

Original

CLINICAL RESULTS OF TENDON TRANSFER TO RESTORE ABDUCTION OF THE INDEX FINGER FOR SEVERE CUBITAL TUNNEL SYNDROME

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Abstract

We employed a combined operation of tendon transfer to restore abduction of the index finger using the extensor pollicis brevis tendon reported by Bruner and decompression of the ulnar nerve for patients with severe cubital tunnel syndrome who required powerful pinch strength and whose pre-operative compound muscle action potential of the abductor digiti minimi muscle was not recordable or almost non-recordable. Six patients were evaluated after a mean follow-up of 19 months. The mean post-operative pinch strength was 81 percent compared with the normal side, and the mean time of the negative Froment sign after surgery was 3 months. Bruner's procedure is simple and useful to restore abduction of the index finger for severe cubital tunnel syndrome.

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—Key words—

severe cubital tunnel syndrome, tendon transfer, index finger abduction

Introduction

Many previous studies have shown good clinical results for cubital tunnel syndrome after surgical decompression of the ulnar nerve^{1)~3)}, but severe cases do not always result in functional recovery^{4)~6)}. We have reported a trend toward poor functional results in patients with non-recordable compound muscle action potential (CMAP) of the abductor digiti minimi (ADM) muscle before surgery⁷⁾. From 2002, we employed a combined operation of tendon transfer to restore abduction of the index finger using the extensor pollicis brevis tendon reported by Bruner⁸⁾ and decompression of the ulnar nerve for patients with severe cubital tunnel syndrome who required powerful pinch strength and whose pre-operative ADM-CMAP was not recordable or almost non-recordable. The purpose of this study is to evaluate the clinical results of Bruner's procedure of tendon transfer for severe cubital tunnel syndrome.

Patients and Methods

Between October 2002 and April 2006, a total of eleven patients with severe cubital tunnel syndrome had operations with Bruner's tendon transfer and ulnar nerve decompression. Six patients were followed-up for seven to 26 months (mean, 19 months), and entered into this study. The details are shown in Table 1. Five patients were men and one was a woman. The age at operation was 45 to 77 years (mean, 61 years). The duration of symptoms had varied from five to 24 months, the mean being 13 months. All six patients were associated with osteoarthritis of the elbow joint. The dominant extremity was involved in five patients and the non-dominant extremity in one (case 4). The occupations were two farmers, one fisherman, one policeman, one seaman, and one retired. All patients had a positive Tinel sign at the cubital tunnel and a positive Froment sign, and marked atrophy of intrinsic muscles with clawing of the ring and little fingers. There was hypesthesia to

Table 1 Details on six patients

No.	Age/ Sex (yr)	Side	Duration of symptoms (mth)	Preoperative clinical status	Occupation	ADM- CMAP	Follow-up period (mth)	Measurements before/after surgery		Time of negative Froment sign after surgery (mth)	Result
								Grip (kg)	Pinch strength (kg)		
1.	61/M	R	5	4	Farmer	(-)	23	21/23	2.8/3.5	7	Fair
2.	45/M	R	16	5	Farmer	(-)	26	35/50	7.0/9.5	2	Excellent
3.	66/M	R	24	5	Fisherman	(+)	25	15/24	3.0/6.5	2	Excellent
4.	59/M	L	5	4	Policeman	(-)	18	13/28	2.4/6.8	3	Good
5.	55/M	R	15	4	Seaman	(-)	16	28/31	3.4/5.5	3	Good
6.	77/F	R	10	4	Retired	(+)	7	5/10	3.9/4.4	1	Good

M, male; F, female; R, right; L, left; Preoperative clinical status, according to Akahori's classification; ADM, abductor digiti minimi; CMAP, compound muscle action potential; (-), not recordable; (+), recordable



Fig. 1 The extensor pollicis brevis tendon is freed at the dorsal surface of the metacarpophalangeal joint of the thumb, and withdrawn to the proximal end of the anatomical snuff box.



