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### **Three-Dimensional Force Systems from Insertion of Ideal Archwires**

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#### **Summary**

The force systems produced by orthodontic archwires have been described previously using primarily two-dimensional models. Orthodontic appliances, however, are three-dimensional in nature. The purpose of this study was to determine the three-dimensional force systems produced when ideal archwires were inserted into malaligned molar and incisor brackets. A finite element computer model was used to predict the force systems that would result at molar and incisor attachments of varying angulations and torques when fully contoured ideal archwires were inserted. The results were compared to those that would be predicted using a two-dimensional model. Three-dimensional predictions of force and moment magnitudes were smaller than those of the two-dimensional model. In addition, differences between relative moments and forces predicted by three-dimensional versus two-dimensional models were found. These findings were consistent with those of a previous study which examined three-dimensional force systems produced by activated orthodontic wires. Differences between two-dimensional and three-dimensional predictions are probably related to three factors: 1) length of the wire is greater when the three-dimensional aspect of the arch form is considered, 2) wire properties are different in bending versus torsion and only bending occurs in a two-dimensional system, and 3) a two-dimensional model can not account for moments and forces produced in the plane out of analysis.