



## Original Article

# Intra-individual evaluation of results between open and endoscopic release in bilateral carpal tunnel syndrome<sup>☆</sup>



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## ABSTRACT

**Objective:** The authors performed an intra-individual comparison of surgical results between the open and endoscopic surgical techniques in patients with bilateral carpal tunnel syndrome. Each hand was submitted to surgery using one of these techniques.

**Methods:** Fifteen patients (30 hands) were evaluated by the Boston Questionnaire, visual analogue pain scale, palmar grip strength, and for tip, key, and tripod pinch strengths. These measurements were taken before surgery and at two weeks, one month, three months, and six months after the procedure. Scores for each evaluation tool in each evaluation time period were compared.

**Results:** In comparison to the group submitted to open surgery, the group submitted to endoscopic surgery had worse scores in the evaluation of the 1st and 6th postoperative months regarding the severity of the symptoms. The authors found no differences in the functional status of the hand. Regarding the intensity of pain evaluated by the visual analogue pain scale, no difference was found between the averages in all time periods evaluated. No differences in palmar grip strength and in fingertip, key (lateral), and tripod pinch strengths were found in all time periods. There were no differences between averages in the preoperative period at two weeks, one month, and three months after surgery. After six months, the group of patients submitted to open surgery presented greater tripod force than the group of patients who underwent endoscopic surgery.

**Conclusion:** No differences were observed by using the intra-individual evaluation in the results between open and endoscopic techniques for the treatment of carpal tunnel syndrome.

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## Avaliação intraindividual dos resultados entre as técnicas aberta e endoscópica de um portal na síndrome do túnel do carpo bilateral

### R E S U M O

#### Palavras-chave:

Síndrome do túnel do carpo  
Procedimentos cirúrgicos  
Descompressão  
cirúrgica/métodos  
Endoscopia  
Resultado do tratamento

**Objetivo:** Foi feito um estudo de comparação intraindividual dos resultados cirúrgicos entre as técnicas cirúrgica aberta e endoscópica de um portal em pacientes com síndrome do túnel do carpo bilateral, cada uma das mãos operada por uma das técnicas citadas.

**Métodos:** Quinze pacientes (30 mãos) foram avaliados no pré-operatório, na segunda semana e no primeiro, terceiro e sexto mês pós-operatório pelo questionário de Boston, escala visual analógica da dor, força de preensão palmar, pinça lateral, pinça polpa-polpa e pinça tripode. Foram comparados os escores de cada ferramenta de avaliação obtidos com as cirurgias endoscópica e aberta em cada um dos tempos de seguimento.

**Resultados:** Em comparação com o grupo submetido a cirurgia aberta, o grupo submetido a cirurgia endoscópica apresentou piores escores na avaliação do primeiro e sexto meses pós-operatório quanto à gravidade dos sintomas. Não foram observadas diferenças quanto ao estado funcional da mão. Quanto à intensidade da dor avaliada pela escala visual analógica da dor, não foram observadas diferenças entre as médias em todos os períodos de tempo avaliados. Não foram observadas diferenças nas forças de preensão palmar, pinça polpa-polpa, polpa-lateral em todos os períodos de tempo. Quanto aos escores da força de preensão tripode, não foram observadas diferenças entre as médias nos períodos pré-operatório, duas semanas, um mês e três meses após a cirurgia. Aos seis meses de pós-operatório, o grupo de pacientes submetido a cirurgia aberta apresentou força tripode maior do que o grupo de pacientes submetidos a cirurgia endoscópica.

**Conclusão:** Com o uso da avaliação intraindividual não foram observadas diferenças entre os resultados das técnicas aberta e endoscópica para o tratamento da síndrome do túnel do carpo.

