Detection of compounds used for soft tissue augmentation in tissue samples with curie point pyrolysis GC/MS

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In the past, a continuous increase of soft tissue augmentation could be observed in Germany. Over 60,000 augmentations were carried out in Germany per year. Biodegradable and non-biodegradable filler substances were used for the correction of wrinkles and scars. Common soft tissue augmentation filler substances are shown in table 1. The filler substances were used mostly separate or in combination of resorbable and non-resorbable fillers.

<table>
<thead>
<tr>
<th>Resorbable fillers</th>
<th>Non-resorbable fillers</th>
<th>Non-resorbable fillers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collagen</td>
<td>Methyl methacrylate</td>
<td>(PMMA, HEMA/EMA)</td>
</tr>
<tr>
<td>Hyaluronic acid</td>
<td>Polyamide</td>
<td></td>
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<tr>
<td>Polyvinyl alcohol</td>
<td></td>
<td>Polyimide</td>
</tr>
<tr>
<td>Polylactic acid</td>
<td></td>
<td>Silicone oil</td>
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</tbody>
</table>

Table 1: Soft tissue augmentation filler substances

From time to time, substances foreign to the body show rejection reactions. Chronic and/or extensive pyrogenic inflammations (Figure 1) are possible. Rejection reactions are observed more often with non-resorbable fillers than with resorbable fillers. However a larger quantity of resorbable substances may result in the same reaction with the body’s defences observed by the use of non-resorbable fillers. The medical prognoses are dependent on the used material. Therefore, the identification of the substances is very important. As a matter of routine the abscised tissues were send to the pathohistological investigation if signs of inflammation were evident. The identification of the applied fillers is not possible with pathohistological method.

With curie point pyrolysis GC/MS – a technique for the detection of polymers, etc. – it is possible to identify the fillers. For the identification, the filler has not to be separated completely from the tissue. Figure 2 shows the pyrograms of different original soft tissue augmentation fillers. Artecoll and DermaLive present filler compounds of PMMA in combination with collagen and HEMA/EMA in combination with hyaluronic acid whereas Outline consists of a polyacrylamide. The last chromatogram in this figure shows silicon oil for medical use.
Figure 3 shows the measurement of the reference sample of the filler HEMA/EMA (B) and the measurement of a medical sample to be based on the filler HEMA/EMA and the tissue (C). The strong signal at the retention time of 16.25 min in the chromatogram of the fixed tissue sample is caused by formalin, a solvent for the conservation of anatomic preparations. The other signals were created from the HEMA/EMA and the tissue.

Chromatogram A in this figure represents the extract ion chromatogram of the mass 69 amu. This is a characteristic mass for the filler HEMA/EMA. The comparison of the three chromatograms shows that the main signals of the HEMA/EMA at the retention time of 7.30 min, 11.88 min and 16.87 min can be found directly in the chromatogram of the tissue sample (C).

Figure 3: Tissues burdened with HEMA/EMA

Figure 4 shows the measurement of an irritated tissue sample burdened with silicone oil. The characteristic masses of the silicone oil at 207, 281, 355 and 429 amu were combined in an extract ion chromatogram shown at the top of this figure. The comparison of both chromatograms illustrates that the identification can be carried out unequivocally by the specialist. These results convincingly demonstrate that the curie point pyrolysis GC/MS is an effective tool for the identification of fillers used for the soft tissue augmentation in samples of tissue. The method is reliable and reproducible.

Figure 4: Tissues burdened with silicone oil

**Instrumentation**

**Pyrolysis:**
- Pyrolysers: Pyromat, manual
- Pyrolysis temperature: 590°C
- Pyrolysis time: 9.9 second

**Gas chromatography:**
- GC 8065, Fisons, Dreieich, Germany
  - Initial temperature: 50°C for 2 minutes
  - Ramp rate: 10°C/min. to 320°C for 10 min.
  - Column: 50m Optima 5 MS, ID 0.20 mm and df 0.25 μm, Machery-Nagel, Düren, Germany

**Mass spectrometry**
- MD800, Fisons, Dreieich, Germany

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