

## Research Article

# Modified Essed–Schroder Technique in Congenital Penile Curvature: Long-Term Outcomes and Quality of Life Evaluation

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**Background.** In this study, long-term functional, cosmetic, and quality-of-life outcomes of patients with congenital penile curvature who were operated on using the modified Essed–Schröder procedure were evaluated. **Materials and Methods.** Between 2009 and 2022, 233 patients with congenital penile curvature were operated using a modification of the Essed–Schröder technique. The average age of the cases was found to be  $23.7 \pm 4.6$  (18–37). The mean postoperative follow-up period was  $76.1 \pm 16.8$  (18–153) months. At the end of the follow-up period, 203 of 233 patients were interviewed retrospectively, and standard questionnaires were filled out to evaluate the functional, cosmetic, and quality-of-life results of the procedure. **Results.** There was a curvature ventral in 103, left lateral in 40, right lateral in 30, dorsal in 17, dorsolateral in 8, and ventrolateral in 5 cases. The mean degree of curvature was found to be  $51.7 \pm 9.4$  (30–80). Recurrent curvature was detected in 16 cases (7.14%), and discomfort due to suture palpation was detected in 17 cases (8.37%). No case reporting erectile dysfunction was detected. 90.6% of the patients reported that they were satisfied with the operation. As a result, the curvature was effectively corrected, and the sensation of postoperative suture palpation was minimized. It has been determined that it increases patient and partner satisfaction and improves the quality of life. **Conclusions.** The modified Essed–Schröder technique is a relatively simple technique and provides successful functional and cosmetic results. It also provides a significant improvement in quality of life.

## 1. Introduction

Congenital penile curvature is caused by the arrest of development in the corpus cavernosum and asymmetric development of the tunica albuginea during embryogenesis [1]. The prevalence of this condition is probably higher than the 0.4–6 per 1,000 men previously reported. Mostly, ventral and/or lateral deviation is detected in congenital penile curvature [2, 3]. Congenital penile curvature not only causes coitus difficulties, but it can also sometimes cause psychological problems. Curvatures that cause difficulty in sexual intercourse and/or psychological problems must be corrected surgically [4, 5]. In 1965, Nesbit [6] described the curvature correction technique, which involves excision on the convex side of the tunica albuginea. Later, different surgical plication techniques have been described [7–9]. In 1985, Essed and Schroeder described their technique in which they make plication instead of excision in the convex part of the tunica

albuginea [10]. Regardless of the technique used, some complications may occur as a result of surgical treatments. Talking about these complications before the operation is an important issue in establishing realistic expectations of the patients. In this study, the long-term functional and cosmetic results and changes in the quality of life of patients with congenital penile curvature who underwent surgery with the modification of the Essed–Schröder technique are presented.

## 2. Materials and Methods

**2.1. Preoperative Evaluation.** A total of 233 patients were operated on with the diagnosis of congenital penile curvature between January 2009 and December 2022. All cases were operated using a modification of the Essed–Schröder technique. At the first admission, all patients were examined genitally after detailed anamnesis was taken. To assess the location and degree of curvature, self-photographs of the

patient or intracavernosal injection of papaverine hydrochloride (60 mg) were used. Cases with more than 30° penile curvature, and/or difficulty during sexual intercourse and/or feel psychological discomfort due to the appearance of a penis was deemed appropriate for the operation. The erectile capacities of the patients were determined using the International Index of Erectile Function 5–15 questionnaire [11]. None of the patients had previously undergone penile or scrotal surgery. Cases with Peyronie's disease were excluded from the study. Postoperative complications of the surgery, such as penile shortening, recurrent curvature, loss of temporary or permanent penile sensation, suture palpation, painful erections, and the possibility of varying degrees of damage in the quality of erectile functions were explained to the patients, and for the operation shared decision was made.