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## Introduction

By definition, carpal tunnel syndrome (CTS) is characterized by compression of the median nerve as it crosses the carpal tunnel region.<sup>1</sup>

In the vast majority of patients, clinical treatment causes temporary remission of symptoms, but relapses cause patient dissatisfaction. In turn, in the vast majority of patients, surgical treatment causes definitive remission of symptoms. Surgeons aim at using a surgical technique that, in addition to symptom remission, presents a lower rate of complications and postoperative pain, and allows a rapid return of hand function.<sup>2</sup> Prospective and randomized clinical trials comparing the results of open surgical treatment with those of endoscopic surgical treatment have been conducted in recent years. Most results do not allow confirmation that one surgical technique has advantages over the other.<sup>3-5</sup> Few studies have evaluated patients who underwent bilateral surgery using different techniques in each hand.<sup>6,7</sup> The advantage of this assessment is the use of the same patient as an internal control. Both techniques have advantages and disadvantages. The open technique does not require sophisticated equipment, but it has the disadvantage of an interthenar incision that causes residual pain. Endoscopic surgery avoids this incision, but its disadvantages include longer equipment assembly and higher cost.<sup>8</sup>

This study was aimed at comparing the clinical results in patients with bilateral carpal tunnel syndrome who underwent median nerve decompression through an open technique with ulnar incision or an endoscopic incision with a single portal, using one technique on each side.

## Material and methods

The study was prospectively approved by the Institution's Ethics and Research Committee under CAAE No. 02034912100005505.

For the clinical diagnosis of CTS, the AAOS criteria and the presence of paresthesia in the territory of the median nerve, nocturnal paresthesia, thenar atrophy, positive Tinel test, positive Phalen test, and decreased sensitivity was used.<sup>9</sup> Patients who presented at least three diagnostic criteria were included for treatment.

Patients at this institution who were not satisfied with the results of clinical treatment were referred for surgery.

All patients undergoing surgical treatment were submitted to an electroneuromyography study that confirmed the median nerve compression.

The patients included in this study were informed that a different technique would be applied on each side.

In this study, 15 patients (30 hands) were diagnosed with CTS. The first hand to be operated on was the one determined

by the patient as the most symptomatic. The surgical technique was chosen at the time of surgery. It was pre-established that the other surgical technique would be used on the contralateral hand. There was no pre-established time interval between the two surgeries.

Using the open technique, seven left hands were operated on and eight were right hands; in turn, eight left hands and seven right hands underwent the endoscopic technique. The right hand was the dominant hand in all patients.

The patients were examined in the preoperative period and at two weeks, one, three, and six months after surgery for each hand.

The Boston Questionnaire (Appendix A) was applied to evaluate symptom severity and the degree of manual disability. This evaluation instrument was recognized as reproducible and valid, with internal consistency and capable of responding to clinical alterations. The Boston Questionnaire has been translated and validated into Brazilian Portuguese. The protocol is easily completed by the patient; if the patient was not literate, the self-administered questionnaire was transformed into an interview. The protocol consists of two scales. The symptoms severity scale (SSS) assesses symptom severity, frequency, time, and type. The functional status scale (FSS) assesses how the syndrome affects daily life. SSS consists of 11 questions that assess symptoms regarding severity, frequency, time and type, pain intensity during the day and at night, frequency of pain during the day and at night, day-time pain duration, numbness, weakness, tingling sensation, tingling at night, frequency of tingling at night, and dexterity. Each question has five answers numbered from 1 to 5, in increasing order of symptom severity. Thus, 1 indicates no symptoms; 2, mild symptoms; 3, moderate symptoms; 4, strong symptoms; and 5, severe symptoms. The FSS consists of eight questions pertaining to activities of daily living, writing, buttoning on clothes, holding a book while reading, holding the phone, doing housework, opening the lid of a jar, carrying grocery bags, showering, and getting dressed. Each activity is scored in five degrees of difficulty. Grade 1 corresponds to no difficulty; grade 2, slight difficulty; grade 3, moderate difficulty; grade 4, severe difficulty; and grade 5, the patient is unable to perform the activity due to the symptoms in their hands and wrists. All answers concerned symptoms of a typical 24-h period in the last two weeks.

