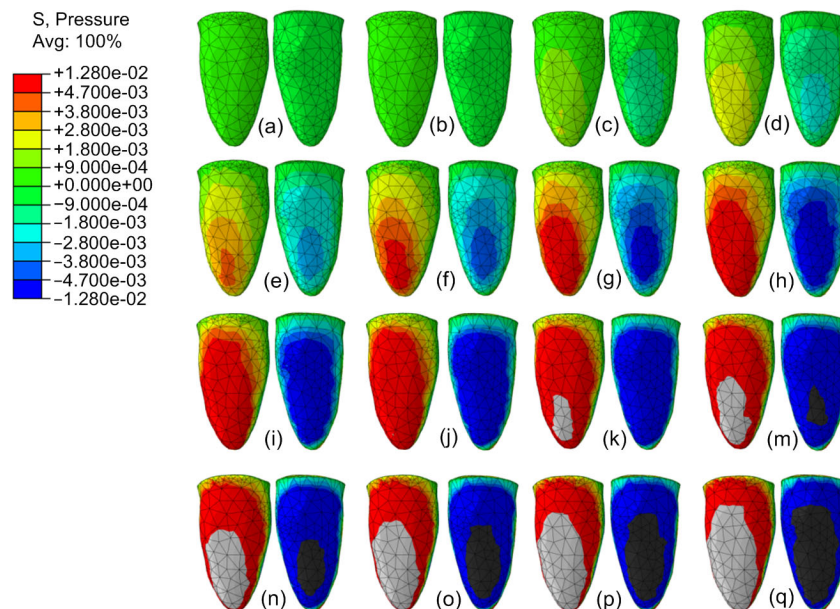# A biomechanical case study on the optimal orthodontic force on the maxillary canine tooth based on finite element analysis[*#]

Jian-lei WU[1], Yun-feng LIU[†‡1], Wei PENG[1], Hui-yue DONG[2], Jian-xing ZHANG[3]
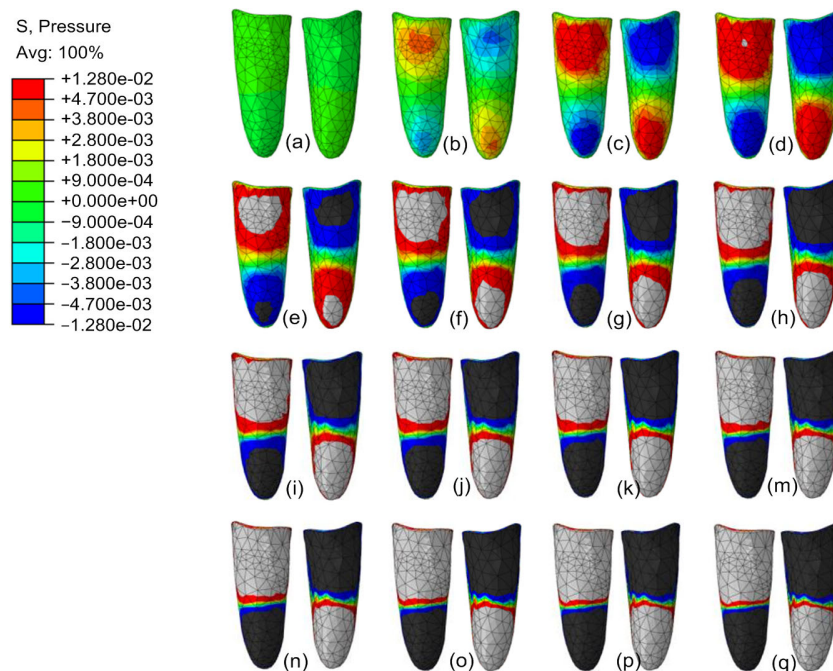
Fig. S1 Hydrostatic stress distribution of canine PDL with distal-direction translation under force
(a) 0 g, (b) 10 g, (c) 20 g, (d) 30 g, (e) 45 g, (f) 60 g, (g) 75 g, (h) 95 g, (i) 115 g, (j) 135 g, (k) 160 g, (m) 185 g, (n) 210 g, (o) 240 g, (p) 270 g, (q) 300 g; The left is distal surface and right is mesial surface. Red and blue areas indicate compressive and tensile hydrostatic stress between 4.7 kPa (capillary pressure) and 12.8 kPa (80% of systolic pressure) while grey and black areas indicate compressive and tensile stress over 12.8 kPa, and other colors indicate stress between -4.7 kPa and 4.7 kPa
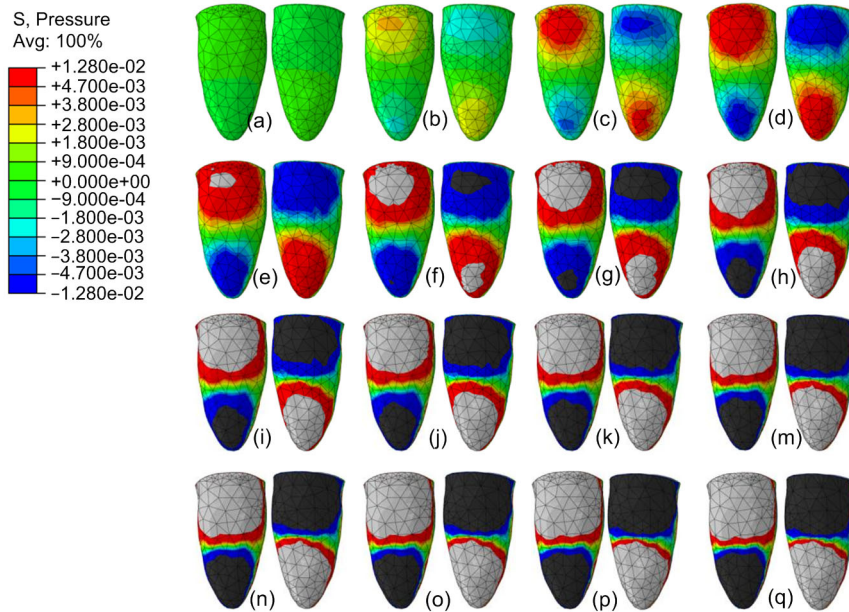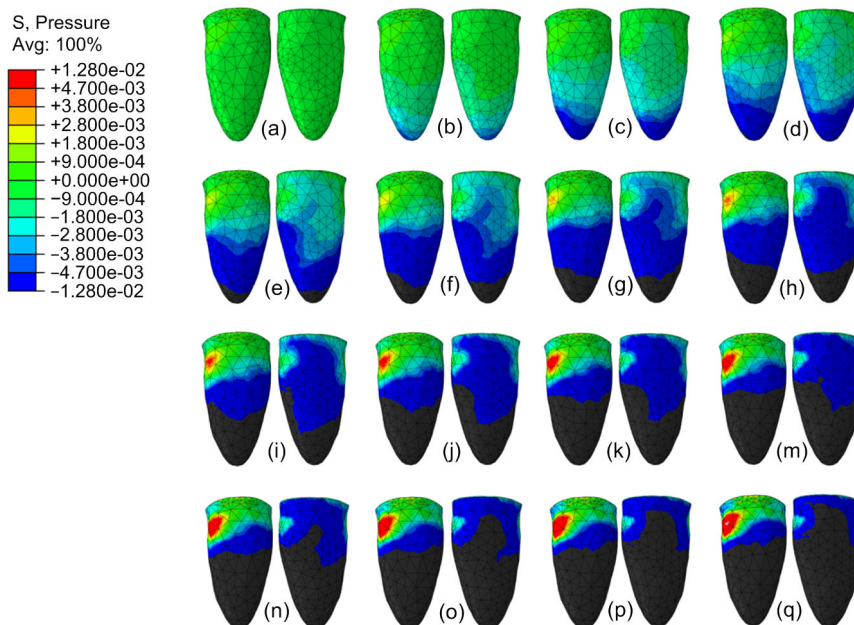
