

Platelet Gel for the Surgical Treatment of Onychocryptosis

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Background: The growth factors derived from platelets contained in platelet-rich plasma comprise a series of molecules that favor the production of collagen with the proliferation of fibroblasts and new blood vessels. These substances exert their effect on the cells, acting in all the stages of cicatrization, especially in hemostasis and early fibroplasia.

Methods: Thirty-five patients (70 feet) were selected, operated on both sides for ingrown hallux nails, and subjected to two different experimental conditions in a crossover clinical trial with positive control of treatment. Two main variables were analyzed: on one side, the bleeding, according to three preestablished categories, and on the other, the mean time of cicatrization in days.

Results: Significant differences ($P < .001$) were found between the two groups for bleeding. We observed that cicatrization time did not differ significantly between the two treatments.

Conclusion: The use of platelet gel for the treatment of onychocryptosis by single nonincisional matricectomy can guarantee good hemostasis, with a significant reduction in bleeding, but does not produce a clinically significant reduction in cicatrization time. (J Am Podiatr Med Assoc 98(4): 296-301, 2008)

The surgical options for the treatment of onychocryptosis are varied. Segmentary phenolization of the matrix is one of the most extended, but it presents a series of drawbacks that remain unresolved, such as delayed cicatrization (between 3 and 6 weeks) because of excessive tissue destruction and long periods of drainage,¹⁻³ acute reaction to the chemical, associated toxicity, and potential risk.⁴⁻⁷ However, experience shows that it is a technically simple and effective procedure in the treatment of onychocryptosis. The local application of phenol produces a cauterization of the vessels that lessens postoperative bleeding⁸⁻¹⁰ and seems to reduce pain because of its neurolytic effect on the nerve fibers.^{9, 11-13}

On the other hand, surgical excision of the matrix by nonincisional matricectomy (Heifetz technique or Suppan technique no. 1) enables a quicker reestablishment of the patient, with minimum postoperative care, presents less risk of contamination, and has proved more effective than incisional (Lapidus and

Zadik) techniques, although it does produce more bleeding than chemical matricectomy.^{14, 15}

Recently, platelet gel has been used as a novel product in the treatment of patients with problems of coagulation and has shown clinical benefits in such patients. It has been used in endoscopic and laparoscopic surgery in patients with altered coagulation (hemophiliacs) because it enables better control of post-traumatic hemorrhages before the hospital treatment. Once activated, the platelet-rich plasma fraction yields a preparation-denominated platelet gel with high resistance to organic fluids, which acts as a hemostatic plug.^{16, 17}

Materials and Methods

The samples were obtained from patients requiring attention in the Podiatry Clinic of Seville University (Seville, Spain) and in two private podology surgeries near Seville. The patients had previously received conservative treatment (chiroprody) without definitive results.

Patients with onychocryptosis in the great toes of both feet were evaluated. Individuals not meeting the criteria for inclusion in the study or not agreeing to

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take part in the clinical trial were excluded. The criteria were that patients presented onychocryptosis in stage I and IIa according to the Mozena classification system¹⁸ (fold depth less than 3 mm). Patients with erythema, drainage, and acute pain were given conservative treatment before surgery (removal of the encrusted nail spicule and local treatment with antiseptic) until the clinical signs and symptoms disappeared. Patients with circulatory problems, coagulation disorders, problems of cicatrization, and abnormal platelet count in peripheral blood were excluded.

The study initially included 40 individuals, of whom five were excluded: one who presented a (slight) Von Willebrand-type blood condition that was detected after the patient's inclusion in the study; two patients presenting a syndrome of postoperative infection; and two patients for defects in the protocol (platelet adhesive nongelled in one and the impossibility of extracting blood in the other). The final study sample consisted of 35 patients (70 feet), of whom 18 were males and 17 females, with a mean \pm SD age of 43.88 ± 23.36 years. The study was carried out between November 2004 and May 2006.

Patients were required to give written consent. The study was approved by the Ethics and Experimental Committee of Seville University and by the governing body of the Podiatry Clinic of Seville University before data collection began.

