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Effects of plication procedures in special cases of Peyronie's disease: a single-center retrospective study of 72 patients

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General recommendations regarding surgical techniques are not always appropriate for all Peyronie's disease (PD) patients. Therefore, the purpose of this study was to investigate the effects of plication procedures in PD patients with severe penile curvature and the effects of early surgical correction in patients who no longer have progressive deformities. The clinical data from 72 patients who underwent plication procedures were analyzed in this study. Patients were divided into Groups A and B according to the curvature severity (≤60° or >60°) and Groups 1 and 2 according to the duration of disease stabilization (≥3 months or <3 months). At the 1-year follow-up, 90.0% (36/40) and 90.6% (29/32) patients reported complete penile straightening, and 60.0% (24/40) and 100.0% (32/32) patients reported penile shortening in Groups A and B, respectively. No curvature recurrence occurred in any patient, and no significant differences were observed in postoperative International Index of Erectile Function–Erectile Function domain (IIEF-EF), erectile pain, sensitivity, or suture knots on the penis whether such outcomes were grouped according to the curvature severity or the duration of stabilization. However, the duration from symptom onset to surgical management in Group 1 was significantly longer than that in Group 2 (mean ± standard deviation [s.d.]: 20.9 ± 2.0 months and 14.3 ± 1.2 months, respectively, $P < 0.001$). The present study showed that the plication procedures seemed to be an effective choice for the surgical treatment of PD patients with severe penile curvature. In addition, the early surgical treatment seemed to benefit those patients who already had no erectile pain and no longer exhibited progressive deformity.

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INTRODUCTION

The symptoms caused by Peyronie's disease (PD), including penile pain, palpable penile plaques, deformity and/or penile curvature during erection, and sexual intercourse difficulties, significantly affect the quality of life in up to 81% of patients.[1–3] If penile deformity and/or curvature are very bothersome in the chronic phase of PD, surgical management can be considered.[4,5]

Patients who have sufficient erectile rigidity for intercourse with or without drug therapy are suitable for either tunica plication procedures or incision (or partial plaque excision) with grafting techniques.[6,7] The common complications of these surgical techniques are incomplete straightening, curvature recurrence, loss of penile length, and erectile dysfunction (ED).[7,8] Therefore, most studies, including the latest guidelines, recommend the use of plication procedures as the first treatment strategy for PD with sufficient penile length and rigidity, curvature of less than 60°, and the absence of complex deformities (hourglass or hinge). In addition, plaque incision or partial excision with grafting is recommended for patients with normal erectile function, insufficient penile length, >60° curvatures, and/or the presence of complex deformities.[9] Regarding the timing of surgery, it is recommended that patients have stable disease, defined as more than 9–12 months after the onset of PD and stable deformation for at least 3–6 months.[8]

In our clinical practice, we found that the above recommendations are inappropriate for certain patients. For example, some PD patients have a sufficient penile length and a curvature >60°. Although some of them do not have a completely hard erection, their erection quality under drug therapy is enough for penetration and does not require penile prosthesis implantation. If these patients receive grafting procedures because the curvature is >60°, it may result in postoperative ED. In addition, although the duration of stabilization of the deformity in some patients is less than 3–6 months, they already have no penile pain on erection and no further progression of the deformity. Because these patients have suffered from PD for a long time, they hope to receive surgery as soon as possible and restore their ability to have sexual intercourse. To improve the therapeutic effect of PD patients with these special conditions and to guide future clinical practice, we performed a retrospective evaluation of the feasibility of 16-dot plication procedures in special cases of PD.

PATIENTS AND METHODS

The present study was approved by the Institutional Research Ethics Committee of the Ninth People's Hospital, School of Medicine,

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Shanghai Jiaotong University, Shanghai, China (No. SH9H-2019-T52-2). Informed consent was waived by the ethics committee due to the retrospective study that only needed to collect medical records without contacting with patients and subsequent intervention. The clinical data of PD patients from February 2013 to August 2018 were analyzed retrospectively. The inclusion criteria were as follows: (1) patients with stable PD for at least 3–6 months; (2) less than 3-month duration of stabilization of the deformity, no penile pain on erection and no further progression of the deformity; (3) sustained penile curvature without an hourglass or hinge deformation that severely precludes intercourse; (4) stretched penile length of more than 10 cm and an anticipated length loss of <20%; (5) sufficient erection quality for penetration without pharmacotherapy; (6) sufficient erection quality for penetration under pharmacotherapy, even if not completely hard; (7) having undergone surgical treatment by plication procedures; and (8) follow-up for at least 1 year after surgical correction.

