

## The Post-Mortem Pink Teeth Phenomenon

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**Abstract:** In certain circumstances, teeth may appear with a discoloration in post-mortem examinations. This phenomenon is called pink teeth. Pink teeth are caused by release of hemosiderin due to the breakdown of haemoglobin of red cells inside the pulp. The hemosiderin then is released inside the dentine tubules and discolour the teeth. Nevertheless, this situation can be reported in living humans, in endodontically treated teeth and in other conditions in primary teeth, etc. There are many reports of pink teeth in the literature, thus the usage of proof in Forensic odontology for a positive identification of a body remains under controversy.

**Key words:** Pink teeth, hemosiderin, endodontic therapy, traumatic injuries, internal resorption, dentinal tubules, post-mortem pink teeth, forensic identification, Forensic odontology

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### INTRODUCTION

The earliest available reference to the post-mortem pink teeth was studied from Bell (1829) who first reported the phenomenon. He described a pink colouration in teeth of drowning or strangulation victims. Bell (1829) suggested that it was due to an intrinsically or extrinsically increased pressure inside the pulp.

The appearance of this phenomenon has been noted many times in the forensic literature and the application of modern techniques has shed some light on its etiology and the mechanism underlying the phenomenon (Sainio *et al.*, 1990).

A devastating tsunami was spawned on 26 December, 2004 by a 9.1 magnitude earthquake off the coast of Sumatra, Indonesia. This was the 3rd biggest natural disaster in the past 100 years which devastated coastal parts of >11 countries in and around the Indian ocean and killed perhaps 230,000 people and left about 2 million homeless.

People from >58 nationalities were amongst the victims and subsequently this led to the greatest international effort undertaken so far to identify victims of natural catastrophes. This created unprecedented challenges for forensic identification of dead bodies. In post mortem examinations, pink teeth were found among the unidentified victims (Fig. 1) (Lau *et al.*, 2005; Stavrianos, 2009). Several corpses were in an advanced stage of decomposition due to prolonged exposure to



Fig. 1: Post-mortem jaws after dissection from the skull. The teeth discoloration is evident, naming the pink teeth form (Stavrianos, 2009)

tropical heat, humidity and fungi (Petju *et al.*, 2007; Perrier *et al.*, 2006; Schuller-Gotzburg and Suchanek, 2007; De Valck, 2006; Kieser *et al.*, 2006).

### THE POST-MORTEM PHENOMENON OF PINK TEETH

The phenomenon of post-mortem pink teeth has been reported in subjects who have died suddenly and unnaturally and whose bodies have been subsequently exposed to a moist environment. In this phenomenon, the dentine is coloured because whilst the enamel remains unaffected. The pink coloration of teeth gets particularly deep towards the cemento-enamel junction, fading off but still visible beneath the enamel (Van Wyk, 1988, 1989; Campobasso *et al.*, 2006; Whittaker *et al.*, 1976).

It is described intra tooth variation in that some teeth were affected mainly in the coronal dentine while in others the root dentine was mostly affected. Almost all researches report a time delay between death and the formation of pink teeth. The post-mortem finding of pink teeth is a pathologic sign that remains may have been in a specific environment for a prolonged duration. The presence of moisture in the environment in which the body was found has been cited as an essential contributing factor in the development of the pink teeth phenomenon, especially in shipwrecks and drowning. Therefore, they are most often associated with water immersion. It seems that this phenomenon is more dependent on physical than chemical factors after death. The intensity of characteristics varies between different cases and also between different teeth in an individual case (Campobasso *et al.*, 2006; Whittaker *et al.*, 1976; Van Wyk, 1987, 1988; Borrman *et al.*, 1994; Matthews, 2000; Clark and Law, 1984; Beeley and Harvey, 1973; Sainio *et al.*, 1990).

### ETIOLOGY OF PINK TEETH

Pink phenomena depend on special anatomical features such as the existence of porous structures protected by a dense material, therefore explaining the existence of pink teeth. Various biochemical investigations have described the nature of the post-mortem occurrence of pink teeth. Spectral studies and isoelectric focusing indicated the presence of haemoglobin derivatives. Pink teeth phenomenon results from haemolysis after seepage of haemoglobin or it is derives into the dentinal tubules. The haemoglobin could originate from intravasal erythrocytes or from extravasated erythrocytes in congestion bleedings (Van Wyk, 1989; Stavrianos, 2009; Matthews, 2000).

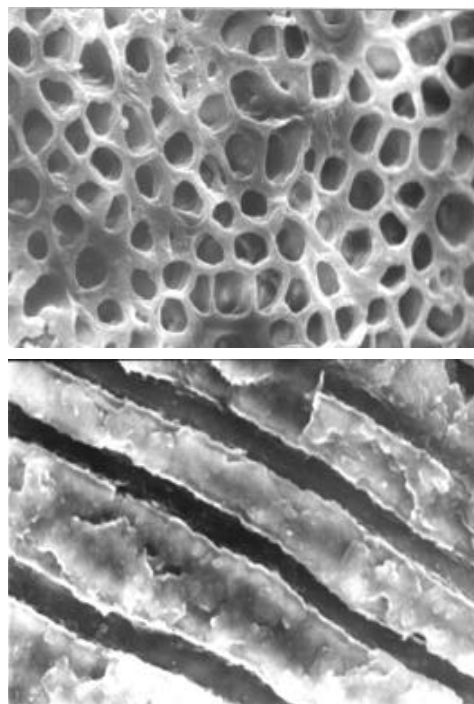


Fig. 2: Left show the appearance of the pulpal surface of the crown dentine. Specimen from female patient, age 15, lower right canine (x2000). Right shows the groups of main dentinal tubules, cut parallel to the tubules (x5000, SEM, Vasiliadis, 1981)

Ikeda *et al.* (1988) using electron probe x-ray micro-analysis showed that the pink teeth contained iron which seemed to be derived from blood haemoglobin and its decay products.

