

# Most common diseases and ailments of feet – prevention and treatment. Part I.

## Najczęstsze schorzenia i dolegliwości stóp – profilaktyka i leczenie. Część I.

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Piękno i estetyka stóp są bardzo ważne, ale równie ważny jest komfort i brak bólu z powodu choroby. W przypadku stopy jest to częstym zjawiskiem. Ponieważ pacjenci mają często dolegliwości chorobowe w obrębie stóp, stanowi to poważny problem społecznym.

W pracy przedstawiono krótką charakterystykę najczęstszych schorzeń i dolegliwości stóp, powstałych na skutek działania stałych mikrourazów spowodowanych np. nieprawidłowym sposobem chodzenia, źle dobranym obuwiem czy deformacją kości – takich jak nagniotek (Clavus), modzel (Callus, Tyloma), czy też dolegliwości powstałych w wyniku tarcia lub ucisku dużego stopnia – takich jak pęcherz (Bulla mechanica). Przedstawiono również inne częste schorzenia występujące w obrębie stóp, do których należą: EBA, krwawienia w obrębie pięty występujące najczęściej u sportowców (Talon noir), wrastający paznokieć, odmrożenia stóp (Congelatio), brodawki stóp (Verrucae plantares), grzybica stóp (Tinea pedis), grzybic paznokci stóp (Onychomycosis), a także nadmierną potliwość stóp (Hyperhidrosis plantares).

W artykule przedstawiono krótką charakterystykę każdego ze schorzenia lub dolegliwości stóp – jego etiologię, patogenezę, objawy, przebieg, profilaktykę i leczenie.

**Słowa kluczowe:** nagniotek, modzel, pęcherz, EBA, wrastający paznokieć, odmrożenie stóp, brodawki stóp, czarna pięta, nadmierna potliwość stóp, grzybica stóp, grzybic paznokci stóp

Beauty and aesthetics of feet are very important, but also important is comfort and absence of pain and disease. In the case of feet it is a common phenomenon. Patients have many disease problems with the feet, is a significant social problem.

The study presents a brief description of the most common diseases and ailments of feet, caused by micro-damages caused by permanent abnormal gait, poorly chosen shoes or deformed bones - such as corn (Clavus), callus (Callus, Tyloma), or the problems caused by friction or high-grade compression – such as blisters (Bull Mechanic). It also presents other common diseases occurring within the foot, which include: EBA, bleeding in the heel that occurs most often in athletes (talon noir), ingrowing toenail, frostbitten feet (Congelatio), foot warts (verrucae plantares), athlete's foot (tinea pedis), fungal toenails (Onychomycosis) and foot sweating (hyperhidrosis plantares).

This article presents a brief description of each of the diseases or ailments of feet – their etiology, pathogenesis, symptoms, course, prevention and treatment.

**Key words:** corn, callus, blister, EBA, ingrown toenail, frostbite feet, foot warts, black heels, sweating feet, tinea pedis, feet onychomycosis

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### Introduction

The skin on the soles of feet is four times thicker than in other parts of the body. Due to its structure it can take the pressure of the body while standing and walking. The rise of thickened skin on feet is a natural process but due to abnormal gait, poorly chosen shoes or bone deformities there may occur many foot ailments. Microtrauma of low intensity running for a long time causes hypertrophy of the living layers of the epidermis and hyperkeratosis, resulting in the formation of corns (*Clavus*) and calluses (*Callus*,

*Tyloma*). A high degree of pressure or friction, acting as recurring trauma in a short time, it can lead to the development of blisters (Bull Mechanic), preceded by cell necrosis spinous layer [1].

There are many diseases and conditions associated with feet; the most common of these can include: sweating feet, foot warts, ingrown toenails, calluses, corns, blisters, EBA, frostbitten feet; heel bleeds usually occur in athletes, commonly referred to as a “black heel” or, finally, athlete’s foot and toenail fungus.

Beauty and aesthetics of feet are very important, but also important is the comfort and absence of pain and disease. In the case of feet is a common phenomenon. Patients have many disease problems with the feet, it is a significant social problem. This causes huge discomfort both mental and physical, and therefore appropriate prevention is desirable, which you will find in the text below. Prevention is definitely better than cure.

