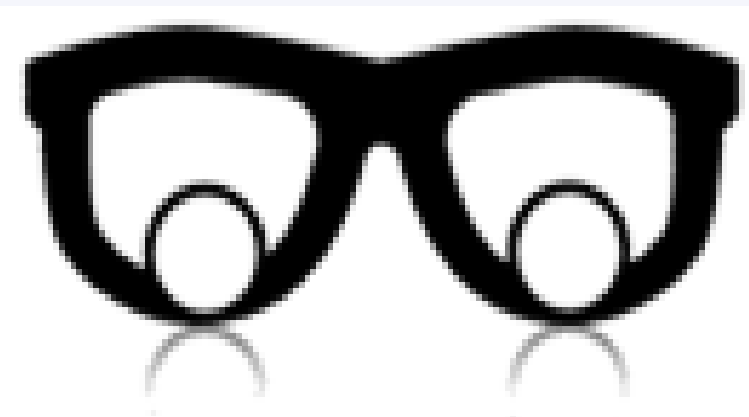




A standardized method to determine the proper working distance for dental magnification utilizing neutral ergonomics positioning



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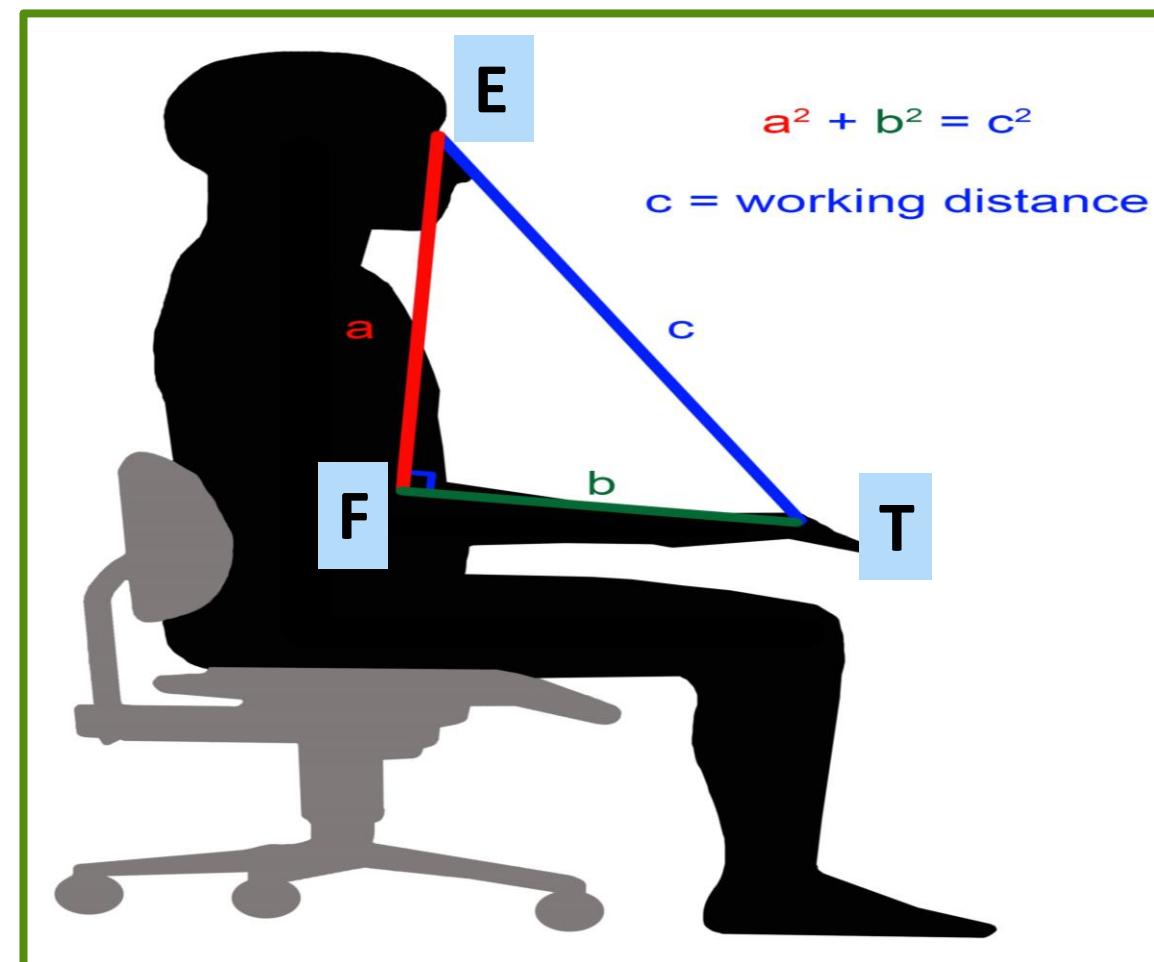
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Objectives

