# Updates in Minimally Invasive Treatment for Peyronie's Disease

Essay

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# Introduction

Peyronie's disease is a benign condition in which a fibrous plaque forms in the tunica albuginea of the penis, resulting in a palpable mass and increased curvature of the penile shaft. The plaque most commonly presents on the dorsal surface of the penis and may be painful in the acute phase. Prevalence is approximately 1-3%, with an age of onset usually between 40-60 years ***(Ralph et al., 2010).***

Peyronie's disease is characterized by a focal inflammatory reaction with progressive fibrosis, formation of sclerotic plaques, and, occasionally, calcification ***(Helweg et al., 1992).***

This area of scarring, or plaque, typically develops on the dorsal surface of the penis (dorsum), although it may also develop on the ventral side or on the lateral side of the penis ***(Devine et al., 1991).***

Peyronie's disease has been reported to occur in association with Dupuytren's contractures, plantar fascial contractures, tympanosclerosis as well as trauma, urethral instrumentation, diabetes, gout, Pagets' disease, and the use of beta- blockers ***(Rhoden et al., 2010).***

During the first year or so after formation of the plaque, while the scar in the tunica is undergoing the process of remodeling, penile distortion may increase, remain static or, as is most often the case in younger men, resolve and disappear spontaneously ***(Devine et al., 1991).***

In most patients the curvature remains static as the scar matures although, in some patients, it becomes worse as fibrosis ensues and the scar contracts. In 25 percent of these patients the scarring process progresses to calcification, and in 25 percent of those it progresses to bone formation ***(Devine et al., 1991).***

After the scar has matured, the configuration of the tunica albuginea is unlikely to be changed by nonsurgical treatments. However, many patients with advanced disease who have not sought surgical correction have been able to continue mutually satisfactory sexual intercourse with a partner. Approximately one third of patients with end-stage disease have a disabling curvature that requires surgical correction ***(Devine et al., 1991).***

At present it seems that a reasonable approach to the nonsurgical treatment of Peyronies Disease might be combined therapy; this should provide synergy between the oral, topical and intralesional drugs ***(Moreland et al., 1998).***

Intralesional verapamil injection for the treatment of Peyronie's disease is based on experimental findings that show that calcium antagonists may significantly affect fibroblast function on several levels, including cell proliferation, extracellular matrix protein synthesis and secretion, as well as collagen degradation. These changes may allow intralesional verapamil to retard, prevent, or possibly reverse plaque formation and progression of PD ***(Levine et al., 2002).***

The efficacy of treatment seems to be independent of disease duration and Kelami classification. In men who subjectively note improvement of erect deformity, the results are durable over at least a two-year period. In addition, patients who have had verapamil injections and subsequent surgery have no evidence of compromised surgical success, and may exhibit hastened pre-surgical plaque stabilization. Thus, intralesional verapamil treatment should be considered a first-line treatment in the great majority of patients presenting with PD ***(Levine et al., 2002).***

Penile traction therapy is a novel modality that requires a a great deal of patient compliance and determination. Continuous extension of the affected fascia results in measurable increases in collagenases and metalloproteinases, with eventual joint softening and extension. Traction therapy's application in Dupuytren's disease has been studied for over 15 years ***(Levine et al., 2008).***

# Aim of the Work

The aim of the work is to provide an update of the current minimally invasive therapies for patients with peyronie's disease.

# Historical Background

Although it was named after the french surgeon François Gigot de la Peyronie, he was not the first to describe it. Gabriel Fallopias was the first to describe Peyronies disease in 1561 and the first to write was Guilio Cesar Aranzi ***(Fisher et al., 2010).***

François Gigot de la Peyronie (January 15, 1678 – April 25, 1747) was born in Montpellier, France. He was surgeon to King Luis XV of France. In 1743 Peyronie described a disorder characterized by induration of the corpora cavernosa of the penis. This condition is now referred to as Peyronie's disease ***(Fisher et al., 2010).***

