



Peyronie`s disease surgery: Surgical outcomes of 268 cases

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ABSTRACT

Objective: To assess the outcomes of the surgical techniques used in Peyronie`s disease (PD) surgery.

Material and methods: Two hundred and sixty-eight patients received surgical treatment for PD. Fifty four and 144 patients underwent simple corporoplasties (shortening procedure, SP, group 1) or plaque incision and grafting surgery (lengthening surgery, LP, group 2), respectively, whereas 70 patients with erectile dysfunction underwent penile prosthesis implantation.

Results: Penile plication and Nesbit surgeries were performed in 5 (9%) and 42 (78%) patients out of total 54 patients. In the remaining 7 (13%) patients, Nesbit and plication suture combination was required for complete penile straightening. Mean curvature degree was 52.2 ± 12.3 degrees. Follow up time was 36.1 ± 29.4 months. No significant difference was demonstrated between the two groups in the baseline features and co-morbidities except age. In 144 patients who underwent plaque incision and grafting, mean age and PD onset duration were 54.1 ± 9.2 years and 28.2 ± 17.3 months respectively. Mean curvature degree was 58.4 ± 18.9 degrees. Post-operative follow up time of the second group was 51.1 ± 39.6 months. Additional plication suture was used in 48 patients (33%) patients. Degree of curvature improvement was 37.9 ± 19.1 and 52.1 ± 23.5 in SP and LP respectively ($p=0.01$). The initial anatomic success rates were 90.4% and 87.5% at their early post-operative follow-ups for group 1 and 2 respectively. These rates dropped to 82.7% and 83.6% at the long term follow-up (36 and 51 months) respectively ($p=0.9$). Although the average follow-up time of LP group was longer than SP group (52.1 mo vs. 37.0 mo), recurrence rates of these two groups were comparable. The combined functional and anatomical success of patients were demonstrated to be 79% and 75% in shortening and grafting surgery. Shortening surgery was not statistically superior to grafting surgery for patients in terms of having erection with or without the aid of PDE-5 inhibitors (94.4% vs. 88.2%, $p=0.28$). Shortening surgery makes a difference in the long term follow-up for patients who had erections without the aid of PDE-5 inhibitors (90.7% vs. 67.3%, $p=0.02$).

Conclusion: Both SP and LP are successful in terms of penile straightening in the short and long-term follow-up. Curvature degree improvement is greater in LP. Patients who undergo LP surgery may suffer from ED in the long-term follow-ups. Greater percentage of patients who underwent LP require PDE-5 inhibitors usage for sexual intercourse. Despite stated shortcomings, combined success (anatomic and functional) is achieved in three out of four patients for both groups. Penile prosthesis implantation should be preferred for patients with ED and penile deformity.

Keywords: Erectile dysfunction; grafting; Nesbit; Peyronie's disease.

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Introduction

Peyronie`s disease (PD) is the fibrotic transformation of penis tunica albuginea accompanied by localized fibrotic plaques, penile curvature, shortening, pain and erectile dysfunction. The prevalence of the disease was reported between 2-13% in different cross sectional studies across multiple countries.^[1] While emerging intralesional treatments such as Clostridium Collagenase are under inves-

tigation, surgery still remains as the definitive treatment of stable PD.^[2,3]

Although the disease was defined three centuries ago, understanding of its aspects like the etiology, pathological mechanisms, its natural course and treatment algorithms are still underdevelopment. The surgery is offered to patients who cannot enter sexual intercourse due to penile deformity, instability or ED with PD onset duration longer than 12 months and

stable/painless episode longer than 6 months. The surgical algorithm is based on curvature degree, presence of complex deformities causing sexual intercourse disability, penile length and erectile function. Shortening procedures (SP) are generally used for men with adequate penile length, curvatures <60 degrees and no complex deformity (hourglass and notching) whereas tunical lengthening procedures (LP) are reserved for PD patients with curvatures >60 degrees, complex curvatures and short penis. Adequate erectile function is a requirement for both surgeries, whereas patients with erectile dysfunction should be offered penile prosthesis implantation with additional curvature correcting maneuvers and techniques as necessary.^[4]

The aim of this study is retrospectively analyzing 268 PD surgery cases performed by a single surgeon (AK). The present study investigates the baseline characteristics of PD surgery patients and compare the surgical outcomes of different techniques.

