Perforator Flap Based Technique for the Treatment of Dupuytren's Contracture

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Research article

Keywords: Perforator Flap Technique, Dupuytren's Contracture

Posted Date: December 11th, 2019

DOI: <https://doi.org/10.21203/rs.2.18591/v1>

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Abstract

Background: Perforator flap based technique was used in treating Dupuytren's Contracture in a cohort of 48 patients. This perforator based on the ulnar palmar digital artery originates from the superficial palmar arch and supplies the hypothenar area.

Methods: A curved incision that exposes the diseased palmar fascia was made in middle to distal palm lateral to the hypothenar eminence beginning 20mm distal to the distal wrist crease up to the heel of the palm. An additional incision from the arch of the curved incision extends into the middle phalanx for exposure of the digital cord. The perforator flap was raised along the hypothenar region in 53 hands of 48 patients, nine females and 39 males and their ages at the time of surgery averaged 56 years. The Tubiana classification illustrates the extent of the disease in our patients' population with no distal interphalangeal joint involvement.

Results: Of the 48 patients, five patients had bilateral hands involvement. Two patients complained of paresthesia in the ring and little fingers after surgery, the symptom had disappeared without further intervention before the latest follow-up. There was no incidence of skin necrosis and delayed healing. Up to date, there has been no reported recurrence.

Conclusion: This perforator flap based technique is technically simple and reliable with better exposure and easier removal of all the diseased fascia, making it possible for primary healing without skin necrosis and acceptable for treatment of patients at all stages of the disease.

Background

Dupuytren's Contracture is a fibroproliferative disorder that affects the palmar surface of the hands presenting as a clinically challenging disorder for both patients and surgeons alike[1]. Operative management has been the hallmark of treatment for Dupuytren's Contracture for decades. There have been evolution of operative techniques since the description of Dupuytren's disease beginning with the open fasciotomy that was practiced by Dupuytren[2], the limited fasciectomy of Goyrand[2, 3], onto complete fasciectomy and returning to the modification of these techniques[4]. In literature, numerous surgical incisions have been described as modifications to the original open palm fasciectomy: open transverse incision in palm and fingers, straight incisions with Z plasties, Bruner incision with V-Y advancement flaps, and transverse incision using full thickness skin graft to close wound[5–9]. These modified techniques have shown acceptable results in various studies. Nonetheless, postoperative skin necrosis due to poor quality of affected skin tissue and extensive dissection is often encountered in these procedures[3, 10, 11]. Open palm fasciectomy has been the traditional treatment of choice for Dupuytren's Contracture for decades from the mildest to the most severe forms[5, 12].

In this study, we introduced a perforator flap based technique(PFBT) for the treatment of Dupuytren's Contracture, which offered a better exposure and avoided skin necrosis.

Methods

The hospital database was assessed after ethical board approval. We recalled and included 48 consecutive patients who were treated for Dupuytren's disease between 2013 to 2017 using the perforator flap based technique. These patients signed informed consent for their medical records to be used for research purposes. The mean follow-up time was 30.6 months (13–60 months).

Anatomy of the perforator flap:

The skin coverage of the hypothenar area is perfused by the subcutaneous perforator based on the ulnar palmar digital artery (UPDA) which originates from the superficial palmar arch [13]. The perforator arborizes about 5mm from its origin to provide subcutaneous blood supply to the skin coverage of the hypothenar area (*Fig. 1 & 2*). The rich vascular network of the ulna palmar region suggests that constant perforator vessels are likely to exist in the hypothenar region, which could supply perforator flaps [14–16].

Surgical Technique and postoperative care: An infraclavicular block was used and the operation was carried out as inpatient under tourniquet control. After sterile preparation of the hand, the Dupuytren's cords were palpated and incisional site was marked using methylene blue (*Fig. 3*).