The clinical trial had a randomized, single-blind, crossover design, with positive control of treatment (a placebo was not used) and each patient was subjected to two different experimental conditions. The positive control of treatment comprised the administration of a water-soluble ointment, Furacin (Seid SA, Barcelona, Spain), previously used as positive control of treatment in other clinical trials.¹⁹ The active principle is nitrofurazone 0.2 g in a polyethylene glycol excipient. Its therapeutic effect comes from a combination of its antimicrobial activity against gram-positive microorganisms and its capacity to generate a moist environment that favors regenerative metabolic reactions.

The surgical procedure consisted of a partial removal of the nail plate, followed by separation of the nail bed and matrix with a scalpel and in one piece (Suppan technique no. 1).²⁰ The procedure was carried out at both nail borders of the hallux. Treatments were selected intraoperatively and randomly (by tossing a coin; heads = right foot, treatment with platelet gel; tails = left foot, treatment with Furacin). All patients received antibiotic prophylaxis with 250 mg or 500 mg of cefuroxime axetil 1.5 hours before the procedure and another dose 12 hours after it. All procedures were performed by the same clinician (A.C.-F.).

To obtain the platelet gel, we used the protocol

proposed by Anitua et al²¹ and approved by the Spanish Ministry of Health for national health service use with the PRGF System (Biotechnology Institute, Victoria, Spain). In contrast with other methods, this one, in a single centrifugation step and with outpatient suitability, yields platelet-rich plasma. Activated with added calcium chloride (10%), the gel is easily manipulable and can be packed into the operated nail grooves (Fig. 1). The protocol follows that of an autologous graft, using the patient's own blood exclusively, thereby avoiding immunological rejection responses.²¹

Both treatments were repeated after 48 hours, and from the fifth day the treatment administered to both the control and experimental groups consisted of applying antiseptic solution of povidone iodide. Daily checks were made until cicatrization was complete. Cicatrization was considered to be the absence of drainage, with the granulation tissue covered by a scab. The patient was allowed to bathe.

After 48 hours, a qualitative and comparative evaluation was made of bleeding, and three categories were established: light (the dressing showed no external staining; only the polypropylene dressing in contact with the wound and the gauze in contact with that were partly stained); moderate (the dressing showed slight staining on the back or sides; the non-stick dressing was completely stained, and the gauze in contact with it was partly stained); and abundant

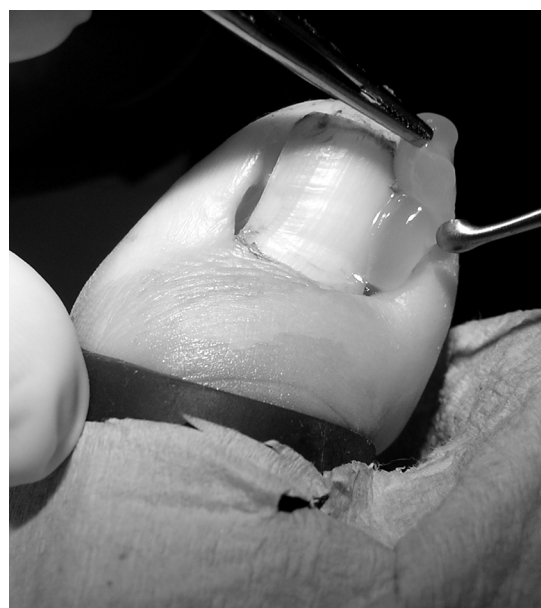


Figure 1. Application of platelet gel into the operated nail grooves.

(the external dressing was completely or almost completely stained).

The presence or absence of secondary bleeding was established by the color of the dressing (deep red, wet bandage or dark red, dry bandage) to know whether there had been a delay or partial failure of the mechanisms of hemostasis 15 to 30 min after removal of the tourniquet and without a blow or traumatism to explain it.

We performed statistical analysis with SPSS version 14.0 (SPSS Science, Chicago, Illinois). The first step in analyzing the studied variables between the two groups (experimental and control) was to determine whether the paired samples of the differences between the two groups for each variable had a normal distribution. Because the sample comprised fewer than 50 elements, the Shapiro-Wilk test was used to test normality. The test was normal for bleeding but not for cicatrization.

As there was no bleeding of category "light" in the control group, the categories "light" and "moderate" for the two groups were considered together for the statistical analysis, and the McNemar test was applied in the two groups. A statistical significance of $P < .05$ was considered.

