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The extent of enamel surface fractures. A quantitative comparison of thermally debonded ceramic and mechanically debonded metal brackets by energy dispersive micro- and image-analysis

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ABSTRACT

This clinical study investigated the practical value of two methods for debonding brackets attached by the adhesive Concise to acid-etched enamel surfaces. Forty-two Ultratrimm Standard metal brackets and 42 Fascination ceramic brackets were collected from juvenile patients undergoing orthodontic treatment. All metal brackets were mechanically debonded by a conventional bracket removal plier, whereas the ceramic brackets were thermally debonded by a commercial Dentaurum ceramic debonding unit. All brackets were evaluated by scanning electron microscopy for the morphology of their adhesive fracture surfaces and for the occurrence of mineral-like particles attached to the adhesive fracture surfaces. These particles were analysed by an energy dispersive X-ray microprobe for their Ca/P ratios and by image analysis of scanning electron micrographs for measurement of their areas. The scanning electron micrographs showed 4 types of debonding fractures. The most frequent fracture was type 1 (between adhesive and bracket base) and type 3 (between adhesive and enamel surface). In the groups of mechanically debonded metal brackets type 1 (38 per cent) and type 2 (45 per cent) showed a similar frequency, whereas thermally debonded ceramic brackets predominantly showed fracture type 1 (79 per cent) and only a minor percentage of type 2 (11 per cent). A statistical evaluation was applied to estimate the range of reproducibility of fracture types with a 95 per cent confidence interval (level of significance [alpha]=5 per cent). In both groups the microprobe analysis of fracture surfaces lying completely or partly between adhesive and enamel surface identified the mineral-like particles as enamel mineral. They occurred partly as single particles (range of thickness: 5-25 [mu]m, mean area: 3500 [mu]m^2) and partly as a coherent covering with a total area of 1.9-5.8 mm^2. It is concluded that the thermodebonding technique is superior to conventional mechanical debonding, because the frequent occurrence of fracture type 1 after thermodebonding affords a protection for the enamel surface, whereas mechanical debonding entails a comparatively high risk of enamel fractures.

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