

Minimally Invasive H-Incision Technique in Penile Plication Surgery Reduces the Complications: Retrospective Cohort Study

Penil Plikasyon Cerrahisinde Minimal İnvaziv H-İnsizyon Tekniği Komplikasyonları Azaltmaktadır: Retrospektif Kohort Çalışması

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ABSTRACT Objective: To compare the long-term results and complications of minimally invasive H-incision complete burying-knot technique and modified Nesbit procedure in penile curvature surgery. **Material and Methods:** The data of 53 patients who underwent penile curvature surgery in our clinic for Peyronie's disease were retrospectively analyzed. While 27 (50.9%) of the patients had excisional modified Nesbit procedure (Group 1), 26 (49.1%) were applied minimally invasive H-incision complete burying-knot technique (Group 2). The postoperative results and complications of the groups were compared. **Results:** The mean age of groups was similar ($p=0.369$). There was no significant difference between the groups in terms of mean operating times (Group 1= 41.92 ± 6.93 minute vs Group 2= 43.14 ± 6.81 minute, $p=0.520$). The mean postoperative penile shortening was 1.07 ± 1.77 cm in Group 1, while it was 0.84 ± 1.59 cm in Group 2 ($p=0.625$). Mean postoperative palpable suture knots, penile pain and penile numbness were found to be significantly lower in Group 2 ($p=0.011$, $p=0.005$, $p=0.011$ respectively). The mean postoperative International Index of Erectile Function scores were similar in both groups (Group 1= 20.14 ± 1.58 vs Group 2= 19.73 ± 1.84 , $p=0.249$). **Conclusion:** Minimally invasive H-incision complete burying-knot technique provides similar success rates with lower postoperative complication compared to the modified Nesbit procedure in penile curvature surgery.

Keywords: Penile diseases; urologic surgical procedures; penile curvature; Peyronie disease

ÖZET Amaç: Bu çalışmanın amacı, penil kurvatur cerrahisinde minimal invaziv H-insizyon komplet sütür-gömme tekniği ile modifiye Nesbit prosedürünün uzun dönem sonuçlarını ve komplikasyonlarını karşılaştırmaktır. **Gereç ve Yöntemler:** Kliniğimizde Peyronie hastalığı nedeniyle penil kurvatur cerrahisi yaptığımız 53 hastanın verileri retrospektif olarak incelenmiştir. Hastaların 27'sinde (%50,9) modifiye Nesbit prosedürü uygulanmışken (Grup 1), 26'sına (%49,1) minimal invaziv H-insizyon komplet sütür-gömme tekniği uygulanmıştır (Grup 2). Grupların postoperatif sonuçları ve komplikasyonları karşılaştırılmıştır. **Bulgular:** Grupların ortalama yaşı benzer bulunmuştur ($p=0,369$). Ortalama operasyon süreleri bakımından gruplar arasında anlamlı fark görülmemiştir (Grup 1= $41,92\pm 6,93$ dk ve Grup 2= $43,14\pm 6,81$ dk, $p=0,520$). Postoperatif ortalama penil kısalma Grup 1'de $1,07\pm 1,77$ cm iken Grup 2'de $0,84\pm 1,59$ cm bulunmuştur ($p=0,625$). Postoperatif ortalama palpe edilebilir sütür knot varlığı, penil ağrı ve penil hissizliğin Grup 2'de anlamlı olarak düşük olduğu görülmüştür ($p=0,011$, $p=0,005$, $p=0,011$ sırasıyla). Grupların postoperatif Uluslararası Eretil Fonksiyon İndeks skorlarının ise benzer olduğu görülmüştür (Grup 1= $20,14\pm 1,58$ ve Grup 2= $19,73\pm 1,84$, $p=0,249$). **Sonuç:** Penil kurvatur cerrahisinde minimal invaziv H-insizyon komplet sütür-gömme tekniği modifiye Nesbit prosedürüyle karşılaştırıldığında benzer başarı ve daha düşük komplikasyon oranları sağlanmaktadır.