**2.2. Surgical Technique.** All of the patients were operated in the same center by two experienced surgeons. The operations were performed under general or spinal anesthesia. The operation started with a circular incision made from the circumcision line. After the skin and tunica dartos were degloved down to the root of the penis, a tourniquet was placed on the root of the penis. Artificial erection was induced by injecting 0.9% saline solution into the corpus cavernosum using a 21-gauge butterfly cannula (Gittes–McLaughlin test) [12]. In this way, penile length and degree of curvature were measured and noted. The penis length was measured based on the distance between the symphysis pubis and the tip of the glans penis. During curvature correction, the neurovascular bundle was partially or totally dissected to avoid damage. In cases with ventral curvature, the dorsal neurovascular bundle was carefully dissected. In cases with lateral or dorsal deviation, the neurovascular bundle on the convex side was partially dissected. In the classic Essed–Schröder technique, plication sutures are placed in tunica albuginea without any excision or incision. In this technique, the plication sutures remain on the surface of the tunica albuginea and are visible to the naked eye. In the modified Essed–Schröder technique we use, two incisions of 0.5–1 cm in length and approximately 0.8–1 cm apart were made transversely to the tunica albuginea at the point of maximum curvature. Then, the outer edges of these incisions were joined with the reverse suture technique using 2/0 nonabsorbable polypropylene sutures. Thus, the sutures are embedded in the tunica albuginea tissue and are not observed from the outside (Figures 1 and 2). The aim of this method is to prevent the feeling of discomfort caused by palpable sutures in the postoperative period. After the correction process, an artificial erection was applied to the penis, the length of the penis was measured, and the correction of the penis was evaluated. Penile shortening of 2 cm or more was accepted as significant shortening. At the end of the operation, a photograph was taken to document that the penis was straightened. A 4x optical magnification was used during the operation. At the end of the operation, the penis was wrapped in a light coban bandage, and the bandage was removed on the 2nd postoperative day.

**2.3. Postoperative Evaluation.** After the operation, a ban on sexual intercourse was imposed for 8 weeks. At the end of the

follow-up period, 203 cases were evaluated retrospectively by phone, live connection, or face-to-face interview. The cases were questioned for their erectile capacities, pain during the erection, numbness of the penile skin or glans penis, palpable sutures, penile shortening, and recurrence of curvature. In addition, the quality of coitus, whether they would choose the same operation again, and their overall satisfaction were questioned. Cases with complaints of severe short penis and recurrent curvature were interviewed face to face, and a more detailed evaluation was made. During this interview, self-photographs taken by the patients or intracavernosal papaverine injections were used. The quality of life of all cases was evaluated using a standard questionnaire (QoL; Appendix). The study protocol was approved by the local ethics committee, and all patients signed an informed consent agreement.

### 3. Results

The mean age of the patients was  $23.7 \pm 4.6$  (18–37) years. The mean follow-up period was  $76.1 \pm 16.8$  (18–153) months. The most important complaint at first admission in 171 (84.2%) of the cases was difficulty in coitus and discomfort with the cosmetic appearance, and in 32 (15.8%) of them, discomfort with the cosmetic appearance of the penis. Penile curvature was found ventral in 103 patients, left lateral in 40 patients, right lateral in 30 patients, dorsal in 17 patients, dorsolateral in 8 patients, and ventrolateral in 5 patients. The mean degree of curvature was found to be  $51.7 \pm 9.4$  (30–80). Penile shortening of 2 cm or more was detected in 22 patients (9.82%). In 16 cases (7.14%), a recurrence curvature greater than 20° was found. Six of these cases reported having intromission difficulty during coitus. The other 10 cases complained about the cosmetic appearance rather than the difficulty in intromission. Seventeen patients (8.37%) reported that they felt suture palpation in the postoperative period. Erectile dysfunction was not detected in any of the cases. The mean IIEF 5/15 scores of the patients were found to be  $22.10 \pm 2.09/65.04 \pm 4.19$  in the preoperative period and  $22.59 \pm 2.28$  and  $64.82 \pm 3.96$  at the final follow-up, respectively. Eight cases reported numbness or pain during erection of the glans penis or corpus penis lasting up to 3 months postoperatively. Thirteen cases reported feeling discomfort during coitus. (Table 1). In the evaluation of quality of life, 88.6% improvement in complaints during sexual intercourse and 91.6% improvement in sexual intercourse quality were detected after the operation. It was determined that 91.9% of the cases were satisfied with the cosmetic results. 89.2% of them stated that they would prefer the same operation again if they had the chance to return to the preoperative period. As a result, 90.6% of the patients and 87.1% of their partners reported that they were satisfied with the result of the operation.

