Turkish Journal of Pediatric Surgery 2026;40(2):99-105
https://doi.org/10.62114/JTAPS.2026.228

Turkish Journal of Pediatric Surgery

Original Article

OPEN ACCESS

Comparison of Z-plasty techniques in the surgical management of congenital penoscrotal webbing: A cross-sectional study

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Abstract

Objectives: This study aims to evaluate the outcomes of patients who underwent penoscrotal webbing (PSW) repair using the Z-plasty and reverse (mirror-image) Z-plasty techniques.

Patients and methods: Between 2016 and 2020, a total of 81 patients identified with PSW during circumcision evaluation who underwent simultaneous circumcision and web repair were enrolled and divided into two groups based on the surgical approach performed: the Z-plasty group (Group 1) (45 males; mean age: 31.9 ± 15.8 months; range, 12 to 72 months) and the reverse Z-plasty group (Group 2) (36 males; mean age: 31.8 ± 17.8 months; range, 12 to 72 months). All patients were followed for 12 months and evaluated for scrotal or penile edema, hematoma, recurrent webbing, wound contracture, infection, flap necrosis, and cosmetic outcomes.

Results: The mean age, body weight, and operative time of Group 1 and Group 2 were 31.9 ± 15.8 months and 31.8 ± 17.8 months, 15.1 ± 3.9 kg and 14.8 ± 3.8 kg, and 49.4 ± 10.5 min and 49.1 ± 9.7 min, respectively. No statistically significant differences were observed between the groups regarding age, body weight, operative time, number of Z-plasties, or postoperative complications ($p > 0.05$).

Conclusion: It has been observed that Z-plasty and reverse Z-plasty techniques are effective in PSW repair and yield similar results.

Keywords: Child, penoscrotal webbing, reverse (mirror-image) Z-plasty, Z-plasty.

Penoscrotal webbing (PSW) is a congenital anomaly in which a skin fold connects the scrotum to the ventral penile shaft, obscuring the penoscrotal angle.[1] This condition is typically detected during infancy or circumcision. It commonly causes penile shortening and is regarded as a frequent reason for delayed circumcision.[2] Performing circumcision without releasing the web may lead to downward urinary flow during childhood and sexual dysfunction in adulthood; therefore, circumcision without web release is contraindicated, and web correction is mandatory.[3] Correcting the web post-circumcision can be challenging due to the loss of preputial tissue.

The abnormal genital appearance causes concern among children and families. Symptoms such as pain, abnormal urinary flow, or genital dysfunction have also been reported.[4] Multiple surgical techniques have been proposed for PSW repair using varying terminology.[5-8] The primary goals of surgery are exposing the glans and coronal sulcus, equalizing the penile skin length to the penile shaft length, straightening the penis, and restoring a normal penoscrotal angle.[9] Regardless of the surgical technique, preservation of adequate ventral penile skin is crucial.

Z-plasty is a plastic surgery technique used to improve the functional and cosmetic appearance

Received: January 21, 2026
Accepted: April 08, 2026
Published online: July 14, 2026

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Citation:

Yalçın K, Kölükçü E. Comparison of Z-plasty techniques in the surgical management of congenital penoscrotal webbing: A cross-sectional study. Turkish J Ped Surg 2026;40(2):99-105. doi: 10.62114/JTAPS.2026.228.

of scars. Common variants of basic Z-plasty include planimetric Z-plasty, double opposing Z-plasty, compound Z-plasty, oblique Z-plasty, and running/serial Z-plasty. Although Z-plasty is one of the treatment options used in the treatment of children with PSW, there are no studies on the reverse (mirror-image) Z-plasty technique. The Z-plasty technique involves creating a surgical "Z" along the ventral penile shaft. A vertical incision is made, and the two wings of the Z are formed at a 60-degree parallel angle at the proximal and distal ends of the incision. The two flaps formed by these three incisions are transposed to expand ventral shaft coverage and recreate the penoscrotal angle.[10] In the reverse Z-plasty technique, all surgical steps are the same except for the incision, which is made in the opposite direction of the Z-plasty. To prevent asymmetry caused by penile skin torsion, the three limbs must be equal in length. Another important consideration is constructing broad-based flaps to prevent flap necrosis.[11] In severe cases, multiple Z-plasties and reverse Z-plasties can be performed sequentially to reinforce the repair, or excess skin can be excised along the median raphe.[12]

This article aims to compare the results of the conventional Z-plasty technique, which is commonly used in cases of congenital PSW, with the reverse Z-plasty technique, which was used for the first time in this study, based on the use of various Z-plasty variants.