Anahtar Kelimeler: Penis hastalıkları; ürolojik cerrahi işlemler; penil kurvatur; Peyronie hastalığı

Penile curvature is a disease that can be seen in approximately up to 9% of the male population and can cause various sexual dysfunctions.¹ Although penile curvature often develops secondary to Peyronie's disease, it can also be seen as congenital penile cur-

vature.² Although it is known that plaque formation is spontaneously absorbed in most Peyronie's patients and heals without the need for additional treatment, it is reported that approximately 10% of the patients require surgical treatment.³ Among the surgical treat-

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ment methods of Peyronie's disease, penile plication surgeries, plaque incision or excision and autologous grafting procedures can be counted.⁴⁻⁶ The classical Nesbit procedure, which was first described in penile curvature surgery, included the incision and removal of the full thickness ellipsoid tunica albuginea from the outer surface of the curvature and plication of this area with non-absorbable sutures.⁷ However, complications caused by non-absorbable sutures used in plication or excision of corpora cavernosa such as penile shortening, postoperative suture granuloma or palpable suture knots formation, penile pain and penile numbness were reported later in the classical Nesbit technique, and more minimally invasive plication techniques without ellipse removal were described in order to reduce these complications.⁸⁻¹⁰ In 1985, Essed and Schroeder developed the minimally invasive corporeal plication technique applied without incision in order to minimize the damage to the neurovascular bundle.¹¹ However, in long-term follow-up, it has been reported in various studies that there is disturbing suture knots developed secondary to non-absorbable sutures, and penile pain and irritation can be seen as well as significant penile shortening with this procedure.^{12,13} Therefore, various more minimally invasive plication techniques including superficial tunica albuginea excision have been used to reduce the suture related complications mentioned recently.¹⁴⁻¹⁶ In this study, we defined a new technique combined with superficial tunica albuginea excision in which the suture material can be completely buried in order to minimize the suture related complications that may occur due to the suture materials used in penile plication surgery and compared this technique with the modified Nesbit method.

MATERIAL AND METHODS

After obtaining approval from Keçiören Training and Research Hospital Clinical Research Ethics Committee (date: September 9, 2020, no: 2012-KAEK-15/2167), the data of 53 patients who underwent penile plication surgery for penile curvature between January 2016 and February 2020 in our clinic were retrospectively analyzed. All the study process was carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. All of

the patients included in the study were adult patients older than 16 years. All patients included in the study had penile curvature at a minimum of 20 degrees and a maximum of 60 degrees due to Peyronie's disease, who were sexually active and had physical or psychological problems in sexual intercourse due to curvature, and plaque resolution was not observed with medical treatment (colchicine, vitamin E) during a minimum 1-year follow-up. International Index of Erectile Function (IIEF-5) score that was validated in Turkish, was used to evaluate the preoperative erection status of the patients.¹⁷ Penile color doppler examination was performed in all patients before the operation. After penile color Doppler examination, the penile deformities of the patients were physically examined before the erection ended and their curvature degrees were measured by a goniometer and recorded. In addition, artificial erection was achieved by intracavernosal saline injection during the operation and the curvature degrees were checked again. Patients with possible vascular-organic erectile dysfunction, a history of psychological erectile dysfunction, congenital penile curvature other than Peyronie's disease, or patients with penile curvature for reasons such as previous hypospadias, epispadias, open urethroplasty surgery, with a curvature of more than 60 degrees or requiring grafting due to complex curvature were not included in the study. Patients were informed in the preoperative about that the modified Nesbit procedure and H-incision technique, and questioned about whether they would be disturbed by the possible presence of palpable suture knots after the operation. The advantages of the H-incision technique were explained to the patients who stated that they would be very uncomfortable with this situation, and this technique was prioritized. In addition, regardless of the degree of curvature, especially in patients with dorsal curvature, the modified Nesbit procedure was preferred because the tunica albuginea is very thin in the ventral penile and therefore the H-incision technique is difficult to apply. In addition, as the degree of curvature increases, the required length of plication increases and accordingly the required H-incision area also increases. The larger H-incision area also prolongs the operating time and increases the risk of neuro-vascular injury. Therefore, the mod-

ified Nesbit procedure was prioritized in patients with a >45 degree of curvature. In line with this information, a decision for modified Nesbit or H incision procedure was made due to the patient's preference and the physician's recommendation.

As a surgical technique, modified excisional Nesbit procedure was applied in 27 (50.9%) of the patients and these patients were classified as Group 1, while the other 26 (49.1%) patients were applied minimally invasive H-incision complete burying-knot technique, and these patients were also classified as Group 2. The demographic data and the postoperative results of groups were compared.