The scores were calculated as the sum of the answers divided by the number of questions on each scale. Unanswered questions were excluded from the calculation. Thus, the higher the score, the greater the symptom severity and the degree of manual disability.

Patients received proper orientation prior to reporting pain intensity on the visual analogue pain scale (VAS). The scale ranges from absence of pain (0 or no pain) to strong pain.

Strength was assessed by palmar grip, pulp (fingertip) pinch, lateral (key) pinch, and three-digit (tripod) pinch strength. A hydraulic palmar grip dynamometer, adjusted to the second position, and a digital hydraulic grip dynamometer, both by Baseline (Irvington, NY, USA), were used. For the measurements, the subjects were seated, with their arms adducted and parallel to the trunk, elbow flexed at 90 degrees, and the forearm and wrist in a neutral position. Three measurements were made, using as much strength as possible.

The mean of the measurements was recorded in kilogram-force.

The endoscopic technique with a single portal<sup>2</sup> and the open technique with a palmar ulnar incision<sup>10</sup> were used in all patients.

All patients underwent the same endoscopic surgical technique for carpal tunnel decompression with the use of the Razek Blade single portal system. Surgeries were performed with upper limb blockade with the use of a pneumatic tourniquet after the upper limb was exsanguinated with a rubber band. A transverse incision of 2–3 cm was made in the distal flexion fold of the wrist between the flexor carpi radialis and flexor carpi ulnaris tendons. After careful dissection and protection of the cutaneous nerves, the antebrachial fascia was opened. The proximal border of the transverse carpal ligament (TCL) and carpal tunnel were identified. Narrow and broad dilators were sequentially inserted to identify the hamate hamulus and felt by percutaneous palpation in the palmar region to identify the end of the TCL. Subsequently, curettage of the entire synovium of the volar region of the TCL was performed to allow a clear view of its transverse fibers. The blade was introduced under palpation, with the thumb opposite the palmar region until it could be felt at the exit of the tunnel. After the endoscopic visualization, the blade was activated to section only the distal fibers of the TCL. The section was performed in two stages; the proximal ligament was kept intact, to prevent fatty tissue from dropping. The distal ligament cut was inspected; if completely sectioned, an incision of the remaining ligament was made. The blade was again placed in the tunnel for inspecting the TCL incision. The arthroscope was slightly rotated at 20° to visualize the sectioned edge of the TCL. The ventral antebrachial fascia was sectioned longitudinally, with blunt scissors in a proximal direction. The incision was closed, followed by dressing and bandaging. Patients were encouraged to perform active finger movements on the same day of surgery.

The open surgical technique with ulnar access was used. The approach consists of a longitudinal incision of approximately 4 cm that follows the external border of the hypothenar eminence. If necessary, the incision is extended ulnarly, following the wrist fold, L-shaped, to an extension of 1 cm. Skin and subcutaneous tissue are incised and the TCL is visualized and sectioned at its ulnar insertion (hamate hamulus and pyramidal), in all its extension. The distal antebrachial ventral fascia was sectioned longitudinally with blunt scissors. After the median nerve decompression, the incision was closed, followed by dressing and bandaging. Patients were encouraged to perform active finger movements on the same day of surgery.

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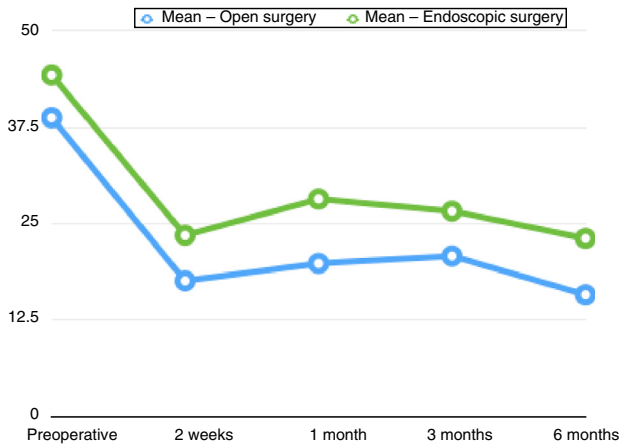
## Results

Comparing the open and endoscopic surgeries regarding the SSS, no difference was observed between the means in the preoperative period and the second week and the third month postoperative. The means in the first month and in the sixth month were lower in the open surgery group (Table 1 and Fig. 1).

