4]. Consequently, these deformities may evolve from simple scar bands into complex, volume-deficient contractures.

The biological behavior of burn scars complicates surgical management because scar tissue tends to re-shortening, particularly in highly mobile regions. Del Piñal et al. [5] emphasized that failure to prevent or correct early posttraumatic web space narrowing may lead to permanent functional impairment, underscoring the importance of timely and definitive intervention. In long-standing cases, adaptive changes may also occur in osseous alignment and capsuloligamentous structures, further limiting the effectiveness of delayed release.

Recognizing the heterogeneity of post-burn first web space contractures, Grishkevich [6] proposed a classification based on contracture depth, extent, and tissue involvement, providing a structured framework for surgical decision-making. This approach reinforces that no single reconstructive method is universally applicable and that treatment should be tailored to the specific characteristics of each deformity. Superficial contractures with preserved tissue volume may respond to local rearrangement, whereas deeper, volume-deficient contractures require more robust reconstructive strategies.

The objective of surgery in first web space contractures is twofold: complete release of all restricting structures and durable preservation of the achieved opening. Simple division of scar bands is insufficient when release results in a true soft tissue defect. Hastings and Davidson emphasized that inadequate primary correction may compromise subsequent reconstructive efforts and limit functional recovery [7]. Therefore, surgical success depends not only on the extent of release but also on the quality and stability of the reconstruction used to fill the resultant defect.

Multiple reconstructive options have been described. Z-plasty and its modifications can be effective for linear, superficial contractures by providing lengthening through tissue rearrangement [8]. However, their utility is limited in burn sequelae when tissue quality is poor and volume deficiency is prominent. The square flap technique described by Hyakusoku and Fumiiri [9] introduced a geometric approach aimed at restoring three-dimensional volume within contracted webs. Subsequent applications of the square flap in axillary and digital web contractures support its conceptual value in selected scenarios [11]. Afzal et al. [10] also reported favorable outcomes with the square flap for post-burn first web space contractures, highlighting its role as an option in appropriate cases.

Despite these advances, secondary contraction remains a major concern, particularly when reconstruction relies on skin grafts alone. Comparative studies indicate that perforator-based interposition flaps provide superior resistance to re-contracture compared with full-thickness skin grafts after burn scar release [12]. Reviews similarly support the role of vascularized flap tissue in maintaining functional gains after contracture release [13]. These data emphasize the importance of interposition tissue that provides coverage, structural support, and resistance to recurrent shortening.

Post-burn hand deformities often involve multiple anatomical units, and addressing a single contracture in isolation may limit overall functional recovery. Sunil et al. [14] reported that combined involvement of multiple fingers or web spaces is common in post-burn hands, supporting a comprehensive reconstructive approach. Algorithmic treatment strategies for first commissure burns similarly highlight the need to integrate release, reconstruction, and rehabilitation into a coherent plan [15].

Within this landscape, the first dorsal metacarpal artery (FDMA)–based kite flap is a reliable local option for perithumb and first web space reconstruction. Originally described by Foucher and Braun [16], this island flap uses the consistent vascular anatomy of the dorsal index finger to provide thin, pliable, well-vascularized tissue suitable for web space reconstruction. The anatomical reliability of the FDMA flap is

supported by vascular studies describing the arterial supply of the thumb, first web space, and index finger [17].

Clinical series have reported favorable outcomes with the FDMA flap in traumatic and post-burn thumb deformities. Eski et al. [18] emphasized its versatility in burn-related thumb deformities, noting stable coverage and functional improvement. Retrospective analyses further support its practicality in clinical use [19]. More recently, the FDMA flap has been described as a dependable technique appropriate for routine thumb reconstruction [20].

Accordingly, the present study evaluates management of post-burn first web space contractures using an FDMA-based kite flap after complete contracture release. By objectively measuring first web space opening preoperatively and postoperatively, this case series aims to clarify the role of the FDMA flap as a stable reconstructive option in selected patients with volume-deficient post-burn first web space contractures.

Materials and methods

Study design and patient population

This study was designed as a retrospective descriptive case series of patients who underwent surgical treatment for post-burn first web space contracture between May 2010 and April 2011. Five patients were included. All patients presented with progressive narrowing of the first web space secondary to childhood burn injuries, resulting in limitation of thumb palmar abduction and impaired hand function. A case series design was selected because post-burn first web space contractures are relatively uncommon and clinically heterogeneous, and focused reporting of surgical rationale and early outcomes remains informative [14, 15].

