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# Sample size calculation for bucco-lingual movement
delta <- 0.29
sd_pooled <- 0.46
alpha <- 0.05
power <- 0.80
ratio <- 1

m_avg <- 1.62
icc <- 0.1935484

z_alpha <- qnorm(1 - alpha / 2)
z_beta <- qnorm(power)

n_opt_unadj <- ((1 + ratio) * (z_alpha + z_beta)^2 * sd_pooled^2) /
  (ratio * delta^2)
n_conv_unadj <- ratio * n_opt_unadj

n_opt_unadj_ceiling <- ceiling(n_opt_unadj)
n_conv_unadj_ceiling <- ceiling(n_conv_unadj)

n_teeth_unadj <- n_opt_unadj_ceiling + n_conv_unadj_ceiling

design_effect <- 1 + (m_avg - 1) * icc
n_teeth_adj <- ceiling(n_teeth_unadj * design_effect)
n_participants <- ceiling(n_teeth_adj / m_avg)

cat("Optimised group =", n_opt_unadj_ceiling)
cat("Conventional group =", n_conv_unadj_ceiling)
cat("Total teeth =", n_teeth_unadj)
cat("Design effect =", round(design_effect, 3))
cat("Cluster-adjusted total teeth =", n_teeth_adj)
cat("Equivalent participants =", n_participants)

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Optimised group = 40

Conventional group = 40

Total teeth = 80

Design effect = 1.120

Cluster-adjusted total teeth = 90

Equivalent participants = 56