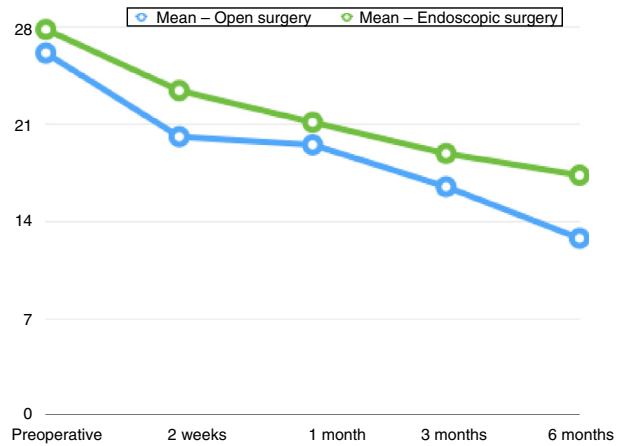
When comparing the VAS scores between the open and endoscopic surgeries in the time periods assessed by the FSS,

**Table 1 – Comparison between open and endoscopic surgeries for SSS scores as to the evaluated time periods.**

	Mean – open	Mean – endoscopic	Interpretation at the level of 0.5%
Preoperative period	38.73	44.27	No difference between the means
2 weeks	17.60	23.50	No difference between the means
1 month	19.86	28.21	Difference between the means
3 months	20.82	26.64	No difference between the means
6 months	15.80	23.10	Difference between the means



**Fig. 1 – Comparison between open and endoscopic surgeries regarding the symptom severity score (SSS) as to the evaluated time periods.**



**Fig. 2 – Comparison between the open and endoscopic surgeries regarding the functional status scale (FSS) scores as to the evaluated time periods.**

no difference was observed between the averages in all the evaluated periods of time (Table 2 and Fig. 2).

Comparing the open and endoscopic surgeries for pain scores, no difference was observed between the mean scores in all time periods evaluated (Table 3 and Fig. 3).

Comparing the open and endoscopic surgeries regarding palmar grip strength scores, no difference was observed between the mean scores in all time periods evaluated (Table 4 and Fig. 4).

Comparing the open and endoscopic surgeries regarding pulp (fingertip) pinch grip strength scores, no difference was observed between the mean scores in all time periods evaluated (Table 5 and Fig. 5).

Comparing the open and endoscopic surgeries regarding lateral (key) pinch grip strength scores, no difference was observed between the mean scores in all time periods evaluated (Table 6 and Fig. 6).

Comparing the open and endoscopic surgeries regarding three-digit (tripod) pinch grip strength scores, no difference was observed between the mean scores in the preoperative

period, and at two weeks, one month, and three months postoperatively. At six months postoperatively, the group of patients who underwent open surgery presented higher three-digit grip strength than the group of patients who underwent endoscopic surgery (Table 7 and Fig. 7).

