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# The efficacy of vein conduits on the healing of digital nerves

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**The aim of the study was to determine the efficacy of wrapping nerve suture over recovery. In this prospective study, 72 patients with injured digital collateral nerves were studied during six months after microsurgical repair. 28 patients had nerve epiperineural suture with vein conduit wrapping and 44 patients had simple epiperineural nerve suture. We compare these two groups in terms of spontaneous pain, pain caused by impact and cold intolerance. We also investigated sensitive recovery with Weber test, Dellon test and the five monofilaments test. We also performed ultrasound at six months after surgery. The result of this study is in favor of using wrapping with vein to decrease presence of neuroma, pain and discomfort caused by contact without negative effect on sensitive recovery.**

**Keywords:** Digital nerve, vein conduit, sensitive recovery, neuroma.

## INTRODUCTION

Several admissions to emergency departments concern trauma of the hand.

During the exploration of these lesions, it is common to find damage to the digital collateral nerves.

The repair of these digital nerves gives quite variable results. The possible persistence of digital hypoesthesia is rarely regarded by the patient as an inappropriate reality. On the other hand, the subsequent presence of residual pain, dysesthesia has a greater functional impact for patients. It is therefore necessary to repair these lesions in an optimal way.

To reduce the occurrence of these events, various techniques have been developed. The wrapping of the nerve suture in order to isolate it from the scar environment is one of them.

Through this prospective study, the objective was to compare the results after simple microsurgical suture of the digital collateral nerve with the suture associated with the wrapping of it by a vein conduit. We evaluated this in terms of sensory recovery, decreased sensitivity to cold, occurrence of pain, dysesthesia, painful neuroma.

## PATIENTS AND METHODS

### *Generalities*

This is a prospective study in an orthopedic and hand surgery department. The study ran from July 2017 to June 2022.

### *Objectives of the study*

The objective of the study is to compare direct suture of the collateral nerve with suture associated with wrapping by a vein conduit. It was taken on the anterior surface of the wrist or forearm.

The comparison covers the functional results in terms of recovery of sensitivity, intolerance to cold, persistence of pain or dysesthesia, development of neuroma, patient satisfaction.

We will also include in the analysis the concepts of smoking, diabetes, pathology with peripheral neurological involvement, recent corticosteroid intake, age and sex of the patients.

### *Randomization and patient inclusion*

Patients were randomized to complete two groups. For patients treated on even days, we performed a direct suture of the collateral nerve without coating the suture with a venous sleeve, whereas in patients operated on odd days, we performed suture associated with vein conduit. All patients were operated by the same surgeon.

*Patient inclusion criteria*

- Adults (18 years and more)
- Hand with section of at least one palmar digital collateral nerve. The level of section was located on proximal phalange, IPP, second phalange.
- With or without other lesion (art, tendon, fracture).

*Criteria for exclusion of patients*

- Minor (less than 18 years)
- Section of a nerve trunk other than a palmar digital collateral nerve
- Loss of nerve substance that does not allow nerve suturing
- Complete amputation of the finger

*Patients*

Eighty-seven patients were treated in our department for a wound on at least one finger of the hand resulting in a complete section of one or more digital collar nerves. However, of these 87 patients, 15 patients did not return for follow up. That leaves us with 72 patients; 28 patients were treated with nerve suture combined with vein conduit and 44 patients had simple suturing.

Of the 28 patients for whom the suture was combined with a vein, two patients did not come to the three months control (but to the six months control) and five patients did not come to the six months control (but to the three months control). The pickup time in the operating room was from 3 a.m. to 7 p.m. Figure 1, Table I and II.

Of the 44 patients for whom a simple suture was performed, seven patients did not come to the three months control (but to the six months control) and 11 patients did not come to the six months control (but to the three months control). Indeed, one patient was

