**Black Stain – A Review**

Valerie Ronay/a/Thomas Attin/a

Summary: The purpose of this review was to summarise the fundamentals about black stain, its diagnosis and possible differential diagnoses as well as its microbiology and therapy. In addition, various studies investigating the relationship between black stain and dental caries are examined. Many studies report lower caries prevalence in children with black stain, but this finding could not be confirmed by all authors. Also, a negative relation between degree of staining and caries severity has been described. Reasons for these results are not yet clear but it was speculated that they are related to the specific oral microflora described in black stain-affected individuals.

Key words: black stain, dental plaque, extrinsic tooth stain, pigmented dental plaque

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Investigations into the nature of black extrinsic tooth stain have now continued for over a century (Pickerill, 1903). With a reported prevalence between around 1% and 20% it can be called a relatively common phenomenon (Gülzow, 1963; Renz, 1976). Terms for this condition include ‘mesenteric line’ (Pickerill, 1903; Shourie, 1947), ‘brown stain’ (Leung, 1950), ‘black extrinsic tooth stain’ (Reid et al, 1977), ‘black line stain’ (Wilkins, 2005) or ‘pigmented dental plaque’ (Shourie, 1947; Bibby, 1931). In this paper, the described condition is generally referred to as ‘black stain’. It is characteristically found as a thin, darkly pigmented line, localised on the cervical enamel following the contour of the gingiva. It also can present as distinctive, incompletely coalescent dark dots that rarely extend beyond the cervical third of the crown. Furthermore, the base of pits and fissures can be affected. In most cases a narrow portion of enamel close to the gingival margin is left clear (Bibby, 1931). This firmly attached deposit is generally of no considerable thickness, but in case of heavy staining it is slightly elevated from the tooth surface and may be detected with a dental probe (Wilkins, 2005). The removal of this persistent film is often not possible through domestic oral hygiene routine, and requires a professional tooth cleaning, including instrumentation and polishing. Upon removal, the underlying enamel surface is found intact and without decalcifications (Gülzow, 1963; Leimgruber, 1950), but a tendency for reformation after cleaning has been described (Wilkins, 2005).

Black stain occurs at any age – therefore on primary as well as permanent teeth – but there seems to be a peak in childhood with descending prevalence in pubescence and adulthood (Gülzow, 1963). In most cases, spontaneous disappearance is seen in the end of the second life decade (Stöckli and Ben-Zur, 1994). Only little information can be found on its prevalence in the adult population. No difference in occurrence between the sexes was found (Sutcliffe, 1967; Paredes Gallardo and Paredes Cencillo, 2005; Koch et al, 2001).

In individuals who present with this condition, a specific oral microflora has been described. Colour producing – chromogenic – bacteria, are suspected to be the cause of these characteristic pigmented stains, which contain a high content of calcium and phosphate and an insoluble ferric salt which has been made accountable for the colour (Slots, 1974). Nevertheless, it has not yet been possible to completely clarify their aetiology.

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The purpose of this review was to briefly summarise the fundamentals about black stain, its diagnosis and possible differential diagnoses as well as its microbiology and therapy. Furthermore, important studies investigating the relationship between black stain and dental caries are abstracted.

LITERATURE SEARCH

For the literature search, the electronic database PubMed was used. The following Mesh Term was applied: ‘dental plaque’. Additional search terms used were ‘black stain’, ‘pigmented plaque’, and ‘extrinsic stain’. Further, the reference lists of articles selected for inclusion in this review were systematically screened. No language restrictions were applied. The search was performed up to and including July 2009.

DIAGNOSIS AND CLASSIFICATION

Koch et al (2001) used the following criteria for the diagnosis of black stain: the presence of dark dots (diameter less than 0.5mm) forming linear discolouration (parallel to the gingival margin) at dental smooth surfaces of at least two different teeth without cavitation of the enamel surface. As standardised classification systems are generally useful for clear communication between practitioners, numerical indices have also been introduced.

