

# Cellulite – from A to Z

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Exceptions prove the rule: the vast majority of women will develop cellulite some time in their life. The treatment of the annoying indentations has grown into a profitable branch of business within cosmetics. There are lots of promises but reality frequently is different. The following overview shows what can be done and what actually is impossible.

**A**ccording to estimates, 90 % of women will develop cellulite. Root cause is the gender-specific structure of the lipid and connective tissue. The epidermis is thinner than in men and the subcutaneous connective tissue shows parallel structures instead of reticular formations. Such construction allows a temporarily increased integration of fatty substances with stretching of the lipid cells in the subcutaneous tissue. Now, what appears perfect to bridge periods of food shortages and pregnancy creates esthetic problems in normal life, though. The increased volume of lipid cells irregularly extends the connective tissue fibers and looks from the outside like a landscape of hills on the skin. The developing little fat stores and the related uneven distribution of lipid and fluid deposits inevitably influence microcirculation and metabolism of the skin. Also skinny women may be affected by cellulite if they have an unstable connective tissue.

Tabloid papers frequently speak of disorders in the acid-base balance and residues of waste products that have to be removed with a whole variety of different concepts. What seems rather plausible and clear for the consumer, however, is not validated by the scientific community. Hormonal influences, unbalanced and sumptuous nutrition, hereditary predisposition to weak connective tissue as well as lack of exercise still increase a cellulite manifestation. It is only logical that the different treatments concentrate on factors like

- controlling the nutrition
- stimulating the metabolism and microcirculation
- stabilizing the connective tissue

The biological-genetic causes can hardly be changed, however the individual behavior generally can contribute to minimize cellulite effects. Experience teaches that substantial improvements can be achieved by combining a number of different measures. The following keywords and explanations are intended to help find a way out of the labyrinth of technical

terms, active agents, physio-therapeutic treatments and counterproductive factors in order to individually develop convincing holistic treatment concepts.

**Adipocytes:** This is another term for lipid tissue cells. **Lipocytes** with a single, space-filling fat storage (vacuole) and cells with several vacuoles pertain to this type of cells. An interesting fact is that lipocytes, among others synthesize the peptide leptin, which has appetite suppressant effects. When the fat storages become empty, less leptin will be released and the sensation of hunger increases. While expanding, the lipocytes can impede the microcirculation in the lymph and blood vessels and affect the collagen structure in the long run.

**Indications of cellulite:** While the latent form of cellulite shows ugly indentions and furrows after pinching only (pinch test), the more progressed forms already are obvious on the outside and back of the thighs, on the buttocks, the hips and sometimes on the upper arms even without pressure. Cellulite is not ascribed to a certain age; it can already appear during or after puberty though.

**Connective tissue:** Premature skin aging due to radiation injuries is caused by the collagen degenerating matrix metalloproteinases and should be considered in the context of prevention since the loss of collagen still aggravates an already existing weak connective tissue. That is why sun screens and sun avoidance are quite important. A successful measure to tighten the connective tissue are hot and cold showers. A similar effect have Kneipp water treatments or the new cryotherapy treatment with short stays in the cold chamber at temperatures of less than minus 100°C.

**Nutrition:** Excessive weight and malnutrition are risk factors par excellence and contribute to the fact that lipid cells still grow larger than already scheduled naturally. On the other hand, diets are hardly ever successful and may even

be counterproductive if there is no change in the way of living towards more exercise. A frequently neglected factor is the fatty acid spectrum in our nutrition. As with many other problems of the human body, it should be kept in mind that sufficient essential fatty acids and particularly omega-3 acids are consumed (from fish, linseed oil, kiwi oil, rose hip seed oil) and only very few hydrogenated or partly hydrogenated fats. In case that the nutrition is well-balanced we generally can trust on the intelligence of Mother Nature and stay off the frequently recommended nutrition supplements. In complicated cases it is recommended to contact a nutrition counseling office. Increased consumption of alcohol and nicotine also has a negative influence in this context.