In this section, we will describe all of the above diseases or disorders associated with feet apart from tinea pedis and feet onychomycosis. Athlete's foot and feet onychomycosis feet will be presented in the second part of the article.

### Callus (*Callus, Tyloma*)

Callus is a limited thickening of the stratum corneum, resulting from prolonged or repeated pressure or friction. The constant pressure on the skin makes it well supplied with blood and it begins to die leading to the formation of growths. Eruptions are usually of circular shape, color, yellowish or yellow-brown horny in the middle, slightly flattened at the periphery. Individual patches can connect with each other and form clusters of considerable size [1, 2].

Calluses are usually painless, but sometimes there may be pain when walking. A typical placement are bony parts, mainly on the sole of the foot (metatarsal heads) and the heel [1-2].

The predisposing factors include calluses [1, 2]:

- ill-fitting shoes
- prostheses
- injuries associated with working tools
- faulty settings of feet or toes, foot defects (e.g., bone spurs, hallux valgus, flat feet, high instep feet too long metatarsal)
- inter-individual tendency to hyperkeratosis
- excessive sweating feet
- neuro-trophic disorders, neurological

In some neuro-trophic and neurological disorders calluses may precede the development of trophic ulcers or bedsores. The most common cause of calluses are the disadvantages of the osteoarticular system and those involving the exercise of the profession (*tyloma professionale*). The disease is chronic and recurrent [1, 2].

Treatment of callus is by means of a chemical softening creams and ointments containing salicylic acid, urea or lactic acid solution and then the mechanical removal using appropriate fine and coarse rasps (non-metallic), or by means of special abrasive cutter: diamond, paper or stone. You should not use a pumice stone as it can become the fungi and bacteria habitat. Sometimes, surgical treatment should be carried out under the supervision of the removal specialist [1, 2].

Warm baths are recommended for limbs with plenty of soap to soften the stratum corneum. The systematic use of creams, exfoliating and moisturizing effectively remove bumps and rough skin, giving a visible effect of cleansing and smoothing the skin on the feet. It eliminates the unpleasant feeling of roughness and chapping and leaves skin soft, supple and smooth [1, 2].

The bottom line is, however, to eliminate the cause of the formation of calluses and appropriate prophylaxis based on perfectly fitting shoes, so that the feet do not feel loose when walking, to use inserts to prevent chafing feet, avoid high-heeled shoes, wear shoes with some elevation and appropriate shock-absorbing rubber sole and maintain proper dryness. The specialist should determine the right shoe inserts to correct the defective structure of the foot. This allows uniform distribution of weight and protects against continuous recurrent [1, 2].

### Corn (*Clavus*)

Corn, commonly known as the imprint, is a limited thickening of the stratum corneum, a horny pin having a center (core) with a smooth surface penetrating deep into the skin and located only in the foot. It develops as a result of constant pressure in the protruding bones. Cord compression on the nerve endings in the skin causes paroxysmal pain [1-2].

Corn is the most common location of dorsal and medial surface of the outer V toe. Subsequently, there is corn on the dorsal surfaces of the fingers IV, III, I and II, the heel is rarely a subungual area. Corns are often found also on the inner surface of the fingers [1, 2].

Corn is produced by hyperkeratosis in response to pressure. It is usually the result of wearing too tight shoes, socks or tights, a seam or links present inside the shoe, which violently scratch toes. Sometimes too loose a shoe, in which the rate of slip at each step of the long descent to the inclined surface (top) can lead to corns. Faulty positioning of the foot (such as hallux valgus, flat rate) will also contribute to the formation of corns [1, 2].

Treatment of corn is its softening using special ointments, creams, gels or patches on prints. Such a procedure should be carried out for several days, then corn should be removed with the core. Corns in cosmetic surgery are removed by mechanical means – calluses are removed with the cylindrical cutter, medium or large grain size, and the corn is removed with the vacuum cutter. Corns large and deep, and those occurring in patients with cardiovascular disorders or diabetes, should be removed by appropriate professionals – a surgeon or dermatologist [1, 2].