Shourie (1947) recorded the presence or absence of pigmented plaque as (1) no line; (2) incomplete coalescence of pigmented spots; and (3) continuous line formed by pigmented spots. Gasparetto et al (2003) added a further criterion based on the extension of the tooth surface area affected: (1) corresponds to the presence of pigmented dots or thin lines with incomplete coalescence parallel to the gingival margin; (2) indicates the presence of continuous pigmented lines, which are easily observed and limited to half of the cervical third of the tooth surface; (3) equals the presence of pigmented stains extending beyond half of the cervical third of the tooth surface.

A similar classification was used by Leung (1950) who used four scores, with (1) indicating a thin line of 1mm or less in width across the surface, (2) and (3) equalling staining of one-third and two-thirds respectively and (4) implying involvement of the entire gingivo-occlusal surface.

DIFFERENTIAL DIAGNOSIS

Tooth discolouration is a frequently found condition that can be associated with medical problems and might also lead to psychological challenges of the individual affected. Its aetiology, appearance, composition, location, severity and degree of adherence vary significantly (Hattab et al, 1999).

Generally, extrinsic and intrinsic tooth stains can be differentiated. Extrinsic stains, which are caused by extrinsic factors, are located on the outer tooth surface. Black stain is part of this group, but there also exist brown, green or orange stain, metallic stain, or stains caused by tobacco, restorative materials and pharmaceuticals. Tannins found in tea, coffee and other beverages are the presumed cause of the thin, bacteria-free and pellicle-like brown stain. Green stain appears as a heavy grey-green, soft and ‘furry’ film, and has been attributed to fluorescent bacteria and fungi (Eisenberg, 1975). This condition is more prevalent in males than in females and has been associated with poor oral hygiene (Hattab et al, 1999). Orange stain is a light, thin deposit with a red to orange colour. It is supposedly caused by chromogenic bacteria and again is found in a population with poor oral hygiene (Eisenberg, 1975). Metallic stains, which form after industrial exposure to iron, manganese and silver are also part of the extrinsic stain group, as well as chlorhexidine stains. The latter are caused by the interaction of the di-cationic antiseptic chlorhexidine with dietary chromogens. Intrinsic stains, in contrast, have a completely different appearance and can hardly be mistaken for black stain. They result from the incorporation of pigments into the dental tissues, which can happen either during odontogenesis or after eruption. Frequent reasons for this condition are infections (e.g. rubella, measles), drug interactions (tetracycline, fluorides), malnutrition, hematopoietic disorders (sickle cell anaemia, thalassemia), or developmental disorders (amelogenesis and dentinogenesis imperfecta).

Another important differential diagnosis is dental caries. However, while caries manifests with an irreversible local enamel or dentin defect, black stain is a deposit that can be removed through instrumentation and polishing. Also, the dental surface is left intact without signs of decalcification (Gülzow, 1963; Leimgruber, 1950). Its dotted appearance and characteristic localisation close to the gingival margin also facilitate the diagnosis.
MICROBIOLOGY, AETIOLOGY AND COMPOSITION OF BLACK STAIN

