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Authors
Moraes, Renata Mendonça
Gouvêa Lima, Gabriela de Morais
Guilhermino, Marinaldo
et al.

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Peer reviewed
Case presentation

Graphite oral tattoo: case report

Renata Mendonça Moraes¹, Gabriela de Morais Gouvêa Lima¹, Marinaldo Guilhermino², Mayana Soares Vieira³, Yasmin Rodarte Carvalho¹, Ana Lia Anbinder¹

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¹Department of Bioscience and Oral Diagnosis, Institute of Science and Technology, Univ. Estadual Paulista-UNESP, São José dos Campos, São Paulo, Brazil.

²São José dos Campos City Hall, Dentist graduated from Institute of Science and Technology, Univ. Estadual Paulista-UNESP, São José dos Campos, São Paulo, Brazil.

³Department of Health Science, Ceuma University, São Luís, Maranhão, Brazil.

Correspondence:

Ana Lia Anbinder
Avenida Engenheiro Francisco José Longo, nº 777 – Jardim São Dimas.
São José dos Campos, São Paulo, Brazil.
Zip Code: 12245-000
+55 (12) 39479358
ana.anbinder@fosjc.unesp.br

Abstract

Pigmented oral lesions compose a large number of pathological entities, including exogenous pigmentations, such as amalgam and graphite tattoos. We report a rare case of a graphite tattoo on the palate of a 62-year-old patient with a history of pencil injury, compare it with amalgam tattoos, and determine the prevalence of oral tattoos in our Oral Pathology Service. We also compare the clinical and histological findings of graphite and amalgam tattoos. Oral tattoos affect women more frequently in the region of the alveolar ridge. Graphite tattoos occur in younger patients when compared with the amalgam type. Histologically, amalgam lesions present impregnation of the reticular fibers of vessels and nerves with silver, whereas in cases of graphite tattoos, this impregnation is not observed, but it is common to observe a granulomatous inflammatory response, less evident in cases of amalgam tattoos. Both types of lesions require no treatment, but in some cases a biopsy may be done to rule out melanocytic lesions or for aesthetic reasons.

Introduction

Pigmented oral lesions may be of an endogenous or exogenous nature. Among the lesions of exogenous origin, the most frequently found are amalgam tattoos, followed by graphite tattoos. Graphite tattoos mainly result from accidental injury involving pencils, in which graphite from the tip of the pencil is inserted into the oral mucosa. Reports of these cases are scarce in the literature because these generally are innocuous and do not require a biopsy except when melanocyte proliferations are considered [1]. The graphite tattoo occurs predominantly in women and youngsters from age 5 to 21 years, mainly in the region of the inserted gingiva and palate. The size is variable, generally from 1 to 15 mm, and macules are bluish-gray in color [2-4]. Histologically, the graphite particles may be randomly distributed in the connective tissue or around vessels and along fibers. Inflammation may be absent, or graphite may induce a chronic inflammatory response with formation of foreign body granulomas exhibiting the presence of multinucleated giant cells [2-4]. These lesions require no treatment. In general, biopsy is performed to exclude other pigmented lesions, such as melanocytic nevus, blue nevus, and melanoma, or for aesthetic reasons.
The aim of this study was to report a rare case of a graphite tattoo and compare it with amalgam tattoos. We also investigate the prevalence of oral tattoos in our Oral Pathology Service.

Case synopsis

The patient, a 62-year-old woman, presented to a community based outpatient dental clinic for a routine consultation. The patient related that at 13 years of age she had pierced her palate with the tip of a pencil. Her medical history showed nothing noteworthy. On clinical exam, a papule of a bluish gray color that faded at the periphery, measuring approximately 0.3x0.1x0.5cm, was observed on the right side of the palate, lateral to the midline. There were some petechiae around the papule, resulting from denture wearing (Figure 1). The patient could not give any information about her previous dental history or the presence of amalgam fillings prior to tooth removal and prosthesis placement. The clinical diagnosis was graphite tattoo and an excisional biopsy was performed to confirm the diagnosis.

