Research Article / Araştırma Makalesi

Foucher's Flap For Reconstruction of Thumb Pulp Defects: Evaluation of 14 Cases

Başparmak Pulpa Defektlerinin Foucher Flebi İle Onarımı: 14 Vakanın Değerlendirmesi

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Abstract

Background: Thumb pulp is a common site for hand injuries and the sensory function gained with its reconstruction is very important for hand function. We aimed the focusing in Foucher's flap of the first dorsal metacarpal artery for coverage of thumb pulp defects.
Materials and Methods: Our study was done over a period of two years, between 2019 and 2021 and involved 14 consecutive cases of thumb pulp defects treated in our institution. The patients included 12 males and 2 female, mean age of 40,5±14,43 years. Three elective and eleven emergency cases were operated in the study. We observed the patients for a period as following first week, 1 st. Month, 3. Month, 6 and 12 month.
Results: The mean used flap was 2,57x2,07 cm. All the patients had good fine touch and the mean two-point discrimination (s2-PD) was 8,9 mm, which was satisfactory. No flap loss occurred in any patient; one patient distal margin necrosis, one patient epidermolysis and one patient venous congestion were observed.
Conclusions: Foucher's flap for thumb pulp defects is successful flap tecnique for sensation reconstruction. It replaces the soft tissue loss at the thumb pulp with minimal donor site morbidity and with good return of thumb pulp sensation. Our experience showed that Foucher's flap is reliable option and has minimal complications.

Key Words: Foucher's flap, Thumb pulp defect, Dorsal metacarpal artery, Island flap

ÖZ.

Amaç: Başparmak pulpası el yaralanmalarının sık görüldüğü bir bölgedir ve yaralanma sonrası yapılan rekonstrüksiyonla kazanılan duyu el fonksiyonu için oldukça önemlidir. Çalışmamız başparmak pulpa defektinin rekonstrüksiyonunda kullanılan birinci dorsal metakarpal arter ada flebi olan Foucher's flebinin kullanımı ve sonuçlarını tartışmak için yapıldı.
Materyal ve Metod: Çalışmamıza 2019 – 2021 yılları arasında hastanemize başvuran 14 başparmak pulp defektli 14 hasta dahil edildi. Hastalarımızın 12'si erkek, 2'si kadın, yaş ortalamaları ise 40,5±14,43 idi. 11 hastaya elektif cerrahi, 3 hastamıza da acil cerrahi uygulandı. Hastalarımız ameliyat sonrasındaki 1. hafta, 1. ay, 3. ay 6. ay ve 12. ay olarak takip edildi.
Bulgular: Ortalama flep boyutu 2,57 x 2,07 cm idi. Hastaların ortalama iki nokta ayrım duyarlılığı (s2-PD) 8,9 mm olarak ölçüldü ve bu sonuç gayet tatmin ediciydi. Bir hastamızda marjinal nekroz, bir hastamızda epidermoliz ve bir hastamızda venöz konjesyon gözlemledik fakat uyguladığımız fleplerin hiçbirinde flep kaybı yaşamadık.
Sonuç: Foucher's flebi başparmak pulp defekti olan hastalarda dokunma hissini sağlayabilen başarılı bir yumuşak doku rekonstrüksiyon tekniğidir. Donör sahada minimal morbidite oluşturarak pulp defekti dokunma hissi elde edilerek rekonstrükte edilmektedir. Çalışmamızda da minimum komplikasyon ve güvenilir bir rekonstrüksiyon tekniği olduğunu göstermiş olduk.

Anahtar kelimeler: Foucher's flep, Başparmak pulp defekti, Dorsal metakarpal arter, Ada flebi

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Introduction

Thumb pulp defects mostly occur due to avulsion injuries and affect the function more than the other finger's injuries. Also, thumb pulp injuries decrease quality of life during daily living activities compared to other finger injuries. The use of skin grafts is quite challenging for reconstructing defects where tendon or bone is exposed. (1,2). It is of utmost importance to reconstruct these defects using sensate flaps to provide the various functions of the thumb.

Many alternatives are practiced for thumb pulp defect reconstruction, such as pulp tissue transfer of toe, Littler's neurovascular island flap, sensate cross-fingered flaps, other small free flaps, and the first dorsal metacarpal artery (FDMA) island flap (3-8). Foucher and Braun first described the FDMA island flap as a sensory island flap to resurface soft-tissue defects of the fingers. The FDMA island flap is also named the Foucher's flap (9).

