Acute Phase Peyronie's Disease Management with Traction Device: A Nonrandomized Prospective Controlled Trial with Ultrasound Correlation

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ABSTRACT

Introduction. Outcome data of penile traction therapy (PTT) for the acute phase (AP) of Peyronie's disease (PD) have not been specifically studied.

Aim. The aim of this study was to assess the effectiveness of a penile extender device for the treatment of patients with AP of PD.

Methods. A total of 55 patients underwent PTT for 6 months and were compared with 41 patients with AP of PD who did not receive active treatment ("no intervention group" [NIG]).

Main Outcomes Measures. Pre- and posttreatment variables included degree of curvature, penile length and girth, pain by 0–10 cm visual analog scale (VAS), erectile function (EF) domain of the International Index of Erectile Function questionnaire, Erection Hardness Scale, Sexual Encounter Profile 2 question, and penile sonographic evaluation (only patients in the intervention group).

Results. The mean curvature decreased from 33° at baseline to 15° at 6 months and 13° at 9 months with a mean decrease 20° ($P < 0.05$) in the PTT group. VAS score for pain decreased from 5.5 to 2.5 after 6 months ($P < 0.05$). EF and erection hardness also improved significantly. The percentage of patients who were not able to achieve penetration decreased from 62% to 20% ($P < 0.03$). In the NIG, deformity increased significantly, stretched flaccid penile length decreased, VAS score for pain increased, and EF and erection hardness worsened. PTT was associated with the disappearance of sonographic plaques in 48% of patients. Furthermore, the need for surgery was reduced in 40% of patients who would otherwise have been candidates for surgery and simplified the complexity of the surgical procedure (from grafting to plication) in one out of every three patients.

Conclusions. PTT seems an effective treatment for the AP of PD in terms of pain reduction, penile curvature decrease, and improvement in sexual function. **Martínez-Salamanca JI, Egui A, Moncada I, Minaya J, Ballesteros CM, del Portillo L, Sola I, and Carballido J. Acute phase Peyronie's disease management with traction device: A non-randomized prospective controlled trial with ultrasound correlation. J Sex Med **;**:**–**.**

Key Words. Peyronie's Disease; Erectile Dysfunction; Therapy; Penile Induration; Therapy; Traction; Methods; Tunica Albuginea

Introduction

Peyronie's disease (PD) is a chronic wound healing disorder characterized by formation of fibrous inelastic scar of the tunica albuginea following trauma of the penis and causing a variety of deformities including curvature, shortening, narrowing, and hinge defect. Additionally in most cases, it is associated with a variable degree of erectile dysfunction (ED), which significantly

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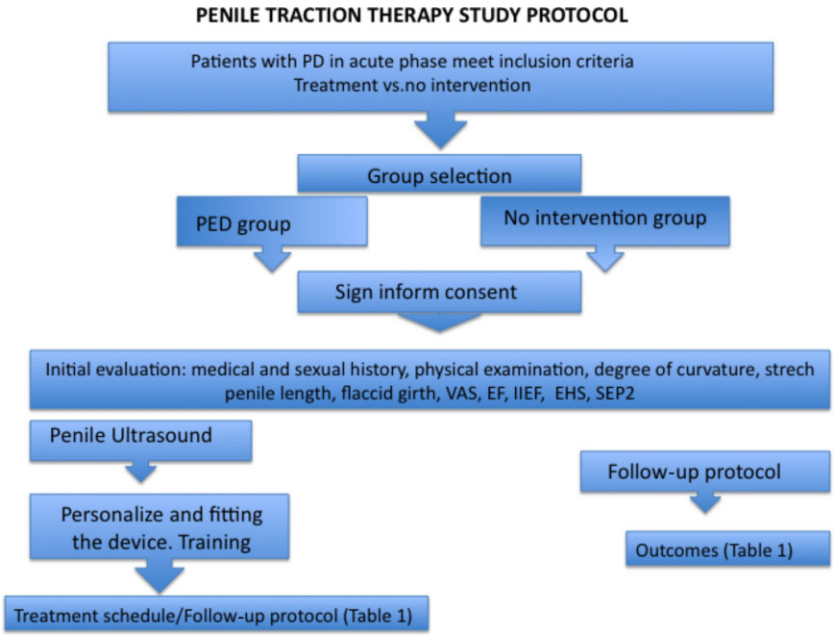