**3.1. Statistics.** All the statistical analyses were performed using SPSS for Windows software (version 21.0, SPSS Inc, Chicago, Illinois, USA). Continuous data were expressed as mean  $\pm$  standard deviation. Student's *t*-test was used to compare means, and the  $\chi^2$  Fischer test was used to compare categorical variations. Categorical data were expressed as

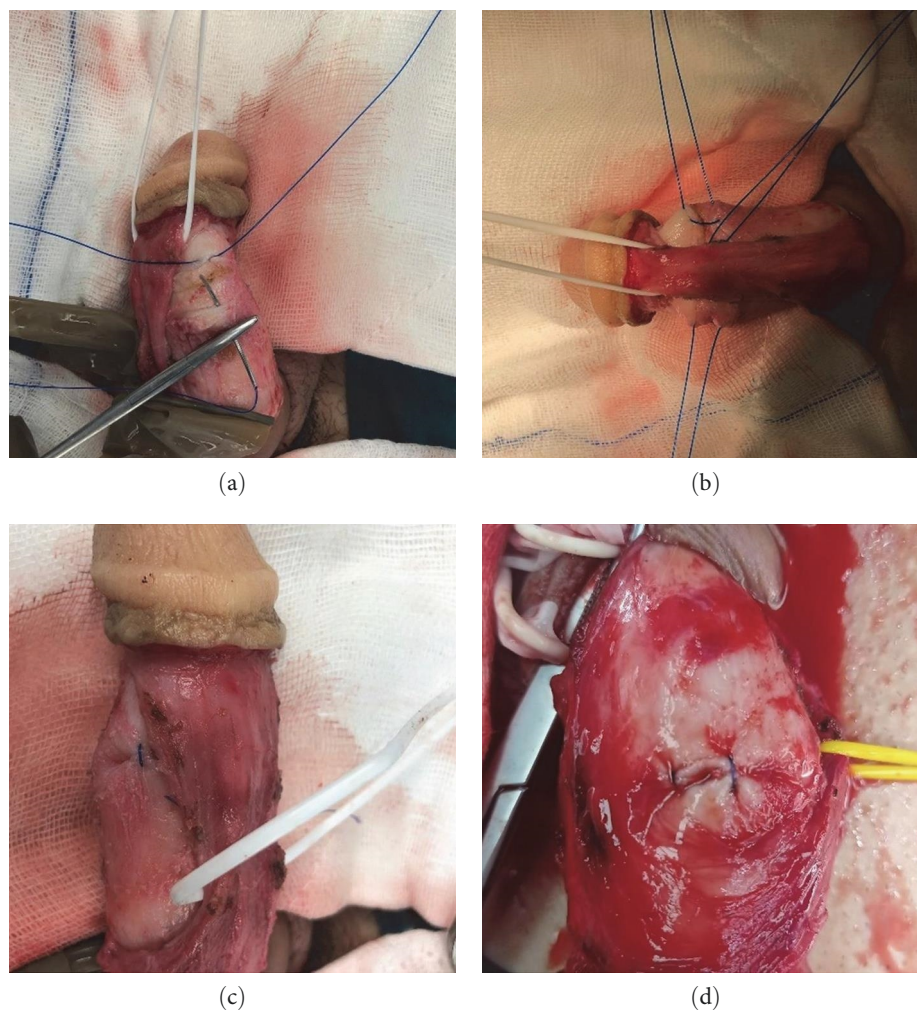


FIGURE 1: (a, b) Incision of tunica albuginea and reverse suture technique; (c, d) suture knots were embedded into the tunica albuginea.

values and percentages.  $P < 0.05$  was considered statistically significant.

#### 4. Discussion

Congenital penile curvature may occur as a result of asymmetric development of the tunica albuginea of the penis, abnormal development of the urethral plate, abnormal fibrotic tissue in the urethra, and mismatched differentiation in the cavernous bodies, or asymmetric development in the embryonal period [1, 13, 14]. Penile curvature is usually noticed during erections in the adolescence. While mild deviations are not a problem, severe penile deviations may cause discomfort in sexual intercourse and psychological trauma as a result [15].

