Research Square

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# Relationship Between Anterior Chamber Depth and Corneal Deformation Parameters in Chinese Myopic Adults

**Tingting Chen**
the First Hospital of Lanzhou University
**Xiaotong Liu**
the First Hospital of Lanzhou University
**Yurui Zhan**
wxzzyr@163.com

the First Hospital of Lanzhou University

**Research Article**

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# Abstract

**Purpose**

To investigate the influence of anterior chamber depth (ACD) on corneal biomechanical properties in a Chinese population, thereby providing a reference for preoperative planning for refractive surgery, glaucoma risk assessment, and corneal disease management.

**Methods**

This cross-sectional study included 158 participants (158 eyes) recruited from a refractive surgery center. Participants were stratified into three groups based on ACD measurements: shallow ACD (ACD < 3.0 mm), medium ACD (3.0 mm ≤ ACD < 3.4 mm), and deep ACD (ACD ≥ 3.4 mm). Ocular biometric parameters were assessed using Pentacam, and corneal biomechanical parameters were measured using Corvis ST. Group differences were analyzed using one-way ANOVA or Kruskal-Wallis H tests. Correlations between ACD and biomechanical parameters were evaluated using Pearson or Spearman correlation coefficients.

**Results**

ACD demonstrated a significant positive correlation with axial length (AL) ($P < 0.05$). Compared to the shallow ACD group, the deep ACD group exhibited significantly lower values for first applanation velocity (A1V), maximum deformation amplitude at highest concavity (HCDA), highest concavity time (HCT), stress-strain index (SSI), Ambrósio's relational thickness to the horizontal profile (ARTh), Corvis biomechanical index (CBI), BAD-D, and tomographic/biomechanical index (TBI), while demonstrating significantly higher stiffness parameter at first applanation (SP-A1) (all $P < 0.05$). Correlation analyses across the entire cohort revealed that ACD was negatively correlated with HCDA, HCT, SSI, CBI, BAD-D, and TBI, and positively correlated with ARTh and SP-A1 (all $P < 0.05$).

**Conclusion**

ACD influences corneal biomechanical responses, with deeper ACD associated with enhanced overall biomechanical stability. These findings suggest that integrating ACD into individualized assessment protocols may improve the sensitivity and specificity of ectasia risk screening in refractive surgery candidates.


# Introduction

As a unique biological soft structure, corneal tissue demonstrates its complex viscoelastic biomechanical properties, a tissue that exhibits complex mechanical responses over time. The biomechanical behavior of the cornea is closely related to the distribution and composition of collagen fibrils. Corneal diseases can collectively alter their biomechanical properties across multiple scales, potentially causing serious pathological changes[1]. The corneal visualization Scheimpflug technology (Corvis ST) is currently the most advanced in vivo biomechanical measurement instrument. It uses a noncontact tonometer and an ultra-high-speed camera, which eliminates the risk of cross-infection and allows automated data acquisition[2]. The device integrates a Scheimpflug camera with non-contact tonometry to capture 140 sequential corneal tomographic images during a standardized air-puff impulse, *thereby allowing* the complete recording and precise quantification of corneal dynamic deformation[3]. Consequently, intraocular pressure and multiple corneal biomechanical parameters can be measured simultaneously, providing comprehensive biomechanical data. The Corvis ST has been increasingly recognized for its significant associations with corneal diseases, glaucoma assessment, or normal eyes[4].

The anterior chamber depth (ACD) is defined as the vertical distance between the corneal endothelium and the surface of the anterior capsule of the lens, which is a critical anatomical indicator of the anterior ocular segment[5]. The depth of the ACD directly alters the chamber's geometry and mechanical environment. Glaucoma has been identified as the leading cause of blindness globally, second only to cataract. A shallow anterior chamber is a significant anatomical risk factor for primary angle-closure glaucoma (PACG). Accurate measurement of ACD is essential for early diagnosis, therapeutic intervention, and monitoring disease progression[6]. Additionally, numerous studies have demonstrated that ACD is a crucial predictor of refractive status and reflects the effective position of the intraocular lens (IOL) after cataract surgery[7]. Furthermore, the postoperative shallow ACD correlates with phacoemulsification complications and endothelial cells[7]. Phakic intraocular lens (PIOL) implantation has gradually become an important surgical method to correct high myopia by placing an artificial lens in the posterior chamber[8]. ACD is of great significance for the available implantation space, which is not merely a static anatomical parameter but a core dynamic variable that governs the safety and efficacy of refractive surgery.