Van buren was the first to publish in English about peyronie's, from here come the other name of the diseae, Van Buren's disease ***(Fisher et al., 2010).***

**Figure (1):** Picture of Francois Gigot de la Peyronie.

# Surgical Anatomy of the Penis

The human penis is composed of the glans penis, the corpus spongiosum with the bulb of the penis, and the paired corpora cavernosa in which skeletal muscle structures and the continuing tunica albuginea completely surround and contain smooth muscle structures, which intermingle with fibrous tissue to form the wall of the sinusoids ***(Hsu et al., 1992).***

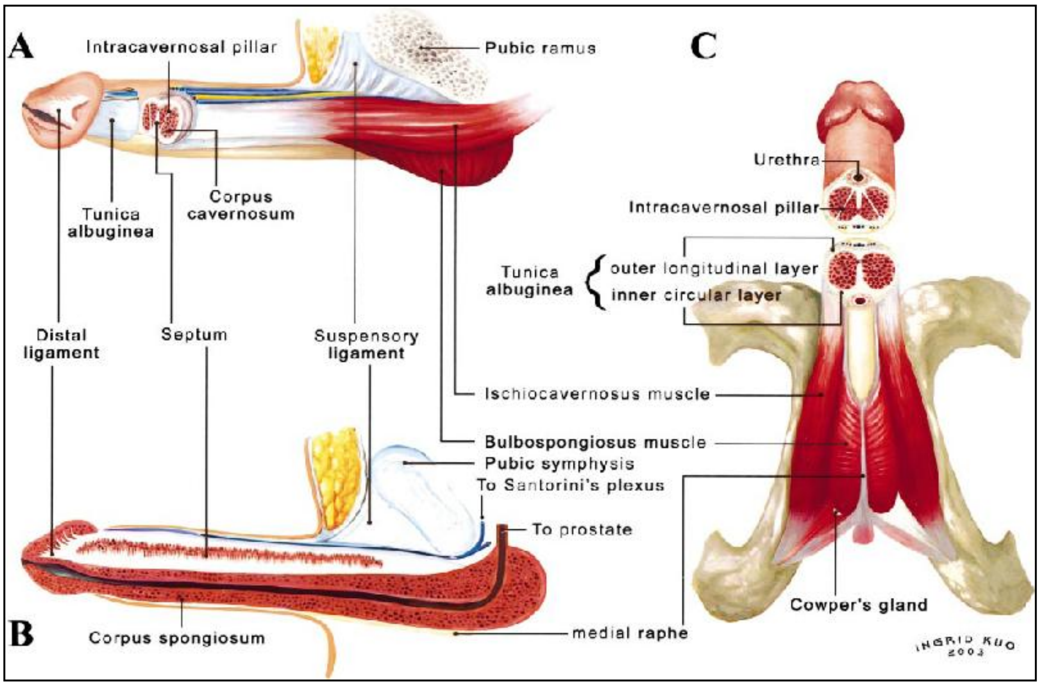


**Figure (2):** Anatomy of the Penis.

The corpus spongiosum is partially entrapped by the skeletal muscle. These encased tissues finally pass through and are regulated by the surrounding structures. The penis gives the appearance of being an independent organ because of its skeletal muscle structures. They are the tissue that determine the penile shape as well as an essential part in the establishment of a rigid penis ***(Lavoisier et al., 2001).***

The human penis mimics the structure of other parts of the human body where skeletal muscles and the skeleton encompass those visceral organs in which smooth muscles reside. It is a pendulous organ that is uniquely suspended from the front and strongly adheres to the pubic ramus and ischium via the tenacious periosteum ***(Lavoisier et al., 2001)***

The organ leans on and is supported by a suspensory ligament that is an extension of the linea alba. An erect penis is analogous to an athletic diver without upper extremities who is standing on a springboard ready to dive. Thus, the glans penis corresponds to the head, and the penile shaft corresponds to the trunk of the body, with the penile crura corresponding to the legs ***(Goldstein et al., 1990).***