FDMA is one of the three branches of the radial artery, which originates at the starting point of the first intermetacarpal cleft and stretches out with the side of the second metacarpal over the first dorsal interosseous muscle. The artery stretches out the fascial layer of the first dorsal interosseous muscle and divides into three branches; the intermediate branch moves towards the first web space, the radial branch to the thumb, and the ulnar branch to the index finger. The dorsal surface of the index finger up to the proximal interphalangeal (PIP) joint finger is fed by FDMA. (10).

The present study aimed to evaluate the patients operated for thumb pulp defect reconstruction using the Foucher's flap.

Materials and Methods

Study design and study population

This retrospective study was conducted at the hand surgery department of a tertiary hospital between December 2019 and November 2021. Ethical approval for this study was obtained from Necmettin Erbakan University Ethical Committee (Date:26/02/2020; Number:2020/2327). Fourteen patients with thumb pulp defects were operated on with the Foucher's flap. We performed emergency surgery on ten trauma patients after six to 23 hours of injury. All patients were followed up postoperatively at the end of the first week and first, third, sixth, and 12th months.

The sensory function of the flaps was evaluated with the fine touch and two-point discrimination (s2-PD) testing. Postoperative complications were recorded.

Surgical technique

Foucher flap is more convenient for the reconstruction of pulp defects of the thumb. (Figure 1). This technique can also be applied to reconstruct the first web, for the lengthening of the thumb and the tissue defects that occur after the resection of the dorsal hand tumors. All patients were operated on with tourniquet control (250 to 300 mmHg) under local anesthesia.

The flap was harvested from the dorsal surface of the second finger up to the proximal interphalangeal (PIP) joint fed by FDMA. Initially, the FDMA was found inside the muscle belly of the dorsal interosseus muscle. Muscle fascia was incised, followed by the second metacarpal bone periosteum elevation on the radial side. The metacarpal nutrient branch of FDMA was found and ligated. The flap was elevated, leaving the paratenon intact on the surface. (Figure 2).

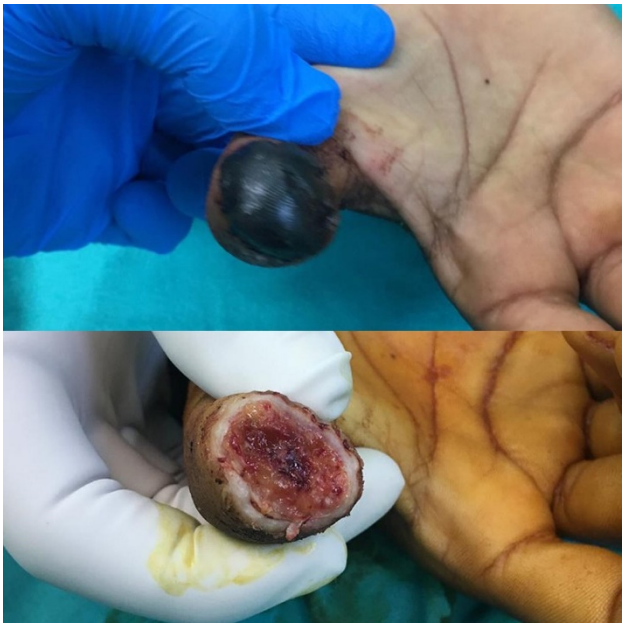

Figure 1. Left thumb of a patient who developed necrosis after primary suture.

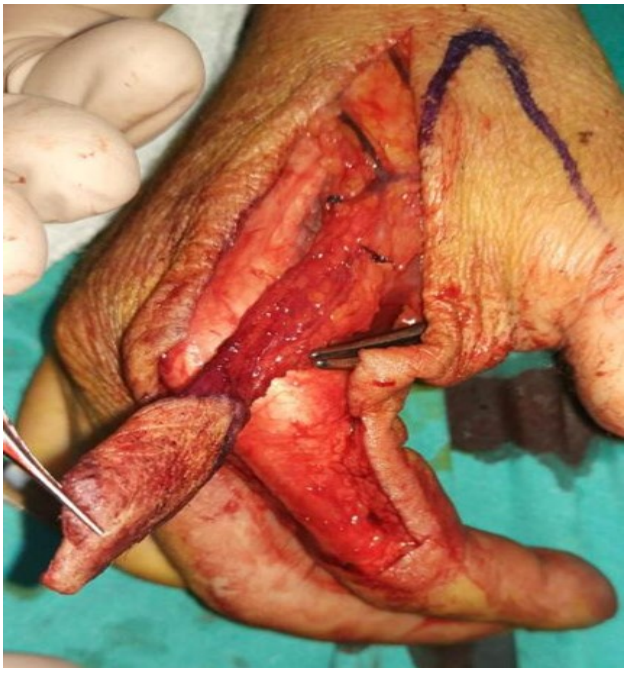

Figure 2. First metacarpal artery-based flap harvesting.

