Narwhal Tooth

The 16th Biennial Conference on the Biology of Marine Mammals in San Diego, California, in December 2005 contained some surprising news about the narwhal whale, also known as the unicorn whale due to the long tooth, or tusk, which emerges from its head. Dr. Martin Nweeia, a researcher at the Harvard School of Dental Medicine (HSDM) revealed that the narwhal’s tooth has ten million tiny nerve connections that extend from the central nerve of the tooth to its outer surface. This lends the tooth hydrodynamic sensor capabilities allowing the narwhal to detect changes in water such as particle gradients, pressure and temperature. Also, given that these whales tend to rub tusks with one another, this behavior likely grants them a unique sensation.

Ancient Drilling

A report in Nature (2006;440:755-756) reveals that dental drilling has been around a lot longer than we ever realized. Researchers at a Neolithic graveyard in Pakistan found eleven drilled molars. The surprise is that these specimens date from 7,500 to 9,000 years ago, which is roughly 1,500 years earlier than any other evidence of drilled teeth currently in collections. Apparently flat drill heads were used on the latest finds. Drill depth was from 0.5 to 3.5 mm, and the fact that it was performed on first or second permanent molars suggests that it certainly was not done for esthetic purposes. Only four of the eleven teeth show signs of caries in relation to the hole drilled, a fact that could mean the drilling was intended to be therapeutic in nature. Additionally, the teeth exhibit marginal smoothing, which attests to the fact that the “patients” were alive at the time and continued to chew with the teeth after the fact.

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Systemic Implications of Oral Health: Diabetes

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Periodontal disease has long been considered a localised infection, however, research over the last few years is now linking the periodontal diseases to a variety of conditions and diseases with systemic implications. These include systemic infections, cardiovascular disease, pregnancy outcomes, respiratory diseases, diabetes and increased all-cause mortality rate. It has been suggested that infection in the periodontal tissues, primarily by gram-negative anaerobic bacteria, can trigger a series of immunologic and inflammatory changes leading to the initiation of systemic disease.

The interaction between oral infection and systemic health was first described in Ancient Egypt, with the concept of focal infection dating back more than a hundred years. Willoughby Dayton Miller again proposed this relationship in an 1891 commentary published in Dental Cosmos. By the 1950s however, the theory was being dismissed. More recently the concept has returned to the dental arena. This was partly because of new data reported by Finnish researchers in the late 1980s when dental infections were found to be statistically linked with heart disease and stroke.

Diabetes

The effect of diabetes on the oral tissues had long been recognized. Diabetics are said to exhibit poorer oral health than non-diabetics. Diabetics have been found to have a higher average gingival index and higher or the same plaque index levels relative to controls. Periodontitis is now considered the sixth most common complication of diabetes mellitus. Persons with non-insulin-dependent diabetes mellitus are three times more likely to develop periodontal disease than non diabetic individuals.

Risk Indicators

The November 2005 edition of the Journal of Periodontology (2005, Vol. 76, No. 11, Pages 2510-2518) featured the results of a study that defined the risk indicators for tooth loss from periodontal disease. Study subjects included 1,775 patients with a total of 3,694 extracted teeth.

The nine risk factors concluded from the study include: age, anterior tooth type, diabetes mellitus, hypertension, inadequate oral hygiene, lack of professional maintenance, male gender, rheumatoid arthritis and smoking.

Periodontal disease accounted for the loss of 2,386 teeth in those with the disease while those without it lost 1,8 teeth. For those subjects older than 35 years, periodontal disease was the reason for 57% of tooth loss with the remaining 43% lost due to other reasons.

Additional results of the study showed that only 16% of study subjects reporting that they brushed their teeth more than twice a day. An amazing 60% admitted to never brushing their tooth or doing so irregularly. Also, 39% of the subjects said that they had never had dental prophylaxis or made a periodontal maintenance visit.

Among the subjects, 31% were either currently smokers or had been in the past. More men (38%) lost their teeth for periodontal problems than women (27%). Finally, 19.2% of the subjects had diabetes mellitus while 13.6% lost their teeth due to other reasons.

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In those that smoke the risk factor is higher. An increased risk for destructive periodontal disease is true for twins with independent diabetes mellitus. 

It has been shown that a causal relationship is mediated through the production of endotoxins and other bacterial products that increase insulin resistance, through the up regulation of macrophage responsive advanced glycation end products. These large molecules accumulate in body tissues, causing dysfunction of normal function. It is suggested that these cellular reactions also occur from bacterial activity in the periodontal tissues causing tissue destruction. Another hypothesis concerns the effects of serum lipids on immune cell phenotype/function. There appears to be a causal relationship between serum lipids and systemic health (particularly cardiovascular disease, diabetes, tissue repair capacity, and immune cell function), susceptibility to periodontitis, and serum levels of proinflammatory cytokines. In terms of the periodontal relationship between periodontitis and systemic disease, it is possible that periodontitis-induced changes in immune cell function cause metabolic dysregulation of lipid metabolism through mechanisms involving proinflammatory cytokines. Sustained elevations of serum lipids and/or pro-inflammatory cytokines may have a serious negative impact on systemic health. It is not clear yet whether the changes in lipid and glucose metabolism are the cause or consequence of periodontitis.

