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Treatment of Peyronie's Disease by Extracorporeal Shockwave Therapy: Evaluation of Our Preliminary Results

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ABSTRACT

***Background*: Peyronie's disease is an idiopathic disorder of the penis that produces erectile dysfunction. It affects mainly the tunica albuginea. We describe our preliminary results with extracorporal shockwave therapy (ESWT) as a new noninvasive modality for the treatment of Peyronie's disease.**

***Patients and Methods*: In this study, 24 patients aged 36 to 67 years were treated with ESWT on the Lithostar overhead-module (Siemens). All our patients had unsuccessful medical treatment before ESWT. The average plaque was 7 × 15 mm. The number of shockwaves ranged from 15,000 to 25,000 (18–21 kV) delivered in four to ten sessions. Most patients needed local anesthesia before therapy.**

***Results*: Four patients (17%) showed marked improvement and complete remission of the penile deviation. Six patients (25%) showed partial remission with painless erections after treatment. Four patients had painless erections after treatment but still had some penile deviation. In 10 patients (41%), ESWT failed, necessitating subsequent penile surgery.**

***Conclusions*: Our preliminary results with a response rate of 59% with ESWT for Peyronie's disease, including a 17% complete remission rate, is encouraging. However, further multicenter studies will have to prove if ESWT is a real therapeutic option for this disease.**

INTRODUCTION

PEYRONIE'S DISEASE is a connective tissue disorder that affects the tunica albuginea of the corpora cavernosa of the penis. The disease is not uncommon: approximately 10% of all men with erectile dysfunction have Peyronie's disease. It appears that severely deforming or disabling contracture of the tunica albuginea attributable to Peyronie's disease is rare, but minor inflammation and post-inflammatory fibrosis affecting the tunica are relatively common.[1] Lindsay and associates[2] found that the incidence of Peyronie's disease in a population-based study in Rochester, Minnesota, was 26 per 100,000 men with a prevalence of 389 per 100,000. The exact etiology of Peyronie's disease has not been established. However, it has been suggested that it may be a disorder of wound healing.[3] Several authors suggest that patients with Peyronie's disease may have a genetic predisposition because of its association with Dupuytren's contracture and HLA-B7 antigens. Others suggest an autosomal-dominant mode of transmission in some families.[4,5] Also, several studies suggest the possibility of an autoimmune etiology of this disease.[6] Trauma to the penis (whether erect or nonerect) is a strongly suggestive etiologic factor. Acute or even minimal repetitive trauma to the erect penis during normal sexual intercourse may induce Peyronie's disease. Patients with partial erectile dysfunction may be even more prone to Peyronie's disease because of the increased mechanical stress associated with the buckling that occurs while attempting sexual intercourse with a partially erect penis.[7] The classical triad of symptoms for patients with Peyronie's disease are pain, abnormal penile curvature during erection, and as a result, to difficult sexual intercourse. On examination, there is palpable calcific plaque in the corpora cavernosa.[8]

Although there are multiple modalities for the treatment of Peyronie's disease, which range from simple medical measures to surgical intervention, there is no well-established treatment for this disease. Oral agents such as vitamin E, potassium para-

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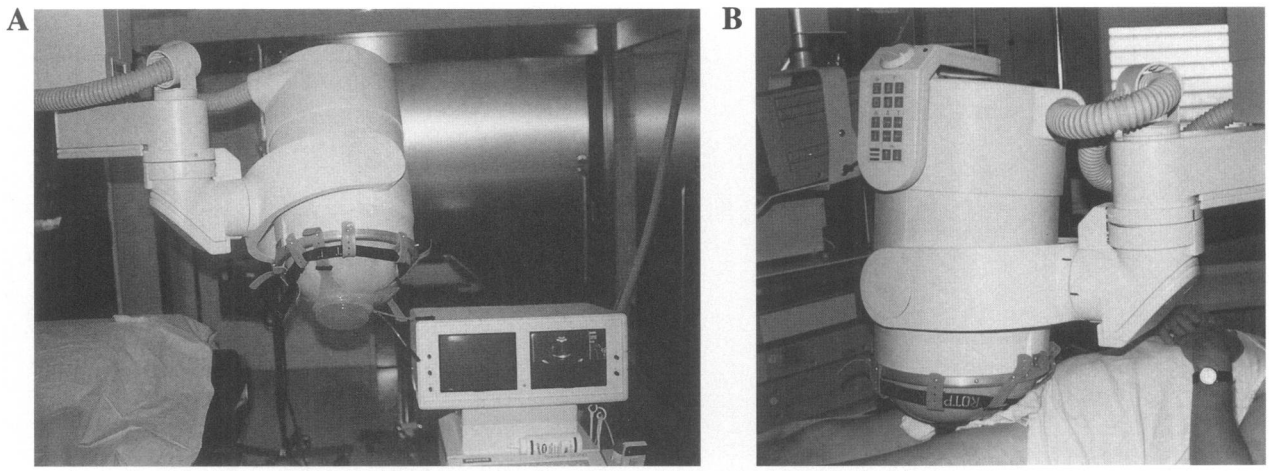