In recent years, the ocular and corneal biomechanical system has remained a focal point of research. However, the influence of anterior chamber depth (ACD) on these properties is not well understood. The purpose of this study was to investigate the influence of ACD on corneal biomechanical properties in a Chinese population. The findings are expected to provide a reference and objective foundation for preoperative planning in refractive surgery, glaucoma risk assessment, and corneal disease management.

## Patients and Methods

# Patients

This cross-sectional study included 158 participants (158 eyes) selected from the Refractive Center database at the First Hospital of Lanzhou University between December 2023 and December 2024. Participants were divided into three groups based on ACD: shallow ACD group, ACD < 3.0 mm, medium ACD, ACD ≥ 3.0 and ACD < 3.4 mm, and deep ACD, ACD ≥ 3.4 mm[9]. The study was approved by the Ethics Committee of the First Hospital of Lanzhou University (LDYYLL2022-458) and conducted in accordance with the principles outlined in the Declaration of Helsinki. All participants signed written informed consent forms before being included in the study.

Inclusion criteria: age ≥ 18 years; stable refractive status over the past 2 years; absence of significant corneal opacities, maculae, or leukoma; with normal slit-lamp examination and normal corneal topography. Exclusion criteria: patients with severe dry eye, uncontrolled glaucoma, keratoconus (KC) or suspected KC, severe cataract, severe ocular surface or fundus diseases; patients with systemic diseases such as diabetes, autoimmune diseases, or keloid predisposition; patients with a history of ocular trauma or previous ophthalmic surgery.

## Basic Ocular Assessments

Objective refraction was performed using an autorefractometer (ARK-1S, NIDEK Co., Ltd., Japan). Subsequently, subjective refraction was conducted under standard examination room lighting conditions using a phoropter (RT-5100, NIDEK Co., Ltd., Japan) in combination with a standardized logarithmic visual acuity chart (SC-1600, NIDEK Co., Ltd., Japan) to determine the spherical equivalent (SE). Axial length (AL) was measured using an optical biometer (IOLMaster 500, Carl Zeiss Meditec AG, Germany). For each eye, no fewer than three consecutive measurements were performed, ensuring all signal-to-noise ratio (SNR) values were ≥ 2.0, and the average value was recorded. Intraocular pressure (IOP) was measured using a noncontact tonometer (NT-530, NIDEK Co., Ltd.,

Japan). Three consecutive measurements were taken per eye, and the average value was used. All patients underwent detailed slit-lamp microscopy (SL-1800, NIDEK Co., Ltd., Japan) examination to rule out active anterior segment pathologies. After pupil dilation, a comprehensive fundus examination was performed using a three-mirror lens (V3MIR, Volk Optical Inc., USA) to exclude significant vitreoretinal disorders.

## Anterior Segment Measurements

All participants underwent separate Scheimpflug imaging sessions using the Pentacam High Resolution (HR) Scheimpflug device 70900 (OCULUS, Wetzlar, Germany). Using the Pentacam automatic acquisition mode, participants were instructed to maintain stable fixation on the central target throughout the scan to minimize motion artifacts, blinking, or unintended eye rotation. The operator manually aligned the device with the pupil center, and after confirming proper alignment, image acquisition proceeded automatically. Measured parameters included: horizontal white-to-white distance (HWTW), central corneal thickness (CCT), corneal volume at 10mm ($CV_{10mm}$), keratometry of flat axial (K1), keratometry of steep axial (K2), mean corneal curvature (Km), anterior chamber angle (ACA), anterior chamber depth (ACD), and anterior chamber volume (ACV). All scans were performed under standardized darkroom lighting conditions with standardized pupil size. Image acquisition was conducted by trained clinical technicians, and substandard images were excluded. All measurements were repeated three times, with the mean value recorded.