Figure 1 PTT study protocol. EF = erectile function; EHS = Erection Hardness Scale; IIEF = International Index of Erectile Function; PD = Peyronie's disease; PED = penile extender device; PTT = penile traction therapy; SEP2 = Sexual Encounter Profile Question 2; VAS = visual analog scale

affects the quality of life of the patient and his partner and is a condition that represents a challenge to manage [1–4]. Surgical therapy is an effective method but should be indicated in the chronic phase (at least 12 months of stable disease) and when penile curvature precludes intercourse. Conservative management is obtaining a progressively larger consensus among experts in the acute phase (AP) [5–7]. In 2010, *Ralph* et al. published evidence-based guidelines about the management of PD and suggest that penile traction therapy (PTT), according to early evidence (from no controlled prospective trials), reported a reduction of deformity and increased penile length [7]. Recently, the European Association of Urology has provided recommendations on the diagnosis and treatment of congenital and acquired (PD) penile curvature, stating, "PTT may reduce penile deformity and increase penile length (LE 3 GR C) [8]."

The principle of mechanotransduction (a cellular process that translates mechanical stimuli into a chemical response that leads to activation of cell proliferation) [9–11] has been applied with the use of penile extender device (PED) in the nonsurgical treatment of PD. Data from pilot studies are encouraging [12,13]; also, in our preliminary experience, PED was found to be safe and effective [14].

To confirm these preliminary results, a prospective study was conducted. Our aim was to assess the effectiveness and safety of the use of the PED for the treatment of the AP of PD as well as to evaluate the clinical sonographic correlation before and after treatment. Data from these patients were compared with a no intervention group (NIG) who did not receive active treatment.

Methods

Design

Between January 2009 and October 2011, all consecutive patients diagnosed with PD in the AP who were considered candidates for PTT and were eligible to participate in a prospective study took part in this report. The primary objective was to determine the effectiveness and safety of the use of a PED. Also, we aimed to assess the correlation between clinical and penile sonographic findings before and after treatment. The Ethics Committee of Hospital Universitario Puerta de Hierro-Majadahonda (Madrid, Spain) approved the study protocol (Figure 1). All patients were fully informed and signed the written informed consent. Patients in the NIG also signed informed consent, refusing any kind of therapy during the AP of PD.

Patient Selection

Patients with a clinical diagnosis of PD in the AP of the disease (progressive penile curvature >15° and/or pain at rest or at erection in the last 12 months) were invited to apply PTT in a prolonged, daily fashion for 6 months, regardless of degree of penile calcification assessed in physical examination. Patients in AP of PD who refuse

Table 1 Intervention and no intervention schedules and follow-up visits

Intervention group				NI group
	Device size	Daily duration	Follow-up	Follow-up
Adaptation period				
First 5 days	Initial size	3 hours	—	—
Day 6–10	+0,5 rod	6 hours	—	—
Day 11–15	+0,5 rod	6–8 hours	—	—
Evolution period				
1st month	+0,5 rod every 7 days	6–8 hours	# Days/hours assessment Subjective curvature assessment Complications/intolerance	Subjective curvature assessment
2nd month	+0,5 rod every 7 days	6–8hours	—	—
3th month	+0,5 rod every 10 days	6–8 hours	# Days/hours assessment Subjective curvature assessment Complications/intolerance Objective curvature assessment (photos) Penile stretch length/penile flaccid girth VAS, IIEF, EHS, SEP2	Subjective curvature assessment Objective curvature assessment (photos) Penile stretch length/penile flaccid girth VAS, IIEF, EHS, SEP2
4th month	+0,5 rod every 10 days	6–8 hours	—	—
Final evolution phase				
5th month	+0,5 rod every 15 days	6–8 hours	—	—
6th month	+0,5 rod every 15 days	6–8 hours	# Days/hours assessment Subjective curvature assessment Complications intolerance Objective curvature assessment (photos) Penile stretch length/penile flaccid girth VAS, IIEF, EHS, SEP2	Subjective curvature assessment Objective curvature assessment (photos) Penile stretch length/penile flaccid girth VAS, IIEF, EHS, SEP2
9th month	—	—	Subjective curvature assessment Final curvature assessment (photos) Penile stretch length/penile flaccid girth VAS, IIEF, EHS, SEP2 Penile ultrasound End of treatment vs. surgery	Subjective curvature assessment Final curvature assessment (photos) Penile stretch length/penile flaccid girth VAS, IIEF, EHS, SEP2 Continue follow-up until stable phase vs.surgery vs. no intervention

EHS = Erection Hardness Scale; IIEF = International Index of Erectile Function; NI = no intervention; SEP2 = Sexual Encounter Profile Question 2; VAS = visual analog scale

therapy were included as NIG. Duration was defined as the period between the date of symptom onset and the date of presentation.