To compare equality of means between the two groups for cicatrization, the Wilcoxon sign-rank test was used. For the study of cicatrization depending on gender, the nonparametric Mann-Whitney U test was used.

Results

The McNemar test was significant ($P < .001$) for bleeding—that is, it detected significant differences (93.9% of patients presented abundant bleeding with the control treatment and 18.2% with the experimental treatment) (Table 1). Similarly, there were significant differences between the secondary bleeding of the experimental group (present in 0 patients) and the control group (present in 10 patients). The absence of bleeding in the experimental group impeded comparative testing of the variable between the two groups.

The test result indicates that the cicatrization time differed between the two groups, in favor of the experimental group, with a lower mean (Tables 2 and 3). It was considered significant, a minimum value of 1 day, and the difference of the mean was only 0.52.

The nonparametric Mann-Whitney U test was not significant for cicatrization depending on gender ($P = .160$), so the mean values of cicatrization between genders do not differ significantly (Table 4).

The clinical results on cicatrization have been supported by the histologic observations made during

the study. Biopsies taken after 48 hours in two patients of the control and the experimental treatment have shown histologic differences in the number of fibroblasts observed, in favor of the experimental group (Figs. 2 and 3).

Discussion

The growth factors derived from platelets contained in the platelet-rich plasma comprise a series of molecules that, besides guaranteeing the triggering of the mechanisms of hemostasis, favor the production of collagen, together with the proliferation of fibroblasts and new blood vessels. These substances exert their effect on the cells, acting in all stages of cicatrization, especially hemostasis and early fibroplasia. Most studies have stressed the important role of the platelets in the cicatrization process, particularly in hemostasis, acute inflammation, and proliferation.

Tayapongsak et al²² were the first to publish on the use of platelet-rich plasma mixed with bovine thrombin in maxillofacial surgery. They obtained a platelet gel with hemostatic properties that reduced the cicatrization time when used in medullar and spongy bone grafts for mandibular reconstruction.²²

Many procedures have been described for the surgical excision of the nail bed and matrix. Chemical ablation has been a popular method of resolving ingrown toenails. However, it has had varying results, with recurrence rates ranging from 1.1%⁹ to 24%.²² There are drawbacks to chemical techniques, and some technical factors can cause serious complications. The major factor is the unpredictability of chemical dispersion, which causes necrosis of adjacent tissues. Another disadvantage of using phenol in chemical ablation is its possible carcinogenic properties.^{23,24}

The Suppan technique no. 1 for removal of an ingrown nail was developed by Dr. R. Suppan in 1958. This procedure has several advantages: no skin incisions, less tissue destruction than the phenol technique, and speedier cicatrization process.¹⁵ In our experience, the main drawback in the use of this technique is postoperative bleeding, causing discomfort to the patient and sometimes requiring greater postoperative monitoring than segmentary phenolization. We have experimented with the use of platelet gel to mitigate this drawback and improve the results of the technique.

The results of this study confirm the effectiveness of the hemoderivative used as hemostat, particularly considering that the treatment was applied in two wounds (both nail borders) in which no kind of primary closure was made. Foot wounds in a healthy patient involve hemodynamic conditioning originated by increased arterial pressure generated by the heart's

Table 1. Bleeding 48 Hours After Treatment Application

		Bleeding with Platelet Gel		Total
		Light/Moderate	Abundant	
Bleeding with Control Treatment				
Light/moderate	Recount	2	0	2
	% of bleeding with control treatment	100%	0%	100%
	% of bleeding with platelet gel	7.4%	0%	6.1%
	% of total	6.1%	0%	6.1%
Abundant	Recount	25	6	31
	% of bleeding with control treatment	80.6%	19.4%	100%
	% of bleeding with platelet gel	92.6%	100%	93.9%
	% of total	75.8%	18.2%	93.9%
Total	Recount	27	6	33
	% of bleeding with control treatment	81.8%	18.2%	100%
	% of bleeding with platelet gel	100%	100%	100%
	% of total	81.8%	18.2%	100%

Note: N = 33 subjects (66 feet). McNemar test: $P < .001$.