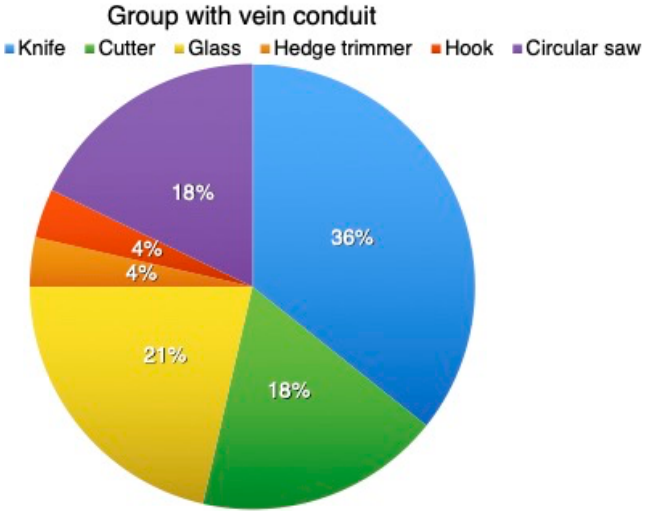



*Fig. 1 — Lesion mechanism for the group with vein.*

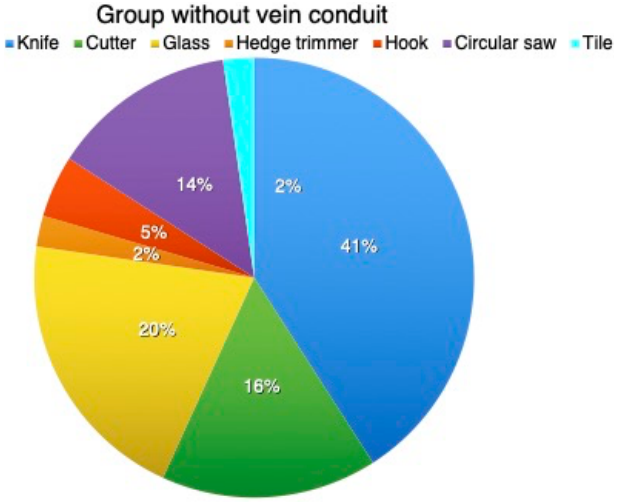



*Fig. 2 — Lesion mechanism for the group without vein.*

treated at six days of the trauma and a second at seven days. Figure 2, Tables I and II.

*Surgical technique*

The operation was carried out in emergency or semi-emergency under regional anesthesia.

During the intervention, patients were wis the limb injured on an arm table with a tourniquet at the root of the limb, inflated to 250 mmHg. We systematically use a microscope for the microsurgical part.

Interventions involve abundant washing of the wound with physiological serum, enlargement of the wound if necessary to facilitate evaluation.

Then we systematically explore the wound in order to highlight the different aspects. Thus, we can confirm the section of the digital collar nerve, we dissect the two extremities of the nerve on about 5 mm of each side. Depending on what is needed, we cut the ends of the nerve in order to find healthy zone while remembering to keep a sufficient length to avoid any tension on the suture.

For all patients, we perform a suture without tension by epi perineural points (3 or 4 points) with nylon 9-0 or 10-0.

For patients operated on odd days, in addition to this simple nerve suture, we perform a wrapping of the suture through a vein. To do this, we remove a vein 15 to 20 mm long on the inner surface of the forearm or wrist (Picture 1); in these regions there are veins of appropriate caliber since the latter must be discreetly wider than the sutured nerve (Pictures 2, 3, 4). Before performing the suture of the nerve, the venous conduit is threaded on one end of the nerve. Once the suture is made, the sleeve is slipped to coat the suture area (Pictures 5, 6).

*Post-operative follow-up and patient evaluation*

Patients were then seen in the study at three months and six months postoperatively. Indeed, we can consider that from 6 months, the result is achieved without change thereafter. The evaluation was done by the same hand surgeon. During the follow-up, we

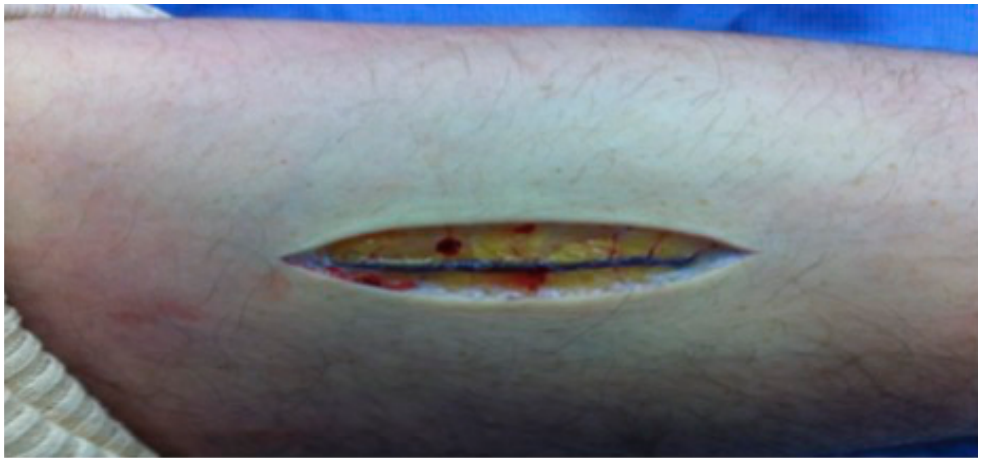
**Table I.** — Patient characteristics.