## Biomechanical Assessments

The Corvis ST instrument (OCULUS, Wetzlar, Germany) takes Scheimpflug images of the anterior segment at a rate of 4330 frames/s, covering 8.0 mm horizontally, and records 140 images, thus illustrating corneal deformation in response to a metered air puff. The corneal biomechanical responses were collected during the first applanation, highest concavity, and second applanation phases. Only data from qualified scans and quality scores (QS) showing OK were included in the analysis. The following parameters were recorded by the Corvis ST Software and selected: biomechanically corrected intraocular pressure (bIOP), first applanation velocity (A1V), first applanation length (A1L), first applanation time (A1T), second applanation velocity (A2V), second applanation length (A2L), second applanation time (A2T), highest concavity time (HCT), stress-strain index (SSI), deformation amplitude at highest concavity (HCDA), and radius at highest concavity (HCR). Integrated parameters included the stiffness parameter at first applanation (SP-A1), integrated radius (IR), deformation amplitude ratio at 2 mm (DA ratio), Ambrosio's relational thickness to the horizontal profile (ARTh), corvis biomechanical index (CBI), Belin/Ambrósio enhanced ectasia deviation index (BAD.D), and tomographic/biomechanical index (TBI).

# Statistical Analysis

SPSS statistical software (version 27.0; IBM, Armonk, NY, USA) and GraphPad Prism Version 10.1.2 (324) (San Diego, USA) were used to perform data analysis. To avoid interference between bilateral eye data, only right eye data were included for analysis. The normality of continuous variables was assessed using the Shapiro-Wilk test. Continuous variables with normal distribution are presented as mean±standard deviation (SD), while those with non-normal distribution are presented as median and interquartile range (IQR). For comparisons among groups, one-way analysis of variance (ANOVA) or the Kruskal-Wallis H test was applied, depending on the data distribution. Pairwise comparisons were performed using the Tukey HSD test (for ANOVA) or Dunn's post-hoc test (for Kruskal-Wallis). The Pearson correlation test was used to analyze the relationships between normally distributed variables, whereas

the Spearman correlation test was used for non-normally distributed data. Furthermore, multivariable linear regression analysis was conducted to evaluate the correlations between multiple corneal biomechanical parameters and ACD. All statistical tests were two-tailed, and a P value < 0.05 was considered statistically significant.

## Results

# Demographic Data of the Study Participants

This study included 158 eyes of 158 Chinese participants. Data were stratified into three groups based on anterior chamber depth (ACD): shallow ACD (n = 33), medium ACD (n = 69), and deep ACD (n = 56). ACD and AL in medium ACD and deep ACD groups were significantly different relative to shallow ACD ($P = 0.002$ and $P < 0.001$, respectively). Moreover, the ACD of deep ACD differed significantly compared with the medium ACD ($P < 0.001$). Conversely, other ocular biometric parameters, including HWTW, spherical refractive error, cylindrical refractive error, SE, K1, K2, Km, CCT, $CV_{10mm}$, and IOP, showed no statistically significant differences among the three groups (all $P > 0.05$). Detailed comparative data are presented in Table 1.

## Comparison of corneal biomechanical parameters between groups

Table 2 illustrates the results of corneal biomechanical characteristics across the three ACD groups. Among the 3 groups, 9 of the 18 Pentacam parameters analyzed exhibited significant differences. The pairwise comparisons indicated that, compared with shallow ACD, medium ACD demonstrated significantly lower values of HCDA, ARTh, BAD.D, and TBI, while SP-A1 was significantly higher (all $P < 0.05$). In contrast, the deep ACD group exhibited significantly lower values of A1V, HCDA, HCT, SSI, ARTh, CBI, BAD.D, and TBI, while SP-A1 was significantly higher (all $P < 0.05$). Moreover, compared with medium ACD, deep ACD had significantly higher ARTh and SP-A1 values, while BAD.D and TBI were significantly lower(all $P < 0.05$). In contrast, parameters such as A1T, A1L, A2L, A2T, HCR, bIOP, DA 2 ratio, and IR showed no significant differences. In addition, simple linear regression analysis demonstrated that ACD was negatively correlated with HCDA, HCT, SSI, CBI, BAD.D, and TBI. In contrast, ACD was positively correlated with ARTh and SP-A1.

