

# Low-intensity extracorporeal shockwave therapy for Peyronie's disease: An Indian experience

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## ABSTRACT

**Introduction:** Efficacy of low-intensity extracorporeal shockwave therapy (LiESWT) in Peyronie's disease (PD) has not been studied in an Indian population. Here, we studied the effect of LiESWT in Indian PD patients.

**Methods:** This prospective study was conducted on 25 patients who completed weekly sessions of LiESWT for 6 weeks with a follow-up of 6 months. Patients were evaluated using International Index of Erectile Function (IIEF)-5 questionnaire for erectile dysfunction and visual analog scale for pain. Baseline and follow-up examinations included measurement of plaque size and curvature. The primary outcome was to assess remission of pain and reduction of plaque size along with improvement of penile curvature and erectile function as the secondary outcome.

**Results:** Primary goal of pain reduction and  $\geq 50\%$  reduction of plaque size was achieved in 64% and 20% of patients, respectively. Improvement in vaginal penetration during sexual intercourse and IIEF-5 score increase of  $\geq 3$  was achieved 20% and 36% cases, respectively. The mean reduction of penile curvature was more with plaque calcification (PC), but the difference was not statistically significant ( $P = 0.26$ ). The difference in mean visual analog scale reduction was more in noncalcified plaque ( $P = 0.002$ ). The mean reduction of plaque size in patients with PC was significant ( $P = 0.03$ ).

**Conclusions:** Shockwave therapy is a probable alternative treatment option. A significant improvement was observed in pain and plaque size in patients treated by LiESWT. The presence of PC may affect the outcome of LiESWT in PD.

## INTRODUCTION

The first published paper on the thickened plaque in tunica albuginea layer of penis was in 1743 by de la Peyronie.<sup>[1]</sup> The incidence of PD ranges from 0.39% to 20.3% in adult male population.<sup>[2]</sup> The pathogenesis and management of PD is still uncertain. The current etiology of PD is proposed to be abnormal wound-healing response after an injury to tunica albuginea layer of the penis.<sup>[3]</sup> This results in a scar which undergoes abnormal remodeling. Therefore, there is persistent deformity.<sup>[4-8]</sup> Full spontaneous resolution of PD is a rare phenomenon.

Conservative therapies do not provide cure for PD. Surgery is the definitive treatment for correcting

the penile curvature but has the potential risk of penile shortening, erectile dysfunction (ED), and decreased penile sensation. Bellorofonte *et al.* in 1989 first proposed the use of shockwave therapy for cavernous fibrosis.<sup>[9]</sup> Palmieri *et al.* in 2009 reported the first randomized trial for evaluating extracorporeal shockwave therapy (ESWT) for PD.<sup>[10]</sup> In this study, we aim to study the efficiency of low-intensity ESWT (LiESWT) for PD in Indian population.

## METHODS

From October 2021 till May 2022, we conducted an open-label single-arm prospective clinical study on 25 male patients affected by PD with or without ED. All patients

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were informed in detail about the available therapeutic options for PD.

After obtaining institutional ethical clearance (IPGME and R/IEC/2021/587 R), patients with written informed consent were enrolled for the study. The inclusion criteria were as follows: stable curvature due to PD  $\geq 6$  months, age between 18 and 65 years, a single penile plaque demonstrated by high-resolution ultrasonography, and penile curvature on erection  $\geq 30^\circ$ . Patients were excluded from enrollment for any of the following: lower urinary tract infections, PD with hinge deformity, previous surgical therapies for PD or ED, bleeding tendency or coagulation disorder, comorbidities (diabetes mellitus, lipid disorders, and cardiovascular diseases), premature ejaculation, ED due to history of radical prostatectomy, or other pelvic surgery with subsequent ED.