**Discussion**

Randomized controlled trials (RCT) are considered the gold standard for assessing treatment effectiveness and are a reference for decision-making by physicians and health professionals.<sup>11</sup>

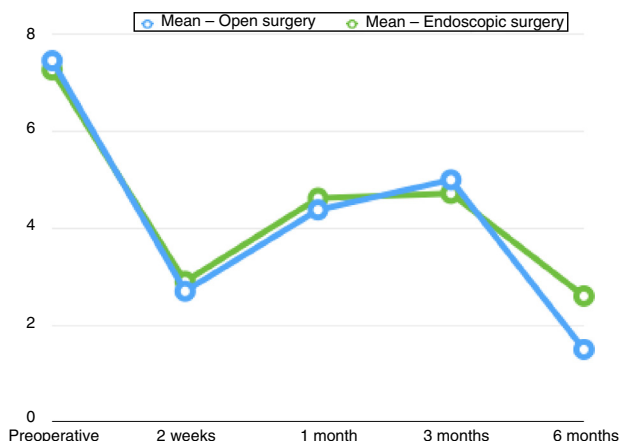
Most randomized clinical trials that evaluate the surgical treatment of CTS compare the results between open and endoscopic techniques. These studies often fail to demonstrate that the results obtained with one surgical technique are better than those obtained with the other.<sup>4,6,7</sup> Some studies demonstrate that patients undergoing endoscopic surgery recover palmar and finger grip strengths faster than those undergoing open surgery.<sup>3,6</sup> Other authors observed that

**Table 2 – Comparison between the open and endoscopic surgeries regarding the FSS scores as to the evaluated time periods.**

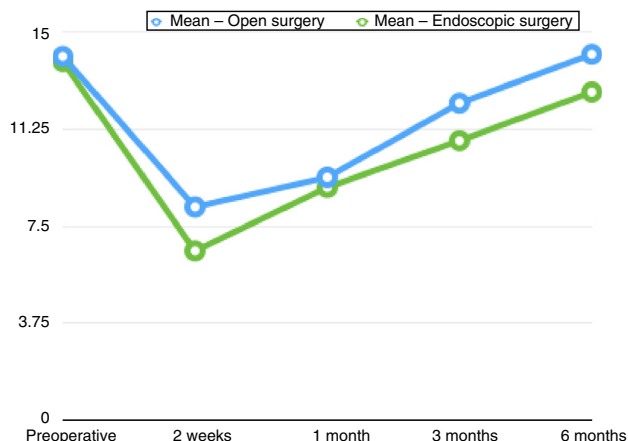
	Mean – open	Mean – endoscopic	Interpretation at the level of 0.5%
Preoperative period	26.15	27.85	No difference between the means
2 weeks	20.11	23.44	No difference between the means
1 month	19.53	21.15	No difference between the means
3 months	16.50	18.90	No difference between the means
6 months	12.78	17.33	No difference between the means

**Table 3 – Comparison of VAS scores between open and endoscopic surgery as to the evaluated time periods.**

	Mean – open	Mean – endoscopic	Interpretation at the level of 0.5%
Preoperative period	7.46	7.27	No difference between the means
2 weeks	2.70	2.90	No difference between the means
1 month	4.38	4.62	No difference between the means
3 months	5.00	4.72	No difference between the means
6 months	1.50	2.60	No difference between the means



**Fig. 3 – Comparison of the visual analogue scale scores between the open and endoscopic surgeries as to the evaluated time periods.**



**Fig. 4 – Comparison of palmar grip strength scores between open and endoscopic surgeries as to the evaluated time periods.**

patients submitted to endoscopic surgery had better results as to remission of symptoms and function of the hand in the first months postoperatively when compared to patients undergoing surgery using the open technique.<sup>5</sup> In all these studies, the superiority of endoscopic surgery is limited, and not enough to reach scientific evidence level. In the researched literature, no studies demonstrating the superiority of the open method over the endoscopic method were retrieved. Comparing the results from these studies is difficult due to the variety of different techniques of open surgery and endoscopic surgery.

In most of the previously mentioned RCT, patients were evaluated regarding surgery on one hand. One of the disadvantages of this methodology is the fact that it compares people of different personal characteristics. Pain is regarded as a genuinely subjective and personal experience.<sup>12</sup> This subjectivity can also be extended to the intensity of symptoms that occur in patients with CTS. To reduce this subjectivity, in the present study the same patient was evaluated preoperatively and after undergoing surgery by two different surgical

techniques. Therefore, the present study has the advantage of using the same patient as an internal control.

