

Bilateral Manta Ray Flap to Treat  
Congenital First Interdigital Space  
Contractures

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## Abstract

Undoubtedly, the main function of the hand is to perform a palmar and pincer grasp. This capacity may be impaired in diverse conditions, specifically, when there is a hand contracture in adduction or in severe cases of decreased first interdigital space. Many techniques are available in order to free the first interdigital space; options include skin grafts, local flaps and free flaps. We describe the use of the bilateral "manta ray flap", in order to free the space simultaneously in both hands. As described by Coombs and Thomas, this flaps confer the advantages of utilizing the skin in the first interdigital space as well as the skin from the lateral areas of the adjacent fingers in order to cover completely the defect, in addition to provide a coetaneous coverage with adequately vascularized, sensitive and tension-free skin. Furthermore, no skin grafts or free flaps, with its poor aesthetic outcome and associated morbidity were required.

## Introduction

The main function of the hand in the human species is the movement of the clamp (50% of the function of the hand). This function cannot be carried out properly if there is a contracture in the first interdigital space. Therefore, this is the interdigital space that has more descriptions of surgical techniques to achieve its release and thus recover the partial or complete function of the thumb [1-3].

The range of reconstructive tools includes cutaneous grafts, local flaps, regional flaps, or other areas of the body (e.g., abdomen and groin); and even, free flaps [1,4-6].

The geometric principle of Z-plasty was demonstrated by Limberg in 1929 [7], but who gave a more practical approach was Davis until 1946 [2]. Iselin in 1962 modified the principle of Limberg, creating a Z-plasty of 4 flaps for the opening of the first interdigital space [2]. Currently, Z-plasty continues to be the basic surgical technique to achieve the release of contractures and scars.

The opening of the first space may be diminished by congenital or acquired diseases. Tissues involved in this condition may affect any soft tissue component including skin, subcutaneous cellular tissue, fascia, first dorsal interosseous muscle, adductor muscle of the thumb and ligaments of the carpometacarpal joint [1,3]. Regardless of the origin of the contracture, the release of all tissues involved, the lengthening of the interdigital space and the provision of new skin for a non-tensioning closure are the objectives [3]. The characteristics of the skin of this region are: a well vascularized skin since it will undergo repeated situations of use, sensitive, both in proprioception and in temperature, as well as tension free and preferably of similar texture and color [1].

The patient in question presents moderate contracture of the first interdigital space, with a thumb-index angle of 40° to 60°. We present the technique of the flap in manta ray, carried out simultaneously in both hands.

Coombs and Thomas [1] proposed to classify the contractures of the first interdigital space in 3 degrees:

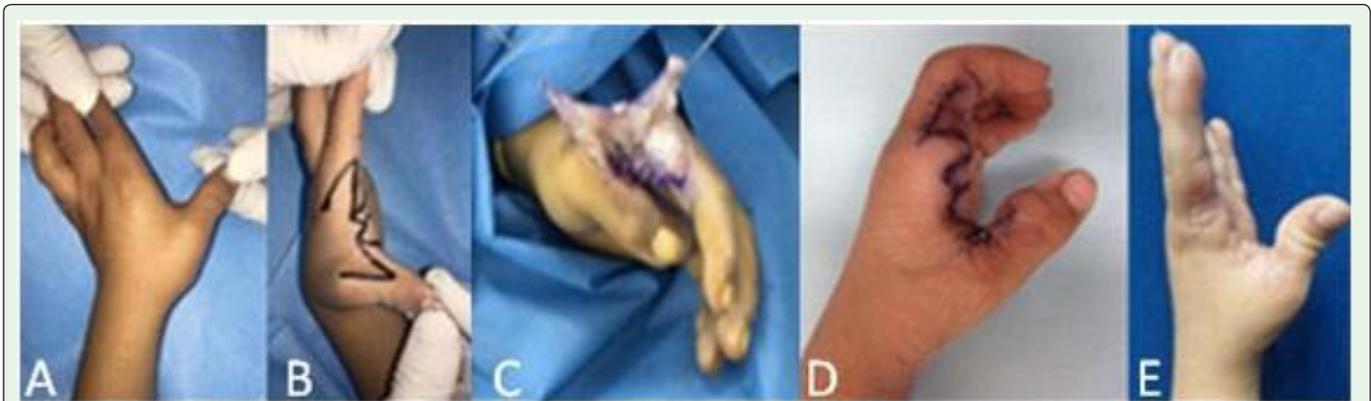


Figure 1: Left hand. A) Preoperative. B) Surgical marking. C) During surgery. D) Two weeks after surgery. E) Eight weeks after surgery.