Pickerill (1903) referred to black stain as a sign of immunity against caries. He used the term ‘mesenteric line’ for this condition because of a suggested association to the mesenteric group of microorganisms. Theilade and Pang (1987) described black extrinsic tooth stain as a special type of dental plaque that is characterised by its simple flora and its tendency to calcify. Electron microscopic examinations revealed that the deposits consist of microorganisms in a granular or filamentous inter-microbial matrix (Theilade et al, 1973). The bacteria of black stain are held together in this inter-microbial substance, with a pellicle-like structure mediating their attachment to the tooth (Theilade, 1977). In the literature, Prevotella melaninogenica has been suspected as the main etiologic cause of these pigmentations. This assumption is not held true any longer. In an enriched blood agar medium, Prevotella melaninogenica (formerly Bacteroides melaninogenicus) is known to form a dark intracellular or cell-associated pigment, identified as hemin-like hemoglobin derivate, or (iron-) protoporphyrin (Reid et al, 1976; Shah et al, 1979). However, also different Actinomycyes species, such as A. odontolyticus, A. graevenitzii and A. radicidentis produce pigments, with colours that range from brown to black (Sarkonen et al, 2001). Further, individual strains of E. coli, P. mirabilis, S. typhimurium and C. welchii as well as P. melaninogenica can form a dense black pigment, namely the black colloidal precipitate of ferrous sulphide, when grown in liquid media containing cysteine and ferrous sulphate (Duerden, 1975). This deposit results from the bacterial production of hydrogen sulphide in the presence of ferrous ions and is unrelated to the characteristic pigment produced by strains of Prevotella melaninogenica when grown on blood agar. Upon studying 32 black stain-affected children with the age of 13 years, this insoluble ferric compound could be found in the black stain group, whereas it could not be verified in the plaque of the control subjects (Reid et al, 1977). The reason why some individuals accumulate this compound while others do not is not clear; however, it was hypothesised that the phenomenon is attributable to differences in plaque flora or its metabolism, or the composition of saliva and gingival fluid (Reid et al, 1977). Reid and Beeley (1976) compared the composition of gingival debris of 84 children with an age of 13 years, 20 of which presented with black stain. A significantly higher concentration of calcium and phosphate was found in children with black extrinsic tooth stain, but a significant difference in carbohydrate or protein content could not be shown. This may partially be responsible for the reduction in dental decay in the individuals concerned. Upon assessment of the chemical composition of saliva in 60 children aged 4 to 16 years presenting with black stain, Surdacka (1989b) found a significantly higher content of total calcium, inorganic phosphates, copper, sodium and total protein and less glucose than a control group. The same author also reported a significantly higher pH of saliva in these children, while the amount of saliva was not different from the control group (Surdacka, 1989a). It can only be speculated what the reasons are for remission of black stain with the onset of adulthood. Improved oral hygiene and consequently a change of the oral microflora may be responsible for this phenomenon (Gülzow, 1963).

Slots’ (1974) bacteriological examination of black stain revealed a characteristic and relatively stable microflora. In a study of 11 children aged 3 to 5 years, 90% of cultivable isolates were Gram-positive rods, of which 90% were identified as Actinomyces. Prevotella melaninogenica (formerly Bacteroides melaninogenicus) averaged less than 1% of the isolated bacteria. Therefore it is probably of lower significance for the colour of the black stain, and it was presumed, that the Actinomycetes are responsible for the formation of the colour. Gram-positive coccii constituted on average only 5% of the cultivable organisms. The latter is a fundamental difference to supragingival dental plaque, which typically is located close to the gingival margin as well, but is predominated by Gram-positive coccii even in old deposits (Theilade, 1977). Also, oral disease does not seem to result from the presence of black stain (Theilade, 1977). In contrast, supragingival plaque accumulation leads to the development of gingivitis with time and under certain circumstances also to dental caries. Saba et al (2006) studied the bacterial subspecies involved in 100 black stain affected children aged 6 to 12 years, and compared the results to 100 stain-free control subjects using PCR and electrophoresis. It was found, that 50% of samples with black stain were positive to Actinomyces, while only 20% of the control group had DNA of this bacterium. 70% of the samples with black stain were positive to A. actinomycetemcomitans, while the corresponding percentage of the control group was 20%. Porphyromonas gingivalis and Prevotella melaninogenica were
absent both in black stain and in control subjects. The latter again indicates an at least subordinate role of these bacteria in the formation of black stain.

In summary there seems to be evidence that multiple bacterial subspecies are involved in the aetiology of black stain with a dominance of Actinomyces ssp. The black colour can be attributed to ferrous sulphide precipitations.

THERAPY

In contrast to supragingival plaque, black stain does not lead to oral disease and therefore primarily poses an aesthetic problem (Theilade and Pang, 1987; Theilade, 1977). Nevertheless, it can challenge the therapist, especially when it is deposited on roughened or pitted areas of the tooth. In a professional dental hygiene appointment, removal through polishing with a rubber cup and fluoride pumice is possible (Leimgruber, 1950). If the staining is resistant, the excess water can be blotted from the pumice and the tooth should be dried before the polishing procedure is performed (McDonald et al, 2004). Also, sharp scaling instruments are of use against firmly attached deposit. Black stain tends to reform again despite good personal oral care, but quantity may be less when biofilm control procedures are meticulous (Wilkins, 2005; Bibby, 1931).

