



Intraoperative Decision-making for Precise Penile Straightening During Inflatable Penile Prosthesis Surgery

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OBJECTIVE	To present a novel algorithm for definitive reconstruction of penile curvature in men undergoing inflatable penile prosthesis (IPP) surgery as an alternative to manual penile modeling and grafting procedures.
METHODS	Patients with erectile dysfunction and concomitant penile curvature undergoing IPP placement were divided into 2 treatment groups: (1) group 1, penile deformity known preoperatively, and (2) group 2, penile curvature recognized intraoperatively after IPP placement. Group 1 patients underwent penile plication after artificial erection and immediately before IPP insertion via the same penoscrotal incision, whereas group 2 patients were treated with a Yachia (Heineke-Mikulicz) corporoplasty over the intact cylinders. Patients completed postoperative Patient Global Impression of Improvement (PGI-I) questionnaires assessing overall satisfaction.
RESULTS	Among 405 men receiving IPP at our institution from 2007 to 2014, 30 patients received synchronous correction of penile curvature (7%). Group 1 included 23 of 30 (77%) patients, and 7 of 30 (23%) were in group 2. Overall mean initial curvature was 36°, and all patients were corrected to <10°. Average operative times were 18 minutes longer compared with patients who underwent IPP placement alone (82 vs 64 minutes, $P < .05$). At an average follow-up of 13 months (range 7-32), 19 of 20 (95%) group 1 and 6 of 7 (86%) group 2 patients who completed surveys reported an improved overall condition. No patient reported chronic pain, recurrent deformity, or device malfunction.
CONCLUSION	Penile curvature can be safely and reliably corrected at the time of IPP placement, regardless of whether the deformity was identified preoperatively. UROLOGY 86: 1048–1052, 2015. © 2015 Elsevier Inc.

Men with erectile dysfunction (ED) often present with concomitant Peyronie's disease (PD). Penile prosthesis insertion alone is often not sufficient to correct penile curvature, requiring many patients to undergo additional straightening maneuvers such as manual modeling, plaque incision or incision and grafting.¹ Synchronous treatment of curvature with penile plication and prosthesis insertion during the same operation has been described with excellent results.^{2,3}

Some men who have long suffered from refractory ED may not be aware of their concomitant development of

curvature before penile prosthesis surgery. When the penile curvature is diagnosed intraoperatively after prosthetic cylinders have been implanted and test-filled, further maneuvers such as plication, plaque incision, and/or grafting techniques require prosthesis removal or risk damage to the device from needle passages. Manual modeling, described by Wilson and Delk⁴ in 1994, involves forcibly fracturing the plaque over inflated cylinders and carries a 3%-5% risk for urethral injury and a tendency for significant residual curvature.⁵ We present an efficient algorithm for definitive correction of PD in men undergoing concomitant inflatable penile prosthesis (IPP) surgery as an alternative to penile modeling.

METHODS

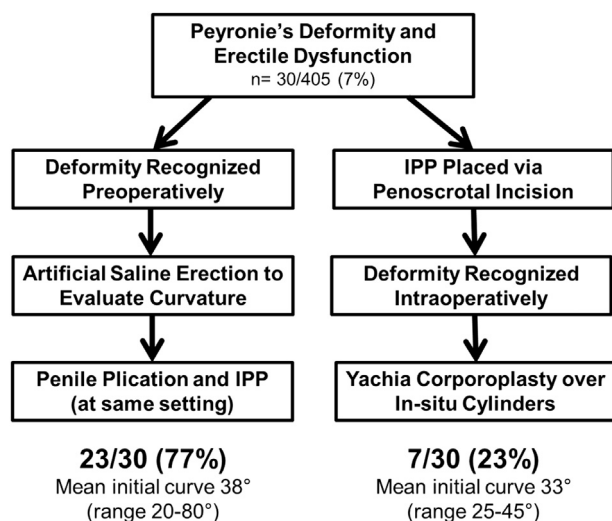
We reviewed our institutional review board approved IPP database and identified patients who underwent IPP insertion with PD correction between 2007 and 2014. We divided the patients into 2 treatment groups based on when the penile curvature was recognized (Fig. 1). Group 1 patients were diagnosed preoperatively and underwent penile plication immediately before IPP

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All patients were corrected to < 10°

Figure 1. Reconstructive algorithm for patients with erectile dysfunction and Peyronie's disease.