A curved incision begins about 20mm distal to the wrist crease in the middle-distal palm, lateral to the hypothenar eminence and extend distally up to the heel of the palm. An additional incision that exposes the digital cord was extended up to the middle phalanx of either the little or ring fingers (the most involved digits) beginning on the arch of the palmar incision. A sharp dissection through the subfascial plane was carried out to raise a 30x20mm subcutaneous flap. The perforator and its branches were identified and the Dupuytren's cord was viewed and resected (*Fig 3*); likewise, local flap or flaps in the digit or digits affected were elevated similar to the palm. The surgeon needs to be vigilant of the neurovascular bundles because they are commonly superficial to the cord at this location. The neurovascular bundles are identified and separated from the cord. After removal of the cord, palmar digital extension was performed by the patients. The tourniquet was released and the palmar defect closed primarily once normal hemostasis was restored. The digital defect was closed directly with interrupted sutures. A wound drainage to prevent hematoma collection and a padded non compressive dressing were applied, the patient was taken to the recovery room and subsequently to the ward. Patients were discharged home on the third day and were asked to return on the seventh day for dressing change. Fourteen days after surgery, stitches were removed. Patients were evaluated quarterly for the first one year. Formal hand therapy was not prescribed for our patients because they could initiate passive flexion and extension on postoperative day three and were advised to begin active flexion and extension after stitches removal.

Results

Fifty-three hands from 48 patients were treated with the PBFT, and primary wound closure was achieved in all patients. Out of the 53 hands treated, five had bilateral hands involvement, three Tubiana type II and two type III. All of our patients obtained functional extension of the affected palm and joints (*Table 1*).

No postoperative complications such as flap necrosis, delayed wound healing and hematoma collection have been recorded in our series. Nerve injury was not reported except for two patients who complained of paresthesia in the ring and little fingers after surgery, the symptom had disappeared without further intervention before the latest follow-up. In addition, there was no reported recurrence of the disease in our patients' population. Patients initiated postoperative passive flexion and extension on day three for 11 days. And continue with active flexion and extension after stitches removal. The average time for wound healing was two weeks.

Case Report:

A 75-year-old male had flexion contractures of both hands for three years, which had no influence on his daily life until three months prior to presentation when his range of motion deteriorated drastically and was diagnosed as Dupuytren's Contracture. Dupuytren's nodules and pretendinous cords, were present in the left palm and metacarpophalangeal(MCP) joint of the ring finger, and in the right palm and proximal interphalangeal (PIP) joints of the little finger. Flexion contracture in the right hand at the PIP joint of the little finger exceeded 100° and the severity was equivalent to Tubiana type III (*Table 1*) while for the left hand, contracture exceeded 60° an equivalent of type II (*Fig. 4*).. A middle-distal ulnar palmar flap of 30x20mm was raised to release the Dupuytren's cord. The flap was technically easy to raise by dissecting in the subfascial plane under infraclavicular block and tourniquet control. Perfusion of the flap was adequate with simple primary closure. The flap survived with no complications and the postoperative course was unremarkable. Fifteen months follow up show great improvement in the patient range of motions with no recurrence or complications of the disease (*Fig 5*)..

Discussion

The traditional open palm fasciectomy and its modifications have shown acceptable results in the treatment of Dupuytren's disease [17–19]. These techniques are indicated after removal of the Dupuytren's cord because primary closure is impossible, but if closed primarily, there is a high risk of skin tension that may result in skin necrosis[4]. In addition, recurrences and primary healing have been the challenges for these modifications [4, 5, 10, 20]. Foucher et al in their series of 54 patients in an open palm technique reported nine recurrences, and delayed wound healing at 26 days[4]; Shaw et al in a series of 31 patients reported delayed healing at three to five weeks[20].

However, the PFBT offers an alternative which emphasizes Uchida's claim from an anatomical study on the clinical significance of the ulnar palmar digital artery perforator flap[13]. In addition to reliable perfusion, other consideration outlined by the PFBT, such as better exposure for complete removal of the diseased fascia, eliminates the possibility of contracture thereby obviating the disease recurrence. Varian and Hueston in their series support the concept of complete excision because they described recurrent cords beneath a full thickness skin graft which they attributed to incomplete clearance[11]. Skin necrosis, delayed wound healing and hematoma collection were avoided with the PFBT. Hematoma collection was

aggressively addressed by the use of tourniquet and the application of wound drainage. Moreover, the lengthening potential and reliable vascular supply of this perforator flap, that allow direct closure without undue tension, logically account for the avoidance of postoperative skin necrosis and delayed healing. Professor Behan [21] in a recent study demonstrated similar concept of wound closure; he used the Keystone Perforator Islander Flap (KPIF) technique which was performed in a rotational fashion with non-specific perforators from the proximal and distal palmar arches for flap perfusion. He reported minimum vascular complications with rapid hand recovery. Besides, comparative studies [1, 22, 23] have associated rapid healing time with closed palm techniques. The average time to healing in our series was two weeks at which time patients had their first outpatient visit and stitches were removed and range of motion (active flexion and extension) were tested (*Fig. 6*). Though it seems intuitive to suppose that a radical excision of the diseased fascia and a perforator flap that provides direct closure for the defect may improve the disease control, we still think that further prospective clinical research is necessary to better understand this debilitating condition.