Table 2. Cicatrization Time of the Control and Experimental Groups

Days After Treatment	Control (no.) (n = 35 patients)	Experimental (no.) (n = 35 patients)
5	5	13
6	8	4
7	10	10
8	5	3
9	4	3
10	2	1
>10	1	1

Table 3. Cicatrization Time Characteristics in the Control and Platelet Gel Groups

Cicatrization	Control (n = 35 patients)	Platelet Gel (n = 35 patients)
Median	7	7
Range	5–15	5–15
Mean	7.30	6.79
SD	1.99	2.07

Table 4. Mann-Whitney U Test for the Analysis of Cicatrization (Abnormal Distribution)

Cicatrization	Females	Males
Mean of difference	0.73	0.31
SD	0.88	0.79

peripheral effect, which also increases with standing. This condition is exacerbated by the reactive hyperemia produced in the toe after removal of the ischemia in a zone particularly vascularized, as is the nail bed. The high resistance of the preparation to its solution in organic fluids has been shown in this study. The effectiveness of the experimental treatment could be observed in the patient excluded from the study for presenting a slight case of Von Willebrand's disease, producing slight bleeding in the study foot and abun-

dant bleeding in the control foot. To control the post-operative bleeding in this patient, platelet gel was applied 24 hours after surgery.

The observed difference in cicatrization was not clinically significant, but we found that cicatrization time differed between the two treatments (in favor of platelet gel, having a lower mean). This difference has been corroborated histologically in two patients.

The use of specific centrifugation apparatus approved by the health authorities to obtain platelet gel is becoming habitual in outpatient surgery, especially in certain medical specialties such as odontology. These systems enable the hemoderivative to be obtained easily from small amounts of blood (20 to 30 cc) with a low cost per treatment.^{21, 25-29} Therefore, we think that the use of platelet gel can contribute a series of advantages to lessen the risk in the surgical management of all types of patient, reducing their perioperative morbidity.

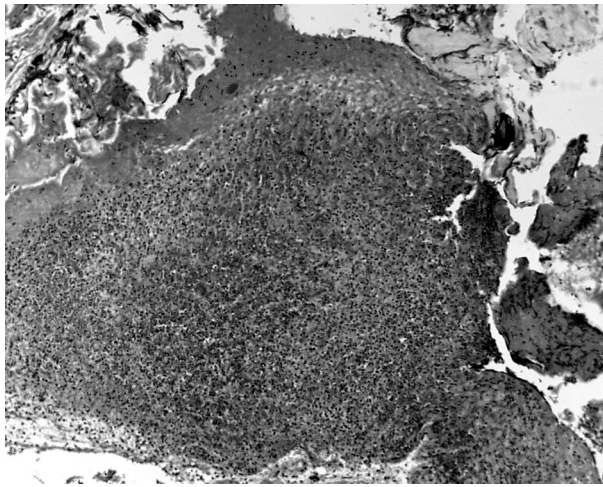


Figure 2. Control group biopsy (H&E, ×10). Inflammatory acute infiltrate can be observed in a lax fibrin network. The necrotic tissue without repair signs persists.

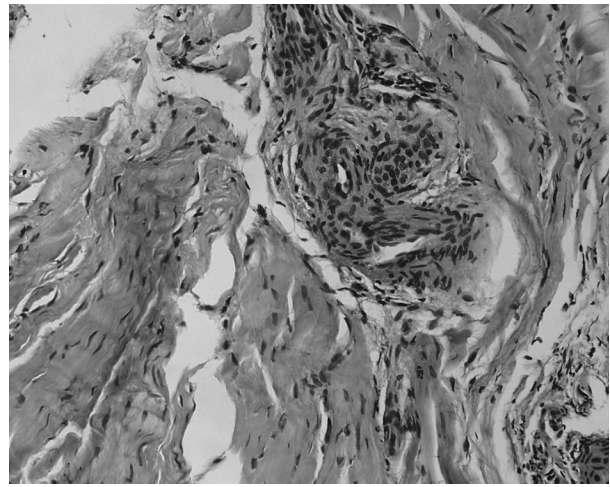


Figure 3. Experimental group biopsy (H&E, ×40). Proliferation of fibroblasts can be observed accompanied by inflammatory acute infiltrate. The tissue has been repaired partially, and collagen filaments are observed.

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Conflict of Interest: None reported.

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