

Penile prosthesis surgery in patients with corporal fibrosis: state of the art

Chirurgia protesica peniena in pazienti con fibrosi dei corpi cavernosi: stato dell'arte

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Summary

We tried to review latest techniques and their results in the surgical treatment of erectile dysfunction. Penile prosthesis has become one of the most accepted treatment options in patients with corporal fibrosis and that do not respond to other medical therapies (injections). When penile fibrosis is present, this surgery becomes a real surgical challenge even for a skillful surgeon. Over the years multiple surgical approaches have been suggested to facilitate implantation in this difficult situation. Traditional approaches include the resection of scar tissue, performing extensive corporotomies and the eventually use of grafts to cover the corporal gap. Outcomes can be improved combining the use of techniques for scar incision (extensive wide excision, multiple incisions minimizing excision, corporal counter incisions, corporal excavation technique or Shaeer's technique) and cavernotomes and downsized Prosthesis. Surgical strategies like upsizing prosthesis, suspensory ligament release or scrotoplasty must be kept in mind to utilize in this special scenario. Finally, regarding patients satisfaction further studies are needed to improve their overall outcomes.

Riassunto

Abbiamo analizzato le tecniche più recenti ed i rispettivi risultati nel trattamento chirurgico della disfunzione erettile. La protesi peniena è diventata una delle opzioni più accettate per il trattamento dei pazienti con fibrosi dei corpi cavernosi, non responsivi ad altre terapie mediche (quali iniezioni intracavernose di sostanze vasoattive). La chirurgia protesica in presenza di fibrosi peniena costituisce una vera sfida anche per un chirurgo esperto. Nel corso degli anni sono stati proposti svariati approcci chirurgici per l'esecuzione dell'impianto anche in questa difficile situazione. Le tecniche tradizionali prevedono la resezione del tessuto fibrotico mediante ampia corporotomia, con possibile impiego di graft a coprire il difetto di albuginea. I risultati possono essere migliorati combinando l'uso di tecniche di incisione della cicatrice (ampia ed estesa escissione, plurime incisioni con minimizzazione dell'escissione, incisioni albuginee contrapposte, tecnica escavativa o tecnica di Shaeer) con sia cavernotomi dedicati che protesi a sezione ridotta. In quest'ambito vanno considerate anche strategie chirurgiche quali protesi sovradimensionate, incisione del legamento sospenditore o scrotoplastiche. Infine, per quanto riguarda la soddisfazione dei pazienti, sono necessari ulteriori studi tesi a migliorarne i risultati.

Introduction

In recent years important advances have been made in the diagnosis and treatment of erectile dysfunction. Penile prosthesis has become one of the most accepted treatment options in patients who do not respond to conservative medical therapies (oral or intracavernous injections). When penile fibrosis is present, this surgery becomes a real surgical challenge even for a skillful surgeon.

There are a variety of causes of corporal fibrosis:

- the worst and most severe fibrosis occurs after removal of an infected implant. In these patients the fibrosis causes significant penile shortening^{1,2};
- priapism³⁻⁵;
- penile trauma⁶;
- Peyronie's disease^{4,7};
- diabetes mellitus⁸.

Penile fibrosis after priapism and infection is usually

extensive and dense. In the presence of fibrosis in the non-implant patient, venous leak will be present and will preclude men having spontaneous erections and will allow only a minority to respond to PDE5i^{9 10}. Surgery is the best option for these patients.

When secondary implant surgery is indicated, the surgeon needs to be very cautious in counseling patients and partners. The penile shortening that usually occurs even when the implant is successful, may be an important issue to the patient. Knoll et al. suggest that no promises, guarantees or unrealistic expectations should be given to them. An implant failure should not be considered a surgeon's error¹¹.

Over the years multiple surgical approaches have been suggested to facilitate implantation in this difficult situation. Traditional approaches include the resection of scar tissue, performing extensive corporotomies and the eventually use of grafts to cover the corporal gap. In 1995, Wilson et al. suggested that the combination of an adequate incision, the use of cavernotomes (Figs. 1, 2) and a downsized implant could be another possible option. Recently some groups have described new techniques to achieve better scar resection^{12 13}. This manuscript is a review of these techniques and their results.