FIG. 1. (A) Siemens Lithostar overhead module for shockwave therapy. (B) Arrangement for treatment.

aminobenzoate, oral tamoxifen, or procarbazine have been used. Intralesional injection of steroids in the form of hydrocortisone, cortisone, dexamethasone; parathyroid hormone; collagenase; or a calcium-channel blocker such as verapamil has been described, but most of these agents have been compromised mainly because of the inadequate follow-up and the inconclusive results.

Because extracorporeal shockwave therapy (ESWT) is a new and very efficient approach to calcifications of connective tissues in orthopedics,[9] we evaluated our preliminary results with ESWT as a minimally invasive modality for Peyronie's disease. The use of ultrasonic waves as a mode of energy transfer has been reported since 1971 as a treatment option for Peyronie's disease.[10] The mode of action of ESWT in Peyronie's disease is not well known. It seems that it destroys the calcific plaque and then improves the elasticity of the penis.[11] Our purpose in this study was to determine whether lysis of the calcific plaque by ESWT would improve the quality of life of our patients by reducing the pain and curvature during penile erection.

PATIENTS AND METHODS

Patient Population and Pretreatment Assessment

This study was done from January 1997 to September 1998 on 24 patients found to have Peyronie's disease by history and clinical examination. Their mean age was 55.2 years (range 36–67 years), and they had suffered from Peyronie's disease for a mean of 25.8 months (range 6 months–20 years). All our patients had undergone previous nonsurgical treatment in the form of potassium para-aminobenzoate (19 patients), vitamin E (4 patients), cortisone injection (4 patients), radiation therapy (3 patients), and ultrasonic therapy (2 patients). Some patients had received many forms of therapy, but all of these treatment modalities failed. We estimated the original plaque size by multiplying the ultrasonically determined length and width. The mean plaque size was 15 × 7 mm (range 4 × 3 mm to 15 × 30 mm). The angle of penile deviation was measured by comparing a Polaroid picture of the erect penis before and after every ESWT session. The angle of deviation in our patients ranged from 30° to 80°.

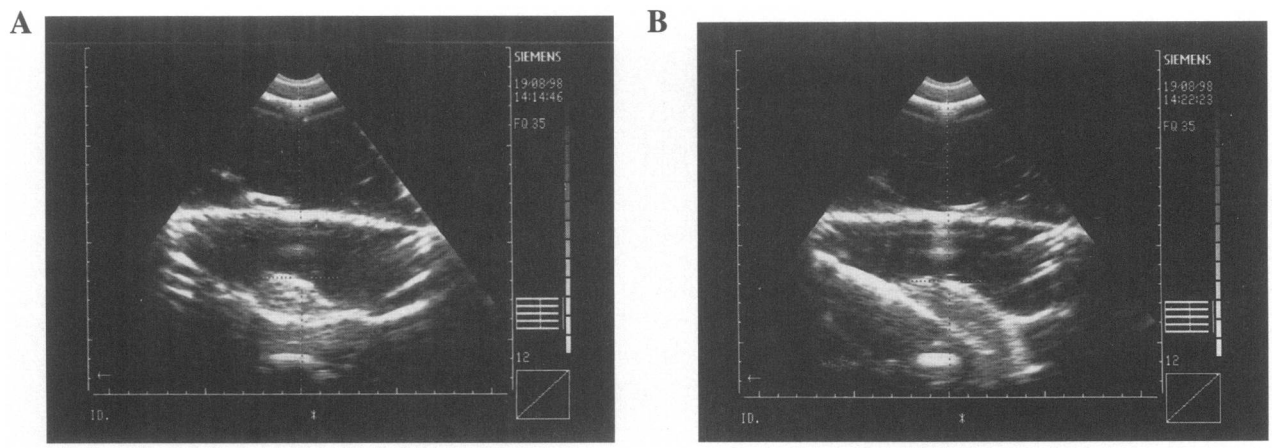


FIG. 2. Ultrasonic localization of calcific plaque. (A) Cross-section. (B) Longitudinal section.