Penile plaque size, penile curvature degree, presence and severity of painful erections (visual analog scale [VAS]), erectile function (International Index of Erectile Function [IIEF] questionnaire-5), and stretched penile length were evaluated at baseline and during 6 months of follow-up. Patients were asked to answer yes/no question: "Do you experience difficulty in vaginal penetration during sexual intercourse?" The degree of curvature was measured with goniometer or protractor before and after treatment using photographic lateral and dorsal pictures taken by the patients during full erection. In patients with ED, oral tadalafil 10 mg was given and post erection photograph was taken. If the patient had curvature in more than one plane, the plane with maximum deviation was taken as the baseline for further evaluation in the study. Plaque calcification (PC) was confirmed and graded by ultrasound using a 7.5 MHz linear transducer. PC was graded as follows: grade 1 ( $<0.3$  cm), Grade 2 ( $>0.3$  cm and  $<1.5$  cm), and Grade 3 ( $>1.5$  cm; or  $\geq 2$  plaques  $>1.0$  cm).<sup>[11]</sup>

Patients with PD and ED (IIEF-5  $<17$ ) were given oral tadalafil (10 mg) daily dose starting 1 week before shockwave and continued for next 6 weeks along the course of Li ESWT [Figure 1]. Li ESWT was performed without anesthesia. The adhesive tape was applied over the glans of the flaccid penis. The penis was stretched such that the other end of the adhesive tape was applied over the back of the right or left thigh for dorsal plaque and front of the opposite thigh for lateral plaque. After skin sensitivity test, perilesional injection of 76% urografin contrast used for plaque localization. The patient was positioned in lateral decubitus position. The shockwave generator arm was rotated to  $90^\circ$  horizontally. The perilesional contrast was focused in both  $0^\circ$  and  $30^\circ$  under the C-arm. After focusing the Peyronie's plaque, lithotripter's coupling cushion was positioned over the skin of the penile plaque. Dornier Compact Delta II lithotripter was used to deliver 1800 shockwaves/session at energy flux density

of  $0.23$  mJ/mm<sup>2</sup> over the PD plaque [Figure 2]. The Li ESWT course consists of weekly sessions for 6 consecutive weeks. Post-Li ESWT, all patients were followed up for at least 6 months. Improvement in erectile function (IIEF-5 score) was evaluated at the end of the study. At the end of the study, patients responded to the question "Post therapy whether you experience any difference during vaginal penetration for sexual intercourse?" with better/no change/worse.

The primary outcome was to assess remission of pain and  $\geq 50\%$  reduction of plaques size. Successful remission of pain meant decrease in VAS of  $\geq 4$  or complete resolution of pain during erection or vaginal penetration. The secondary outcome of the treatment was to assess subjective improvement during vaginal penetration and improvement in erectile function associated with increase of IIEF-5 score  $\geq 3$ .

The data were tabulated in Microsoft Excel and were analyzed with SPSS (statistics for windows, version 24.0 IBM Corp., Armonk, N.Y., USA). The continuous variables were expressed with mean and standard deviation (SD). The categorical variables were expressed with frequency and percentage. Paired *t*-test was used for the comparison of the variables between different intervals.  $P \leq 0.05$  was considered statistically significant.