Material and methods

We performed a systematic search in the following databases: PubMed; EMBASE; Cochrane; SCOPUS; Science Citation Index without any date limits for the terms: "penile prosthesis"; "penile fibrosis"; "impotence"; "fibrosis"; "cavernotomes"; "downsized prosthesis cylinders"; "patient satisfaction"; penile

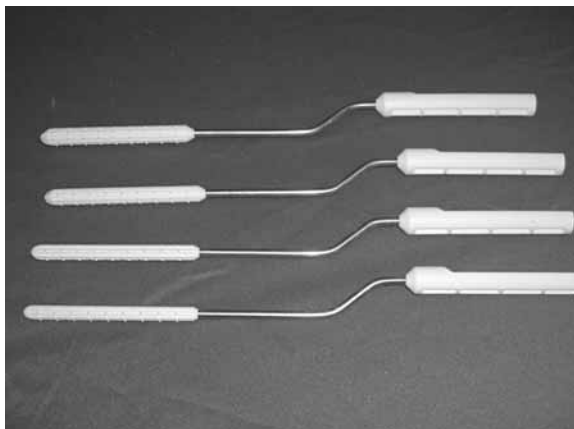


Fig. 1. Carrión-Rosello Cavernotomes. *Dilatatori di Carrión-Rosello*.

graft"; "vascular graft". We analyzed the most representative series and description of techniques.

Different surgical techniques and results

SCAR EXCISION

Implantation of a penile prosthesis into scarred corpora almost always presents a surgical challenge. Conventionally, penile fibrosis has been treated surgically by extensive excision of scar tissue. We describe several available techniques:

Extensive wide excision of the scar tissue

This should be considered the classic approach. Many Authors have reported their experience with this technique^{11 14-17}.

The technique consists of dissecting the fibrotic corporal tissue carefully from the surrounding relatively normal tunica albuginea by extending the penoscrotal incision and the corporotomy distally as far as is feasible. The early complication rate is about 30% and the incidence of later complications is 50-65%. These include infection (18-30%), penile angulation (6%), pain (6%), reoperation (30-50%) and malfunction of the device (6-12%)^{11 14-18}.

Wilson et al. reported their experience from 1987-91 in 20 cases of salvage penile prosthesis implantation via standard infrapubic or penoscrotal approach us-



Fig. 2. Uramix, or "Mooreville", Cavernotomes. *Dilatatori Uramix, o "Mooreville"*.

ing extensive corporotomies, fibrotic tissue resection and frequent Gore-Tex grafting. The one year prosthesis survival was only 50%; complications were urethral laceration (3 cases), inadequate proximal dilation (4 cases) and prosthetic infection (3 cases)¹⁹.

Multiple incisions and minimal scar tissue excision

This was first published in 1996 and then in 1999 by Dhabuwala et al.^{10 20}.

The Author performs a minimal excision (small corporotomy 2 cm) (Fig. 3) of scar tissue followed by dilation of the corpus cavernosum under vision (starting with blunt-tipped Metzenbaum scissors and then 7 or 11/gauge Hegar dilators and/or Dilamezinsert) and the insertion of the penile implant. If dilation of the distal corpora was difficult, an additional subcoronal incision is made and the distal fibrotic area dilatated. When was difficult to close the defect in the tunica albuginea after insertion of the prosthesis, they used a PTFE graft. They did not use any kind of cavertomes and they were able to achieve successful dilation and implantation. They reported their experience in 34 patients, 2.9% had intraoperative complications and another 2.9% post-operative complications. None of the patients developed infection after surgery. They have not reported data about penile length or patient/partner satisfaction.

Corporal counter incisions

Published by Ghanem et al. in 2000²¹, the technique has several steps:

- step 1: a subtunical tract is created and dilated using Metzenbaum scissors followed by small caliber Hegar dilators and finally the dilamez insert instrument;
- step 2: a subcoronal incision is made, and the corpora is incised in the manner mentioned above.



Fig. 3. Small corporotomy (less than 2 cm). *Corporotomia ridotta (inferiore a 2 cm)*.

Lateral subtunical tracts are then established using scissors and fine Hegars dilator but this time from distal to proximal.

The technique only allows implanting malleable rods and might not be suitable for implanting inflatable cylinders based on the space limitations. The Authors have reported that sometimes the closure of the corporotomy is difficult but they never use grafts. If the defect is small (less than 4 cm) it is covered with Buck fascia²¹.

After treating seventeen patients, they report only one intra-operative complication (crural perforation) and no infection or other post-operative complications.