All patients underwent a medical history evaluation and preoperative physical examination. The angle and degree of penile curvature during maximum erection were recorded by autophotography using the Kelami technique.[10] If the photograph was unable to be obtained by the patient himself, an artificial erection was induced by intracavernous injection of 30 mg papaverine hydrochloride (Shandong Beida high tech Huatai Pharmaceutical Co., Ltd., Penglai, China). The Chinese version of the International Index of Erectile Function–Erectile Function domain (IIEF-EF) score was used to evaluate erectile function,[11] and a score below 26 was considered to indicate ED.[11,12] A detailed and frank preoperative patient consultation was conducted, with aspects including the anesthesia type, duration of the surgery, probability of correcting the curvature, possibility of postoperative curvature recurrence, erectile pain, penile shortening, loss of erectile rigidity, loss of penile sensation, *de novo* ED, and palpable penile suture knots. The 16-dot plication procedure was performed according to the technique described by previous studies.[13]

After surgery, patients were advised to avoid all forms of sexual intercourse for 2 months. Although penile traction therapy or a vacuum device was not used, daily low-dose phosphodiesterase type 5 inhibitors (PDE5Is) were recommended starting 2 weeks after surgery for 2 months to promote nocturnal erections.[14] At follow-up, the erectile function was evaluated using the IIEF-EF questionnaire at 3 months, 6 months, and 1 year postoperatively. Satisfaction was assessed by asking the patients whether they were satisfied or completely dissatisfied overall with the surgery and the subsequent results.

Statistical analyses

Statistical analyses were performed by Student's *t*-test for data with a normal distribution, the Mann–Whitney U test for data with a nonnormal distribution, and the Chi-square (χ^2) test for categorical variables using SPSS version 20.0 software (SPSS Inc., Chicago, IL, USA). $P < 0.05$ was considered statistically significant.

RESULTS

During the study period, 72 PD patients met the inclusion criteria. Among these patients, 40 patients (Group A) had a curvature of ≤60° without complex deformities (hourglass or hinge), and 32 patients (Group B) had a curvature of >60° without complex deformities. In addition, 34 patients (Group 1) had stable PD for at least 3–6 months, and 38 individuals (Group 2) had no penile pain on erection and no further progression of the deformity even though the duration of stabilization of the deformity was less than 3 months. Age varied between 38 years and 63 years. Except for the duration from the onset of symptoms to surgical management in Groups 1 and 2 ($P < 0.001$) and the mean angle of penile curvature in Groups A and B ($P < 0.001$), no significant differences were observed in the baseline demographics and disease characteristics (all $P > 0.05$, **Table 1**). No surgery-related complications, such as penile hematoma, glandular ischemia, or wound infection, occurred in any case.

At the 1-year follow-up after surgery, 90.0% (36/40) and 90.6% (29/32) of patients had complete penile straightening in Groups A and B, respectively, and no significant differences were observed ($P = 0.929$). The remaining patients with slight residual curvature (<20°) did not receive further treatment because none of these patients were dissatisfied with this condition. The occurrence of penile shortening in Group B was significantly higher than that in Group A ($P < 0.001$). Penile shortening was observed in 60.0% (24/40) and 100.0% (32/32) of patients, with an average shortening of 0.7 cm and 1.6 cm in Groups A and B, respectively. However, the patients not only did not express any dissatisfaction about this condition but were also satisfied because they could maintain the preoperative erectile quality for penetration (**Table 2**).

At the 1-year follow-up after surgery, no postoperative curvature recurrence was observed either in the two groups divided according to the degree of penile curvature (Group A and Group B) or in the two groups divided according to the disease duration (Group 1 and Group 2). However, the period from onset of disease to the receipt of surgery in Group 1 was significantly longer than that in Group 2 ($P < 0.001$, **Table 1**). There was no significant difference in the IIEF-EF score after surgery compared with that before surgery in all patients (all $P > 0.05$, **Table 1**). The erectile capacity with or without PDE5Is was sufficient for sexual intercourse in all patients.