It is important for surgeons who want to perform a surgical procedure for tunica albuginea to know the functional and structural components of the penis in terms of preserving erectile functions. Tunica albuginea is a fibrous framework surrounding the cavernous sinusoids and contains collagen and elastin fibers in its structure. While elastin fibers are responsible for the compliance of the penis, collagen fibers form a hard structure that is resistant to penile tensions

during erection [16]. In their research, Hsu et al. [17] determined that the tunica albuginea consists of a two-layered structure, outer longitudinal and inner circular, that surrounds and supports the cavernous sinusoids. The longitudinal outer layer is a structure that contains predominantly Type 1 but also Type 3 collagen, varies greatly in thickness and strength, determines the hardness and shape of the penis during erection, and resembles the tendon of skeletal muscle [18–20]. The two-layered structure of the tunica albuginea has been likened to a bicycle wheel. In a bicycle wheel, the inner tube traps the swollen air. Likewise, the inner layer of the tunica albuginea traps blood in the sinusoids. The outer layer ensures the preservation of penile hardness and structure, just like the outer layer of a bicycle wheel. Achieving a good erection with sufficient hardness and shape is achieved thanks to this two-layer structure of the tunica albuginea [21].

The first plication technique for the treatment of congenital penile curvature was described by Nesbit [6] in 1965. Later, different plication techniques have been developed and high success rates have been reported [9, 22–27]. However, postoperative complications such as permanent or recurrent

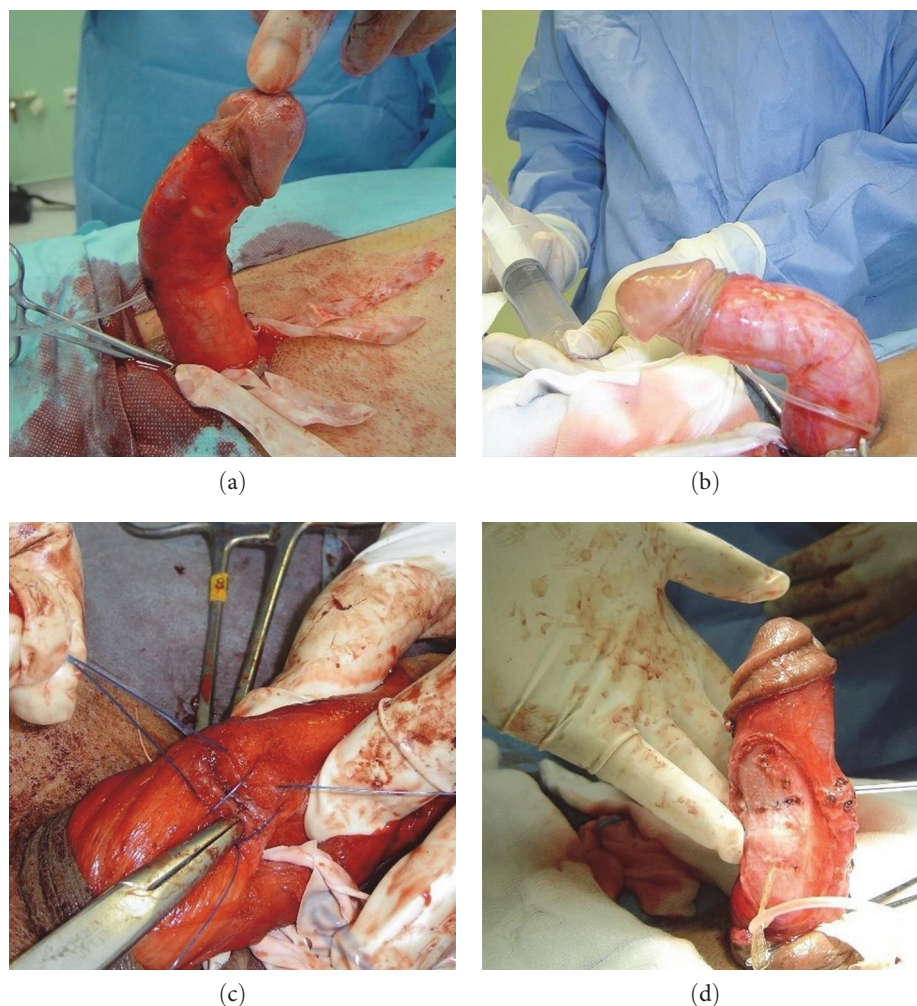


FIGURE 2: (a, b) Severe ventral or lateral curvatures; (c) in the modified Essed–Schröder plication technique, incisions made lateral into the tunica albuginea and reverse suture technique are seen; (d) complete correction of the curvature has been achieved, and the suture knots are seen embedded in the tunica albuginea.

