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Computational fluid dynamics analysis of conventional irrigation and the combination with adjuvant suction cannulas in human molars with isthmus communication

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Abstract-

This study evaluated CFD key irrigation parameters (flow pattern, irrigant velocity, wall shear stress and apical pressure) of conventional irrigation with positive pressure side-vented (SV) needle and the combination of different suction cannulas in the mesial root of human mandibular molars with 2 independent root canals and isthmus communication. A micro-CT scan of a molar presenting 2 root canals and an isthmus communication in the mesial root was obtained for computational analysis after root canal preparation and geometric reconstruction. Computational models of a 30G SV needle and three different suction cannulas (EndoVac Macro cannula (MaC), Surgitip (SURG) and iNP needle (iNP)) were designed. Four different simulations were carried out: simulation SV (SV needle located at 2.5 mm from working length (WL) in mesiolingual root canal (ML)), simulations SV-iNP, SV-SURG and SV-MaC (SV needle in ML plus the respective suction cannula placed at 7.5 mm from WL in mesiobuccal root canal). Key magnitudes of irrigation were compared with CFD. The irrigant solution did not enter the isthmus in SV simulation. Simulations SV-iNP, SV-SURG and SV-MaC exhibited a better performance in shear stress and apical pressure. Fluid flow did not reach the apical millimeters of the main root canal, but substantial flow and shear stress was observed in the isthmus in SV-SURG and SV-MaC simulations. The use of suction cannulas aids conventional irrigation in roots with 2 independent root canals and isthmus communication by improving irrigant flow, increasing shear stress in the root canal walls and isthmus, and slightly decreasing apical pressure.

Index Terms-

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