Fig. 2 Re-routed extensor pollicis brevis tendon is sutured to the tendinous portion of the first dorsal interosseous muscle near its insertion.

light touch in the above-mentioned fingers in four patients, and ulnar nerve sensation was absent in two. The pre-operative clinical status was graded according to Akahori's classification¹⁾. Four patients were stage 4 and two were stage 5. Recording and analysis of ADM-CMAP as a nerve conduction study was performed in all patients before surgery. If ADM-CMAP was not recordable, CMAP from the flexor carpi ulnaris muscle was recorded. Four patients underwent decompression of the nerve and medial epicondyle excision⁹⁾, and two had simple decompression of the nerve¹⁰⁾. All patients had Bruner's tendon transfer. The extensor pollicis brevis tendon was freed at the dorsal surface of the metacarpophalangeal joint of the thumb (Fig. 1), and withdrawn to the proximal end of the anatomical snuff box. It was then re-routed subcutaneously under the tendon of the extensor pollicis longus, toward the insertion of the first dorsal interosseous (FDI) muscle. The re-routed extensor pollicis brevis tendon was sutured to the tendinous portion of the first dorsal interosseous muscle near its insertion (Fig. 2). After surgery, the hand and forearm were held in a plaster splint with the index finger in slight abduction and the wrist in slight extension. Physical therapy was started in three weeks with caution against strong ulnar flexion of the index finger until after six weeks. The results were evaluated into four categories according to Akahori's criteria¹⁾. Excellent was complete or almost complete recovery. Good meant that the patient had recovery of motor function with a negative Froment sign and clawing of fingers with some residual complaints. Fair was slight improvement with no functional recovery. Poor was no benefit from the operation. Grip and pinch strength were measured before and after surgery. Statistical analysis was performed with Student's t-test, and a P value of less than 0.05 was considered significant.

Results

The results were excellent in two patients, good in three patients, and fair in one (Table 1). Pre-operative

ADM-CMAP was not recordable in four patients and recordable in two (cases 3 and 6). Amplitude of ADM-CMAP was 1 percent compared with the normal side in case 3, and 6 percent in case 6. All patients were relieved of pre-operative discomfort and showed recovery of motor and sensory function. Only case 1 had residual annoying hypesthesia and numbness in the ring and little fingers, but all patients had improvement in grip and pinch strength. The mean pre-operative grip and standard deviation (SD) was 19.5 ± 10.8 (kg), and the mean post-operative grip was 27.7 ± 13.1 (kg), which showed no significant difference. The mean pre- and post-operative grip was 65 percent and 96 percent compared with the normal side, respectively. The mean pre-operative pinch strength and SD was 3.8 ± 1.7 (kg), and the mean post-operative pinch strength was 6.0 ± 2.1 (kg), which indicated no significant difference. The mean pre- and post-operative pinch strength was 50 percent and 81 percent compared with the normal side, respectively. The time of a negative Froment sign after surgery was one to 7 months (mean, 3 months). There were no patients with weakness of extension on the metacarpo-phalangeal joint of the thumb after using the extensor pollicis brevis tendon.

Discussion

Previous studies have reported that severe cases of cubital tunnel syndrome do not always result in functional recovery after surgical decompression of the ulnar nerve^{4)–6)}, and the indication for tendon transfer to restore abduction of the index finger is still controversial. Shiraishi et al.⁴⁾ described that 6 cases of 20 cases were fair or poor in which ADM-CMAP was not recordable and the duration of pre-operative symptoms was 10 years or more. They showed that 5 cases who had tendon transfer to restore index finger abduction were satisfied with functional recovery. Yokomura et al.⁵⁾ reported that 18 out of 32 cases had fair or poor results, and concluded that reconstructive surgery was indicated if ADM-CMAP was not recordable or functional recovery was not seen at two years after surgery. Nakagawa et al.⁶⁾ showed the indication of restoration of the index finger abduction for patients in which the pre-operative first dorsal interosseous muscle power was zero. Matsuzaki et al.¹¹⁾ reported that restoring abduction of the index finger by tendon transfer is not always necessary, but it is indicated for patients who require powerful pinch from the early post-operative phase.

