The Results of Percutaneous Release of Trigger Digits by using Full Handle Knife 15°

: An Anatomical Hand Surface Landmark and Clinical Study †

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Objective: The purpose of the present study was to know the results of percutaneous release of trigger digits by using full handle knife 15°.

Material and Method: The 338 digits of trigger digit, 248 patients were treated by percutaneous release by using full handle knife 15° with this landmark. The author identified 510 cadaveric digits to find the anatomical landmark of A1 pulley which relates to the knuckle and measurements of A1 pulley lengths. The proximal margin of the A1 pulleys on the perpendicular line from the knuckle to the palm was in the same line in 327 (64.1%) digits, while 464 (91.0%) digits were ≤ 1 mm and 509 (99.8%) were ≤ 2 mm. The average lengths of A1 pulleys in each digit were as follows: thumb; 5.30, index finger; 6.32, middle finger; 6.58, ring finger; 6.32, and little finger 5.30 mm. The average lengths of all fingers were 6.13 mm.

Results: There was complete resolution of symptoms in 314 digits (92.90%) when followed up 6 weeks after operation. 1 digit of the index finger had residual grade 1 after 3 weeks and complete resolution in 8 weeks. 3 digits (0.89%), which were 1 thumb and 2 index fingers, underwent local steroid injection because of painful scar. 19 digits (5.62%) were stiff at proximal interphalangeal joint because of grade 4 triggering and osteoarthritis of the proximal interphalangeal joint but they could increase the range of motion after 6 months. A case (0.30%) had numbness of the radial tip of the thumb which may have been caused by injury to the radial digital nerve of the thumb. No one had open release of A1 pulley.

Conclusion: This technique is a safe and effective outpatient procedure on 248 patients and complete resolution of symptoms 92.90%

Keywords: Trigger finger, Percutaneous release, Landmark, A1 pulley, Result

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Introduction

Trigger finger or trigger thumb is common and treatment by local steroid injection is often recommended (1-15). The success rate varies from 38% to 95% (3,4,7,8,10-16). Although simple and low with morbidity this has a high rate of recurrence and repeated injections may be required (2,3,5,15). When conservative treatment fails, open
release of the A1 pulley is usually recommended\textsuperscript{(1,2,3,7,9,16-19)}. Lorthioir\textsuperscript{(20)} first described a technique of percutaneous release by using a fine tenotome. After that there were several methods by using various instruments which have been reported with satisfactory results and few complications\textsuperscript{(1-3,7,16-18,20)}. Knowledge of the location of the A1 pulley edges can facilitate safer release of the A1 pulley\textsuperscript{(1,2,3,7,9,16-18,20)}. A1 pulley starts 2 mm proximal to the metacarpophalangeal joint\textsuperscript{(22)}. Furthermore, the developing of a surface landmark to more consistently identify the location and reliability of percutaneous techniques of trigger digit release\textsuperscript{(1,2,7,9,16)}.

The purpose of the present study was 2-fold; first, to identify hand surface landmark by measuring the length of A1 pulley and landmark of proximal edge of A1 pulley which relates to knuckle line in a perpendicular line to the palm of its finger and thumb of cadaver dissections and second, describes the results of percutaneous trigger digit release by using full handle knife 15\textsuperscript{v}

Material and Method
An anatomic study of a total of 510 cadaveric fingers and thumbs were dissected in 51 preserved cadavers. There were 25 females and 26 males whose ages at the time of death ranged from 48 to 89 years. On dissection, the pulleys were identified, and A1 pulley lengths of fingers and thumbs were measured with a 4X loupe using a caliper by 1 orthopaedic surgeon. Also measurements of proximal A1 pulley margins in relation to the central tip of knuckle which lines up perpendicular to palm. The distance from the proximal edge of A1 pulley to the perpendicular line from the knuckle to the palm of each finger and thumb was measured, by using a large reduction which one point was fixed to the center of the knuckle gripped over the palm and the other to the flexor tendon while the hand was placed over the table with both the shaft and the handle of reduction with point perpendicular to the palm. Each distance was measured twice.(Fig. 1)

![Fig. 1](image_url)

**Fig. 1** Landmarks for measurements of proximal A1 pulley margins with relation to the central tip of knuckle which lined up perpendicular to palm (A). The distance from the proximal edge of the A1 pulley (B) to the perpendicular line from the knuckle to the palm of each fingers (left) and thumbs (right) was measured

