Peyronie’s disease, also known as induratio penis plastica (IPP), was first described in 1743 as an acquired disorder (1). In this article, the prevalence of the disease and the available treatment options are discussed in the light of a selective analysis of literature published in the last ten years. Review articles were included prominently in the analysis. Recent epidemiologic studies in Germany have shown that the prevalence of this disease is 3.2%, significantly higher than previously assumed. The disease seems to become more common with advancing age, with peak prevalence between the ages of 50 and 70 (2). An association with Dupuytren’s contracture has been described in as many as 30% of cases. Penile plaques were found in 8.9% of the men in an American prostate cancer screening study (3). In a Turkish study, Peyronie’s disease was an incidental finding in 16% of men who were evaluated for erectile dysfunction (4). Clearly, the prevalence of this disease has been underestimated. Spontaneous remissions are described as occurring in ca. 13% of cases. The longitudinal study of men with Peyronie’s disease is difficult, because many sufferers may keep the condition secret out of embarrassment, while some older men may accept it as a supposedly natural part of aging (2, 5).

**Pathophysiology**

The precise etiology and pathogenesis of Peyronie’s disease (IPP) remain unknown. For some reason, normal structural elements of the connective tissue covering of the erectile body (the tunica albuginea) are replaced by profuse amounts of disorganized collagen, fragmented elastic fibrils, and calcifications. Apparently, there is an initial phase of active inflammation, followed by a transition to a stable, progression-free phase. Proposed models for the pathophysiology of IPP are generally based on the concept of an imbalance in certain mediating substances (including transforming growth factor and nitrous oxide synthase). These models, however, lack clinical predictive ability and have had no effect on the treatment of the disease. In the human being, there are various factors that appear to
promote the development of penile plaques, of which the most important seems to be penile microtrauma during coitus in susceptible men (5, 6, 7). There is, apparently, a genetic predisposition to the disease. It is also often associated with systemic fibromatosis (Dupuytren's contracture) and with the human leukocyte antigen B27, as well as with aberrant function of the cell cycle protein p53 (8, 9).

Clinical evaluation
The most important elements in the clinical evaluation and diagnosis of Peyronie's disease are the formation (usually de novo) of palpable plaques in the erectile body of the penis and penile deviation during erection (figures 1 and 2). Plaques usually form over a period of a few weeks to months. They vary in size and shape. Patients often complain of significant shortening of the penis and worsening of erectile function over the course of a few months.

The degree of deviation during erection determines the extent of functional impairment in sexual intercourse (2, 3). Photographic documentation of the deviation is helpful. The patient's subjective sensations of pain and/or paresthesia in the penis are also clinically important (5). Micturition is usually unimpaired. When taking the patient's history, the physician should ask about the onset of symptoms, any past trauma, congenital penile distortion, and the patient's previous erectile ability and frequency of sexual intercourse.

The elements of treatment
There are no official guidelines for the treatment of Peyronie's disease. The available medical and surgical treatments are all provided on an exclusively symptomatic basis, as there is as yet no causal treatment (10, 11). The consensus is that, in the initial phase of active inflammation, patients should be treated expectantly, and surgical interventions should be avoided. Surgery is indicated only in the stable phase, when no progression has occurred for at least six months. The patient should also be free of pain for at least six months before surgery. Thus, in most cases, surgery is performed six to twelve months after the onset of symptoms.

Penile deviation can be corrected with a number of different surgical procedures. The natural history of Peyronie's disease in neither uniform nor predictable, and spontaneous remissions occur in as many as 13% of cases, particularly in younger patients with small, relatively soft plaques. This fact makes it more difficult to assess the efficacy of the various conservative treatments that are available, particularly because publications on the subject often fail to include any objective parameters for success, as well as being retrospective and
uncontrolled. To date there are no comparative studies of conservative versus operative treatment for Peyronie’s disease that could be used to make an evidence-based judgment. This situation is unlikely to improve in the near future, because surgical reconstructive treatment, in particular, depends very strongly on individual factors. An outstanding review of Peyronie’s disease was published recently by Hauck et al., in German, in the specialized urological literature (10).

