

# Comparison of the results of open carpal tunnel release and KnifeLight® carpal tunnel release

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## ABSTRACT

**Introduction:** The study compares the results of open release of carpal tunnel syndrome with a release done with a proprietary instrument, the KnifeLight®, which uses a minimal access approach.

**Methods:** A retrospective study was conducted on two groups of patients operated on by the same surgeon between January 1998 and August 2002. All cases presented with numbness of six months duration or more, and a positive Phalen's test. Open carpal tunnel release was done in the first group of 26 consecutive patients before the KnifeLight® was introduced in January 2000. The KnifeLight® technique was used in a second consecutive group of 49 patients. In two patients, the KnifeLight® procedure was abandoned because the median nerve could not be safely separated from the transverse carpal ligament.

**Results:** The two groups were shown to be comparable with respect to clinical presentation and nerve conduction studies. There was no complication in both groups. However, no advantage could be demonstrated in the use of the KnifeLight® procedure as compared to the open procedure in respect to improvement in pain, numbness or patient satisfaction. The study also showed that the severity of nerve conduction changes is not related to the severity of numbness. It is also not a good guide to the improvement of numbness and patient satisfaction after the operation.

**Conclusion:** The method was found to be acceptable to patients as an office procedure. The cost of doing either procedure is reduced when done as an office procedure, but there is a cost incurred in the use of the KnifeLight® instrument.

**Keywords:** Carpal tunnel release, KnifeLight®, minimal access surgery, nerve conduction changes, office surgery

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## INTRODUCTION

Carpal tunnel syndrome is a relatively common condition affecting mainly middle-aged women. It is caused by pressure of the transverse carpal ligament (TCL) on the median nerve. The diagnosis is confirmed by nerve conduction studies. Surgical release of the carpal ligament is advised when conservative treatment fails.<sup>(1,2)</sup> The standard approach is to do an open release of the carpal ligament. The results are generally good but reported complications included pain from the scar or pillar syndrome.<sup>(3)</sup> Minimal access techniques using the endoscope were introduced in the early 1990s to overcome the problem of making a long incision near the wrist. However, complications described with endoscopic procedures included injuries to the digital nerves, vessels, flexor tendons, median nerve, and even the ulnar nerve. The KnifeLight® minimal access procedure was introduced in Singapore in 1998. This can be done as an office procedure. It uses a special knife with a battery-operated transilluminating light source introduced through a small, proximal or distal incision.

## METHODS

A comparison of the results of the open carpal tunnel release technique and the minimal access carpal tunnel release using the KnifeLight® instrument (Stryker Instruments, Kalamazoo, MI, USA) (Fig. 1) was made in patients operated on by the same surgeon between 1998 and 2002. Patients in the study presented with numbness in the hand along the median nerve distribution and a positive Phalen's sign. No conservative treatment was instituted. All cases had symptoms of more than six months' duration. A group of 26 consecutive patients in which open carpal tunnel release was done before the KnifeLight® was introduced was compared with a group of 49 consecutive patients in which the KnifeLight® was used. In the second group, there were two cases where the procedure was abandoned because the median nerve could not be safely separated from the TCL. The following preoperative clinical data

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were collected: pain, numbness, weakness, presence of the Tinel's and Phalen's sign. Pain, numbness and weakness were graded as: 0 (none), 1 (mild), 2 (moderate) and 3 (severe). Nerve conduction studies were performed for all except eight cases. This was graded by the neurologist who conducted the test as: 0 (no change), 1 (mild), 2 (moderate), and 3 (severe).

The following features were assessed at 6–24 months after operation.

1. Improvement in numbness: This was recorded as the difference between the grade before and after the operation.
2. Patient satisfaction: This was recorded as 0 (not satisfied), 1 (slightly satisfied), 2 (moderately satisfied), 3 (very satisfied).

Presence of pain over the scar and “pillar pain”, defined as pain over the thenar and hypothenar eminence, were specifically recorded. Continuous variables were expressed as mean and range. Data was analysed using the Statistical Package for Social Sciences version 10.0 (SPSS Inc, Chicago IL, USA). Continuous variables were compared using the Student's *t*-test and categorical variables were compared using the chi-square test.