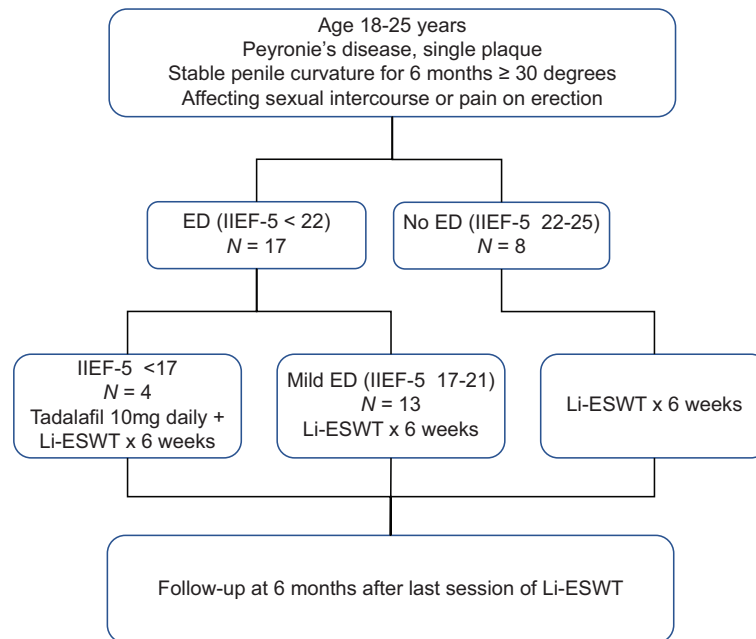
## RESULTS

The mean age of the patients included in the study was  $44.36 \pm 11.02$  years. The duration of the disease was  $13.68 \pm 7.88$  months. Eight patients had taken nonsurgical treatment before being enrolled for this study [Table 1]. All the patients had some discomfort either during erection or sexual activity. The mean pretreatment VAS was  $3.2 \pm 1.88$ . The IIEF-5 score was  $20.04 \pm 2.39$ . Four patients had IIEF score  $<17$  and were on oral daily 10 mg tadalafil. Thirteen patients had

**Table 1: Basic pretreatment patients' characteristics data of the study population**

Patients' characteristics	Parameters
Age (years)	
Mean $\pm$ SD	44.36 $\pm$ 11.02
Range	27–59
Disease duration (months)	
Mean $\pm$ SD	13.68 $\pm$ 7.88
Range	36–6
Plaque position, <i>n</i> (%)	
Dorsal $\pm$ septum	17 (68)
Right lateral	4 (16)
Left lateral	4 (16)
Ventral	0
Number of pretreatment, <i>n</i> (%)	8 (32)
Potassium-para-aminobenzoate	0
Vitamin E	3 (12)
Verapamil	1 (4)
Intralesional triamcinolone acetonide	4 (16)

SD=Standard deviation



**Figure 1:** Flowchart showing the study design



**Figure 2:** (a) Dorsal curvature of 60° is seen in photograph taken in lateral view of the erect penis. (b) With the help of adhesive tape, the flaccid penis is maintained in stretched condition during the shockwave session. The perilesional contrast injected for plaque localization. (c) The contrast over the plaque is being focused in both 0° and 30° under C-arm. Some of the contrast had spread in the subcutaneous space beyond the area of interest. (d) Dornier Compact Delta II lithotripter with mobile arm was used. Patient in lateral decubitus position. Shockwave generator arm was rotated to 90° horizontally. The lithotripter's coupling cushion was positioned over the skin of the penile plaque, after the Peyronie's plaque being focused using perilesional contrast injection

mild ED (IIEF score 17–21). Most plaques were located dorsally over the penis. The mean plaque size was  $1.25 \pm 0.66$  cm in largest dimension. About an average of  $44.72^\circ \pm 9.28^\circ$  mean penile deviation was noted. Penile ultrasonography noted

PC in 12 (48%) patients [Table 2]. Twenty-two patients had difficulty in vaginal penetration during intercourse.

At 24 weeks of follow-up, after the final Li ESWT session, more than 50% reduction of plaque size was achieved in 5 (20%) patients. The reduction of mean plaque size in the greatest dimension from  $1.25 \pm 0.66$  cm to  $0.94 \pm 0.37$  cm was found to be significant [Table 2]. Primary goal of pain reduction with decrease in VAS  $\geq 3$  score or complete pain resolution (VAS score 0) was achieved in 16 (64%) patients post therapy. The VAS reduction from  $3.2 \pm 1.88$  to  $0.8 \pm 0.8$  was found significant [Table 2]. Only five patients reported subjective improvement in vaginal penetration during sexual intercourse. Three participants experienced worsening during vaginal penetration.

The increase in mean IIEF-5 score from  $20.04 \pm 2.34$  to  $21.72 \pm 1.75$  was significant [Table 2]. The IIEF-5 score improvement of  $\geq 3$  was found in 9 (36%) patients. None had worsening of erectile function after the treatment.

No significant change in stretched penile length and penile curvature was achieved. Post-ESWT nonsignificant increase in mean stretched penile length was observed [Table 2]. Nonsignificant improvement in mean penile curvature from  $44.72^\circ \pm 9.28^\circ$  to  $43.12^\circ \pm 9.74^\circ$  was observed [Table 2]. Four patients had no change in penile curvature. Four patients had worsening of penile curvature.

Decrease in grade of PC was observed post-Li ESWT. Complete resolution of penile PC was seen in four patients (two patients each of Grade 1 and Grade 2).