**Oral and transdermal medication**

Potassium paraaminobenzoate, the oral drug most often given in Germany to treat Peyronie’s disease, has been in use for more than 50 years. Its precise mechanism of action is unknown. In a recent prospective, randomized, double-blind study over a twelve-month period, patients taking this medication were found to have significantly smaller plaques and significantly less progression of penile deviation at six months. There was, however, no significant difference between the verum and placebo groups with regard to regression of deviation, or reduction of pain. Thus, the clinical endpoints of this study were negative.

Vitamin E is said to exert an anti-inflammatory effect in Peyronie’s disease, as in other diseases, through its anti-oxidative action, which leads to the inactivation of free radicals. A positive effect was reported as early as 1948 by Scott and Scardino (13). Although vitamin E is still given orally in Germany to treat Peyronie's disease, a placebo-controlled study in 1990 demonstrated no effect from vitamin E in comparison to the natural history of the disease (10, 11). Transdermal treatment with ointments does not play a major role in the treatment of Peyronie’s disease.

**Intralesional treatment**

Medication can be directly injected into or around plaques in the hope of achieving a local effect. Injection into a plaque requires high mechanical pressure and often causes pain. Furthermore, the intralesional injection of cortisone (for example) often leads to local tissue reactions, such as atrophy, and placebo-controlled studies have not revealed any significant therapeutic effect. Levine was the first to describe the intralesional injection of verapamil, a calcium-channel blocker (14). Small placebo-controlled, double-blinded studies have been performed, but the overall clinical effect is minor. The same holds for intralesional treatment with collagenases or interferon. A current study concludes that intralesional treatment with interferon is effective, but this result needs to be confirmed by further studies and other investigators (15). In summary, there is no clear proof of the efficacy of intralesional treatment. At present, it can only be recommended in individual cases.

**BOX 1**

**The Giessen Therapy Concept* 

- **Early phase**
  - Pain, no calcification, deviation  
    Treatment: potassium paraaminobenzoate
  - Pain, calcification, deviation  
    Treatment: extracorporeal shock wave therapy

- **Stable phase (> 6 months)**
  - Deviation < 60°  
    Treatment: plication (Nesbit)
  - Deviation > 60° and shortened penis  
    Treatment: excision and grafting
  - Severe erectile dysfunction  
    Treatment: penile prosthesis

* after Hauck and Weidner (11)

**BOX 2**

**Clinical summary**

- The signs and symptoms of Peyronie’s disease must be stable for at least six months before any genital surgical procedure is performed.
- The most important indications for surgery are the patient’s impaired quality of life and his inability to have normal, satisfying sexual intercourse.
- Erectile function must be tested in addition to penile deviation, because the choice of surgical procedure depends on the quality of erectile function.
- Any surgical procedure carries the risks of penile shortening, sensory disturbance, and erectile dysfunction.
- The benefits and risks of any surgical procedure should be discussed thoroughly beforehand with the patient and his partner.
**Extracorporeal shock wave therapy and radiotherapy**

Extracorporeal shock wave therapy (ESWT) involves the direct destruction of calcified structures, which is thought to lead to improved perfusion, so that the remnants of calcification can be resorbed. ESWT is also thought to relieve pain either by the overstimulation or the direct destruction of nociceptors. Though this form of treatment has rapidly increased in popularity, it has not been shown to have any effect on plaque size or penile deviation in prospective, randomized studies. It does, however, seem to bring about a more rapid relief of pain. ESWT is not considered a standard mode of treatment for Peyronie's disease according to the official position statement of the German Urological Society (16, 10).