### Black heel (*Talon Noir*)

It occurs most often in athletes. Arises as a result of injuries. Often mistakenly diagnosed as melanoma. Eruptions are small, brownish or black discoloration of acute delimiting. This extravasation is mainly surrounding the side and back of the heel. Lasts long because the extravasated blood is not absorbed due to hypertrophy of the stratum corneum [1, 2].

### EBA (*epidermolysis bullosa acquisita*)

A high degree of pressure or friction can lead to the development of the blisters (*bulla mechanica*). It is an original eruption on the skin surface, filled with fluid, arising as a result of full or partly separation of the epidermis and receding without leaving scars. The blistering occurs mostly as a result of no physiological pressure and stretching [1-4].

There are four types of blistering [1-4]:

- stratum corneum (the cover is easily interrupted, fluid accumulates in the stratum corneum, at the bottom of the blister there are the cells of the stratum corneum, such as impetigo, pemphigus leaf)
- intra-epidermal (acantholytic, as a result of loss of communication between the cells of the stratum corneum into the epidermis or surface layer of corneum intercellular edema, such as pemphigus right)
- subcuticular (Cover blister of the skin, the nipple and the bottom of the dermis, e.g. pemphigoid)
- blisters associated with cellular swelling (these changes are characteristic of herpes zoster)

One of the most common diseases that cause blisters on the feet is acquired epidermolysis bullosa (*epidermolysis bullosa acquisita*, EBA). It is a disease which in most cases begins with the 3<sup>rd</sup> and 4<sup>th</sup> decade of life (may also apply to children, but it happens rarely) and belongs to the group of subepidermal, autoimmune bullous skin diseases. EBA is characterized by the formation under the influence of mechanical damage; blisters heal, leaving scars and milia within them [2, 4-6].

Clinically EBA comes in several varieties. Most distinguished character as a non-(classic), inflammatory (like pemphigoid) and a rare variety that resembles the clinical picture cicatricial pemphigoid Brunstinga-Perry, in which the cystic lesions and erosions are located on the scalp, face and neck [6, 7].

Noninflammatory character has a prominent sensitivity of skin, which leads to the formation of blisters on the backs of the feet, the hands but also the hands and knees. Inflammatory character is reminiscent of pemphigoid (called *pemphigoid-like* EBA), which is characterized by the presence of numerous blisters scattered on the trunk and limbs. But this is not what pemphigoid, numerous studies have shown.

Immunopathological examination revealed the presence of EBA and associated IgG antibodies circulating in the skin of the patient, which are directed against antigens of the basilar membrane 46 (as is the case in bullous 8), but the exact test of immuno microscopically-electron revealed that in cases of *epidermolysis bullosa acquisita* deposits of IgG are located below the lamina densa 9.10 (differently than it is in bullous 4.5). In addition, molecular studies and biochemical studies have estimated that the antigen recognized by autoantibodies from patients with EBA is collagen type VII, which is the basement membrane anchoring fibers to the skin [11, 12].

**Treatment.** Do not pierce the blisters as it can lead to infection. Best to change shoes and allow the blister to heal itself. If the blister becomes cloudy, it becomes more and more red and painful, most likely it was infected. Then remove the oil and apply antibiotic [1-4].

With EBA disease the response to therapy is diverse. Here, too (as well as in any other case) do not pierce the blisters. In some cases, the clinical course of the disease is severe despite intensive treatment with high doses of encorton, dapsone and immunosuppressive drugs 13, but in some cases the disease is mild and does not require systemic treatment [4, 5, 14]. Severe course of the disease may be due to the coexistence of EBA systemic diseases such as endocrinopathies, systemic lupus erythematosus or inflammatory bowel disease – in particular Crohn's disease.

### Ingrown nails (*unguis incarnatus, onychocryptosis*)

As a result of improper nail care, too tight shoes or the wrong setting of foot during walking, it comes to an ingrown nail in the nail shaft. The typical location is the hallux rate (usually medial to the throne), rarely other toes. Ingrown toenail causes pain and inflammation of the nail, which becomes red and swollen. Secondary bacterial infection is almost always present. A complication of this may be, among others: purulence fold, phlegmon, paronychia, ulceration and necrosis caused by chronic compression [2, 3].