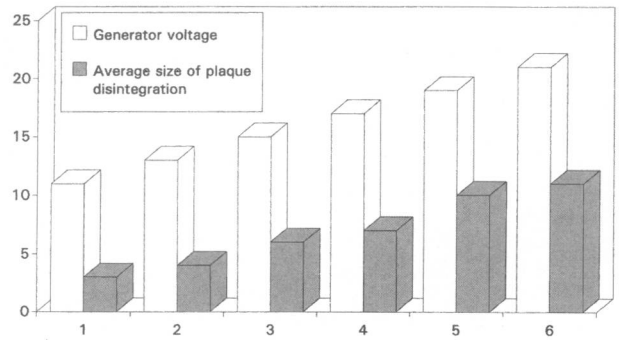


FIG. 3. Extent of plaque destruction in relation to generator voltage.

Technique

We performed ESWT using the Lithostar overhead module from Siemens (Fig. 1). The patient lies in the supine position. Ultrasonic localization of the plaque was done with a coupling device especially designed for SWL in children. (Fig. 2).

In the first four cases, we started our treatment without using local anesthesia, but we found that with local anesthesia, we could increase the generator voltage of the shockwaves, which proved to be important for disintegration of the plaque (the extent of calcific plaque disintegration is directly proportional to the energy of the shockwaves) (Fig. 3). We used local anesthesia in the form of 10 mL of Xylonest 1% as penile innervation blockade in all of the following patients. The number of shockwaves ranged from 5000 to 43,000 given over multiple sessions (average 4000/session). The mean number of shockwaves for patients not previously manipulated with local anethesia was 17,500. The mean number of shockwaves for patients previously manipulated with local anesthesia was 26,000. Also, we increased the shockwave power to 21 kV, but without local anesthesia, we used a power of not more than 15 to 17 kV. The mean number of ESWT sessions was 5 (range 3–10).

Sexual activity was not permitted in the first 24 hours after ESWT.

Follow-Up

The length of follow-up of our patients ranged from 3 to 9 months and was done only in the responders. Patients in whom ESWT failed were submitted to surgical intervention. Follow-up was done once monthly in the first 3 months and then every 3 months for 1 year. We did our follow-up by patient interview and examination as follows:

Evaluation of pain during erection:

- No pain
- Improvement but still with some pain
- No change
- Pain became worse after therapy;
- Ultrasonographic evaluation of the plaque size;
- Evaluation of the angle of penile deviation by comparison of Polaroid pictures of the fully erect penis before and after ESWT.

RESULTS

Table 1 summarizes the response of our patients. Four patients (17%) reported complete remission of all signs and symptoms and could practice a normal sexual life. Ten patients (42%) had painless erection with a reduced angle of deviation. The size of the calcific plaque decreased in all responders, and the average amount of plaque disintegration correlated with the generator voltage of the shockwaves (Table 2; see Fig. 3). The improvement of the penile angle in all responders with restoration of a straight penis in four patients indicates that the main effect of ESWT is lysis of the calcific plaque, In turn, this change improves the angle of penile deviation and the elasticity of the penis.

The only complication was intolerable pain during therapy in two patients, which necessitated stopping the session. After we began using local anesthesia, we found that there is no pain during therapy, regardless of the energy power used. Most patients developed minimal penile ecchymosis after ESWT, which improved spontaneously without medication within 2 to 3 days.

DISCUSSION

The first experimental results on the effect of shockwaves on bony and connective tissues were reported in 1988 by Graff et al.[12] Their work stimulated further experiments that eventually led to significant clinical applications in orthopedics.[13–15] Peyronie's disease, in many cases, cannot be corrected by conservative or surgical methods. A targeted application of shockwaves promises relief in some cases. The goal is to reduce the pain and the kink (bend) of the erect penis.[16]

The first application of ESWT in Peyronie's disease was reported in 1995 by Butz at the 13th World Congress on Endourology & SWL.[17] In his study of 12 patients, he found that in 8 patients, penile deviation was abolished almost completely, and in 3 patients, deviation improved. Eleven patients had pain-

TABLE 1. RESULTS OF ESWT FOR PEYRONIE'S DISEASE (%)

Symptom/Sign	*Complete Remission*	*Better*	*Stable*	*Worse*
Pain	14 (59)	3 (13)	7 (29)	0
Penile deviation	4 (17)	10 (42)	10 (42)	0
Ability of intercourse & overall condition	4 (17)	10 (42)	7 (29)	3 (13)

TABLE 2. CORRELATION BETWEEN EXTENT OF CALCIFIC PLAQUE DISINTEGRATION AND GENERATOR VOLTAGE

Generator Voltage (lcV)	*Average Size of Plaque Destroyed (mm)*
11	3
13	4
15	6
17	7
19	10
21	11

less erections after therapy, and treatment failure was observed in only one patients. Plaque disappeared completely in six patients.