Evaluate and compare the relationship between the anatomic measurements of the dental clinician in a neutral ergonomics position and the proper working distance and test the hypothesis that working distance can be estimated using the specific anatomical measurements of the operator.

Materials and Methods

Specific measurements were obtained from 134 participants utilizing a neutral ergonomics position. The values were applied using the Pythagorean Theorem to calculate a hypothesized working distance (HWD) from lateral the epicanthus (E) to the antecubital fossa (F) and the antecubital fossa to the tip of the thumb (T). The actual working distance (ET) was measured from the lateral epicanthus to the tip of the thumb in a neutral ergonomics position in a simulated setting.



(1)



(2)

Measurements were collected with a right-angle square and measuring tape. Participants were seated at a simulation station at the 9:00 position for right-handed participants and 3:00 for left-handed participants. Participants were instructed into neutral ergonomics position. Each session took no longer than 5 minutes to complete.



(3)

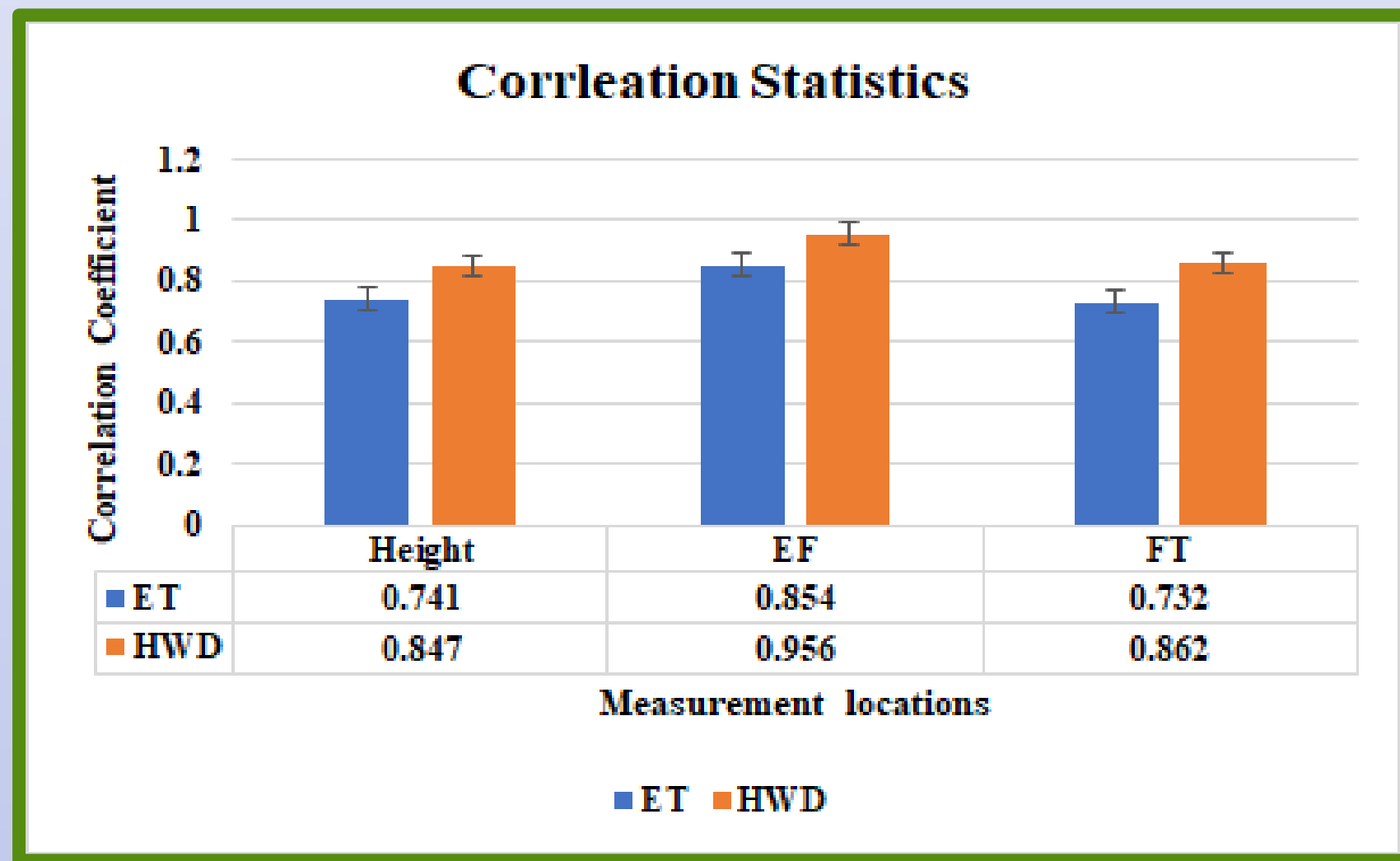
Participant Age			
Participant's Gender	Male	Female	Do not wish to Answer
Participant's Educational Status	D1	D2	D3
Handedness	Right	Left	
Standing height			
Do you wear glasses/contacts? LASIK or related procedure?	Yes	No	
"Eye to Elbow" lateral epicanthus of the eye to mid-elbow fold (cm and inch)			
"Elbow to Tooth" mid-elbow fold of the cubital fossa to tip of thumb OR to occlusal surface #19 or #30 (cm and inch)			
"Eye to Tooth". Working distance without loupes lateral epicanthus eye to typodont mandibular molar (cm and inch)			

