**Problem**

**Safe exposure (NIOSH)**

<table>
<thead>
<tr>
<th></th>
<th>8h</th>
<th>4h</th>
<th>2h</th>
<th>1h</th>
<th>5h</th>
<th>25h</th>
</tr>
</thead>
<tbody>
<tr>
<td>dB(A)</td>
<td>85</td>
<td>88</td>
<td>91</td>
<td>94</td>
<td>97</td>
<td>100</td>
</tr>
</tbody>
</table>

Musicians exposure: 80 - 117 dB(A)!

HPD usage rate: 6 - 64%

Reasons for not using HPD: Difficulties...
- hearing themselves: 79%
- hearing others: 72%
- intonation: 57%
- balancing with other players: 50%

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**Solution**

**Principle**

- Sound environment
- Air Conduction
- Bone & Tissue Conduction

**One size fits-all:**

**Oclusion**
Reduction of 10 dB from 100 Hz to 500 Hz

**Isolation Effect**
Up to 25 dB of quasi-uniform attenuation

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**Conclusions**

Able to alleviate causes of discomfort using presented strategy
Next step: Complete and characterize implementation of custom occlusion effect reduction

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**References**

- Eaton & Gillis (2002)
- Patel (2008)
- Santoni & Fiorini (2010)
- Santoni & Fiorini (2010)
- Killion, DeVilbiss & Stewart (1988)
- Royster, Reyster & Killion (1991)
- Huttunen, Suivonen & Pöykkö (2013)
- Hagberg, Thiringer & Brandström (2005)
- Fabbrocchi (2010)
- Chassin (2005)

**Drawings**

- Chittka & Brockmann (2005)

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