SURGICAL TECHNIQUES

Routine preoperative 1 g intravenous cefazolin prophylaxis was applied to all patients. In both techniques we applied, a suspension suture was placed with 3-zero Vicryl (Ethicon, Inc. USA) on the glans penis, than the penile skin was degloved to the penoscrotal junction. Then, an artificial erection was obtained by applying a tourniquet to the proximal side of penis with injecting saline into the corpus cavernosum, and the degree of preoperative curvature was measured with a goniometer. The plication area on the opposite side of the curvature where the optimum correction would be achieved was determined and marked with a marker pen.

Depending on the type of curve, the deep dorsal vein and neurovascular bundle were preserved in the patients in Group 1 to whom we applied the modified Nesbit procedure. Then, the marked ellipsoid area of the tunica albuginea was removed from the opposite side of the curvature by excising half-layer. Then, using 3-zero non-absorbable (polypropylene) sutures,

the ellipsoid area was closed in a continuous water tight fashion using the inverted-stitch technique.

In Group 2, the tunica albuginea interval where optimum correction was achieved was determined by holding the opposite side of the curvature with an Alice clamp. Then, a longitudinal H mark was drawn with a marker pen on the tunica albuginea, in the middle of this gap, on the opposite side of the curvature. The midline of the H mark was adjusted to the middle of the opposite side of the curvature (Figure 1). Unlike the classical Nesbit procedure, a longitudinal H-incision was made on the marked area, including the superficial layers of the tunica albuginea, without fully excising the opposite side of the curvature. Then the superficial layer of the tunica albuginea was dissected bilaterally, without opening the corpus cavernosum towards both H-incised areas (Figure 2). One side of the bilaterally lifted tunica albuginea folds was excised and removed. Then, plication was performed on the midline of H-incision with individual sutures with burying-knot technique using by non-absorbable sutures (polypropylene) (Figure 3). Care was taken that a 1 mm transverse longitudinal tunica albuginea plication on the opposite side of the curvature was required for approximately every 10 degrees of curvature. Following plication, the unremoved layer of the superficial tunica albuginea fold was covered over the plication area and fixed with 4-zero or 5-zero Vicryl sutures (Figure 4). In this way, the penis was completely straightened and the plication sutures buried completely between the deep and superficial layers of the tunica albuginea and became non-palpable (Figure 5).

After the plication, penis was checked whether sufficient straightening was achieved by providing



FIGURE 1: Longitudinal H-marked area on opposite side of the curvature.

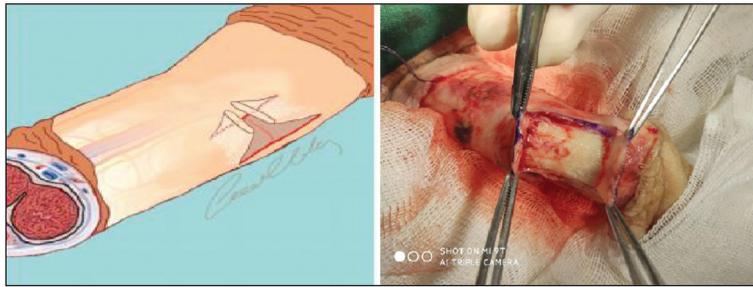


FIGURE 2: H-incision of the superficial layer of tunica albuginea.

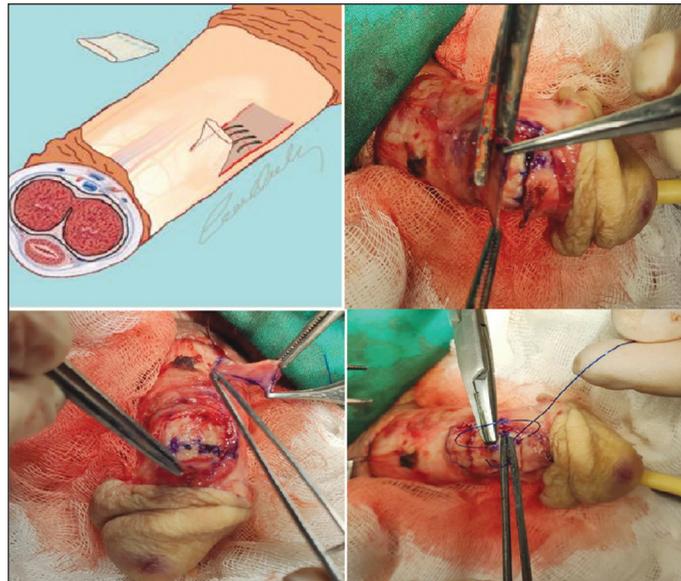


FIGURE 3: Removed fold of tunica albuginea and plication on the middle of H-incision.