Data Collection Table

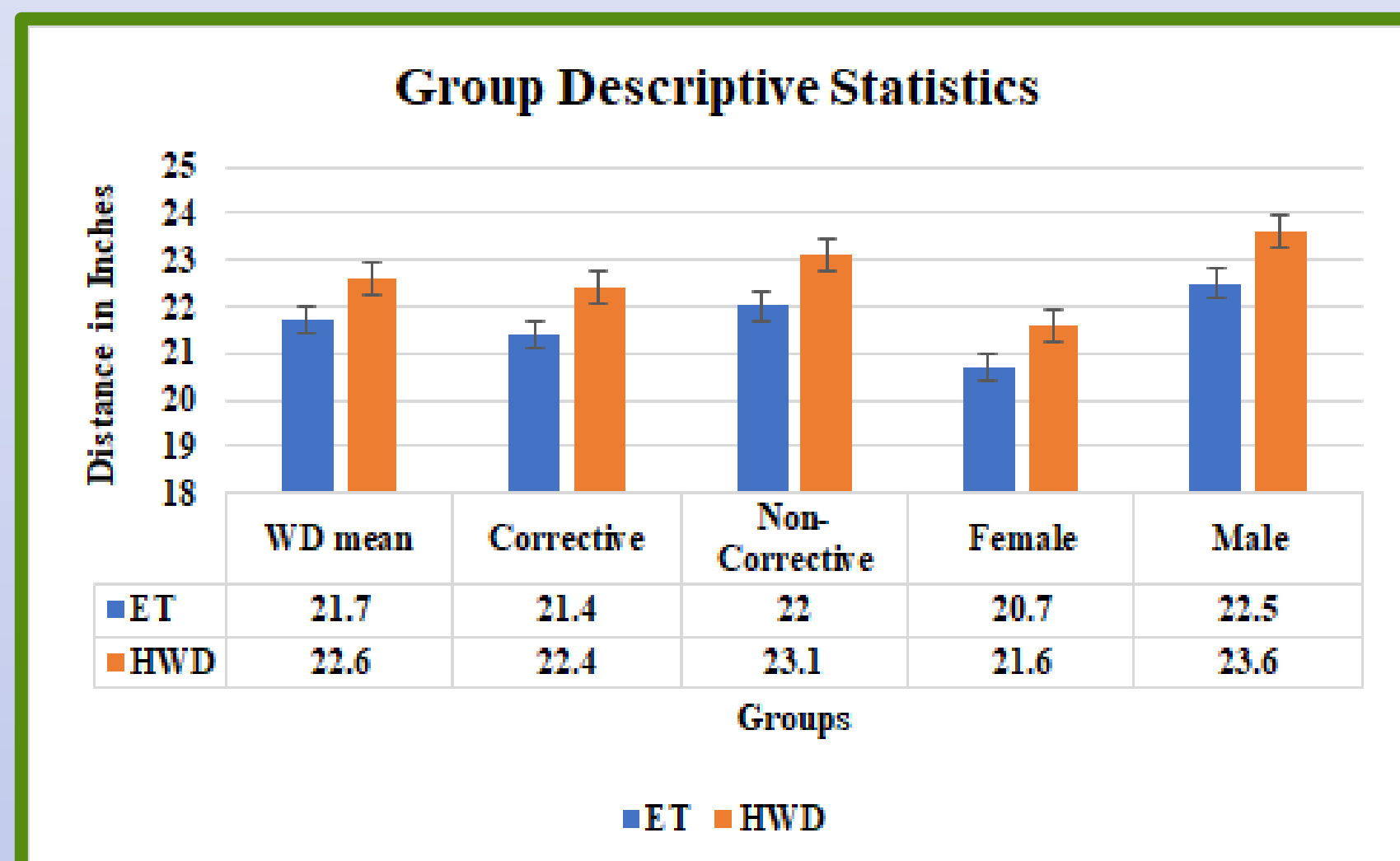
Results

Results of the study showed a significant positive correlation between actual (ET) and hypothesized working distance (HWD), confirming the suggested hypothesis. Further analysis shows a positive correlation for all the anatomic measurements taken in simulation: **ET to height**, **HWD to height**, lateral epicanthus to antecubital fossa measurement (**EF**) and **ET**, **EF and HWD**, antecubital fossa to thumb (**FT**) and **ET**, **FT and HWD** ($p < 0.00$) .

There was a marginally significant difference when comparing vision types, corrective and non- corrective ($p < 0.058$), with non-corrective vision having a higher actual working distance. There was a statistical difference when comparing gender and hypothesized working distance with male participants ranking higher hypothesized and actual working distance. Future applications of this study may assist in the development of standardized measuring methods thus promoting good head and neck posture.

