Hypothesis

In the following section are the statistical analysis of each hypothesis listed. All hypotheses are tested using the primary outcome *movement efficiency* (CT_{facial} / F_{fl}) to assess significant differences. Because the positive direction of F_{fl} is defined towards lingual, the movement efficiency is a negative value. Nevertheless, the higher the absolute value of efficiency, the more accurate the simulated movement is expected to happen clinically. Since 5 aligners were each tested twice, the two testing rounds are analyzed separately for each design (repetition 1 and 2).

Composite flash and position

H1.1: Composite flash around the engager shows a significant lower movement efficiency compared to an optimal engager design.

The Wilcoxon rank sum test revealed p-values of <0.001 for both repetitions, indicating highly significant differences between the movement efficiencies of both designs for both repetitions. Diagram 1 shows boxplots of the movement efficiencies for the optimal rectangular engager centrally placed on the crown (recV) as well as the same design but with added composite flash (recVf).

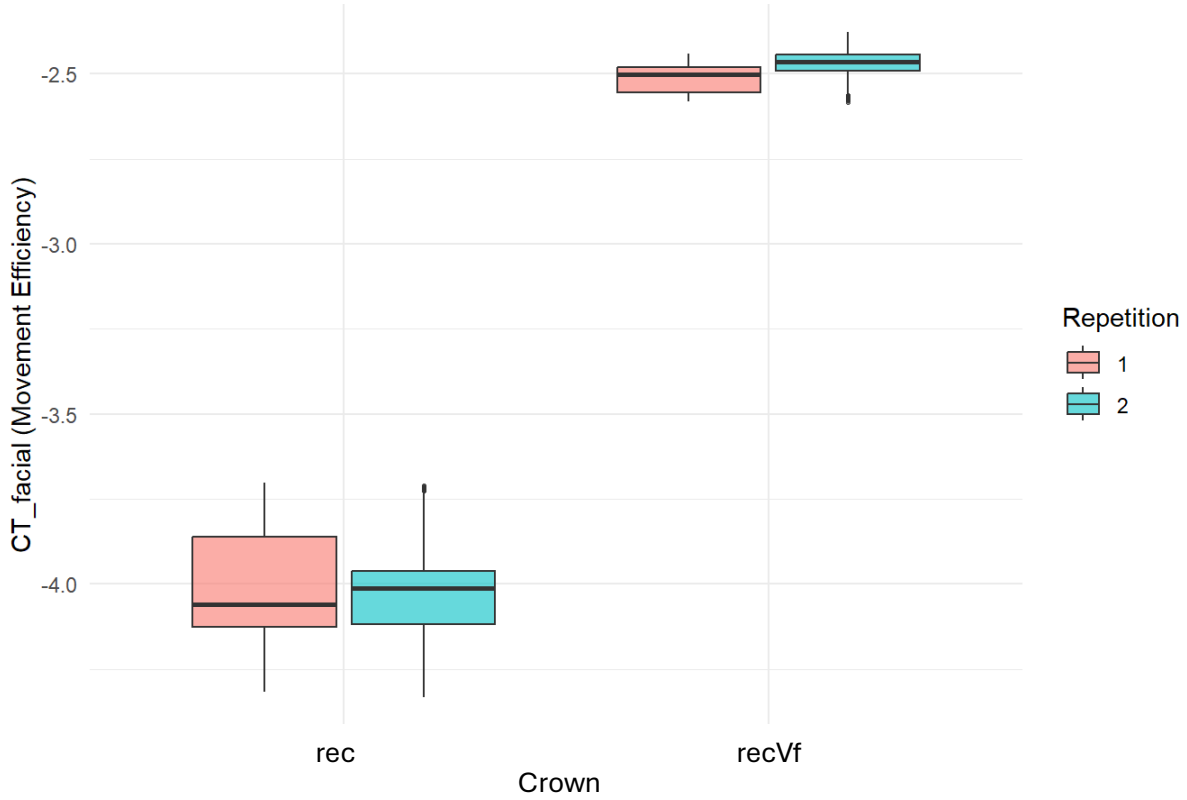

Diagram 1: H1.1 Boxplot – Movement Efficiency is demonstrated per crown design and testing repetition.

H1.2: Composite flash and a vertical shift show a significant lower movement efficiency compared to an optimal engager design.