PATIENTS AND METHODS

This retrospective study was conducted at the Department of Urology, Tokat Gaziosmanpaşa University Faculty of Medicine, between 2016 and 2020. A total of 1,093 male children undergoing circumcision evaluation were screened; among these, 81 patients identified with Grade 2 or Grade 3 PSW who underwent simultaneous circumcision and web repair were enrolled and divided into two groups based on the surgical approach performed: the Z-plasty group (Group 1) (45 males; mean age: 31.9 ± 15.8 months; range, 12 to 72 months) and the reverse Z-plasty group (Group 2) (36 males; mean age: 31.8 ± 17.8 months; range, 12 to 72 months). Patients were eligible for inclusion if they met the following criteria: (1) being male children aged between one and six years; (2) being diagnosed with congenital Grade 2 or Grade 3 PSW according to the El-Koutby and El-Gohary[9] classification system; and (3) having the webbing identified during a routine pre-circumcision evaluation and subsequently undergoing simultaneous circumcision and surgical web repair in a single operative session. Patients with Grade 1 PSW, hypospadias, prior circumcision, micropenis, torsion, chordee, buried penis, or previous PSW surgery were excluded. Families were informed that patient data would be used for scientific purposes, and written consent was obtained. The study protocol was approved by the Tokat Gaziosmanpaşa University Faculty of Medicine Non-Interventional Scientific Research Ethics Committee (Date: 16.12.2025, No.: 25-MOBAEK-426). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Penoscrotal webbing grading was performed using the classification developed by El-Koutby and El-Gohary.[9] Grade 1 indicates webbing involving the proximal third; Grade 2 extends to the middle and distal thirds; and Grade 3 involves extensive webbing reaching the distal third.

The choice of technique and whether to apply single or double Z-plasty was determined intraoperatively for Grade 2 and Grade 3 patients. After web repair using one of the two techniques, circumcision was performed using the dorsal slit method. Age, operative time, weight, length of hospital stay, number of Z-plasties, scrotal or penile edema, hematoma, recurrent webbing, wound contracture, infection, flap necrosis, and subjective cosmetic outcomes were recorded. All surgeries were performed by the same surgeon.

Surgical techniques

General anesthesia was used in all patients. A third-generation cephalosporin antibiotic (50-100 mg/kg) was given prophylactically.

Z-plasty technique

Preoperative examination under anesthesia was performed, as shown in Figure 1a. Depending on PSW severity, single or double Z-plasty flaps were created bilaterally using 60-degree angles, as shown in Figure 1b. Two equally sized flaps were developed by blunt and sharp dissection of

the skin and subcutaneous tissue, as shown in Figures 1c and d. The flap indicated by the yellow arrow was transposed with the flap indicated by the red arrow, as shown in Figures 1c-e. Hemostasis was ensured, and simple closure was performed using absorbable synthetic polyglactin sutures (5-0 Vicryl; Ethicon Inc., Somerville, NJ, USA), as shown in Figure 1f.

