DOI: 10.4081/aiua.2022.1.87

ORIGINAL PAPER

The use of a polyglycolic acid polymer graft in Peyronie's disease - preliminary outcomes

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Summary ***Objective: Plaque incision and grafting is indicated for patients with Peyronie's Disease [PD] and severe curvature, complex deformities or for patients with significant penile shortening. To date, no graft studied has been considered ideal. The aim of this study is to conduct a descriptive analysis about functional results with the use of a bioabsorbable graft for PD treatment.***

Materials and methods: A single-center, retrospective evaluation of a cohort of patients who were treated by plaque incision and grafting with a polyglycolic acid polymer graft (Gore® Bio-A®) between 2018 and 2021 was conducted. Correction of penile curvature was the main outcome. Loss of penile sensitivity, de novo erectile dysfunction and any other adverse event were the secondary endpoints.

Results: 14 patients were included in this study (mean age 59.5 ± 7.2 years). The median follow-up time was 12 months (range 3-12). The curvature correction rate was 78.5%. Glans hypoesthesia was present in one of 14 patients (7.1%) and refractory erectile dysfunction was reported in 64.2%. None of the patients presented any major adverse event based on Clavien-Dindo classification.

Conclusions: Curvature correction and changes in penile sensitivity rates were similar to those found in the literature. No major surgical complications, such as graft rejection, infection, and extrusion, occurred in this sample. Although a population with a higher prevalence of erectile dysfunction was included in this sample, higher rates of refractory erectile dysfunction were observed and these findings should be confirmed in further studies.

KEY WORDS: *Peyronie's disease; Penile induration; Penile curvature; Erectile dysfunction; Bioabsorbable implants; Polyglycolic acid.*

Submitted 21 December 2021; Accepted 18 January 2022

INTRODUCTION

Peyronie's Disease (PD) is characterized by a disorder of the connective tissue of the penis that affects the tunica albuginea, which can lead to local pain and tortuosity. Although the etiology is unknown, the most accepted hypothesis is repetitive microvascular trauma, leading to inflammation, fibrinogenesis and excessive collagen deposition on the tunica albuginea, facilitated by risk factors such as hypertension, diabetes, dyslipidemias, smoking and alcoholism (1-3).

Clinically, PD has two distinct phases: inflammatory (acute), when there is pain and the onset and progression of penile deformity; and fibrotic (chronic), when there is stabilization of the penile curvature, cessation of the pain, and possibly the formation of a well-defined plaque on the corpora cavernosa (4).

Surgical treatment for PD is reserved for patients who are in the second stage of the disease, with stable tortuosity for at least three to six months. There are basically two types of procedures for correction of penile curvature: tunical shortening and tunical lengthening techniques (5). The latter consists in plaque incision/excision and grafting, following this indication: patients without refractory *erectile dysfunction* (ED), with curvatures greater than sixty degrees, complex deformities or in patients with smaller curvatures but significant penile shortening for plication procedures (6, 7).

The ideal graft should be traction resistant, easy to suture and manipulate, flexible, readily available, cost-effective and with minimal associated morbidity. So far, no material studied has met all these criteria. Several studies have analyzed the use of autografts, allografts and xenografts. Synthetic grafts are historically not recommended, due to the increased risk of infection, allergic reactions and material rejection. The use of bioabsorbable synthetic grafts, on the other hand, has been little studied to date (8-11).

The aim of this study was to perform a descriptive analysis about functional results with the use of a bioabsorbable graft in the setting of Peyronie's disease surgical treatment.

MATERIALS AND METHODS

The present study protocol was reviewed and approved by the *Institutional Review Board of Hospital Governador Celso Ramos* (approval No. 47537021.0.0000.5360). Informed consent was submitted by all subjects when they were enrolled. Psychological counseling was offered to all patients before the surgery, although it was not considered obligatory. A single-center, retrospective cohort study of patients undergoing treatment for Peyronie's disease using a bioabsorbable graft between 2018 and 2021 was conducted. The graft used was the Gore® Bio-A® (*W.L. Gore & Associates, Inc. Flagstaff, Arizona, US*), composed of a network of synthetic polymers (67% of polyg-

No conflict of interest declared.