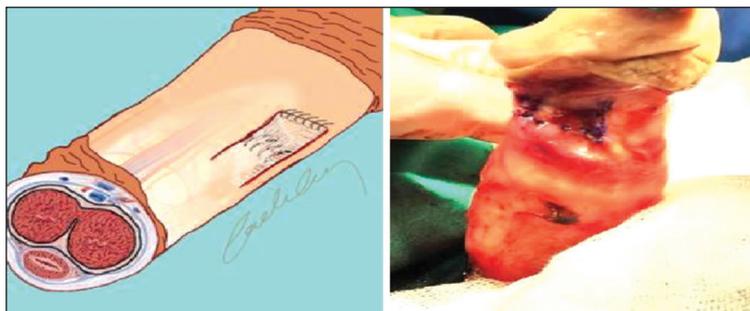


FIGURE 4: Plication area covered with other H incision fold and sutured with absorbable sutures.

artificial erection with saline injection again in both techniques.

POSTOPERATIVE EVALUATION AND FOLLOW-UP

All patients were called for a control on the post-operative 1st week and checked for wound healing

and infection. At 12th month control, penile curvature degree and the penile shortening was evaluated and recorded by using an intracavernosal vaso-active agent injection. Patients were also questioned about penile pain, disturbing palpable suture knot presence and the penile numbness. Erection status



FIGURE 5: Full straightened penis with no palpable polypropylene plication suture on tunica albuginea.

of the patients was evaluated according to the IIEF-5 scores.

STATISTICAL ANALYSIS

All statistical analyses were performed using the SPSS 24.0 (IBM Corp., Chicago) software for Windows. In the univariate analysis, the chi-square test was used for nominal data, while the Mann-Whitney U test was used for nonparametric variables. A p-value of <0.05 was considered statistically significant.

RESULTS

The mean follow-up was 19.60 ± 4.73 months and the mean age was 61.83 ± 7.69 years. In the postoperative period, disturbing palpable suture knots were detected in 12 (22.6%) of the patients, while 13 (24.5%) had penile pain and in 12 (22.6%) penile numbness was detected. Descriptive characteristics and postoperative data of the patients are shown in Table 1. While the mean age of the patients in Group 1 was 60.88 ± 8.01 years, it was 62.80 ± 7.73 years in Group 2 ($p=0.369$). Preoperative mean curvature degree was significantly higher in Group 1 compared to Group 2 (39.25 ± 7.29 degrees vs 35.00 ± 7.74 degrees respectively, $p=0.044$). The mean operating time was 41.92 ± 6.93 minutes in Group 1, and it was 43.14 ± 6.81 minutes in Group 2 ($p=0.520$). At the postoperative 12th month control, palpable suture knot was detected in 10 (37.03%) patients in Group 1, while it was detected in only 2 (7.69%) in Group 2

($p=0.011$). In addition, in Group 2, it was observed that vicryl sutures that we used to fix the tunica albuginea leaf for covering the plication sutures were absorbed in all patients. Similarly, the presence of postoperative penile pain was found to be significantly lower in Group 2 compared to Group 1 (26/2, 7.69% vs 27/11, 40.74% respectively, $p=0.005$). Postoperative penile numbness was also seen in 2 (7.69%) patients in Group 2, while it was seen in 10 (37.03%) patients in Group 1 ($p=0.011$). However, the mean curvature straightening degree was significantly higher in Group 1 compared to Group 2 (32.22 ± 6.55 degrees vs 27.30 ± 8.51 degrees respectively, $p=0.022$). At the end of the 12th month, 4 (15%) patients in Group 1 had more than 20 degrees of curvature recurrence, while it was 3 (12%) in Group 2 ($p=0.725$). The mean postoperative IIEF-5 scores were found to be similar in both groups (Group 1 = 20.14 ± 1.58 vs Group 2 = 19.73 ± 1.84 , $p=0.249$) (Table 2).

DISCUSSION

Despite the reported high success and patient satisfaction rates, one of the most important complications of penile plication surgery is the granulomatous reaction secondary to the plication sutures and the palpable suture plaques caused by it.¹⁸ In addition, in some cases, plication sutures can be directly palpated without granulomatous reaction, which can cause psychosexual problems in the patient.¹⁹

TABLE 1: Characteristics and the results of the patients.