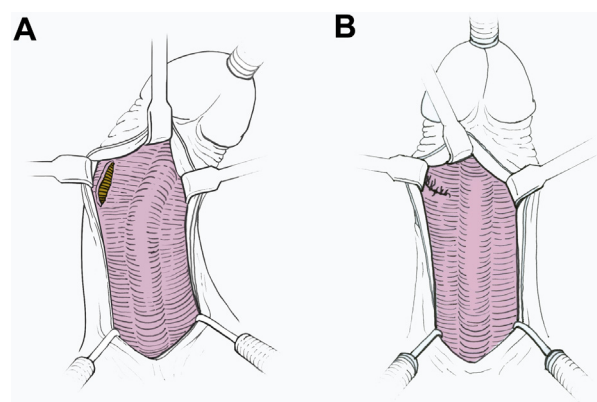


Figure 2. Yachia corporoplasty after prosthetic cylinders have been placed. **(A)** 2-cm longitudinal incision made in the convex tunica albuginea overlying the in-situ cylinder. **(B)** Interrupted 2-0 polydioxanone sutures with buried knots are used to close the incision transversely in a Heineke-Mikulicz fashion. (Color version available online.)

insertion.³ Group 2 patients were diagnosed intraoperatively after inflation of a newly inserted IPP and were treated with a Yachia (Heineke-Mikulicz) corporoplasty over the intact cylinders (Fig. 2).⁶ In both groups, all procedures were performed via the same penoscrotal incision. Preoperative diagnosis of PD was based on history (including autophotography) and physical examination. Patients with known PD were required to have painless, stable penile curvature for at least 6 months before undergoing curvature correction.

Penile Plication

Group 1 patients underwent penile plication before IPP insertion via the following steps: (1) transverse scrotal incision first with exposure of the tunica albuginea bilaterally; (2) artificial erection with injectable saline and tourniquet; (3) retraction of incision distally as needed for exposure of the tunica albuginea; (4) a series of parallel, 2-0 polyester sutures placed in an inverting, interrupted fashion in the tunica albuginea at the

convex surface opposite of greatest curvature; (5) confirmation of correction with repeat artificial erection; and (6) IPP placement with corporotomies proximal to the plication sutures.

Yachia Corporoplasty

Group 2 patients underwent Yachia (Heineke-Mikulicz) corporoplasty over the intact cylinders after IPP placement: (1) complete IPP cylinder insertion with inflation; (2) exposure of the distal corporal body contralateral to the curve via the same penoscrotal incision, in a reverse-degloving manner (Supplementary Fig. 1); (3) using low-level (≤ 20 W) electrocautery, a longitudinal 2.0-cm incision was made directly over the in-situ cylinder overlying the area of greatest curvature. Stay sutures were placed to pull the vertical incision laterally to facilitate transverse closure with interrupted 2-0 polydioxanone sutures (Fig. 3).

Photographs from lateral and inferior views were taken intraoperatively to calculate degree of curvature (Supplementary Fig. 2). The wound was meticulously closed in 3 layers to bury tubing, prevent skin tethering, and ensure robust tissue coverage. A drain was placed in all patients, and they were observed overnight and discharged home the following morning after drain removal and voiding trial.

Postoperative evaluation and IPP instruction were conducted 6 weeks after surgery. Further clinic follow-up was conducted according to patient's preference or as medically indicated. A research assistant unfamiliar with the surgery or outcomes queried all patients with the Patient Global Impression of Improvement (PGI-I), assessing patient-perceived postoperative improvement (Supplementary Table 1).⁷

RESULTS

Among 405 men receiving IPP at our institution from 2007 to 2014, 30 patients received synchronous surgical reconstruction for penile curvature (7%). Group 1 included 23 of 30 (77%) patients who underwent simultaneous plication and IPP for dorsal ($n = 11$), lateral ($n = 5$), and biplanar curvature ($n = 7$). Group 2 included 7 of 30 (23%) patients who underwent IPP and Yachia corporoplasty for dorsal ($n = 1$), lateral ($n = 4$), and biplanar curvature ($n = 2$).