Fig. S2 Hydrostatic stress distribution of canine PDL with distal-direction tipping movement under force
(a) 0 g, (b) 10 g, (c) 20 g, (d) 30 g, (e) 45 g, (f) 60 g, (g) 75 g, (h) 95 g, (i) 115 g, (j) 135 g, (k) 160 g, (m) 185 g, (n) 210 g, (o) 240 g, (p) 270 g, (q) 300 g; The left is distal surface and right is mesial surface. Red and blue areas indicate compressive and tensile hydrostatic stress between 4.7 kPa (capillary pressure) and 12.8 kPa (80% of systolic pressure) while grey and black areas indicate compressive and tensile stress over 12.8 kPa, and other colors indicate stress between -4.7 kPa and 4.7 kPa
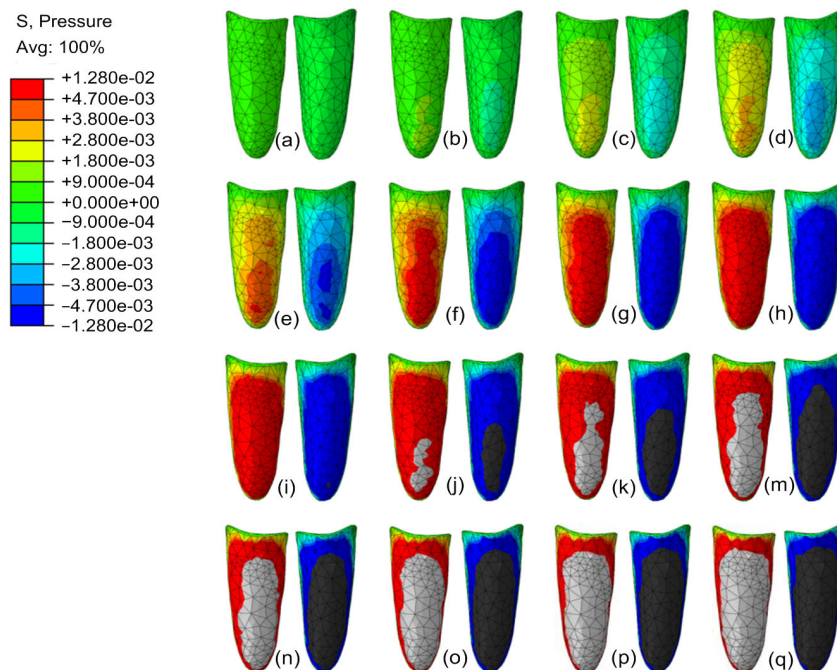
Fig. S3 Hydrostatic stress distribution of canine PDL with labial-direction translation under force
(a) 0 g, (b) 10 g, (c) 20 g, (d) 30 g, (e) 45 g, (f) 60 g, (g) 75 g, (h) 95 g, (i) 115 g, (j) 135 g, (k) 160 g, (m) 185 g, (n) 210 g, (o) 240 g, (p) 270 g, (q) 300 g; The left is labial surface and right is lingual surface. Red and blue areas indicate compressive and tensile hydrostatic stress between 4.7 