# Correlation between ACD and biometric values

The correlation analyses of biometric values for the three groups are summarized in Table 2. In shallow ACD, no statistically significant correlations were observed between ACD and any of the assessed biomechanical parameters. In medium ACD, ACD demonstrated significant negative correlations with A1V, HCDA, CBI, and IR. Concurrently, significant positive correlations were identified with A1T, bIOP, SSI, ARTh, and SP-A1. In deep ACD, significant negative correlations were found between ACD and HCDA, while significant positive correlations were observed with SSI and SP-A1. In the total cohort, ACD was negatively correlated with A1V, HCDA, HCT, SSI, CBI, BAD.D, and TBI, whereas positively correlated with ARTh and SP-A1 (Fig. 1).

## Discussion

The present study systematically demonstrates a significant correlation between ACD and corneal biomechanical properties, including A1V, HCT, HCDA, SSI, ARTh, SP-A1, CBI, BAD.D, and TBI, in a myopic Chinese population. The analysis revealed that ACD was significantly correlated with corneal Corvis ST parameters. As presented in the

results section, ARTh and BAD.D were positively and negatively correlated with ACD, respectively. Simple linear regression analyses confirmed these correlations, providing a quantitative basis for integrating ACD into clinical assessments for refractive surgery, glaucoma management, and corneal diseases.

The ACD serves as the posterior anatomical support for the cornea, which offers a critical reference for evaluating intraocular structural remodeling and biomechanical compensation mechanisms[10]. Previous studies have shown that ACD was associated with multiple factors, such as age, sex, LT, etc[11]. Corneal hysteresis (CH) and corneal resistance factor (CRF) significantly decrease with age, while the ACD becomes shallower. This observation suggests a potential correlative trend between these age-related structural changes[12]. According to a population-based study of 400 individuals, the lens thickness-to-anterior chamber depth (LT/ACD) ratio was the only determinant of anterior chamber angle width (ACAW) in medium eyes and medium–long eyes[10]. Previous studies have already described the correlation between anterior segment parameters and corneal biomechanics. Bueno-Gimeno described that CH and CRF were positively associated with CCT and corneal volume (CV), and negatively with AL in healthy Caucasian children[13]. Results of De Bernardo et al. emphasize that corneal refractive surgery (CRS) can induce unexpected ocular morphological changes, especially the AL and ACD reduction[14]. However, the role of biomechanical properties of the cornea in PACG is still under debate. Some earlier findings did not find a statistically significant correlation between CH and anterior segment parameters, including ACD[15].

We observed that HCDA and HCT decreased as the ACD increased, likely due to the less substantial physical obstruction from the iris and lens. The cornea, aqueous humor, and iris/lens constitute a coupled biomechanical system. Flow of the aqueous humor into the deeper ACD provides space for posterior corneal displacement[16]. Parameters indicative of corneal stiffness highlighted in our analysis had strong correlations with ACD, including SSI and ARTh. Meanwhile, in terms of cornea deformation dynamics and viscoelasticity, ACD was negatively correlated with SSI. These observations were particularly evident in the deep ACD group compared with those with shallow and medium ACD.

BAD.D is a comprehensive diagnostic index derived from elevation and pachymetric measurement data. It comprises a statistical deviation chart containing nine distinct indicators[17]. TBI plays a crucial role in detecting both subclinical and clinical keratoconus; a deviation greater than 0.6 standard deviations is considered abnormal[18]. In our study, we found that BAD.D, CBI, and TBI were negatively correlated with ACD. Similarly, Yu et al.[16] reported corneal topographic and biomechanical changes, such as ACD, A2T, CBI, and BAD.D decreased following mydriasis in KC eyes. In anisometropia, Wang et al reported that there is no correlation between the interocular difference of biomechanical parameters and the interocular difference in ACD[19].

It is widely recognized that the safety requirement for ICL implantation is that patients with ordinary myopia have ACD ≥ 2.80 mm, despite slight differences in clinical guidelines across regions such as the US FDA, Europe, and China[20]. Given the small population with ACD below 2.80 mm, this would have resulted in an insufficient sample size and compromised statistical power. Therefore, our subgroup analysis only stratified patients with an ACD of 2.80 mm or above in this study. When the participants were stratified by ACD, there was a statistically significant difference in corneal responses under pressure from the shallow group to the deep group. These consistent patterns suggest that corneas with deeper ACD may possess relatively higher rigidity and better resistance to deformation. Therefore, routine dynamic corneal biomechanical assessment is still recommended for myopic patients with an ACD of 2.80 mm or deeper. Future research should focus on developing a multi-parameter warning model that integrates ACD and biomechanical indicators. Such a model would serve two main purposes. On the one

hand, it could help clarify the association between increased ACD and reduced corneal biomechanical strength in high myopia, considering that a deeper ACD may influence biomechanical responses after refractive surgery. On the other hand, it could enable effective identification of high-risk individuals whose ACD remains normal but who already exhibit abnormal biomechanical properties.

