

·基础与临床研究·

口腔修复用金属三维打印件中夹杂物和孔隙率问题分析

肖燕萍 谢胜芬 徐苏华 陈小君 陈 能

(广东省医疗器械质量监督检验所三水中心, 佛山 528137)

【摘要】目的 探讨口腔修复用金属三维打印件中夹杂物和孔隙率不合格原因, 为三维打印口腔金属修复体的加工制作过程控制提供参考。方法 选择 44 批次钴铬合金和钛合金激光选区熔化 (SLM) 修复体 3D 打印件, 在金相显微镜下放大 100 倍测定夹杂物和孔隙的面积分数, 分析打印件的孔隙特征和产生不合格的原因。结果 夹杂物和孔隙的面积分数 >2.8% 的有 16 批次, 不合格率为 36.4%。44 批次检测样品中未见明显夹杂, 不合格均由孔隙面积分数超过 2.8% 导致。结论 目前口腔修复体加工制作行业对数字化 3D 打印技术的掌握尚不成熟, 加工工艺技术有待进一步提高。

【关键词】3D 打印 夹杂物 孔隙率 口腔金属修复体

DOI : 10.11752/j.kqcl.2023.04.06

Analysis of inclusions and porosity in metal 3D printing devices for dental restorations

Xiao Yanping Xie Shengfen Xu Suhua Chen Xiaojun Chen Neng

(Sanshui Center of Guangdong Medical Devices Quality Surveillance and Test Institute, Foshan 528137)

【Abstract】Objective To investigate the reasons of unqualified inclusions and porosity in metal 3D printed dental restorations, and to provide a reference for controlling the process of fabrication of 3D-printed dental metal restorations. Methods Forty-four batches of cobalt-chromium alloys and titanium alloys with 3D-printed laser selective zone melting (SLM) restorations were selected to determine the area fraction of inclusions and porosity at 100× magnification of the microscope, and to analyze the pore characterisation and the unqualified reasons. Results There were 16 batches with an area fraction of inclusions and porosity greater than 2.8%, the rejection rate was 36.4%. No obvious inclusions were found in the 44 batch samples, and the non-conformities were all caused by porosity exceeding 2.8%. Conclusions At present, the dental restoration production industry is still immature in digital 3D printing technology, and the 3D printing technology needs to be further improved.

【Key words】3D printing Inclusions Porosity Dental metal restoration

口腔修复体用于修复患者的牙体缺损、牙列缺损及牙列缺失。临床牙体预备、制作工艺、就位过程以及后期患者的使用保养等因素均影响着修复体的使用年限^[1]。具备良好机械性能的修复体是保障咀嚼功能持续有效的前提, 因此, 从制作工艺的源头上对修复体产品质量进行控制极为重要。

3D 打印数字化口腔医学凭借其高效、准确、安全等优点, 能满足复杂、个性化和快速制作等口腔产品需求, 用于打印金属材料的激光选区熔化 (selective laser melting, SLM)^[2] 技术已经在口腔修复体加工企业运用得非常广泛, 而打印过程中出现的各类缺陷一直是困扰选择性激光熔化应用的一个难题^[3]。2020 年 1 月国内第一个口腔修复用选择性激光熔化金属粉末获批上市, 临

基金项目: 广东省药品监督管理局科技创新项目 (编号: 2022ZDZ05)

通信作者: 肖燕萍, Email: 1312910132@qq.com