The tunica albuginea of the corpora cavernosa is a bilayered structure. The inner circular layer completely contains and, along with the intracavernosal pillars, supports the sinusoids ***(Hsu et al., 2005).***

There is a paucity of outer-layer bundles in the region between the 5-o'clock and 7-o'clock positions, where there is close contact with the corpus spongiosum.Distally, they are grouped into the glans penis, which forms the distal ligament, a continuation of the outer longitudinal layer of the tunica, and is located at the 12- o'clock position of the distal urethra. Coital ability can be lost if the penis loses its intact distal ligament, even though its erectile function is normal ***(Hsu et al., 2005).***

This unique anatomic arrangement may explain why the glans penis is strong enough to bear the buckling pressure of coitus, as well as how an erect penis is sufficiently rigid but never compresses the corpus spongiosum, which otherwise would present an obstacle to ejaculation ***(Hsu et al., 2005).***

A strong glans protects the reflexogenic erectile mechanism that may be evoked in response to global contraction of the perineal muscles, which in turn compresses the veins and erectile tissue to encourage penile rigidity and allows rhythmic ejaculation ***(Hsu et al., 2004).***

Smooth muscle is an essential component of the sinusoids in the corpora cavernosa, the corpus spongiosum, and the glans penis. In the corpora cavernosa, the ischiocavernosus muscle and its continuation as the tunica albuginea contain and support the smooth muscle, and together, they meet the requirements for erection, whereas in the corpus spongiosum, the skeletal muscle partially entraps the smooth muscle to allow ejaculation when in a state of erection.The young cadavers, unequivocally, a remarkable muscle bulk, whereas elderly subjects sustaining chronic diseases tend to demonstrate a lighter skeletal muscle bulk and slimmer distal ligament as well as a thinner tunica albuginea ***(Hsu et al., 2004).***

Traditional anatomy states that there are 2 end-artery organs in the human body (ie, the retina and the kidney). However, we believe that the sinusoids of the corpora cavernosa, the corpus spongiosum, and the glans penis should be included in this grouping.Most emissary veins often ran in an oblique path between the inner and outer layers of the tunica albuginea ***(Hsu et al., 2004).***

However, the arteries take a more direct route through the tunica. The veins, therefore, play a passive, yet over-whelmingly important, role in erectile function.In the area of the penis with a complete medium septum bulking is obvious in both the bulbospongiosus and ischiocavernosus muscles. The anterior fibers of the bulbospongiosus muscle are bulky, and similarly, the ischiocavernosus muscle bulk is apparent at this ***(Hsu et al., 2004).***

# Physiology of Erection

The penile erectile tissue, specifically the cavernous smooth musculature and the smooth muscles of the arteriolar and arterial walls, plays a key role in the erectile process ***(Sattar et al., 1995).***

In the flaccid state, these smooth muscles are tonically contracted, allowing only a small amount of arterial flow for nutritional purposes. The blood partial pressure of oxygen ($PO_2$) is about 35 mmHg range.The flaccid penis is in a moderate state of contraction, as evidenced by further shrinkage in cold weather and after phenylephrine injection.Sexual stimulation triggers release of neurotransmitters from the cavernous nerve terminals. This results in relaxation of these smooth muscles and the following events:

1. Dilatation of the arterioles and arteries by increased blood flow in both the diastolic and the systolic phases.
2. Trapping of the incoming blood by the expanding sinusoids.
3. Compression of the subtunical venular plexuses between the tunica albuginea and the peripheral sinusoids, reducing the venous outflow.
4. Stretching of the tunica to its capacity, which occludes the emissary veins between the inner circular and the outer

longitudinal layers and further decreases the venous outflow to a minimum.

5. An increase in PO2 (to about 90 mmHg) and intracavernous pressure (around 100 mmHg), which raises the penis from the dependent position to the erect state (the full-erection phase)
6. A further pressure increase (to several hundred millimeters of mercury) with contraction of the ischiocavernosus muscles (rigid-erection phase).

