

## Determining Which Material Properties Resist the Tool Wear When Machining Pre-Sintered Zirconia

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**Abstract :** In the dental restoration sector, there has been a shift to using zirconia. With the ever increasing need to decrease lead times to deliver restorations faster the zirconia is machined in its pre-sintered state instead of grinding the very hard sintered state. As with all machining, there is tool wear and while investigating the tooling used to machine pre-sintered zirconia it became apparent that the wear rate is based more on material build up and abrasion than it is on plastic deformation like conventional metal machining. It also came to light that the tool material can currently not be selected based on wear resistance, as there is no data. Different works have analysed the effect of the individual wear mechanism separately using similar if not the same material. In this work, the testing method used to analyse the wear was a modified from ISO 8688:1989 to use the pre-sintered zirconia and the cutting conditions used in dental to machine it. This understanding was developed through a series of tests based in machining operations, to give the best representation of the multiple wear factors that can occur in machining of pre-sintered zirconia such as 3 body abrasion, material build up, surface welding, plastic deformation, tool vibration and thermal cracking. From the testing, it found that carbide grades with low trans-granular rupture toughness would fail due to abrasion while those with high trans-granular rupture toughness failed due to edge chipping from build up or thermal properties. The results gained can assist the development of these tools and the restorative dental process. This work was completed with the aim of assisting in the selection of tool material for future tools along with a deeper understanding of the properties that assist in abrasive wear resistance and material build up.

**Keywords :** abrasive wear, cemented carbide, pre-sintered zirconia, tool wear

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