STUDIES ON BLACK STAIN AND CARIES

Table 1 summarises the study results obtained in the investigations described below.

Shourie (1947) studied 1097 boys from the former Indian province Punjab to determine the prevalence of black stain (referred to as pigmented plaque or mesenteric line in this paper) and caries. The population was between 13 and 16 years old. Black stain could be found in 14.2% of the boys. Children without mesenteric line had caries on 30.5% of deciduous and 8.3% of permanent teeth, while in boys with pigmented plaque the corresponding percentages were only 13.7% and 4.5%. This was interpreted as lower caries susceptibility in the stain group. Also, an association between caries and degree of pigmentation could be found. The scale applied, as already described earlier, was (1) no line; (2) incomplete coalescence of pigment-ed spots; and (3) continuous pigmented line. The percentages given for caries-affected teeth in the deciduous dentition were (1) 30.5%, (2) 11.1% (3) 18.1%, and (1) 8.3%, (2) 5.6% (3) 3.3% for the permanent dentition.

Leung (1950) studied dental caries and the occurrence of natural stains in 355 children living at five different juvenile custodial institutions in a Middle Western U.S. state. The age range of this group was from 4 to 20 years, with a mean age of 13.7 years. Confusingly, the term ‘brown stain’ was used, but because of the references quoted and description applied it can be assumed that black stain was meant. For evaluation of the staining, a four-point scale was introduced, which was already described above. 19% of the children presented with black stain, which showed a DMFT of 7.6 ± 4.2, while children with no stain had a DMFT of 8.8 ± 4.8. However, no relation between degree of staining and dental caries was found.

Commerell (1955) studied 12,890 children in the political district of Hamburg-Altona in the course of school dentist examinations. The investigations were made during the school year of 1954/55 and comprised of the first to the tenth school grade. 11% of the children were found to have black stain. In the permanent dentition, the overall caries experience was 69%, whereas in the black stain group, this percentage was only 50%, indicating a lower caries risk in this group.

Mellanby et al (1957) made a survey of the dental condition of 1,205 5-year-old London school children. This investigation of 1955 was part of a series that begun in 1929 and was carried out at two-yearly intervals. In these surveys it was found that children with black superficial stains generally appeared with a lower caries prevalence (20.2%) than children with no stains (29.1%). An exact percentage of children with black stain was not given.

Gülzow (1963) studied 2,127 school children from the city of Basel, aged 7 to 15 years, in the course of school dentist examinations. The average frequency of black stain was 19%, with no difference in gender distribution. With increasing age up until age 13 or 14, a rising incidence of black stain was studied, which declined after this peak. The author correlated this phenomenon to better oral hygiene. A significant difference in caries experience could not be found in the two different groups.

Sutcliffe (1967) described the association of black tooth stain with oral cleanliness as well as with caries prevalence. A population of 520 boys and 466 girls with the mean age of 11 years and 9
months was investigated. Three categories of oral cleanliness were determined: ‘good’ – teeth are clean, no signs of debris; ‘fair’ – some debris present, but not sufficient to be recognised as poor, and ‘poor’ – teeth are dirty with considerable debris. This assessment was confined to the labial surfaces of the incisors and canine teeth. 1.6% of the children examined presented with black stain. No difference in the standard of oral cleanliness between children with and those without staining could be found. Children with black staining had a mean DMF of 3.06, which was substantially smaller than the mean DMF of 5.67 of children with no stains.

Renz (1976) evaluated the dental health of 614 children in Geneva aged 5.5 to 6.5 years. 28.1% of the 5.5-year-old and 18.2% of the 6.5-year-old groups had no caries or fillings. 5.4% presented with black stains, but no detailed information on the difference in caries prevalence to those without black stain was given.

Koch et al (1996) examined the prevalence of black stain in 801 children aged 6 to 11 years in the Rhine-Neckar region in Germany. It was found that 4% of the children had black stain. Children in first and second grade showed a significantly higher prevalence (P < 0.01) than those from the third and fourth grade.