The pedicle included the fascia of the first dorsal interosseous muscle, the dorsal veins, and the sensory branch of the radial nerve. Then, the flap was placed over the defect area (Figure 3). A full-thickness skin graft was used to cover the donor area. The patient's hands were elevated for 48 hours in the early postoperative period. The patients were discharged after the first postoperative day and were observed for postoperative complications until the fifth postoperative day. After surgery, a daily dose of 100 mg acetylsalicylic acid was prescribed for one month.

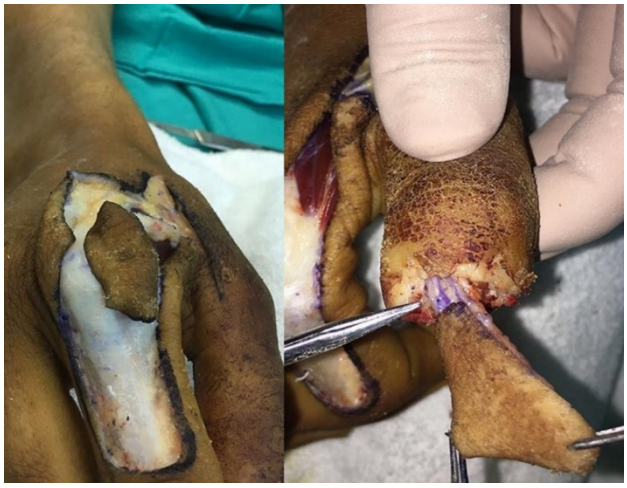

Figure 3. Transport of the first metacarpal artery-based flap with the pedicle stem.

Statistical analysis

The data obtained in the study were transferred to the database created in the SPSS (Statistical Package For Social Sciences) v.18.0 package program for the statistical analysis. Continuous variables were presented as mean ± standard deviation for the normally distributed data. Categorical variables were presented as number, and percentage in the descriptive statistics section.

Results

Of the fourteen patients with a mean age of 40.5±14.4 (range, 16 to 66) years, 12 were male, and two were female. Eleven patients presented with trauma, while two patients had thumb pulp infection, and one had tissue defects after tumor resection (Table 1). The mean diameter of the defect was 5.21±2.83 (2x1 to 3x5) cm. The mean used flap size was 2,7±0,73 x 2,57±0,93 cm. No flap loss occurred in any patient. We had only three complications: venous congestion in one patient, epidermolysis in one patient, and distal margin necrosis in one patient (Table 2).

The mean sensory function of the Foucher's flaps was s2-PD of 8.9±2,1 mm. Subjective satisfaction score was 8.24±1,97 (range:4-10). Twelve patients recovered with a satisfactory cosmetic appearance of both the flap and donor site (Figure 4). The range of motion restriction was observed in two patients.

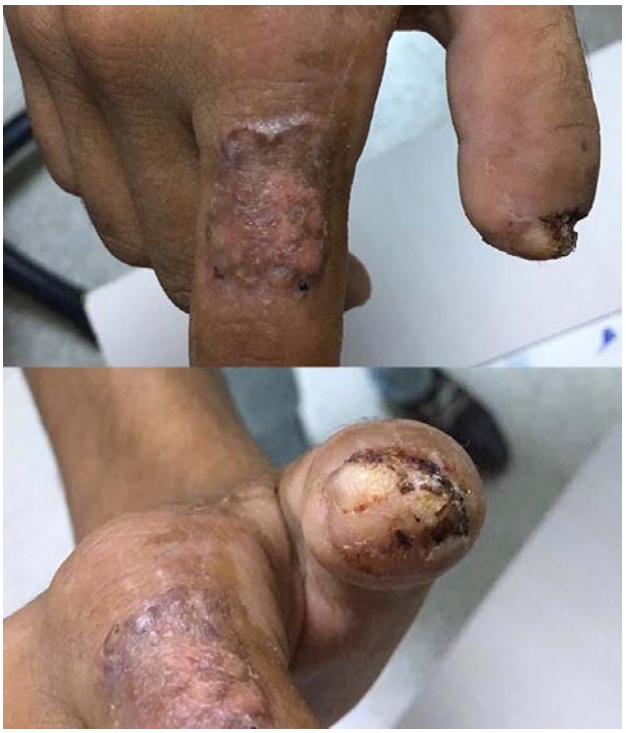

Figure 4. Clinical outcome of the flap and graft site at the 2nd postoperative month.