Acute viral and bacterial infections are known to induce insulin resistance. To demonstrate a bidirectional effect can eliminate of peripheral tissue and reduce metabolic control of diabetes? 

Glycemic Control

It is well-established that poor glycemic control is known as an established risk factor for periodontitis. However, there is also evidence that severe periodontal disease may deteriorate glycemic control. A positive association between variations in the blood glucose level and the degree of periodontal disease was reported in type II diabetes mellitus. One study demonstrated loss of attachment is greater in controlled diabetes ages 30–40 with a disease duration of over ten years. Periodontal treatment has been shown to be associated with improved diabetic control as demonstrated by reduced glycosylated haemoglobin in diabetic patients. In this study however, periodontal therapy on its own did not significantly affect glycemic control due to a low treatment levels. This was only achieved when combined with antibiotics. Other studies have shown a reduced need for insulin administration in diabetic patients after receiving periodontal treatment. Further studies are needed to show a consistency in these associations. Other groups also need to be examined such as women and low income groups. Common risk factors also need to be evaluated.

Common Risk Factors

Similarities in the aetiology of periodontal disease and other complications of diabetes are emerging. The aetiology of diabetes seems to be a combination of intrinsic (genetic) factors and environmental influences. In much the same way as the periodontal diseases are viewed, diabetes is considered a series of diseases that have glucose intolerance in common. It is suggested that increased genetic susceptibility, impaired host response and excessive production of collagenase all play a role in the development of both periodontal disease and diabetes. In addition to a possible causal link, confounding risk factors may explain part of the association.

There are many lifestyle factors the two diseases have in common. These include stress, smoking, dietary intake, socio-economic status, weight, fear and depression.

Stress

Factors such as elevated levels of hormones antagonistic to insulin such as cortisol can play a role in the development of insulin resistance and inflammatory bone loss. Stress has been shown to play a role in affecting glycemic control and as a negative factor in periodontal treatment outcome. Smoking and diabetes are considered to be two major factors in the development of periodontal disease. Smoking is recognized as a major factor in the aetiology of periodontal disease with inflammatory bone loss and is also considered a modifiable risk factor in the progression and development of diabetes. 

Nutrition

Diabetes is fundamentally affected by dietary intake. Several dietary factors have been linked to systemic disease. These include adequate antioxidant intake from fruits and vegetables, adequate fiber and a reduction in refined carbohydrate consumption. Antioxidant status has shown to be impaired in diabetic patients, negatively affecting the production of the antioxidant enzymes, glutathione peroxidase and superoxide dismutase. These provide a defence against the damage of cells by reactive oxygen species, which is increased in the diabetic state. The impairment of this same system has also been implicated in the increased susceptibility to the periodontal diseases.

Obesity

Obesity has also been linked to the development of diabetes and periodontal disease. The link between obesity, periodontal infections and diabetes has been suggested as being mediated by increased levels of tumour necrosis factor (TNF) which may lead to a hyper inflammatory state. This would in turn increase the risk for periodontal disease and accounting for part in insulin resistance. Further research is required. Recent study has shown both smoking and obesity are independent risk factors for periodontal disease exhibiting a dose-responsive relationship with periodontal disease.

Healthy Lifestyle

Maintaining normal weight, engaging in the recommended levels of exercise, and eating healthy food are known to improve general health. The impact of these behaviours on periodontal disease was examined and it was found an increased number of healthy-enhancing behaviours is associated with a lower periodontitis prevalence.

Conclusion

It is plausible that there may be a causal link between periodontal disease and diabetes. If this is so then it is likely to include several pathways. These include adequate antioxidant intake from fruits and vegetables, adequate fiber and a reduction in refined carbohydrate consumption. Antioxidant status has shown to be impaired in diabetic patients, negatively affecting the production of the antioxidant enzymes, glutathione peroxidase and superoxide dismutase. These provide a defence against the damage of cells by reactive oxygen species, which is increased in the diabetic state. The impairment of this same system has also been implicated in the increased susceptibility to the periodontal diseases.

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Similar results have also been found with reference to diabetes. 

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38 Dr Kirsten McAuley, Targeted lifestyle management and oral health visit, www.perio-nutrition.com. Juliette has written a number of posts for Smile magazine and clinical articles for smileon.com. Juliette is an experienced Dental Hygienist and qualified Nutritionist. She writes regularly for the dental press including a regular column in Dentistry magazine and clinical articles for smileon.com. Juliette has written a number of post graduate training modules in nutrition and oral health for the dental profession. Her main areas of interest are nutritional influences in periodontal disease, stress, bone density and female hormones. She currently divides her time between writing, researching and lecturing in nutrition and oral health. For further information on nutrition and oral health visit, www.pento-nutric.com.