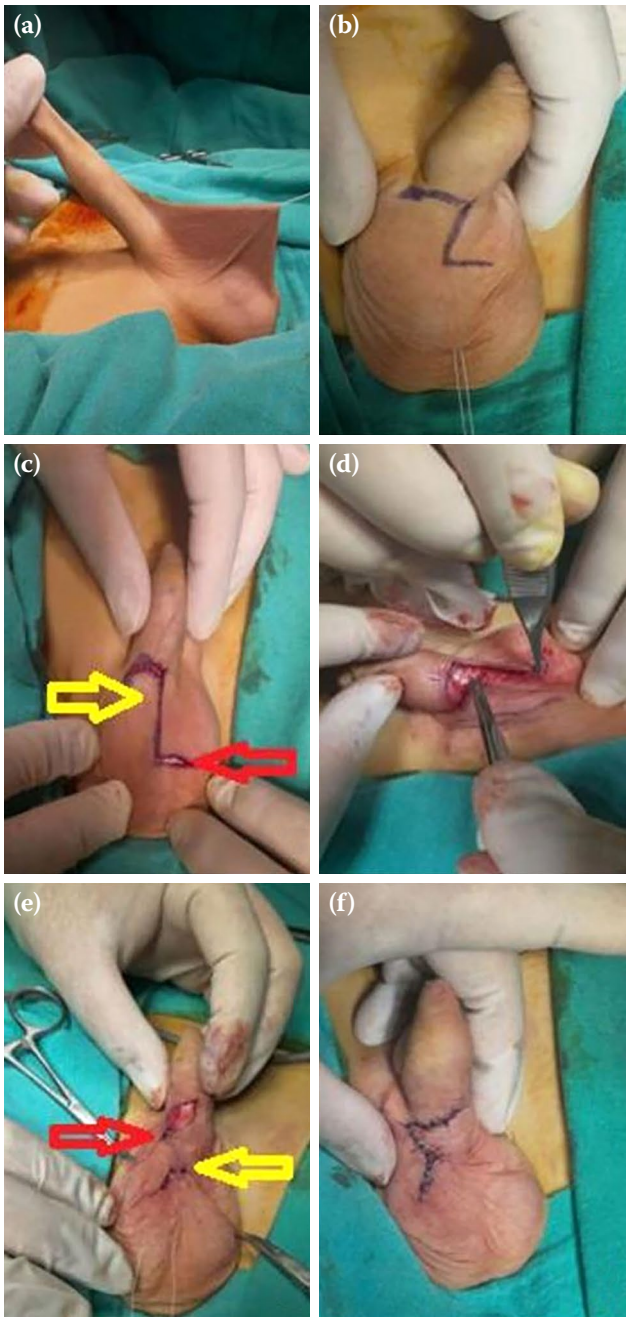

Figure 1. Stage of Z-plasty technique. **(a)** Web review. **(b)** Image showing the Z-plasty flap with a 60-degree angle formed on both sides. **(c-e)** Images showing the creation of two flaps of equal size through blunt and sharp dissection of the skin and subcutaneous tissues, and the transposition procedure. **(f)** Image showing simple closure using absorbable synthetic polylactic acid sutures.

