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*Influence of nicotine and other cigarette smoke compounds
on the skin*

Smoking proclaims an essential problem for the present medicine. This is the biggest preventable cause of death and disability in developed countries. In the United Kingdom there are about 13 million smokers and 1.2 billion estimated worldwide. Nowadays about 5 million deaths worldwide each year (8.8% of all deaths annually) are attributed to smoking. They are projected to increase to more than 10 million by 2030. (1, 2).

Over the last few years, there has been a growing number of smoking women when compared to the general number of smokers. Smoking has the direct negative influence on aesthetical functions of the skin.

Cigarette smoke contains about 4 thousand harmful substances and about 60 of them are carcinogens (3). Depending on their biological effects, chemical components of the smoke are divided into six groups: toxic substances, irritating substances, ciliotoxic substances (they obstruct the activity of respiratory enzymes and block movement of cilium), cancerogens, cocancerogens, and initiators of tumors (Table 1). The intake of such big amounts of chemical compounds to the human organism cannot be neutral for its biological function. When smoking, physicochemical heterogeneous processes such as: distillation, oxygenation, deoxidization, decarboxylation, dehydration processes, and disintegration processes take place in the human body. It has been shown that the concentration of toxic substances in sidestream cigarette smoke is significantly higher than in mainstream (4).

Smoking is an admitted accelerating factor of the processes of aging. It was proved that the skin of a smoker who smokes about 20 cigarettes per day has comparable parameters as the skin of a non-smoker, but ten years later (5).

Mechanisms of premature aging of the skin are multifactorial. Medical research proved the presence of increased amounts of elastic fibres of collagen in the skin of smoking women in comparison to non-smokers. In this research, skin biopsies were taken from areas of the forehead and forearms. In the studied group of smokers the amount of capillary vessels in the skin of the forehead was considerably decreased, however no statistical difference was observed in the skin of the forearms. In the course of skin aging, the amount of capillary vessels gets reduced in time (6).

Finnish scientists compared the *in vivo* collagen synthesis and its degradation in the skin of smokers and non-smokers. For the skin of smokers they proved lower amounts of proteins which are engaged in the process of collagen synthesis. Procollagen propteides of type I (PINP) concentration was 18% lower and procollagen propteides of type III (PIIINP) was also about 22% lower in the skin of smokers when compared with non-smokers. The level of matrix metalloproteinase (MMP-8) – enzyme which participates in the degradation of collagen was about twice higher in smokers than in non-smokers, however the level of tissue inhibitor of MMP (TIMP 1) showed a decrease of about

14% in smokers compared with non-smokers. The highest level of MMP-8 was found in smokers under the age of 50. The largest intensity of changes in transmutation of metabolic extracellular matrix occurs in middle-aged smokers. This research proved that the compound substances of cigarettes have got an essential influence on the decrease of level of substances indispensable to biosynthesis of collagen, thus leading to the increase in collagen degradation. A disturbed balance of exchanged alternatively metabolic processes which take place in the skin of smokers is the next mechanism explaining premature skin ageing (7).

Table 1. Contents of cigarette smoke

Action	Chemical compounds
Toxic substances	Nicotine Carbon monoxide Hydrogen cyanide Ammonia Nitrogen monoxide
Irritating substances	Akroleine Sulphur monoxide Ammonia Formaldehyde
Ciliotoxic substances	Hydrogen cyanide Akroleine Acetaldehyde Formaldehyde
Cocancerogens	Formaldehyde Pyrene Fluoranten Naphthalene Catechol
Cancerogens	Benzene Dimethylnitrozoamine Ethylomethylnitrozoamine Nitrozopirolidyne Hydrazine Vinyl chloride
Activators of tumors	Toluene Phenol Urethane

All the mentioned mechanisms lead to elastosis. Elastosis is the disease of connective tissue including changes in the figure of condensation such as disorderly pulps of collagen and a decreased number of collagenous fibres. The study conducted among 956 smokers showed that smoking cigarettes is strictly connected with the occurrence of elastosis, regardless of the sex (8).