Overall, mean initial curvature was 36° corrected to $< 10^\circ$ in both cohorts. For group 1 patients, mean initial curvature was 38° (range 20° - 80°) and 33° (range 25° - 45°) for group 2 ($P = .86$). All patients were corrected to $< 10^\circ$. A median of 4 sutures (range 3-6) was used for plication with each suture providing correction of approximately 8° . Average operative times were only 18 minutes longer for group 1 patients (83 vs 64, $P < .05$) compared with patients who underwent IPP placement only (82 vs 64 minutes, $P < .05$), and times for Group 2 patients were only 24 minutes longer (88 vs 64, $P < .05$). At an average 13 months of follow-up (range 7-32), on postoperative PGI-I questionnaires 19 of 20 (95%) group 1 patients who completed surveys reported an improved overall condition (mean 1.4, range 1-3) and in group 2, 6 of 7 (86%) patients reported improvement (mean response 1.3, range 1-2). No patient reported chronic pain, recurrent deformity, or device malfunction. To date, there have been no revisions or infections of any devices.

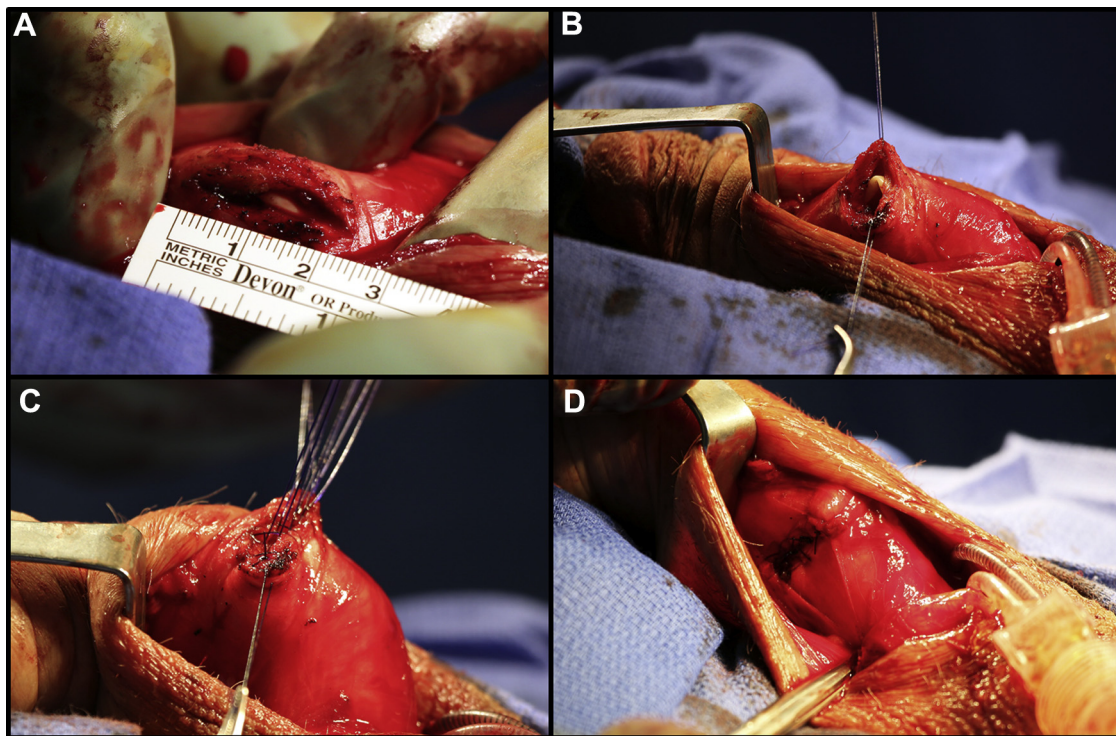


Figure 3. (A) Low-current (≤ 20 W) electrocautery is used to create a 2-cm longitudinal incision directly over the in-situ cylinder. (B) Stay sutures retract the edges of the tunica laterally to align the edges for transverse closure. (C) A series of interrupted 2-0 polydioxanone sutures are placed to close the defect over the cylinder and tied with buried knots (D). (Color version available online.)