We find that conservative management of Peyronie's disease is always advisable in the first 6 months to allow the pathology of the disease to stabilize. Our preliminary results with the use of ESWT as a minimally invasive treatment option showed improvement of the clinical symptoms in 59% of our patients. We found that ESWT results in rapid reduction of pain, decrease of the angle of penile curvature, and improvement of sexual function. Our results are similar to those of Butz,[17] Gianneo and associates,[11] and Baumann and Tauber[18,19] in separate studies. Those groups of investigators showed that after ESWT, more than 60% of patients had marked improvement of their symptoms, considerable straightening of the penis, and easier and more satisfactory sexual intercourse. To date, there are no reported complications of ESWT.

From our results, we found that the ideal candidates for ESWT are those patients with:

- Painful erection;
- Failed previous medical treatment;
- Mild to moderate degree of penile curvature (angle of deviation $<50°$);
- Plaque $<20 \times 10$ mm in diameter.

Patients with no response to ESWT after 6 sessions should be considered nonresponders. Surgical intervention (i.e., corporrhaphy) is the treatment of choice.

We think that the use of local anesthesia in every ESWT session is very important to reduce the pain. This in turn allows the use of higher shockwave energies, which is important to increase the efficacy of ESWT.

CONCLUSION

Our results are encouraging, especially for patients in whom conservative treatment fails. Because of the noninvasive characteristics of shockwaves and the good objective and subjective results, shockwave therapy is obviously a new alternative or complementary treatment modality. It has also been requested by patients. However, a multicenter randomized study is necessary for further evaluation of the effectiveness of this new, minimally invasive modality for the treatment of Peyronie's disease.

REFERENCES

1. Gelbard MK, Dorey F, James K. The natural history of Peyronie's disease. J Urol 1990;144:1376.
2. Lindsay MB, Schain DM, Grambsch P, Benson RC, Beard CM, Kurland LT. The incidence of Peyronie's disease in Rochester, Minnesota, 1950 through 1984. J Urol 1991;146:1007.
3. Levine LA, Merrick PF, Lee RC. Intralesional verapamil injection for the treatment of Peyronie's disease. J Urol 1994;151:1522.
4. Nyberg LM, Bias WB, Hochberg MC, Walsh PC. Identification of an inherited form of Peyronie's disease with autosomal dominant inheritance and association with Dupuytren's contracture and histocompatability B7 cross-reacting antigens. J Urol 1982;128:48.
5. Bias WB, Nyberg LM, Hochberg MC, Wash PC. Peyronie's disease: A newly recognized autosomal dominant trait. Am J Med Genet 1982;12:227.
6. Ralph DJ, Mirakian R, Pryor JP, Bottazzo GF. The immunological features of Peyronie's disease. J Urol 1996;155:159.
7. Jorow JP, Lowe FC. Penile trauma: An etiologic factor in Peyronie's disease and erectile dysfunction. J Urol 1997;158:1388.
8. Levine LA. Treatment of Peyronie's disease with intralesional verapamil injection. J Urol 1997;158:1395.
9. Rassweiler J, Haupt G, Brümmer F, Steinbach P, Loening SA, Seemann O. Nonurological applications of extracorporeal shock waves. In Smith AD, Badlani GH, Bagley DH, et al. (eds): Smith's Textbook of Endourology. 1996, Quality Medical, St. Louis, MO, pp 633–660.
10. Frank IN, Scott WW. The ultrasonic treatment of Peyronie's disease. J Urol 1971;106:83.
11. Gianneo E, Nespoli R, Conti G, Comeri G. Extracorporal shockwave treatment (ESWT) in la Peyronie's disease (IPP): one year experience (abstract). J Endourol 1998;12(suppl):S-167.
12. Graff J, Richter KD, Paster J. Effect of high energy shock waves on bony tissue. Urol Res 1988;16:252.
13. Seemann O, Rassweiler J, Chvapil M, Alken P, Drach GW. Effect of low dose shock wave energy on fracture healing: An experimental study. J Endourol 1992;6:219.
14. Haupt G, Haupt A, Ekkernkamp A, Gerety B, Chvapil M. Influence of shock waves on fracture healing. Urology 1992;39:529.
15. Valchanov V, Michailov P. High energy shock waves in the treatment of delayed and non-union of fractures. Int Orthop 1991;15:181.
16. Von der Assen N. Quality assurance in the field of roll-on roll-off (inhouse) ESWL. In: Chaussy Ch (ed): High Energy Shock Waves in Medicine: Clinical Application in Urology, Gastroentrology, Orthopedics. Basel: S Karger, 1997, pp 32–34.
17. Butz M. Treatment of Peyronie's disease (PD) by extracorporeal shock waves (ESW) (abstract). J Endourol 1995;9(suppl):S-165.
18. Baumann M, Tauber R. Induratio Penis plastica: Extrakorporale piezoelektrische Stoβwellentherapie (EPT) als neuer Therapieansatz. Akt Urol 1998;29:1.
19. Baumann M, Tauber R. A new treatment of Peyronie's disease: Extracorporeal shock wave therapy (abstract). J Endourol 1998;12(suppl):S-167.