Discussion

Reconstruction of complex thumb pulp tissue defects is a challenging intervention, and different techniques have been described in the literature (1-5,8,11,12). Our study used the Foucher's flap, which contains the dorsal metacarpal artery and its vein, covering the superficial part of the radial nerve, for thumb pulp defects. We observed favorable results in the postoperative period, and the technique was applicable and beneficial for the functioning and sensation of the joint.

The sensibility of the thumb is the most crucial issue for thumb pulp reconstruction. The mean s2-PD of patients was 8,9 mm. We found that the sensation (pain and temperature) was protected after reconstructing the thumb pulp defects via the Foucher's flap. Ghelani et al. (13) examined 15 patients with thumb defects who had FDMA island flap and reported that FDMA island flap for thumb defects was a reliable and good option with a low complication rate. Similarly, Chang et al. (6) operated on eight patients who had extensive pulp defects of the thumb along with joint, bone, tendon exposure. They used the FDMA island flap technique, and the mean s2-PD was reported as 8.1mm. In a retrospective study conducted by Muyldermans and Hierner (2), the mean s2-PD test result was reported as 10.57 mm. They also stated that the differences in sensibility with FDMA island flap depended on the patient's age. There were seven patients with a mean age of 54.9±22,3 (range, 28 to 89) years in their study.

There were 14 patients with thumb pulp defects in the present study with a mean age of 40.5±14.4 years. The ability of cortical reorientation can be attributed to age-related differences in surgical results.

In our study, the mean flap size was 2,07±2,57 x 2,57±0,93 cm, and we observed distal margin necrosis in only one patient. Other flap methods such as Vilain flap or Moberg flap are not recommended when the defects are greater than 20 mm (14). In Foucher's modification, the flap commonly has reduced microinjury complication rate and is also preferable for different geometric designs by using dorsal metacarpal artery (15).

We observed venous congestion in one patient, epidermolysis in one patient, and distal margin necrosis in one patient as early postoperative complications. Similarly, Delikonstantinou et al. (1) reported that only one out of eight patients had partial Foucher's flap necrosis while all patients' thumbs had optimal stability. Al Lahham et al. (16) operated on nine patients with distal thumb injuries with the FDMA island-Holevich flaps and reported that two of the flaps had epidermolysis, and none of the patients had an infection or distal necrosis. They concluded that FDMA was one of the best choices for reconstructing the distal thumb, although it had an unfavorable effect of distal necrosis that could be avoided by surgical technique experience. The main disadvantage is necrosis of the distal part of the valve, leading to further complications such as prolonged wound healing, infection, and even the necessity for further surgery. This condition can be attributed to subcutaneous tunneling of the island valve, which may tighten in the next few postoperative days due to hematoma or edema accumulation. Another important cause may be inadequate venous drainage of the valve, leading to distal end occlusion and necrosis. Inadequate venous drainage of the flap cause edema, distal margin congestion, necrosis, and other related early complications. Kola et al. (17) focused on the Foucher's neurovascular flap, which is acknowledged to be an effective thumb reconstruction method. They reported the results of seven patients with extensive pulp defects of the thumb reconstructed with the Foucher's flap and concluded that Foucher's flap had successful results with rare complications.

Couceiro and Sanmartin (18) compared the outcomes of the Holevich technique and FDMA island flap technique in 10 patients. The outcomes revealed that the Holevich group had less occlusion and necrosis. Zhang et al. (19) operated on 42 patients with thumb pulp defects via Foucher's flap, and thumb flap necrosis occurred in only two patients. In addition, they did not need further surgery. Ghoraba et al. (11) reported that FDMA flap was a sensate flap for reconstruction of the thumb and concluded that FDMA island flap provided reliable functional and aesthetical results.

Although surgical options are limited in thumb pulp injuries, we successfully use Foucher's flap as a standard treatment method in our clinic in cases of primary tissue loss or post-surgical necrosis. Foucher's flap is our first-line treatment option regarding low donor site morbidity, no major complications after the flap, and providing the thumb two-point discrimination sense.

Limitations

This study has several limitations. First, the study has a retrospective design with small sample size. Second, there was no patient group operated with other techniques to compare the effectiveness of the surgical technique. However, there are studies with a limited number of patients, similar to the present study, and the number of comparative studies in the literature is limited.