Material and methods

Between July 1997 and July 2016, all the patients were diagnosed with PD by the principle author after the sexual history and physical examination. Penile curvature and erectile capacity was assessed via a combined injection and stimulation (CIS) test with a vasoactive agent. The curvature degree was measured using a protractor during maximum erection in response to CIS and/or vacuum device. The penile deformity were also recorded by photo and/or hand drawings. Surgical technique preference (reconstructive surgery/penile prosthesis) was determined by patients` erectile capacity which was assessed via CIS test and penile Doppler US if necessary. Simple corporoplasties, plaque incision and saphenous vein grafting (PIG) or penile prosthesis implantation surgeries were performed for 268 patients. This retrospective study was conducted in accordance with the ethical principles defined in the Helsinki Declaration.

Surgical methodology

Surgery indication and choice of technique were determined according to the ICSM guidelines as summarized in the introduction.^[2] The fine details about surgical techniques are mentioned below.

Modified Nesbit and/or plication technique was performed as simple corporoplasties for shortening procedures (SP). Plication technique as described by Essed and Schroeder was performed.^[5] For the choice of suture material, 2-0, nonabsorbable, synthetic, braided polyester was favored. As the modified Nesbit technique, lateral approach to neurovascular bundle (NVB) dissection (bundle is mobilized using a longitudinal lateral incision of the Buck`s fascia above the urethra at the 5 and 7 o`clock positions via a bilateral approach) were preferred for lateral curvatures. Lateral approach was also used for ventral curvatures until 2007 and changed to medial NVB dissection (Buck`s fascia is opened at the dorsal side of the penis, the deep dorsal vein is removed at the most prominent site of the curvature and a diamond-shaped tunica albuginea (TA) is excised from the midline of the penis) after 2007.^[6]

Plaque incision and grafting (PIG) was the choice of technique for lengthening procedures (LP). During PIG of dorsal curvatures, “medial dissection” was preferred for isolating the neurovascular bundles from the underlying tunica albuginea under optic magnification. The plaque was incised, extending the ends to an H shape or Double Y (Egydio). The harvested saphenous vein was divided into segments and assembled again with 5-0 polydioxanone (PDS1, Ethicon Inc., Piscataway, NJ, USA) sutures. The preassembled vein patch was sutured to the defect with continuous 5-0 PDS sutures. After an artificial erection, further plication sutures were applied to obtain perfection, if needed. Pubic incision was the choice of insertion for inflatable penile prosthesis. If insertion of the prosthesis could not correct the curvature (>20 degrees remaining curvature), manual modeling was attempted. If neither manual modeling nor incision of the plaque without grafting achieved adequate penile straightening, grafting surgery was preferred. The incisional defect was interposed with autologous rectus sheath patch in all cases.^[7]

Follow-up protocol

The erectile capacity of the patients and penile deformity status were assessed initially at 3rd post-operative month and routine quarterly visits continue until the end of first year. All of the patients were invited to our andrology outpatient clinic prior to this study for the long term follow-up. Patients who attended the clinic were evaluated for erectile capacity, residual/recurring penile deformity and potential complications. Patients, who could not come, were interviewed via phone survey using a systematic institutional questionnaire. Post-operative penile length and IIEF scores were not included in the study since they were not available for all patients.

Main outcome measures

“Anatomic success” was defined as complete straightness or curvature less than 20 degrees, whereas “functional success” was accepted as being able to have sexual intercourse with or without the aid of PDE-5 inhibitors.

Statistical analysis

All the statistical analyses were prepared by using Statistical Package for the Social Sciences version 22 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY, USA: IBM Corp.). Student t test, chi-square test, paired sample t test, and Mann-Whitney U test were used for this study where appropriate.

