How to preserve the severe hypoplastic thumb?

——JST experiences

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The thumb has a role in approximately over 40% of hand function.

The hand without a thumb is at worst nothing but an animated fish-slice, and at best a pair of forceps whose points don’t meet properly. —John Napier

“Reconstruction of an opposable thumb should be attempted whenever possible by using whatever technical pathways are available to the surgeon.”
Thumb Hypoplasia

- For Manske type IIIB or IV thumb hypoplasia, index pollicization is a milestone procedure, and stands and shines continuously even after decades of practice.

- However, finger ablation may not always be acceptable for parents.

- Often times, we are asked by the parents:

  “is there any way at all to preserve five fingers?”
In the search for the answers, we have tried various approaches
»Started from Non-vascularized methods

PC’s Method

Takayama’s Method
However, the results were less satisfactory usually

Without vascularity was the main reason
Then, vascularized tissue transfer was considered
O’BRIEN: Great toe transfer, 2 cases

Shibata’s method: type III-B

YK Tu’s Method: type IV, type V
»All the above three methods has its own inherent drawbacks—
trading an entire toe for a finger

»Which is unacceptable also for most parents
Reversed second metatarso-cutaneous free flap (from 2014)

The core of this surgical modality is to utilize a vascularized second metatarsal osteocutaneous flap, put in reverse, to reconstruct the skeletal framework of the first metacarpal and carpometacarpal joint. Of same importance, a split of the adjacent third metatarsal with vascularity were transposed to reconstruct the second metatarsal.

Tong DD, Chen SL. *Reversed vascularized second metatarsal flap for reconstruction of Manske type IIIB and IV thumb hypoplasia with reduced donor site morbidity*. Chin Med J 2019;132:2565–2571
Exploration and dissection of the hand —choose the recipient artery
Exploration and dissection of the hand
• Trapezium existed or not is crucial for the final outcome
  It seems that it is irrelevant with the severity degree of the hypoplastic thumb
How to harvest the composite flap

Technique Introduction
Technique Introduction

How to harvest the composite flap

- Split the third metatarsal
- Using Half third metatarsal to reconstruct the second metatarsal
Material and Methods

» 2014.5~2016.12: 17 cases, 18 hypo-plastic thumbs

» Average age: 4.2 yrs

» 11 boys, 6 girls

» Type III B: 8 cases; Type IV: 9 cases

» Average flap area: 1.8X5 cm

» Average surgical time: 6 hr

» 15 cases were received second stage treatment half year later for reconstruction of the thumb abduction
First case: 5-year-old girl, Type 3B
Appearance and Function 19 months after reconstruction
Without Donor site problems
32 months follow-up
Case 2: 3 yrs boy, type 3B
8 months after reconstruction
7 months after second-stage operation
Results
<table>
<thead>
<tr>
<th>No.</th>
<th>Gender</th>
<th>Age(y)</th>
<th>Type</th>
<th>Side</th>
<th>Flap Size cm x cm</th>
<th>Complications</th>
<th>Staged Reconstruction</th>
<th>Kapandji Score</th>
<th>Pinch Force (kg)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>7</td>
<td>IIIB</td>
<td>L</td>
<td>1.8*4.0</td>
<td>N/A</td>
<td>MLR, FT, thenar plasty</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>2</td>
<td>IIIB</td>
<td>R</td>
<td>1.5*3</td>
<td>N/A</td>
<td>MLR, FT</td>
<td>4</td>
<td>0.5</td>
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<tr>
<td></td>
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<td></td>
<td>IIIA</td>
<td>L</td>
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</tr>
<tr>
<td>3</td>
<td>F</td>
<td>5</td>
<td>IIIB</td>
<td>R</td>
<td>1.5*3</td>
<td>Minor foot skin necrosis</td>
<td>MLR</td>
<td>10</td>
<td>5</td>
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<tr>
<td>4</td>
<td>M</td>
<td>5</td>
<td>IV</td>
<td>R</td>
<td>2*4</td>
<td>N/A</td>
<td>MLR, thenar plasty</td>
<td>9</td>
<td>4</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>IV</td>
<td>L</td>
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<tr>
<td>5</td>
<td>F</td>
<td>3</td>
<td>IV</td>
<td>R</td>
<td>1.5*5.5</td>
<td>N/A</td>
<td>MLR</td>
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<td>1</td>
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<tr>
<td></td>
<td></td>
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<td>IV</td>
<td>L</td>
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<tr>
<td>6</td>
<td>M</td>
<td>3</td>
<td>IV</td>
<td>R</td>
<td>1.6*4</td>
<td>Delayed Bone Union</td>
<td>Bone Fusion, MLR</td>
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<tr>
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<td>3</td>
<td>IIIB</td>
<td>L</td>
<td>1.8*5.5</td>
<td>Flap Loss, Bone Exposure</td>
<td>Pedicled flap transfer, MLR, FT, thenar plasty</td>
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<td>Over-developed thumb</td>
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<td>IV</td>
<td>R</td>
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<td>Vascular Thrombosis</td>
<td>Local flap transfer, MLR, thenar plasty</td>
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<tr>
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<td>MLR</td>
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<td>N/A</td>
<td>MLR, thenar plasty</td>
<td>7</td>
<td>0.5</td>
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</tbody>
</table>