The main limitation is that the cross-sectional study design is unable to characterize the longitudinal evolution of biomechanical properties over time. The study sample was restricted to Chinese adults with myopia, which limits the generalizability of the findings to non-myopic populations, other age groups, or different ethnicities. Furthermore, eyes with an extremely shallow anterior chamber depth (ACD < 2.8 mm) were not included. This exclusion means the findings may not apply to individuals at the highest clinical risk, such as those susceptible to primary angle-closure glaucoma. Finally, potential confounding factors and the uneven distribution of sample sizes across groups may have compromised the statistical power of the study. Further prospective studies need to enroll larger sample sizes and to extend follow-up duration to provide more comprehensive insights.

## Conclusions

ACD influences corneal biomechanical responses, with deeper ACD associated with enhanced overall biomechanical stability. These findings suggest that integrating ACD into individualized assessment protocols may improve the sensitivity and specificity of ectasia risk screening in refractive surgery candidates.

## Declarations

# Acknowledgments

**CRediT authorship contribution statement**

Tingting Chen: Investigation, Data Curation, Writing - Original Draft.

Xiaotong Liu: Investigation, Data Curation, Writing - Original Draft.

Chuanrui Fu: Investigation, Data Curation.

Yixuan Chen: Investigation, Resources.

Yurui Zhan: Conceptualization, methodology, writing–review and editing, supervision, project administration, and funding acquisition.

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**Ethics approval and consent to participate:** The study was approved by the Ethics Committee of the First Hospital of Lanzhou University (LDYYLL2022-458) and conducted in accordance with the principles outlined in the Declaration of Helsinki. All participants signed written informed consent forms before being included in the study.

**Declaration of Interest Statement:** None of the authors has any conflicts of interest.

Availability of data: template data collection forms are available on reasonable request

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# Tables

**Table 1. Comparison of ocular characteristics among the three groups with different anterior chamber depths**

| Parameters | shallow ACD(n=33) | medium ACD (n=69) | deep ACD (n=56) | *F* | *P* |
|---|---|---|---|---|---|
| HWTW (mm) | 11.44±0.24 | 11.54±0.41 | 11.53±0.36 | 1.16 | 0.316 |
| Spherical (D) | -4.97±1.47 | -5.07±1.33 | -5.07±1.71 | 0.06 | 0.943 |
| Cylindrical (D) | -0.69±0.54 | -0.71±0.61 | -0.91±0.63 | 1.19 | 0.244 |
| SE (D) | -5.26±1.50 | -5.42±1.44 | -5.53±1.73 | 0.30 | 0.742 |
| K1 (D) | 42.55±1.14 | 42.11±1.48 | 42.13±1.36 | 1.19 | 0.307 |
| K2 (D) | 43.72±1.50 | 43.30±1.64 | 43.55±1.46 | 1.09 | 0.341 |
| Km (D) | 43.13±1.30 | 42.69±1.53 | 42.83±1.36 | 1.26 | 0.287 |
| CCT (μm) | 539.00±21.21 | 544.42±24.24 | 547.03±22.74 | 0.93 | 0.395 |
| $CV_{10mm}$ ($mm^3$) | 61.37±2.60 | 61.30±2.74 | 61.23±2.58 | 0.03 | 0.972 |
| IOP (mmHg) | 16.79±1.87 | 17.05±2.62 | 16.92±2.40 | 0.14 | 0.873 |
| AL (mm) | 24.43±0.76 | 25.04±0.92[a] | 25.23±0.94[a] | 6.58 | **0.002** |
| ACD (mm) | 2.82±0.12 | 3.21±0.11[a] | 3.75±0.29[ab] | 215.79 | **<0.001** |

The one-sample Kolmogorov-Smirnov test showed that all data were normally distributed. Results are expressed as means±standard deviation (range). [a] $P < 0.05$; compared with shallow ACD, [b] $P < 0.05$, compared with medium ACD. $P<0.05$ was considered statistically significant. HWTW: horizontal white to white distance; D: diopters; SE: spherical equivalent; K1: keratometry of flat-axial; K2: keratometry of steep-axial; Km: the mean simulated keratometry; CCT: central corneal thickness; $CV_{10mm}$: corneal volume at 10mm; IOP: intraocular pressure; AL: axial length; ACD: anterior chamber depth; 1 mmHg=0.133 kPa.