Koch et al (2001) examined a total of 1,086 children from four elementary schools in Potenza, Italy. Four examiners were calibrated to the WHO-criteria for caries diagnosis. DMFT, dmf-T, gender and age were recorded together with presence or absence of black stain. Black stain was observed in 6.3% of children examined. The higher occurrence in males was statistically not significant (p = 0.05, X2-test). In the black stain group, 23.9% showed caries in the permanent dentition, while the corresponding percentage in children without black stain was 62.7%. Thus, the proportion of stain-affected children with caries-free permanent dentition was statistically significantly higher (P < 0.001). 41.8% children with black stain and 30.4% of children without black stain had caries-free primary and permanent teeth (P > 0.05, x2-test). The mean DMFT was 0.49 ± 1.95 for children with black stain and 0.97 ± 1.40 for children without black stain, but this difference was not statistically significant (P = 0.05, U-test). No correlation between presence of black stain and age could be found (correlation coefficient: 0.008).

Gasparetto et al (2003) examined 263 children aged 6–12 years, attending the only public school in the village of Porto Rico (2,600 inhabitants) in Brazil. Presence or absence of black stain as well as the DMFT score was recorded only for the permanent dentition. 14.8% of the sample presented with black stain. In this group, 33% of children had a caries-free permanent dentition, whereas the corresponding percentage in children without black stain was 27.2%. This difference was not statistically significant. Among the children with black stain, 41% were classified as (3) staining extending beyond half of the cervical third of tooth surface, followed by 30.8% for (2) continuous pigmented lines limited to half of the cervical surface and 28.2% for score (1) pigmented dots parallel to the gingival margin. The mean DMFT was 1.46 ± 1.39 for children with black stain and 2.42 ± 2.09 for children without staining. Spearman’s correlation test showed that the presence of staining was negatively correlated to the severity of caries (r = -0.16; P < 0.05). Also, a significant negative correlation between the severity of the black stains and DMFT (r = -0.16; P < 0.01) was observed.

Paredes Gallardo and Paredes Cencillo (2005) studied 1,100 children aged 4 to 11 years old in Valencia, Spain. 7.54% of the subjects studied had black stain. In the black stain group, no difference in prevalence was found between sexes and anterior and posterior teeth. Furthermore, the authors could not confirm a difference in caries prevalence between children with and those without staining.

Heinrich-Weltzien et al (2009) assessed the prevalence of black stain in Filipino schoolchildren in 32 public elementary schools with the aim to study its association with caries levels. 1,748 children, aged 11.7 ± 1.1 years were studied for black stain. Also, their DMFT score (1,121 children) or DMFS score (627 children) was assessed using WHO criteria. Black stain was found in 16% of the children, with no significant difference between those attending schools with different oral health intervention programs. The prevalence of black stain was significantly higher (P < 0.05) in remote than in more accessible schools (45% versus 16%). Children with black stain had significantly lower (P < 0.05) caries prevalence than those without black stain, but no difference in DMFS pattern could be found between the two groups.

**DISCUSSION**

Studies performed on the nature of this still enigmatic condition vary considerably in design and
Table 1. Black stain prevalence and its association with caries prevalence