**Infrared radiation:** Infrared radiation serves as a means to warm up the skin either on the surface or down into deeper skin layers, depending on the wavelength. As with radio wave treatments, skin care products with active agents are faster available for the skin. On the other hand, short wave infrared laser with a wave length of 800 to 1500 nm are used to liquidize fat deposits and remove them by means of small cuts (see also liposuction). Intense infrared radiation from sun exposure, however, accelerates the skin aging process.

**Injection lipolysis:** This method is used to remediate fat deposits in the face and on the thighs. It consists of a combination of phosphatidylcholine (PC) and desoxycholic acid (bile acid) which is injected into the respective areas. The fats solubilize in form of tiny drops and can be hydrolyzed by the natural lipases of the body and finally be metabolized in the liver.

**Cavitation:** Closely related to the energy of ultrasound waves is the acoustic pressure. The acoustic wave periodically produces vacuum and excessive pressure. Excessive vacuum may cause gas bubbles in the tissue (cavitation) which subsequently lead to tissue damages. This method has recently been used to destroy lipid cells. Similar to traditional ultrasound procedures, active agents with lipolytic or anti-inflammatory effects are also used in this type of treatment.

**Lipedema:** This disorder of the lipid tissue only affects women. The subcutaneous fat deposits of the lipedema frequently hide behind a cellulite condition and are characterized by painful swellings. Pressure marks often develop into bruises.

**Lipolysis:** It denominates the breakdown of triglycerides (fats) into glycerin and fatty acids.

Adipose tissue undergoes lipolytic hydrolysis; the fatty acids then are transported out of the tissue and finally degraded through  $\beta$ -oxidation. There are a number of substances that inhibit the phosphodiesterases and thus externally stimulate the lipolysis. Among these substances are xanthines, a group of natural substances comprising caffeine, theobromine, theophylline and aminophylline.

**Lipoma:** The lipoma is a fat tumor consisting of adipocytes. Lipomas develop in the subcutaneous tissue and are characterized by a hard and spherical structure. They are considered as benign tumors and are removed in outpatient therapy. There is no relationship between cellulite and lipomas though.

**Liposomes:** Main component of liposomes is native phosphatidylcholine which is used for the injection lipolysis (fat melting injection). As liposomes fuse with the barrier layers of the skin and make them more permeable for active agents, they are used as transport vehicles for water soluble active agents. Combined with encapsulated caffeine (about 2%), which has lipolytic effects and stimulates the microcirculation, it will mobilize the fat stores. Significant results can be achieved if the fat stores are simultaneously irritated with ultrasound or massage treatments, for instance.

**Liposuction:** The suction of entire lipid cells after injecting a fat mobilizing aqueous phase (tumescent solution) is a surgical treatment and carried out under anesthesia. Hence, there are certain risks involved.

**Lymph drainage:** In contrast to the classic massage, we are here not dealing with a stimulated microcirculation but with the removal of tissue fluid via lymphatic system. As a general rule, lymph drainage is applied manually in case of fluid-induced swellings. The procedure can be combined with active-agent enriched skin care products.

**Phosphatidylcholine (PC):** This substance belongs to the group of phospholipids. The native substance is gained from soybean lecithin and contains three chemically bound essential components: choline (cell protection factor), linoleic acid (omega-6 acid) and alpha-linolenic acid (omega-3 acid). PC is the main component of all cell membranes.

**Massages:** When it comes to massaging thigh areas with suspected cellulite or eventually treating certain areas of the thighs with ultrasound therapy, hydrogels with liposomal caffeine or alternatively liposome concentrates

(see phosphatidylcholine) in combination with green tea extract have proved successful. They mobilize fat stores and improve the microcirculation.

Lipid-containing massage creams can be individually adapted with essential oils and other active agents however, they are not suitable for ultrasound treatments. Vegetable oils and waxes (as e.g. jojoba oil) as well as oleogels (lipogels) are the non-aqueous variants. Means like brushes, hot stones or herb stamps intensify the massages. Herb stamps continuously release the active agents during the massage.

A specific type of massage is the vacuum massage with its pulsating pump effect which is intended to drain accumulated fluids into the lymphatic ducts.