The Wilcoxon rank sum test revealed p-values of <0.001 for both repetitions, indicating highly significant differences between the movement efficiencies of both designs for both repetitions. Diagram 2Diagram 1 shows boxplots of the movement efficiencies for the optimal rectangular

engager centrally placed on the crown (recV) as well as the design with added composite flash and a 1 mm incisal shift (recVfs).

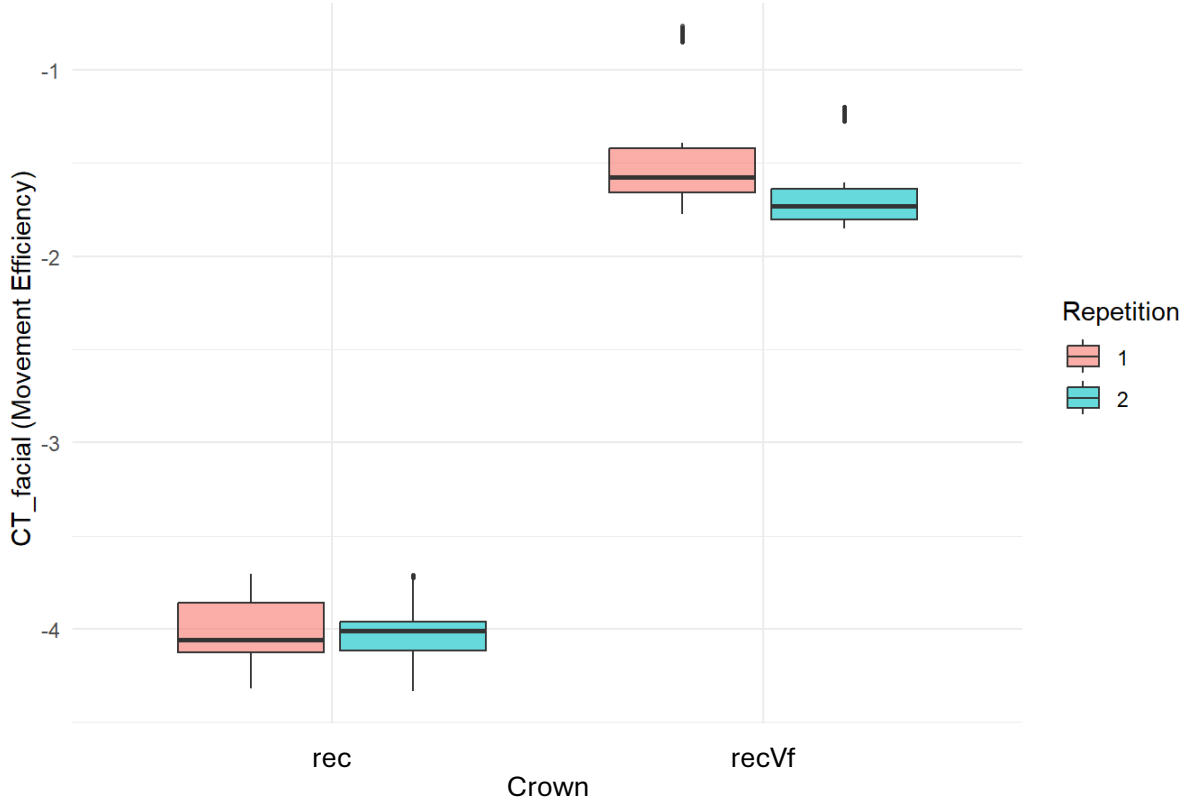

Diagram 2: H1.2 Boxplot – Movement Efficiency is demonstrated per crown design and testing repetition.

Engager shape

H2.1a: The presence of a centrally placed rectangular engager significantly increases movement efficiency compared to no engager.

The Wilcoxon rank sum test revealed p-values of <0.001 for both repetitions, indicating highly significant differences between the movement efficiencies of both designs for both repetitions. Diagram 3Diagram 1 shows boxplots of the movement efficiencies for the optimal rectangular engager centrally placed on the crown (recV) as well as the design with no engager (NoEng).