## RESULTS

The 26 cases of open carpal tunnel release and 49 cases using the KnifeLight® technique were compared. 74.7% of the patients were between the ages of 41 and 60 years (Fig. 2). 89.3% were female. 65.3% were on the right hand. All cases show a positive Phalen's test, but only 14.7% showed a positive Tinel's sign. Only four of the 75 cases (5.3%) presented with pain (two in each group), but 21.3% had severe numbness (Table I). Only four cases showed mild or moderate weakness (Table III). The two cohorts were comparable in relation to age, gender and side affected (Table II). They were also comparable in relation to the clinical features of duration of symptoms, severity of numbness and pain, presence of the Tinel's sign, and severity of the changes of nerve conduction studies (Table III).

A positive Phalen's sign was present in all the cases. 85.0% showed moderate to severe nerve conduction changes with only two cases showing no change (both cases had numbness grading moderate). Nerve conduction test was not available in eight cases. Nerve conduction tests did not appear to reflect the severity of numbness at presentation nor was it a good indicator of improvement after surgery (Table IV).

At 6–24 months after surgery, the results of the two procedures were compared based on two criteria; viz., the improvement of grade of numbness, and grade of patient satisfaction. Pain as a criterion was

not considered, as only four cases presented with pain before the operation (two in each group). No significant difference could be established between the two procedures (Table V). No other complication was recorded for both procedures.

## DISCUSSION

Carpal tunnel syndrome is one of the most common compression neuropathies affecting peripheral nerves and is the commonest nerve entrapment syndrome in the upper limb. It was first described in the English literature in 1854 by Sir James Paget.<sup>(6)</sup> It affects 1% of the general population and 10% of those over the age of 40, and occurs most frequently among middle-aged women.<sup>(7)</sup> Conventional carpal tunnel release was first described by Learmonth in 1933.<sup>(8)</sup> Complications described included painful wounds especially near the wrist; delayed wound healing; “pillar” syndrome,

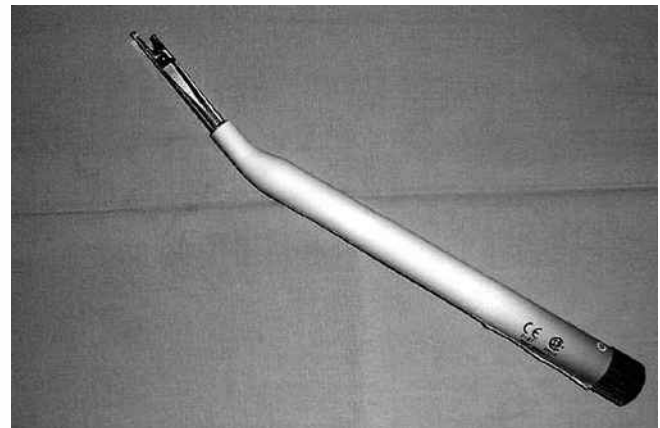


Fig. 1 Photograph of the KnifeLight® instrument.

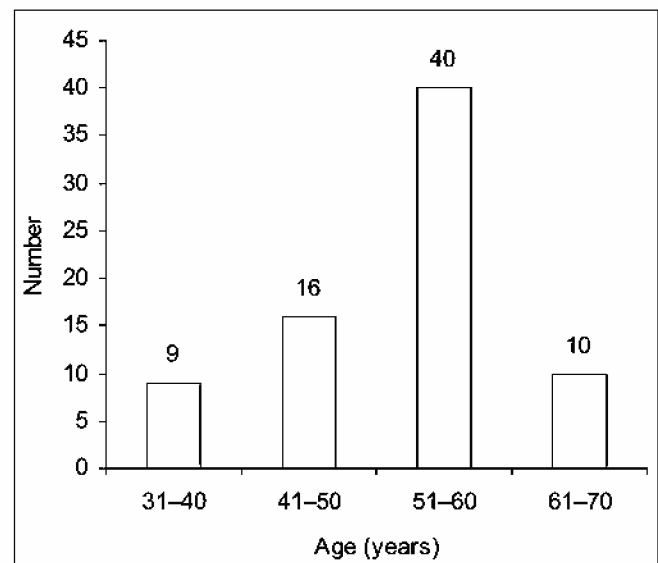


Fig. 2 Bar chart shows age distribution of the combined cases.