Corporal excavation

The corporeal excavation technique was briefly described by Fishman in 1989, without reported results²². Then, it was well reported by Montague and Angermeier in 2006¹².

The technique begins with a long corporotomy. Metzenbaum scissors are used to establish a plane of dissection between the undersurface of the tunica and the fibrotic area. The fibrotic core is transected distally proximal to the glans and proximally into the crural area. This long segment of scar is completely excised. The Authors suggest placing a down-sized inflatable prosthesis (CXM cylinders or Titan Narrow Base).

The Authors reported on a total of nine patients with a mean follow-up of 44 months. The only intra- or post-operative complications reported was prosthesis replacement due to cylinder failure after 46 months of use. No data about penile length or satisfaction were provided.

Shaer's technique

Recently, this unique and innovative technique was described by Shaer et al.¹³. They propose a transcorporeal resection using Optical Corporotomy in order to excavate the fibrotic tissue under direct vision. The instruments and technique are the same as for endoscopic urethrotomy and transurethral resection. An optical corporotomy is performed where the corpora are incised¹³ and after an wide enough channel is created, they use a resectoscope (with loop) to excise all the fibrotic tissue under vision. They report that the introduction of the instrument inside the corpora is not difficult. A 26-French sheath (8.6 mm in diameter) can be easily introduced through a 1 cm corporotomy.

After six cases, no intraoperative complications or infection were recorded. The patients and partner sat-

isfaction based on the length (2 cm average of increase) and girth (increased of 40%) were high. Average operative time was 90 minutes. The post-operative pain was tolerable.

Grafting (materials)

Many authors using the technique of fibrotic excision often utilize a graft because closure of the corpora is difficult. Several strategies and graft materials have been proposed. One strategy suggests leaving the defect open and closing the overlying fascia and skin over the implant. This technique has several problems, including a greater risk of infection, migration, deformity during inflation, malfunction or erosion^{23,24}. Grafts have become popular for this reason. There are several grafts reported: heterologous synthetic (Gore-TexTM^{11,25}, Dacron, Prolene), biological (human cadaveric fascia, porcine tissue (dermis, pericardium^{26,27} and small intestinal submucosa^{28,29}). Harvested autologous grafts represent another interesting option, including rectus fascia, fascia lata, dermis, saphenous vein, temporalis fascia and tunica albuginea³⁰⁻³².

Synthetic grafts differ from native tunica in tensile strength and expandability³⁰. These characteristics limit the full expansion potential of the cylinders^{33,34}. The advantages of autologous materials include being non-immunogenic and having decreased likelihood of becoming infected²⁷.

The major adverse factor in using vascular graft material with a penile implant is the risk of infection. Knoll et al. reported a 30% infection rate in 57 patients with cavernous fibrosis who received prosthesis with polutetrafluoroethylene (PTFE) grafting and a 5% infection rate in a similar group of 20 patients who received downsized inflatable cylinders to obviate the need of grafting³⁵. Similarly, Jordan et al. reported 3 infections in 7 patients with PTFE grafts on implants for phallic reconstructions and the implants were removed in all 3 patients³⁶. Conversely, no infections were reported in other series of grafting of Mulcahy³⁷, Levine³⁸, Seftel³⁹ and Herschorn²⁵.

Pathak et al. reported their experience using rectus fascia grafts for corporeal reconstruction during penile implantation. They performed the technique in a total of 15 patients with severe fibrosis of the corpora or tunica that underwent penile prosthesis surgery. After a mean follow-up of 18 months all the implants were functioning correctly with no evidence of com-

plications including infection³⁰. The disadvantage of this approach is that there is a need for another incision to harvest the autologous graft.

Palese et al. described the technique using pericardium allograft (Tutoplast®) in four patients. No complications were reported.

Use of cavernotomes

In 1995 Wilson et al. introduced the concept of drilling into a fibro cavernous body instead of resecting the scar tissue. For this purpose the use of cavernotomes is indispensable. Basically there are two available. The first one is the *Carrion-Rosello* cavernotome (Fig. 1)⁴⁰. The original one was made from stainless steel but now a single use polycarbonate version (sized from 9 mm to 12 mm) is in the market.