Pellaton and others proved that in a person who has been smoking for many years superficial blood circulation was handicapped. The level of acetylcholine and nitropruside of sodium (vasodilating substance) in the serum was decreased (9). Nicotine increases blood levels of vasopressine, which is a vasoconstrictor causing an acute decrease of capillary and arteriolar blood flow in the skin leading to chronic ischemia of the dermis. This leads to proliferation of small blood vessels, which are visible as telangiectasia. The sex-dependent difference noticed was an enlarged number of telangiectases in the skin of male smokers, in contrast to that of female smokers (8).

Giving up smoking can slow down all the processes of skin aging. People who smoked many cigarettes in their youth, but stopped smoking, have considerably fewer face wrinkles than people smoking uninterruptedly from young years. The researchers observed a typical wrinkling directly connected with cigarette smoke and smoking. This kind of wrinkling occurs at the age over twenty (9).

Smoking cigarettes contributes directly to premature aging of the skin and it leads to characteristic changes in the face mimic called "the smoker's face". One observes lines or wrinkles on the face typically radiating at right angles from the upper and lower lips or corners of the eyes, deep lines in the cheeks and numerous shallow lines on the cheeks and lower jaw. Skin becomes weakly gray-sallow coloured, dry and rough. It is more exposed to microtrauma. In such regions as: thighs, shoulders or buttocks, the growth of subcutaneous aliphatic tissue occurs. Hair becomes dry and loses its glitter and elasticity (8, 10).

Mucosa of the oral cavity becomes more susceptible to mechanical trauma. Leukoplakia occurs more often and, unless smoking is given up, neoplastic transformation in the oral cavity may take place. A yellow deposit appears on teeth, which transmits an unpleasant odour from the mouth (10).

Smoking leads to hypoxia of all tissues. Insufficient oxygenation of organism cells and reduced amounts of collagen fibres determine the main cause of difficulty in proper wound healing after surgeries in smokers. Smoking decreases interleukin-1 production, inhibits early signals for B-cell transduction pathways, decreases cytotoxicity of natural killer cells, and causes T-cell anergy. By decreasing blood flow to damaged skin, smoking increases postsurgical infections. As a result of poor wound outcomes, plastic surgeons often refuse to perform cosmetic breast surgeries and facelifts on patients who refuse to quit smoking (11).

Cigarette smoke consists of chemical substances directly connected with cancer transformation and of substances which do not have such properties, but are able to amplify neoplastic processes in case vestigial quantities of cancerogens appear (Table 2). It is also claimed that smoking cigarettes influences the growth of skin cancer: basal cell carcinoma, spinocellular cancer, melanoma (12–15).

Table 2. Cancers caused by cancerogens included in cigarette smoke

Cancer	Chemical compounds
Oesophageal cancer	N-nitrozonornicotine Nitrozopiperidine Nitrozoprolidine
Pulmonary cancer	Polonium-210 Compounds of nickel Compounds of cadmium
Pancreatic cancer	Nitrozamins
Cancer of kidneys and bladder	B-naphthylamine x-aminofluoren x-aminostylben o-toluidyne n-nitrotoluene di-n-butylonitrozamine

The research conducted by Friedman's team proved an increased appearance of basal cell carcinoma (BCC) in ex-smokers in comparison to current smokers. It should be remarked that among smoking women there was no connection between the pronouncement of BBC and the intensity and duration of smoking cigarettes. However, a significant growth was noticed among male smokers who smoked 35–40 cigarettes per day. A surprising observation was that the risk of appearance of BBC was reduced together with duration of the habit (12). Among young female smokers with diagnosed BBC, intensively smoking women proclaimed a significant group (13).

It was also proved that smoking cigarettes played the main role in the occurrence of the morpheaform basal cell carcinoma. Turkish researchers found that among patients with diagnosed BCC almost 43% were smokers. In this group 67.7% were patients who had morpheaform basal cell carcinoma. In this group, an increased level of mast cells was observed (14).

Swedish, French and American scientists carried out a cohort analysis on a group of 338,000 smokers. In this study, a connection between the number of smoked cigarettes together with the duration of smoking and the occurrence and development of squamous cell carcinoma (SCC) was observed. However, an increased risk of occurrence of SCC was noticed in the group of people who were tobacco snuff dipping (15).