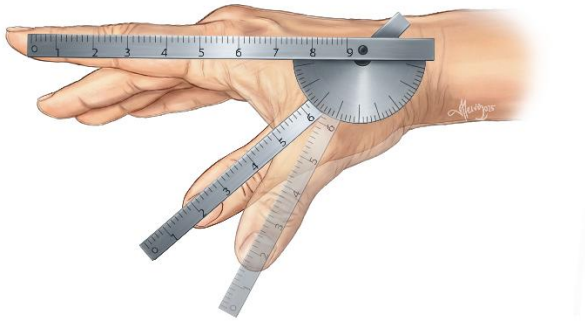
Burn etiology and contracture characteristics

In all patients, contracture etiology was a childhood domestic burn injury, predominantly stove contact burns and scald injuries from hot liquids. Initial burn management had been conservative in all cases. The first web space was involved in all patients. One patient also had an associated fifth-finger flexion contracture, consistent with reports that post-burn deformities frequently involve multiple anatomical units [14]. Intraoperative assessment confirmed that contractures extended beyond superficial scar bands into deeper planes, consistent with deeper contracture patterns described in post-burn classification systems [6].

Clinical evaluation and measurement method

The primary outcome measure was first web space opening (first web span), defined as the maximum achievable opening between the thumb and index finger during palmar abduction. Measurements were obtained preoperatively and postoperatively using a standardized protocol. Patients were evaluated seated, with the forearm in neutral rotation and the hand supported on a flat surface. The thumb was brought into maximum tolerated palmar abduction, and the angle corresponding to first web space opening was measured with a goniometer. This approach aligns with commonly used clinical assessment methods for thumb web reconstruction [3]. To minimize interobserver variability, all measurements were performed by the same examiner throughout the study period under consistent conditions (Figure 1).

Figure 1: Measurement method with goniometer

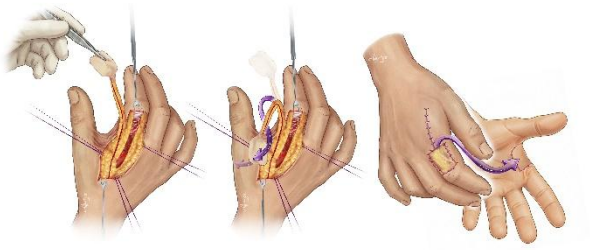


Surgical technique

Contracture release

In all cases, surgery began with complete release of the first web space contracture. Release was not limited to superficial scar incision but was performed to eliminate all fibrotic structures restricting thumb palmar abduction. Dissection continued until full passive opening of the web space was achieved. After release, a true soft tissue defect was present in all patients, indicating tissue deficiency rather than isolated linear shortening (Figure 2). Because lack of defect reconstruction is associated with a high risk of recurrent contracture, interposition reconstruction was performed in all cases [5].

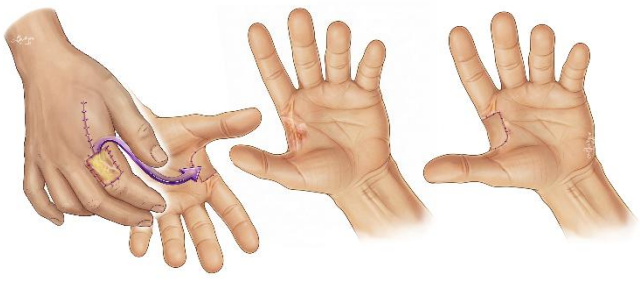
Figure 2: Surgical technique and flap elevation.



FDMA-based kite flap reconstruction

Reconstruction of the post-release defect was performed with an FDMA-based kite flap. This island flap was elevated from the dorsal aspect of the index finger and supplied by the first dorsal metacarpal artery, using the technique described by Foucher and Braun as the technical basis [16]. The flap was transposed into the first web space as interposition tissue to provide coverage and restore web space volume (Figure 3). The reconstructive aim was stable restoration of three-dimensional volume with resistance to secondary contraction, supported by the dependable vascular anatomy of the FDMA pedicle [17,18].

Figure 3: Final result of contracture release.



Additional procedures

In one patient, a concomitant fifth-finger flexion contracture was corrected during the same session using a cross-

finger flap. Addressing multiple deformities in a single operation aimed to restore both radial and ulnar functional columns of the hand, consistent with comprehensive strategies described for complex post-burn deformities [14].