**2. Corneal biomechanical parameters in patients stratified by ACD groups**

| Parameters | shallow ACD(n=33) | medium ACD (n=69) | deep ACD (n=56) | *F* | *P* | Regression Analyses | |
|---|---|---|---|---|---|---|---|
| | | | | | | *r* | *P* |
| A1L (mm) | 2.05±0.22 | 2.07±0.25 | 2.07±0.21 | 1.323 | 0.244 | 0.127 | 0.113 |
| A1V (m/s) | 0.13±0.01 | 0.12±0.01 | 0.12±0.01[a] | 3.840 | 0.024 | -0.129 | 0.107 |
| A1T (ms) | 7.77±0.33 | 7.83±0.39 | 7.82±0.38 | 0.280 | 0.760 | 0.128 | 0.110 |
| A2L (mm) | 2.37±0.22 | 2.37±0.25 | 2.45±0.21 | 1.800 | 0.169 | 0.133 | 0.095 |
| A2V (m/s) | -0.27±0.02 | -0.26±0.03 | -0.26±0.03 | 0.660 | 0.521 | 0.102 | 0.204 |
| A2T (ms) | 22.25±0.29 | 22.10±0.42 | 22.11±0.40 | 1.680 | 0.189 | -0.143 | 0.073 |
| HCR (mm) | 7.52±0.78 | 7.66±0.83 | 7.53±0.85 | 0.600 | 0.550 | -0.005 | 0.945 |
| **HCDA (mm)** | **1.09±0.07** | **1.06±0.10[a]** | **1.06±0.09[a]** | 3.178 | **0.026** | **-0.183** | **0.022** |
| **HCT (ms)** | **17.28±0.46** | **17.10±0.48** | **17.05±0.40[a]** | 3.478 | **0.033** | **-0.166** | **0.037** |
| bIOP (mmHg) | 16.79±1.87 | 17.05±2.62 | 16.92±2.40 | 0.140 | 0.873 | 0.106 | 0.186 |
| **SSI** | **0.92±0.11** | **0.90±0.16** | **0.88±0.11[a]** | 3.049 | **0.030** | **-0.174** | **0.029** |
| DA 2 ratio | 3.98±0.22 | 4.02±0.34 | 3.97±0.28 | 0.360 | 0.698 | -0.045 | 0.571 |
| IR (mm) | 7.92±0.72 | 7.66±0.95 | 7.61±0.81 | 1.520 | 0.222 | -0.148 | 0.064 |
| **ARTh (μm)** | **544.41±106.71** | **686.05±167.78[a]** | **713.68±154.33[ab]** | **13.210** | **<0.001** | **0.402** | **<0.001** |
| **SP-A1** | **103.74±12.79** | **106.48±15.79[a]** | **109.49±15.55[ab]** | **4.027** | **0.020** | **0.191** | **0.017** |
| **CBI** | **0.04±0.08** | **0.02±0.10[a]** | **0.00±0.02[a]** | 5.487 | **0.001** | **-0.213** | **0.007** |
| **BAD.D** | **1.29±0.43** | **1.05±0.64[a]** | **0.69±0.54[ab]** | **10.28** | **<0.001** | **-0.441** | **<0.001** |
| **TBI** | **0.24±0.20** | **0.22±0.22[a]** | **0.14±0.24[ab]** | 4.712 | **0.004** | **-0.248** | **0.002** |

The one-sample Kolmogorov-Smirnov test showed that all data were normally distributed. Results are expressed as means±standard deviation. [a] *P*<0.05; compared with shallow ACD, [b] *P*<0.05, compared with medium ACD. *P* values less than 0.05 are written in bold and italics. A1L: first applanation length; A1T: first applanation time; A1V: first applanation velocity; A2L: second applanation length; A2T: second applanation time; A2V: second applanation velocity; HCT: highest concavity time; HCR: highest concavity radius; HCDA: deformation amplitude at highest concavity; IOPnct: non-contact tonometry IOP; bIOP: biomechanically corrected intraocular pressure; SSI: stress-strain index; DA 2 ratio: deformation amplitude ratio at 2 mm; IR: integrated radius; ARTh: Ambrosio's relational thickness to the horizontal profile; SP-A1: stiffness parameter at first applanation; CBI: Corvis Biomechanical Index; BAD.D: Belin/Ambrosio enhanced ectasia display total deviation value; TBI: tomographic/biomechanical index.