Freedman and his research team performed an international study among about 70,000 people, which established risk factors for the development of melanoma. In this study, a significant clinical implication was observed between the group of current smokers in comparison to non-smokers. The risk of development of melanoma was unrelated to the number of packs per day, it was inversely associated with long duration. The risk of development of melanoma was about 40% lower in the group of smokers who had smoked for a period of 30 years when compared with the group of non-smokers ($p=0.03$). An essential finding in the group of female smokers was that the duration of smoking of above 25 years and smoking over 30 packs of cigarettes was inversely proportional to the risk of occurrence of melanoma. The apparent absence of an elevated risk of melanoma among long-term smokers with indicators of high residential sunlight in contrast to the increased risk observed in non-smokers could reflect various biases or chance (16).

There are medical reports which prove that smoking cigarettes has an influence on the development of some diseases such as polymorphic light eruption (PLE) or psoriasis, and on the exacerbation of clinical symptoms in diseases such as acne or lupus erythematosus (LE).

Smoking cigarettes during recovering from essential states makes the healing process difficult. American scientists performed a medical study on patients suffering from discoid lupus erythematosus (DLE) and subacute lupus erythematosus (SLE) in two groups of smoking and non-smoking people. In both groups antimalarial drugs (hydroxychloroquine or chloroquine) were used. In this study, it was observed that the therapeutic effect was more difficult to acquire in the group of smokers (17).

A medical study also proved that palmoplantar pustulosis is an autoimmune disease which is induced by smoking cigarettes. 95% of patients with palmoplantar pustulosis are smokers at onset disease. Smoking is a trigger factor in the development of this disease (18,19). Some studies revealed that active use of nicotine can aggravate clinical picture of psoriasis and can also trigger its development (20).

Smoking has a positive influence on some diseases. Smoking cigarettes reduces the frequency of occurrence of oral and genital aphthosis and other symptoms in the course of Behcet disease. Some studies proved that smoking cigarettes decreases the risk of occurrence of Kaposi carcinoma in patient suffering from AIDS. A protective effect of smoking was proved in patients suffering from melanoma with changes situated on distal regions of the human body. It is also worth mentioning that the use of nicotine in patients with pyoderma gangrenosum brings some good therapeutical results (11).

Chemical substances in cigarette smoke have a direct and indirect influence on every organ of the human organism. These substances evoke many undesirable effects and lead to metabolic disorders and genetic disorders. These disorders produce undesired results such as: accelerated aging of the human organism and the development of diseases which are difficult to treat. Sometimes smoking makes the management of an effective therapeutic process difficult.

People who use cigarettes should be informed by their own doctor about the risk of development of skin cancer and of occurrence of premature skin aging. This information can have an essential

influence on the decision to stop smoking and abandon the bad habit which is harmful for patients and for people who stay in their company.

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SUMMARY

Numerous adverse effects and health problems are associated with smoking, but it also leads to variety of skin lesions. Premature skin aging, impaired wound healing are caused by the toxic chemical compounds contained in cigarettes (nicotine, carbon monoxide). There are medical reports which prove that smoking has the influence on the development of some dermatologic conditions such as: polymorphic light eruption (PLE), psoriasis, morphea and on the exacerbation of clinical symptoms in diseases such as acne or systemic lupus erythematosus. In addition, smoking has impact on the etiopathogenesis of squamous cell carcinoma. This paper presents the latest update on the influence of smoking on skin.

Wpływ nikotyny i innych związków zawartych w dymie papierosowym na skórę

Powszechnie znane są skutki zdrowotne palenia papierosów, ale należy podkreślić, że palenie prowadzi również do licznych zmian w skórze. Przyspieszony proces starzenia się skóry, utrudnione gojenie ran spowodowane jest wpływem licznych szkodliwych substancji chemicznych zawartych w papierosie (nikotyna, tlenek węgla). Udowodniono, że palenie ma istotny wpływ na rozwój takich zaburzeń dermatologicznych, jak: polimorficzne osutki świetlne, łuszczyca, twardzina skórna, a także na nasilenie objawów w przebiegu takich schorzeń, jak trądzik czy tocień rumieniowaty. Ponadto palenie jest jednym z czynników etiologicznych raka kółczystokomórkowego. Praca przedstawia przegląd najnowszego piśmiennictwa na temat wpływu palenia papierosów na procesy przebiegające w obrębie skóry.