**Mesotherapy:** The therapy is based on the idea of replacing injection lipolysis by microinjections. The term “meso” indicates that the microinjections will reach into the “middle” skin layer. Similar to the injection therapy, phosphatidylcholine/desoxycholic acid solutions were initially used; in the meantime the procedure has also been applied with for a series of other skin treatments although with different active agents. A modification hereof is the micro needling procedure (derma roller), which, up to a needle length of 0.2 mm can also be carried out by cosmeticians. In cellulite therapy, the derma roller frequently is combined with the application of vitamin A and caffeine.

**Microcirculation:** Similar to the microcirculation disorders caused by cellulite, the impaired activity of blood vessels vice versa seems to cause tissue modifications (ping pong effect). Occasionally, it is also assumed that inflammatory vascular processes in the background act as triggers here. In this context the daily working conditions like long hours in a standing position or sedentary work may be crucial for the impaired capillary network. Fluid deposits cause additional swellings. Hence, it is all the more important to start with exercises at an early stage; this will support both blood circulation and the microcirculation of the whole body. Light clothing and physical inactivity at cold temperatures also cause damages of the capillary vessels. Typical active agents to stimulate the microcirculation are caffeine, green tea and horse chestnut.

**Estrogens:** Responsible for the fat deposits are the female sex hormones. Skin alterations similar to cellulite can also be observed in male individuals undergoing estrogen therapy.

**Phytohormones:** Isoflavonoids gained from soybean or red clover, have light estrogen-like

effects and stimulate the collagen metabolism. As the natural estrogens of the body are responsible for the cellulite fat deposits, a moderate fat consumption is recommended if phytohormones are topically applied. In contrast to what is frequently claimed, it has not been proved yet to what extent their anti-oxidative effect plays a role for cellulite conditions.

**Radio wave therapy:** This method can be beneficial if active agents are used. The moderate local warming of the tissue (see infrared radiation) improves the permeation of active agents. They are activated. Furthermore, the fibroblasts in the dermis are stimulated. The formation of collagen and elastin fibers is activated.

**Sport:** Unlike static movements, most of the sports are of dynamic character with a large number of body segments participating simultaneously. Metabolism, tissue formation and microcirculation are maximally stimulated. Examples are jogging, swimming (preferably crawl movements) and climbing. At first glance, the latter mentioned sport appears unfeminine however, an interesting fact is that specifically women are quite talented in this discipline and excel by harmonious movement sequences. Biking and dynamic stair climbing also contribute to the individual fitness.

**Ultrasound:** Mechanical and thermal effects combined with increased circulation and stimulated metabolism are in the foreground of this treatment. Ultrasound can be perfectly combined with massage and infrared therapies. The method improves the penetration of active agents which are partly used as concentrates in pure form without medium (as e.g. gel).

**Cellulitis:** The term has nothing in common with cellulite. Cellulitis is a bacterial inflammation of the subcutaneous tissue and can affect all the different areas of the skin, however in the majority of cases it appears in the facial area.

### **Cosmetic agents**

A considerable number of different cosmetic agents are supposed to treat cellulite. In fact, only a few effects have been proved in-vivo though, and many of the ascribed effects only are suspected. Nevertheless, there are several interesting effects which have been circulating again and again, thus they are described in the following:

**Antioxidants:** The effects of flavonoids that occur in vegetable extracts like rock samphire, tea, pomegranate, ginkgo and calendula have

been emphasized time and again. In how far the flavonoids mentioned and also further antioxidants like lipoic acid, resveratrol, and carotenoids can get through to the matrix metalloproteinases and actually are able to inhibit these enzymes or have other effects, has not been clarified yet.

**L-Carnitine:** This substance is reported as a catalyst for the fatty acid combustion and recommended as a dietary supplement. Up to now, there have been no indications for a direct influence on cellulite – this applies for oral as well as for the topical application.

**Centella Asiatica:** Tiger grass extracts stimulate the collagen synthesis and improve the microcirculation. Combined with phytohormones, green tea and caffeine they are frequently used as a base for tightening combination products that are also applied for the care of the décolleté.

**Coenzyme Q10:** The coenzyme occurs in the fat burning mitochondria and has an activating effect on atrophic skin. Effects on cellulite have not been proved yet.