Results

Baseline demographics and parameters

1. Simple corporoplasties (SP, Group 1)

Penile plication and Nesbit surgeries were performed in 5 (9%) and 42 (78%) patients out of total 54 patients. In the remaining 7 (13%) patients, Nesbit and plication suture combination

was required for complete penile straightening. Mean age and PD onset duration were 52.9 ± 15.3 years and 33.0 ± 28.4 months respectively. Mean curvature degree was 52.2 ± 12.3 degrees. Mean post-operative follow up time was determined as 36.1 ± 29.4 months (Table 1). The number of patients operated via lateral or medial NVB dissected Nesbit plication surgery was 16 (33%) and 33 (67%) respectively.

In 18 (33%) patients, degree of curvature were greater than 60 degrees. The distribution of curvature side in these patients were as 11 (20.4%) lateral; 16 (29.6%) dorsal and 27 (50%) ventral. Biplanar curvature patients (14) constituted 26% of the whole group (Table 2).

2. Incision of the plaque and venous patch grafting (LP, Group 2)

PIG surgery was performed in 144 patients while additional Nesbit or plication suture was used to achieve complete straightness in 48 patients (33%) patients. Mean age and PD onset duration were 54.1 ± 9.2 years and 28.2 ± 17.3 months respectively. Shortening surgery patients were slightly younger than grafting group (52.9 vs. 54.1 years, $p=0.6$) with a longer PD duration prior to surgery (33 vs. 28.2 months, $p=0.3$). Mean curvature degree of PIG group was 58.4 ± 18.9 degrees. There was a statistically meaningful difference between the two groups for initial curvature degree (52.2 vs. 58.4 degrees, $p=0.01$). Post-operative mean follow up time of the second group was 51.1 ± 39.6 months (Table 1). Furthermore second group (LP) had a significantly longer follow-up time than the first group (36.1 vs. 51.1 months, $p=0.02$). No significant difference was demonstrated between the two groups in the remaining baseline features and co-morbidities.

Curvature degree greater than 60 were present in 68 (48.6%) PIG patients. Despite the statistical insignificance, the percentage of patients with great curvatures (>60 degrees) were noticeably higher in this group than group 1 (33% vs 48.6%, $p=0.056$). Biplanar curvature patients (41) constituted 28.5% of the whole group. Hourglass and notching deformities were present in 21 (14.6%) and 16 (11.1%) patients with a total complex deformity rate (hourglass/ notching or biplanar curvature) of 54.2% in the grafting group. The distribution of curvature side in these patients were as 87 (60.4%) dorsal, 34 (23.6%) lateral and 23 (16.0%) ventral. There was a significant difference between the 2 groups for curvature sides ($p=0.001$). While lateral curvature ratios were similar (20.4% vs. 23.6%), ventral and dorsal curvatures were predominant in shortening and lengthening surgeries respectively. (V: 50% vs. 16%, D: 29.6% vs. 60.4%) (Table 2).

3. Penile prosthesis implantation (IPP, Group 3)

Penile prosthesis and remodeling was conducted in 70 patients in this group. While penile prosthesis surgery was performed in 24 (34%) patients, additional Nesbit/plication or grafting surgery were used to achieve complete straightness in 7 (10%) and 23 (32%)

patients respectively. Wilson maneuver was used as penile curvature remedy in 16 (23%) patients. Mean age and PD onset duration were 57.6 ± 8.1 years and 43.2 ± 38.1 months respectively. Mean curvature degree and post operative follow up were calculated as 40.0 ± 18.7 degrees and 43.2 ± 38.1 months respectively (Table 1).

Great curvature (curvature degree greater than 60 degrees) were found to be present in 15% of the patients. Biplanar curvature patients (8) constituted 12.3% of the whole group. The presence of hourglass and notching deformity were found out in 8 (12.3%) and 12 (18.5%) patients with a total complex deformity rate (hourglass/notching or biplanar curvature) of 42.5% in the grafting group. Ratios of curvature sides were shown as 38% lateral, 49% dorsal and 13% ventral in this group (Table 2).