In each of these 510 cadaveric fingers and thumbs dissections, the A1 pulley originated from the volar plate of the metacarpophalangeal joint. The margin from the proximal edge of A1 pulley to the perpendicular line from the knuckle to the palm was in the same line 327 (64.1\%) fingers and thumbs, 464 (91.0\%) fingers and thumbs were different ≤ 1 mm and 509 (99.8\%) were different ≤ 2mm. The overall
mean difference 0.37 ± 0.55 mm. The margin from the proximal edge of A1 pulley of thumb, index, middle, ring and little fingers were 65.7%, 57.85%, 60.80%, 67.65%, 68.60% respectively to the same line in the perpendicular line from the knuckle to the palm. The thumb, index, middle, ring and little fingers were 93.10%, 89.20%, 88.2%, 92.2%, 92.2%, the differences were ≤ 1 mm to the line in the perpendicular line from the knuckle to the palm.

The length of A1 pulley averaged 5.30 ± 0.53 mm for thumb, 6.32 ± 0.17 mm for index, 6.58 ± 0.19 mm for middle, 6.32 ± 0.19 mm for ring, and 5.30 ± 0.49 mm for small finger whereas the A1 pulley of small fingers were not significantly shorter (p>0.05) than the length of the A1 pulley for the index, middle and ring fingers with a 95 percent confidence interval.(Table 1 and 2)

Table 1. Measurements of the distance from the proximal edge of the A1 pulley to the perpendicular line from the knuckle to the palm of each finger and thumb in 510 digits

<table>
<thead>
<tr>
<th>Digit</th>
<th>Same line(digit)</th>
<th>≤1 mm(digit) %</th>
<th>≤2 mm(digit) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thumb</td>
<td>67</td>
<td>65.70</td>
<td>95</td>
</tr>
<tr>
<td>Index</td>
<td>59</td>
<td>57.80</td>
<td>91</td>
</tr>
<tr>
<td>Middle</td>
<td>62</td>
<td>60.80</td>
<td>90</td>
</tr>
<tr>
<td>Ring</td>
<td>69</td>
<td>67.60</td>
<td>94</td>
</tr>
<tr>
<td>Little</td>
<td>70</td>
<td>68.60</td>
<td>94</td>
</tr>
<tr>
<td>Average of all digits</td>
<td>327</td>
<td>64.10</td>
<td>464</td>
</tr>
</tbody>
</table>

Table 2. The length of A1 pulleys of 51 cadaveric digits

<table>
<thead>
<tr>
<th>Digit</th>
<th>Length of A1 pulley (mm)</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Mean SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thumb</td>
<td>4.4</td>
<td>6.50</td>
<td>5.30</td>
<td>0.53</td>
</tr>
<tr>
<td>Index</td>
<td>6.0</td>
<td>6.75</td>
<td>6.32</td>
<td>0.17</td>
</tr>
<tr>
<td>Middle</td>
<td>6.0</td>
<td>7.00</td>
<td>6.58</td>
<td>0.19</td>
</tr>
<tr>
<td>Ring</td>
<td>6.0</td>
<td>6.80</td>
<td>6.32</td>
<td>0.20</td>
</tr>
<tr>
<td>Little</td>
<td>4.1</td>
<td>6.40</td>
<td>5.30</td>
<td>0.49</td>
</tr>
<tr>
<td>Average of all digits</td>
<td>5.8</td>
<td>6.46</td>
<td>6.13</td>
<td>0.17</td>
</tr>
</tbody>
</table>

All the procedures were done by 1 surgeon in the office from 1 January 2003 to 31 January 2006, clinically, hand surface landmark were used to release trigger digits in 248 patients (338 digits with 297 visits). 43 patients were done with 2 visits. 3 patients were done with 3 visits. 202 were in one time. 261 patients were done one digit, 31 patients were done two digits. 5 patients were done three digits. There were 238 women and 59 men with a mean age of 57.5 years (26 to 88). In 338 digits, 69(20.4%) were trigger thumb, 44(13.0%) trigger index finger, 135(39.9%) trigger middle finger, 85(25.1%) trigger ring finger and 5(1.5%) were little finger.