Patients in NIG were informed about the successful rates of different treatments employed in the AP of the disease, available in our center (intralesional injections of verapamil and steroids, oral vitamin E, extracorporeal shock wave lithotripsy, topical verapamil) and decided to postpone therapy until stable phase to undergo surgery if necessary.

Exclusion criteria were congenital penile curvature, previous penile surgery, concomitant oral treatment for PD, intralesional therapy or use of any traction device, clinically stable disease, and history of symptomatic disease greater than 12 months. No additional therapies during the study period were applied.

PED and Treatment Schedule

Patients were instructed and properly trained by the same person (A. Egui) in the use of a common brand of PED, the Andropeyronie® (Andromedical, S.L., Madrid, Spain), a device designed to exert a continuous and gradually increasing traction force on the penis. Patients were advised to use the device at least 6 hours a day and no more than 9 hours, preventing its use during sleep. Also, patients were taught to remove the device at least 30 minutes every 2 hours to prevent glans ischemia. PTT schedule is shown in Table 1. The subjects were taught the importance of patience and perseverance to remain compliant to the protocol. In all patients, the duration of treatment was, at least, 6 months. Penile length did not represent a limitation for treatment; nevertheless PED requires a minimal stretch penile length (measured from the pubis to the tip of the glans) of 12 cm; a version for shorter penile length is also available.

Ultrasound Technique

The goal of sonographic evaluation was to quantify the fibrotic involvement caused by the disease

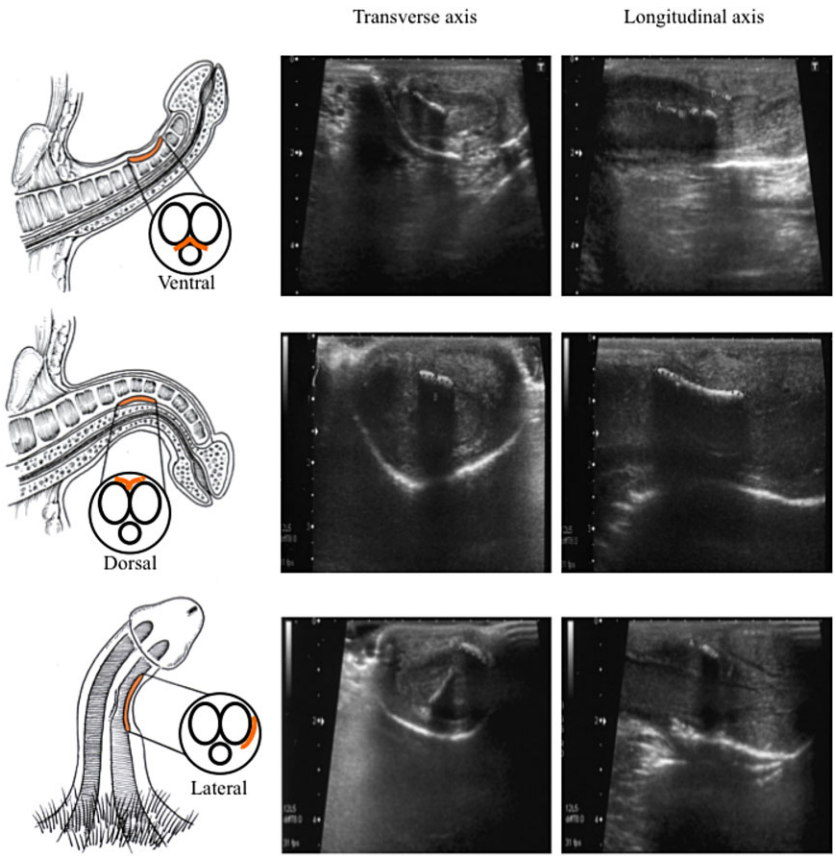

Figure 2 Sonographic aspects of plaques (transverse and longitudinal axes) ventral, dorsal, and lateral approaches.

while determining the precise location of the lesions in the penis and thickness of the plaques. The latter parameter could only be measured in fibrotic plaques, which did not show acoustic shadowing. Penile sonography was performed by the same radiologist (J. Minaya) before and after treatment with the patient supine, using the dorsal, ventral, and lateral approaches with the penis in a flaccid state (Figure 2).