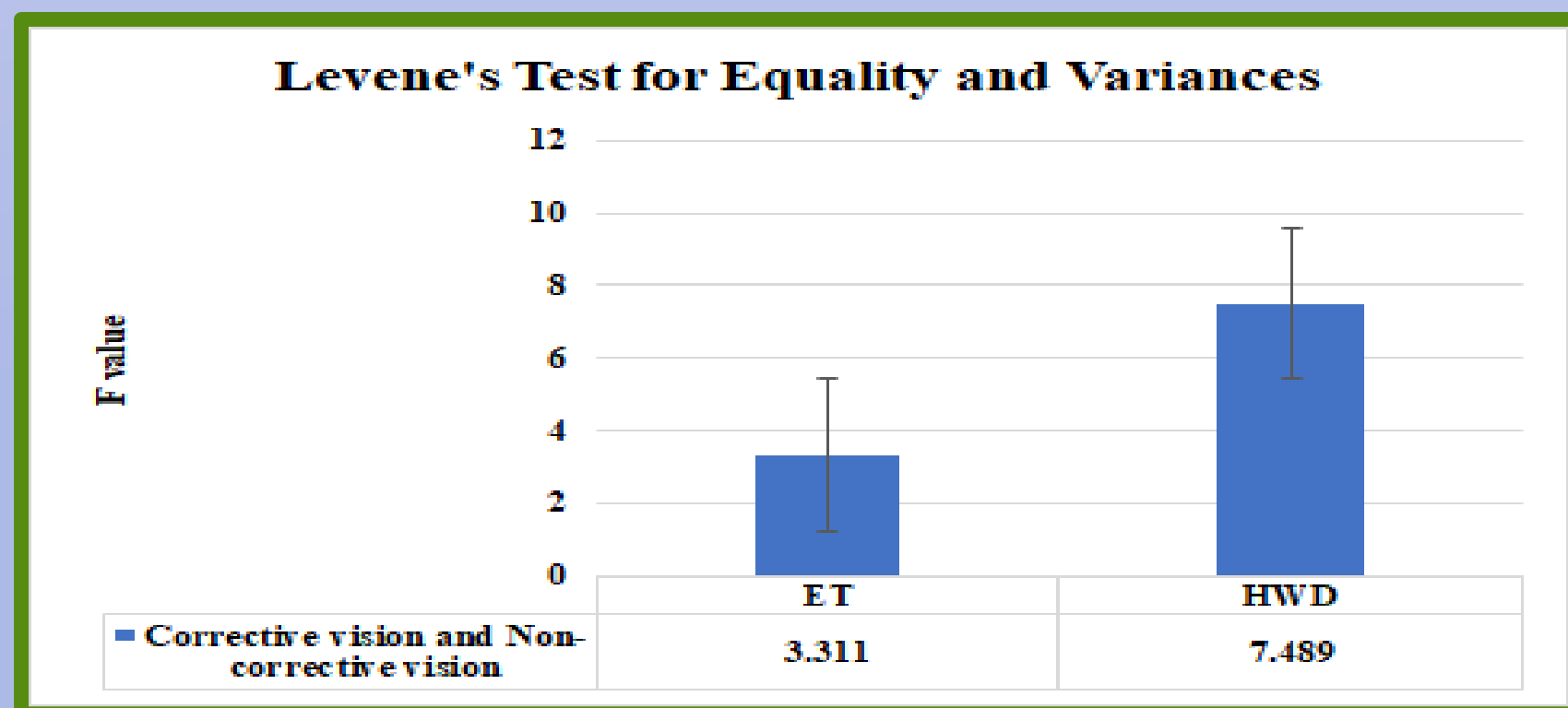


With a $p = .000$ we accept the hypothesis that there is no statistical difference between the variables compared.



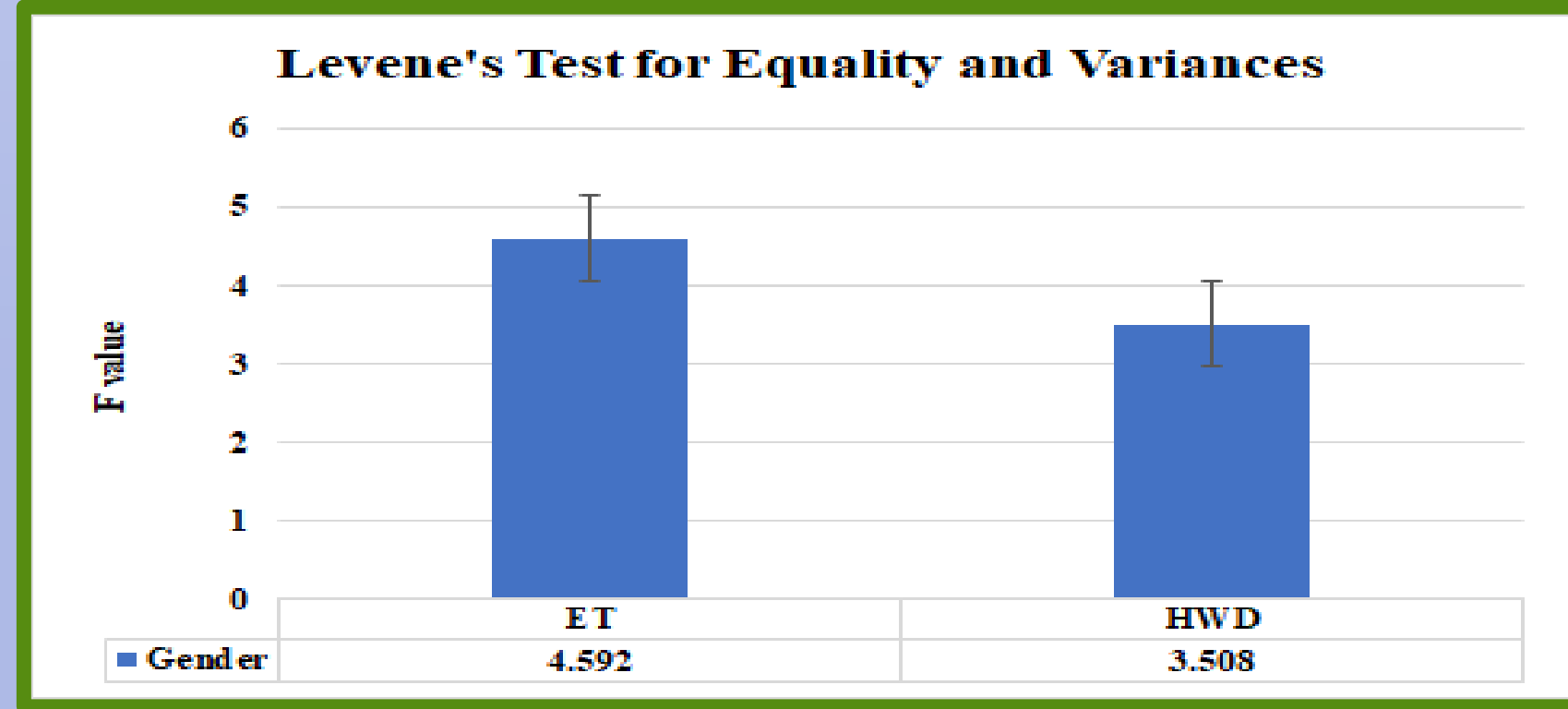
Further research is warranted to collect measurements from additional populations. Group statistic analysis is dependent on the diversity of the loupes wearer in question.