| | Group with vein conduit | Group without vein conduit |
|---|---|---|
| Number of patients = Number of sutured nerves | 28 | 44 |
| Average age | 37 years | 41 years |
| Number of women/men | 16w/12m | 11w/33m |
| Dominand hand | 13 | 20 |
| Number of smokers | 15 | 16 |
| Number of diabetics | 0 | 1 |
| Number of patients with neurological disease | 0 | 0 |
| Number of patients taking corticosteroids | 0 | 0 |
| Accident at work | 13 | 13 |

**Table II.** — Lesions associated with palmar collateral nerve section.

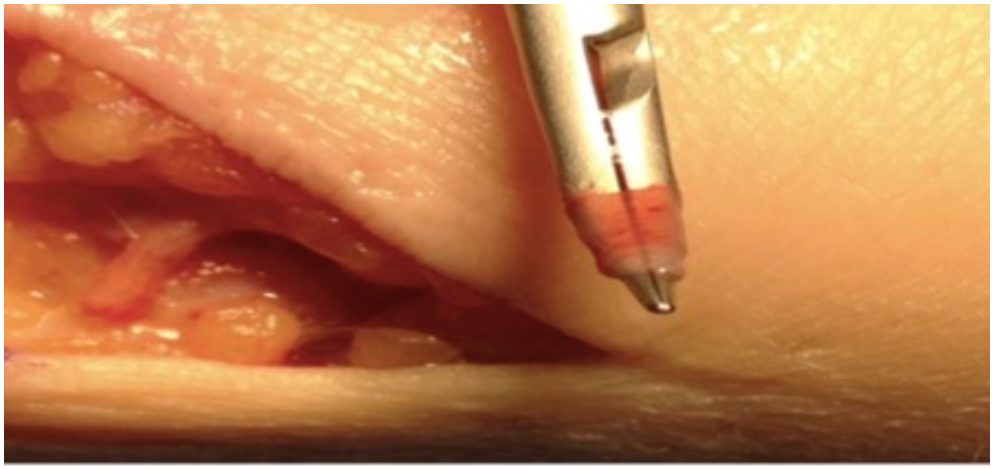
| Injuries found | Group with vein n=28 | Group without vein n=44 |
|---|---|---|
| Isolated collateral nerve | 7 | 16 |
| Collateral nerve + Collateral artery | 8 | 11 |
| Collateral nerve + Deep/superficial flexor tendons | 3 | 8 |
| Collateral nerve + Collateral artery + Deep/superficial flexor tendons | 9 | 8 |
| Collateral nerve + Collateral artery + Extensor tendon | 0 | 1 |
| Collateral nerve + Collateral artery + Phalanx + Extensor tendon | 1 | 0 |

*Picture 1 — Vein collection area and nerve suture area.*



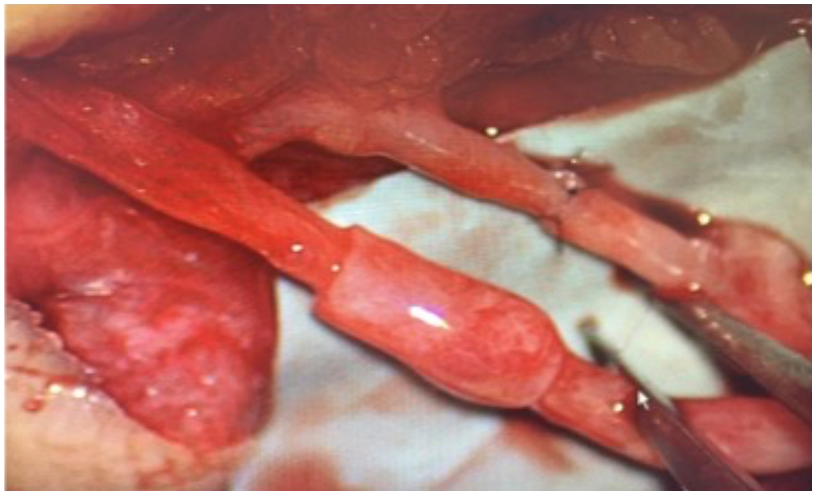
*Picture 2 — Vein conduit.*

*Picture 3 — Vein conduit.*



*Picture 4 — Vein conduit removed.*

*Picture 5 — Nerve suture wrapped by vein.*



*Picture 6 — Nerve suture wrapped by vein.*

collected different data needed to draw up the results. We were able to highlight patient satisfaction, the presence of spontaneous pain, the presence of pain caused by contact, impact on the finger). We also looked for cold intolerance, a symptomatic neuroma.

