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# Comparison of residual strength behavior after indentation, scratching and grinding of zirconia-based ceramics for medical-technical applications

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## Abstract

In this study, three methods of characterizing the damage tolerance of different zirconia-based ceramics for medical-technical applications are presented. The damage is inflicted statically, with Vickers hardness impressions and dynamically by scratching with a Rockwell diamond, as well as by means of a reproducible grinding process. The damage intensity is, in each case, successively increased.

The measured strength values as a function of the inflicted damage thus provide information on the grinding robustness of the material. This permits the determination of critical grinding parameters above which the component quality is impaired and, ultimately, the patient is endangered. The continuing pressure to reduce production costs by shortening processing times makes damage tolerant behavior of materials extremely important. Ultimately, this permits the reduction of production costs while maintaining component quality and the guarantee of future patient safety.

*Keywords:* zirconia; residual strength; indentation; scratching; grinding

## 1. Introduction

With an average from 25 to 50% of total manufacturing costs, grinding with diamond grains is the most cost-intensive process step in the production of ceramic components [1]. Depending on the grinding parameters the ceramic component can be influenced by introduced residual stresses or cracks in the surface and subsurface area [2]. Due to the demand of cost reduction, higher material removal rates during grinding increase the risk of adversely affecting the functional reliability of the ceramic component in the subsequent application. For this reason, it is important to define the critical grinding parameters for each type of

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