Postoperative care and rehabilitation

Flap viability was monitored clinically, and no early complications such as vascular compromise or wound-related problems were observed. Immobilization was maintained during the initial healing period. Rehabilitation was initiated during the first postoperative month after wound healing, focusing on gradual restoration of thumb motion and maintenance of the achieved web space opening, consistent with algorithmic approaches to first web space management [15].

Ethical considerations

All procedures were performed according to institutional standards and the principles of the Declaration of Helsinki. Written informed consent was obtained from all patients for surgical treatment and the use of clinical photographs. Ethics committee approval was obtained before study initiation.

Results

Five patients with post-burn first web space contracture were included. The cohort had a narrow age range (21–22 years). All contractures resulted from childhood domestic burn injuries, predominantly stove contact burns and scald injuries. The first web space was affected in all patients, and one patient additionally presented with a fifth-finger flexion contracture. Patient characteristics are summarized in Table 1.

Preoperative clinical examination demonstrated marked limitation of thumb palmar abduction in all patients, corresponding to narrowing of the first web space. Representative preoperative appearances of isolated and combined deformities are shown in Figure 4a and Figure 5a.

Figure 4a. Preoperative appearance of Case 1. Narrowing of the first web space due to post-burn scar tissue with limitation of thumb abduction.

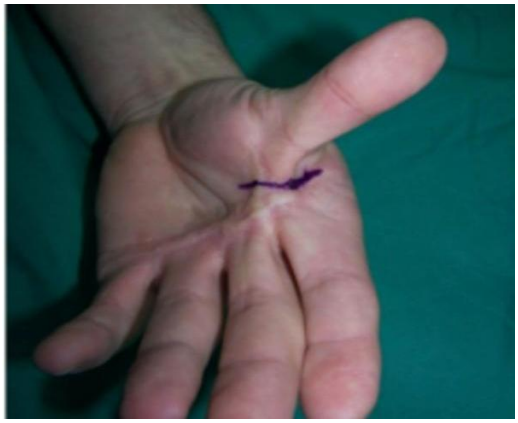


Figure 4b. Early postoperative appearance of Case 1 after complete release and reconstruction with an FDMA-based island flap, demonstrating increased first web space opening.

Complete release of the first web space contracture was achieved in all patients. Reconstruction of the resulting defect was performed with an FDMA-based kite flap in all cases. In one patient, an additional cross-finger flap was used for concomitant fifth-finger contracture correction. A total of six flaps were performed in five patients. Surgical procedures are summarized in Table 2.

Table 1. Demographic and clinical characteristics of patients (n = 5)

Patient no.	Age	Burn etiology	Affected region	Associated deformity
1	22	Stove contact	First web space	None
2	22	Stove contact	First web space	Fifth-finger flexion contracture
3	21	Hot water	First web space	None
4	21	Hot water	First web space	None
5	22	Stove contact	First web space	None

Table 2. Surgical procedures performed and flap distribution

Patient no.	Contracture release	First web reconstruction	Additional procedure	Total flaps
1	Complete	Kite (FDMA) flap	None	1
2	Complete	Kite (FDMA) flap	Cross-finger flap (fifth finger)	2
3	Complete	Kite (FDMA) flap	None	1
4	Complete	Kite (FDMA) flap	None	1
5	Complete	Kite (FDMA) flap	None	1

Early postoperative appearances following contracture release and flap reconstruction demonstrated restoration of web space width and thumb positioning (Figure 4b, Figure 5b).

Figure 5a. Preoperative appearance of Case 2. Narrowing of the first web space due to post-burn scar tissue with an associated fifth-finger flexion contracture.

Figure 5b. Early postoperative appearance of Case 2 after complete release. Reconstruction of the first web space with an FDMA-based island flap and reconstruction of the fifth finger with a cross-finger flap, demonstrating improved web space opening and finger position.

Preoperative first web space opening ranged from 65 to 75. Postoperatively, all patients achieved a first web space opening of 90. The mean preoperative opening was 70.0 (3.5), which increased to 90.0 (0.0), corresponding to a mean absolute

improvement of 20.0 (3.5). Individual measurements are presented in Table 3.

Follow-up ranged from 5 to 7 months. The achieved first web space opening was preserved in all patients throughout follow-up, and no residual or recurrent contracture was observed. In the patient who underwent combined reconstruction, improvement in both web space opening and finger position was maintained. Follow-up data are summarized in Table 4.