Histopathology showed a fragment of mucosa covered by parakeratinized mucosal epithelium, under which the lamina propria of fibrous connective tissue could be noted to be permeated with blackened exogenous particles enveloped by granulation tissue and surrounded by large and multinucleated histiocytes. A moderate lymphocytic infiltration was also noted (Figure 2). The final diagnosis was exogenous pigmentation, compatible with graphite tattoo. In order to confirm the origin of the granules found in the histologic exam and to illustrate the case, energy dispersive x-ray (EDS) and scanning electron microscopy (SEM) were performed. For the EDS analysis, 5µm unstained and deparaffinized cuts without the cover slips were used. Analysis was performed using the Inspect S50 SEM (Fei, Hillsboro, Oregon, USA) appliance with Bruker detector, voltage 25kV and count per second above 1500. The images were captured with a secondary electron detector. In the EDS analysis, the presence of silica, magnesium, calcium, nitrogen, oxygen, sodium, and carbon was observed (Figure 3). For the illustrative analysis by SEM, the slides were metalized using gold alloy with 8nm thickness (Emitech SC7620, Fall river, Massachusetts) and the images were captured at a voltage of 20kV, at 430x magnification (Figure 4). Coarse granules were observed among the connective tissue fibers.

Figure 1. Clinical image of lesion: Note bluish-gray, oval papule with smooth margins in region of hard palate close to border with soft palate, measuring 0.3x0.1x0.5cm.
Figure 2. Graphite tattoo photomicrograph. Hematoxylin and Eosine (HE) staining. Original magnification 400x. Note deposition of blackened granules of variable size and irregular shape (arrow) in the midst of connective tissue with granulomatous inflammation. Multinucleated giant cells encircling the graphite granules are seen (tip of arrow).

Figure 3. Electron dispersive spectrography analysis (EDS) of graphite tattoo slide: Note the peaks that represent the chemical elements, demonstrating the remarkable presence of silica, the material used for fabricating graphite used in pencil manufacturing.

Figure 4. Scanning electron microscopy of case of graphite tattoo. Note graphite granules that exhibit variable diameter, irregular shape, and appear to be superimposed on connective tissue fibers (arrow).
Figure 5. Photomicrograph of a case of amalgam tattoo from files of our institution. Hematoxylin and Eosine (HE) staining. Original magnification 400x; Note blackened granules distributed throughout connective tissue (arrow), being smaller and more regular when compared with those of graphite tattoo. Also note impregnation of elastic fibers of vessels and nerves with silver, giving them a brownish pigmentation (tip of arrow).

Figure 6. Scanning Electron Microscopy of a case of amalgam tattoo from files of our institution. Note deposition of granules along the connective tissue fibers (tip of arrow) and other coarser granules (arrow).

Analysis of the files

All the reports with diagnosis of "amalgam tattoos", "exogenous pigmentation compatible with amalgam tattoos", or "exogenous pigmentation compatible with graphite tattoos", in the oral pathology laboratory at our institution were selected from 1975 through to 2013. The criteria for diagnosis of amalgam tattoo were the presence or history of amalgam fillings associated with the presence of histological dark particles along connective tissue fibers and basement membrane of epithelium or blood vessels. In amalgam tattoo, reticulin fibers stain golden-brown and foreign body granulomas may be observed. For the graphite tattoo, the criteria for diagnosis included the presence of black granules of non-refractile, foreign material, some of which reside within multinucleated giant cells, with no fiber pigmentation. The history of accidents with pencils was important for the diagnosis.
In conclusion, the graphite tattoo represents a rare oral tattoo, which shares some clinical characteristics with the amalgam tattoo. However, the two types may be differentiated by means of clinical, radiographic, and histopathological exams, in addition to EDS analysis. This differentiation is of a merely academic nature, since the treatment for both types is observation, biopsy to exclude other pigmented lesions, and removal in cases of esthetic discomfort.
Table 1. Summary of published articles on graphite tattoos. F: Female. NI: not informed.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sex</th>
<th>Age (years)</th>
<th>Location</th>
<th>Size</th>
<th>Color</th>
<th>Radiograph</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rihani and Da'ameh, 2006 [4]</td>
<td>F</td>
<td>5</td>
<td>Attached gingiva</td>
<td>15X5mm</td>
<td>Bluish-black</td>
<td>NI</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Anderegg and Lyles, 1992 [2]</td>
<td>F</td>
<td>21</td>
<td>Attached gingiva</td>
<td>1X2mm</td>
<td>Bluish-gray</td>
<td>NI</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Present Case</td>
<td>F</td>
<td>62</td>
<td>Palate</td>
<td>3x1x0.5mm</td>
<td>Bluish-gray</td>
<td>NI</td>
<td>Biopsy</td>
</tr>
</tbody>
</table>