The recovery of sensitivity was then investigated by different tests, namely the Weber test, the Dellon test and the five monofilaments test[1,2].

We also looked at the appearance of the scar at the vein collection area and impact on patient satisfaction.

Finally, we noted the occurrence of complications such as infection, stiffness, algoneurodystrophy.

At six months after surgery, we requested, for all our patients, the realization of ultrasound by the same radiologist specialized in order to evaluate the nervous continuity, the importance of fibrosis around the suture, the presence of a neuroma.

During this exam, the forearm was hidden, the radiologist didn't if there was a vein collection.

*Statistical tests*

To interpret our results and compare the results obtained in the two groups, we used the K hi square test and the Mann Whitney test. We chose a significance threshold of 95 %, i.e. p = 0.05.

## RESULTS

During the follow up at three months and at six months, we evaluated different anamnestic and specific clinical tests as described above.

*Results at three months*

*General clinical examination*

Group "suture with vein conduit"

Regarding patient satisfaction in this group of 26 patients, 25 patients were satisfied. One patient had spontaneous pain. Eleven patients described pain caused by impact, contact with the operated finger. Also, five patients complained of cold intolerance like a real pain and eight patients of a simple discomfort. At this stage, we had a painful nerve during the clinical examination. We found no pain or harm in the scar of the vein conduit. Figure 3.

Group "suture without vein conduit"

At this stage, three patients were dissatisfied. No patient complained of spontaneous pain. Pain caused by impact, contact was reported by 20 patients. In addition, cold intolerance was described by ten patients as pain and by eight patients as a discomfort. At this stage, we found clinical suspicion of painful neuroma in nine patients. Figure 4.

*General clinical examination*

Group "suture associated with a vein conduit"

The result at the two points static discrimination test (Weber) was excellent (less than 6 mm) for five patients, good (between 7 and 10 mm) for nine patients, medium (between 11 and 15 mm) for nine patients and poor (16 mm and more) for three patients. Figure 5.

For the result at the dynamic two points discrimination test (Dellon), we found three patients with excellent results (less than 3 mm), 17 patients with good results (4 to 7 mm), six patients with poor results (greater than or equal to 8 mm). Figure 6.

Two patients perceived the finer monofilament (2.83) and four patients that of 3.61 in the Semmes-Weinstein test. Filament 4.31 was perceived in 15 patients, 4.56 in four patients and 6.65 filament in one patient. Figure 7.

*Comparison between the two groups*

At three months, we found no significant difference between the two groups regarding patient satisfaction,

