Reduction of tool wear and elimination of air pollution in micro milling of materials for dental applications by liquid covered micro-milling process

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Abstract

Due to the high demands regarding manufacturing accuracy in the field of industrial dental technology, the component accuracy, the lifetime of milling tools and the process costs for machining of zirconium oxide (ZrO_2) and cobalt-chromium (CoCr) are of major importance. The processing of zirconium oxide (ZrO_2) in particular requires great technical effort, as it is almost impossible to plastically deform the material. Furthermore, the machining of ZrO_2 results in considerable tool wear and the release of large quantities of fine dust, which correlates with previously unresolved economic and technological restrictions. This fine dust leads to a considerable contamination of the workpiece and the machine tool and to an increase in process costs due to cleaning and shielding expenses. In this study, a solution for solving these problems is presented by shifting the machining zone within the machine tool to a fluidic environment with superimposed pressure. In a first step, the influence of the relocation of the machining zone to a fluidic environment on tool wear is shown. In a second step, the advantages of the solution on dust formation and dust removal during the machining of graphite (C) and ZrO2 are demonstrated. The wear on the milling tool could be significantly reduced by the presented development. With regard to air pollution, it was possible to almost completely avoid the formation of dust. Future investigations should transfer the results completely into a dental environment.