Levene's Test for Equality and Variances and t-test for equality of means was used to compare the variables



• There was a marginally significant difference in vision type by "Eye to Tooth"; where non-corrective vision had higher "Eye to Tooth" values than corrective vision:: $F = 3.311$, $p = .071$; t-test $p = .058$

• There was a marginally significant difference in vision type by "Hypothesized Working Distance"; where non-corrective vision had higher "Hypothesized Working Distance" values than corrective vision: $vF = 7.489$, $p = .007$; t- test $p = .022$



• There was a significant difference in "Eye to Tooth" values by gender with males having significantly higher "Eye to Tooth" values than females: $F = 4.592$, $p = .034$; t-test $p = .000$

• There was a significant difference in "Hypothesized Working Distance" by gender with males having a significantly higher "Hypothesized Working Distance" than females : $F = 3.508$, $p = .063$; t-test $p = .000$

Discussion

When applying the principles of the Pythagorean Theorem with specified anatomic measurements the hypothesized working distance has a significant positive correlation to a participant's actual measured working distance. This finding may contribute to a more standardized method to measure the working distance that fits the proper neutral ergonomics for the operator. Our interpretation of the results provide that our hypothesis was correct, and our working distance value obtained through anatomic measurements is similar to a measured working distance in neutral ergonomics. In addition, by using identifiable landmarks (ie: the outer canthus and antecubital fossa), one may be able to obtain these measurements to calculate the desired working distance assuming ergonomics position without the aid of simulation in a dental chair or with a mannequin.

Early intervention is acknowledged as integral in the prevention of musculoskeletal disorders. Through this study, we are able to provide applicable information for students to reinforce proper ergonomics through the analysis of individual working distance values and the relationship to individual anatomic measurements in order to utilize adjuncts like magnification in dentistry.



(4)

Conclusion

When applying the Pythagorean Formula using anatomic landmark measurements, the HWD that was calculated is repeatable for most operators and may contribute to a more standardized method to measure the accurate working distance that fits the proper neutral ergonomics.

References

1. Valachi, B., & Valachi, K. (2003). Preventing musculoskeletal disorders in clinical dentistry. The Journal of the American Dental Association, 134(12), 1604-1612. doi: 10.14219/jada.archive.2003.0106
2. Gehrig, J. S., Sroda, R., & Sacuzzo, D. (2019). Fundamentals of periodontal instrumentation & advanced root instrumentation (8th ed.).
3. Aghilnejad, M., Kabir-Mokamelkhan, E., Talebi, A., Soleimani, R., & Delghan, N. The effect of magnification lenses on reducing musculoskeletal discomfort among dentists. Med jour the Islamic Rep of Iran, (2016) 30, 473
4. David Burger (January 12, 2018) ADA wellness survey reveals dentists ergonomic issues, ADA News.
5. Carpentier, M., Auboux, D., Armengol, V., Pérez, F., Prud'Homme, T., & Gaudin, A. (2019). The Effect of Magnification Loupes on Spontaneous Posture Change of Dental Students During Preclinical Restorative Training. Journal of Dental Education, 83(4), 407-415. doi: 10.21815/jde.019.044
6. Figure 1: Pythagorean Theorem. Modeled from Gehrig, J. S., Sroda, R., & Sacuzzo, D. (2019). Fundamentals of periodontal instrumentation & advanced root instrumentation (8th ed.).
7. Figure 2 and 3: all participants in photos are researchers conducting this study
8. Figure 4: Neutral Ergonomics. Modeled from Gehrig, J. S., Sroda, R., & Sacuzzo, D. (2019). Fundamentals of periodontal instrumentation & advanced root instrumentation (8th ed.). Editing to contain research formula