**Table 2: Results of low-intensity extracorporeal shockwave therapy for Peyronie's disease**

Parameters	Before ESWT	Posttherapy (24 weeks follow-up)	Remarks
<b>VAS</b>			
Mean±SD	3.2±1.88	0.8±0.8	Overall significant ( $P<0.00001$ )
Range	1-7	0-3	Difference in the mean reduction of VAS is significantly more in patient without PC ( $P=0.02$ )
Patient with noncalcified plaque (mean±SD)	3.77±1.3	0.77±0.7	On comparison mean VAS reduction ( $4.4±0.55$ ) in 5 patients who experienced improvement in vaginal penetration with rest of the 17 patients who experienced difficulty during vaginal penetration (mean= $2.05±1.35$ ) was found to be significant ( $P=0.00063$ )
Patient with PC (mean±SD)	2.58±2.1	0.83±0.89	
Patient who initially had difficulty but posttherapy they experienced improvement in vaginal penetration (mean±SD)	5.2±1.3	0.8±0.84	
Posttherapy patient who experienced no improvement or worse in vaginal penetration but initially had difficulty (mean±SD)	2.88±1.73	0.82±0.88	
<b>IIEF-5 score</b>			
Mean±SD	20.04±2.39	21.72±1.8	Significant ( $P<0.00001$ )
Range	15-23	17-24	On comparison mean IIEF-5 score increase ( $1.4±1.34$ ) in 5 patients who experienced improvement in vaginal penetration with rest of the 17 patients who experienced difficulty during vaginal penetration (mean= $1.7±1.53$ ) was found to be nonsignificant ( $P=0.346$ )
Patient who initially had difficulty but posttherapy they experienced improvement in vaginal penetration (mean±SD)	20.4±3.5	21.8±2.8	
Posttherapy patient who experienced no improvement or worse in vaginal penetration but initially had difficulty (mean±SD)	20±1.97	21.7±1.49	
<b>Plaque size (largest dimension, cm)</b>			
Mean±SD	1.25±0.66	0.94±0.37	Overall significant ( $P<0.0092$ )
Range	0.5-3.6	0.4-1.9	Not significant ( $P=0.072$ )
Patient with noncalcified plaque (mean±SD)	1.07±2.9	0.91±0.24	Significant ( $P<0.030$ )
Patient with PC (mean±SD)	1.44±0.87	0.97±0.48	Comparison of mean reduction of plaque size between calcified plaque and noncalcified plaque was found to be not significant ( $P=0.108$ )
<b>Penile curvature (degree)</b>			
Mean±SD	44.72°±9.28°	43.12°±9.74°	Overall not significant ( $P=0.0523$ )
Range	30°-63°	25°-62°	Difference in the mean reduction of penile curvature in patient with and without PC was not statistically significant ( $P=0.062$ )
Patient with noncalcified plaque (mean±SD)	42.15±6.24	41.15±7.87	On comparison mean angle decrease ( $3.2±2.78$ ) in 5 patients who experienced improvement in vaginal penetration with rest of the 17 patients who experienced difficulty during vaginal penetration (mean= $1.06±5.04$ ) was found to be nonsignificant ( $P=0.204$ )
Patient with PC (mean±SD)	47.5±11.07	45.25±11.04	
Patient who initially had difficulty but posttherapy they experienced improvement in vaginal penetration (mean±SD)	39±7.03	35.8±9.31	
Posttherapy patient who experienced no improvement or worse in vaginal penetration but initially had difficulty (mean±SD)	48.12±8.92	47.05±8.25	
<b>Stretched penile length (cm)</b>			
Mean±SD	12.60±1.7	12.66±1.64	Not significant ( $P=0.109$ )
Range	8.6-15	9.1-15	
<b>PC, n (%)</b>			
Grade 0 (no calcification)	13 (52)	17 (68)	Complete resolution of penile PC seen in four patients (two each of PC Grade 1 and Grade 2)
Grade 1	5 (20)	7 (28)	
Grade 2	5 (20)	1 (4)	
Grade 3	2 (8)	0	

VAS=Visual Analog Scale, IIEF-5=International Index of erectile function-5, SD=Standard deviation, PC=Plaque calcification

Further subanalysis showed that the mean reduction of angle in patients with and without PC after LiESWT was  $2.25° ± 4.47°$  and  $1.0° ± 4.72°$ , respectively.