**Table 3. Correlation coefficients and their statistical significance between ACD and corneal biomechanical parameters**

| Parameters | Shallow ACD(n=33) | | Medium ACD (n=69) | | Deep ACD (n=56) | | Total | |
|---|---|---|---|---|---|---|---|---|
| | *r* | *P* | *r* | *P* | *r* | *P* | *r* | *P* |
| A1V (m/s) | 0.117 | 0.596 | **-0.352** | **0.004** | 0.554 | 0.053 | **-0.196** | **0.013** |
| A1T (ms) | 0.296 | 0.171 | **0.298** | **0.015** | 0.054 | 0.553 | 0.050 | 0.529 |
| A1L (mm) | 0.041 | 0.609 | -0.118 | 0.130 | 0.122 | 0.126 | 0.048 | 0.547 |
| A2L (mm) | 0.381 | 0.073 | -0.066 | 0.600 | **0.381** | **0.073** | 0.048 | 0.547 |
| A2V (m/s) | -0.049 | 0.823 | **0.262** | **0.033** | -0.167 | 0.065 | 0.003 | 0.966 |
| A2T (ms) | -0.189 | 0.388 | **-0.249** | **0.044** | -0.102 | 0.261 | -0.087 | 0.276 |
| HCR (mm) | -0.314 | 0.144 | 0.211 | 0.089 | -0.024 | 0.792 | -0.138 | 0.084 |
| HCDA (mm) | -0.114 | 0.605 | **-0.277** | **0.025** | **-0.254** | **0.001** | **-0.160** | **0.045** |
| HCT (ms) | 0.115 | 0.600 | 0.051 | 0.686 | 0.112 | 0.216 | **-0.182** | **0.022** |
| bIOP (mmHg) | 0.212 | 0.331 | **0.343** | **0.005** | 0.126 | 0.166 | 0.023 | 0.773 |
| **SSI** | 0.013 | 0.952 | **-0.179** | **0.025** | **-0.397** | **0.000** | **-0.205** | **0.010** |
| DA 2 ratio | 0.177 | 0.419 | -0.177 | 0.154 | **0.177** | **0.419** | -0.065 | 0.415 |
| IR (mm) | 0.267 | 0.218 | **-0.290** | **0.018** | **0.267** | **0.218** | -0.066 | 0.410 |
| **ARTh (μm)** | 0.120 | 0.585 | **0.446** | **0.000** | **0.120** | **0.585** | **0.411** | **0.000** |
| **SP-A1** | 0.222 | 0.005 | **0.223** | **0.005** | **0.597** | **0.000** | **0.185** | **0.020** |
| CBI | -0.085 | 0.701 | **-0.295** | **0.016** | **-0.180** | **0.046** | **-0.376** | **0.000** |
| BAD.D | -0.194 | 0.374 | -0.133 | 0.288 | **-0.194** | **0.374** | **-0.442** | **0.000** |
| TBI | -0.227 | 0.297 | -0.062 | 0.619 | **-0.227** | **0.297** | **-0.309** | **0.000** |

Results are expressed as means±standard deviation. *P* values less than 0.05 are written in bold and italics. A1L: first applanation length; A1T: first applanation time; A1V: first applanation velocity; A2L: second applanation length; A2T: second applanation time; A2V: second applanation velocity; HCT: highest concavity time; HCR: highest concavity radius; HCDA: deformation amplitude at highest concavity; IOPnct: non-contact tonometry IOP; bIOP: biomechanically corrected intraocular pressure; SSI: stress-strain index; DA 2 ratio: deformation amplitude ratio at 2 mm; IR: integrated radius; ARTh: Ambrosio's relational thickness to the horizontal profile; SP-A1: stiffness parameter at first applanation; CBI: Corvis Biomechanical Index; BAD.D: Belin/Ambrosio enhanced ectasia display total deviation value; TBI: tomographic/biomechanical index.