<table>
<thead>
<tr>
<th>Subjects studied Black stain prevalence</th>
<th>Caries prevalence</th>
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<tbody>
<tr>
<td><strong>Shourie, 1947</strong>&lt;br&gt;Former province of Punjab, India&lt;br&gt;1097 children&lt;br&gt;Age: 13–16 years&lt;br&gt;Black stain: 14.2%</td>
<td>Given for (2) incomplete or (3) complete coalescence of pigmented spots&lt;br&gt;d (2): 11.1%&lt;br&gt;d (3): 18.1%&lt;br&gt;p (2): 5.6%&lt;br&gt;p (3): 3.3%</td>
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<td><strong>Leung, 1950</strong>&lt;br&gt;5 juvenile custodial institutions, a Midwestern state, USA&lt;br&gt;355 children&lt;br&gt;Age: 4–20 years&lt;br&gt;Black stain: 19.2%</td>
<td>N/A</td>
<td>N/A</td>
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<td><strong>Commerell, 1955</strong>&lt;br&gt;School dental examination, District Hamburg-Altona, Germany&lt;br&gt;12,890 children&lt;br&gt;1st–10th school year&lt;br&gt;Black stain: 11.3%</td>
<td>30.7%</td>
<td>49.1% Percentage given for children in total</td>
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<td><strong>Mellanby et al, 1957</strong>&lt;br&gt;London County Council Day Schools, London, UK&lt;br&gt;1205 children&lt;br&gt;Age: 5 years&lt;br&gt;Black stain: N/A</td>
<td>20.2%</td>
<td>29.1%</td>
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<tr>
<td><strong>Gülzow, 1963</strong>&lt;br&gt;School dental clinic, Basel, Switzerland&lt;br&gt;2127 children&lt;br&gt;Age: 7–15 years&lt;br&gt;Black stain: 19.9%</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td><strong>Sutcliffe, 1967</strong>&lt;br&gt;8 grammar schools, Leeds, UK&lt;br&gt;86 children&lt;br&gt;Age: 11–12 years&lt;br&gt;Black stain: 1.6%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Renz, 1976</strong>&lt;br&gt;22 schools in or around Geneva, Switzerland&lt;br&gt;614 children&lt;br&gt;Age: 5.5–6.5 years&lt;br&gt;Black stain: 2.9%</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td><strong>Koch et al, 1996</strong>&lt;br&gt;4 elementary schools, Rhein-Neckar region, Germany&lt;br&gt;801 children&lt;br&gt;Age: 6–11 years&lt;br&gt;Black stain: 4%</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td><strong>Koch et al, 2001</strong>&lt;br&gt;4 elementary schools, Potenza, Italy&lt;br&gt;1086 children&lt;br&gt;Age: 6–12 years&lt;br&gt;Black stain: 6.3%</td>
<td>23.9%</td>
<td>62.7%</td>
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<tr>
<td><strong>Gasparetto et al., 2003</strong>&lt;br&gt;Public school, Porto Rico, Brazil&lt;br&gt;263 children&lt;br&gt;Age: 6–12 years&lt;br&gt;Black stain: 14.8%</td>
<td>66.6%</td>
<td>72.8%</td>
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<td><strong>Paredes Gallardo and Paredes Cencillo, 2005</strong>&lt;br&gt;Centro de Salud, Valencia, Spain&lt;br&gt;1100 children&lt;br&gt;Aged 4–11 years&lt;br&gt;Black stain: 7.54%</td>
<td>30%</td>
<td>30%</td>
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<td><strong>Heinrich-Weltzien et al, 2009</strong>&lt;br&gt;32 elementary schools, Misamis Oriental Province, Philippines&lt;br&gt;1748 children&lt;br&gt;Age: 11.7 ± 1.1 yrs&lt;br&gt;Black stain: 16%, in remote schools up to 45%</td>
<td>59%</td>
<td>81%</td>
</tr>
</tbody>
</table>