The penile shaft was examined by scanning in three planes, always starting from the fixed portion of the penis toward the glans. The study included a complementary evaluation in the longitudinal plane so that the three dimensions of the lesion and its precise location inside the penis could be determined using high-frequency linear array transducer of 7.5 MHz or higher. Calcification of Peyronie's plaques was graded as grade 1 (<0.3 cm), grade 2 (>0.3 cm, <1.5 cm)m and grade 3 (>1.5 cm; or ≥2 plaques >1.0 cm) as proposed by Rybak [15].

Study Variables and Follow-Up Visits

Baseline patient's assessments included full medical and sexual history, and physician examination. The following variables were recorded: age (years) at diagnosis; duration of disease from the onset of symptoms (months); nature and degree of curvature on auto-photographs (Kelami test) in full erection using a goniometer (in case of ED, auto-photographs were taken after in-office intracavernous injection (ICI) of 20 μg alprostadil); stretched penile length, using a metal ruler from the pubis to the tip of the glans (mean of three consecutive measurements); flaccid penile girth at mid-shaft using a flexible tape (mean of three consecutive measurements); pain in erection and flaccidity by 0–10 cm visual analog scale (VAS). Associated ED was assessed by the erectile function (EF) domain of the International Index of Erectile Function (IIEF) questionnaire (EF-IIEF) (cut point <21), erection hardness using the Erection Hardness Scale (EHS), and an affirmative answer (yes) to the Sexual Encounter Profile Question 2 (SEP2), "Were you able to insert your penis into your partner's vagina?"; presence or absence of plaques in the sonographic examination (number of plaques, location, length, thickening, and presence/absence of calcification) in the treatment group only.

Follow-up visits were scheduled at 1, 3, 6, and 9 months (Table 1). Moreover, compliance with treatment (number of days and number of hours per day of penile extender use) and subjective improvement of penile curvature (categorized as "yes" or "no"), as well as complications or intolerance to the PED, were also recorded by clinical interviews. At the end of treatment, patient's overall satisfaction (OS) (0–100%) was assessed. Success of treatment was primarily defined as at least 10° reduction of penile curvature. No progression of incurvation maintained during subsequent visits after treatment (6 and 9 months) was also a complementary criterion of satisfactory result. Those patients with failure to PTT after 6 months and indication of surgical therapy were followed until fulfillment of criteria of stable phase and were then offered surgical treatment. Patients in the NIG completed 6 months of follow-up visits without any treatment as requested. After follow-up, surgical treatment was offered if they meet the criteria.

Statistical Analysis

The Wilcoxon signed-rank test was used to compare the first and second measurements of penile length and girth with baseline. The Student's *t*-test was used for the comparison of continuous variables and the chi-square (χ^2) test for categorical data. A Cox proportional hazard univariable and multivariable analysis including relative risks and confidence intervals was performed to identify predictive factors of treatment success. Statistical significance was set at $P < 0.05$.

Results

Study Population

Of a total of 110 patients with PD included in the study, 63 (57.3%) patients agreed to use the PED, whereas the remaining 47 (42.7%) formed the NIG. Eight patients included in the study group (7.8%) were finally excluded because of protocol violations (use the traction device <3 hours a day, n = 3), refusal to continue treatment (n = 2), and loss to follow-up (n = 3). Also, six patients in the NIG (5.4%) were excluded for the same reasons. Therefore, data from 55 patients treated with PTT were analyzed and compared with 41 patients in NIG. All patients in PED group were treated for at least 6 months. Mean PED use was 4.6 hours per day (3.1–9.2%). Patients in NIG completed a 6-month follow-up period. As shown in Table 2, baseline characteristics of patients in both groups were similar, without statistically significant differences.

