

## Over View of Smoking

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About twenty percent of adults smoke, averaging 14 a day (See NHS choices) making this the most common chronic deadly disease. Smoking has many characteristics of a chronic disease. Researchers have shown that many would quit if they could see how smoke was damaging their health. Cigarette smoke contains nicotine, many cancer inducing heavy metals and reactive oxygen species. Oxygen species inflame the blood vessels and possibly throat mucus plays a part. Increased inflammation makes it behave like an auto immune disorder.

I knew very little about smoking and spent a considerable time researching modern papers on the effect of smoking both good and bad. I wanted to know why people smoke and understand the pleasure they derive from this. I was surprised to find that the nicotine in smoking uprates dopamine in the brain lightening the mood, reduces anxiety, potentiates alcohol and food, making it more pleasurable. It acts as a hunger suppressant and many people are concerned that if they quit - they will put on weight. A recent study found that quitters only put on about a pound.

### General changes

The bad effects of smoking are well known and can be classed as cancers, lung disorders and vascular and heart diseases. Long term nicotine consumption causes nerve damage that is seen in the fine tremors that many older smokers have. It causes wrinkles and cools the body so that smokers tend to feel cold. It increases the risk of many chronic diseases.

### Ocular changes

The ocular effects are as reported in the Beaver Dam Report to be 1.5 risk of dry eye, nuclear cataracts and neovascular wet macula degeneration. Macula degeneration was further studied in the Singapore Malay Eye Study that found that ethnicity was not a factor but genetics, vascular disease and lifestyle (smoking) were.

### Tobacco amblyopia

is a reduction in visual sensitivity of the macula, seen in heavy smokers. This shows as poor vision, low contrast with poor colour discrimination.

### Thyroid disease

Smoking increases the risk of Thyroid Graves Disease (goitre) four to five fold, and this can cause dry eye symptoms from associated Graves Eye Disease.

### Migraines

A recent Spanish Study into Headaches among student smokers reported that smokers of 5 or more have a increased risk of migraine headaches. I looked at this myself and found that many smokers have migraines every week, compared to non smokers who typically get migraines rarely.

### Diabetes

Chronic smoking causes a big rise in diabetic retinopathy and macula oedema.

### Vascular disease

Smokers carry a higher risk (2x) of hypertension, stroke and aneurysm. These can cause catastrophic visual problems.

### Uveitis

It carries two fold risk of uveitis. see Cigarette Smoking as a risk factor for Uveitis.

### Inflammatory Diseases

Because smoke increases vascular inflammation, it carries increased risk of Sarcoidosis, Arthritis and other autoimmune disorders - many have dry eye and episcleritis and uveitis as their ocular components.

## Eye Infections

Smokers have about three times the ocular infections than non-smokers. These also last longer and are worse. This is an important risk for contact lens wearers who carry an enhanced infection risk. I have noticed this with my patients.

## Ocular Rosacea

Smoking seems to accelerate and exacerbate this condition and I found that patients quitting was significant in treatment.

It can be assumed that even light smoking risks both acute and long term changes to the eye.

My starting point was dry eye and I decided to interview 400 smokers and compare them to 400 never smokers. This was formally organised into a research proposal and was submitted to the NHS research committee for ethical approval. I also informed my employers, who raised no objection. I found from the NHS that this study was exempt.

The study was designed to be a case/ control study with confounders being taken into consideration. I decided to grade eyelid changes and see if they related to smoking history and symptomology.

This resulted in a huge pile of data that was beyond my ability to statistically analyse. However, there was an echo of smokers mortality, in that the smokers' average age was 48 years old and never smoker average age was 56. I found that smokers collected meibomian gland loss with the passing years of smoking. The eyelid margins showed inflammatory changes and showed melanosis patches.

With the seeming failure of the data analysis, but getting even more interested - I decided to keep going.

## Dose

I found symptomology depended with their weight and number of cigarettes per day smoked. (This can only ever be approximated, as each smoker will smoke in their own way, some inhale to the lungs (1mg intake per cigarette) and others may simply take it into their mouth and then exhale (0.3mg intake).) This may account for some of my results scatter.

## Lacrimation

I found that even new smokers had lacrimation and dry eye symptoms - but these obeyed a daily cycle, with gritty eye on awak-

ing and wet eye in the evenings. This was even true for new smokers.

However, after thirty pack years many persons have less symptoms, perhaps due to reduced ocular sensitivity.