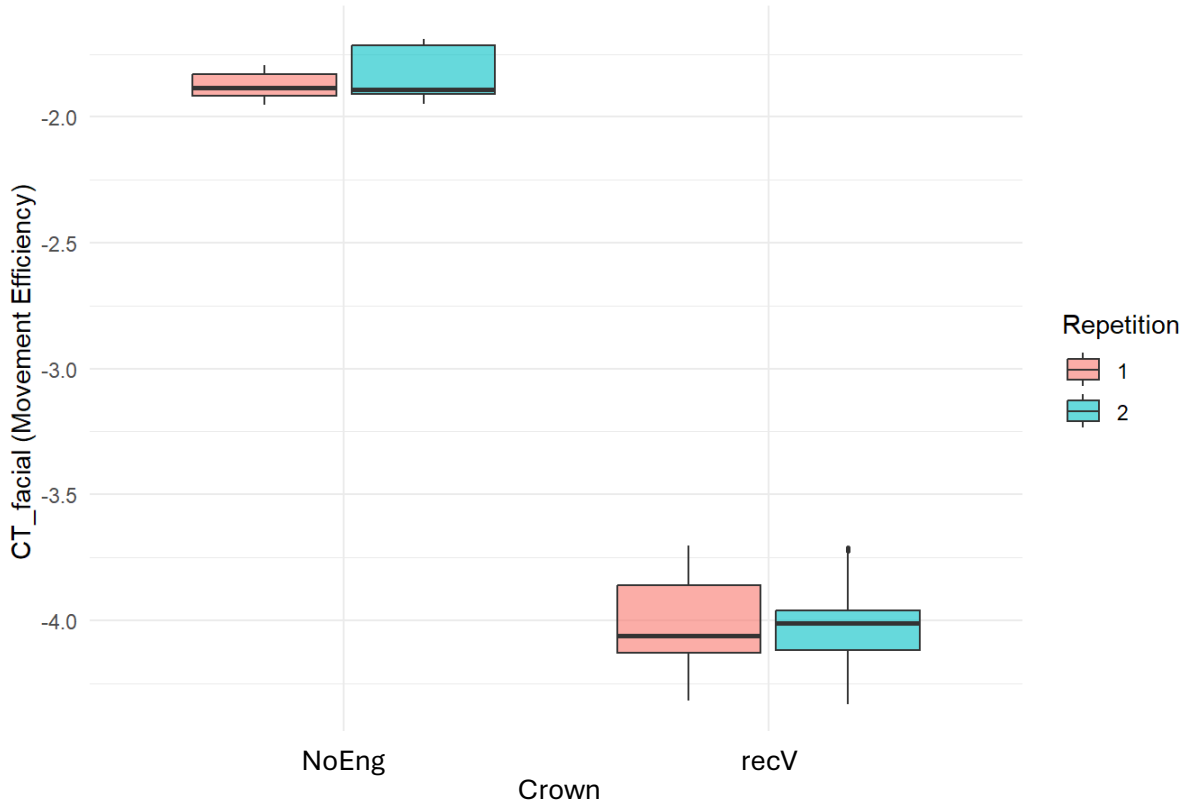

Diagram 3: H2.1a Boxplot – Movement Efficiency is demonstrated per crown design and testing repetition.

H2.1b: The presence of a centrally placed beveled engager significantly increases movement efficiency compared to no engager.

Like the results from H2.1a, also H2.1b can be confirmed given the p-values < 0.001 for both repetitions using the Wilcoxon rank sum test. Diagram 4 shows boxplots of the movement efficiencies for the design with no engagers (NoEng) as well as the design with a centrally placed beveled engager (bevC).