Table 2 Baseline characteristics of 55 patients with Peyronie's disease treated with penile extender during the AP and 41 NIG

Variable	Study group (n = 55)	Control group (n = 41)*
Age, years	50.2 ± 12 (23–75)	47.5 ± 10 (25–61)
Duration of symptoms, months	8.1 ± 7.9 (1–12)	7.1 ± 8.9 (2–9)
Degree of curvature (erection)	33 (10–90)	29 (12–85)
Degree of curvature, no. (%)		
≤45°	35 (63.6)	30 (73.1)
>45°	20 (36.4)	11 (26.9)
Penile length (stretch), cm	12.4 ± 2.1 (10.9–13.9)	14.5 ± 3.1 (11.9–13.9)
Penile girth, cm	9.5 ± 1.2 (8.5–12)	8.5 ± 2.2 (8.0–13)
Pain, VAS score	5.5 ± 0.9 (1–6)	6.0 ± 1.2 (2–8)
Patients with pain, no. (%)		
No pain	35 (63.6)	29 (70.7)
Any degree of pain	20 (36.4)	12 (29.3)
EF-IIEF	17 ± 2.5 (10–24)	16 ± 3.5 (12–23)
Erection Hardness Scale (EHS)	2.5 ± 0.5 (1.5–3.5)	3.5 ± 0.5 (2.5–3.0)
SEP2†		
0: No	34 (61.8)	30 (73.1)
1: Yes	21 (38.2)	11 (26.9)

*Patients in the control group were treated oral agents, such as nonsteroidal anti-inflammatory agents, vitamin E, colchicine, tamoxifen citrate, pentoxifylline, and others

†"Were you able to insert your penis into your partner's vagina?"

Data as mean ± standard deviation (range) unless otherwise stated

AP = acute phase; EF = erectile function; IIEF = International Index of Erectile Function; NIG = no intervention group; VAS = visual analog scale

Effectiveness of Traction Therapy

As shown in Table 3, there was a statistically significant decrease in the mean curvature, from 33° at baseline to 15° at 6 months and maintained at 9 months (13°), with a mean decrease of 20° ($P < 0.05$) from the baseline curvature in the PTT Group. At the 9-month follow-up visit, 20 (36.4%) of the 55 patients showed a reduction of the penile curvature >20°, 30 (54.5%) reduction range from 12–20°, and 5 (10%) showed a stable curvature or with an improvement <10° despite PTT (Figure 3). These five patients had a baseline curvature >45°. There were 10 patients with straight penis after treatment. Also, there was a significant increase in stretched penile length and flaccid girth ($P = 0.03$). At baseline, 28 patients (51%) had penile pain in flaccidity or during erection. The mean VAS score for pain decreased from 5.5 to 2.5 at 6 months of treatment ($P < 0.05$). EF and erection hardness also improved significantly. The 20 patients who showed a reduction of curvature >10° had compliance rates >6 hours a day.

Table 3 Changes of study variables from baseline to 9 months in patients undergoing PTT and no intervention group

	Intervention group						No intervention group					
		Treatment			Posttreatment		Treatment				Posttreatment	
Variable	Baseline	1 month	3 months	6 months	9 months	*P* value	Baseline	1 month	3 months	6 months	9 months	*P* value
Degree of curvature (erection)	33	29	22	15	13	<0.05	29	35	42	51	52	<0.05
Penile length (stretch), cm	12.4	12.7	12.9	13.7	13.9	0.03	14.5	13.7	12.9	12.1	11.9	0.03
Penile girth, cm	9.5	9.6	9.9	10.3	10.4	0.03	8.5	8.4	8.3	8.4	8.4	NS
Pain, VAS score	5.5	4.0	3.5	2.5	2.5	<0.05	6.0	6.5	7.5	8.4	6.5	0.02
EF-IIEF score	18	18	20	24	28	<0.05	16	15	13	10	10	<0.05
Erection Hardness Scale (EHS)	2.5	3.1	3.5	3.8	3.8	0.2	35	3.1	2.9	2.5	2.0	<0.05
SEP2*, % patients												
0: No	62	55	42	35	20	<0.03	73	75	77	82	85	0.03
1: Yes	38	45	58	65	80	<0.03	27	25	23	18	15	0.02

*"Were you able to insert your penis into your partner's vagina?"
Data as mean unless otherwise stated
EF = erectile function; IIEF = International Index of Erectile Function; PTT = penile traction therapy; SEP = Sexual Encounter Profile Question 2; VAS = visual analog scale

Figure 3 Changes from baseline after 6 months of treatment with the PED showing reduction of the penile curvature. PED = penile extender device

At baseline, 34 (61.8%) were not able to penetrate (SEP2) because of the degree of curvature or painful erection, whereas only (20%) were not able to penetrate at the end of treatment ($P < 0.03$). According to this data, surgical therapy could be avoided in 42% of the patients. After 6 months of treatment, 11 patients (incurvation <45° in 8, >45° in 3) met criteria for surgery (inability to penetrate) and expressed a desire to undergo surgical treatment. Eight patients underwent plication procedure, two patients underwent grafting with bovine pericardium patch, and one patient underwent penile prosthesis implantation with modeling. In these patients undergoing penile reconstructive surgery, no difficulties were encountered. All patients who underwent surgical treatment had compliance rates <6 hours daily.