One patient with prior severe S-shaped deformity had diminished but persistent S-shaped deformity after surgery but it did not inhibit sexual intercourse. Meanwhile, one patient had a residual penile deformity of 40 degrees, which occurred 3 months after the operation. One patient with diabetes mellitus had explantation of the penile prosthesis. In addition, the prosthesis was replaced because of mechanical failure in 6 (8.6%) patients in an average time of 7.6 years.

Table 1. Baseline parameters of the patients who underwent PD surgery

	Nesbit/ Plication	Venous grafting	p*	Penile Prosthesis
N	55	144		70
Age (years)	52.9 ± 15.3	54.1 ± 9.2	0.6	57.6 ± 8.1
PD duration (mo)	33.0 ± 28.4	28.2 ± 17.3	0.3	30.3 ± 25.0
Curvature Degree	52.2 ± 12.3	58.4 ± 18.9	0.01	40.0 ± 18.7
Follow-up time (mo)	36.1 ± 29.4	51.1 ± 39.6	0.02	43.2 ± 38.1
	n (%)	n (%)		n (%)
Preop ED	20 (37)	37 (27.8)	0.21	70 (100)
Fracture	3 (2.1)	3 (5.6)	0.35	1 (1.4)
Previous Catheter	30 (20.8)	16 (29.6)	0.19	17 (24.3)
Smoker	12 (34.3)	41 (49.4)	0.13	29 (42.1)
Alcohol usage	6 (17.1)	17 (21)	0.63	19 (27.2)
Co-morbidity	25 (50)	76 (53.9)	0.63	67 (94.3)
DM	9 (18)	28 (19.7)	0.8	32 (45.7)
HT	9 (18)	33 (23.2)	0.44	24 (34.3)
HL	10 (20)	33 (23.2)	0.64	24 (34.3)
IHD	12 (34.3)	41 (49.4)	0.13	10 (14.3)

Statistical analysis was performed for simple corporoplasties and venous grafting
ED: erectile dysfunction; DM: diabetes mellitus; HT: hypertension; HL: hyperlipidemia; IHD: ischaemic heart disease

Table 2. Curvature characteristics of the patients who underwent reconstructive surgery

	Nesbit/ Plication	Venous grafting	p	PPI
>60 degrees	18 (33%)	68 (48.6%)	0.056	11 (15%)
Deformity	n (%)	n (%)		
Bidirectional Curvature	14 (25.9)	41 (28.5)	0.77	8 (12.3)
Hourglass	0	21 (14.6)	<0.001	8 (12.3)
Notching	0	16 (11.1)	<0.001	12 (18.1)
Complex deformity	14 (25.9)	78 (54.2)	<0.001	28 (42.5)
Curvature direction				
Lateral	11 (20.4)	39 (28.1)		20 (37)
Dorsal	16 (29.6)	86 (61.9)		26 (49)
Ventral	27 (50)	14 (10.1)		7 (13)

PPI: penile prosthesis implantation

Table 3. Post operative results of reconstructive surgery

	Nesbit/ Plication	Venous grafting	p
Curvature degree	10 [0-20]	0 [0-10]	
Mean delta curvature	37.9±19.1	52.1±23.5	0.01
Recurrence	9 (17.3%)	20 (16.4%)	0.9
ED	5 (9.3%)	48 (33.3%)	0.02
PDE-5 inhibitor refractory ED	3 (5.6%)	17 (11.8%)	0.28
Success	40 (79%)	108 (75%)	

ED: erectile dysfunction; PDE-5: phosphodiesterase type 5

Post-operative results

The median post-operative curvature degrees were 10 [0-20] and 0 [0-10] degrees for shortening and grafting groups respectively. Degree of curvature improvement was significantly greater in grafting surgery when compared to shortening surgery (37.9±19.1 and 52.1±23.5, p=0.01). The initial anatomic success rates were 90.4% and 87.5% at their early post-operative follow-up for group 1 and 2 respectively. These rates dropped to 82.7% and 83.6% at the long term follow-up (36 and 51 months) respectively (p=0.9). Although the average follow-up time of LP group was longer than SP group (52.1 mo vs. 37.0 mo), recurrence rates were similar (Table 3).