Table 3. First web space opening measurements

Patient no	Preoperative	Postoperative	Absolute increase
1	70	90	20
2	75	90	15
3	65	90	25
4	70	90	20
5	70	90	20

Table 4. Follow-up duration and early clinical outcomes

Patient no.	Follow-up (months)	Early clinical outcome	Residual contracture
1	7	Web opening maintained	Not observed
2	5	Web opening and finger position maintained	Not observed
3	6	Web opening maintained	Not observed
4	6	Web opening maintained	Not observed
5	6	Web opening maintained	Not observed

Discussion

Post-burn first web space contractures are functionally critical deformities that disproportionately impair hand performance. Narrowing of this region restricts thumb palmar abduction, alters grip geometry, and compromises opponens function, thereby limiting both power and precision grip. Classical hand surgery literature has emphasized that thumb adduction contracture should be viewed not as a localized scar problem, but as a condition with broad biomechanical consequences for the entire hand [1, 2].

Effective surgical management requires both complete release and durable preservation of the achieved opening. This balance is particularly challenging in burn sequelae because scar tissue remains prone to secondary contraction. Classification systems for post-burn first web space contractures highlight the need to tailor surgical strategy according to depth, extent, and tissue deficiency [6]. In the present series, a true soft tissue defect was consistently present after release, supporting the interpretation that these deformities were volume-deficient rather than simple linear scar bands.

The first prerequisite for meaningful correction is complete release of all restricting structures. Limited division of superficial scar bands may leave residual restriction despite reconstruction. Functional recovery depends on restoration of the three-dimensional web space volume rather than surface widening alone. Interposition tissue is therefore essential because it provides volume, redirects tension vectors, and reduces the risk of re-shortening, aligning with Sandzen's volumetric concept of thumb web reconstruction [3]. In burn-related contractures, flap-based reconstruction offers both biological and mechanical advantages over graft-only closure [4, 5].

The FDMA-based kite flap is a well-established local island flap with reliable vascular anatomy and favorable tissue characteristics for first web space reconstruction. Its anatomical basis, described by Foucher and Braun and supported by vascular studies, explains its clinical reliability [16, 17]. The flap provides thin, pliable, well-vascularized tissue that is particularly suited to interposition in a highly mobile region.

In this series, the FDMA flap was used to meet both coverage and volume requirements after complete release. Use of similar local tissue may facilitate integration and improve resistance to secondary contraction. Previous reports support the versatility and practicality of the FDMA flap in post-burn thumb deformities and routine thumb reconstruction [18-20].

In one patient, simultaneous correction of an associated fifth-finger flexion contracture was performed using a cross-finger flap. Addressing multiple deformities in a single session supports the principle that post-burn hand deformities are frequently multifocal and that isolated correction may limit functional recovery [14].

Alternative techniques may be appropriate depending on contracture type. Z-plasty can be effective for superficial linear bands but may be insufficient when tissue deficiency is present [8]. The square flap is a volumetric technique that can expand contracted webs and has been used successfully in selected post-burn cases [9-11]. Skin grafting, although technically simpler, remains vulnerable to secondary contraction in mobile areas; comparative data support greater resistance to re-contracture with flap-based interposition reconstruction than with full-thickness grafting alone [12,13].

In this study, outcome assessment relied on first web space opening, an objective and clinically meaningful measure reflecting thumb positioning and grip span. Restoration and maintenance of this parameter suggest improved palmar abduction and grip geometry. However, web space opening alone does not fully capture hand function. Future studies could incorporate additional measures such as pinch strength and validated functional or patient-reported outcome instruments.

Limitations

This study has limitations. The sample size was small (n=5), limiting generalizability and precluding meaningful comparison with alternative techniques. Follow-up was limited to 5–7 months, which is insufficient to assess long-term recurrence in the setting of ongoing burn scar remodeling. Functional assessment relied on a single measurement parameter without complementary strength testing or patient-reported outcomes. Finally, the absence of a comparator group limits conclusions regarding superiority over other reconstructive options.

Conclusion

This case series suggests that complete release of post-burn first web space contractures followed by reconstruction with an FDMA-based kite flap can restore and maintain functional web space opening in the short to mid-term. The findings support the concept that these contractures should be treated as volume-deficient deformities rather than isolated scar bands and that interposition tissue after adequate release may provide a stable basis for preserving thumb palmar abduction. Larger studies with longer follow-up and broader functional assessment are needed to better define optimal reconstructive strategies.