## Reduced Ocular Sensitivity

I found smokers to have reduced ocular sensitivity: I could poke them with fluorescein without much ado, while never smokers tend to jump and lacrimate. This difference is also seen on the air puff tonometer. I found a study also reporting this. However, sensitivity depends on nicotine level and in the morning, the eyes are fully sensitive due to overnight abstinence.

## Blepharitis

Most smokers had some form of blepharitis - mainly posterior and this increased with pack years. Strangely, they rarely complain of irritation, even during meibomian gland distress. Ivan Cher of New South Wales University in 1997 found that when a meibomian gland was shrinking - it caused the overlying lid margin to sink. I had the fortune to observe this in a friend who smoked and found that this takes a whole year to happen. He never ever had any discomfort, except occasional tearing.

Smokers, gradually build up their pack years and at 25 pack years, which related to a typical 45 year old, things start to happen. They have measurable glare - as measured by a spot light, they will show vascular irregularity due to arteriosclerosis, odd hard drusen and perhaps beginnings of an arcus from increased cholesterol level.

I found that the tear meniscus of smokers were not statistically different from non- smokers or ex-smokers.

The lipid layer was deficient in smokers as showed by reduced TBUT (9 in smokers), the lipid layer was unmeasurable in most (as measured by getting them to look down, which concentrates the tear film, observed at 25 mag). The tears, as observed using fluorescein, had that streaky appearance seen in lipid deficiency.

Most meibomian glands show white meibum, and when the meibomian glands are observed carefully, a gradual disorganisation is seen. This ends in very poor, broken, shortened glands that are useless in their primary role. It is remarkable that meibomian glands don't repair or regenerate.

Once damaged always damaged - leading to cumulative loss of glands and tear lipids. Which in turn leads to increased tear evaporation, which leads again to increased tear thickness (osmolarity) which sucks water out of the ocular surface cells. This leads to the gritty eyes they feel.

However, the gritty eyes improve during the day. In the morning the first glorious fag of the day may switch on the lacrimal glands nicotinic receptors and increase lacrimal tear flow which masks the dry eye symptoms. Coffee has also been found to increase lacrimal tears. Smoking Associated with Lipid Layer of the Ocular Surface (June 06 Am J Ophth) makes the point widely held that the gritty feel is due to inflammation within the anterior segment. we don't know how this all happens together.

Smoking perhaps causes or accelerates meibomian destruction and dysorganisation.

The Meibomian Gland Report 2011 says that meibum may not only control tear evaporation but important for Ocular Comfort.

### Speculation

If I was a little bacteria or inflammatory immune body on the eyes surface. If I looked out into the adjoining eyelid, I would see massive meibomian glands with tiny spaces in between. I would know that the conjunctiva is porous and easily crossed. Perhaps then, the meibomian gland forms part of a feedback to inflammation, by soaking up any inflammatory bodies and antigen, combining them with meibum, causing meibum thickening.

It is entirely possible that men have accelerated meibomian changes due to the effect of the tobacco on the prostate gland causing enlargement. (see the meibomian gland report 2011).

So, the tears in my smoking fathers eyes, which are also seen in a late photo of Franz Liszt - were mucousy thick tears.

Further problems happen when the smoker quits.

Quitting causes the immune system re-adjustment and takes months to find a new balance.

Obviously, ocular sensitivity recovers and their gritty eye gets worse and lasts all day. I found three healthy women in their thirties after sudden cessation started to get Graves Thyroid Disease with orbitopathy. This is an inflammation of the fatty orbit which spreads to the conjunctiva causing dry eye symptoms as reported

in ? Ocul Thyroid Eye Disease in Patients Presenting with Dry Eye Symptoms? April 2009 Ophthalmology.

It seems that chronic smoking sets the person on a different trajectory to the non-smoker. This is most likely due to its uprating of vascular inflammation and inflammatory bodies circulating within the body. Smoking can be seen as an low grade inflammatory disease in its own right.

I place the patient on a regime of eyelid cleansing with propriety cleansers and wipes. I suggest they very slowly reduce their cigarette intake and seek a check up from the doctor which includes a thyroid function. They will need lipid sprays, comfort eyedrops and they may also need Eye Bag heat treatment of the glands. It will take many months to clear, I found that it takes nearly a year to achieve good ocular comfort after cessation. Most patients are relieved to find that the help for their dry eye is within their grasp.

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