Age, years, mean \pm SD	61.83 \pm 7.69
Preoperative curvature degree, mean \pm SD	37.16 \pm 7.75
Operation time, minutes, mean \pm SD	42.54 \pm 6.83
Follow-up, months, mean \pm SD	19.60 \pm 4.73
Curvature type n (%)	
Ventral	37 (69.8)
Dorsal	9 (17)
Left lateral	4 (7.5)
Right lateral	3 (5.7)
Postoperative palpable suture knot, n (%)	12 (22.6)
Postoperative penile pain, n (%)	13 (24.5)
Postoperative penile numbness, n (%)	12 (22.6)

SD: Standard deviation.

TABLE 2: Comparison of the groups.

	Group 1 (n=27)	Group 2 (n=26)	p value
Age, years, mean±SD	60.88±8.01	6.80±7.37	0.369
Preoperative curvature degree, mean±SD	39.25±7.29	35.00±7.74	0.044*
Preoperative IIEF-5 score, mean±SD	20.70±1.93	20.50±1.92	0.703
Operating time, minutes, mean±SD	41.92±6.93	43.14±6.82	0.520
Follow-up, months, mean±SD	20.33±4.97	18.84±4.44	0.257
Penile shortening, cm, mean±SD	1.07±1.77	0.84±1.59	0.626
Curvature improvement degree, mean±SD	32.22±6.55	27.30±8.51	0.022*
Palpable suture knot, n (%)	10 (37.03)	2 (7.69)	0.011*
Penile pain, n (%)	11 (40.74)	2 (7.69)	0.005*
Penile numbness, n (%)	10 (37.03)	2 (7.69)	0.011*
Curvature recurrence (>20 degree), n (%)	4 (14.81)	3 (11.53)	0.725
Postoperative IIEF-5 score, mean±SD	20.14±1.58	19.73±1.84	0.249
Decrease in IIEF-5 score, mean±SD	0.55±2.1	0.76±2.04	0.712

* Statistically significant.

SD: Standard deviation; IIEF-5: International Index of Erectile Function-5.

Penile shortening, penile pain and penile numbness are other important postoperative complications.¹⁵ Since it was first defined by Nesbit in 1965, more minimally invasive methods have been developed to reduce such complications, and for this purpose, the technique of transversely closing the longitudinal incision made to the tunica albuginea without removing the ellipsoid piece has been defined by Yachia et al.²⁰ The tunical plication technique, which was described by Essed-Schroeder without tunical incision, was modified by Gholami and Lue, and the 16-dot plication technique was developed to reduce penile shortening and irritative symptoms.²¹ As a result, in penile plication surgery, better preservation of the integrity of the tunica albuginea and minimization of neurovascular bundle damage was achieved and the complications we mentioned were reduced to a certain extent.

Although the complications have been reduced to a certain extent, the presence of palpable suture knots or granulomas in the plication area in the postoperative period in both the 16-dot plication method and the modified Nesbit procedure emerges as a serious problem.²² Therefore, more minimally invasive surgical methods have begun to be used today to reduce both suture-related complications and other complications secondary to plication.^{14,16} Hamed et al. compared the combined plication-incision method, which they defined with the 16-dot plication method in a total of 39 patients.²³ According to this

study, they reported that while palpable suture knots were detected in 12 (57.1%) patients in the 16-dot plication group, no palpable suture knots were detected in any patient in the combined plication-incision group (p=0.005). In another similar study, Leonardo et al. compared the classical Nesbit operation with the corporeal plication method they performed with the superficial scalpel incision and double-crossed in-troflexing stitches technique.²⁴ According to this study, while penile hyposensitivity developed in 7 (38%) patients in the postoperative period in the superficial scalpel incision group, 9 (75%) patients in the classical Nesbit group developed penile hyposensitivity and it was reported that the superficial scalpel incision was advantageous (p=0.03). In another recent study, Çayan et al. reported the results of their multicentric studies involving a total of 387 patients, 260 with congenital penile curvature and 127 with penile curvature secondary to Peyronie's disease.²⁵ According to this study, while the 16-dot plication technique was applied to 202 patients, the modified Nesbit method was applied to 185 patients and the postoperative palpable suture knot rate was detected in 71 (35.1%) patients in the group operated with the 16-dot plication method, while 35 (18.9) patients in the modified Nesbit group was detected and was significantly higher in the 16-dot plication group (p=0.001). On the other hand, they reported that the rates of penile sensory loss and de-novo erectile dys-