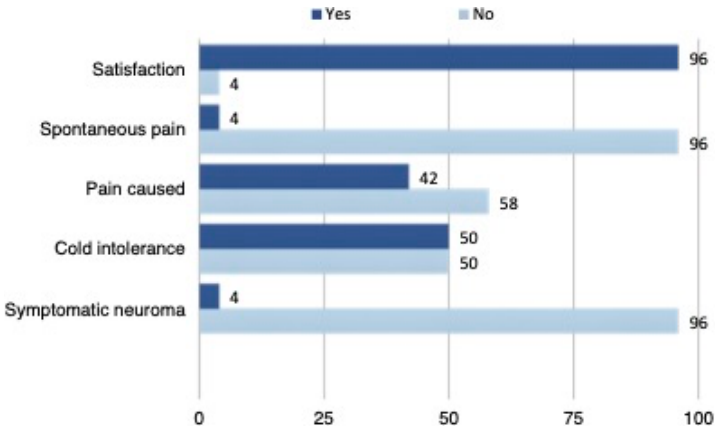



*Fig. 3 — General data for the group with vein at three months.*

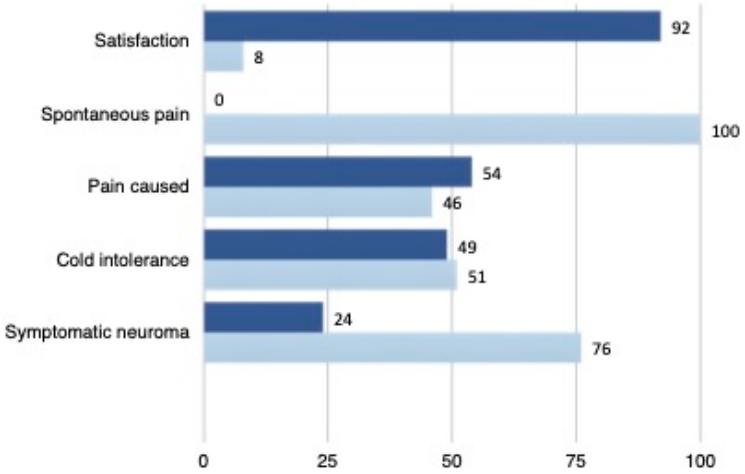



*Fig. 4 — General data for the group without vein at three months.*

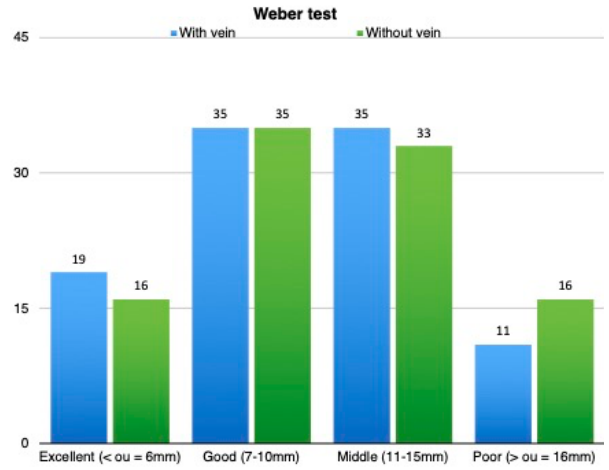



*Fig. 5 — Weber test for the two groups at three months.*

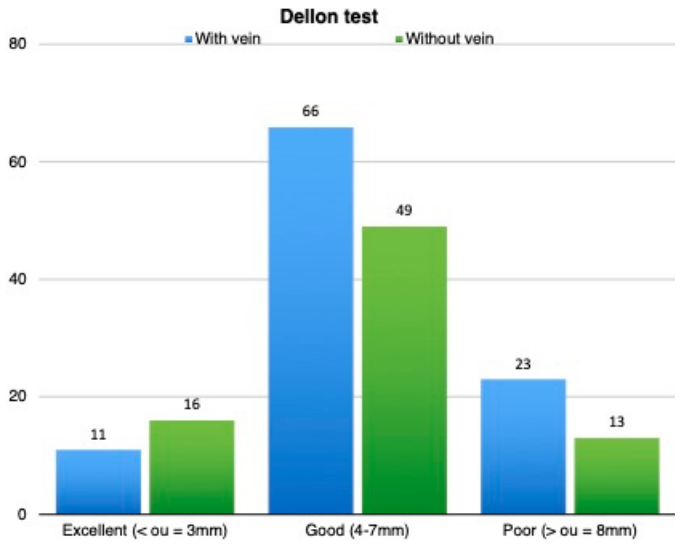



*Fig. 6 — Dellon test for the two groups at three months.*

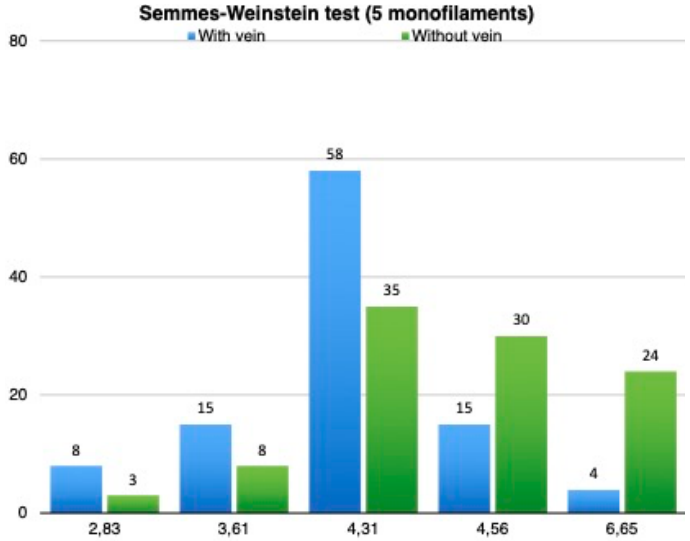



*Fig. 7 — Semmes-Weinstein test for the two groups at three months.*

presence of spontaneous or induced pain and cold intolerance. The recovery of sensitivity studied by the Weber and Dellon test was similar between the two groups.

However, we found statistically significatively more symptomatic neuromas in patients with simple nerve suture (p-value < 0.5). Also, we found better sensory recovery following the monofilament test for patients with suture associated with a vein conduit. Table III.