Figure 2: Right hand. A) Postoperative. B) Surgical marking. C) During surgery. D) Two weeks after surgery. E) Eight weeks after surgery.

- Light: thumb-index angle from  $60^\circ$  to  $90^\circ$ . In these cases space needs to be increased by less than 50%.
- Moderate: thumb-index angle from  $40^\circ$  to  $60^\circ$ . In these cases you need to increase the space from 50 to 125%.
- Severe: thumb-index angle less than  $40^\circ$ . In these cases, the interdigital space needs to be increased by more than 125%.

### Technique

The marking was carried out based on the principles of Coombs and Thomas; three flaps based on the back and four flaps based on the palmar surface (Figures 1 and 2). We chose to mark the flap length of about 75% of the respective proximal phalanx, and with a considerable width, based on the laxity of the skin. The incision and the dissection of the flaps were performed under vision with magnifying glasses, with the sole exception of leaving the tip of the flaps discretely rounded when cutting. The terminal branches of the superficial radial nerve, as well as the neurovascular components properly identified were preserved. The left side required the release of the carpometacarpal joint. Absorbable sutures (monocryl 5-0 and vicryl rapide 5-0) were used for closure, ensuring that the base of one of the flaps was not thinned [1]. A fiberglass splint was placed with the thumb in maximum abduction until delivered the four postoperative weeks to avoid contractile scars. The splint was indicated for exclusive nighttime use for an additional four weeks.

### Discussion

In this case, the patient presented a contracture in adduction of the first interdigital space of moderate degree when presenting a thumb-index angle of  $40^\circ$  to  $60^\circ$  in both hands. Based on the degree of affection, in a bilateral manner and with the objective of elongating the interdigital space and providing a skin with similar characteristics and safely in both upper limbs, it was decided to perform a bilateral manta ray flap. The technique of manta ray flap creates transposition flaps in and out of the interdigital space, taking to this as much skin as possible and leaving the smaller amount of scar in the back of the hand.

The result after the performance of manta ray flaps was an increase in the length of the first interdigital space of approximately 111%. This figure represents a significant gain, especially if we consider that local flaps were used. One of the multiple advantages of this flap is to place the incisions (and scars) inside the palmar surface of the same first space and in the midline of the radial and ulnar surfaces of the index and the thumb respectively, thus minimizing scars on the back of the hand.

The use of regional flaps is another option in cases of mild to moderate contractures. They are pedicled flaps or large rotational flaps on the back of the hand that result in poor aesthetic results due to residual scars and the need, in many cases, to cover the donor areas

with a cutaneous graft with the highest morbidity that this maneuver implies. Some regional flaps may confer a neurosensitive skin cover, but with a high cost of morbidity in the donor zone. The use of pedicle regional flaps based on the forearm or inguinal region may also confer quality tissue; however, they do involve leaving the affected hand in a very uncomfortable position for varying periods of time.

The procurement of a full thickness skin graft represents a reconstructive option. However, the primary contraction of the graft and the characteristics of the transferred skin make it a less viable therapeutic option. The area involved would have shown a loss of sensitivity, which greatly determines the functionality of the region. In addition, from the aesthetic perspective, graft placement may show a patch appearance.

We are aware that performing the same procedure in patients with contractures secondary to burn defects does not have the same functional outcome. This is due to the loss of elasticity of the skin caused by the thermal injury. In addition, often the degree of contracture of the underlying tissues does not allow the mobilization of the tissue involved.

The placement of tissue expanders represents another viable option; however it has associated at least two surgical times, in addition to the cost of tissue expander and multiple visits for infiltration. Both options would have represented impractical alternatives for our patient that presented involvement of both hands.

Free tissue transfer through free flaps is an excellent option in patients with a severe contracture degree in whom local and regional tissues do not have the characteristics that are suitable for their use. In addition, they involve longer procedures, with a variable grade condition for the donor zone [3,8,9].

## Conclusion

We can conclude that the manta ray flap has a great number of advantages:

1. Technically simple.
2. Preservation of the reconstructive principle likes to like.
3. Preservation of sensitivity.

4. Allows adequate exposure of the structures of the first interdigital space.
5. Absence of dorsal scars.
6. Gain in the length of the first interdigital space up to 111%.

Although this flap was initially described in congenital contractures of the first interdigital space, its use can be extrapolated to any anatomical region and can also be used in acquired contractures. The use of a simultaneous bilateral approach represents a viable and safe option for patients with affections of both hands in whom it is possible to avoid a subsequent anesthetic and surgical event.

There is a very wide range of reconstructive options for people with contracture of the first interdigital space. The proper selection of the procedure based on the characteristics of the patient largely determines the success of this intervention.

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