The 338 digits were graded according to the severity of symptoms similar to that suggested by other authors. In grade 1, there was no triggering, but uneven finger movements. In grade 2, triggering was actively correctable. In grade 3, it was usually correctable by the other hand, and in grade 4 the digit was locked. There were 4(1.2%) digits as grade 1, 50(14.8%) digits as grade 2, 147(43.5%) digits as grade 3
and 137(40.5%) digits as grade 4. Of the last, 49 were locked in flexion and 88 in extension. (Table 3)

<table>
<thead>
<tr>
<th>Grade</th>
<th>thumb</th>
<th>index</th>
<th>middle</th>
<th>ring</th>
<th>little</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>4(1.2%)</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>6</td>
<td>14</td>
<td>6</td>
<td>1</td>
<td>50(14.8%)</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>19</td>
<td>67</td>
<td>43</td>
<td>3</td>
<td>147(43.5%)</td>
</tr>
<tr>
<td>4</td>
<td>31</td>
<td>19</td>
<td>51</td>
<td>36</td>
<td>-</td>
<td>137(40.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>69(20.4%)</td>
<td>44(13.0%)</td>
<td>135(39.9%)</td>
<td>85(25.1%)</td>
<td>5(1.5%)</td>
<td>338(100%)</td>
</tr>
</tbody>
</table>

Of 297 visits, 78(26.3%) were related to other conditions such as diabetes, hypertention, hyperlipidemia, gout and a case with tendon sheath ganglion, 219 (73.7%) were not related to anything.

The procedure was done in the office under local anesthesia with 2% lidocain with adrenalin 2 cc, waiting about 10 minutes. The patients scrubbed the hand by themselves with betadine scrub and lay down on the bed and placed the hand on the examining table. 70% alcohol or betadine paint was used to disinfect the skin. Relax the patient's hand. Test triggering of digit before operation. Insert the tip of full handle knife 15°, (Fig. 2) slope 45° to the palm, 2 mm proximal to the point which was perpendicular from the knuckle to the palm of each finger and thumb until the blade goes beneath the skin. The bevel of the knife was placed 30° to the palm. The tip of the knife was pressed down to divide the step off the stoma of A1 pulley. It was then moved from proximal to distal and from superficial to over the A1 pulley. Grating sensation and sound indicated the cutting of the A1 pulley. When the grating sensation and sound stopped, the knife was withdrawn. The procedure was repeated until relief of clicking was confirmed by the patients flexing and extending the digit. If not, reinsertion of full handle knife 15°, 5 mm distal or 3 mm proximal to the first penetration and additional release should be performed.(Fig. 3) The operation of the thumb, the positioning of the thumb was in palmar abduction and flexing the wrist, the volar surface of the thumb was placed facing the surgeon. Using the same techniques as above and clinical release was defined as the relief of active triggering immediately after percutaneous release.

Fig. 2 The picture of full handle knife 15° or ophthalmic knife
Fig. 3  
(A) Technique of percutaneous A1 pulley release of ring finger Grade 3 of trigger finger  
(B) Landmark from knuckle of ring finger perpendicular line to the palm will be the landmark of proximal margin of A1 pulley  
(C) Insert tip of full handle knife 15°, slope 45° to the palm, 2 mm proximal to the point which perpendicular line from the knuckle to the palm  
(D) The bevel of the knife was placed 30° to the palm the tip of the knife is pressed down to divide the step off the stoma of A1 pulley  
(E) Grating sensation and sound stopped, the knife was withdrawn the procedure was repeated until relief of clicking was confirmed by the patients flexed  
(F) Extended the digit
After surgery, an elastic bandage was applied for 4 days and the patients were advised to vigorously flex and extend the digit several times a day. The patients should assist full flexion and extension of the digit and massage around the penetrated skin with opposite hand. The patients were examined once a week for 3 weeks, then every month for 6 months and were reached by phone to determine if they had any symptom. The follow-up period ranged from three weeks to sixteen months (average seven months).

All cases were done by 1 surgeon in the office from January 1, 2003, to January 31, 2006. The results were classified as satisfactory if the treated digit had no triggering and was comfortable, and as unsatisfactory if there was persistent discomfort or if local steroid injection or if open surgery had been required.

