INTRODUCTION

Toe transfer to the hand is a procedure by which missing digits of the hand (thumb or fingers) are reconstructed by transferring the toes of the feet to the hand. Current indication includes replacing single or multiple digits of the hand which were either congenitally absent or which had been lost due to trauma. With the help of physiotherapy, the digit functions parallels that of a hand digit and the patient has better hand function. Complications of this procedure include a less aesthetically pleasing foot and possible loss of the transferred digit as microvascular skills are required for anastamosis. However, there is no loss of function of the foot and the patient is able to walk normally.

Nicoladoni was the first surgeon who described a toe transfer as a viable option for missing hand digits, in the late nineteenth century. However, it fell into disfavour as the patient had to be in an awkward position for several weeks. This changed with the advent of the microsurgical era.

In 1965, Buncke performed the first toe-to-hand transfer in a Rhesus monkey. Cobbett was the first one to perform a thumb-to-toe transfer in humans in 1968. Double toe transfer gained popularity in the last two decades of the twentieth century. Good knowledge of anatomy and toe harvest specific techniques have led to good function after transfer and decreased donor site morbidity.

We present the case of a girl who had lost all fingers of her right hand except the thumb. This is the first case of its kind reported from Pakistan where two adjacent toes were transferred for hand function.

CASE REPORT

A 14-year-old girl presented with injury to her right hand which had occurred 4 months ago. She had been working in the fields and her hand had been caught in the Toka (fodder chopping machine) resulting in amputation of all her fingers except the thumb. The level of amputation had been the metacarpophalangeal (MPJ) in the lateral three fingers and just distal to the MPJ in the index finger (Figure 1a). The skin at the distal end had been sutured and was soft and supple.

She underwent surgery to replace the second and third digits of her right hand four and a half months after the injury. Before the tourniquet was elevated, the leg was draped with gamjee dressing to avoid vasospasm of the vessels of the foot. Prior to the incision, the leg was examined. Two veins, one draining the second toe and the other draining the third toe, were marked. A V-shaped incision centered over the second and the third toes was marked (Figure 1b). Incision was first given in the first webspace and then extended proximally along the V. The apex of the V was at the level of the junction of the second and third metatarsophalangeal joints. Both veins were visualized and their common connection draining into the larger vein was isolated. The vein was then isolated and the area below the vein leading to the first web space was explored. The digital artery and the digital nerve to the medial side of the second toe were then traced back first to dorsal metatarsal artery (FDMA) and then to the dorsalis pedis artery. The arcuate artery was then located taking off from the dorsalis pedis. The lateral incision was then given and extensor retinaculum located. The extensor retinaculum was then opened and extensor digitorum longus and brevis tendons were located, followed proximally and cut once a good length of the tendons had been achieved. The arcuate artery was then followed distally to the second web space. After both the dorsalis pedis and arcuate artery and their branches to
isolated after cutting the intermetacarpal ligaments. Once this had been achieved the artery of the plantar side was ligated. The tourniquet was then let down and both the fingers could be seen bleeding well. K-wires were then placed in both the fingers.

A second team by this time had opened the hand wound with a cruciate incision. On the volar side, three digital nerves and two flexor tendons were isolated and on the dorsal side two extensor tendons were isolated. The cephalic vein and the radial artery were isolated in the anatomical snuff-box for microvascular anastomosis.

Measurements were then taken making sure that enough length of the vascular pedicle had been reached. The dorsalis pedis artery and the vein were then ligated, and the toes brought to the hand (Figure 1d). K-wires were then advanced into the metacarpals bones of the second and third fingers. The flexor side was then approached and the flexor tendons were repaired to the plantar tendons and the nerves of the hand were sutured to the digital plantar nerves. The hand was then turned and the dorsalis pedis artery was anastomosed to the radial artery end to side and the vein to the cephalic vein end to end. The extensor tendons were then repaired. Skin graft was then harvested and placed over the vessels leading to the fingers.

Postoperatively a loose and light dressing was done. A splint was placed making sure there was no compression present. The patient was then shifted to intensive care unit and kept warm, well perfused and pain free. The fingers were continually monitored every hourly for any arterial or venous ischaemia. As per our protocol for performing free flaps surgery, tablet Aspirin 75 mg was started the next day. The fingers remained well perfused and had normal consistency with good capillary refill. After 2 days, the patient was shifted to the ward, she was mobilized on the fourth postoperative day and discharged on the sixth postoperative day.