The problem of ingrown nail rarely affects children. The problem is most frequently encountered in patients aged 15-40 years and more often in men than in women [2, 3].

There are two types of ingrown nail [2, 3]:

- youthful – nail plate is flat, with the “meaty” nail shaft
- adult – nail plate is rounded with a tendency to roll

Depending on the severity of the changes, there are three degrees of ingrown nail:

- I – with erythema, swelling and slight pain
- II – with erythema, edema, pleural and disturbing pain
- III – with erythema, edema, exudate, granulation tissue and large pain

**Treatment.** The goal of treatment is to eliminate as soon as possible the inflammation, bacterial infection and protection against further growing into the nail plate. It is important to proper foot care – straight nail clipping and the use of shoes with a wide front, not pressing on the side of the nail plate. With minor symptoms the convex edge of the nail plate can be filed or a small window cut at the top of the ridge [2, 3].

Conservative treatment involves the use of tamponade (putting rolls under the nail such as cotton wool, gauze, lignin to repel the nail plate from the nail or the free edge of the nail pad, allowing to get a new “track” in nail growth), anti-inflammatory drugs and ointments with antibiotics. If doing so, however, causes a recurrence a surgical removal of the nail is recommended. You can also use a splint on a flexible tube (a tube placed between the shaft and the sharp nail banks to protect against the oppression of the nail and as security for the growing nail) and post brackets (metal piece, three-piece metal, plastic buckle, metal buckle - plastic spring clamp, wire clamp, stainless steel buckle). The clipping method has been known since the 1960-ies, but only recently it has become a form of treatment of ingrown nail and correct distortion of nail plates. It is a good, effective way and in many cases even more effective than surgery. The conservative treatment from a doctor, however, requires patience and dedication of much attention and time to the patient [2, 3].

Surgical treatment usually consists of a wedge excision of the nail plate. In this procedure a narrow strip is cut out in portion of the nail comprising the ingrowing with adjacent nail shaft in the hyphae. Healing, the nail plate usually does not tend to grow in. In time, after a few weeks, the nail regains its normal shape [2, 3].

If the nail plate is firmly perched and very thick it is removed in its entirety. This implies a permanent deprivation of the nail as the base must be planning which prevents the regrowth [2, 3].

Żaba R., et al. [15] in their work presented modern methods of treatment of ingrown nail. They compared three therapies: surgery, using a CO2 laser and the Nd: YAG. The study was conducted on three groups of patients. In the first group, randomized 26 patients underwent a surgical method Barletta (procedure to remove part of the skin and subcutaneous tissue in the shape of an ellipse along a side edge of a toe in an uncomplicated infection ingrown) or quen (which

consists of excision of the lateral edge of the nail from the nail fragment in the accompanying chronic current infection or infected granulation tissue). The second group, which consisted of 30 patients, was treated with CO2 laser. The third group of 23 people was treated with Nd: YAG laser (laser method using a CO2 laser or a Nd: YAG relies on an elliptical excision of the nail matrix and the destruction of part of the laser light beam). All patients had local anesthesia. The recurrence rate in at least one month post-treatment observation period was as follows: 15%, 13% and 9%. The results of this study indicate that the treatment of ingrown nail with CO2 laser and Nd: YAG laser is effective and can be an alternative to the traditional surgical treatment [2, 3].

Unfortunately, surgical treatment does not always bring improvement. Often used is just a picture of the nail plate, which does not adjust its growth. Therefore, it is important to educate patients how to care for feet and nails, so that the treatment is not returned to the doctor. It often happens that after surgery the patient is not properly instructed on how to proceed and on a possible recurrence and they do not follow the recommendations thinking that surgery was one hundred percent effective [2, 3].

### *Frostbite feet*

Frostbite is the effect of low ambient temperatures. Most often it affects homeless people. The factors contributing to frostbite include: alcohol and peripheral circulatory disorders [2].

There are fourth degrees of frostbite – see Table I.