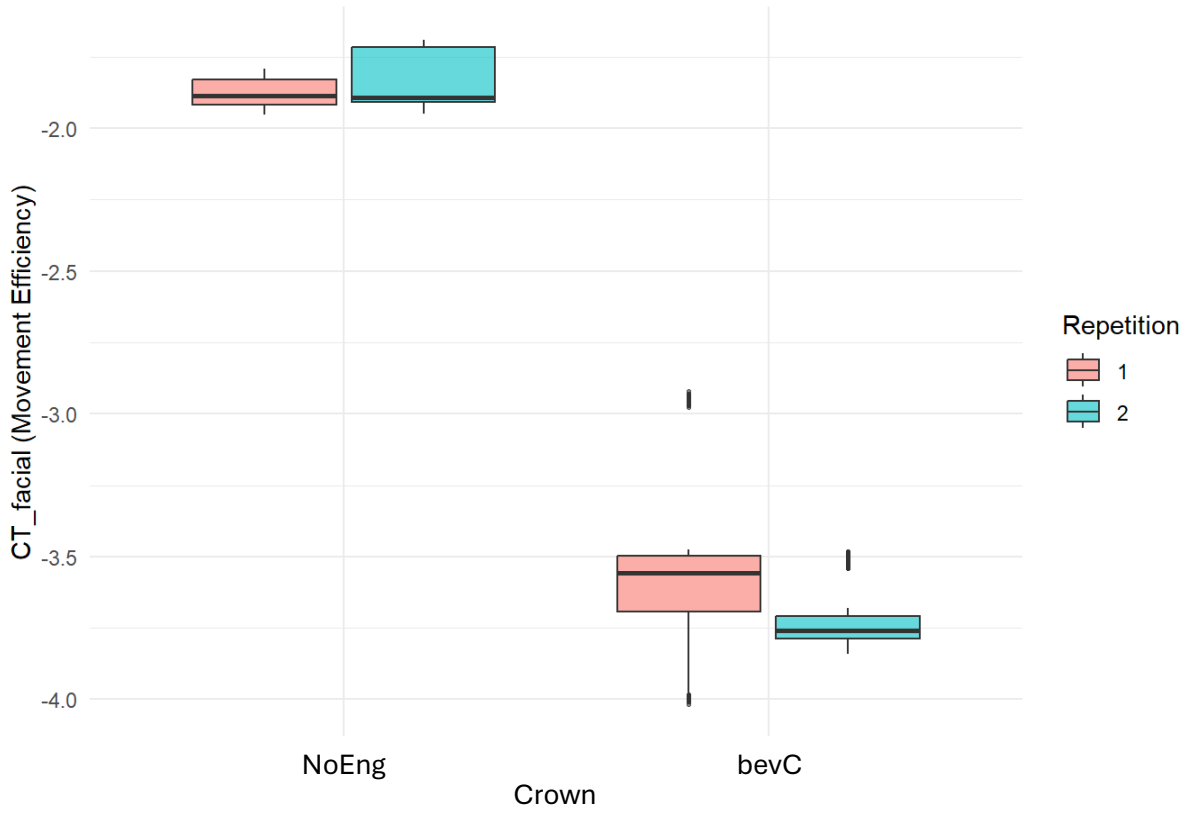

Diagram 4: H2.1b Boxplot – Movement Efficiency is demonstrated per crown design and testing repetition.

H2.2: The beveled and rectangular engager show no significant difference in movement efficiency when centrally placed on the crown.

The Wilcoxon rank sum test revealed p-values of <0.001 for both repetitions, indicating highly significant differences between the movement efficiencies of both designs for both repetitions. This result indicates that the vertical rectangular engager design creates a significantly higher movement efficiency compared to the beveled design and thus the hypothesis H2.2 is rejected. Diagram 5 shows boxplots of the movement efficiencies for the optimal rectangular engager

centrally placed on the crown (recV) as well as the design with the centrally placed beveled engager (bevC).