kPa (capillary pressure) and 12.8 kPa (80% of systolic pressure) while grey and black areas indicate compressive and tensile stress over 12.8 kPa, and other colors indicate stress between -4.7 kPa and 4.7 kPa
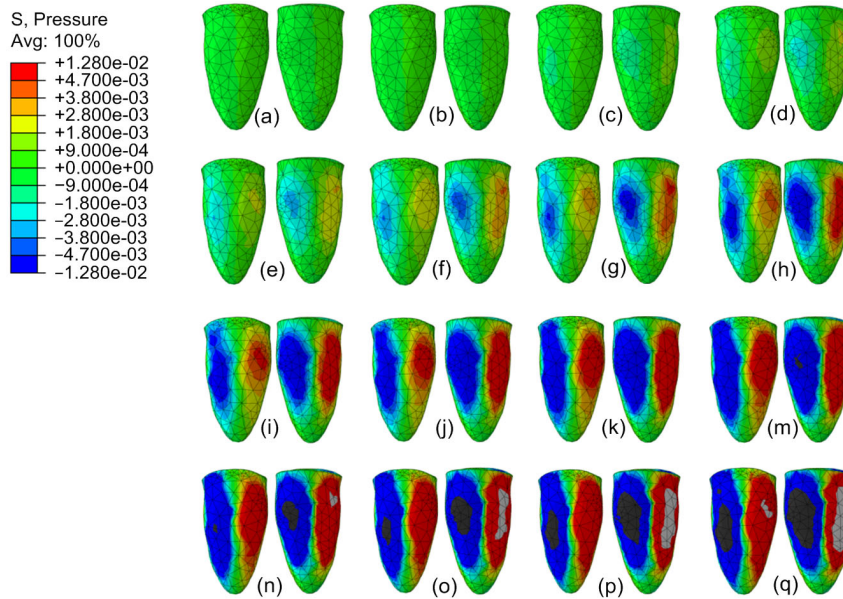
Fig. S4 Hydrostatic stress distribution of canine PDL with labial-direction tipping movement under force
(a) 0 g, (b) 10 g, (c) 20 g, (d) 30 g, (e) 45 g, (f) 60 g, (g) 75 g, (h) 95 g, (i) 115 g, (j) 135 g, (k) 160 g, (m) 185 g, (n) 210 g, (o) 240 g, (p) 270 g, (q) 300 g; The left is labial surface and right is lingual surface. Red and blue areas indicate compressive and tensile hydrostatic stress between 4.7 kPa (capillary pressure) and 12.8 kPa (80% of systolic pressure) while grey and black areas indicate compressive and tensile stress over 12.8 kPa, and other colors indicate stress between -4.7 kPa and 4.7 kPa
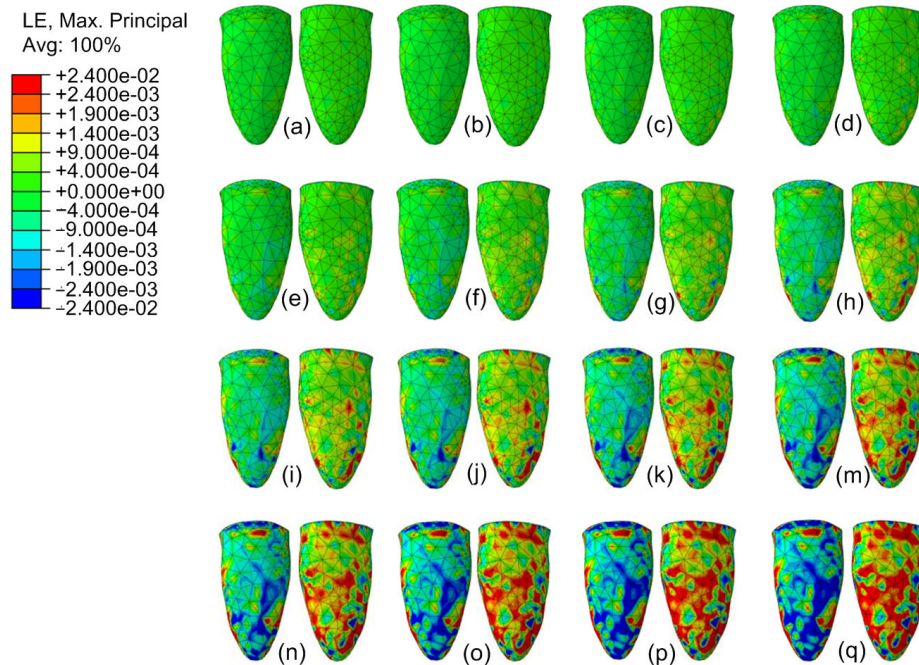

Fig. S5 Hydrostatic stress distribution of canine PDL with extrusion under force