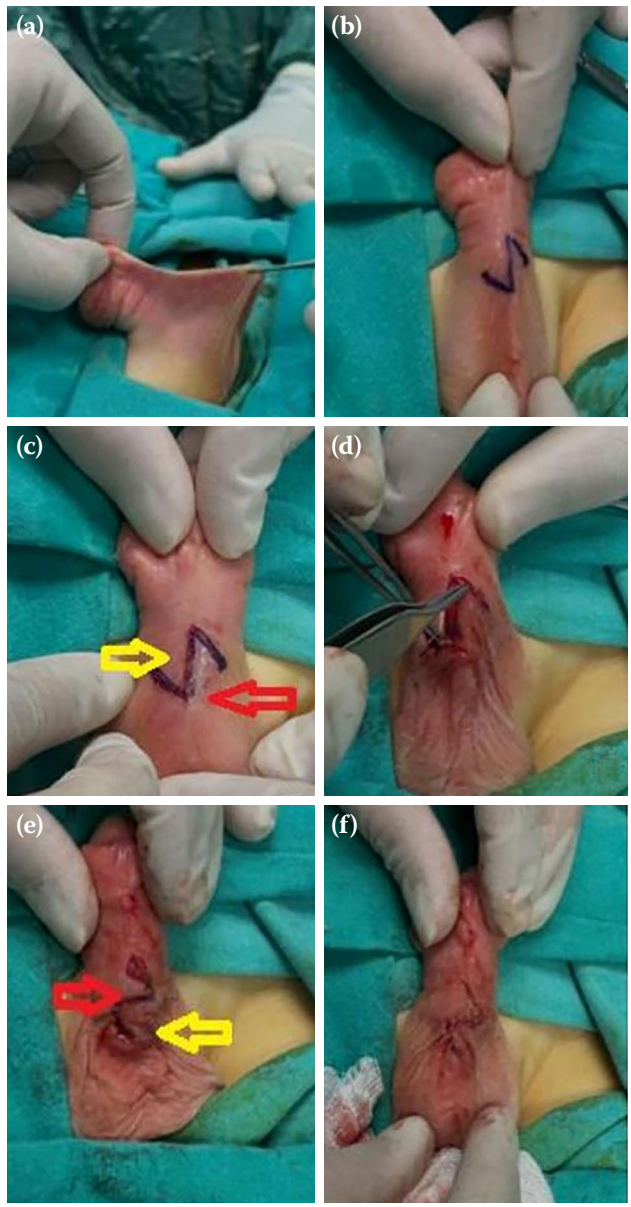

Figure 2. Reverse (mirror-image) Z-plasty technique stages. **(a)** Web review. **(b)** Image showing the mirror Z-plasty flap with a 60-degree angle formed on both sides. **(c-e)** Images showing the creation of two flaps of equal size through blunt and sharp dissection of the skin and subcutaneous tissues, and the transposition procedure. **(f)** Image showing simple closure using absorbable synthetic polylactic acid sutures.

Reverse Z-plasty technique

Preoperative examination under anesthesia was performed, as shown in Figure 2a. In this technique, one or two reverse Z-plasty flaps were created at 60-degree angles depending on PSW severity, as shown in Figure 2b. Two equally sized flaps were dissected from skin and subcutaneous tissue, as shown in Figures 2c and d. The flap indicated by the yellow arrow was transposed with the flap indicated by the red arrow, as shown in Figures 2c-e. Hemostasis was ensured, and closure was performed using absorbable synthetic polyglactin sutures (5-0 Vicryl; Ethicon Inc., Somerville, NJ, USA), as shown in Figure 2f.

In both groups, postoperative elastic compression dressings were applied, and patients were discharged on postoperative day 2. Follow-ups were scheduled at 1 week and at 1, 3, 6, and 12 months. Outcomes were evaluated through history and physical examination. Successful repair was defined as the absence of PSW and cosmetic satisfaction of the family.

Statistical analysis

Data were analyzed using the MedCalc software package version 20.009 (MedCalc Software Ltd., Ostend, Belgium). Qualitative variables were reported as numbers and percentages, and quantitative variables as mean ± standard deviation (SD), median (min-max). Normality was assessed using the Kolmogorov-Smirnov test. Non-normally distributed quantitative variables between two groups were compared using the Mann-Whitney test. Categorical variables were compared using the chi-square test. Statistical significance was set at $p < 0.05$.

RESULTS

The mean age and body weight of Group 1 were 31.9 ± 15.8 months and 15.1 ± 3.9 kg, respectively; in Group 2, they were 31.8 ± 17.8 months and 14.8 ± 3.8 kg. The mean operative time was 49.4 ± 10.5 min in Group 1 and 49.1 ± 9.7 min in Group 2. The mean number of Z-plasties in Group 1 was 1.31 ± 0.47, and in Group 2 it was 1.33 ± 0.48. No statistically significant differences were found between the groups regarding age, body weight, operative time, or number of Z-plasties ($p > 0.05$), as shown in Table 1. In Group 1, Grade 2 PSW was observed in 27 (60%) patients and Grade 3 PSW in 18 (40%) patients. Edema in the penis or scrotum was observed in five (11.1%) patients, wound contracture in two (4.4%) patients, hematoma in four (8.9%) patients, and infection in three (6.7%) patients. No recurrent webbing or flap necrosis was observed. In Group 2, 22 (61.1%) patients had Grade 2 PSW, and 14 (38.9%) had Grade 3 PSW. Edema of the penis or scrotum was observed in three (8.3%) patients, wound contracture in two (5.6%), hematoma in two (5.6%), and infection in two (5.6%). No recurrent webbing or flap necrosis was observed. No statistically significant differences in postoperative complications were detected between the groups ($p > 0.05$), as shown in Table 2.