In the NIG (Table 3), the mean curvature showed a statistically significant increase from 29° at baseline to 52° at 9 months ($P < 0.05$). Also, stretched flaccid penile length decreased signifi-

Table 4 Ultrasound findings in patients undergoing PTT

	Baseline	6 months of treatment
Total patients	51	51
Absence of plaques	10 (19.6)	30 (58.8)
Presence of plaques	41 (80.4)	21 (41.2)
Calcified plaques	18 (43.9)	18 (43.9)
Grade 1 (<0.3 cm)	10 (55.6)	14 (77.7)
Grade 2 (>0.3 and <1.5 cm)	4 (22.2)	3 (16.6)
Grade 3 (<1.5 cm or ≥2 plaques >1 cm)	4 (22.2)	1 (5.7)

Percentages in parenthesis
PTT = penile traction therapy

cantly from 14.5 cm to 11.9 cm ($P < 0.03$). The mean VAS score for pain increased from 6.0 at baseline to 8.4 at 6 months, then decreasing to 6.5 at 9 months. Worsening of EF and erection hardness was also observed ($P < 0.05$). The percentage of patients who were not able to achieve penetration also increased throughout the study period. Eleven patients underwent surgery, seven patients required a plication procedure, and four patients grafting procedure.

All patients both in the PTT group and the NIG group who underwent grafting procedures had curvatures >60° and very good EF.

Ultrasound Findings

A total of 51 patients treated with the PED underwent penile sonography. At baseline, plaques were found in 41 (80.4%) patients (dorsal 30, lateral 5, ventral 6). As shown in Table 4, the percentage of patients with penile plaques decreased from 80.4% at baseline to 41.2% at 6 months of treatment. Although the number of patients with calcified plaques did not vary, the percentage of patients with grade 1 increased from 55.6% at baseline to 77.7% at 6 months of treatment, whereas the percentage of patients with grade 2 and grade 3 decreased from 22.2% at baseline to 16.6% and 5.7% after 6 months of treatment (Figure 4).

Predictors of Success of Traction Therapy

As shown in Table 5, predictors of success were penile curvature <45° at baseline, VAS score for penile pain >5, time from diagnosis <3 months, absence of plaque on the ultrasound study, and age <45 years.

Adverse Events

Treatment-related adverse events included two cases of erythema in the balanoprepucial sulcus, which resolved with local measures and stopping PTT for 24–48 hours. Fourteen patients (25.4%) presented some degree of discomfort. Worsening of EF over the treatment period was not observed, and the OS was 85% (range 60–90%) at 9 months. No case of sensory loss after PTT was reported.

Discussion

The present results in a prospective clinical series of 55 patients with PD treated with PTT and 41 patients in NIG show that PTT seems an effective and safe treatment during AP. Benefits included correction or preventing progression of penile curvature in 90% of patients, mean reduction of 3 points in the VAS score for pain, and high levels of

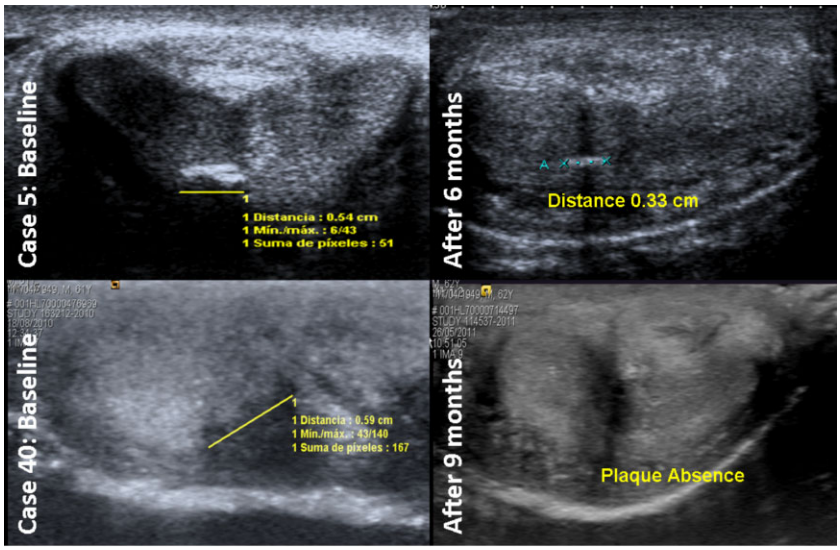

Figure 4 Decrease in the length of calcified plaque (Case #5) and disappearance of plaque (Case #40) after 6 and 9 months of PTT, respectively. PTT = penile traction therapy