The mean age and curvature degree of the patient who required additional plication/Nesbit in the grafting group (33%) were 53.7±8.9 years and 61.8±16.5 degrees respectively. The additional suture usage rates were 29.2% and 39.7% for patients with curvatures less and greater than 60 degrees (p=0.2).

Although not significant, the presence of biplanar curvature increased the need for additional suture usage from 30.1% to 41.5% (p=0.2). No statistical significant parameter or predictor could be found for the need of additional suture.

The rates of patients who could not have sexual intercourse with the aid of PDE-5 inhibitors were shown as 3 (5.6%) and 17 (11.8%) for group 1 and 2 respectively. In addition 2 (3.6%) and 31 (21.5%) patients required PDE-5 inhibitors for sexual intercourse after the operation in group 1 and 2 respectively (p=0.02). The combined functional and anatomical success of patients were demonstrated to be 79% and 75% in shortening and grafting surgery.

Discussion

Surgery for stable PD remains as the golden standard because greatest curvature improvement can be achieved with speed and persistence through surgical intervention. The comparison of baseline parameters and surgical outcomes of shortening and lengthening procedures may both direct the surgeons evidence based preferences and patient`s choices.

Plication/Nesbit surgery should be preferred for men with adequate erectile function (with or without pharmacotherapy), adequate penile length, and mild to moderate curvature but without the presence of hourglass deformity causing hinging.^[2] The penile length threshold is required because plication surgeries results in penile shortening and therefore cause post-surgical distress in patients who end up with inadequate penile length.^[8] Although all of our patients reported penile shortening, none of them complained of sexual disability or dissatisfaction due to shortening. In two large series investigating penile corporoplasty surgery, penile shortening with an interval between 1.5-3 cm were detected in 13% of the patients and sexual disability due to shortness of the penis was reported in 1.6-1.8% of the patients.^[9,10] The absence of sexual disability due to shortness reported in our study may be explained by our strict adherence to 13 cm threshold for shortening surgery.

There was no statistically significant difference between the baseline features of the patient groups except curvature degrees and characteristics (52.2 vs. 58.4 degrees, p=0.01). The most plausible explanation of this difference is that PIG surgery is generally preferred for the patients with curvature greater than 60 degrees (percentage of patients with >60 degree curvature in group 1 and 2: 33% vs. 48.6%, p=0.056). Severe curvature (>60 degrees) is accepted as the key limitation for sexual intercourse and therefore higher ratio of these patients in LP (48.6%) may be associated with earlier presentation tendency of LP patients (28.2 vs. 33.0 months).^[11] Patients with ventral curvature were predominant in group 1 (VC: 50% vs. 16%) as in contrast with the dorsal curvature predominance in group 2 (DC: 29.6% vs. 60.4%). These stats reflect the general surgical tendency to perform SP for ventral curvatures and LP for dorsal curvatures. In addition the dominance of ventral curvatures in patients who underwent shortening

surgery explains why ventral curvature was demonstrated to be a risk factor for shortening in previous studies.^[12]

Penile straightness was achieved in 90% of the shortening patients initially and decreased to 82% after three years of follow-up. Residual curvature and recurrence rates were similar to grafting surgery and in accordance with literature. Penile straightness and patient satisfaction rate for Nesbit were reported as 79-100% and 67-100% in the literature. Curvature recurrence rates were conveyed between 4-27% in the same studies.^[2,9,10,13-16] The recurrent cases who underwent SP were predominated by bi-planar curvatures (50%) and recurring side was lateral in general in our series. Therefore instead of suture/tissue problems, cavernosal anatomy which is weaker at the lateral sides may be blamed for the recurrences. Erectile dysfunction of 12% and temporary penile sensation loss of 24% were reported in the literature and associated with neurovascular bundle mobilization.^[5] Only 9% of ED was reported by our patients whose mean age was 52 years old.