All patients underwent surgery under general anesthesia and were discharged uneventfully on postoperative Day 2. Postoperative edema, infection, and hematoma resolved with warm bathing, antibiotics, and oral anti-inflammatory medications. Both Z-plasty techniques effectively corrected PSW with no major complications. Secondary surgical intervention was not required. Wound contractures improved over time. Families

TABLE 1
Difference between the two studied groups according to demographic data and operative duration

	Group 1 (n = 45)			Group 2 (n = 36)				
	Mean ± SD	Median	Min-Max	Mean ± SD	Median	Min-Max	Test of significance	*p*
Age at operation (month)	31.9 ± 15.8	30	12-72	36 31.8 ± 17.8	27	12-72	U = 794.50	0.881
Weight at operation (kg)	15.1 ± 3.9	15	9-27	14.8 ± 3.8	14	10-27	U = 763.50	0.657
Operative duration (min)	49.4 ± 10.5	50	30-70	49.1 ± 9.7	49	32-70	U = 795.00	0.886
Number of Z-plasty	1.31 ± 0.47	1	1-2	1.33 ± 0.48	1	1-2	U = 792.00	0.833

SD, standard deviation; * Mann-Whitney U test results indicate a significant difference at the < 0.05 level.

TABLE 2
Comparison of the two groups according to the postoperative follow-up parameters

	Group 1		Group 2			
	n	%	n	%	Test of significance	*p*
Degree of web						
Grade 1	0	0.0	0	0.0	$\chi^2 = 0.010$	0.920
Grade 2	27	60.0	22	61.1		
Grade 3	18	40.0	14	38.9		
Penile or scrotal edema						
Not present	40	88.9	33	91.7	$\chi^2 = 0.174$	0.679
Present	5	11.1	3	8.3		
Postoperative wound contracture						
Not present	43	95.6	34	94.4	$\chi^2 = 0.052$	0.820
Present	2	4.4	2	5.6		
Recurrence of the web						
Not present	45	100.0	36	100.0	-	-
Present	0	0.0	0	0.0		
Hematoma						
Not present	41	91.1	34	94.4	$\chi^2 = 0.320$	0.572
Present	4	8.9	2	5.6		
Infection at the wound site						
Not present	42	93.3	34	94.4	$\chi^2 = 0.042$	0.837
Present	3	6.7	2	5.6		
Flap necrosis						
Not present	45	100.0	36	100.0	-	-
Present	0	0.0	0	0.0		

* Chi-square test results indicate a significant difference at the < 0.05 level.

reported high satisfaction regarding penile length and cosmetic appearance.

DISCUSSION

Congenital PSW is one component of anatomical male genital anomalies classified under concealed or inconspicuous penis. The exact etiology is unclear; however, one theory proposes a congenital deficiency of ventral penile skin, leading to compensatory borrowing of scrotal tissue and formation of a web.[13] Its prevalence has been reported as 4%. Although childhood urinary symptoms are typically mild, congenital PSW can cause painful erections and difficulty during intercourse, making surgical correction necessary.[9] In our clinical practice, PSW is well recognized, and a routine web examination is performed during every circumcision evaluation. If detected, one of the established surgical repair methods is performed concurrently with circumcision.[14]

Maizels et al.[1] originally proposed a classification system including buried penis, trapped penis, webbed penis, and micro/small penis. More recently, El-Koutby and El-Gohary[9] subclassified PSW as simple, compound, or secondary. Although some authors believe that PSW severity affects surgical complexity,[1] others argue that the El-Koutby grading system does not necessarily correlate with surgical difficulty or approach.[15] In clinical practice, surgical decisions are typically based on intraoperative findings rather than preoperative classification. In our

study, grading was performed using the El-Koutby system; however, the operative strategy was determined independently of the grade.