Table 5 Baseline variables associated with treatment success. Univariate and multivariate Cox regression analysis

	Univariate analysis		Multivariate analysis	
Covariates	Hazard ratio (95% CI)	*P* value	Hazard ratio (95% CI)	*P* value
Age, years				
<45	1.15 (1.01–1.22)	0.35	1.19 (0.95–1.23)	0.023
>45	1.09 (0.99–1.23)	0.40	1.02 (1.0–1.34)	0.34
Time from diagnosis, months				
<3	2.20 (2.01–2.35)	0.003	2.26 (2.12–2.30)	<0.001
>3	1.01 (0.97–1.21)	0.34	1.01 (0.98–1.23)	0.15
Degree of curvature				
<45°	2.62 (2.0–3.43)	<0.001	2.26 (1.11–2.66)	0.000
>45°	1.24 (0.86–1.78)	0.24	1.08 (0.89–1.31)	0.42
Penile pain, VAS score				
<5	1.19 (1.01–1.41)	0.39	1.01 (0.86–1.23)	0.89
>5	2.35 (1.99–2.76)	<0.01	1.69 (1.27–2.24)	0.000
Sonographic findings				
Absence of plaques	2.45 (2.23–2.76)	0.001	2.45 (2.21–2.39)	<0.001
Presence of plaques	1.13 (1–09–1.23)	0.36	1.23 (1.12–1.45)	0.16
Calcification	1.08 (0.89–1.31)	0.27	1.02 (0.99–1.31)	0.31

CI = confidence interval; VAS = visual analog scale

OS. Interestingly enough, pain improvement was quickly achieved, between 1 and 3 months of wearing the PED, independently of the degree of curvature. Also, only 3–6% reported minor adverse effects. Curvature degree was assessed by auto-photographs (Kelami test) in full erection in patients without ED and by ICI-induced erection in patients with ED. In 2007, Ohebshalom et al. demonstrate that the degree of curvature using auto-photographs is underestimated compared with ICI [16]. This issue could be interpreted as a study limitation; however, we believe that curvature should be measured in "physiological conditions" because this is the performance status of patients without ED during intercourse. The primary goal of the treatment is making the patient "functionally straight", which is loosely defined as a curvature of less than 20° [17].

A significant mean reduction 20° in the penile curvature from the onset of treatment to the follow-up control at 9 months was found. Additionally, significant differences as compared with baseline in penile length and girth were also observed. After 6 months of treatment, there was also a significant improvement in the sexual function (SF) measured by the EF-IIEF (mean increase of 10 points), probably in relation to a decrease of pain during erection and/or correction of the curvature. Moreover, patients reported a significant improvement in the ability to penetrate, with a reduction of 40% in those reporting penetration inability at the beginning of the study. EHS also improved with the use of the PED, although differences as compared with baseline did not reach statistical significance. According to the present experience, the duration of PTT should not be shorter than 6 months and the device should be worn for at least 6 hours a day to obtain these results. In 2011, Abern et al. concluded that the benefit of PTT seems to be related to treatment adherence and demonstrated that men using the PED more than 3 hours per day had significantly better results. We recommend that our patients use the PED at least 6 hours per day and, with this schedule, we obtained a mean treatment adherence rate of 4.6 hours per day. In our study, we did not recommend advising patients to wear the PED for just 3 hours per day because we suspect that treatment adherence rate could dramatically decrease, thus achieving worst results [18]. It should be note, that benefits of PTT achieved at 6 months were maintained at 9 months. The fact that follow-up was not extended beyond 9 months should be considered a study limitation.