curvature, shortening of the penis, loss of sensation, erectile dysfunction, suture granuloma, hematoma, and edema in the penis may occur. Implementation of the appropriate surgical correction procedure for each patient can reduce complication rates as well as high patient satisfaction. In severe curvatures, the plication method may not be sufficient. In these cases, penile lengthening and grafting techniques can be used. For this purpose, different materials such as dermis, small intestine submucosa, tunica vaginalis, dura, pericardium, and saphenous vein have been used [28–30]. Postoperative complications such as venous leakage, graft contracture, erectile dysfunction, and glans paresthesia can be seen in the grafting technique. Therefore, it has been recommended that this technique should be preferred in patients with severe penile curvature or in whom penile shortening would pose a problem [31, 32]. The Essed–Schröder technique has been used in the surgical treatment of congenital curvature and Peyronie’s disease since 1985 [10]. In this technique, simple tunica albuginea plication is performed with non-absorbable sutures without making any incision or excision in the tunica albuginea. In studies using the Essed–Schröder technique, it has been stated that this technique allows an effective

correction of congenital curvature without damaging the functions of the penis.

There is no clear data showing which technique is superior in congenital curvature correction. Success rates have been reported as 53%–100% in studies using the Nesbit technique and 29.5%–100% in studies using the Essed–Schröder technique. Friedrich et al. [33] reported the 22-month follow-up results of 19 patients to whom they applied the Essed–Schröder technique due to congenital penile curvature. About 18 of 19 patients with congenital curvature reported good or excellent postoperative results. In the same study, when 12 Peyronie’s disease and 19 congenital penile curvature cases were evaluated together, it has been reported that there was an improvement in sexual performance with the plication method in 48% of the cases [33]. Hauck et al. [34], as a result of their 34-month follow-up, reported that 15 of 23 patients who underwent the Essed–Schröder procedure had an average penis shortening of 1.8 cm. Additionally, recurrent curvature over 20° was reported in six cases, and bothersome side effects from plication nodes were reported in two cases. In the same study, 82% of the cases reported that they were satisfied

TABLE 1: Patient characteristics, erectile functions, and postoperative complications.

Patient characteristics		
Average age (year-range)	23.7 ± 4.6	(18–37)
Mean follow-up period (months-range)	76.1 ± 16.8	(18–153)
Mean degree of curvature (degree-range)	51.7 ± 9.4	(30–80)
Erectile functions		
Preoperative mean IIEF (5/15)	22.10 ± 2.09/65.04 ± 4.19	—
Postoperative mean IIEF (5/15)	22.59 ± 2.28/64.82 ± 3.96	—
Postoperative complications		
	Number	(%)
Penile shortening (>2 cm)	22	(9.82)
Recurrent curvature (>20°)	16	(7.14)
Erectile dysfunction (impaired or no erection)		
Palpable suture	17	(8.37)
Discomfort during coitus	13	(6.40)
Numbness and pain during penile erection	8	(3.94)
Intromission difficulty	6	(2.95)

IIEF: International Index of Erectile Functions.