Although there is no consensus on optimal timing of PSW repair, reconstruction is recommended within 6-12 months when significant PSW is identified.[15] In our study, the youngest patient was 12 months old, likely due to delayed referral or customary circumcision age in our region. We emphasize that reconstruction should ideally occur before gender identity develops.

Multiple techniques have been described for PSW repair. Bonitz and Hanna[2] compared three approaches, Heineke-Mikulicz, V-Y, and Z-plasty, and reported no significant differences in outcomes, noting that technique selection depends on surgeon preference. Negm and Nagla[16] compared two approaches and suggested that Heineke-Mikulicz is effective for Grade 1 PSW, while multiple Z-plasties are preferable for Grades 2 and 3. Elrouby[17] also reported similar outcomes between Heineke-Mikulicz and Z-plasty. In our study, the results of the Z-plasty and reverse Z-plasty techniques were compared with each other, and it is believed that the similarity of the results will contribute to the literature. We would also like to note that it is more appropriate for the surgeon to use the technique in which they have experience, and for Z-plasty techniques to be performed in Grade 2 and Grade 3 web cases.

Bonitz and Hanna[2] reported that operative time was significantly shorter for Heineke-Mikulicz (22.90 ± 4.58 min) compared to Z-plasty (45.50 ± 6.67 min) and recommended Heineke-Mikulicz to reduce anesthesia exposure. Similarly, Elrouby[17] observed shorter operative times with Heineke-Mikulicz compared to Z-plasty. In our series, both Z-plasty techniques required longer operative time, especially when multiple Z-plasties were used. When compared to each other, the surgery times were similar. This may reflect higher surgical complexity, greater intraoperative planning, and a steeper learning curve. For simple PSW, Z-plasty techniques are not recommended solely based on operative time. As reported in our previous study, Heineke-Mikulicz or V-Y scrotoplasty is preferable for simple cases.[14]

Elrouby[17] reported a 95% success rate for Z-plasty, with postoperative contracture and recurrence occurring in only one case.[17] Bonitz and Hanna[2] reported a 2.9% complication rate in their Z-plasty group. Negm and Nagla[16] observed mild, spontaneously resolving penile edema in three (11.1%) patients and scrotal hematoma in two (7.4%) patients following multiple Z-plasties. In our study, satisfaction in both groups was nearly 100%. Group 1 showed edema in five (11.1%) patients, wound contracture in two (4.4%), hematoma in four (8.9%), and infection in three (6.7%); Group 2 showed edema in three (8.3%), wound contracture in two (5.6%), hematoma in two (5.6%), and infection in two (5.6%). All complications were resolved with simple management. No recurrence or flap necrosis was observed. Complication rates in the Z-plasty group were consistent with the literature. No comparison could be made for the reverse Z-plasty group, as no studies have been conducted on this technique. However, the complication rates for the Z-plasty and reverse Z-plasty techniques were similar. Furthermore, no literature comparing these techniques was found in the article. This comparison is being made for the first time in this study.

However, this study has some limitations. Firstly, it has a single-center, cross-sectional, observational, retrospective design, and there is no control group to test the hypothesis of the relationship between these two anomaly groups. Secondly, the use of a single classification system for grading, the relatively small sample size, the limited comparison of alternative techniques, and the short follow-up period can be cited.

In conclusion, PSW is a condition requiring surgical management. When penile skin abnormalities are suspected during circumcision, simultaneous circumcision and PSW repair should be performed. Both physical and psychological components of PSW are clinically important. Z-plasty and reverse Z-plasty are among the surgical approaches providing favorable outcomes. We also consider it important that the reverse Z-plasty technique was defined for PSW for the first time in this study. Further prospective, randomized, controlled studies are warranted to evaluate their long-term effectiveness.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: All authors contributed equally to this article.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

AI Disclosure: The authors declare that artificial intelligence (AI) tools were not used, or were used solely for language editing, and had no role in data analysis, interpretation, or the formulation of conclusions. All scientific content, data interpretation, and conclusions are the sole responsibility of the authors. The authors further confirm that AI tools were not used to generate, fabricate, or 'hallucinate' references, and that all references have been carefully verified for accuracy.

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