Intraindividual control for evaluation of treatment outcomes is a valuable tool that should be increasingly used in clinical research. The disadvantage of the methodology is in its difficulty of application in some clinical situations. Only one recent meta-analysis of intraindividual comparison studies between open and endoscopic technique was retrieved in the literature. Those authors retrieved only five studies, totaling only 142 patients who underwent surgery.<sup>13</sup> The present research is pioneering in Brazil, and the present authors believe it will be useful for future meta-analyses.

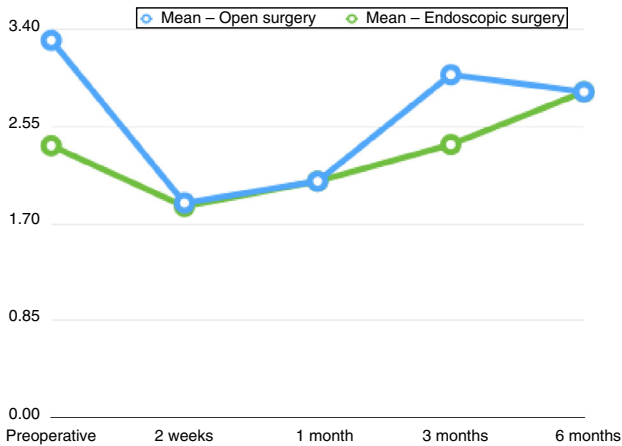
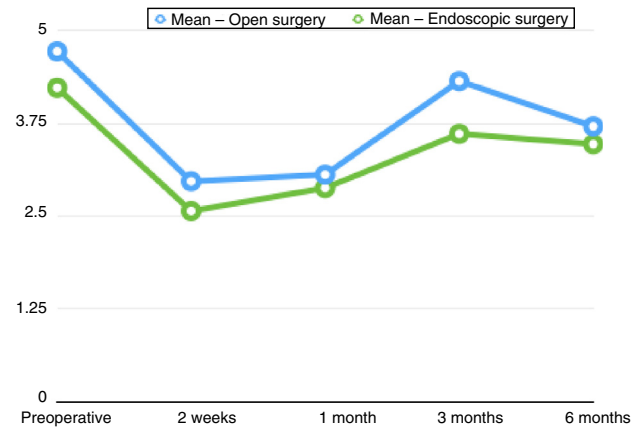
One of the limitations of the present study was the fact that the hands were not operated on during the same surgical act. In the present study, surgery was only indicated for the contralateral hand when the symptoms justified the surgical treatment. Another weak point was the number of patients evaluated in the present study (15, a total of 30 hands). This number of patients is lower than that of most of the randomized trials that assessed unilateral surgery. However, a reduced

**Table 4 – Comparison of palmar grip strength scores between open and endoscopic surgeries as to the evaluated time periods.**

	Mean – open	Mean – endoscopic	Interpretation at the level of 0.5%
Preoperative period	14.08	13.88	No difference between the means
2 weeks	8.25	6.55	No difference between the means
1 month	9.40	9.01	No difference between the means
3 months	12.27	10.82	No difference between the means
6 months	14.16	12.70	No difference between the means

**Table 5 – Comparison of pulp (fingertip) pinch grip strength scores between open and endoscopic surgeries as to the evaluated time periods.**

	Mean – open	Mean – endoscopic	Interpretation at the level of 0.5%
Preoperative period	3.30	2.38	No difference between the means
2 weeks	1.88	1.85	No difference between the means
1 month	2.07	2.07	No difference between the means
3 months	3.00	2.39	No difference between the means
6 months	2.85	2.85	No difference between the means