Posttherapy the mean reduction in VAS in noncalcified plaque participants and in cases with PC was  $3 ± 1.47$  and  $1.73 ± 1.42$ , respectively. The mean reduction of plaque size in patients with PC from  $1.44 ± 0.87$  cm to  $0.97 ± 0.48$  cm

was significant ( $P = 0.03$ ) [Table 2]. The mean reduction of plaque size of  $0.16 ± 0.36$  in noncalcified plaque was not significant ( $P = 0.72$ ).

There was no incidence of penile pain, penile swelling, skin hematoma, urethral bleeding in the first void after each Li ESWL course. None of the patient developed urethral stricture during or post shockwave therapy. Among the

**Table 3: Studies related to the effect of shockwaves in Peyronie's patient**

Studies	Number of patients	Effect on curvature	Effect on plaque size	Sexual function	Pain during erection
Palmieri <i>et al.</i> <sup>[10]</sup>	Placebo therapy-50 Shockwave therapy-50	Placebo: 1.8 mean degree increase Shockwave: 1.43 mean degree decrease (nonsignificant) Between-group difference statistically significant ( $P<0.05$ )	Placebo: 0.14 cm <sup>2</sup> increase Shockwave: 0.06 cm <sup>2</sup> decrease (nonsignificant) Between-group difference statistically significant ( $P<0.05$ )	Placebo: 0.58 mean IIEF-5 score increase Shockwave: 5.4 mean IIEF-5 score increase (significant $P<0.001$ ) Between-group difference statistically significant ( $P<0.001$ )	Placebo: 2.53 mean VAS decrease Shockwave: 5.05 mean VAS decrease (significant $P<0.001$ ) Between-group difference statistically significant ( $P<0.001$ )
Mirone <i>et al.</i> <sup>[15]</sup>	21	75% of patients noticed improvement in penile curvature	Plaque size decreased in 52% of cases	75% of patients noticed improvement in sexual function	76% of patients noticed improvement in pain during erection (91%) noticed relief immediately posttherapy (2.9 mean VAS reduction) ( $P<0.00001$ )
Lebret <i>et al.</i> <sup>[14]</sup>	54	For 29 patients (53.7%), an improvement in angulation ( $>10^\circ$ ) was observed, with a mean reduction of 31 ( $P<0.001$ )	Plaque size decreased in 43% of patients	For patients with erectile dysfunction, only 6 (25%) had an increased IIEF-5 score ( $>4$ )	76% of patients noticed improvement in pain during erection
Hauck <i>et al.</i> <sup>[16]</sup>	96	Mean curvature before and after ESWT was 48.3 and 42.5°, respectively ( $P=0.078$ ) Sub analyses depending on the degree of curvature revealed that ESWT has a significant effect on decreasing angulation in the 31°–60° group ( $P=0.003$ )	41% of cases plaque size decreased, 2% of cases the plaque completely disappeared, 30% of cases it remained unchanged, 27% of cases it increased	26% reported improved sexual function. In 69% of patients sexual function remained unchanged and in 5% it worsened	76% of patients noticed improvement in pain during erection
Abdel-Salam <i>et al.</i> <sup>[17]</sup>	24 patients	Four patients (17%) showed complete remission of the penile deviation Four patients had painless erections after treatment but still had some penile deviation Six patients (25%) showed partial remission with painless erections after treatment	Plaque size decreased in 58% of cases	58% reported improvement in sexual function (IIEF-5 not used)	72% of patients reported improvement in penile pain (VAS not used)
Chitale <i>et al.</i> <sup>[18]</sup>	Placebo therapy-20 patients Shockwave therapy-16 patients	Placebo: Improvements in the mean±SD dorsal and lateral angle of 5.3°±11.66° and 3.5°±17.38° Shockwave: Deterioration of 0.9°±16.01° dorsal and 0.9°±15.56° Lateral angle (nonsignificant $P=0.190$ for dorsal angle and $P=0.438$ lateral angle)	Placebo therapy: 15% of cases had a reduction in their plaque size and one case developed a new plaque in place of the original one that had resolved Shockwave: 25% men had a reduction in their plaque size, worsened in two cases, and one case developed a new plaque in place of the original one that had resolved	Placebo: 0.1 mean IIEF-5 score increase Shockwave: 0.6 mean IIEF-5 score increase (nonsignificant $P=0.652$ )	Placebo: 0.8 mean VAS decrease Shockwave: 1.1 mean VAS decrease (nonsignificant $P=0.679$ )
Hatzichristodoulou <i>et al.</i> <sup>[19]</sup>	Placebo therapy-51 patients Shockwave therapy-51 patients	Placebo: 5° mean decrease Shockwave: 9° mean decrease (significant $P=0.66$ ) Worsening of deviation in 40% of patients in ESWT group	Mean plaque size reduction was not different between the two groups ( $P=0.33$ ) However, plaque size increased found in five patients (10.9%) of the shockwave group only	Sexual function assessed by a scale regarding the ability to perform sexual intercourse IIEF-5 not used An improvement in sexual function could not be verified ( $P=0.126$ , RR=0.46)	Only 45 patients experienced pain at baseline Placebo: 1.00 mean VAS decrease. 12/25 (48.0%) patients in the placebo group Shockwave: 2.5 mean VAS decrease. Pain decreased in 17/20 (85.0%) patients in shockwave group. ( $P=0.013$ statistically significant)