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1. Eric Chung, David Ralph, Ates Kagioglu, Guilio Garaffa, Ahmed Shamsodini, Trinity Bivalacqua, Sidney Glina, Lawrence Hakim, Hossein Sadeghi-Nejad, Gregory Broderick. 2016. Evidence-Based Management Guidelines on Peyronie's Disease. *The Journal of Sexual Medicine* **13**:6, 905-923. [CrossRef]
2. Grzegorz Lukasz Fojecki, Stefan Tiessen, Palle Jörn Sloth Osther. 2016. Extracorporeal shock wave therapy (ESWT) in urology: a systematic review of outcome in Peyronie's disease, erectile dysfunction and chronic pelvic pain. *World Journal of Urology* . [CrossRef]
3. Elliot B. Lander, Mark H. Berman, Jackie R. See. 2016. Stromal Vascular Fraction Combined with Shock Wave for the Treatment of Peyronie's Disease. *Plastic and Reconstructive Surgery - Global Open* **4**:3, e631. [CrossRef]
4. James R. Craig, William O. Brant, James F. Smith, Tom F. LuePeyronie's Disease: Natural History, Diagnosis, and Medical Therapy 289-300. [CrossRef]
5. Eric Chung. 2015. Peyronie's disease and low intensity shock wave therapy: Clinical outcomes and patient satisfaction rate in an open-label single arm prospective study in Australian men. *Korean Journal of Urology* **56**:11, 775. [CrossRef]
6. Ronny B. W. Tan, Premsant Sangkum, Gregory C. Mitchell, Wayne J. G. Hellstrom. 2014. Update on Medical Management of Peyronie's Disease. *Current Urology Reports* **15**:6. . [CrossRef]
7. Ather Mohamed Abdelbaky, Anneliese Lawn, Anurag Nigam. 2012. Extracorporeal shock wave therapy for Peyronie's disease. *Human Andrology* **2**:2, 45-48. [CrossRef]
8. Rany Shamloul, Anthony J Bella. 2011. Management of Peyronie's disease in the aging male. *Aging Health* **7**:1, 65-78. [CrossRef]
9. Sudhanshu Chitale, Mohammed Morsey, Louise Swift, Krishna Sethia. 2010. Limited shock wave therapy vs sham treatment in men with Peyronie's disease: results of a prospective randomized controlled double-blind trial. *BJU International* **106**:9, 1352-1356. [CrossRef]
10. J F Smith, T J Walsh, T F Lue. 2008. Peyronie's disease: a critical appraisal of current diagnosis and treatment. *International Journal of Impotence Research* **20**:5, 445-459. [CrossRef]
11. Alexander Müller, Yemi Akin-Olugbade, Serkan Deveci, John F. Donohue, Raanan Tal, Keith A. Kobylarz, Michael Palese, John P. Mulhall. 2008. The Impact of Shock Wave Therapy at Varied Energy and Dose Levels on Functional and Structural Changes in Erectile Tissue. *European Urology* **53**:3, 635-643. [CrossRef]
12. Yemi Akin-Olugbade, John P Mulhall. 2007. The medical management of Peyronie's disease. *Nature Clinical Practice Urology* **4**:2, 95-103. [CrossRef]
13. Shalom J. Srirangam, Ramaswamy Manikandan, Jawad Hussain, Gerald N. Collins, Patrick H. O'Reilly. 2006. Long-Term Results of Extracorporeal Shockwave Therapy for Peyronie's Disease. *Journal of Endourology* **20**:11, 880-884. [Abstract] [Full Text PDF] [Full Text PDF with Links]
14. M. Chaudhary, N. Sheikh, S. Asterling, I. Ahmad, D. Greene. 2005. Peyronie's disease with erectile dysfunction: Penile modeling over inflatable penile prostheses. *Urology* **65**:4, 760-764. [CrossRef]
15. A. Skolarikos, E. Alargof, A. Rigas, Ch. Deliveliotis, E. Konstantinidis. 2005. Shockwave Therapy as First-Line Treatment for Peyronie's Disease: A Prospective Study. *Journal of Endourology* **19**:1, 11-14. [Abstract] [Full Text PDF] [Full Text PDF with Links]
16. Alberto Briganti, Andrea Salonia, Giuseppe Zanni, Federico Dehò, Nazareno Suardi, Bruno Mazzoccoli, Vincenzo Scattoni, Francesco Montorsi. 2004. A Critical assessment of extracorporeal shock-wave therapy for Peyronie's disease. *Current Sexual Health Reports* **1**:1, 19-23. [CrossRef]
17. EKKEHARD W. HAUCK, ULRICH O. MUELLER, THOMAS BSCHLEIPFER, HANS U. SCHMELZ, THORSTEN DIEMER, WOLFGANG WEIDNER. 2004. Extracorporeal Shock Wave Therapy for Peyronie's Disease: Exploratory Meta-Analysis of Clinical Trials. *The Journal of Urology* **171**:2, 740-745. [CrossRef]
18. EKKEHARD W. HAUCK, ARNE HAUPTMANN, THOMAS BSCHLEIPFER, HANS U. SCHMELZ, BORA M. ALTINKILIC, WOLFGANG WEIDNER. 2004. Questionable Efficacy of Extracorporeal Shock Wave Therapy for Peyronie's Disease:: Results of a Prospective Approach. *The Journal of Urology* **171**:1, 296-299. [CrossRef]
19. Po-Jung Pan, Chen-Liang Chou, Hong-Jen Chiou, Hsiao-Li Ma, Hui-Chen Lee, Rai-Chi Chan. 2003. Extracorporeal shock wave therapy for chronic calcific tendinitis of the shoulders: a functional and sonographic study. *Archives of Physical Medicine and Rehabilitation* **84**:7, 988-993. [CrossRef]