Table 2. Summary of published articles on amalgam tattoos. F: Female; M: Male; NI: Not informed; RO: Radiopaque

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sex</th>
<th>Age (years)</th>
<th>Location</th>
<th>Size</th>
<th>Color</th>
<th>Radiograph</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buchner e Hansen, 1980 [5]</td>
<td>M</td>
<td>172F/94M</td>
<td>Mean 43.1</td>
<td>1 to 20 mm</td>
<td>Blue, black or gray</td>
<td>10 cases with RO areas</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Megannis, Greer and Daniels, 1985 [22]</td>
<td>M</td>
<td>13</td>
<td>Alveolar mucosa</td>
<td>3x5mm</td>
<td>Blue-black</td>
<td>NI</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Weaver, Auclair and Taybos, 1987 [17]</td>
<td>F</td>
<td>33</td>
<td>Oral mucosa</td>
<td>7X7 mm</td>
<td>Brown</td>
<td>RO Points</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Martin et al., 2005 [23]</td>
<td>F</td>
<td>60</td>
<td>Alveolar mucosa</td>
<td>8mm</td>
<td>Bluish-black</td>
<td>RO Points</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Donetti et al., 2008 [25]</td>
<td>F</td>
<td>58</td>
<td>Inferior gingiva</td>
<td>11X7 mm</td>
<td>Dark-brown</td>
<td>NI</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Campbell and Deas, 2009 [18]</td>
<td>F</td>
<td>56</td>
<td>Alveolar mucosa</td>
<td>18-10 mm</td>
<td>Bluish</td>
<td>NI</td>
<td>Biopsy+Graft+Laser</td>
</tr>
<tr>
<td>Parizzi e Nai, 2010 [26]</td>
<td>F</td>
<td>46</td>
<td>Fornix</td>
<td>2mm</td>
<td>Black</td>
<td>RO Points</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Amano et al., 2011 [27]</td>
<td>F</td>
<td>63</td>
<td>Floor of the Mouth</td>
<td>9X6mm</td>
<td>Bluish-black</td>
<td>Without alteration</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Galletta et al., 2011 [29]</td>
<td>F</td>
<td>34</td>
<td>Alveolar mucosa</td>
<td>NI</td>
<td>dark blue</td>
<td>RO Points</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Ricart e Martin, 2011 [30]</td>
<td>F</td>
<td>60</td>
<td>Alveolar mucosa</td>
<td>6mm</td>
<td>Bluish-black</td>
<td>NI</td>
<td>Biopsy</td>
</tr>
<tr>
<td>D'acunto et al., 2012 [31]</td>
<td>F</td>
<td>45</td>
<td>Floor of the Mouth</td>
<td>6X3mm</td>
<td>Bluish-brown</td>
<td>NI</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Grazzini et al., 2012 [32]</td>
<td>Male</td>
<td>52</td>
<td>Floor of the Mouth</td>
<td>5mm</td>
<td>Blue-gray</td>
<td>NI</td>
<td>Incisional biopsy</td>
</tr>
<tr>
<td>Vera-Sirera et al., 2012 [6]</td>
<td>5F/1M</td>
<td>Mean 56.5</td>
<td>Gingival, buccal and palatal mucosa</td>
<td>3 to 10mm</td>
<td>Bluish-black</td>
<td>Without alterations</td>
<td>Biopsy</td>
</tr>
<tr>
<td>Lundin, Schmidt and Bonde, 2013 [33]</td>
<td>F</td>
<td>51</td>
<td>Bilateral buccal mucosa</td>
<td>NI</td>
<td>Dark-brown</td>
<td>NI</td>
<td>Biopsy</td>
</tr>
</tbody>
</table>

References