References

1. Littler JW. The prevention and the correction of adduction contracture of the thumb. Clin Orthop Relat Res. 1959;13:182-95.
2. Herrick RT, Lister GD. Control of first web space contracture, including a review of the literature and a tabulation of opponensplasty techniques. Hand. 1977;9(3):253-64. doi: 10.1016/S0072-968X(77)80111-3.
3. Sandzen SC. Thumb web reconstruction. Clin Orthop Relat Res. 1985;195:66-82.
4. Bhattacharya S. Management of burn contractures of first web space of the hand. Burns. 1992;18(1):54-7. doi: 10.1016/0305-4179(92)90012-L.

5. Del Piñal F, García-Bernal FJ, Delgado J. Is posttraumatic first web contracture avoidable? Prophylactic guidelines and treatment-oriented classification. Plast Reconstr Surg. 2004;113(6):1855-60. doi: 10.1097/01.PRS.0000117191.19962.F2.
6. Grishkevich VM. First web space post-burn contracture types: contracture elimination methods. Burns. 2011;37(2):338-47. doi: 10.1016/j.burns.2009.11.001.
7. Hastings H 2nd, Davidson S. Tendon transfer for ulnar nerve palsy: evaluation of results and practical treatment considerations. Hand Clin. 1988;4(2):167-79.
8. Kamath BJ, Bhardwaj P. Adjustable distractor for management of thumb web contracture. Burns. 2009;35(2):274-9. doi: 10.1016/j.burns.2008.03.018.
9. Hyakusoku H, Fumiiri M. The square flap method. Br J Plast Surg. 1987;40(1):40-6. doi: 10.1016/0007-1226(87)90009-9.
10. Afzal MO, Tarar MN, Rafi Y. Reconstruction of the post-burn first web space contractures of hand with square flap: efficacy of the technique. Pak J Med Health Sci. 2019;13(1):176-80.
11. Huang C, Ogawa R. Three-dimensional reconstruction of scar contracture-bearing axilla and digital webs using the square flap method. Plast Reconstr Surg Glob Open. 2014;2(5):e149. doi: 10.1097/GOX.0000000000000110.
12. Stekelenburg CM, Jaspers MEH, Jongen SJM, Baas DC, Gardien KLM, Hiddingh J, et al. Perforator-based interposition flaps perform better than full-thickness grafts for the release of burn scar contractures: a multicenter randomized controlled trial. Plast Reconstr Surg. 2017;139(2):501e-509e. doi: 10.1097/PRS.0000000000002993.
13. Stekelenburg CM, Marck RE, Verhaegen PDHM, Marck KW, van Zuijlen PPM. Perforator-based flaps for the treatment of burn scar contractures: a review. Burns Trauma. 2017;5:5. doi: 10.1186/s41038-017-0071-2.
14. Sunil NP, Ahmed F, Jash PK, Gupta M, Suba S. Study on surgical management of post-burn hand deformities. J Clin Diagn Res. 2015;9(8):PC06-PC10.
15. Yuste V, Delgado J, Agulló A, Sampietro JM. Development of an integrative algorithm for the treatment of various stages of full-thickness burns of the first commissure of the hand. Burns. 2017;43(4):812-8. doi: 10.1016/j.burns.2017.01.002.
16. Foucher G, Braun JB. A new island flap transfer from the dorsum of the index to the thumb. Plast Reconstr Surg. 1979;63(3):344-9. doi: 10.1097/00006534-197903000-00008.
17. Earley MJ. The arterial supply of the thumb, first web and index finger and its surgical application. J Hand Surg Br. 1986;11(2):163-74. doi: 10.1016/0266-7681(86)90253-6.
18. Eski M, Nisanci M, Sengezer M. Correction of thumb deformities after burn: versatility of first dorsal metacarpal artery flap. Burns. 2007;33(1):65-71. doi: 10.1016/j.burns.2006.04.030.
19. Muyldermans T, Hierner R. First dorsal metacarpal artery flap for thumb reconstruction: a retrospective clinical study. Strategies Trauma Limb Reconstr. 2009;4(1):27-33. doi: 10.1007/s11751-009-0056-1.
20. Can B. The first dorsal metacarpal artery flap: a practical operation for thumb reconstruction. Hand Microsurg. 2018;7(3):143-8. doi: 10.5455/handmicrosurg.285127.