20. SHAHRAM S. GHOLAMI, NESTOR F. GONZALEZ-CADAVID, CHING-SHWUN LIN, JACOB RAJFER, TOM F. LUE. 2003. Peyronie's Disease: A Review. *The Journal of Urology* **169**:4, 1234-1241. [CrossRef]
21. Maurice Stephan Michel, Taras Ptaschnyk, Anton Musial, Peter Braun, Sylvia Tamara Lenz, Peter Alken, Kai Uwe Köhrmann. 2003. Objective and Subjective Changes in Patients with Peyronie's Disease after Management with Shockwave Therapy. *Journal of Endourology* **17**:1, 41-44. [Abstract] [Full Text PDF] [Full Text PDF with Links]
22. T. GROTH, M. MONGA. 2003. EXTRACORPOREAL SHOCKWAVE THERAPY FOR PEYRONIE DISEASE. *Archives of Andrology* **49**:3, 205-213. [CrossRef]
23. R Manikandan, W Islam, V Srinivasan, C.M Evans. 2002. Evaluation of extracorporeal shock wave therapy in Peyronie's disease. *Urology* **60**:5, 795-799. [CrossRef]
24. John Mulhall. 2002. Editorial comment 1. *Urology* **60**:5, 799-800. [CrossRef]
25. Hiroshi Kiyota, Yukihiko Ohishi, Koji Asano, Norio Hasegawa, Jun Madarame, Kenta Miki, Nobuki Kato, Takahiro Kimura, Takehito Ishiyama, Shigetaka Maeda, Tatsuya Shimomura, Yutaka Shiono, Jun Miki. 2002. Extracorporeal shock wave treatment for Peyronie's disease using EDAP LT-02; preliminary results. *International Journal of Urology* **9**:2, 110-113. [CrossRef]
26. R. Hamm, E. Mclarty, J. Ashdown, S. Natale, A. Dickinson. 2001. Peyronie's disease-the Plymouth experience of extracorporeal shockwave treatment. *BJU International* **87**:9, 849-852. [CrossRef]