Technique: the instrument works like a wood rasp with teeth projecting from sides of the device. The configuration as a bayonet allows the surgeon to advance and cut the fibrosis inside the corpora. Consecutive movements of pronation and supination of the hand facilitate a tunnel creation (Figs. 4, 5). The teeth allow the cavernotome to “walk” forward through the fibrosis and seem to protect against a sudden forward uncontrolled movement that can cause an inadvertent urethral laceration¹.

Wilson et al. reported in 1995 their results with 32 salvage inflatable penile prosthesis using this technique. Using a transverse incision (Fig. 6), cavernotomes and downsized prosthesis (AMS 700 CXM), the one-year prosthesis survival increased to 87% and complications were significantly reduced with just 2 cases of inadequate proximal dilation and

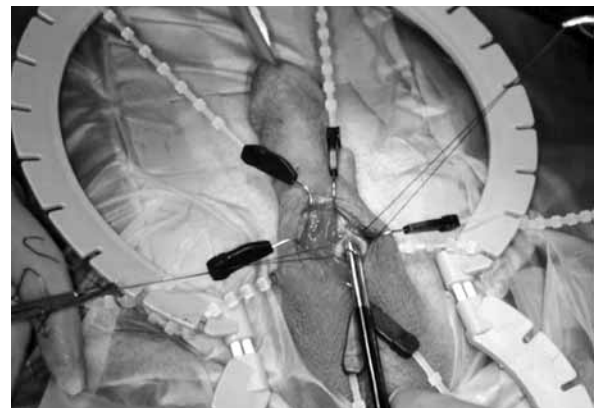


Fig. 4. Movements in order to drill the corpora. *Manovra di escavazione del corpo cavernoso.*

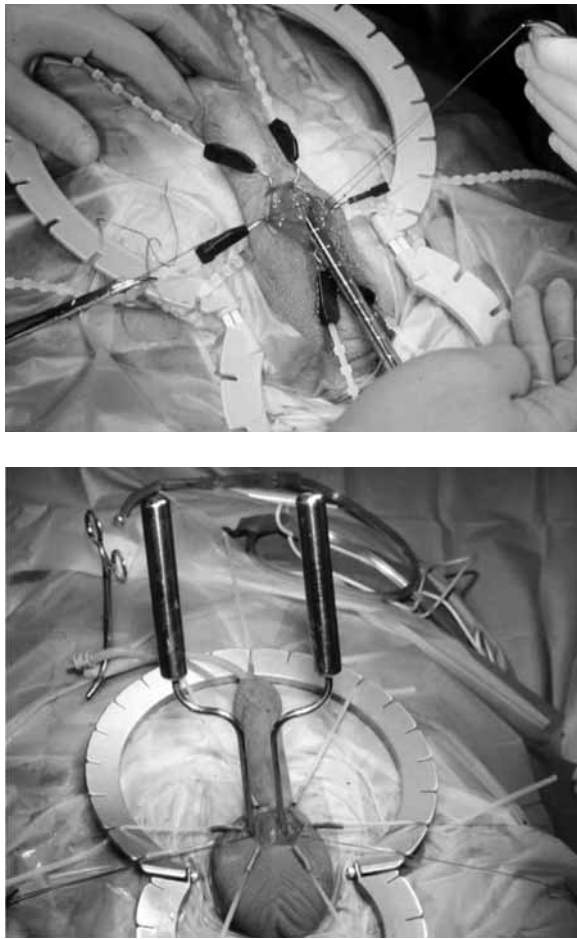


Fig. 5. Furrow insertion and dilators insertion. *Inserimento di "Furrow" e di dilatatori.*

two cases of prosthesis infection. Urethral perforation was not observed and they did not use any grafting¹⁹.

There is another type of cavernotome called "Uramix or Mooreville" cavernotome⁴¹ (Fig. 2). It comes in a set of five cavertomes made of stainless steel, sized from 6-13 mm and 23 cm in length.

Technique: the blade arises from a beveled surface that allows 1 mm shavings of tissue to be resected. Cutting can be done in a longitudinal, up and down movement, or in a "drilling" rotational movement. The design and oscillating advancement promote safe dilation without perforation⁴¹.