Grafting materials are be classified as autologous, ECM (allografts and xenografts), synthetic.^[17] Saphenous vein is preferred by the authors due to its endothelial transforming capability, high burst strength (984 mmHg) and high elasticity but successful usage of different grafts (Buccal, 4-SIS, pericardium, fascia lata) were reported by different centers.^[4,17,18] Since early 90's saphenous vein has been used as the graft of PIG surgery in our institution. The initial anatomic success rate of 87.5% following PIG only decreased by 4% (to 83.6%) after 4 years of follow-up. This success rate is satisfactory and in the upper tier of previously reported data (64-100%).^[19,20] The initial success of saphenous vein at 1993 (95.5% straightness, 92% patient satisfaction) was continued in the majority of predecessor studies.^[20] In the long term studies by Dr Kalsi and Wimpissinger, high penile straightening rates (80% and 86%) persisted even after 5 and 10 years of follow-up.^[21,22]

Erectile dysfunction is the Achilles heel of the grafting surgery. In our series the total rate of ED was 30% in the long term follow up of LP patients. Similarly high Denovo-ED rates were reported by Wimpissinger et al.^[22] (36%), Kalsi et al.^[21] (22.5%) and Montorsi et al.^[23] (22%) for grafting patients in their long term follow-up. In the light of current data both from literature and our series, the assessment and exclusion of patients with prior ED is vital to prevent de-novo ED. It should also be noted that these patients became between 55-65 years after 5-10 year follow-up and exposed to the deteriorating of old age. Shortening surgery was not statistically superior to grafting surgery for patients in terms of having erection with or without the aid of PDE-5 inhibitors (94.4% vs. 88.2%, $p=0.28$). The combined anatomic and functional overall success for both groups were 79% and 75% for both of these surgeries. Shortening surgery makes a difference only in the long term follow-up for patients who had erections without the aid of PDE-5 inhibitors (90.7% vs. 67.3%, $p=0.02$).

In conclusion, both SP and LP are successful in terms of penile straightening in the short and long-term follow-up. Curvature degree improvement is greater in LP. Patients who undergo PIG surgery may suffer from ED in the long-term follow-ups. Greater percentage of patients who underwent LP may require PDE-5 inhibitors usage for sexual intercourse. Despite stated shortcomings, combined success (anatomic and functional) is achieved in three out of four patients for both groups. Penile prosthesis implantation should be preferred for patients with ED and penile deformity.

Ethics Committee Approval: Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

Informed Consent: This article is based on a retrospective study. All data were collected from the patient files.

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References

1. Dibenedetti DB, Nguyen D, Zografos L, Ziemiecki R, Zhou X. A Population-Based Study of Peyronie's Disease: Prevalence and Treatment Patterns in the United States. *Adv Urol* 2011;2011:282503. [\[CrossRef\]](#)
2. Chung E, Ralph D, Kagioglu A, Garaffa G, Shamsodini A, Bivalacqua T, et al. Evidence-Based Management Guidelines on Peyronie's Disease. *J Sex Med* 2016;13:905-23. [\[CrossRef\]](#)
3. Talib RA, Ibrahim MA, Canguven O. Nonsurgical treatment options in Peyronie's Disease: 2016 update. *Turk J Urol* 2016;42:217-23. [\[CrossRef\]](#)
4. Kadioglu A, Kucukdurmaz F, Sanli O. Current status of the surgical management of Peyronie's disease. *Nat Rev Urol* 2011;8:95-106. [\[CrossRef\]](#)
5. Essed E, Schroeder FH. New surgical treatment for Peyronie disease. *Urology* 1985;25:582-7. [\[CrossRef\]](#)
6. Akbulut F, Akman T, Salabas E, Dincer M, Ortac M, Kadioglu A. Neurovascular bundle dissection for Nesbit procedure in congenital penile curvature patients: medial or lateral? *Asian J Androl* 2014;16:442-5.
7. Kadioglu A, Sanli O, Akman T, Cakan M, Erol B, Mamadov F. Surgical treatment of Peyronie's disease: a single center experience with 145 patients. *Eur Urol* 2008;53:432-9. [\[CrossRef\]](#)