Contd...

Studies	Number of patients	Effect on curvature	Effect on plaque size	Sexual function	Pain during erection
Shimpi and Jain <sup>[20]</sup>	30	Subjective assessment of mean curvature degree showed significant improvement ( $P < 0.05$ ) improving from 0.5 (pretherapy) to 0.3 (posttherapy)	Significant decrease in Doppler-measured mean plaque size from 90.3–44.08 mm <sup>2</sup> ( $P < 0.0001$ )	Statistically significant ( $P < 0.0001$ ) improvement in mean IIEFS from 33.7 (pretherapy) to 43.10 (posttherapy)	Statistically significant ( $P < 0.05$ ) improvement in mean VAS from 3.03 (pretherapy) to 2.77 (posttherapy)

VAS=Visual Analog Scale, IIEF-5=International index of erectile function-5, SD=Standard deviation, ESWT=Extracorporeal shockwave therapy, RR=Relative risk

four patients who took a daily tadalafil 10 mg dose, three reported adverse effect of nasal congestion, dyspepsia, and headache.

## DISCUSSION

The exact mechanism for Li ESWT in PD is not known. A probable hypothesis is that low intensity shockwaves induces mechanical trauma leading to inflammatory reaction, neovascularization and plaque lysis by macrophage activity.<sup>[12]</sup>

The number of shockwaves per session, the number of sessions, and the duration between consecutive sessions for treatment of PD has not been standardized. Our initial proposal of two angle or three angle approach of delivering 12 course shockwave therapy as per plaque size was based on the work by Li *et al.*<sup>[13]</sup> However, this was not feasible with the standard lithotripter. Hence, 1800 low-intensity shocks were delivered directly over the plaque in each session. As this study was started during the COVID pandemic, we reduced the ESWT course from 12 to 6. Each session was performed weekly for next 6 consecutive weeks. Follow-up was planned after 6 months. [Figure 1]. We faced difficulty in focusing the Peyronie's plaque and patient positioning using standard Dornier Compact Delta II lithotripter. Based on the study by Lebret *et al.*,<sup>[14]</sup> we used perilesional contrast for radiologic localization of plaque.

Similar to most of the previous studies [Table 3], we observed nonsignificant decrease of  $1.44^\circ \pm 4.69^\circ$  of curvature in mean penile curvature observed at 6-month follow-up ( $P = 0.0523$ ). There was no significant change in stretched penile length seen. Hauck *et al.*<sup>[16]</sup> also observed a nonsignificant ( $P = 0.078$ )  $5.8^\circ$  decrease in mean penile curvature. However, subgroup analysis revealed a statistically significant  $7.2^\circ$  decrease in penile curvature in the  $31^\circ$ – $60^\circ$  patient group after therapy ( $P < 0.003$ ).