with the operation and would prefer the same operation again. It has been reported that the use of Goretex suture does not provide an advantage in terms of curvature recurrence. It is hypothesized that the reverse suture technique will reduce the uncomfortable suture palpation sensation [34]. Van Der Horst et al. [35] reported a study, including 26 cases, in which they compared the classical Essed–Schröder technique (11 patients) with its modification (15 patients). The follow-up period in the modified technique was reported as 13 months. They reported a penis shortening rate of 91% in the classical technique and 87% in the modified technique. However, the dimensions of this shortening are not specified. In this study, 88% of the patients in the classical technique and 93% in the modified technique were satisfied with the cosmetic results [35]. Schultheiss et al. [36] reported their study of 61 cases, 21 with Peyronie’s disease and 40 with congenital curvature. In the aforementioned study, they reported that they detected curvature recurrence at a rate of 29.5%, which would make sexual intercourse difficult, a palpable suture sensation that would prevent sexual intercourse due to pain and discomfort in 32.8%, and penile shortening in 49.5%. In the same study, they reported that patients with congenital penile curvature had more difficulties in sexual intercourse than patients with Peyronie’s disease due to the greater ventral curvature in the preoperative period. In addition, according to the results of the study in which they used the Essed–Schröder technique, they reported that this plication technique gave more successful results in cases with congenital curvature than in Peyronie’s disease [36]. The few studies using the Essed–Schröder technique generally included a small number of cases of congenital curvature and Peyronie’s disease. Although the number of patients is limited, studies have reported that patients with congenital curvatures have more successful outcomes than those with Peyronie’s disease [15, 23–36].

The Nesbit procedure involves full-thickness excision of the tunica albuginea transversely and elliptically and suturing it longitudinally. In the meantime, the underlying erectile tissues may be damaged, and bleeding may occur. A

tourniquet is usually used to prevent bleeding. However, blocking penile perfusion for a long time may have negative effects on the erectile and sensory nerves as well as the corpus cavernosum. Additionally, leakage from the excised tunica albuginea may cause hematoma formation in the postoperative period [37]. Apart from this, if the suture breaks or tunica albuginea tears as a result of erections in the postoperative period, a herniation may occur. Perdziński and Adamek [38] reported that they preserved the inner layer by excising and suturing only the outer layer of the tunica albuginea. They reported that they applied plication only to the inner layer with suturing of the outer layer. Thus, they reported that less pressure was applied to the cavernosal vessels compared to other techniques in which full-thickness excision and plication were applied to the tunica albuginea, and a flatter appearance and a better healing surface were obtained with the plication of the outer layer. In the modified Essed–Schröder technique we applied, instead of excising the tunica albuginea, we made parallel incisions that included only the longitudinal layer. We buried the knots by applying the reverse suture technique to the outer layer.

The advantage of this method, in which we use a modification of the Essed–Schröder technique, is that it does not require excision of the tunica albuginea; it does not always require total dissection of the neurovascular bundle for plication. In this way, we think that postoperative erectile functions are better preserved. The feeling of suture palpation, which causes discomfort in patients in the postoperative period, is minimized as the nodes are buried inward, thanks to the reverse stitching technique used. It can also guarantee that complications such as cavernous leakage, hematoma, and herniation will be less in case of suture breakage or tunica albuginea tear due to postoperative erections. Since a tourniquet was not used except for artificial erection, the negative effects of interruption of penile perfusion on erectile tissues were prevented. Although Goretex sutures are softer, they do not completely eliminate the uncomfortable feeling of suture palpation. Penile shortening is an important

problem seen in the postoperative period. Patients with congenital curvature complain less about penile shortening compared to patients with Peyronie's disease. Because plaque formation in Peyronie's disease can cause one side of the penis to shorten [36]. Moreover, in our experience, the penis length in cases with congenital curvature is in a better condition compared to those with Peyronie's disease, thus reducing complaints about postoperative penile shortening. This technique we have applied can be used for congenital curvature with a high success rate and patient satisfaction. However, especially in cases of very serious and complicated curvatures, the plication method may not be sufficient. In more complex and severe curvatures, applying only tunica albuginea plication may cause further shortening in penis length and more tension in the tunica albuginea during erection. As a result, sutures may break, or tunica albuginea may rupture and thus increases the likelihood of curvature recurrence. In addition to the plication technique used in such cases, incision and grafting may increase the chance of success. In order to evaluate the results of the modified technique more accurately, we excluded the cases that we had grafted from this study. Before and after the operation, the length of the penis was measured based on the distance between the symphysis pubis and the tip of the glans penis. Penile shortening of 2 cm or more was detected in 22 patients. Erectile dysfunction was not observed in any patient. Curvature recurrence of more than 20° was detected in 16 patients. The lack of a control group to compare this technique with other techniques, the retrospective design of the study, problem recall bias, and the use of nonvalidated questionnaires can be considered limitations of the study. However, it is the longest-term study with the highest number of patients in the literature in which the modified Essed-Schröder technique is used. According to the results of our study, the penile straightening technique we applied achieved a high rate of success, and 90.6% of the patients reported that they were satisfied with the results of the operation.