(a) 0 g, (b) 10 g, (c) 20 g, (d) 30 g, (e) 45 g, (f) 60 g, (g) 75 g, (h) 95 g, (i) 115 g, (j) 135 g, (k) 160 g, (m) 185 g, (n) 210 g, (o) 240 g, (p) 270 g, (q) 300 g; The left is distal surface and right is mesial surface. Red and blue areas indicate compressive and tensile hydrostatic stress between 4.7 kPa (capillary pressure) and 12.8 kPa (80% of systolic pressure) while grey and black areas indicate compressive and tensile stress over 12.8 kPa, and other colors indicate stress between -4.7 kPa and 4.7 kPa

Fig. S6 Hydrostatic stress distribution of canine PDL with rotation around long axis under force moment
(a) 0 g·mm, (b) 10 g·mm, (c) 20 g·mm, (d) 30 g·mm, (e) 45 g·mm, (f) 60 g·mm, (g) 75 g·mm, (h) 95 g·mm, (i) 115 g·mm, (j) 135 g·mm, (k) 160 g·mm, (m) 185 g·mm, (n) 210 g·mm, (o) 240 g·mm, (p) 270 g·mm, (q) 300 g·mm; The left is distal surface and right is mesial surface. Red and blue areas indicate compressive and tensile hydrostatic stress between 4.7 kPa (capillary pressure) and 12.8 kPa (80% of systolic pressure) while grey and black areas indicate compressive and tensile stress over 12.8 kPa, and other colors indicate stress between -4.7 kPa and 4.7 kPa