After surgery, pain during erections was observed in all patients, and most patients complained of pain for up to 3 months. At the 1-year follow-up, approximately 5%–6% of patients in each group complained of slight pain during intercourse and slightly decreased sensitivity in the penis. Even though all patients felt suture knots on the penis, none of the patients complained of significant discomfort because of this. Regarding overall satisfaction, more than 90% of patients in each group, whether they were grouped according to curvature severity or duration of stabilization, were satisfied after surgery and willing to advise other patients to receive surgery. However, when asked about the points of most dissatisfaction in the whole treatment process, 85.3% of patients in Group 1 replied that the waiting time for surgery was too long and that they had hoped to receive surgery as soon as possible ($P < 0.001$, **Table 2**).

DISCUSSION

Tunica albuginea plication, especially Lue's 16- or 24-dot minimal tension plication as a less invasive approach, is favored in many cases because it does not require tunica incision or neurovascular bundle mobilization and thus is beneficial for preserving erectile capacity.[7,13] However, the severity of penile shortening, which is the main complication of the tunical shortening procedure, is directly related to the degree of curvature; thus, these procedures are most suited for patients with adequate penile length and a curvature ≤60°.[15,16] Moreover, it is generally considered that tunical lengthening procedures should be performed for patients with severe penile length loss or a curvature >60°.[17,18] However, according to the literature, in contrast to the ED incidence after tunica plication procedures, which usually do not affect erectile function, the incidence of ED after tunical lengthening procedures is as high as 50%.[13,19,20] In addition, the minimally invasive intracorporeal incision of Peyronie's plaque

Table 1: Clinical and demographic features of the Peyronie's disease patients

Variable	*Group 1 (n=34)*	*Group 2 (n=38)*	*P value (Group 1 vs Group 2)*	*Group A (n=40)*	*Group B (n=32)*	*P value (Group A vs Group B)*
Age (year), mean±s.d.	50.8±6.9	50.7±7.0	0.961	50.5±6.6	51.0±7.4	0.737
Duration from the onset of symptoms to surgical management (month), mean±s.d.	20.9±2.0	14.3±1.2	<0.001	17.0±3.3	17.8±4.1	0.356
Penile deformity, *n* (%)						
Dorsal	15 (44.1)	16 (42.1)	NA	17 (42.5)	14 (43.8)	NA
Ventral	6 (17.6)	5 (13.2)	NA	7 (17.5)	4 (12.5)	NA
Lateral	2 (5.9)	4 (10.5)	NA	5 (12.5)	1 (3.1)	NA
Ventrolateral	5 (14.7)	4 (10.5)	NA	4 (10.0)	5 (15.6)	NA
Dorsolateral	6 (17.6)	9 (23.7)	NA	7 (17.50)	8 (25.0)	NA
Degrees of penile curvature (°), mean±s.d.	54.7±15.7	54.2±15.3	0.892	42.3±8.2	69.8±4.8	<0.001
Patients with ED, *n* (%)	14 (41.2)	17 (44.7)	0.761	17 (42.5)	14 (43.8)	0.915
IIEF-EF score in ED patients, mean±s.d.	19.9±3.3	19.1±1.9	0.366	20.0±2.7	18.8±2.5	0.204

Group A: patients with curvature of ≤60° without complex deformities; Group B: patients with curvature of >60° without complex deformities; Group 1: patients with stable Peyronie's disease for at least 3–6 months; Group 2: patients without penile pain on erection and no further progression of the deformity even though the duration of stabilization of the deformity was <3 months. ED: erectile dysfunction; IIEF-EF: International Index of Erectile Function–Erectile Function domain; NA: not available; s.d.: standard deviation

Table 2: Surgical outcomes of the 16-dot plication procedure after 1 year of follow-up