The FDI muscle function is necessary for index finger abduction, and we reported that the conduction delay was larger and the amplitude was lower in FDI-CMAP than in ADM-CMAP in cubital tunnel syndrome¹²⁾, and reported a post-operative poor pinching function in patients with unrecordable ADM-CMAP⁷⁾. Therefore we performed a combined operation of tendon transfer to restore abduction of the index finger reported by Bruner⁸⁾ and decompression of the ulnar nerve for severe cubital tunnel syndrome in which pre-operative ADM-CMAP was not recordable or almost non-recordable. Bruner⁸⁾ described that the extensor pollicis brevis tendon has a favorable angle of pull and is long enough to be used without lengthening by graft, and is strong enough to restore useful abduction of the index finger. Takeda et al.¹³⁾ showed the results of Bruner's procedure for six cases and described that the mean post-operative pinch strength was 2.76kg and the mean time of functional recovery after surgery was 3.1 months. In our six patients, all had improvement in grip and pinch strength. The mean post-operative pinch strength was 81 percent compared with the normal side, and the mean time of the negative Froment sign after surgery was 3 months, which was almost similar to a previous report¹³⁾. Froment sign is shown when the flexor pollicis longus plays a part of the paralysed adductor pollicis in the pinching function, and a negative Froment sign means that abduction of the index finger is useful in the pinch movement. There were no patients with weakness of extension on the metacarpo-phalangeal joint of the thumb after surgery. Concerning other procedures of tendon transfer to restore abduction of the index finger, Neviasser et al.¹⁴⁾ reported abductor pollicis longus transfer for replacement of the first dorsal interosseous. Saito et al.¹⁵⁾ showed that post-operative pinch strength was 7.7 kg after surgery with Neviasser's procedure. Futami et al.¹⁶⁾ described the results of Neviasser's operation for 14 cases, and showed that recovery of pinch strength was attained in all cases at about 3 months after operation. Nemoto et al.¹⁷⁾ reported Neviasser's procedure for 16 cases and stated that the mean postoperative pinch strength was 86 percent compared with the normal side. In Neviasser's procedure, the abductor pollicis longus tendon is reported to be stronger than the extensor pollicis brevis tendon¹³⁾, but it is not long enough to be used and needs lengthening by tendon graft to suture to the tendinous portion of the first dorsal interosseous muscle. We considered that Bruner's procedure

is simple and useful to restore abduction of the index finger for severe cubital tunnel syndrome.

Conclusions

Six patients had operations with Bruner's tendon transfer and ulnar nerve decompression. The mean post-operative pinch strength was 81 percent compared with the normal side, and the mean time of the negative Froment sign after surgery was 3 months. Bruner's procedure is simple and useful to restore abduction of the index finger for severe cubital tunnel syndrome.