Table I. Frostbite feet

The degree of frostbite	Clinical Picture
I	– pale skin – painful erythema – changes disappear without a trace
II	– blisters on erythematous base
III	– profound changes, leading to necrosis of the skin and deeper tissues
IV	

In order to avoid frostbite feet it is recommended to wear warm and no oppressor shoes, cotton socks. Avoid socks of artificial textiles.

Treatment of frostbite depends on the clinical condition. Recommended is gradual heating of the skin, setting dressings with a disinfectant and if necessary – surgery [2].

Care in cosmetic surgery covers only degree frostbite. Screenings with Sollux skin exposure lamp or Minin with blue filter should last five minutes. After the surgery, a healing mask of Peruvian balsam or camphor can be put on [2].

### Foot warts (*verrucae plantares*)

The infection is transmitted by contact with a change caused by HPV virus – 1 and 2, or biological material, such as skin containing HPV DNA.

There are two types of feet warts [2, 4, 5, 16, 17]:

- myrmecia
- Mosaic warts

Foot warts of myrmecia type are generally scarce, penetrate deeply into the skin, cause inflammation and pain. Myrmecia is the causative agent of human papilloma virus (human papillomavirus) HPV-1. The infection often occurs in children and young people (usually as “infection pool”, so it is important to avoid direct contact with the surface of infectious bare feet) and is not associated with a decreased immunity. Due to the very large number of viral particles it is highly infectious. Warts are manifested by pain when walking, which is associated with the deep penetration of the infection deeply into the dermis and located mainly in the areas of mechanical trauma (the metatarsal heads). Infection with HPV-1 leaves a lasting immunity because reinfections occur sporadically [2, 4, 5, 16, 17].

The recovery from a foot wart myrmecia is very distinctive. All patches are black with highly flushed substrate. This type of change is the precursor of spontaneous regression. Darkening depends on the deposition of blood pigment in the stratum corneum of the skin and hemorrhagic changes of Arthus phenomenon type [2, 4, 5, 16, 17].

Mosaic warts are superficial, usually large, partially fused with each other which creates a resemblance to the mosaic. They do not give pain. They are of long-term persistence with frequent relapses because they give a stable resistance. They are caused by HPV-2, the same one that causes common warts (*verrucae vulgares*). The infection is often associated with decreased immunity. Most infections occur in the swimming pool, sauna and sports hall.

**Treatment** of foot warts: electrocoagulation treatment with liquid nitrogen, laser therapy and surgery. Prior treatments of salicylic ointment should be applied (10-20%), optionally with the addition of lactic acid (5-10%) for softening the stratum corneum [2, 4, 5, 16, 17, 26].

Liquid nitrogen for foot wart removal is usually effective, but because of the deep location of the wart the liquid nitrogen application should be long (30-60 seconds). The treatment is painful. Cryotherapy causes redness, swelling, blistering and bloody strokes. The application should be repeated every three weeks. Sometimes, the site treated, especially around the blisters it may become recurrent.

Very favorable results are obtained by Verrumal formulation which contains in its composition 10% salicylic acid (keratolytic action), 10% DMSO (resulting in increased penetration) and 0.5% of 5-fluorouracil (cytostatic effect). 2-6 weeks of using the product gives 70-80% of cure rate [2, 4, 5, 16, 17].

In the treatment of warts resistant to other methods intralesional bleomycin is injected (0.5-1 ml). However, this method is a painful and often causes complications [2, 4, 5, 16, 17].

Surgical treatment is not indicated for the removal of multiple changes, but can be used in the removal of individual changes. On the border of the nipple the skin is incised (the area is previously numbed with lidocaine) and removed. If bleeding, it is cauterized before the final curettage cauterization. Sutures are usually not necessary. The process takes about five minutes. The wound heals in about 2-3 weeks. In too deep curettage foot scar tissue foot [2, 4, 5, 16, 17, 26].

The treatment does not remove all the changes at once, because it often happens that after the removal of warts others disappear. This is probably related to the fact that as a result of liberated virions entering the systemic circulation of keratinocytes the body produces specific immunity. Also, do not cut the warts with scissors, knife or bite them, because this way only facilitates their spread [2, 4, 5, 16, 17].