* For the 15 cases who received second stage function reconstruction
Table 2: VAS Questionnaire

<table>
<thead>
<tr>
<th>Question</th>
<th>Average Score (Low, High)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1: Looks like a thumb (0=Not at all; 10=Totally Agree)</td>
<td>Ave. 6.93 (Low2, High10)</td>
</tr>
<tr>
<td>Q2: Works like a thumb (0=Not at all; 10= Totally Agree)</td>
<td>Ave. 5.38 (Low2, High10)</td>
</tr>
<tr>
<td>Q3: How often does the child use the thumb to pinch versus scissor pinch for small objects?</td>
<td>Ave. 5.79 (Low2, High10)</td>
</tr>
<tr>
<td>Q4: How often does the child incorporate the thumb when holding larger objects like a bottle?</td>
<td>Ave. 6.01 (Low2, High10)</td>
</tr>
<tr>
<td>Q5: How often do you have to remind the child to incorporate the thumb into daily activities?</td>
<td>Ave. 4.57 (Low2, High1)</td>
</tr>
<tr>
<td>Q6: In general, would you recommend this type of surgery to others?</td>
<td>Ave. 10 (Low10, High10)</td>
</tr>
</tbody>
</table>
Results

» 17/18 metatarsal flaps had complete survival (94.4%)

» With average of 19.3-months follow-up, the reconstructed thumbs had acceptable functional and aesthetic outcomes

» The donor site mobility was minimal

» All 18 children have improved the Kapandji score (from 0 to an average of 6.7), pinch force (from 0 to an average of 1.5 kg), with ability of grip and pen holding.

» X-ray indicated continuous bone growth

» Patients and parents had good acceptance of the new thumb
Pros

» Good or at least acceptable Appearance
» Five, not Four fingers’ hand
» Growth Potential
» Less foot mobility
» Do not have to harvest iliac

Cons

» Super technique demanding procedure
» Time consuming (6 hours)
» Staged surgical procedures
» Long term outcome?
One flap was necrosis
1 year after reconstruction
2 years after reconstruction
38 months after reconstruction
54 months after reconstruction
Experiences learned from this case, we started to design and use “local perforator flap with non-vascularized metatarsal transfer” for severe hypo plastic thumb (2015).

It is our main weapon for severe hypo plastic thumb (88 cases), if the children is under 3 yrs old.
Case 1: 26 months, boy

Local perforator flap with non-vascularized metatarsal transfer
2 Years post operation
Parents very satisfied with the final outcome
Case 2. 34 months, boy
Case 3. 24 months, girl
1 year after operation
It is not the end of the story

**Good is the enemy of Great**

“精益求精”

» Vascularized metatarsal transfer with a buoy flap combined with local perforator flap has been tried since 2016
Case introduction. 39 months, Boy
Case introduction. 39 months, Boy
Case 2.45 months, girl
Discussion
»From a greater perspective, our team has provided a full set of surgical modalities to severe thumb hypoplasia, by now over 200 cases are completed.

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**2014~2019, 200, Type III-B /V**

- **Index pollicization**: 42 cases
- **Modified Index pollicization**: 20 cases
- **Local Flap with Non-vascularized metatarsal**: 88 cases
- **Metatarso-cutaneous free flap**: 23 cases
- **Metatarso-cutaneous free flap + Local Flap**: 8 cases
- **The other methods**: 19 cases
Index finger pollicization

Is it cost effective?

»Milestone for severe hypoplastic thumb
»A time-tested procedure
For type V deformity, it seems no other choices; however, for type IIIb/IV, the parents insist on maintaining the “useless floating thumb” always, even after the surgeon show them the “beautiful” pictures from pollicization.
Hence, to recap question: Can we do it?

YES!
Second Question:

Is it cost effective?
Case Introduction 1
Case 2
Case Introduction 3: 4 yrs girl
Four years after reconstruction
Case 4
Question 3: Donor Site Morbidity?

»Not only keep the second toe, but also reconstruct the second metatarsal
I have to emphasize that it is never our intention to outcompete Index Polli, as it is a time tested, almost “golden standard”

I just want to say: as a surgeon, your favorite procedures are not always in accordance with the patients requirements
For the similar type of hypoplasia thumb

Index pollicization  or Reconstruction?

Which one is better?
Finally, I want to stress again: our methods

» Provides a new approach to reconstruct a functionally capable and cosmetically acceptable thumb that also retains growth potential, with minimal donor site morbidities

» It has been a mainstay method for mark hypo plastic thumb when parents insist on “5” rather than “4” in our department
Acknowledgement

DD Tong

Bo Liu

PC Li

JH Wu

WJ Li

YB Rong

Y Yang
Thank you!