**Fig. 5 – Comparison of pulp (fingertip) pinch grip strength scores between open and endoscopic surgeries as to the evaluated time periods.****Fig. 6 – Comparison of lateral (key) pinch grip strength scores between open and endoscopic surgery as to the evaluated time periods.**

number of patients was also observed in studies that performed intraindividual comparison in bilateral surgery with different techniques: ten patients in the study by Rab et al.<sup>6</sup> and 25 patients in the study by Michelotti et al.<sup>7</sup>

All surgical techniques described in the literature present a high symptom remission rate. Surgery using the Razek Blade single-portal system presents similar clinical results to other endoscopic surgery techniques described in the literature.<sup>2</sup> Open surgery with ulnar incision was advocated by Raoul Tubiana and introduced in Brazil by Galbiatti et al.<sup>10</sup> The ulnar incision aims to prevent the median nerve from becoming involved in the scar tissue of the incision.

In the literature, several instruments are used by researchers to evaluate the results of CTS treatment, including pain degree assessment, finger sensitivity assessment, palmar and fingers grip strength, the Boston Questionnaire, complication rates, and return to work.<sup>2,14</sup> These studies varied regarding the postoperative time period in which the evaluation was done.<sup>7</sup> Regarding the time of return to work, it is

worth mentioning that many patients in the present series were elderly, outside the traditional age range for work.

The Boston Questionnaire is the most commonly used tool in CTS patients for symptoms and hand dysfunction assessment. In the present study, the SSS in the first and sixth months indicated the superiority of the open technique when compared with the endoscopic technique. The authors consider that this small difference is not enough to indicate a superiority of the open technique. These findings are contrary to those of Hu et al.,<sup>13</sup> in which endoscopic surgery promoted a better recovery of hand function.

As for the VAS, the present results coincide with the literature and no differences between the two surgical techniques were observed.

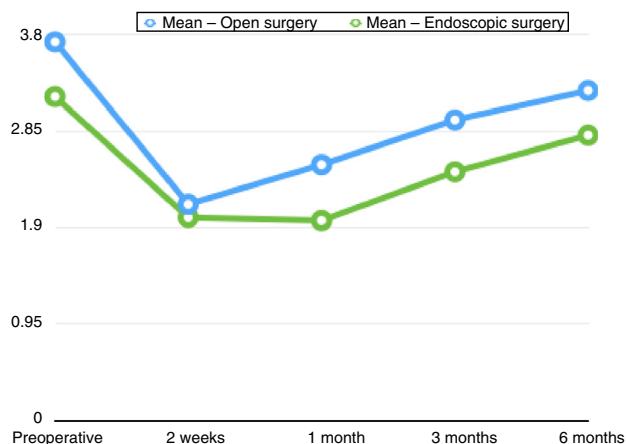
Regarding palmar grip strength, the present results were similar to those of Ferdinand and MacLean,<sup>15</sup> Rab et al.,<sup>6</sup> and Michelotti et al.,<sup>7</sup> who also failed to observe differences between the techniques.

**Table 6 – Comparison of lateral (key) pinch grip strength scores between open and endoscopic surgeries as to the evaluated time periods.**

	Mean – open	Mean – endoscopic	Interpretation at the level of 0.5%
Preoperative period	4.72	4.23	No difference between the means
2 weeks	2.97	2.57	No difference between the means
1 month	3.06	2.88	No difference between the means
3 months	4.32	3.61	No difference between the means
6 months	3.71	3.47	No difference between the means

**Table 7 – Comparison of three-digit (tripod) pinch grip strength scores between open and endoscopic surgeries as to the evaluated time periods.**

	Mean – open	Mean – endoscopic	Interpretation at the level of 0.5%
Preoperative period	3.73	3.19	No difference between the means
2 weeks	2.13	2.00	No difference between the means
1 month	2.52	1.97	No difference between the means
3 months	2.96	2.45	No difference between the means
6 months	3.25	2.81	Difference between the means

**Fig. 7 – Comparison of three-digit (tripod) pinch grip strength scores between open and endoscopic surgeries as to the evaluated time periods evaluated.**

No studies assessing finger grip strength were retrieved in the literature, which prevented the authors from making comparisons.