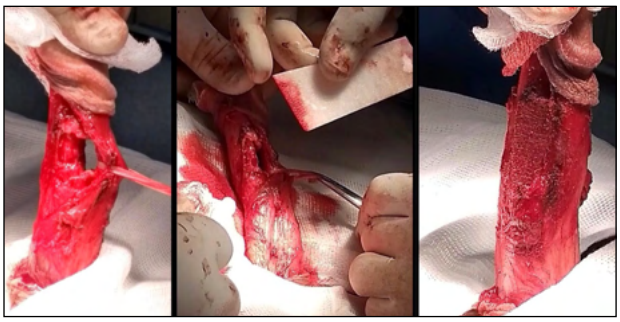
lycolic acid and 33% trimethylene carbonate) which are gradually absorbed by the body and registered by ANVISA for use in humans as a soft tissue substitute.

The inclusion criteria for this study were all patients undergoing treatment for PD using the Bio-A® graft between 2018 and 2021 at *Hospital Governador Celso Ramos, Florianópolis, State of Santa Catarina, Brazil*. No exclusion criteria were applied.

Data was obtained exclusively from medical charts retrospective review, and patients' identity was kept confidential. Curvature correction, was the primary endpoint, characterized by the absence of residual curvature greater than 15 degrees. All patients underwent interview and physical examination during the routine postoperative follow-up visits. Patients who reported residual curvature underwent artificial erection in the office to confirm this finding. Secondary endpoints were penile sensory change, postoperative ED and surgical complications (based on Clavien-Dindo classification). The secondary outcomes were also assessed through anamnesis and physical examination performed during routine follow-up visits and described in the patients' medical chats. Refractory ED, identified pre- or postoperatively, was characterized as the self-reported inability to develop or maintain an erection despite the use of *phosphodiesterase type 5 inhibitors* (PDE5i). Patients were informed about the risks of erectile function worsening, and the possibility of penile prosthesis implantation in a second-stage surgery.

Surgical technique was similar in all cases. Under general anesthesia, a subcoronal incision was made and the penis was degloved. An artificial erection was performed at this point and the curvature was identified. In case of dorsal curvatures, the neurovascular bundle was carefully dissected from the corpora cavernosa. In case of ventral curvature, the urethra was dissected from the corpora cavernosa. Then again, an artificial erection was performed to identify the point of greatest curvature of the plaque. An H-incision was then made into the plaque and the defect created was measured to determine the size of the graft. Gore® Bio-A® graft was then placed and fixed over the defect with running sutures of its margins with 3-0 Vicryl (Figure 1). The penis was then covered and a circumcision was performed. The average surgery time was 137.2 (± 19.5 minutes). All patients were discharged after 24 hours of the surgery and were prescribed 5 mg of tadalafil to use once a day. Statistical analyses were performed using IBM® SPSS® Statistics, version 28.0.0.0. Variables and results related to the primary and secondary outcomes were presented descriptively for each patient. Continuous variables were described in the comparative analysis as the median and respective interquartile range. Categorical variables were described as percentages of the total number of patients.

Figure 1.
Gore® Bio-A® graft being placed and secured with running sutures. An H-shaped incision was performed at the point of maximum curvature, after degloving the penis. The defect is measured and the graft is secured with Vicryl 3.0 stitches.



Results

Patient characteristics, risk factors and preoperative findings

A total of 14 patients were included in this study. The mean age was 59.5 years (± 7.2).Overall, 42.8% (6/14) of patients had hypertension, 21.4% (3/14) diabetes, 42.8%

Table 1.
Patients characteristics and postoperative outcomes. This table describes important preoperative findings for each patient, as well as the main postoperative outcomes.