Fig. S7 Logarithmic strain distribution of canine PDL with distal-direction translation under force
(a) 0 g, (b) 10 g, (c) 20 g, (d) 30 g, (e) 45 g, (f) 60 g, (g) 75 g, (h) 95 g, (i) 115 g, (j) 135 g, (k) 160 g, (m) 185 g, (n) 210 g, (o) 240 g, (p) 270 g, (q) 300 g; The left is distal surface and right is mesial surface. Red and blue areas indicate tensile and compressive strain over 0.24% (80% of peak strain during canine maximal moving velocity)
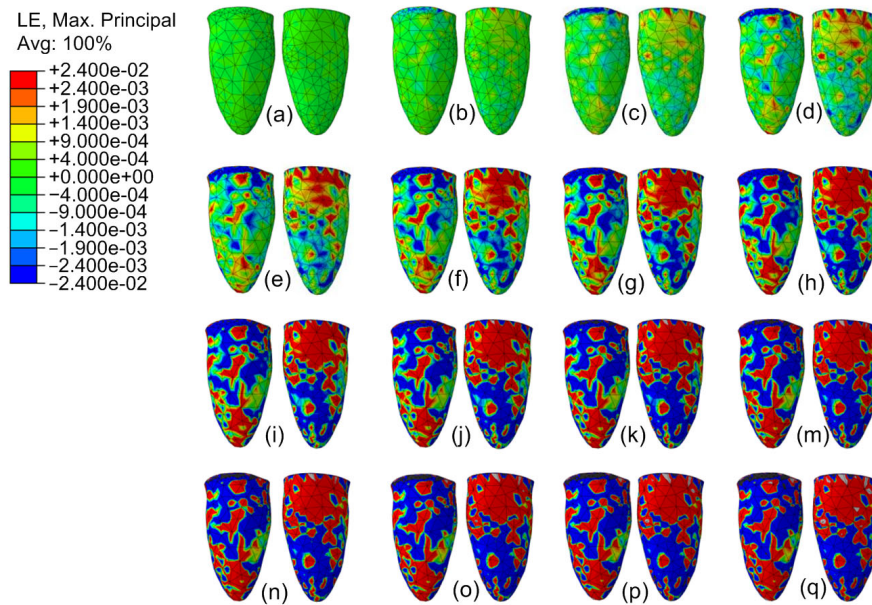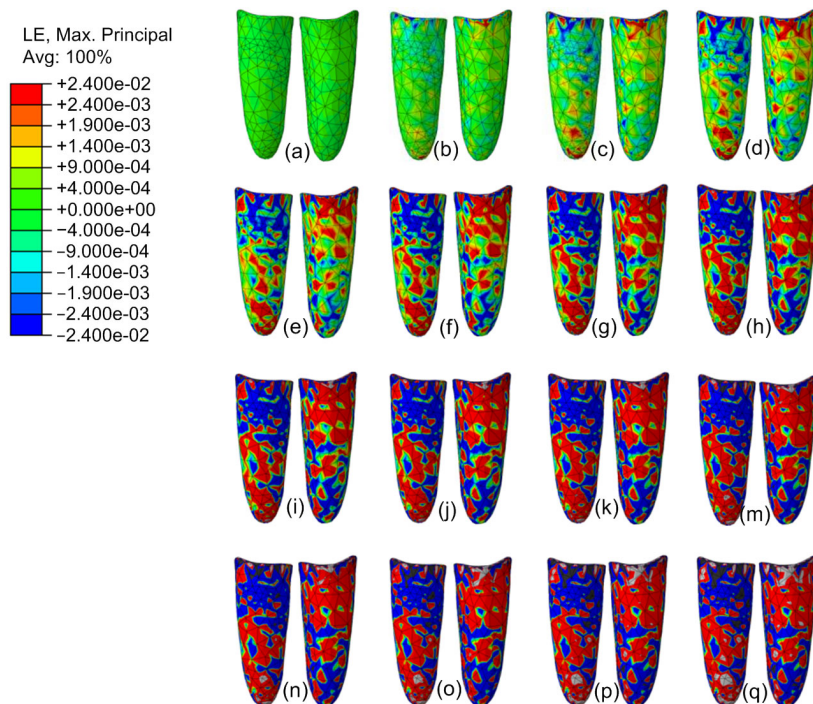
Fig. S8 Logarithmic strain distribution of canine PDL with distal-direction tipping movement under force
(a) 0 g, (b) 10 g, (c) 20 g, (d) 30 g, (e) 45 g, (f) 60 g, (g) 75 g, (h) 95 g, (i) 115 g, (j) 135 g, (k) 160 g, (m) 185 g, (n) 210 g, (o) 240 g, (p) 270 g, (q) 300 g; The left is distal surface and right is mesial surface. Red and blue areas indicate tensile and compressive strain over 0.24% (80% of peak strain during canine maximal moving velocity)