Surgical outcomes	*Group 1 (n=34)*	*Group 2 (n=38)*	*P value (Group 1 vs Group 2)*	*Group A (n=40)*	*Group B (n=32)*	*P value (Group A vs Group B)*
Complete straightening, *n* (%)	31 (91.2)	34 (89.5)	0.808	36 (90.0)	29 (90.6)	0.929
Occurrence of penile shortening, *n* (%)	26 (76.5)	30 (78.9)	0.801	24 (60.0)	32 (100.0)	<0.001
Penile shortening after surgery (cm), mean±s.d.	−1.1±0.8	−1.1±0.6	0.835	−0.7±0.7	−1.6±0.4	<0.001
Occurrence of penile shortening <1.0, *n* (%)	5 (14.7)	3 (7.9)	NA	8 (20.0)	0 (0)	NA
Occurrence of penile shortening of 1.0–2.0, *n* (%)	18 (52.9)	25 (65.8)	NA	15 (37.5)	28 (87.5)	NA
Occurrence of penile shortening >2.0, *n* (%)	3 (8.8)	2 (5.3)	NA	1 (2.5)	4 (12.5)	NA
Postoperative curvature recurrence, *n* (%)	0 (0)	0 (0)	NA	0 (0)	0 (0)	NA
Preoperative ED patients, *n* (%)	14 (41.2)	17 (44.7)	0.761	17 (42.5)	14 (43.8)	0.915
Preoperative IIEF-EF score in ED patients, mean±s.d.	19.9±3.3	19.1±1.9	0.366	20.0±2.7	18.8±2.5	0.204
Postoperative IIEF-EF score in ED patients, mean±s.d.	18.4±6.0	19.1±1.9	0.650	20.0±2.9	19.0±2.8	0.339
Preoperative IIEF-EF score in all patients, mean±s.d.	24.5±4.5	23.2±4.0	0.174	24.1±4.1	23.4±4.5	0.522
Postoperative IIEF-EF score in all patients, mean±s.d.	24.6±4.5	23.4±4.2	0.273	24.2±4.2	23.7±4.7	0.641
Penile pain during intercourse, *n* (%)	2 (5.9)	2 (5.3)	0.909	2 (5.0)	2 (6.3)	0.818
Decreased sensitivity in the penis, *n* (%)	2 (5.9)	2 (5.3)	0.909	2 (5.0)	2 (6.3)	0.818
Discomfort because of suture knots, *n* (%)	0 (0)	0 (0)	NA	0 (0)	0 (0)	NA
Dissatisfied with waiting time for surgery, *n* (%)	29 (85.3)	3 (7.9)	<0.001	17 (42.5)	15 (46.9)	0.710
Overall satisfaction, *n* (%)	31 (91.2)	37 (97.4)	0.252	39 (97.5)	29 (90.6)	0.206
Willingness to recommend surgery, *n* (%)	31 (91.2)	37 (97.4)	0.252	39 (97.5)	29 (90.6)	0.206

Group A: patients with curvature of ≤60° without complex deformities; Group B: patients with curvature of >60° without complex deformities; Group 1: patients with stable Peyronie's disease for at least 3–6 months; Group 2: patients without penile pain on erection and no further progression of the deformity even though the duration of stabilization of the deformity was <3 months. ED: erectile dysfunction; IIEF-EF: International Index of Erectile Function–Erectile Function domain; NA: not available; s.d.: standard deviation

using an endoscopic carpal tunnel scalpel described by Bella *et al*.[21] attained promising results in the correction of curvature. However, this technique also shows an incidence of penile shortening as high as 85%.[21] Furthermore, this technique may have a risk of damaging the cavernous tissues because it requires an incision of the tunica albuginea and disruption of the plaque intracorporeally. Therefore, this technique may be more suitable during the inflatable penile prosthesis implantation process for PD patients with severe curvature and ED.[22,23]

Due to the advantages and disadvantages of such surgical procedures, there are difficulties in choosing a suitable type of surgical technique for some patients who have adequate penile length, curvature >60° and decreased erection quality. A previous study reported that correction of 132 cases of congenital and acquired penile curvature using 16- or 24-dot plication procedures yielded excellent durable results.[13] In that study, the angle of penile curvature ranged from 30° to 120°, with an average curvature of approximately 64°. After surgery, severe curvature recurrence occurred in only 4 cases (3%), and only 1 patient underwent secondary procedures for recurrence of curvature.[13]

Based on the clinical characteristics of some patients and the achievements of previous studies in the correction of severe penile curvature, 16- or 24-dot plication procedures were performed in our clinical practice for those patients with special conditions. As a result, there was no significant difference in complete penile straightening between patients with a curvature of >60° and patients with a curvature of ≤60°. Although more patients with a curvature of >60° felt that there was penile shortening after surgery, there were no significant differences, and they did not express any dissatisfaction about this. In addition, postoperative curvature recurrence did not occur in these patients. These results indicate that 16- or 24-dot plication procedures can also be considered for the stable phase of PD patients with severe penile curvature if they have adequate penile length.