Both of the cavernotomes are very helpful and the final effect on the cavernous body will be similar. The thickness of the tunica is considerable and the configuration of either of the cavernotomes does not lend itself to cutting through it¹. Wilson recommends the Uramix cavertome for distal and Rosello

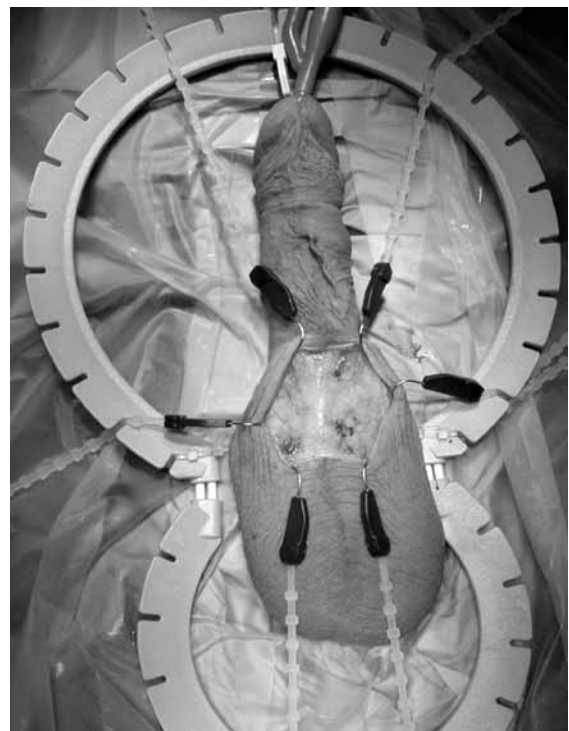
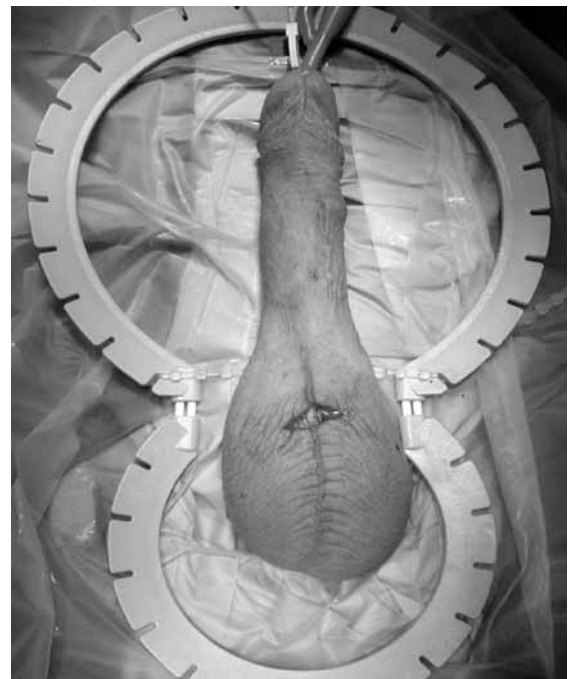


Fig. 6. Transverse incision. *Incisione trasversale.*

for proximal dilation. The Otis urethrotome can also be used for this purpose. Mulcahy reported the use of it in this fashion⁴². Initially a channel is developed inside the corpora with scissors. Once this is done, the urethrotome is used for sharply incising, keeping away from the urethra.

Use of downsized prostheses

Knoll described this concept in 1995. He proposed using a downsized inflatable prosthesis plus Gore-Tex graft when the dilation was not possible⁴³.

The use of a downsized prosthesis cylinder allowed secondary implantation since it does not require dilating a space as large as is necessary for insertion of a standard cylinder. There are two types of prosthesis devices available. The AMS CXM and the Mentor Titan NB ("Narrow Base") and both require dilation to 10 or 11 mm (11 mm is enough to pass a Furlow inserter) for proximal and distal insertion. The standard device cylinders require proximal dilation to at least 13 mm.

Wilson recommends liberal use of rear tip extenders to avoid running the input tubing along the cylinders¹. He suggested that the downsized cylinders have smaller inflatable chambers, which obviate the use of grafting material to close the corpora¹.

The cavernotomies can drill a channel through the fibrotic corpora without extending the corporotomy and avoiding the graft.

Knoll reported his experience in a total of 20 patients without a graft; they had one SST deformity and one infection requiring device removal as post-operative complications.

Erection rigidity with downsized implant is good in the majority of cases⁴³. The major complaint of these patients is the shortening in penile length after reimplantation. Typically the downsized cylinder is 4-6 cm shorter than the original implant⁴³.