**Chili:** Chili extracts contain the agent capsaicin and stimulate the blood circulation similar to ginger and vanillin ester. Capsaicin is a component of heat plasters.

**Dimethylaminoethanol (DMAE):** is a natural amine of the human body which is metabolized inter alia into choline that is chemically bound to phosphatidylcholine (PC). It is ascribed a multitude of effects already proved for choline respectively PC. Among them are cell protective effects during oxidative stress (liver, skin) and anti-inflammatory properties. It is used in anti-aging preparations. A direct effect on cellulite could not be proved yet.

**Don Quai:** The extract of the Chinese angelica root contains phytohormones. In Asia it is used against menopause symptoms. It also is an appropriate massage additive.

**Ivy or English ivy extract:** contains saponins and is used against swellings similar to butcher's broom.

**Kigelia extract:** contains phytohormones and has tightening effects on the skin.

**Horse chestnut extract:** The aescin contained in chestnut extract is a saponin which stabilizes the vascular walls of the veins. It originates from traditional folk medicine, has decongesting

effects and is a medical drug to treat the leg veins.

**Caffeine:** belongs to the xanthenes which show lipolytic (fat splitting) activities. Extracts of green tea, cola or guarana can substitute the pure agent. Caffeine is particularly effective in liposomal dispersions where it is used in concentrations of up to 2 %.

**Butcher's broom:** The extract is gained from the plant *Ruscus aculeatus*. It contains saponins and sapogenins like ruscin, ruscogenin and neo-ruscogenin as well as the alkaloid spartein. Besides cellulite it is also recommended against edemas and couperosis. Modelages and packs still augment the effects. Ruscogenin and neo-ruscogenin have tightening effects on the tissue and stabilize the vascular system.

**Pueraria mirifica:** The extracts of the kwao-krua root which originates from Thailand contain phytoestrogens and phytosterols. They are appropriate additives for body packs in the cellulite treatment.

**Horsetail extracts:** contain saponins and flavonoids. Besides astringent effects, silicic acid is worth mentioning. The connective tissue as well as the skeleton depends on the supply of silicic acid.

**Vitamins:** Among the vitamins that are relevant for the cellulite treatment are retinol (vitamin A) and ascorbic acid (vitamin C). Both vitamins stimulate the collagen formation and are valuable components in cellulite preparations. The availability of retinol in form of retinol palmitate (INCI) is considerably increased by nanoparticles. The availability of ascorbic acid in form of sodium ascorbyl phosphate (INCI) is significantly augmented by liposomes.

Vitamin K has a tightening and vessel-stabilizing effect. It has been recently banned as a cosmetic ingredient. An interesting fact is the relatively high concentration of vitamin K<sub>2</sub> in Natto, the Japanese national dish which basically is a bacteria-fermented soybean dish.

**Boswellia extract:** inhibits the collagen degradation process caused by the matrix metalloproteinases.

**Xanthoxylone (4,6-Dimethoxy-2-hydroxyacetophenone):** activates the protein thermogenin (USP1) and hence catalyzes the lipolysis of triglycerides into glycerin and free fatty acids.

**Yams roots:** The extracts have a high content of diosgenin. Diosgenin is a steroidal sapogenin with estrogenic activity. That is the reason why

the natural medicine uses yams extract against menopause problems. It is supposed to reduce the fat absorption in the lipid cells.

### **Outlook**

Reproducible and statistically and metrologically faultless double-blind studies documenting active agent based cellulite treatments and related improvements of the initial situations are scarce though. This can partly be ascribed to the missing logical measuring methodology. On the other hand, the empirical values gained from practice dominate however, these values are not reliable. Frequently only one parameter is measured while others are neglected. Simple parameters for example are upper thigh circumference and photographs. In this context, manipulations are the order of the day. And, the predominant mechanisms in a series of oral dietary supplements are the draining and diuretic effects.

There is no convenient panacea to be swallowed like pills or applied like creams against cellulite. However, if negative factors are largely excluded and positive influences are supported, there is a chance to achieve an optimum situation in the long run. Nevertheless, there is the same rule as in many other cases: Just keep at it, ladies!

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