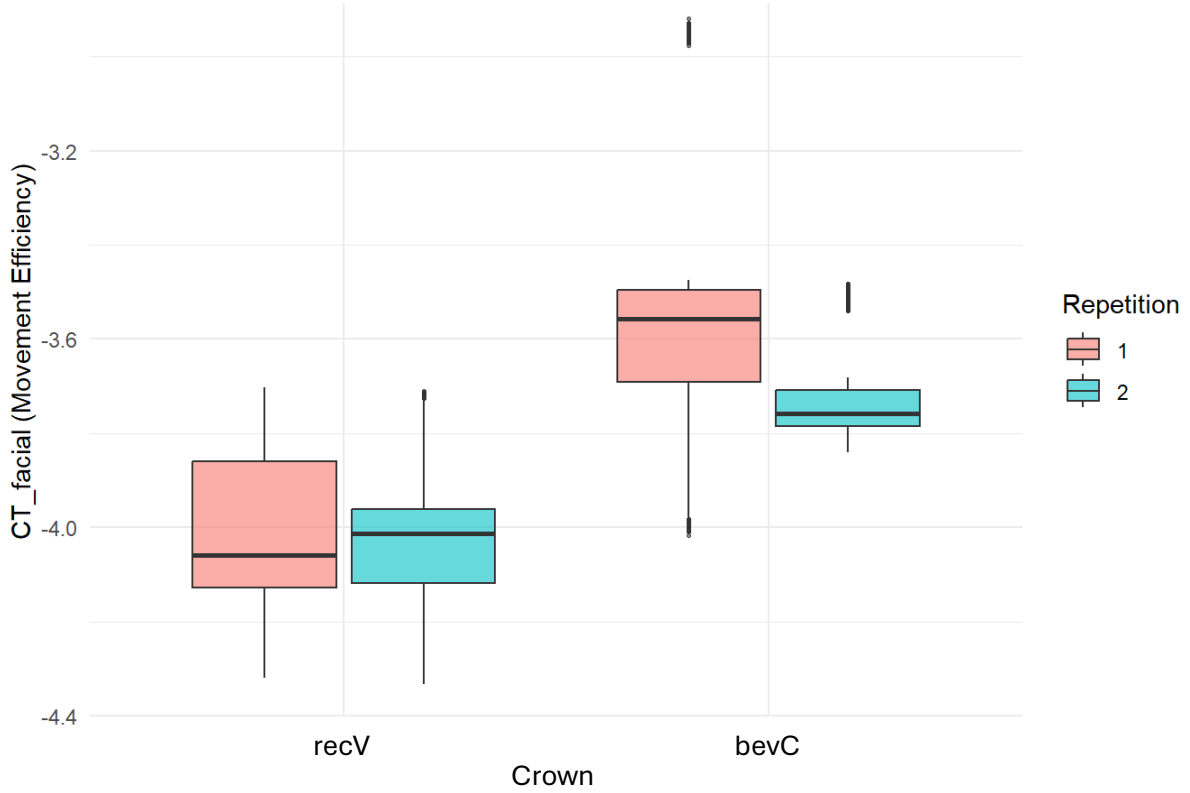

Diagram 5: H2.2 Boxplot – Movement Efficiency is demonstrated per crown design and testing repetition.

Vertical position

H3.1: The beveled engager placed more gingival shows significant higher movement efficiency compared to centrally placed.

The Wilcoxon rank sum test revealed p-values of <0.001 for both repetitions, indicating highly significant differences between the movement efficiencies of both designs for both repetitions. Diagram 6 shows boxplots of the movement efficiencies for the beveled engager centrally placed on the crown (bevC) as well as the beveled engager with a 2 mm shift towards gingival (bevG).