## 5. Conclusion

There are various techniques used in the surgical treatment of congenital penile curvature. Although it can be applied with high success and satisfaction rates, none of them are without complications. We think that informing the patients about possible complications before the operation will be beneficial in optimizing the expectations. According to the results of our study, the modified Essed-Schröder technique we have applied is a method that can be used with high success rates and provides a high level of patient satisfaction, and provides a significant improvement in the quality of life in the long term.

## Appendix

Questionnaire prepared for the evaluation of QoL after modified Essed-Schröder tunical plication.

Please answer the below questions about your condition before surgery.

- (1) Please estimate the severity of the deviation.
  - (a) No
  - (b) Yes (mild, moderate, severe)
- (2) Did you suffer from pain during erection?
  - (a) No
  - (b) Yes (mild, moderate, severe)
- (3) Did you complain about impaired corpus or glans penis sensation?
  - (a) No
  - (b) Yes (mild, moderate, severe)
- (4) Did you have pain during sexual intercourse?
  - (a) No
  - (b) Yes (mild, moderate, severe)
- (5) Please state your complaints about sexual intercourse.
  - (a) No complaints
  - (b) Yes (mild, moderate, sexual intercourse impossible)
- (6) Please rate the quality of sexual intercourse.
  - (a) Good
  - (b) Impaired
  - (c) Poor
- (7) Please state the quality of erectile function.
  - (a) Good
  - (b) Impaired
  - (c) No erection
- (8) Did you suffer psychiatric problems from the disease?
  - (a) No
  - (b) Yes (mild, moderate, severe problems)

Please answer the below questions about your complaints about your current status after the operation.

- (1) Is there still some deviation of the penis?
  - (a) No
  - (b) Yes (mild, moderate, severe)

- (2) Do you have pain during erection?
- (a) No  
(b) Yes (mild, moderate, severe)
- (3) Is there a worsening about the sensation of the corpus or glans penis compared to before surgery?
- (a) No  
(b) Yes (mild, moderate, severe)
- (4) Do you have pain during sexual intercourse?
- (a) No  
(b) Yes (mild, moderate, severe)
- (5) Please state your complaints with sexual intercourse.
- (a) No complaints  
(b) Yes (mild, moderate, sexual intercourse impossible)
- (6) Please rate the quality of sexual intercourse.
- (a) Good  
(b) Impaired  
(c) Poor
- (7) Please state the quality of erectile function.
- (a) Better  
(b) Unchanged  
(c) Impaired  
(d) No erection
- (8) Please estimate your psychological situation compared with that before surgery.
- (a) Slightly worse  
(b) Moderately or severely worse  
(c) No change  
(d) Slight improvement  
(e) Significant improvement
- (9) Please indicate your satisfaction with the cosmetic result.
- (a) Excellent  
(b) Good acceptable  
(c) Unacceptable

- (10) Are you satisfied with the result?
- (a) Very satisfied  
(b) Satisfied  
(c) Slightly satisfied  
(d) Dissatisfied
- (11) Is your partner satisfied with the result?
- (a) Very satisfied  
(b) Satisfied  
(c) Slightly satisfied  
(d) Dissatisfied
- (12) Would you choose to have the same operation again?
- (a) No  
(b) Yes

### Data Availability

The data used to support the findings of this study are included within the article.

### Ethical Approval

The study protocol was approved by the local ethics committee.

### Conflicts of Interest

The authors declare that they have no conflicts of interest.

### Authors' Contributions

All authors contributed to the article. Fatih Akdemir was responsible for designing and reviewing the study protocol, writing the protocol and manuscript, conducting the study, screening potentially eligible studies, extracting and analyzing data, interpreting results, updating reference lists, and creating "Summary of findings" tables. Önder Kayıgil contributed to the design of the review protocol, writing the report, arbitrating potentially eligible studies, extracting and analyzing data and interpreting results. In addition, contributed to data extraction and provided feedback on the report.

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