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References

- 1) Akahori O : Cubital tunnel syndrome. *Orthop Surg Traumatol (Seikei Saigai Geka)* 29 : 1745—1751, 1986 (Japanese).
- 2) Eaton RG, Crowe JF, Parkes JC : Anterior transposition of the ulnar nerve using a non-compressing fasciodesmal sling. *J Bone Joint Surg* 62-A : 820—825, 1980.
- 3) Froimson AI, Zahrawi F : Treatment of compression neuropathy of the ulnar nerve at the elbow by epicondylectomy and neurolysis. *J Hand Surg* 5-A : 391—395, 1980.
- 4) Shiraishi M, Funami S, Wakabayashi K, et al : Results of surgical treatment of severe cubital tunnel syndrome. *J Jpn Soc Surg Hand* 6 : 359—363, 1989 (Japanese).
- 5) Yokomura N, Kikuchi S, Tayama N, Seki M : Long follow up study in severe cubital tunnel syndrome. *J Jpn Soc Surg Hand* 10 : 402—405, 1993 (Japanese).
- 6) Nakagawa T, Nagano A, Mikami Y, et al : Recovery of muscle power in severe cubital tunnel syndrome followed up more than 2 years after the operation. *J Jpn Soc Surg Hand* 7 : 381—384, 1990 (Japanese).
- 7) Nobuta S, Sato K, Kasama F, et al : Postoperative results of severe cubital tunnel syndrome and indication for reconstructive surgery. *Orthop Surg (Bessatsu Seikeigeka)* 49 : 178—181, 2006 (Japanese).
- 8) Bruner JM : Tendon transfer to restore abduction of the index finger using the extensor pollicis brevis. *Plast Reconstr Surg* 3 : 197—201, 1947.
- 9) King T, Morgan FP : Late results of removing the medial humeral epicondyle for traumatic ulnar neuritis. *J Bone Joint Surg* 41-B : 51—55, 1959.
- 10) Osborne G : Compression neuritis of the ulnar nerve at the elbow. *Hand* 2 : 10—13, 1970.
- 11) Matsuzaki H, Yoshizu T, Maki Y, et al : Long-term clinical and neurological recovery in the hand after surgery for severe cubital tunnel syndrome : a patient series. *J Jpn Soc Surg Hand* 19 : 745—748, 2002 (Japanese).
- 12) Nobuta S, Sato K, Komatsu T, et al : Compound muscle action potentials and prognosis at surgery in cubital tunnel syndrome. *J Jpn Soc Surg Hand* 18 : 740—745, 2001.
- 13) Takeda Y, Amano M, Nakahara K, et al : Treatment by Bruner's method for cubital tunnel syndrome. *Orthop Surg (Seikeigeka)* 47 : 193—197, 1996 (Japanese).
- 14) Neviasser RJ, Wilson JN, Gardner MM : Abductor pollicis longus transfer for replacement of first dorsal interosseous. *J Hand Surg* 5 : 53—57, 1980.
- 15) Saito H, Shibata M, Seki T, et al : Biomechanical analysis of Neviasser's abductor pollicis longus transfer for replacement of the first dorsal interosseous. *J Jpn Soc Surg Hand* 6 : 448—452, 1989 (Japanese).
- 16) Futami T, Wakabayashi N, Kobayashi A, et al : Abductor pollicis longus tendon transfer for augmentation of the index abduction. *J Jpn Soc Surg Hand* 6 : 443—447, 1989.
- 17) Nemoto K, Arino H, Amako M, et al : The results of Neviasser's procedure for severe cases of cubital tunnel syndrome. *J Jpn Elbow Soc* 10 : 17—18, 2003 (Japanese).

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肘部管症候群重症例に対する示指外転機能再建術の治療成績

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—キーワード—

重度肘部管症候群, 腱移行術, 示指外転機能

小指の鉤爪変形や知覚脱失を呈する肘部管症候群の重症例の中で, 神経伝導検査で小指外転筋 (ADM) の複合筋活動電位 (CMAP) が導出不能の, より重症の症例に対して早期のピンチ力の獲得を目的として一期的に示指外転機能再建術を行ってきたので, その治療成績を検討した. 2002 年以後に本手術を行った肘部管症候群 11 例の中で術後 6 カ月以上経過観察できた 6 例を対象とした. 男性 5 例, 女性 1 例で年齢は平均 61 歳である. 職業は農業, 畜産業, 漁業, 警察官, 船員が各々 1 例, 無職が 1 例であった. 臨床的病期の赤堀分類は, 小指の鉤爪変形を示す 4 期が 4 例, 小指の知覚脱失を伴う 5 期が 2 例であった. 術前の神経伝導検査で ADM-CMAP は 4 例が導出不能であり, 2 例が導出可能で振幅は対側比で 1%, 6% と小さかった. 手術は尺骨神経剝離術と示指外転機能再建術を行い, 神経剝離術の術式は King 変法が 4 例, 単純除圧術が 2 例であった. 示指外転機能再建術は

Bruner 法を行い, 短母指伸筋腱を母指 MP 関節部で切離し皮下を通して第一背側骨間筋腱へ移行, 縫合し, 3 週間の外固定の後にピンチ力増強の理学療法を 1~2 週間行った. 術後経過観察期間は平均 19 カ月であった. 術後成績は赤堀の評価法で優が 2 例, 良が 3 例, 可が 1 例であった. 可の 1 例は気になる程の知覚障害が残存していた. 全例に筋力の改善を認め, 握力は術前平均 19.5kg (対側比 65%) が術後 27.7kg (96%) に, ピンチ力は術前平均 3.8kg (対側比 50%) が術後 6.0kg (81%) と改善し, 術後に Froment 徴候が陰性となった時期は平均 3 カ月であった. 母指 MP 関節の伸展力低下はみられず, 全例が原職に復帰していた. 肘部管症候群重症例に対する Bruner 法による示指外転機能再建術は, 手技が簡便で術後早期にピンチ力の回復が得られる優れた方法であると考える.