Her donor site healed in 2 weeks and she was walking normally in 3 weeks time (Figure 1f). K-wires were removed at 6 weeks time and physiotherapy started. The second toe showed good movement from the beginning but the third toe was stiff and needed more focused physiotherapy. The patient was followed systematically and the final hand measurements were taken at 4 months time when the patient requested to go back to her native village. At that time, patient had good movements (Table I) and the tips had also become sensate though the two points discrimination was greater than 12 mm. She was able to write again with her right hand, hold a cup and had achieved good tripod pinch (Figure 1e).

<table>
<thead>
<tr>
<th>Metacarpophalangeal joint</th>
<th>Proximal interphalangeal joint</th>
<th>Distal interphalangeal joint</th>
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<tbody>
<tr>
<td>Second toe</td>
<td>0-40 degrees</td>
<td>0-40 degrees</td>
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<tr>
<td>Third toe</td>
<td>0-35 degrees</td>
<td>0-15 degrees</td>
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DISCUSSION

The choice of procedure in toe to hand transfers depends upon the level of the amputation. For amputations at MPJ level, a combined second and third toe transfers are suitable. For proximal phalangeal level, two separate toe transfers are suitable. In this case, the patient did not have any fingers on the transplanted hand so the contralateral little finger was used as a guide. The choice of the procedure was also easy as the amputations had occurred at the level of the MPJ in the medial three fingers and just distal to the MPJ in the index finger.

Prior to surgery, an angiogram to assess the anatomy of the arterial vasculature was not done as good pulse of the dorsalis pedis artery was felt on examination. The dorsalis pedis artery is only absent in 3 – 12% of cases and the first dorsal metatarsal artery is bigger than the corresponding plantar artery in 50 – 80% of cases.

The radial artery was used as the recipient artery. Donor site selection of the radial artery as the recipient artery also has advantages. It has good diameter, greater use of end to side anastomoses and its location is away from the side of the injury. The cephalic vein also has good diameter, is located away from the site of injury and so it can be used as the recipient vein. Both the vessels were located in the region of the anatomical snuff box where the cephalic vein is seen superficially and the radial artery is found after dissecting the snuff box.

The goals for a double toe transfer include a good function of the new toe-to-digit unit and decreased donor site morbidity. As previously stated by Wei et al., addition of two mobile sensate digits provides for tripod pinch, enhances lateral stability and hook grip capability, enhances power grip, augments precision handling and overall hand prehension and makes the hand somewhat cosmetically more pleasing. Four months after the surgery, the patient was able to bring the three digits together and had a good tripod pinch. Her power grip and hook grip were enhanced and she had better prehension. However, she did not think that the hand was cosmetically better than before. This may be part of gradual acceptance of the toes as hand fingers and it was noticed that people would ask her why her right hand fingers were smaller than those of her left hand.

Continuous physiotherapy also led to improvement in the function of the fingers. Coskunfirat et al. showed in their study that the average range of movement for DIPJ was 15 degrees, for PIPJ 30 degrees and for MPJ 35 degrees. This patient had achieved this range at her follow-up at 4 months. Patient then decided to go back to her village as she was satisfied with the outcome. For her, the ability to do simple tasks like holding a cup had been achieved that was enough for her. At the end of 4 months, the patient had developed sensibility in the fingers and was able to appreciate sensibility with calibrated paper clips but the two-points discrimination was still greater than 12 mm in both the fingers. The patient did not have any donor site complications after the surgery and was able to walk normally.

The essence of doing a double toe to hand transfer is to give function to a hand which had lost its function or to improve the function of a hand which was handicapped because of the loss of one or more digits. This procedure converted a non-functional hand to a functional hand which could be used by the patient for daily activities. Thus, a potentially disabled upper limb was converted into a functional one.

There were a few details that were missed in this surgery. Those included paying more attention to collateral ligament and volar plate during harvest and attachment and harvesting the plantar digital vessel for anastomoses to the digital artery in the hand.

REFERENCES