COMMENT

Given the plethora of cardiovascular risk factors that frequently affect men with PD, concomitant ED can affect as many as 54%.⁸ In cases of PD with ED refractory to medical management, IPP implantation alone can completely correct the curvature in up to a third of cases, but the results may not be verifiable until many weeks postoperatively after a period of repeated self-inflations.^{4,9} Overall, 19%-42% of PD/ED patients will require adjunctive straightening procedures after cylinder implantation.^{10,11}

Some implanters prefer to perform an artificial erection before beginning every case, as this identifies any penile deformities before the cylinders are implanted. However, only 7% of our IPP patients needed correction of their curvature, and adding this additional step to every procedure would significantly increase operative time and procedural costs, with no benefit to the vast majority. Penile Doppler ultrasound may also be used to demonstrate to the patient that he indeed has impaired blood flow, but as our patients have failed conservative treatment for their ED, their only option for return of sexual function is IPP implantation.

Straightening Maneuvers

Manual modeling over inflated cylinders, as first described by Wilson and Delk,⁴ is often considered as a first-line method to correct persistent curvature after IPP implantation.⁵ The technique involves fully inflating the device, clamping the tubing leading to the pump, and manually

straightening the penis by forcibly fracturing the plaque. Successful correction of curve deformities with modeling is highly variable, ranging from 34% to 100%, indicating surgeon dependence and procedural variability, and takes up to 6 months for resolution.^{1,5,12-15} Although long-term overall patient and partner satisfaction rates can reach 80%-88%, patient-reported correction of curvature is lower (73%) with modeling alone.^{1,8}

It is clear that modeling is more successful in inflatable compared with malleable devices, but the results remain inconsistent.¹¹ A recently described "scratch" technique has been advocated, as an adjunct, wherein the plaque is incised from inside the corpus cavernosum using a curved scalpel blade.¹⁶ However, the curvature must be recognized before cylinder implantation, and patient outcomes have yet to be reported.

Some groups advocate tunical incision overlying the apex of the concave side, with grafting for defects >2 cm to prevent aneurismal cylinder dilation.^{13,17-19} In cases of severe ($>60^\circ$) curvature, complete plaque excision with or without a graft has also been reported.¹¹ These complex repairs necessitate removal of the cylinders to avoid damage and can require significant additional operative time and multiple or longer incisions. We have avoided grafting in this setting because of concerns about graft shrinkage and the potential for device infection near a foreign body.

Penile plication with synchronous IPP insertion has been shown to be an effective alternative solution.^{2,3}

Plication was once reserved for noncomplex, small degrees of deformity but has now been shown to be effective for biplanar, complex ($\geq 60^\circ$), and ventral curvatures.²⁰⁻²² Patients having synchronous plication and IPP insertion for PD and ED reported high levels of satisfaction and improvement in their overall condition and curvature.³

Intraoperative Recognition of Peyronie's Disease

Patients and surgeons may not always recognize the presence and degree of penile curvature preoperatively. Patients may fail to report penile curvature during their preoperative evaluation, whereas others may have underlying, unidentified curvature due to their lengthy inability to obtain satisfactory erections. Even if known, surgeons may underestimate the degree of curvature and incorrectly predict that IPP insertion alone will resolve the deformity.

Differing degrees of PD severity and the associated deformities can affect the percentages of men who need procedures in addition to IPP placement alone.^{10,23} For this reason, it is difficult to establish an algorithmic approach to all cases. Garaffa et al¹¹ described their flowchart with modeling, plication, or incision +/-grafting for all cases of ventral curvature or dorsal/lateral curves $>20^\circ$. Our algorithm as described in the current series can be used as an alternative to the potentially unpredictable modeling maneuvers and the additional time and risk of grafting, regardless of whether the presence of PD is known preoperatively.