Although we found significant ( $P = 0.0092$ ) mean plaque size in greatest dimension post therapy, only 20% of cases had more than half plaque size reduction. None had complete resolution of plaque. Shimpi and Jain<sup>[20]</sup> observed a significant decrease in Doppler-measured mean plaque size from 90.3 mm<sup>2</sup> to 44.08 mm<sup>2</sup> ( $P < 0.0001$ ). However,

most studies showed a nonstatistically significant decrease in plaque size postshockwave therapy [Table 3].

Posttherapy VAS reduction was found significant ( $P < 0.00001$ ). The secondary goal of subjective improvement in vaginal penetration during sexual intercourse was achieved in 20% ( $n = 5$ ) of cases. The reason for this improvement was due to a significant decrease in pain [Table 2]. Lebret *et al.*<sup>[14]</sup> noticed relief immediately after ESWT in 91% of cases. Chitale *et al.*<sup>[18]</sup> reported a nonsignificant decrease of 1.1 mean VAS in the shockwave group compared to 0.8 mean VAS decrease in the placebo group ( $P = 0.679$ ).

The sexual dysfunction in PD may be associated with penile deformity, painful erections, and ED or psychosocial factor. The erectile function IIEF-5 score improvement of  $\geq 3$  was achieved only in 36% of cases. Increase IIEF-5 score of  $\geq 3$  caused change in ED classification from mild ED to normal and mild-moderate ED to mild ED category in five patients and three patients, respectively. The increase in mean IIEF-5 of  $1.68 \pm 1.43$  was found statistically significant ( $P < 0.00001$ ) but was not overall clinically significant. Abdel-Salam *et al.*<sup>[17]</sup> reported 58% improvement in sexual function, but they had not used IIEF-5. However, Chitale *et al.*<sup>[18]</sup> did not report any statistically significant improvement in IIEF-5 in both therapy and sham group. The adverse effects with tadalafil 10 mg used in patients with PD + ED did not warrant discontinuation of the drug during the study.

The mechanism for resorption of calcifications post-LiESWT is not known. Four patients (two each of PC Grade 1 and Grade 2) had complete resolution of penile PC posttherapy. None of the patients developed new calcification during and after shock therapy. Hauck *et al.*<sup>[16]</sup> found that post shockwave therapy, 6 patients had resolution of calcification, but three patients developed new PC after treatment.

The impact of PC on the outcome of Li ESWT has not been well studied. The sub-analysis showed that the reduction of penile curvature was almost twice in PC group ( $n = 12$ , mean reduction =  $2.25^\circ$ , SD = 4.47) than in plaques without calcification ( $n = 13$ , mean reduction =  $1.0^\circ$ , SD = 4.72), but this difference was non-significant ( $P = 0.26$ ). The mean reduction in plaque size was significant in the PC group [Table 2]. The mean plaque size reduction was almost

three times in the PC group ( $n = 12$ , mean reduction = 0.47 cm, SD = 0.74) than the noncalcified plaque group ( $n = 13$ , mean reduction = 0.16 cm, SD = 0.36), but this difference was not significant ( $P = 0.108$ ) [Table 2]. Furthermore, the mean VAS reduction was about 1.7 times more in the noncalcified plaque than in the calcified plaque group.

Absence of control group, no comparison with other therapeutic modalities, and small sample size are the limitations of this study. Our study results was found to be comparable with other studies [Table 3]. Surgery is the gold standard treatment modality for PD. Based on this study and literature review, shockwave therapy is not a standard treatment for PD but can be used as an alternative treatment modality. However, a randomized controlled trial of long-term treatment sessions with shockwave on larger sample might show positive results.

## CONCLUSIONS

Shockwave therapy is a probable alternative to surgery in patients with PD. Significant improvement was observed in pain and plaque size by LiESWT. However, no significant change was seen in penile curvature and penile length. The presence of PC may affect the outcome of Li ESWT in PD.