From the literature appears that pink coloration of teeth may occur more easily in the teeth in which the dentin is less compact and contains more dentinal tubules (Borrman *et al.*, 1994; Ortmann and DuChesne, 1998). Van Wyk (1989)'s research ruled out possible staining from hemosiderin, bile and bile-related pigments and porphyrins. The time delay observed between death and blood products getting into the dentine may be explained by the fact that erythrocytes average 7.5  $\mu\text{m}$  in diameter whilst dentinal tubules are only 3  $\mu\text{m}$  in diameter (Fig. 2) so pink dentine can only occur after the breakdown of erythrocyte cell walls (haemolysis) to allow haemoglobin and breakdown products such as porphyrins to filter into the dentine (Van Wyk, 1989).

For the appearance of pink teeth in living individuals other factors have been reported such as discoloration due to endodontic therapy, blood extravasation into the dentin after traumatic injuries, internal resorption, systemic diseases, occurrences of pulp polyp, caries and

primary teeth may appear pink during the normal course of resorption and exfoliation (Campobasso *et al.*, 2006; Van Wyk, 1987; Matthews, 2000; Clark and Law, 1984). Pink teeth have been also described in the archaeological science literature on a number of occasions. A clear difference between the archaeological pink teeth and those described as pink teeth in the forensic literature is the external appearance. Archaeological samples did not show any external sign of pink dentine. It is reported that pink pigmentation in ancient teeth is a consequence of post-mortem decay factors, particularly caused by the tunnelling hyphae of various species of saprophytic fungi (Dye *et al.*, 1995).

## RESULTS AND DISCUSSION

While the phenomenon of pink teeth has been known since 1829, its application in Forensic dentistry has been limited, since pink teeth are observed in victims of drowning and asphyxia but have also been reported in subjects who died suddenly and unnaturally. There is general agreement that there is no obvious connection between the occurrence of pink teeth and the cause of death. It may be concluded that pink teeth are not pathognomonic for a specific cause of death and this is therefore, an unspecific phenomenon (Campobasso *et al.*, 2006; Borrmann *et al.*, 1994).

Whittaker *et al.* (1976) used a group of golden hamsters, half of the group being strangled, the other half given a barbiturate overdose. Half of each group was then placed in soil and the other half in seawater. The onset of pink pigmentation was observed between 2 and 3 months later and came about faster and more intensely in the strangled animals. Animals buried in soil developed pink teeth slower than the others.

Brondum and Simonsen (1987) published a survey of the circumstances of death where pink teeth had been observed. The study showed that pink teeth are occurring in 26 out of 119 forensic cases considered. Where 21 were men whose bodies had been found in sea water from a few days to 8 months after they had 1st gone missing, 3 were men who had been found hanging by the neck and 2 were men who had been poisoned.

Ortmann and DuChesne (1998) studied a female corpse found in a forest in a state of advanced decomposition with pink teeth and an equivalent discolouration of several fingernails. A combination of intoxication, hypothermia and pneumonia could be established as the cause of death

The aim of Van Wyk (1989) study was to produce pink teeth experimentally with cadaver blood and to correlate the time sequence of the coloration with the

pattern of haemolysis of the blood. It is concluded that pink staining of teeth can only occur after haemolysis and that discoloration becomes obvious macroscopically at about 6 days. Van Wyk (1987, 1988, 1989) also commented upon the frequency of pink teeth in forensic cases. Among of 200 corpses examined between 1985 and 1989, 21 displayed pink teeth. Apparently nine were drowned at sea, three were stabbed to death and four died from having a lighted petrol-filled tyre placed around their necks. The other four were too decomposed to determine the cause of death. In all cases, the interval between death and examination was >5 days.

Campobasso *et al.* (2006) studied the frequency and distribution of postmortem pink coloration of the teeth among a representative sample of 52 bodies that were victims of a single shipwreck and were recovered from the seawater after approximately 7 months. A distinct pink coloration of the teeth was found in only 18 cadavers of ages ranging between 13 and 60 years.

The phenomenon was more pronounced in younger individuals. Soriano *et al.* (2009) presented in a case report findings that suggested strangulation as the cause of death. All teeth presented the pink teeth phenomenon. The pink discolouration was most pronounced at the neck of the teeth.

## CONCLUSION

Due to the different circumstances in which pink teeth have been observed and the diverse results obtained on either experimental and/or real cases studied, it can be concluded that no specific correlation exists between the formation of the phenomenon and the cause of death. The formation of pink teeth is a recurring phenomenon and remarkably unpredictable since the ante-mortem prerequisites are non-specific and can be replaced by certain post-mortem conditions. Thus, there is no single satisfactory explanation for pink teeth in the forensic literature. So, it must not be considered as specific forensic evidence (Borrmann *et al.*, 1994; Ortmann and DuChesne, 1998).

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