***(Sattar et al., 1995)***

The angle of the erect penis is determined by its size and its attachment to the puboischial rami (the crura) and the anterior surface of the pubic bone (the suspensory and funiform ligaments).In men with a long heavy penis or a loose suspensory ligament, the angle usually will not be greater than 90 degrees, even with full rigidity. Three phases of detumescence have been reported in an animal study. The first entails a transient intracorporeal pressure increase, indicating the beginning of smooth muscle contraction against a closed venous system. The second phase shows a slow pressure decrease, suggesting a slow reopening of the venous channels with resumption of the basal level of arterial flow. The third phase shows a fast pressure decrease with fully restored venous outflow capacity ***(Sattar et al., 1995).***

Erection thus involves sinusoidal relaxation, arterial dilatation, and venous compression. The importance of smooth muscle relaxation has been demonstrated in animal and human studies ***(Bosh et al., 1991).***

## Corpus Spongiosum and Glans Penis:

- During erection, the arterial flow increases in a similar manner; however, the pressure in the corpus spongiosum and glans is only one third to one half of that in the corpora cavernosa because the tunical covering (thin over the corpus spongiosum and virtually absent over the glans) ensures minimal venous occlusion ***(Lue et al., 1983).***

- During the full-erection phase, partial compression of the deep dorsal and circumflex veins between Buck's fascia and the engorged corpora cavernosa contribute to glanular tumescence, although the spongiosum and glans essentially function as a large arteriovenous shunt during this phase ***(Lue et al., 1983).***

- In the rigid-erection phase, the ischiocavernosus and bulbocavernosus muscles forcefully compress the spongiosum and penile veins, which results in further engorgement and increased pressure in the glans and spongiosum ***(Lue et al., 1983).***

## The Innervation of the Penis:

Innervation of penis is both autonomic (sympathetic and parasympathetic) and somatic (sensory and motor). From the neurons in the spinal cord and peripheral ganglia, the sympathetic and parasympathetic nerves merge to form the cavernous nerves, which enter the corpora cavernosa and corpus spongiosum to affect the neurovascular events during erection and detumescence. The somatic nerves are primarily responsible for sensation and the contraction of the bulbocavernosus and ischiocavernosus muscles ***(Saenz de Tejada et al., 1989).***

### 1) <u>Autonomic pathways:</u>

- The sympathetic pathway originates from the 11th thoracic to the 2nd lumbar spinal segments and passes through the white rami to the sympathetic chain ganglia. Some fibers then travel through the lumbar splanchnic nerves to the inferior mesenteric and superior hypogastric plexuses, from which fibers travel in the hypogastric nerves to the pelvic plexus. In humans, the T10 to T12 segments are most often the origin of the sympathetic fibers, and the chain ganglia cells p projecting to the penis are located in the sacral and caudal ganglia ***(De Grout et al., 1993).***

- The parasympathetic pathway arises from neurons in the intermediolateral cell columns of the second, third, and fourth sacral spinal cord segments. The preganglionic fibers pass in the pelvic nerves to the pelvic plexus, where they are joined by the sympathetic nerves from the superior hypogastric plexus ***(Walsh et al., 1990).***
- The cavernous nerves are branches of the pelvic plexus that innervate the penis. Other branches of the pelvic plexus innervate the rectum, bladder, prostate, and sphincters. The cavernous nerves are easily damaged during radical excision of the rectum, bladder, and prostate ***(Paick et al., 1993).***
- Stimulation of the pelvic plexus and the cavernous nerves induces erection, whereas stimulation of the sympathetic trunk causes detumescence ***(Courtois et al., 1993).***

**2) <u>Somatic pathways:</u>**

- The somatosensory pathway originates at the sensory receptors in the penile skin, glans, and urethra and within the corpus cavernosum.
- In the human glans penis are numerous afferent terminations: free nerve endings and corpuscular receptors with a ratio of 10:1. The free nerve endings are derived from thin myelinated Aδ and unmyelinated C fibers and are unlike any other cutaneous area in the body.

***(Halata et al., 1986)***