Abbreviations:<br>d: deciduous dentition; N/A: not applicable; p: permanent dentition; *statistically not evaluated; yrs: years; ** Statistically significant
<table>
<thead>
<tr>
<th>dmft / DMF-T</th>
<th>Association of black stain with lower caries prevalence</th>
<th>Relevant additional findings</th>
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<tbody>
<tr>
<td>Black stain</td>
<td>No black stain</td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>Confirmed**</td>
</tr>
<tr>
<td>DMF-T: 7.6 ± 4.2</td>
<td>DMF-T: 8.8 ± 4.8</td>
<td>Not confirmed*w</td>
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<tr>
<td>N/A</td>
<td>N/A</td>
<td>Confirmed*</td>
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<tr>
<td>N/A</td>
<td>N/A</td>
<td>Confirmed*</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>Not statistically significant</td>
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<tr>
<td>DMF-T: 3.06 ± 0.50</td>
<td>DMF-T: 5.67 ± 0.13</td>
<td>Confirmed*</td>
</tr>
<tr>
<td>dmft for age group</td>
<td>dmft for age group</td>
<td>Not evaluated</td>
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<tr>
<td>5.5 yrs: 3.34 ± 0.48</td>
<td>5.5 yrs: 3.34 ± 0.48</td>
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<tr>
<td>6.5 yrs: 4.40 ± 0.56</td>
<td>6.5 yrs: 4.40 ± 0.56</td>
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<tr>
<td>N/A</td>
<td>N/A</td>
<td>Not evaluated</td>
</tr>
<tr>
<td>dmft: 1.87 ± 2.47</td>
<td>dmft: 2.39 ± 2.62</td>
<td>Confirmed**</td>
</tr>
<tr>
<td>DMF-T: 0.49 ± 1.05</td>
<td>DMF-T: 0.97 ± 1.40</td>
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<tr>
<td>DMF-T: 1.46 ± 1.39</td>
<td>DMF-T: 2.42 ± 2.09</td>
<td>Not confirmed**</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>Not confirmed*</td>
</tr>
<tr>
<td>DMF-T: 1.5 ± 2.1</td>
<td>DMF-T: 2.5 ± 2.5</td>
<td>Confirmed**</td>
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</table>
quality. Also, the definition of black stain is not homogenously described, therefore verification and comparison of study results prove problematic. Nevertheless this condition has been observed for a remarkable time. Various investigations have been undertaken to study diverse populations. It can be said that black stain is a global phenomenon, which apparently is rather independent of local cultural and nutritional habits and appears to be slightly more common in rural areas (Heinrich-Weltzien et al, 2009). There also seems to be an individual predisposition as not all members of the same family, despite having similar nutritional and oral care habits, present with black stain (Leimgruber, 1950).

Many of the studies investigating black stain and its relation to caries applied the DMF-T index, which is very useful from the epidemiologic viewpoint. However, for this purpose the determination of caries prevalence might be more suitable. In children with early childhood caries black stain might be misdiagnosed due to similarity to the dark colour of caries (Koch et al, 2001), and reasons for past extractions cannot be clarified easily.

Most investigations found a lower caries prevalence in children with black stain (Shourie, 1947; Leung, 1950; Sutcliffe, 1967; Koch et al, 2001; Gasparetto et al, 2003; Commerell, 1955; Mellanby et al, 1957; Heinrich-Weltzien et al, 2009). This might be due to various reasons. Black stain leads to discoloration of the tooth surface, which might result in different oral hygiene habits and demand for dental care (Koch et al, 2001). No difference in the DMFS pattern of children with black stain versus those without this condition was found, as the dominant occurrence of black stain on smooth surfaces was not connected with less caries on these surfaces (Heinrich-Weltzien et al, 2009). Therefore it can be assumed that black stain is associated with a lower caries activity rather than having a localised caries-protective effect. The role of the Actinomycetes in regard to the low caries frequency is unknown. In early childhood, the human mouth already is colonised by this species. Upon studying a group of 329 2-year-old infants, Sarkonen et al (2000) could verify salivary Actinomycetes in 97% of the children. It has been shown, that high levels of Actinomyces naeslundii in biofilms on teeth correlate with low caries experience and low Streptococcus mutans adhesion (Stenudd et al, 2001). In this context, the microbiota of black stain might be a good model for replacement of oral pathogens (Hillman and Socransky, 1987). This phenomenon could be of interest in the context of a probiotic approach in caries prophylaxis (Teughels et al, 2008).

However, not all authors found a different caries prevalence in children with black stain (Gülzow, 1963; Paredes Gallardo and Paredes Cencillo, 2005; Gasparetto et al, 2003). Gasparetto et al (2003) could not confirm statistically significant lower caries prevalence in black stain-affected children, but they discovered a strong correlation between the severity of the disease and the presence of black stains (DMFT > 3 was seen for 10.3% of children with stains versus 31.3% of children without stains). Also, some authors report a correlation between degree of staining and caries (Shourie, 1947; Gasparetto et al, 2003), while others cannot confirm this finding (Leung, 1950).

CONCLUSION

Black stain is a characteristic, pigmented deposit that is generally found in children and normally shows spontaneous remission in adulthood. Its prevalence is stated to be between 1.6% and 19.9%. Apart from an aesthetic problem, no impairment of oral health has been reported. In contrast, individuals with this condition seem to present with lower caries prevalence. A possible reason for this might be the different oral microflora described in association with black stain.

REFERENCES