## Figures

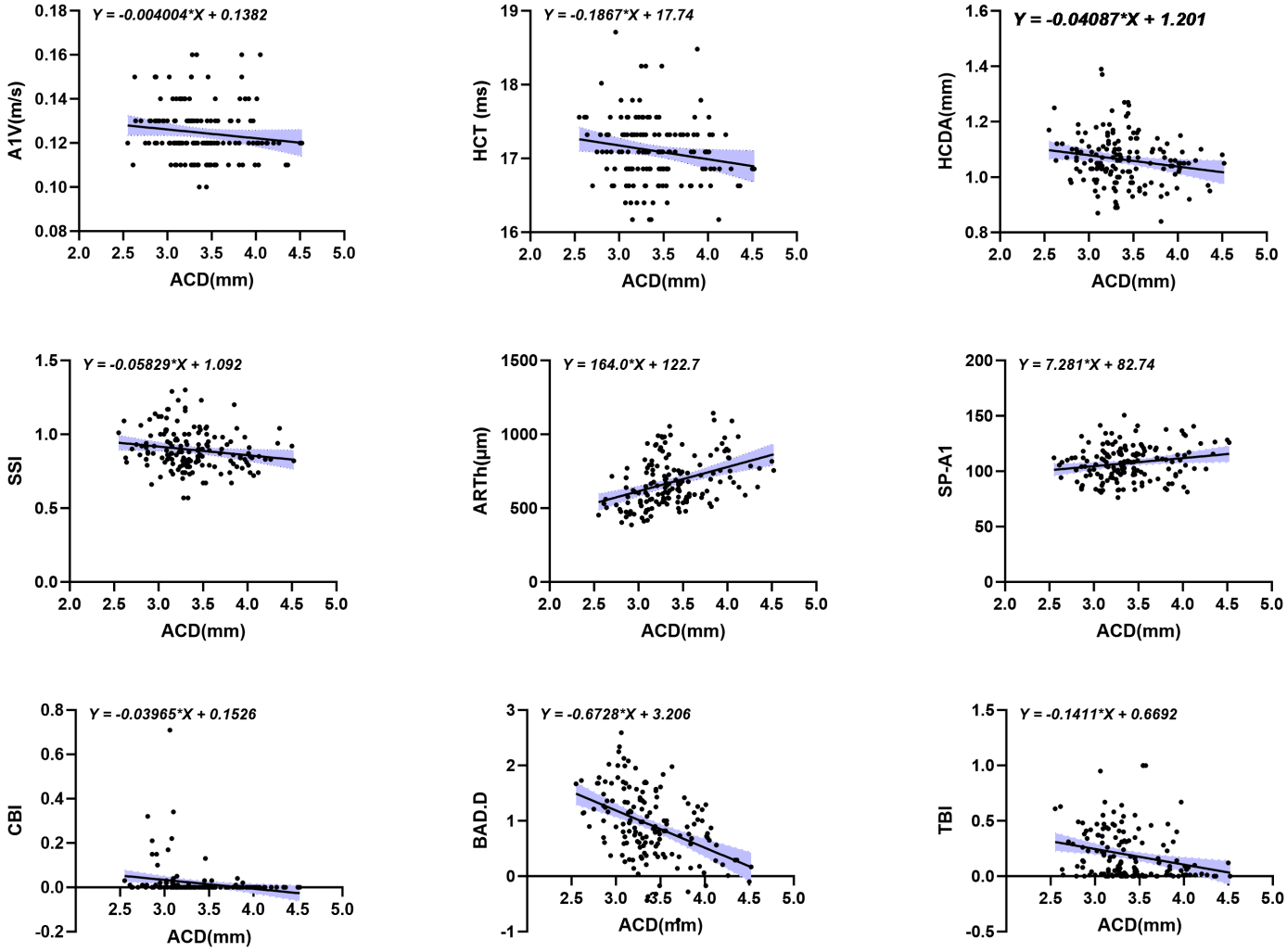



**Figure 1**

Correlations between ACD and corneal deformation parameters in the total cohort. ACD was negatively correlated with A1V, HCDA, HCT, SSI, CBI, BAD.D, and TBI, whereas positively correlated with ARTh and SP-A1.