Size matters: strategies to minimize length loss

Even when a surgeon considers the operation a technical success, the patient in these difficult cases is disappointed and desires the same penile length as with the original implant. Replacement of the elastic spongy erectile tissue with fibrosis manifests itself clinically by shortening of the penis⁴⁴. This contracted scar tissue leads to a shorter erection by up to 6 cm⁴⁵. Several strategies have been proposed in order to fix this problem.

UPSIZING AFTER REIMPLANTATION

Proposed in 2006 by Wilson et al., the idea is to use the downsized inflatable penile prosthesis cylinders as tissue expander in patients with corporal fibrosis. They reported a total of 37 patients with previous reimplantation into scarred bodies. In no case was it

possible to dilate to 12 mm in order to insert a standard prosthesis. Patients were advised to inflate their implants for up to 3 hours daily. After several months intracorporal stretching occurred. The objective was to replace the smaller-width cylinders with a standard cylinder. The original implants had length measurement 2-7 cm less than the corporal measurements at the time of original implantation. The final cylinder length represents a 12.4% decrease in the mean length (2.3 cm) from the original implant.

RELEASE OF THE SUSPENSORY LIGAMENT

This was first proposed by Knoll et al. in 1996 along a suprapubic Y-V flap advancement procedure and a lower abdominal tissue debulking to improve the functional length. They reported that the patients gain an additional 3.5 to 6.5 cm in functional length. All patients had a functional device after a mean follow-up of 12 months. No complications related with the procedure were recorded⁴⁶.

Recently Borges et al. reported their experience adding suspensory ligament release to the standard penile prosthesis implantation. They recommended that the ligament be incised when the device is inflated because an inflated device allows the penis to be easily pressed down. This maneuver is useful to identify the corpora structure and the neurovascular bundle, avoiding possible damage to them. In 303 procedures, the erect measurement increased an average of 1.73 cm (1.1-2.2 cm), from 10.7 cm to 12.4, after suspensory ligament incision.

SCROTOPLASTY

The cosmetic appearance can be improved by closing the transverse incision in a vertical fashion. Many of these patients have a webbed penoscrotal union caused by multiple surgeries. And removing this tissue may improve the final appearance¹⁴⁴.

Patient satisfaction after reimplantation

Patient satisfaction is a complex issue that is related to the expectations that are formulated in the preoperative period⁴⁷.

Several studies have shown that patients who undergo prosthesis implant into fibrotic corporal bodies, have significantly less device efficacy and satisfaction^{44 48}.

While the loss of penile length remains the most likely cause of diminished satisfaction with prostheses re-

implantation, it does not fully explain why the device efficacy measured by Erectile Function (EF) domain is significantly lower in this group of patients⁴⁸.

Mulcahy et al. suggested that there may be diminished penile sensitivity, as well as ejaculatory problems in patients with penile fibrosis⁴⁹. Altered sensitivity may directly impact on the EF domain and the indirect impact of ejaculatory disturbances is unknown⁴⁸.

Conclusions

The secondary implantation of a penile prosthesis in

a patient with severe corporal fibrosis remains a surgical challenge. We can improve outcomes combining the use of techniques for scar incision (Extensive Wide Excision, Multiple Incisions minimizing excision, Corporal Counter Incisions, Corporal Excavation Technique or Shaeer's Technique) and Cavernotomes and Downsized Prosthesis. We should always consider the size matter and give appropriate advices to our patients. Surgical strategies like Upsizing Prosthesis, suspensory ligament release or scrotoplasty must be kept in mind to utilize in this special scenario. Finally, regarding patients satisfaction further studies are needed to improve their overall outcomes.

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1: One of the following is not a potential cause of penile fibrosis:

- a. Priapism
- b. Hypertension
- c. Penile trauma
- d. Diabetes Mellitus

2: What is the best advantage of autologous materials using as a graft?

- a. High tensile strength
- b. Less expandability
- c. Be non-immunogenic
- d. Limit potential full expansion of cylinders

3: One of them is not a name of a cavertome

- a. Mooreville
- b. Carrion-Rosello
- c. Uramix
- d. Otis

4. What is the advantage of Mentor Titan NB™?

- a. Is covered by antibiotics
- b. Require more dilation than the standard ones
- c. The prosthesis base is more narrow (10-11 mm)
- d. Is recommend for virgin implant

5: What is the most frequent patient complaint after post-fibrosis penile implant?

- a. Infection
- b. Scrotal Pain
- c. Loss of penile length
- d. Less sensation