Advantages of Yachia Corporoplasty Overlying Intact Cylinders

The modified incisional technique for correcting penile curvature was initially described by Yachia.⁶ The longitudinal incision was thought to be safer (avoidance of the neurovascular bundles) compared with the transverse incision of the Nesbit procedure. An updated report of 19 men with PD who underwent the procedure demonstrated excellent results, with 18 of 19 (95%) reporting successful outcomes.²⁴ We adapted this technique to be performed after IPP cylinders have been placed and corporotomies closed. Using low levels of electrocautery (≤ 20 W) and precise suture placement under direct vision while protecting the cylinders, one can readily avoid damage to the device with a low risk of postoperative device malfunction.

An advantage of our approach is that both the IPP placement and precise straightening procedure can be performed through the same penoscrotal incision traditionally used for IPP placement alone. Scrotal skin laxity allows for manipulation of the incision distally (reverse-degloving maneuver usually via blunt dissection), providing ready access to any lateral or ventral corporal surface that may need corrected (Fig. 3). Without the need for additional dissection and closure of multiple incisions, we observed only an 18-minute average increase in operative time compared with IPP placement

alone, with no increased risk of infection or increased blood loss.

Because of the smaller increase in operative time and our familiarity with the plication procedure for all Peyronie's patients, we still prefer to perform plication with IPP for patients with known curvature. However, the Yachia corporoplasty can be applied to any case in which residual dorsal or lateral curvature is identified intraoperatively after IPP insertion. It does not expose the cylinders to additional risks involved with removal and reinsertion, while allowing for precise and definitive correction of the curvature. It also avoids the technically challenging morbid adjunctive maneuvers such as plaque excision with graft placement.

Using our algorithm, either synchronous penile plication or Yachia corporoplasty can avoid the time and potential problems associated with circumcision, plaque incision and grafting, and possible urethral damage from manual modeling. Our patients were very satisfied with both the correction of their penile curvature and postoperative sexual function. In addition, plication and Yachia corporoplasty do not appear to have any negative impact on IPP function, safety, or durability as demonstrated by the lack of revisions required. Both procedures are precise and add only a few extra minutes of operative time compared with IPP insertion alone.

Limitations

This study is limited by its retrospective design, a small patient cohort, and lack of long-term clinic follow-up. We also did not use any other straightening maneuvers and thus cannot directly compare our algorithm with other methods. The PGI-I questionnaire is validated, but nonspecific, but does assess overall patient satisfaction and perceived improvement. Future studies could use the recently validated 15-question survey assessing bother and distress in patients with Peyronie's disease, which may confer reproducibility and uniformity to the literature.²⁵ Finally, because many men with ED did not know they had PD before IPP placement (group 2), it remains difficult to assess postoperative improvement in penile curvature.

CONCLUSION

Using an algorithmic approach with synchronous plication/IPP or Yachia corporoplasty, penile curvature can be safely and reliably reconstructed during the same procedure, regardless of whether the deformity was identified preoperatively.

References

1. Levine LA, Benson J, Hoover C. Inflatable penile prosthesis placement in men with Peyronie's disease and drug-resistant erectile dysfunction: a single-center study. *J Sex Med.* 2010;7:3775-3783.
2. Rahman NU, Carrion RE, Bochinski D, et al. Combined penile plication surgery and insertion of penile prosthesis for severe penile curvature and erectile dysfunction. *J Urol.* 2004;171:2346-2349.
3. Chung PH, Scott JF, Morey AF. High patient satisfaction of inflatable penile prosthesis insertion with synchronous penile plication for erectile dysfunction and Peyronie's disease. *J Sex Med.* 2014;11:1593-1598.