Patient number	Age	Curvature type	Curvature degree	Preoperative ED	Curvature correction	Penile sensory change	Postoperative ED	Surgical complications (Clavien-Dindo grade)
1	64	Uniplanar [a]	65	Yes	Yes	No	Yes	Yes (I)
2	64	Uniplanar [a]	80	No	Yes	No	No	No
3	67	Biplanar (with ventral component)	80	Yes	Yes	No	Yes	No
4	47	Biplanar [b]	50	No	Yes	No	Yes	No
5	64	Biplanar [b]	45	No	Yes	No	No	Yes (I)
6	55	Uniplanar [a]	60	Yes	Yes	No	Yes [d]	No
7	51	Complex [c]	90	No	No	No	No	No
8	61	Biplanar (with ventral component)	80	Yes	Yes	No	Yes [d]	No
9	45	Biplanar [b]	90	No	Yes	No	Yes	Yes (I)
10	58	Uniplanar [a]	50	No	No	No	No	No
11	67	Biplanar [b]	45	No	Yes	Yes	No	No
12	65	Uniplanar [a]	60	No	Yes	No	Yes	No
13	61	Biplanar [b]	50	Yes	No	Yes	Yes [d]	Yes (I)
14	64	Biplanar [b]	60	No	Yes	No	No	No

ED: erectile dysfunction.
a. Uniplanar includes dorsal and lateral and excludes ventral curvatures.
b. Biplanar includes dorso-lateral curvatures and excludes biplanar with ventral component curvatures.
c. Complex curvatures includes hour-glass and hinge deformities.
d. Patients that underwent malleable penile prosthesis implantationn.

(6/14) smoking habits and 21.4% (3/14) dyslipidemia. Regarding the presence of preoperative ED, 35.7% of patients (5/14) reported impaired erections even with PDE5i before the surgery. On the other hand, 64.3% reported satisfactory erections. The median curvature degree was 60° (range 45-90°). The median time of plaque stability was 36 months (range 12-72). Regarding the curvature type, 35.7% (5/14) had uniplanar curvatures (except ventral); 50% (7/14) had biplanar (except ventral) or complex (hourglass or hinge) deformities, and 14.2% (2/14) had curvatures with some ventral component.

Surgical outcomes

The median follow-up time was 12 months (range 3-12). In terms of curvature correction, 3 of the 14 patients (21.4%) reported residual curvature greater than 15°, that was confirmed after performing artificial erection in the office. The curvature correction rate, therefore, was 78.5% (11/14).

Regarding the secondary endpoints, 1 of 14 patients (7.1%) reported glans hypoesthesia. Nine of 14 patients (64.2%) reported refractory ED postoperatively (using 5 mg of tadalafil). Three of the these patients decided to underwent a malleable penile prosthesis implantation after 12 months of the first surgery. Excluding sensory changes and erection impairment, four patients (24.5%) presented minor surgical complications (penile pain and swelling) classified as Clavien-Dindo grade I. None of the patients (0/14) presented major surgical complications, Clavien-Dindo grade ≥ II. Table 1 describes the characteristics and postoperative outcomes for each patient.

Discussion

This study described our initial experience with the Gore® Bio-A® graft, which, to our knowledge, has never been studied for Peyronie's disease management before. Residual curvature after surgery was a concern, given the physiology of graft integration, which is based on complete replacement of the synthetic material by native scar tissue, which could again result in fibrosis and curvature (12, 13). What was obtained, in fact, was a similar rate to that found in other studies, even after 6 months, which is the time described by the manufacturer for complete absorption of the material (13). The *European Association of Urology* (EAU) 2021 guidelines describe curvature correction average rates (involving different non-comparable studies), or success rates, for porcine *intestinal submucosa* (SIS) grafts of 83.9% (range 54 -91), 87.4% for bovine pericardium (range 76.5-100) and 81.2% for dermis (range 60-100) (14). Table 2 describes curvature correction rates with different patches.

Regarding decreased glans sensitivity, we obtained lower rates compared to those described in other series, such as *Chung et al.* (15), with 13% impaired sensitivity after dermis graft, and as *Horstmann et al.* (16), with 16%, after using TachoSil®, but slightly higher compared to the series by *Sansalone et al.* (17), with 3%, after bovine pericardium. Table 3 describes penile sensory changes with different patches. This outcome, however, seems to be more related to the technique used for dissection of the neurovascular bundle, rather than to the type of material used (8). Furthermore, a recent study by *Terrier JE et al.* showed that penile sensory changes tends to decrease in frequency and severity with time, with only rare cases occurring after 12 months (18).

