The Online
ANGLE ORTHODONTIST
An International Journal of Orthodontics and Dentofacial Orthopedics
78th Anniversary 1930-2008

[Print Version]
[PubMed Citation] [Related Articles in PubMed]

The Angle Orthodontist: **Vol. 69, No. 1, pp. 71–80.**

Assessment of second-order clearances between orthodontic archwires and bracket slots via the critical contact angle for binding

Robert P. Kusy, BS, MS, PhD;[a] John Q. Whitley, BS[b]

[a]Professor Robert P. Kusy, University of North Carolina, DRC Building 210H, CB# 7455, Chapel Hill, NC 27599. R.P. Kusy, Dental Research Center, School of Dentistry; Department of Orthodontics, School of Dentistry; Department of Biomedical Engineering, School of Medicine; Curriculum in Applied and Materials Sciences, University of North Carolina, Chapel Hill, N.C. E-mail: rkusy@bme.unc.edu

[b]John Q. Whitley, Dental Research Center, School of Dentistry, University of North Carolina, Chapel Hill, NC.

ABSTRACT

Twenty-six archwires and 24 brackets were selected from among the hundreds of products available that nominally have from 18 to 22 mil bracket slots and 14, 16, 17, 18, 19, and/or 21 mil archwire sizes. After the archwires and brackets were dimensioned, a minimization-maximization algorithm was applied to the measurements in order to establish the likely boundaries of the critical contact angle for binding (θ_c) as defined by the presence and absence of second-order clearance. From among the myriad archwire-bracket permutations possible, 64 combinations were identified—20 using the bracket slot as the controlling dimension and 44 using the bracket width. Using a previously derived mathematical expression that relates the dimensions of each archwire-bracket couple to its calculated θ_c, the corresponding sets of indices were plotted. The results show that the maximum value of the calculated θ_c can never exceed about 5°, or else sliding mechanics will always be hampered. Other outcomes were validated experimentally using 5 of the 64 archwire-bracket couples by measuring the resistance to sliding (RS) at 15 different contact angles (θ) ranging from $\theta = 0°$ to $\theta = 12°$ and by subsequently determining a measured θ_c. These values agreed with the calculated θ_c values. When the practitioner knows the θ_c, treatment time might be reduced because the teeth do not need to be over-aligned prior to employing sliding mechanics (i.e., by not making $\theta \ll \theta_c$) and, further, because the contact angle beyond which the binding phenomenon retards or halts tooth movement does not need to be exceeded (i.e., by not making $\theta > \theta_c$) These results underscore the importance of exact wire and bracket dimensions on packaging; otherwise, sliding mechanics can be compromised by miscalculating θ_c.

KEY WORDS: Archwires, Brackets, Clearances, Contact angles, Sliding mechanics.

Submitted: November 1997
Accepted: June 1998.