### Excessive sweating feet (*Hyperhidrosis plantares*)

Excessive sweating (general) usually affects people aged 25-64 years [17-19]. It comprises about 0.5% to 1% of the adult human population [19-23]. In half of the cases of excessive sweating a familial susceptibility to the disease is noted, which indicates the participation of genetic factors. There is the gene responsible for overproduction of sweat, the sweat glands present in 5% of the general population [20, 24, 25]. The process of inheritance is autosomal dominant [19, 20, 24].

Most hyperhidrosis relates to the plantar foot. It starts in childhood or adolescence. It can lead to maceration of the skin, skin lesions and secondary infections. Sweating causes the foot to become damp at stratum corneum and thus provides ideal conditions for the development of fungal infection of the skin. It is often the cause of embarrassing situations in personal lives.

**Treatment:** Most often done in the form of aerosol antiperspirants, lotions, sticks, which mask the smell of sweat and prevent the growth of bacteria digesting sweat and antiperspirants in the form of suspensions, solutions, powders, which inhibit the secretion of

sweat by the sweat glands. Antiperspirants contain aluminum salts (usually aluminum chloride hexahydrate) in solutions of 1% to 20%. There are also alcoholic solutions with a concentration of 70-90%, and gels. Unfortunately, their effect is maintained over a very short period of time.

Also carried out are iontophoresis treatments [19, 25, 26] (water iontophoresis and iontophoresis with anticholinergic substances such as glycopyrrolate), which lead to local hyperkeratosis within the range of sweat glands, inhibiting the secretion of sweat. Treatments are carried out 2-3 times a week (or more often at very high intensity of excessive sweating), for 30 minutes with the conversion of the electrodes after 15 minutes. Current Baseline averages 6mA and after a few sessions you can increase the intensity to 18 mA, or until the patient can feel tingling. Sweating persists for weeks and treatment should be repeated, however, often iontophoresis is limited by the anatomical conditions. You should also keep in mind the precautions and possible complications in the form of skin irritation, burns or paresthesia [19].

The overall therapy uses drugs [23, 27] calm, anticholinergic and beta-blockers. However, they do not bring much effects and can often lead to adverse side effects, such as addiction (sedatives), excessive drying of the mucous membranes, or visual field defect (anticholinergic drugs) or conduction disturbances in a conducting system – conducting heart, bradycardia, and bronchospasm (the beta blockers).

The method by which quick results are achieved, as well as long-term efficacy and significant improvement in quality of life, is the treatment with botulinum toxin type A. Botulinum toxin does not cure the cause of excessive sweating, but effectively removes the symptoms, because it inhibits the release of acetylcholine and blocks the sweat gland innervation sympathetically leading to block excessive sweating [19]. Before surgery, anesthesia should be used and the test Minor [19-21]. This qualitative test consists

of applying a solution of potassium iodide on the area covered by excessive sweating. In places where there is a large amount of sweat secretion, there is a color reaction (black), which shows the doctor the surface on which to perform the injection. In addition, after 14 days, you can re-run the test in order to confront where the earlier given botulinum toxin fulfills its function, and where not. Another procedure is carried out after the removal of the toxins, usually after 3-6 months [19, 20].

Botulinum toxin type A can also be applied to a patient suffering from excessive sweating feet by mesoporation (transcutaneous electroporation). This is the method of transdermal delivery of the active molecules which is used in the treatment of various pathologies of the local character. To the cells using pulsed current there are supplied pharmacological substances or drugs. Mesoporation treatments are carried out with the help of special devices, which are generators of pulsating currents and a bloodless and non-invasive way to bring the substance or drug into the cell. Often these treatments are comparable with iontophoresis treatments, but they are more effective.

## Summation

Nurturing the body with numerous amenities, we often forget about the feet. Regular and proper care can make them our true pride. In addition, this way we prevent creation of a number of unpleasant symptoms. All diseases and disorders of the feet are cumbersome, and also it is difficult to fight against them, because they tend to recur. We remind ourselves of them only when they hurt or we want to show them off in the summer. It is therefore important to know how to prevent problems (appropriate prevention) and how to treat common illnesses and ailments of feet and nails. It is always easier to prevent than to cure, especially because these diseases and ailments are often recurrent and difficult to get rid of permanently.

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