RESULTS

Of the 338 trigger digits which were treated, there were complete resolution of symptoms in 314 digits (92.90%) when followed up 6 weeks after operation. 1 digit of index finger had residual grade 1 after 3 weeks and resolved in 8 weeks. 3 digits (0.89%), which were 1 thumb and 2 index fingers, underwent local steroid injection because of painful scar. 19 digits (5.62%) were stiff of proximal interphalangeal joint because of grade 4 triggering and osteoarthritis of the proximal interphalangeal joint, but it could increase the range of motion after 6 months. A case (0.30%) had numbness of the radial tip of the thumb which may be caused by injury to the radial digital nerve of the thumb. No one had open release of A1 pulley.

Significant complication, such as tear tendon, tendon bowstring due to excessive flexor tendon sheath release, infection, painful neuroma and reflex sympathetic dystrophy were not encountered.

DISCUSSION

The decision how to treat trigger digit is often based on personal experience rather than on scientific fact. Up to 29% of patients may resolve the problem spontaneously. The cost effectiveness and lack of complication prefer to use steroid injection rather than surgery. Quinnell(10) reported a cure rate of 38% at 1 year, with a further 10% of the treated digits being improved. Rhoades et al(11) injected and used local anesthetic and combined this with 3 weeks of splint. Their cure rate 64%, and overall 72% of their patients were satisfied although a second injection was required. With a history of symptoms less than 4 months the success rate is higher, with 93% satisfactory results. If these is a long history of symptoms, the success rate was only 41%(20). Kolind-Sorensen(13) reported a success rate of 67% after a single injection and found that the success rate was lower when trigger digit was associated with other conditions, rheumatoid arthritis and diabetes mellitus. In the present paper one quarter were related to other conditions. With careful attention of the injection technique there was a success rate of 84%(14) and 79%(17) were achieved after a single injection.

The author’s technique of percutaneous release was done in the office and was convenient. Complete relief of symptoms was 314 digits in 338 digits (92.90%) of the patients in 6 weeks.

Percutaneous technique to release A1 pulley has various techniques such as instruments, landmark and technique. The author had no difficulties when releasing the A1 pulley in the thumb, little and index finger. Pope and Wolfe(17) did not perform percutaneous release in the index finger. Bain et al(16) reported the same problem for the little finger. According to the oblique course of the flexor sheath and neurovascular bundles can be difficult to predict for the index and small fingers and

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prone to injury. Longitudinal line of flexor tendon for index and little finger(9) and knuckle landmarks can be used to more accurately and efficiently manage percutaneous release. At the level of metacarpophalangeal joint of thumb, radial digital nerve were placed 2.19 mm beneath the dermis and 1.15mm directly anterior to the radial sesamoid bone. In this position the nerve is vulnerable to injury by the knife blade(23). So the surgeon should know the landmark of A1 pulley exactly, tendons lining and boundary A1 pulley, especially the digital nerve of the thumb. One case in the present paper had numbness of the radial tip of thumb which may be caused by injury to the radial digital nerve of the thumb. The patient refused operation for repair of the nerve.

Short-term stenosing tenosynovitis in any digit is probably best treated by steroid injection. In the present paper only 1.2% were grade 1 which was done by percutaneous technique because they had the other finger done before and needed to do this technique. However, when injection therapy does not succeed, percutaneous or open release are the best treatment.

Percutaneous release of A1 pulley avoids a potentially painful scar at palmar incision, should be done gently and should know the landmark of the A1 pulley exactly. It is cost-effective because you can perform it in the office.

Tanaka(24) et al used a fine scalpel blade and Lyu(25) used a curved scalpel blade to perform percutaneous release and reported an excellent result. Several reports, Eastwood(3) et al, Stothard and Kumar(26), Patel and Moradia(8), Bain et al(16), Pope and Wolfe(17), described excellent results by using a needle for percutaneous release. The studies described techniques that rely on skin creases to locate the A1 pulley, and subtle variations in these skin creases can contribute to surgical error. In general, potential complications of percutaneous A1 pulley release include incomplete release, digital nerve injury, flexor tendon injury, and volar plate injury. Incomplete release of the distal pulley has been described to occur frequently, but it does not result in persistent or recurrent triggering because the proximal part is a more significant contributor to the triggering. By using the C0 line or 5 mm. proximal to the palmar digital crease(1) for distal release could facilitate complete A1 pulley release. Several studies report a high percentage of flexor tendon injuries with percutaneous release, but there are no reports that this injury is significant enough to require flexor tendon repair.