In terms of postoperative (de novo) erectile dysfunction, the EAU 2021 guidelines describe average rates of 21.9% (range 7-54) for porcine intestinal submucosal grafts (SIS), 26.5% (range 0-50) for bovine pericardium, and 20.5% (range 7-67) for autologous dermis (14). Other series, as *Fabiani et al.* (19, 20), report even lower rates, with 5.8% and 7.2% of ED after buccal mucosa graft. In our cohort, we found higher rates of refractory erectile dysfunction (Table 4).

However, a possible selection bias must be considered, as 35.7% of patients (5/14) reported impaired erectile function prior to the surgical procedure. In this study, all patients were enrolled to undergo curvature correction surgery –

Table 2.

Curvature correction with different patches.
This table describes the curvature correction rates, expressed as weighted average, with grafts that are frequently used worldwide, along with the rate found with Gore®Bio-A®.

Author, year and graft used	EAU 2021 average rates for porcine intestinal submucosa (SIS)[a]	EAU 2021 average rates for bovine pericardium[a]	EAU 2021 average rates for Dermis[a]	*Zandoná et al.* (2021) – Gore® Bio-A® patch
Curvature/deformity correction	83.9% (54-91)	87.4% (76.5-100)	81.2% (61-100)	78.5%

a. Data are expressed as weighted average and range in parenthesis (from different non-comparable studies).

Table 3.

Penile sensory changes with different patches.
This table describes the rates of penile numbness, or penile hypoesthesia with grafts that are frequently used worldwide, along with the rate found with Gore®Bio-A®.

Author, year and graft used	*Chung et al.* (2011) - dermis graft	*Horstmann et al.* (2011) - Tachosil®	*Sansalone et al.* (2011) - bovine pericardium	*Zandoná et al.* (2021) - Gore® Bio-A® patch
Penile Hypoesthesia	13%	16%	3%	7.1%

a. Data are expressed as weighted average and range in parenthesis (from different non-comparable studies).

Table 4.

De novo erectile dysfunction with different patches.
This table describes the rates of postoperative erectile function worsening with different grafts, that are frequently used worldwide, along with the rate found with Gore®Bio-A®.

Author, year and graft used	EAU 2021 average rates for porcine intestinal submucosa (SIS)[a]	EAU 2021 average rates for bovine pericardium[a]	*Fabiani et al.* (2016/2021) buccal mucosa patch	*Zandoná et al.* (2021) – Gore® Bio-A® patch
De novo erectile dysfunction	21.9% (7-54)	26.5% (0-50)	5.8%/ 7.2%	64.2%

a. Data are expressed as weighted average and range in parenthesis (from different non-comparable studies).

plaque incision and grafting – as a first-stage procedure. Although penile prosthesis implantation can be offered as a second procedure, it's possible to perform both surgeries at the same time, even with the use of grafts, for patients at high-risk of developing refractory ED (14).

The absence of major surgical complications, especially graft rejection, infection or extrusion, seems to be a characteristic of bioabsorbable materials, as opposed to synthetic grafts. We know that the incorporation process, comprising graft cell infiltration, neovascularization, and collagen deposition, which occurs in bioabsorbable materials, seems to lead to a lower risk of infection and erosion, compared to encapsulation, which occurs with the use of non-absorbable materials (21, 22).

This study has some limitations, and therefore it should be interpreted with caution. The "self-reported" assessment of patients regarding erectile dysfunction, residual curvature and sensitivity change parameters, although described and recognized in the literature, is based on a subjective parameter and, therefore, reduces the statistical value and the possibility of extrapolating the results (23). The loss of follow-up of patients in the expected returns after surgery, largely due to the COVID-19 pandemic and cancellation of elective appointments, also had a negative impact on the results of this sample.

Conclusions

In this study, it was possible to demonstrate our initial experience with the use of Gore® Bio-A® graft. The rates of curvature correction and change in glans sensitivity were similar to those found in the literature. The rates of major complications related to the graft, as rejection, infection, and extrusion, were negligible in this sample. Although a population with a higher prevalence of erectile dysfunction was included in this sample, higher rates of refractory erectile dysfunction were observed and these findings should be confirmed in further studies. We believe that this study brings the perspective that similar bioabsorbable grafts can be used as an alternative in PD's treatment, although prospective studies with a larger population and longer follow-up are needed to validate such findings.

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