Data in NIG illustrate the natural history of PD, with an increase in deformity, decrease in penile length, and worsening of sexual dysfunction symptoms. These findings are consistent with results of other studies assessing the natural history of the disease [19,20]; overall, 12–13% of the patients believed the disease to be one of gradual resolution, 40–45% believed there had been little or no change, and 42–48% believed that the disease pattern was one of gradual progression [19,20]. The mean VAS score for pain showed a clear increase from baseline up to 6 months. Then, from 6 to 9 months, there was a reduction of pain probably in relation to cessation of inflammatory activity. In contrast, PTT was an effective method of relieving pain during the 6 months of treatment.

Penile sonography was performed in 93% of the patients treated with the PED. The fact that sonographic findings were not available in controls may be considered a study limitation. At initial clinical evaluation, penile plaques were observed in 80% of patients and calcified plaques in 43%. In 48% of patients, plaques were not documented sonographically after PTT, but calcified plaques remained stable. In the multivariable analysis, presence of plaques and calcification were inversely associated with treatment success. The predictive value of the presence of plaques, however, should be interpreted, taking into account that standard duplex ultrasound devices with 7.5 MHz probes were used in our study. Although the percentage of patients with calcified plaques did not vary, 55% of patients with grade 1 calcification at baseline increased to 78% after 6 months of PTT (some patients with grades 2 and 3 calcification were reclassified to grade 1), which may indicate that overall the degree of calcification decreased as a result of PTT. In a large cohort of 528 patients with PD undergoing ultrasonography of the penis, tunical thickening was observed in 50% of cases, calcifications in 31%, septal fibrosis in 20%, and intracavernosal fibrosis in 15%. Men with tunical thickening and intracavernosal fibrosis were more likely to have decreased ability or difficulty in penetration during intercourse [20].

Penile ultrasound is the most accurate tool to identify and measure calcification. As reported in literature, penile ultrasound has been used in men with PD to localize and measure plaque lesions and cavernosal disease patterns, follow the plaque size, and identify smaller and no palpable lesions. The addition of ICI allows optimum evaluation for reliable diagnosis of relevant disturbed vascular status and cavernous function in patients with associated ED and should be considered as a limitation of the study [21–23].

Also, the fact that there was no consistency in the measurement of erection deformity (evaluation by auto-photographs and vasoactive injection) throughout the study is certainly a weakness. It should be noted that penile duplex Doppler ultrasonography, which is the preferred noninvasive method for the functional evaluation of the penile vascular system, was not performed in our study. Also, it did not assess the type of penile curvature that gets benefit most from PTT. Another aspect that deserves mentioning is that about half of the candidates seemed to be willing to use the PED. This low rate may be explained by the strict conditions of use of the device in order to be effective, and in this respect, it may be expected that patients who agreed to undergo PTT were highly motivated.

Initial assessment of patients and provision of full information about the characteristics of PTT are essential to select appropriate candidates. In the present study, patients <45 years of age with <45° of incurvation, painful erection, sonographic absence of plaques, and duration of disease <3 months were the best candidates.

If it is assumed that most patients with penile incurvation ≥45° or inability to penetrate are candidates for surgical therapy, a 6-month treatment with PED reduced the need for surgery in 40% of patients who would otherwise have been theoretical candidates for surgery and also simplified the complexity of the operation (from patch grafting to plication) in one out of every three patients.

The present findings are consistent with previous data in small series of patients. In a pilot study of 10 patients with PD in which nearly all (90%) had failed prior medical therapy, PED was applied for 2–8 hours/day for 6 months [12]. The PTT resulted in subjectively reported as well as objectively measured improvement in penile deformity, enhanced stretched flaccid length and erect girth, as well as improved SF with no reported adverse events. The improvements appeared to be stable without recurrence for 6 months following completion of PTT [12]. In a phase II study in which 19 patients with stabilized PD with a curvature not exceeding 50° were treated with PTT for 6 months, penile curvature decreased in 40% of patients and remained unchanged in 53%, with results maintained at 12 months [13]. However, the requirement of a stable disease for study entry may have led to the selection of a subgroup of patients with a disease less amenable to plastic changes following the application of traction forces as opposed to Peyronie's plaques in the AP. It should be also recognized that comorbidities in our patients were not assessed. Kendirci et al. [24] have shown that the presence of diabetes mellitus as the only risk factor significantly increases the severity of PD.

In summary, PTT seems a safe an effective treatment for the AP of PD in terms of pain reduction, penile curvature (reduction >10° in 36.4% of patients), OS, SF improvement, and avoidance of subsequent surgery in a substantial percentage of patients. The advantages of this noninvasive therapy as opposed to observation may be assessed prospectively in a randomized study.

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