In the author’s experience of open release of A1 pulley, The author tried to use the tip of a 20 gauge needle 1.5 inch divide A1 pulley, 10 to 20 times succeeded and was non traumatic to flexor tendon. The author thought that the tip of the needle could not be done easily in percutaneous release. So the author decided to use full handle knife 15° which is used in eye operations and has sharpness to cut A1 pulley in percutaneous trigger release. While releasing the pulley the author used the tip of the knife pressed down to divide the step off the stoma of A1 pulley. It was then moved from proximal to distal and from superficial to over the A1 pulley. This technique should not be injurious to flexor tendon and volar plate.

After injecting anesthesia the triggering of the digit may decrease 1 grade. From grade 4 will be grade 3 and can be done in the flexion stage. The finger will be extended spontaneously after A1 pulley completed release. But grating sensation and sound stopped after the tip of the knife pressed down to divide the step off the stoma of A1 pulley, and triggering of the finger are important signs to know if the percutaneous release has been completed.
REFERENCES


ผลการรักษาวิธีเจาะผ่านผิวหนังโดยใช้มีดปลายแหลม 15 องศา พร้อมด้วย โดยใช้ตำแหน่งแผลผ่าตัดเป็นจุดเจาะผ่านผิวหนัง

ผลการศึกษา: ผลการทราบผลการรักษาวิธีเจาะผ่านผิวหนังโดยใช้มีดปลายแหลม 15 องศา พบว่าผู้ติดแนวทางเดียวกับuratorสังเกตุการณ์ที่มากที่สุดในนิ้วมือ 327 นิ้ว (ร้อยละ 64.1) ที่ความผิดพลาดไม่เกินหรือเท่ากัน 1 และ 2 มิลลิเมตรเท่ากับ 464 นิ้ว (ร้อยละ 91.0) และ 509 นิ้ว (ร้อยละ 99.8) ตามลำดับ และความยาวของปลอกหุ้มเอ็นเอื่อมิติ นิ้วหัวแม่มือ นิ้วนางและนิ้วก้อยเท่ากับ 5.30, 6.32, 6.58, 6.32 และ 5.30 มิลลิเมตรตามลำดับ ผู้รายงานได้รักษาผู้ป่วย 248 รายที่เป็นนิ้วล็อก 338 นิ้วด้วยวิธีการเจาะผ่านผิวหนังโดยใช้มีดปลายแหลม 15 องศา และใช้ตำแหน่งปุ่มกระดูกหลังมือที่ลากมาตั้งฉากมาที่ฝ่ามือเป็นจุดที่เจาะ

ผลการรักษา: หากจากอาการนิ้วล็อก 314 นิ้ว (ร้อยละ 92.90)ภายใน 6 สัปดาห์หลังจากผ่าตัด มีอาการนิ้วล็อกของนิ้วขวานิ้วหัวแม่มือ 3 นิ้ว (ร้อยละ 0.30) ในระดับ 1 และมีหลังจากผ่าตัด 8 สัปดาห์ มีอาการปวดปวดแผลบริเวณที่เจาะผ่านผิวหนังของฝ่ามือ 3 นิ้ว (ร้อยละ 0.89) คือนิ้วหัวแม่มือ 1 นิ้ว นิ้วขวานิ้วหัวแม่มือ 2 นิ้ว ผู้ป่วยได้รับการดีไซน์โดยเฉพาะที่อาการขึ้น 19 นิ้ว (ร้อยละ 5.62) เมื่ออาการขึ้นนิ้วด้วยอุปกรณ์ที่มีความผิดพลาดไม่เกินหรือเท่ากัน 4 และข้อเท้าของขวานิ้วมือและสามารถเพิ่มการเคลื่อนไหวของข้อวิ่งได้ขึ้นหลังจากผ่าตัด 6 คืน นิ้วหัวแม่มือ 1 นิ้ว มีอาการขึ้นนิ้วมือต้านเวลิดี้ซึ่งอาจเกิดจากการได้รับบาดเจ็บจากการผ่าตัด ไม่มีผู้ป่วยรายใดได้รับการเปิดบาดแผลผ่าตัดเพื่อคลายปลอกหุ้มเอ็นเอ
สรุป: ผู้รายงานแนะนำให้ใช้วิธีนี้ในการรักษาผู้ป่วยที่นิ้วเท้าจากปลดล็อกมัน ประหยัดค่าใช้จ่าย และสามารถทำที่ห้องตรวจผู้ป่วยนอกได้