*Results at six months*

*General clinical examination*

Group "suture with vein conduit"

At six months, 22 patients of the 23 in this group were satisfied. One patient complained of spontaneous pain. Pain caused by impact, contact was reported by six patients. In addition, cold intolerance was described by three patients as pain and by nine patients as a discomfort.

We did not find any painful neuromas on clinical examination in this group. We found no pain or harm in the scar of the vein conduit. Figure 8.

Group "suture without vein conduit"

Regarding patient satisfaction in this group of 33 patients, 30 patients described themselves as satisfied. Spontaneous pain was reported by four patients. Also, 18 patients described pain caused by impact, contact against the operated finger. Also, 12 patients complained of pain and six patients of severe pain when exposed to cold.

We found clinical suspicion of painful neuroma in 10 patients. Figure 9.

*Specific clinical tests*

Group "suture with vein conduit"

The result of Weber test was excellent for six patients, good for 13 patients, middle for three patients and poor for one patient. Figure 10.

Regarding the result of Dellon test, we found 7 patients with excellent results, 14 patients with good results, 2 patients with poor results. Figure 11.

Three patients perceived the finer monofilament (2.83) in the Semmes-Weinstein test. The filament 3.61 was perceived by eight patients, that of 4.31 by 11

**Table III.** — Results of the p-value for the evaluated and compared data of the two groups at three months.

| Assessed data | P-value |
|---|---|
| Patient satisfaction | 0.495 |
| Spontaneous pain | 0.229 |
| Pain caused | 0.359 |
| Presence of clinical symptomatic neuroma | 0.029 (= p-value < 0.5) |
| Cold intolerance | 0.857 |
| Weber test | 0.719 |
| Dellon test | 0.522 |
| Monofilaments test | 0.008 (= p-value < 0.5) |

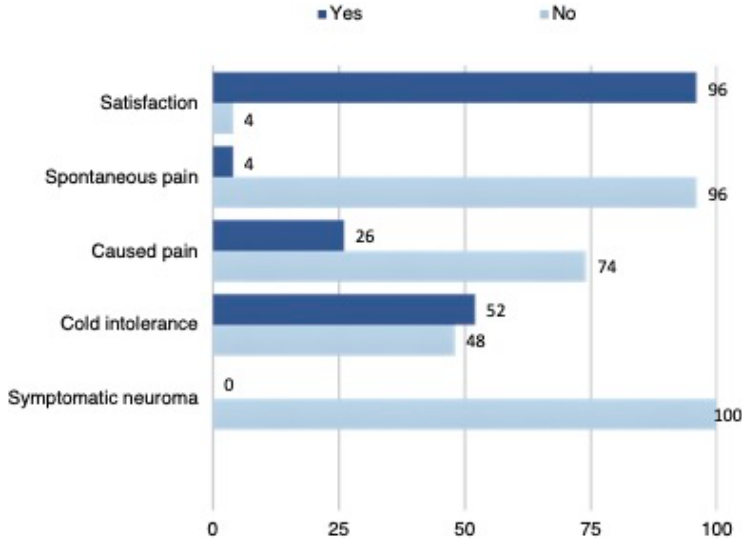



*Fig. 8 — General data for the group with vein at six months.*

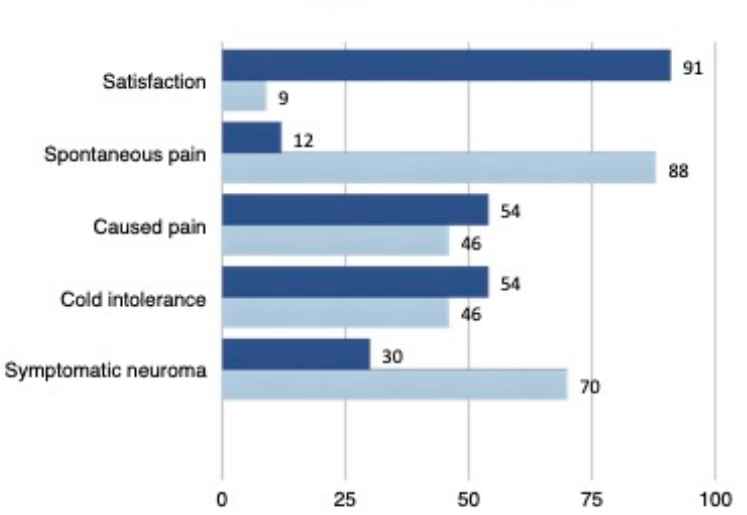



*Fig. 9 — General data for the group without vein at six months.*

patients, that of 4.56 by one patient and that of 6.65 by none. Figure 12.

*Complications*

Group "suture with vein conduit"

None of this group had any complication.