The results of radiotherapy are similar to those of extracorporeal shock wave therapy. Most of the studies published to date are retrospective and include no control group. The results with regard to plaque size and penile deviation are unconvincing. The only positive result is more rapid relief of pain. This form of treatment cannot be recommended. Moreover, prior radiotherapy can be a complicating factor in any surgical treatment that might be required afterward.

**Genital surgical procedures**

Surgery to straighten penile deviation should only be performed once the disease has entered its stable, progression-free phase, i.e., after at least six months without any progression of disease manifestations (17, 18, 19). A detailed evaluation of the penile vessels and erectile function must be carried out by a specialized urologist or andrologist before any surgical correction is undertaken, and the patient must be thoroughly informed about the benefits and risks of the procedure, including its possible side effects and complications. If performed too early, surgery can reactivate the inflammatory process, leading to scarring, accelerated shortening of the penis, and worse penile deviation. Penile shortening, erectile dysfunction, and sensory disturbance must be mentioned among the risks of all surgical procedures on the penis. At present, reconstructive surgery is essentially limited to four types of operation: Nesbit's procedure (18), the plication procedure of Essed and Schroeder (19), plaque surgery involving excision of the plaque and covering the defect with a graft, and implantation of hydraulic penile prostheses (10, 17, 20). Circumcision is usually performed at the same sitting.

Nesbit's procedure is performed on the convex side of the penis opposite the plaque. After neurolysis, an ellipse of the tunica is excised on the longer side, and the tunica is then resewn. This procedure straightens the penis but simultaneously shortens it. In the procedure of Essed and Schroeder, the longer side of the penis is shortened with plication sutures, rather than with excision of the tunica. This surgical technique is most suitable for patients with good erectile function, adequate penis length, and mild deviation without any hourglass-like narrowing. Many modifications of these two basic types of procedure have been described in the literature.

Plaque excision followed by covering of the defect with a graft straightens the shortened and curved side of the penis but often results in worsening of erectile function. Lue introduced the “small incision technique,” in which the plaque is incised one or more times in an I- or H-shaped pattern without injury to the underlying tissue of the corpora cavernosa. Lue used the great saphenous vein for grafting (20); alternative sources for the graft include the temporal fascia, tunica albuginea, collagen fleece, and bovine pericardium. There is still no consensus regarding the best graft material. The main complications of this procedure, too, are erectile dysfunction and sensory disturbances of the glans penis. All operations cause penile shortening, to a degree depending on the extent of the deviation. The patient must be informed of this explicitly. In a current comparative review and meta-analysis of the various surgical procedures, Kadioglu et al. report successful straightening of the penis in ca. 80% of cases and high overall patient satisfaction in 60% to 80%, after a mean follow-up interval of two to three years. The frequency of side effects such as major shortening of the penis, sensory disturbances, and recurrent deviation is 10% to 20%, according to this review (21). The studies are very heterogeneous with respect to the number of patients treated, the study endpoints, and the procedures that were performed. The authors of the review emphasize the need for surgical treatment to be individualized for each patient (21). The implantation of a penile prosthesis is considered when the patient also suffers from refractory erectile dysfunction. The Giessen Therapy Concept of 2001 (11) can be very helpful in the decision how and when to treat (box 1).
Summary
Peyronie’s disease is a urogenital condition whose prevalence has been underestimated. There is no reliable method of conservative treatment. Surgery should be performed only in the stable phase of the disease, i.e., when it has not progressed any further for at least six months. The choice of surgical treatment is based on the extent of penile deviation; it may range from a simple straightening procedure to complex plaque excisions with grafting. The complications and side effects for which the risk is highest are erectile dysfunction, sensory disturbance, and penile shortening. Patients should thus be thoroughly informed about the procedure and its risks beforehand, and its precise indications must be explained so that false hopes will not be raised (box 2).

Conflict of Interest Statement
The authors declare that they have no conflict of interest as defined by the guidelines of the International Committee of Medical Journal Editors.

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