Conclusion

In conclusion, the Foucher's flap for reconstruction of thumb pulp defects is a reliable method with good functional results. Furthermore, the FDMA island flap successfully provides thumb sensation in thumb pulp defects with minimal donor site morbidity.

Ethical Approval: *Ethical approval for this study was obtained from Necmettin Erbakan University Ethical Committee (Date:26/02/2020; Number:2020/2327)*

Author Contributions:
Concept: N.A.,T.S,Ç., N.D., M.R.K.
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Data acquisition: N.D., M.R.K.
Analysis and interpretation: N.A.,T.S,Ç., N.D.
Writing manuscript: N.A.,T.S,Ç., N.D., M.R.K.
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References

1. Delikonstantinou IP, Gravvanis, AI, Dimitriou V, Zogogiannis I, Douma A, Tsoutsos DA. Foucher First Dorsal Metacarpal Artery Flap Versus Littler Heterodigital Neurovascular Flap in Resurfacing Thumb Pulp Loss Defects. Ann Plast Surg. 2011; 67(2):119-22.
2. 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.
3. Xarchas KC, Tilkeridis KE, Pelekas SI, Kazakos KJ, Kakagia DD, Verettas DA. Littler's flap revisited: An anatomic study, literature review, and clinical experience in the reconstruction of large thumb pulp defects. Med Sci Monit. 2008;14(11):CR 568–73.
4. Guelmi K, Barbato B, Maladry D, Mitz V, Lemerle JP. Reconstruction of digital pulp by pulp tissue transfer of the toe. Apropos of 15 cases. Rev Chir Orthop Reparatrice Appar Mot. 1996;82(5): 446–52.
5. Woon CY, Lee JY, Teoh LC. Resurfacing hemipulp losses of the thumb: The cross finger flap revisited: Indications, technical refinements, outcomes and long-term neurosensory

recovery. Ann Plast Surg. 2008;61(4): 385–91.
6. Chang SC, Chen SL, Chen TM, Chuang CJ, Cheng TY, Wang HJ. Sensate first dorsal metacarpal artery flap for resurfacing extensive pulp defects of the thumb. Ann Plast Surg. 2004;53(5): 449–54.
7. Sherif MM. First dorsal metacarpal artery flap in hand reconstruction. I. Anatomical study. J Hand Surg Am. 1994;19(1): 26–31.
8. El-Khatib HA. Clinical experiences with extended first dorsal metacarpal artery island flap for thumb reconstruction. J Hand Surge Am. 1998;23: 647–52.
9. Foucher G, Braun JB. A new island flap transfer from the dorsum of the index to the thumb. Plast Reconstr Surg. 1979;63: 344–49.
10. 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.
11. Ghoraba SM, Mahmoud WH. Outcome of Thumb Reconstruction Using the First Dorsal Metacarpal Artery Island Flap. World J Plast Surg. 2018 May;7(2):151-158.
12. Luttenberger M, Taqatqeh F, Dragu A, Bota O. Thumb Reconstruction after Severe Trauma Using the Masquelet Technique and the Foucher Neurovascular Flap. Plast Reconstr Surg Glob Open. 2020;8(9): e3097.
13. Ghelani N, Shah S, Kaushal A, Ponkiya H. First Dorsal Metacarpal Artery (FDMA) flap: A reliable choice for thumb defects. BJKines-NJBAS;11(2):2019.
14. Ray EC, Sherman R, Stevanovic M. Immediate reconstruction of a nonreplantable thumb amputation by great toe transfer. Plast Reconstr Surg. 2009;123(1):259-67.
15. Dogan F, Coruh A. Novel biogeometric designs of first dorsal metacarpal artery flap in hand reconstruction. J Burn Care Res. 2014;35(6): 399-405.
16. Al Lahham S, Ahmed MB, Aljassem G, Sada R, Alyazji ZTN, Thomas J. A Modification to Enhance the Survival of the Island FDMA Flap by Adding a Skin Bridge. Plast Reconstr Surg Glob Open. 2021;9(2): e3434.
17. Kola N. Thumb Reconstruction Using Foucher's Flap. Open Access Maced J Med Sci. 2016;4(1):70-3.
18. Couceiro J, Sanmartín M. The Holevich flap revisited: a comparison with the Foucher flap, case series. Hand Surg. 2014;19(3):469-74.
19. Zhang X, Shao X, Ren C, Zhang Z, Wen S, Sun J. Reconstruction of thumb pulp defects using a modified kite flap, J Hand Surg Am. 2011;36(10):1597– 603.