## REFERENCES

- de la Peyronie F. On some obstacles which oppose the natural ejaculation of semen. *Mém Acad Chir* 1743;1:425-34.
- Mulhall J, Ahmed A, Anderson M. Penile prosthetic surgery for Peyronie's disease: Defining the need for intraoperative adjuvant maneuvers. *J Sex Med* 2004;1:318-21.
- Devine CJ Jr., Horton CE. Peyronie's disease. *Clin Plast Surg* 1988;15:405-9.
- Van de Water L. Mechanisms by which fibrin and fibronectin appear in healing wounds: Implications for Peyronie's disease. *J Urol* 1997;157:306-10.
- Greenfield JM, Levine LA. Peyronie's disease: Etiology, epidemiology and medical treatment. *Urol Clin North Am* 2005;32:469-78, vii.
- Del Carlo M, Cole AA, Levine LA. Differential calcium independent regulation of matrix metalloproteinases and tissue inhibitors of matrix metalloproteinases by interleukin-1beta and transforming growth factor-beta in Peyronie's plaque fibroblasts. *J Urol* 2008;179:2447-55.
- Ralph D, Gonzalez-Cadavid N, Mirone V, Perovic S, Sohn M, Usta M, *et al.* The management of Peyronie's disease: Evidence-based 2010 guidelines. *J Sex Med* 2010;7:2359-74.
- Levine LA, Burnett AL. Standard operating procedures for Peyronie's disease. *J Sex Med* 2013;10:230-44.
- Bellorofonte C, Ruoppolo M, Tura M, Zaatari C, Tombolini P, Menchini Fabris GF. Possibility of using the piezoelectric lithotripter in the treatment of severe cavernous fibrosis. *Arch Ital Urol Nefrol Androl* 1989;61:417-22.
- Palmieri A, Imbimbo C, Longo N, Fusco F, Verze P, Mangiapia F, *et al.* A first prospective, randomized, double-blind, placebo-controlled clinical trial evaluating extracorporeal shock wave therapy for the treatment of Peyronie's disease. *Eur Urol* 2009;56:363-9.
- Levine L, Rybak J, Corder C, Farrel MR. Peyronie's disease plaque calcification – Prevalence, time to identification, and development of a new grading classification. *J Sex Med* 2013;10:3121-8.
- Gholami SS, Gonzalez-Cadavid NF, Lin CS, Rajfer J, Lue TF. Peyronie's disease: A review. *J Urol* 2003;169:1234-41.
- Li PC, Chen X, Zhu XB, Shi T, Song F, Huang HW, *et al.* Low-intensity extracorporeal shockwave therapy for Peyronie's disease: A preliminary study of 32 cases. *Zhonghua Nan Ke Xue* 2018;24:340-4.
- Lebret T, Loison G, Hervé JM, Mc Eleny KR, Lugagne PM, Yonneau L, *et al.* Extracorporeal shock wave therapy in the treatment of Peyronie's disease: Experience with standard lithotripter (siemens-multiline). *Urology* 2002;59:657-61.
- Mirone V, Imbimbo C, Palmieri A, Fusco F. Our experience on the association of a new physical and medical therapy in patients suffering from induratio penis plastica. *Eur Urol* 1999;36:327-30.
- Hauck EW, Hauptmann A, Bschiepfer T, Schmelz HU, Altinkilic BM, Weidner W. Questionable efficacy of extracorporeal shock wave therapy for Peyronie's disease: Results of a prospective approach. *J Urol* 2004;171:296-9.
- Abdel-Salam Y, Budair Z, Renner C, Frede T, Rassweiler J, El-Annany F, *et al.* Treatment of Peyronie's disease by extracorporeal shockwave therapy: Evaluation of our preliminary results. *J Endourol* 1999;13:549-52.
- Chitale S, Morsey M, Swift L, Sethia K. Limited shock wave therapy versus sham treatment in men with Peyronie's disease: Results of a prospective randomized controlled double-blind trial. *BJU Int* 2010;106:1352-6.
- Hatzichristodoulou G, Meisner C, Gschwend JE, Stenzl A, Lahme S. Extracorporeal shock wave therapy in Peyronie's disease: Results of a placebo-controlled, prospective, randomized, single-blind study. *J Sex Med* 2013;10:2815-21.
- Shimpi RK, Jain RJ. Role of extracorporeal shock wave therapy in management of Peyronie's disease: A preliminary report. *Urol Ann* 2016;8:409-17.

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