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An analytical evaluation of a new spring design for segmented space closure

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ABSTRACT

Contemporary segmented-arch space-closure springs require activation techniques that have the side effect of producing a significant amount of geometric nonlinearity. This nonlinearity makes these springs difficult to manipulate because it allows tipping during space closure which may be considered adverse. A new spring mechanism has been designed in response to these difficulties so that the advantages of the segmented-arch technique can be extended to those clinicians presently using simple sliding mechanics as a means of space closure. This spring mechanism has eliminated a significant portion of the geometric nonlinearity by using force-application devices (activators) such as elastics or coil springs as the means of activation. By selecting the right activator it may be possible to close an entire extraction site (approx. 7 mm) with one activation. The proposed mechanism essentially consists of two units: an anchorage unit (M/F = 18 mm), and a translational unit (M/F = 11 mm). These units are combined in order to achieve anterior retraction, posterior protraction, or a combination of the two, which is termed reciprocal attraction. The finite-element method was used in place of bench studies to test the new spring design. The commonly used reciprocal-attraction spring tested with a nearly constant M/F ratio equal to 11 ± 1 mm over an effective force range of 50 gm to 450 gm. The results from the other two tests also showed that precisely controlled couple-to-force (M/F) ratios can be maintained over a wide range of effective forces.

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