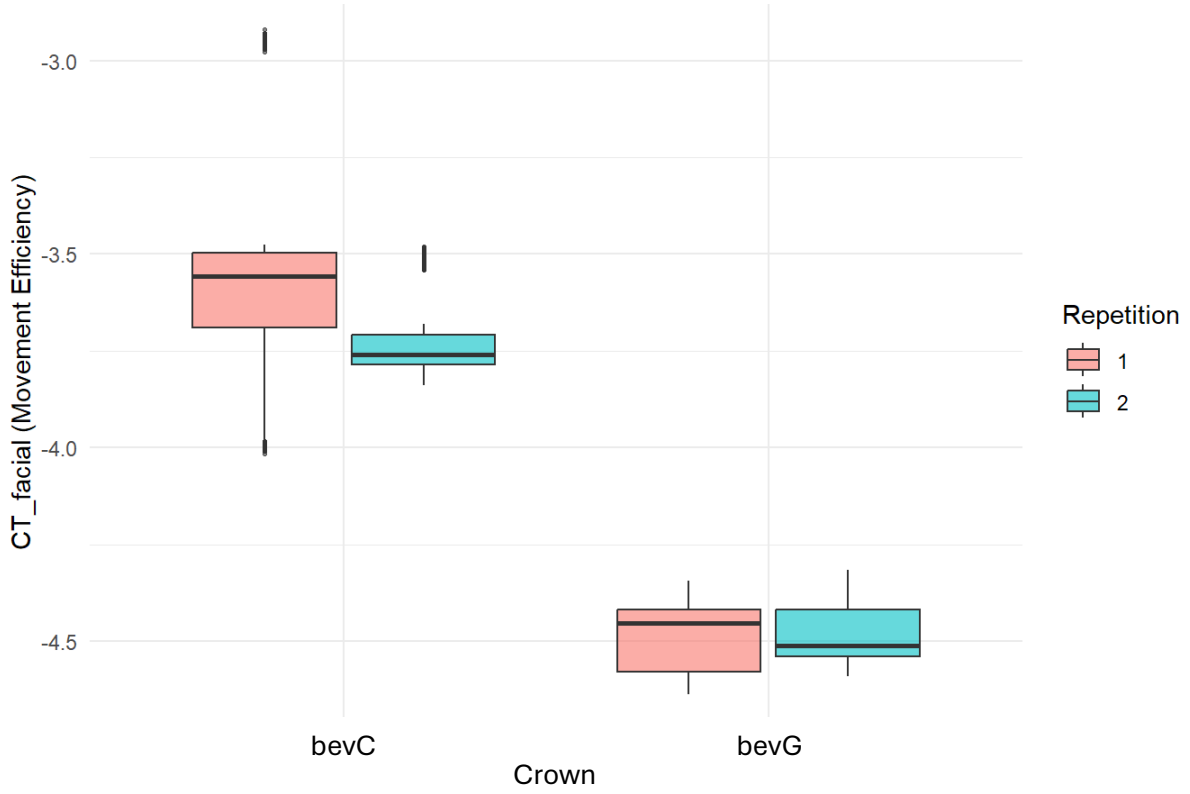

Diagram 6: H3.1 Boxplot – Movement Efficiency is demonstrated per crown design and testing repetition.

H3.2: The beveled engager placed more incisal shows significant higher movement efficiency compared to centrally placed.

The Wilcoxon rank sum test revealed p-values of <0.001 for both repetitions, indicating highly significant differences between the movement efficiencies of both designs for both repetitions. Diagram 7 shows boxplots of the movement efficiencies for the beveled engager centrally placed on the crown (bevC) as well as the beveled engager with a 2 mm shift towards occlusal (bevO).

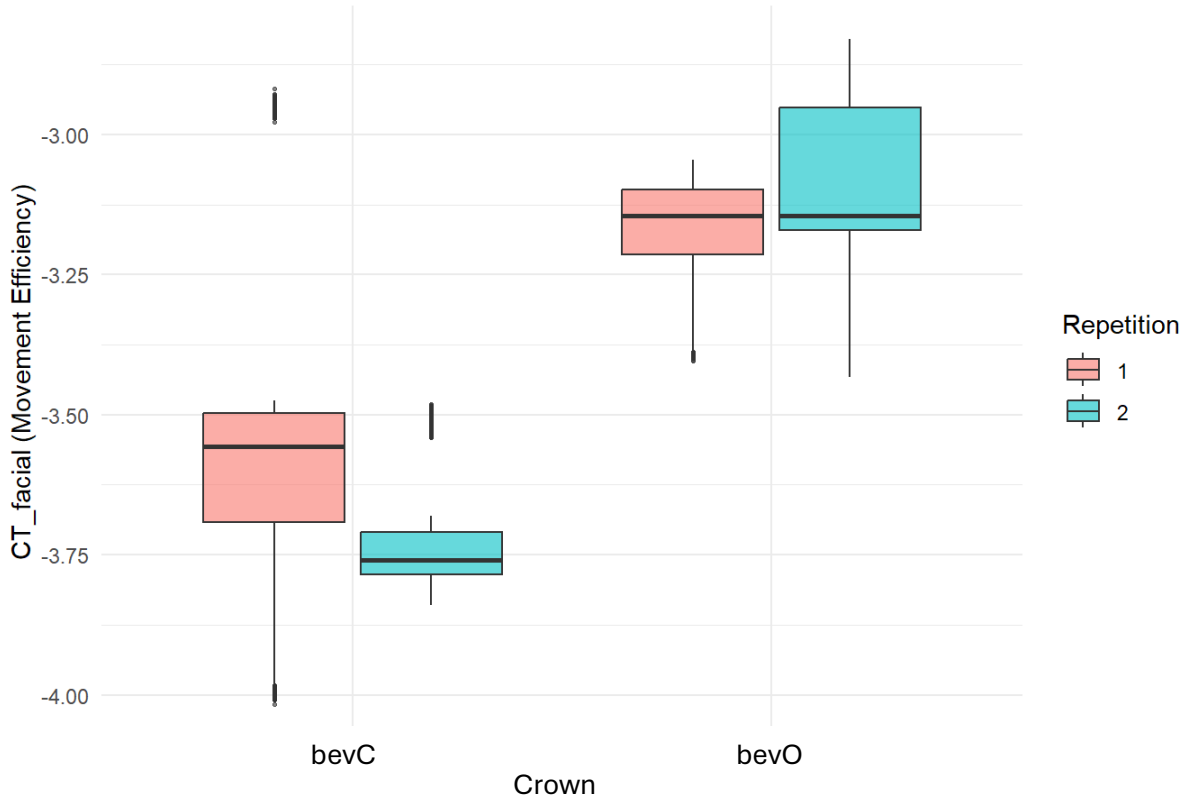

Diagram 7: H3.2 Boxplot – Movement Efficiency is demonstrated per crown design and testing repetition.