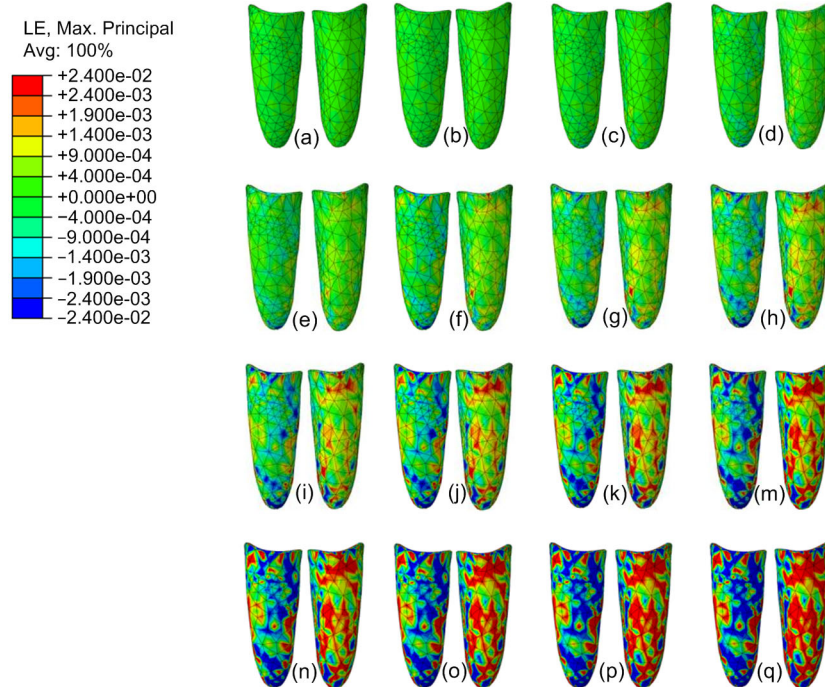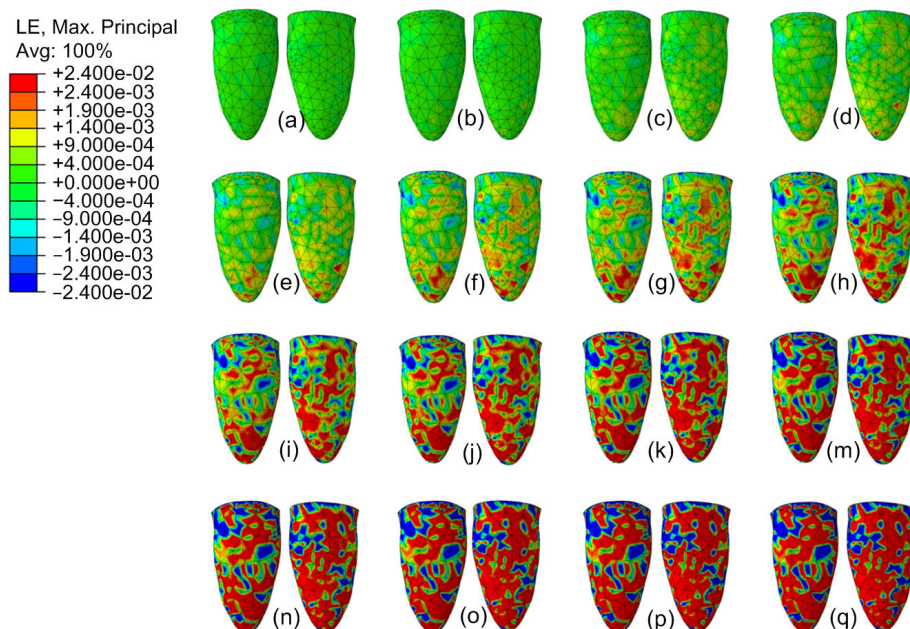

Fig. S9 Logarithmic strain distribution of canine PDL with labial-direction translation under force
(a) 0 g, (b) 10 g, (c) 20 g, (d) 30 g, (e) 45 g, (f) 60 g, (g) 75 g, (h) 95 g, (i) 115 g, (j) 135 g, (k) 160 g, (m) 185 g, (n) 210 g, (o) 240 g, (p) 270 g, (q) 300 g; The left is labial surface and right is lingual surface. Red and blue areas indicate tensile and compressive strain over 0.24% (80% of peak strain during canine maximal moving velocity)
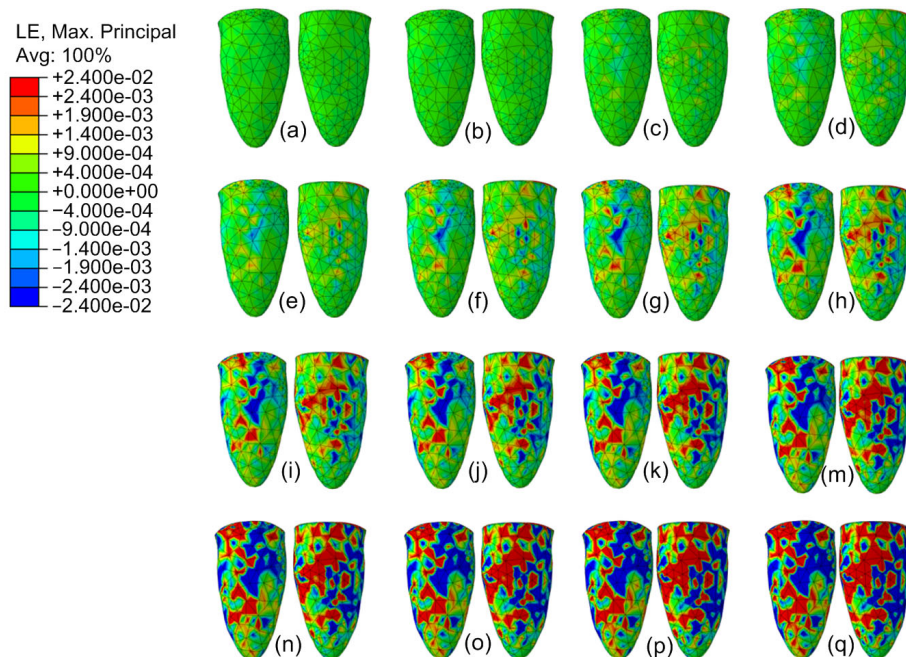
Fig. S10 Logarithmic strain distribution of canine PDL with labial-direction tipping movement under force
(a) 0 g, (b) 10 g, (c) 20 g, (d) 30 g, (e) 45 g, (f) 60 g, (g) 75 g, (h) 95 g, (i) 115 g, (j) 135 g, (k) 160 g, (m) 185 g, (n) 210 g, (o) 240 g, (p) 270 g, (q) 300 g; The left is labial surface and right is lingual surface. Red and blue areas indicate tensile and compressive strain over 0.24% (80% of peak strain during canine maximal moving velocity)

Fig. S11 Logarithmic strain distribution of canine PDL with extrusion under force
(a) 0 g, (b) 10 g, (c) 20 g, (d) 30 g, (e) 45 g, (f) 60 g, (g) 75 g, (h) 95 g, (i) 115 g, (j) 135 g, (k) 160 g, (m) 185 g, (n) 210 g, (o) 240 g, (p) 270 g, (q) 300 g; The left is distal surface and right is mesial surface. Red and blue areas indicate tensile and compressive strain over 0.24% (80% of peak strain during canine maximal moving velocity)

Fig. S12 Logarithmic strain distribution of canine PDL with rotation around long axis under force moment
(a) 0 g·mm, (b) 10 g·mm, (c) 20 g·mm, (d) 30 g·mm, (e) 45 g·mm, (f) 60 g·mm, (g) 75 g·mm, (h) 95 g·mm, (i) 115 g·mm, (j) 135 g·mm, (k) 160 g·mm, (m) 185 g·mm, (n) 210 g·mm, (o) 240 g·mm, (p) 270 g·mm, (q) 300 g·mm; The left is distal surface and right is mesial surface. Red and blue areas indicate tensile and compressive strain over 0.24% (80% of peak strain during canine maximal moving velocity)