4. Wilson SK, Delk JR 2nd. A new treatment for Peyronie's disease: modeling the penis over an inflatable penile prosthesis. *J Urol.* 1994; 152:1121-1123.
5. Wilson SK, Cleves MA, Delk JR 2nd. Long-term followup of treatment for Peyronie's disease: modeling the penis over an inflatable penile prosthesis. *J Urol.* 2001;165:825-829.
6. Yachia D. Modified corporoplasty for the treatment of penile curvature. *J Urol.* 1990;143:80-82.
7. Hossack T, Woo H. Validation of a patient reported outcome questionnaire for assessing success of endoscopic prostatectomy. *Prostate Int.* 2014;2:182-187.
8. Usta MF, Bivalacqua TJ, Tokatli Z, et al. Stratification of penile vascular pathologies in patients with Peyronie's disease and in men with erectile dysfunction according to age: a comparative study. *J Urol.* 2004;172:259-262.
9. Ralph DJ, Minhas S. The management of Peyronie's disease. *BJU Int.* 2004;93:208-215.
10. Mulhall J, Ahmed A, Anderson M. Penile prosthetic surgery for Peyronie's disease: defining the need for intraoperative adjuvant maneuvers. *J Sex Med.* 2004;1:318-321.
11. Garaffa G, Minervini A, Christopher NA, et al. The management of residual curvature after penile prosthesis implantation in men with Peyronie's disease. *BJU Int.* 2011;108:1152-1156.
12. Carson CC. Penile prosthesis implantation in the treatment of Peyronie's disease and erectile dysfunction. *Int J Impot Res.* 2000; 12(suppl 4):S122-S126.
13. Levine LA, Dimitriou RJ. A surgical algorithm for penile prosthesis placement in men with erectile failure and Peyronie's disease. *Int J impotence Res.* 2000;12:147-151.
14. Kadioglu A, Sanli O, Akman T, et al. Surgical treatment of Peyronie's disease: a single center experience with 145 patients. *Eur Urol.* 2008;53:432-439.
15. Montague DK, Angermeier KW, Lakin MM, et al. AMS 3-piece inflatable penile prosthesis implantation in men with Peyronie's disease: comparison of CX and Ultrex cylinders. *J Urol.* 1996;156: 1633-1635.
16. Perito P, Wilson S. The Peyronie's plaque "scratch": an adjunct to modeling. *J Sex Med.* 2013;10:1194-1197.
17. Mulhall J, Anderson M, Parker M. A surgical algorithm for men with combined Peyronie's disease and erectile dysfunction: functional and satisfaction outcomes. *J Sex Med.* 2005;2: 132-138.
18. Ralph D, Gonzalez-Cadavid N, Mirone V, et al. The management of Peyronie's disease: evidence-based 2010 guidelines. *J Sex Med.* 2010;7:2359-2374.
19. Mulcahy JJ, Wilson SK. Management of Peyronie's disease with penile prostheses. *Int J impotence Res.* 2002;14:384-388.
20. Hudak SJ, Morey AF, Adibi M, et al. Favorable patient reported outcomes after penile plication for wide array of peyronie disease abnormalities. *J Urol.* 2013;189:1019-1024.
21. Adibi M, Hudak SJ, Morey AF. Penile plication without degloving enables effective correction of complex Peyronie's deformities. *Urology.* 2012;79:831-835.
22. Chung PH, Tausch TJ, Simhan J, et al. Dorsal plication without degloving is safe and effective for correcting ventral penile deformities. *Urology.* 2014;84:1228-1233.
23. Kadioglu A, Akman T, Sanli O, et al. Surgical treatment of Peyronie's disease: a critical analysis. *Eur Urol.* 2006;50:235-248.
24. Yachia D. Our experience with penile deformations: incidence, operative techniques, and results. *J Androl.* 1994;15(suppl): 63S-68S.
25. Hellstrom WJ, Feldman R, Rosen RC, et al. Bother and distress associated with Peyronie's disease: validation of the Peyronie's disease questionnaire. *J Urol.* 2013;190:627-634.

APPENDIX

SUPPLEMENTARY DATA

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.urology.2015.06.042>.