Conclusion

This perforator flap based technique is technically simple and reliable with better exposure and easier removal of all the diseased fascia, making it possible for primary healing without skin necrosis and acceptable for treatment of patients at all stages of the disease.

List Of Abbreviations

- PFBT- Perforator Flap Based Technique
- KPIF- Keystone Perforator Islander Flap
- UPDA-Ulna palmar digital artery
- SPA- Superficial palmar arch
- MCP- Metacarpophalangeal
- PIP- Proximal interphalangeal

Declarations

Ethic approval and consent to participate:

The Second Hospital of Wenzhou Medical University Research Ethics Committee (Ethics reference number: L-214-0), The Second Affiliated Hospital and YuYing Children's Hospital of Wenzhou Medical University. All patients included in this study had a written informed consent to participate.

Consent for publication:

Not applicable

Availability of data and materials:

The dataset generated and/or analysed during the current study are not publicly available because our database center is not part of the online system but can be made available from the corresponding author on reasonable request.

Competing interests:

The authors declare that they have no competing interests.

Funding: This study was funded by Zhejiang Provincial Natural Science Foundation (Grant No. LY18H060010) for data collection and analysis; Project of Administration of Traditional Chinese Medicine of Zhejiang Province of China (Grant No. 2018ZB079) for data interpretation.

Authors contributions: H Y and T C conducted the conception and design of the study, acquisition of data, drafting the article; B Z and X C conducted final drafting and English editing; Z L and W G performed statistical analysis and took part in drafting of the article. All authors have reviewed, read and approved the manuscript.

Acknowledgement: We thank Dr. Keshav Poonit for English revision and Dr. Mandika Chetry of the Second Affiliated Hospital and YuYing Children's Hospital of Wenzhou Medical University for the schematic diagram of the perforator flap.

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Table

Table 1: Mean Pre-op flexion contractures and Post-op extension deficits

Tubiana Classification Types	Number of patients	Mean Pre-op flexion contractures (°)		Mean Post-op extension deficits (°) (in 5 years)		Mean percentage gain in extension (%)	
		MCPJ	PIPJ	MCPJ	PIPJ	MCPJ	PIPJ
I	2	42.5	45.2	11.3	14	73.4	69.0
II	28	66.8	75.5	10.3	18.8	84.6	75.1
III	15	111.2	112.1	11.9	22.9	89.3	79.6
IV	3	133.0	141.7	22.2	28.8	83.3	79.7

MCPJ: Metacarpophalangeal joint; PIPJ: Proximal interphalangeal joint

*There was no distal interphalangeal joint (DIPJ) involved in any of our patients

*The student t- test with Welch Correction at 95% confidence interval to calculate the mean flexion contractures and extension deficits

Figures

Figure 1

A step by step photograph of how the perforator flap was raised: a, the incisional site being marked b, subfascial incision showing the raised flap with the perforator (red arrow) c, the adjacency of the perforator and the diseased fascia elevated. The inset picture on the right top further demonstrates the perforator in a schematic manner (red arrow) d, the resected diseased fascia.

Figure 2

Schematic of the Perforator flap: Perforator (green dotted arrow) arborizes in the subcutaneous tissue supplying the hypothenar area, the superficial palmar arch-SPA (red arrow), origin of the perforator and the digital arteries (blue arrow).

Figure 3

Pre-op, intra-op and immediate post-op findings of a 64-year-old male: a, both palmar and digital contracture cords (black arrows) b, after dissection, the palmar and digital flaps are reflected exposing the Dupuytren's cords, c, the resected Dupuytren's cords with surrounding fat tissues d, primary closure of the defects.

Figure 4

75-year old male with bilateral Dupuytren's Contracture. Pre & intra-op findings of the left palm and ring finger MCP joint $>60^\circ$ contractures (a, b); right palm and little finger PIP joint contracture $>100^\circ$ (c), intra-op findings (d)

Figure 5

15months follow-up findings of the same patient in Figure 4

Figure 6

64 years old male (same patient in figure 3) with 6 months follow up range of motions (extension and flexion)