## Conclusion

With the use of the intraindividual evaluation, no differences were observed between open and endoscopic surgery when assessed by the Boston Questionnaire, VAS, and palmar and digital grip strength results.

## Conflicts of interest

The authors declare no conflicts of interest.

## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.rboe.2017.09.010](https://doi.org/10.1016/j.rboe.2017.09.010).

## REFERENCES

- Mackinnon SE, Novak CB. Compression neuropathies. In: Green DP, editor. *Green's operative hand surgery*. 6th ed. Philadelphia: Elsevier; 2010. p. 977-1015.
- Okamura A, Meirelles LM, Fernandes CH, Raduan Neto J, Santos JB, Faloppa F. Avaliação dos pacientes com síndrome do túnel do carpo tratados pela técnica endoscópica. *Acta Ortop Bras*. 2014;22(1):29-33.
- Vasiliadis HS, Xenakis TA, Mitsionis G, Paschos N, Georgoulis A. Endoscopic versus open carpal tunnel release. *Arthroscopy*. 2010;26(1):26-33.
- Chen L, Duan X, Huang X, Lv J, Peng K, Xiang Z. Effectiveness and safety of endoscopic versus open carpal tunnel decompression. *Arch Surg*. 2014;134(4):585-93.
- Malhotra R, Kiran EK, Dua A, Mallinath. Endoscopic versus open carpal tunnel release: a short-term comparative study. *Indian J Orthop*. 2007;41(1):57-61.
- Rab M, Grünbeck M, Beck H, Haslik W, Schrögendorfer KF, Schiefer HP, et al. Intra-individual comparison between open and 2-portal endoscopic release in clinically matched bilateral carpal syndrome. *J Plast Reconstr Aesthet Surg*. 2006;59(7):730-6.
- Michelotti B, Romanowsky D, Hauck RM. Prospective, randomized evaluation of endoscopic versus open carpal tunnel release in bilateral carpal tunnel syndrome. An interim analysis. *Ann Plast Surg*. 2014;73 Suppl. 2: S157-60.
- Chung KC, Walters MR, Greenfield ML, Chernew ME. Endoscopic versus open carpal tunnel release: a cost-effectiveness analysis. *Plast Reconstr Surg*. 1998;102(4):1089-99.
- Kyle D, Bickel MD. Carpal tunnel syndrome. *J Hand Surg Am*. 2010;35(1):147-52.
- Galbiatti J, Komatsu S, Faloppa F, Albertoni WM, Silva SEA. Via de acesso ulnar da síndrome do túnel do carpo. *Rev Bras Ortop*. 1991;26(11/12):389-94.
- Reis FB, Lopes AD, Faloppa F, Ciconelli RM. A importância da qualidade dos estudos para a busca da melhor evidência. *Rev Bras Ortop*. 2008;43(6):209-16.
- Silva JA, Ribeiro Filho NP. A dor como um problema psicofísico. *Rev Dor*. 2011;12(2):138-51.
- Hu K, Zhang T, Xu W. Intraindividual comparison between open and endoscopic release in bilateral carpal tunnel syndrome: a meta-analysis of randomized controlled trials. *Brain Behav*. 2016;6(3):e00439.
- Meirelles LM, Dos Santos JB, Dos Santos LL, Branco MA, Faloppa F, Leite VM, et al. Avaliação do questionário de Boston aplicado nos pós-operatório tardio da síndrome do túnel do carpo operados pela técnica de retinaculótomo de Paine por via palmar. *Acta Ortop Bras*. 2006;14(3):126-32.
- Ferdinand RD, MacLean JG. Endoscopic versus open carpal tunnel release in bilateral carpal tunnel syndrome. A prospective, randomised, blinded assessment. *J Bone Jt Surg [Br]*. 2002;84(3):375-9.