function were significantly higher in the modified Nesbit group ($p=0.001$ and $p=0.016$ respectively). In this study, mean operating time was significantly higher in the modified Nesbit group compared to the 16-dot group ($p=0.001$). However, as a result of the study, there was no difference between the groups in terms of total patient satisfaction rates ($p=0.782$). In the minimally invasive H-incision method applied in present study, postoperative palpable suture knots was found to be significantly lower than modified Nesbit group. Similarly, postoperative penile pain and penile sensory loss rates were found to be significantly lower in minimally invasive H-incision method. Even though the mean operating time was a little longer in Group 2, it did not create a statistically significant difference between the groups. These results also indicate that the minimally invasive H-incision technique we applied can significantly reduce suture-related complications.

Schneider et al. also described a method combining simple plication and superficial excision-Nesbit procedure to reduce complications in penile plication surgery.¹⁵ In this method, the minimal ellipsoid superficial excision areas made on the opposite side of the curvature were pliated with the inverted stitch technique. According to the data of 48 patients included in this study, palpable suture knots were detected in 24 (50%) patients, while 3 (6%) patients had numbness in the incision area, and 21 (44%) patients had penile shortening of approximately 1.2 cm. In the same study, the patient satisfaction rate was found to be 75%. In another similar study conducted in 8 patients by Shefi et al., non-absorbable suture burying technique was used in simple cavernotomy incision and it was reported that none of the patients had postoperative penile pain or suture nodules.²⁶ In another recent study, Salem described the technique in which he modified the 16-dot plication to reduce knot-related complications.²⁷ In this study included the data of a total of 15 patients, it was reported that 2 patients had <20 degree curvature recurrence, on the other hand, penile shortening of 0.5-1.5 cm was detected in 6 patients, and none of the patients developed knot-related complications, penile pain or penile numbness. In the present study, while the rates of penile shortening were similar in both groups, it was observed that the Nesbit group was a little more advantageous in terms

of the degree of straightening in curvature. This situation probably suggests that the preoperative curvature degree in Nesbit group was a little higher than the minimally-invasive group, and therefore the degree of improvement could be higher. In addition, in the present study, the postoperative erection status and curvature recurrence were similar in both groups. Additionally, the difficulty of the H-incision technique should be kept in mind, especially in patients with dorsal curvature, due to the thin ventral tunica albuginea, and another appropriate technique should be applied to these patients. These results indicate that, although minimal-invasive techniques are becoming widespread, the classical or variously modified Nesbit procedure remains up-to-date and can be used when necessary. As numerous minimally-invasive plication techniques were previously described, we have also applied a new H-incision technique that allows non-absorbable plication sutures to be fully embedded. We aimed to show that complications secondary to both suture-related and tunical deep excision that may develop in the postoperative period can be reduced with this technique. We think that there is a limited number of data in the literature on this subject and that new studies involving more patients are needed, and the technique we described in our study will contribute to the development of different minimally invasive techniques.

LIMITATIONS

The most important limitation is the retrospective nature of our study. The limited number of patients in the groups can be considered as an additional limitation. A limitation was that the preoperative mean degree of curvature was statistically different between the groups. However, we believe that this difference is not clinically significant.

CONCLUSION

The minimally invasive H-incision complete burying-knot technique is an easy-to-apply and effective method in accordance with general plication surgery principles. It provides a significant advantage in reducing postoperative both suture-related and the other complications such as penile pain, penile numbness with a comparable erectile functions.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, work-

ing conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Kubilay Sarıkaya, Muhammed Arif İbiş; **Design:** Kubilay Sarıkaya, Çağrı Şenocak, Fahri Erkan Sadioğlu; **Control/Supervision:** Çağrı Şenocak, , Ömer Faruk Bozkurt; **Data Collection and/or Processing:** Kubilay Sarıkaya, Mehmet Çiftçi, Fahri Erkan Sadioğlu; **Analysis and/or Interpretation:** Çağrı Şenocak, Muhammed Arif İbiş, Ömer Faruk Bozkurt; **Literature Review:** Kubilay Sarıkaya, Fahri Erkan Sadioğlu, Mehmet Çiftçi; **Writing the Article:** Kubilay Sarıkaya, Muhammed Arif İbiş.

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