If the disease is not stable, progressive penile curvature may result in postoperative recurrence. Although the chronic phase is considered to be a period of the absence of penile pain and unchanging curvature or plaque size, surgery should be considered after the deformity is stable for at least 3 months (preferably, 6 months).[18,24–26] In our clinical practice, we found that some patients had no surgical requirements after waiting at least 3–6 months until the deformity is stable. The reasons were their older age, reduced sexual desire, poor physical conditions, and other factors. Interestingly, we also found that the penile curvature in sexually active patients had already tended to be stable; however, the deformity was further aggravated, or the new onset of palpable plaques and subsequent penile pain occurred within 3–6 months of waiting for complete stability. In the present study, no postoperative curvature recurrence was observed in patients who already had no penile pain on erection and no longer exhibited progressive deformity, even though the duration of stabilization of the deformity was less than 3 months.

PD is known as an acquired disease of the tunica albuginea. Repetitive buckling forces (including unrecognized penile trauma) may induce mechanical stresses upon the tunica albuginea and incite a latent fibrous response that can lead to plaque formation.[27] Therefore, we considered that under conditions of penile deformity, especially in cases of curvature, buckling forces may aggravate penile trauma during sexual intercourse, resulting in delayed stabilization or further aggravation of the penile deformity. In addition, PD mainly occurs in middle-aged and elderly men over 45 years of age. The sexual desire of most men in this age group is already relatively low. During the waiting period for surgery, they may experience the new onset of palpable plaques, poor physical condition, or other situations, which will further extend the waiting time for surgery. Over time, some patients give up on the prospect of surgery and eventually lose the opportunity to restore their ability to have sexual intercourse. In the present study, there were no significant differences in postoperative IIEF-EF, pain during erections, sensitivity in the penis, or suture knots on the penis in all patients, whether they were grouped according to curvature severity or duration of stabilization. However, most of the patients in Group 1 were dissatisfied with the long waiting time for surgery. Based on the fundamental mechanism of PD and the findings in our clinical practice, we believe it is necessary to reconsider the definition of the stability period and the decision regarding operative timing. We believe that early surgical treatment after a detailed and frank preoperative consultation is beneficial for patients with a strong desire for surgical treatment when they already have reached a state of no penile pain on erection and no longer exhibit progressive deformity.

This study had several important limitations, such as its retrospective design, which includes inherent bias. In addition, only the IIEF-EF questionnaire was used for evaluating erectile function in the present study. The IIEF-EF questionnaire as a subjective tool may be affected by certain preoperative and postoperative factors. Therefore, objective evaluation methods such as the nocturnal penile tumescence test, video-provoked erectile response measurements, or penile Doppler ultrasound may provide more data related to erectile function. Moreover, postoperative management is not sufficient. Penile traction therapy has been shown to reduce postoperative loss of penile length or to enhance penile length gain with both grafting and plication procedures.[25] Since the therapeutic effect of penile traction therapy requires at least 2–8 h sessions daily for 3 months,[24] it is difficult for patients to adhere to it. Therefore, the patients were not prescribed mandatory traction therapy in the present study. Finally, because the sample size included in this study was relatively small, it is difficult to draw decisive conclusions, and consequently, multicenter, large sample, long-term, prospective, and randomized studies are needed in future.

CONCLUSIONS

The present study suggests that the 16- or 24-dot plication procedures are an effective option in the surgical management of PD patients with severe penile curvature, adequate penile length, and decreased erectile rigidity but sufficient erection quality for penetration under pharmacotherapy. In addition, early surgical treatment after detailed and frank preoperative consultations when patients already have no penile pain on erection and no further progressive of the deformity seems to be helpful to prevent further aggravation of the penile curvature or the new onset of palpable plaques, which is beneficial to patients with a strong desire for surgical treatment.

AUTHOR CONTRIBUTIONS

WJL, JWB, MKX, and ZW designed the study, collected the clinical data, performed the statistical analyses, and drafted the manuscript. WJL, JHG, DCZ, MKX, and ZW participated in the operation. WJL, JWB, JHG, DCZ, MKX, and ZW revised the manuscript. All authors read and approved the final manuscript.

COMPETING INTERESTS

All authors declared no competing interests.

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