Group "direct suture without vein conduit"

Two patients developed algoneurodystrophy. Also, two patients were inclined towards stiffness with a need for revision surgery for tenolysis at six months after surgery. In these two patients, a flexor tendon suture was performed initially. However, we had also sutured the flexor tendons in four other patients without the need for tenolysis afterwards. One patient presented at six months with a recurrence of rupture of the deep flexor tendon sutured during the first intervention with the need of new intervention. One patient presented with a superficial multi-sensitive staphylococcus infection treated by ten days of oral antibiotics.

*Ultrasounds data*

Group "suture with vein conduit"

For all patients in this group, at the echography realized at six months of the intervention, it was possible to find and follow the nerve along its length, its structure is a little bit modified. Also, there is very little fibrous tissue around the suture area. No neuroma in this group were found.

Group "direct suture without vein conduit"

In this group, at six months after surgery, there is a greater rearrangement around the nerve and in particular

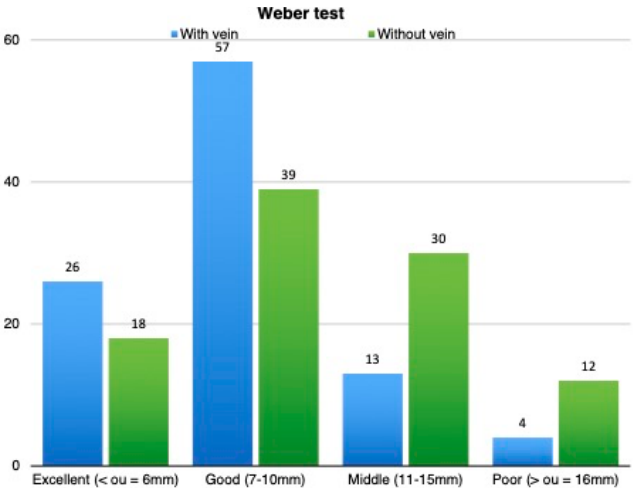



*Fig. 10 — Weber test for the two groups at six months.*

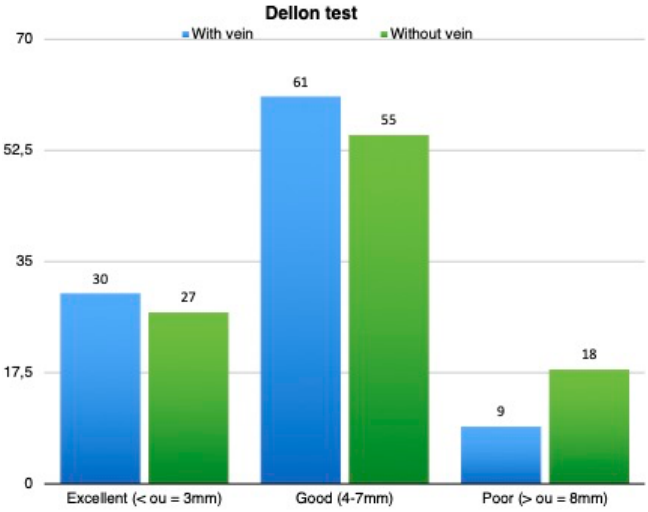



*Fig. 11 — Dellon test for the two groups at six months.*

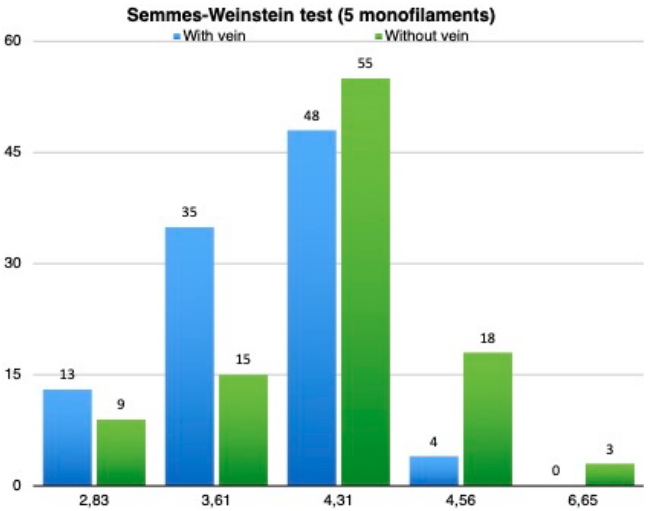



*Fig. 12 — Semmes-Weinstein test for the two groups at six months.*

around the suture causing a difficulty in following the nerve along its length. This rearrangement is due to fibrosis around the suture. For five patients in whom a painful neuroma has been clinically diagnosed, ultrasound confirmed it for three patients. For the other two, the importance of the fibrosis around the nerve made diagnosis more difficult.

