The Restorative Use of Fibre-Reinforced Materials in the Posterior Region

PhD Thesis

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List of the publications providing the basis of and related to the topic of the thesis

Publications providing the basis of the thesis:

I. **Fráter M**, Forster A, Keresztúri M, Braunitzer G, Nagy K. In vitro fracture resistance of molar teeth restored with a short fibre-reinforced composite material. J Dent. 2014 Sep;42(9):1143-50. doi: 10.1016/j.jdent.2014.05.004. Epub 2014 May 21. PubMed PMID: 24859462. **IF : 2.749** (2014)

II. **Fráter M**, Forster A, Jantyik Á, Braunitzer G, Nagy K. Flexibilis és merev üvegszál megerősítésű intraradikuláris csapok törési ellenállásának in vitro összehasonlító vizsgálata - pilot study. *Fogorvosi Szemle* 2015.

Related publications:

1. **Fráter M**, Braunitzer G, Urbán E, Bereczki L, Antal M, Nagy K. In vitro efficacy of different irrigating solutions against polymicrobial human root canal bacterial biofilms. Acta Microbiol Immunol Hung. 2013 Jun;60(2):187-99. doi: 10.1556/AMicr.60.2013.2.9. PubMed PMID: 23827750**. IF : 0.78** (2013)

To find the ideal material(s) for the restoration of posterior teeth (premolars and molars) has long been a central issue in restorative dentistry. To be able to fabricate a perfect restoration, one must be aware of the potential risk factors and characteristic types of failure in the region. Two main causes of posterior restoration failure have been identified: fracture (either of the restoration or the tooth itself) and secondary caries. Fracture occurrence remains a problem, even when adhesive (direct or indirect) restoration is done.

According to the principles of modern restorative dentistry, the restoration and the tooth should form a structurally adhesive and mechanically unified medium, which has the ability to withstand repetitive multi-axial bio-mechanical force loads over a prolonged period of time. The definition of the term “biomimetic” in the field of restorative dentistry is the study of the structure, function, and biology of the tooth organ as a model for the design and engineering of materials, techniques, and equipment to restore or replace teeth. In practice, the primary aims of biomimetic dentistry are to be as minimally invasive as possible and to substitute the

missing hard dental tissues with restorative materials closely resembling the natural tissues regarding their mechanical features and properties.

Utilizing different types of fibres with various orientations and lengths is quite an old idea in engineering and in architectural applications to construct devices with high strength and fracture toughness. In dentistry, attempts to apply glass fibres to reinforce dental polymers have been made for over 30 years. The rationale behind the usage of fibre reinforcement is partly to internally strengthen the structurally compromised tooth and partly to prevent the occurence of fractures.

The first goal of the in vitro studies presented here was to assess the effect of short fibre-reinforced composite (SFRC) restorative composite materials on the biomechanical stability of molar teeth restored with a large class II MOD composite filling, utilizing different layering strategies. The second goal was to determine and compare the fracture resistance and fracture patterns of endodontically treated premolar teeth restored with different fibre-reinforced composite (FRC) posts in different configurations.

The studies described in this thesis sought to examine how FRC materials can be used in the most efficient way to reinforce the dental structure in both endodontically non-treated and root canal treated cases. Within the limitations of these in vitro investigations, it can be concluded that when restoring MOD cavities in endodontically non-treated molar teeth, the use of SFRC does not lead to a statistically significant increase in fracture toughness; however, there is a clear tendency towards higher fracture resistance and more favourable (restorable) fractures when using SFRC with an oblique layering technique. In the case of endodontically treated, single-root premolars restored in the absence of a ferrule, significantly higher fracture resistance is seen when a multi-post technique is used, as compared to utilising a single conventional FRC post. No statistically significant difference was found between using conventional or elastic FRC posts for multiple post restorations. Premolar teeth restored with a single elastic FRC post exhibited significantly higher fracture resistance than those restored with a single conventional FRC post. Fracture

patterns were similarly favourable in all premolar groups. Finally, multi-post techniques are superior to single-post techniques in terms of achieved fracture resistance, regardless of the type of posts. In summary, it is recommendable that root canal treated premolar teeth be restored with multiple posts, but if for some reason a single post is chosen, this should be an elastic, fibre-reinforced one. As for the restoration of endodontically non-treated molars, the dentine should be substituted with SFRC for a more favourable fracture pattern, should fracture occur.