**Table I. Clinical presentation in the open and Knifelight® groups.**

Characteristics	Open (n = 26)	KnifeLight® (n = 49)	Combined (n = 75) (%)
Age (years)			
Range	32–68	31–62	31–68
Mean ± standard deviation	50 ± 9.8	51 ± 7.6	51 ± 8.5
Gender			
Female	23	44	67 (89.3)
Male	3	5	8 (10.7)
Occupation			
Housework	17	28	45 (60.0)
Work involving repetitive use of the hand	1	5	6 (8.0)
Manual work	2	1	3 (4.0)
Others	6	15	21 (28.0)
Side			
Right	20	29	49 (65.3)
Left	6	20	26 (34.7)
Numbness			
Nil	0	0	0
Mild	0	0	0
Moderate	20	39	59 (78.7)
Severe	6	10	16 (21.3)
Nerve conduction change*			
Nil	1	1	2 (3.0)
Mild	0	8	8 (11.9)
Moderate	15	26	41 (61.2)
Severe	6	10	16 (23.9)
Tinel's sign			
Positive	1	10	11 (14.7)
Negative	25	39	64 (85.3)
Pain			
Nil	24	47	71 (94.7)
Mild	0	0	0
Moderate	2	2	4 (5.3)
Severe	0	0	0
Duration (months)			
Range	6–24	6–24	6–24
Mean ± standard deviation	14.2 ± 7.8	15.5 ± 8.0	14.7 ± 7.9

\* Nerve conduction tests were not conducted in eight cases.

**Table II. Comparability of age, gender, occupation and affected side between the open and Knifelight® groups.**

Characteristics	Open	KnifeLight®	p-value
Age (years)			
Range	32–68	31–62	
Mean	50	51	0.159 <sup>#</sup>
Gender			
Female	23	44	0.859*
Male	3	5	
Occupation			
Housework	17	28	
Work involving repetitive use of the hand	1	5	0.664*
Manual work	2	1	
Others	6	15	
Side			
Right	20	29	0.124*
Left	6	20	

<sup>#</sup> Independent sample t-test; \* Pearson's chi-square test.

which refers to pain over the thenar and hypothenar region arising from the loss of the skin and subcutaneous bridge; and injuries to nerves and vessels. Reported complication rate ranges from 1% to 20%.<sup>(9,10)</sup>

Minimal access techniques using the endoscope were introduced in the early 1980s to overcome the problems of open surgery.<sup>(8-12)</sup> This consists of making a proximal and/or distal portal and developing

**Table III. Comparability of duration, numbness, nerve conduction changes, Tinel's sign, pain and weakness between the open and KnifeLight® groups.**

Characteristics	Open	KnifeLight®	p-value
Duration (months)			
Range	6–24	6–24	
Mean	14.2	15.5	0.521 <sup>#</sup>
Numbness			
Nil	0	0	
Mild	0	0	
Moderate	20	39	0.788*
Severe	6	10	
Nerve conduction change			
Nil	0	1	
Mild	0	8	
Moderate	15	26	0.132*
Severe	6	10	
Tinel's sign			
Positive	1	10	
Negative	25	39	0.054*
Pain			
Nil	24	47	
Mild	0	0	
Moderate	2	2	0.508*
Severe	0	0	
Weakness			
Nil	0	0	
Mild	2	0	
Moderate	2	0	Not analysed: numbers too small
Severe	0	0	

<sup>#</sup> Independent sample *t*-test; \* Pearson's chi-square test.

**Table IV. Correlation of nerve conduction studies with pre- and postoperative numbness.**

Characteristics	Numbness grade 2	Numbness grade 3	p-value
<b>Nerve conduction</b>			
0 (No change)	1	1	
1 (Mild change)	8	0	
2 (Moderate change)	40	1	34.302*
3 (Severe change)	4	12	
	Postoperative improvement of 2 grade	Postoperative improvement of 3 grade	
<b>Nerve conduction</b>			
0 (No change)	1	1	
1 (Mild change)	8	0	
2 (Moderate change)	40	1	25.888*
3 (Severe change)	5	11	

\* Pearson's chi-square test.

a tunnel between the median nerve and the TCL. The nerve is protected with various sheaths. An endoscope is then introduced and the TCL is divided under endoscopic vision. However, complications described with endoscopic procedures include injuries to the digital nerves and vessels, the median nerve, the superficial palmar arterial arch and the flexor tendons.<sup>(10-14)</sup> The procedure lengthens operating time and the surgeon requires special training

and equipment, thus the need for it to be done in a hospital or a facility with endoscopic equipment.