*Comparison between the two groups*

At six months, we found no significant difference in patient satisfaction, spontaneous pain, cold intolerance and recovery of sensitivity. However, we found statistically significatively more induced pain and symptomatic neuromas in patients with simple nerve suture (p-value < 0.5). Table IV.

## DISCUSSION

The problem associated with the management of wounds with palmar collateral nerve section is not only represented by the recovery of a correct sensitivity at the level of the finger and more particularly of the hemi-pulp involved[1]. Indeed, the persistence of spontaneous pain or even pain caused by contact or support, the presence of a real intolerance to cold, the presence of dysesthesias are elements generating a feeling of failure of the treatment for the patient[5-7]. The literature describes a certain degree of association between the presence of a neuroma and the existence of cold intolerance[3,4].

In this context, various techniques have been used to combat this problem of pain, dysesthesia, intolerance to persistent cold after surgical management of a section of palmar collar nerve in the finger.

We are obviously familiar with the classical technique of microsurgical suture of the nerve usually epiperineural, but which can also be epineural, interfascicular, fascicular[3,8,9]. The stitches and the increase in their number, the tension of the suture, the contact of the suture with the scar environment are elements generating a fibrous reaction[8]. The idea of enveloping the nerve, ensuring a hermeticism of the suture and avoiding adhesion to this fibrous environment has been known for a long time[9]. Thus, various processes have emerged such as biological glues made of human fibrin and bovine thrombin forming a cylinder around the suture area and associated with one or two points with nylon 9-0. Neurotubes have also been developed, particularly based on animal research[3]. However, these procedures, unlike the removal of a venous sleeve on the patient, involve a certain cost as well as the placement of a tissue with risk an inflammatory reaction. Neurotubes are also described as stiffer and causing difficulty in finger mobilization[3].

The literature contains various studies on the use of the venous conduit but there is a few prospective comparative studies.

Roux and al.[10] compared 14 palmar collar nerve sutures with veins to 16 simple sutures without vein in a communication to the French Hand Surgery Society in 2012. Their results showed that there was no difference in terms of recovery of awareness between the two groups. However, none of the patients in the venous conduit group experienced persistent pain.

Aligand and al.[11] published a detailed study in 2011 on 53 venous coduits (in 48 patients) after suturing palmar collar nerves. 96 % of patients were satisfied. None of their patients experienced any pain, persistent pain. On the other hand, 58 % of patients described cold intolerance but only in the form of a discomfort and not real pain. 40 % of patients perceived in the monofilament of 3.61 in the test of Semmes and Weinstein and presented an average Weber test result of 10.3 mm. No patient described a prejudice esthetic related to scar of vein sampling.

The series of Elias and al.[12] on simple sutures without wrapping found 93 % of patients satisfied. However, 25 % of fingers were painful with a result to the Weber test on average good (9 mm).

Other series with coating after nervous suture such as that of Lousbersac[13] published in 2012 studying the

**Table IV.** — Results of the p-value for the evaluated and compared data of the two groups at six months.

| Assessed data | P-value |
|---|---|
| Patient satisfaction | 0.498 |
| Spontaneous pain | 0.316 |
| Pain caused | 0.034 (= p-value < 0.05) |
| Presence of clinical symptomatic neuroma | 0.004 (= p-value < 0.05) |
| Cold intolerance | 0.373 |
| Weber test | 0.112 |
| Dellon test | 0.024 (= p-value < 0.05) |
| Monofilaments test | 0.056 |

addition of neurotube for one study and the addition of biological glue for the other have found good results of functional tests (average Weber test of 8 mm for glue and 9 mm for tube) with the absence of persistent pain.

The results of our study are like those of the previous studies, while having the advantage of being prospective and comparing the two techniques.
The use of a nerve suture wrap therefore shows its effectiveness mainly to limit the development of painful neuromas sand to avoid the persistence of pain without positively or negatively modifying the results of functional tests of sensitive recuperation.

## CONCLUSION

The analysis of the results of our study leads to favorable findings.

The re-coating of the nerve suture by a vein have not a negative effect on sensitive recovery. However, this also did not result in a better response to sensitive recovery tests across clinical trials.

On the other hand, the patients in whom we placed this vein had less neuroma pain or even discomfort caused by contact on this finger.

These results are therefore very clearly in favour of using vein conduit in the surgical management of palmar collar nerve sections.

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