8. Chen R, McCraw C, Lewis R. Plication procedures-excisional and incisional corporoplasty and imbrication for Peyronie's disease. *Transl Androl Urol* 2016;5:318-33. [\[CrossRef\]](#)
9. Savoca G, Scieri F, Pietropaolo F, Garaffa G, Belgrano E. Straightening corporoplasty for Peyronie's disease: a review of 218 patients with median follow-up of 89 months. *Eur Urol* 2004;610-4.
10. Ralph DJ, al-Akraa M, Pryor JP. The Nesbit operation for Peyronie's disease: 16-year experience. *J Urol* 1995;4:1362-3. [\[CrossRef\]](#)
11. Walsh TJ, Hotaling JM, Lue TF, Smith JF. How curved is too curved? The severity of penile deformity may predict sexual disability among men with Peyronie's disease. *Int J Impot Res* 2013;25:109-12. [\[CrossRef\]](#)
12. Greenfield JM, Lucas S, Levine LA. Factors affecting the loss of length associated with tunica albuginea plication for correction of penile curvature. *J Urol* 2006;175:238-41. [\[CrossRef\]](#)
13. Horstmann M, Kwol M, Amend B, Hennenlotter J, Stenzl A. A self-reported long-term follow-up of patients operated with either shortening techniques or a TachoSil grafting procedure. *Asian J Androl* 2011;13:326-31. [\[CrossRef\]](#)
14. Rolle L TA, Timpano M. The Nesbit operation for penile curvature: An easy and effective technical modification. *J Urol* 2005;171-3.
15. Licht MR, Lewis RW. Modified Nesbit procedure for the treatment of Peyronie's disease: A comparative outcome analysis. *J Urol* 1997;460-3.
16. Bokarica P, Parazajder J, Mazuran B, Gilja I. Surgical treatment of Peyronie's disease based on penile length and degree of curvature. *Int J Import Res* 2005;17:170-4. [\[CrossRef\]](#)
17. Kadiođlu A, Sanli O, Akman T, Ersay A, Guven S, Mammadov F. Graft materials in Peyronie's disease surgery: a comprehensive review. *J Sex Med* 2007;4:581-95. [\[CrossRef\]](#)
18. Roeder R, Wolfe J, Lianakis N, Hinson T, Geddes LA, Obermiller J. Compliance, elastic modulus, and burst pressure of small intestinal (SIS), small diameter vascular grafts. *J Biomed Mater Res* 1999;47:65-70.
19. Hatzichristodoulou G. Grafting techniques for Peyronie's disease. *Transl Androl Urol* 2016;5:334-41. [\[CrossRef\]](#)
20. El-Sakka AI, Rashwan HM, Lue TF. Venous patch graft for Peyronie's disease. Part II: outcome analysis. *J Urol* 1998;160:2050-3. [\[CrossRef\]](#)
21. Kalsi J, Minhas S, Christopher N, Ralph D. The results of plaque incision and venous grafting (Lue procedure) to correct the penile deformity of Peyronie's disease. *BJU Int* 2005;95:1029-33. [\[CrossRef\]](#)
22. Wimpissinger F, Parnham A, Gutjahr G, Maksys S, Baierlein M, Stackl W. 10 Years' Plaque Incision and Vein Grafting for Peyronie's Disease: Does Time Matter? *J Sex Med* 2016;13:120-8.
23. Montorsi F, Salonia A, Maga T, Bua L, Guazzoni G, Barbieri L, et al. Evidence based assessment of long-term results of plaque incision and vein grafting for Peyronie's disease. *J Urol* 2000;163:1704-8. [\[CrossRef\]](#)