The KnifeLight® was introduced into Singapore in 1998. As in the endoscopic technique, a tunnel is developed between the median nerve and the TCL, but another tunnel is developed between the TCL and the subcutaneous plane to isolate the TCL. The ligament is then divided under transillumination with a disposable illuminable bifid knife. The injuries to the vessels and

**Table V. Postoperative improvement of numbness grading and patient satisfaction in the open and KnifeLight® groups.**

Characteristics	Open	Closed	p-value
Numbness			
0	0	0	
1	0	0	
2	20	40	0.627*
3	6	9	
Satisfaction			
Satisfied	0	4	
Very satisfied	26	45	0.664*

\* Pearson's chi-square test.

nerves are avoided by making a distal portal and dividing the ligament distal-proximally. The procedure has an advantage over endoscopic procedures in that it can be done as an office procedure and no endoscopic equipment or special training is required. The additional cost incurred was in the cost of the KnifeLight®, which was S\$98. The present study showed no correlation between improvement of numbness after surgery and the severity of the nerve conduction changes. Nerve conduction changes did not appear to be a good determinant of improvement of numbness after surgery.

No complication developed in all the cases. However, no advantage could be demonstrated in the use of the KnifeLight® procedure, as compared with an open procedure in respect of improvement in numbness and patient satisfaction.<sup>(15-17)</sup> No "pillar" pain occurred in cases done with the open or the KnifeLight® procedure. The study was based on a small cohort of cases done by a single orthopaedic surgeon. The results were based on the subjective assessment by the patient, and no objective parameters (such as strength measured with appropriate instruments) had been used.

No difference could be demonstrated between the results using a conventional incision and the minimal incision. However, maintaining a skin and subcutaneous bridge would cause less mechanical disruption to the wrist and an incision away from the thenar region would cause less disturbance of the grip. The authors found that the minimal access procedure is acceptable to patients as a clinic procedure, which avoids the inconvenience and cost incurred in a hospital procedure.

## REFERENCES

- Eversman WW. Entrapment and compression neuropathies. In: Green DP, ed. *Operative Hand Surgery*. New York: Churchill-Livingstone, 1993.
- Wright PE. Carpal tunnel and ulnar tunnel syndromes and stenosing tenosynovitis. In: Crenshaw AH, ed. *Campbell's Operative Orthopaedics*. 8th ed. St. Louis: Mosby-Year Book Co, 1992.
- MacDonald RI, Lichtman DM, Hanlon JJ, Wilson JN. Complications of surgical release for carpal tunnel syndrome. *J Hand Surg (Am)* 1978; 3:70-6.
- Phalen GS, Gardner WJ, La Londe AA. Neuropathy of the median nerve due to compression beneath the transverse carpal ligament. *J Bone Joint Surg Am* 1950; 32:109-12.
- Tinel J. [Le signe du fourmillement dans les lésions des nerfs périphériques]. *Presse Med* 1915; 47:388-9. French.
- Paget J. *Lectures on Surgical Pathology*. Philadelphia: Lindsay and Blakinston, 1854.
- Szabo RM. Carpal tunnel syndrome. In: Gelberman RH, ed. *Operative Nerve Repair and Reconstruction*. Philadelphia, PA: JB Lippincott, 1991: 869-88.
- Leamonth JR. The principle of decompression in the treatment of certain diseases of peripheral nerves. *Surg Clin North Am* 1933; 13:905-13.
- Cannon BW, Love JG. Tardy median nerve palsy: median neuritis: median thenar neuritis amenable to surgery. *Surgery* 1946; 20:210-6.
- Okutsu I, Nimomiya S, Takatori Y, Ugawa Y. Endoscopic management of carpal tunnel syndrome. *Arthroscopy* 1989; 5:11-8.
- Chow JCY. Endoscopic release of the carpal ligament for carpal tunnel syndrome: 22-month clinical result. *Arthroscopy* 1990; 6:288-96.
- Agee JM, McCarroll HR Jr, Tortosa RD, et al. Endoscopic release of the carpal tunnel: a randomized prospective multicenter study. *J Hand Surg (Am)* 1992; 17:987-95.
- Agee JM, Peimer CA, Pyrek JD, Walsh WE. Endoscopic carpal tunnel release: a prospective study of complications and surgical experience. *J Hand Surg (Am)* 1995; 20:165-71.
- Palmer DH, Paulson JC, Lane-Larson CL, Peulen VK, Olson JD. Endoscopic carpal tunnel release: a comparison of two techniques with open release. *Arthroscopy* 1993; 9:498-508.
- Avci S, Sayli U. Carpal tunnel release using a short palmar incision and a new knife. *J Hand Surg (Br)* 2000; 25:357-60.
- Helm RH, Vaziri S. Evaluation of carpal tunnel release using the knifelight instrument. *J Hand Surg (Br)* 2003; 28:251-4.
- Bhattacharya R, Birdsall PD, Finn P, Stothard J. A randomized controlled trial of knifelight and open carpal tunnel release. *J Hand Surg (Br)* 2004; 29:113-5.