The Subtalar Calcaneal Angle; A Novel Angle for Evaluation of Displaced Calcaneal Fractures

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Research Article

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Abstract

Objectives: The radiological measurement of the Böhler angle (BA) and the critical angle of Gissane (CAG) is used not only to diagnose and corroborate the suspicion of the presence of calcaneal fractures but also to assess the prognosis of different injury patterns and to evaluate the operative reduction of calcaneal fractures. Notwithstanding, many previous studies indicated the poor intra- and interobserver reproducibility of both angles. In this review article, we present the subtalar calcaneal angle (SCA) as an additional diagnostic tool - to BA and CAG - which can be applied on pre- and postoperative radiographs to assess calcaneal fractures involving the posterior facet.

Design: Retrospective Study.

Methods: Two retrospective groups were established, a ‘CF-group’ including radiographs of patients who were diagnosed with a calcaneal fracture and underwent operative treatment in the authors’ traumatology department, and a ‘control group’ with 50 lateral calcaneal radiographs clear of osseous lesions. Initially, the SCA, BA and the CAG were measured in both groups by three examiners. Those measurements were repeated one month later. Both the intra- and intertester reliabilities of all three angles were tested through the determination of the intraclass correlation coefficient (ICC). A paired $t$-test was used to prove the statistically significant difference between the SCA values for the pre- and postoperative groups, while the significant difference between the SCA values for the control and preoperative groups was tested through an independent-samples $t$-test.

Results: The intra- and interobserver reliability of the SCA and the BA was in close proximity. The CAG showed poor intertester reliability. The values of the SCA in both the control and postoperative groups were significantly different compared to the measurements of the preoperative group.

Conclusion: The subtalar calcaneal angle is a new instrument with proven reliability in estimating the prognosis of displaced calcaneal fractures and the postoperative alignment of the posterior facet.

Introduction

The introduction of the Böhler angle (BA) in 1931 by Dr. Lorenz Böhler is considered to be a milestone in the management of calcaneal fractures.[4] As described in his historical article, the tuber-joint angle is used to evaluate the operative restoration of the calcaneal height and the congruency of the subtalar joint. On the other hand, the critical angle of Gissane [10] (CAG) is found to be an unreliable diagnostic tool in previously conducted studies [1, 15, 23]. Hence, it is barely used in clinical practice, yet interestingly still being applied in modern research. The normal physiological value of the BA was estimated between 20°-40° [35], while the normal range of the CAG was quoted to be between 100°-133°. [31]

Besides radiological tools, unified fracture classification systems are important to facilitate communication between surgeons by reflecting the severity of the injury and serving as a basis for treatment and evaluation of the results.[12, 22] It was not until Essex-Lopresti[9] in 1952 described the
first classification of calcaneal fractures, that we began to understand the mechanism of injury of calcaneal fractures and the relation between the injury pattern and the co-occurring soft tissue damage. More recently, Sanders [28] proposed a classification scheme based on coronal CT sections of the calcaneum which, later on, became one of the most commonly used classification systems. Relevant works also indicated the high prognostic value of the Sanders classification evaluating different injury patterns of calcaneal fractures.[27, 29]

In view of the ongoing controversial issues regarding treatment concepts, operative strategies, and outcome measurements in cases of intraarticular calcaneal fractures, some authors stated, that operative treatment is only indicated if anatomical reduction can be achieved.[5, 16] A number of previous studies correlated overlooked step offs of the posterior facet of the calcaneus with postoperative subjective complaints and persistent disability.[8, 13] According to Rammelt et al., anatomical reconstruction of the posterior facet of the calcaneus - assisted by subtalar arthroscopy - is a decisive factor to improve functional outcomes and avoid subtalar arthritis.[26] Accepted criteria for calcaneal reconstruction are the restoration of Böhler's and Gissane's angles, axial alignment, and calcaneal width.[4, 5, 7, 24] However, recent articles have raised concerns regarding the intra- and interobserver reliabilities of both the BA and the CAG.[1, 18, 23] Nonetheless, considering the anatomical complexity of the calcaneus [14], reliable radiological markers that contribute greatly to the management of calcaneal fractures are believed to be indispensable [11, 34].

The primary aim of this study is to introduce a reliable screening tool that is applicable on lateral calcaneal radiographs, to evaluate calcaneal fractures involving the posterior facet. The secondary aim was to determine the normal ranges of all three angles and to detect the intra- and intertester reliability of each separately.

**Materials And Methods**

Two groups were formed for this retrospective study. In the first group, 50 lateral calcaneal radiographs were included after the exclusion of bony injuries. In the second group, lateral calcaneal radiographs of 40 patients who sustained a calcaneus fracture (ICD-Code: S.92) and underwent operative treatment through ORIF (open reduction and internal fixation) between 2010 and 2020 in the authors’ traumatology department were pre- and postoperatively evaluated. The main and only inclusion criterion for this study was the presence of pre- and postoperative x-ray lateral calcaneal radiographs. X-rays of patients with isolated fractures of the sustentaculum tali or isolated injury of the anterior process of the calcaneus were excluded. Between January 2010 and December 2020, a total of 68 patients with calcaneal fractures were operated on in the author’s traumatology department. Radiographs of 23 Patients were excluded as the injury was preoperatively diagnosed through lateral ankle or foot views, whereas pre- or postoperative native x-ray records of the remaining 5 patients were lost in Archive. All three angles; the BA, the CAG, and the SCA were measured for all groups. The measurement process was conducted by two orthopedic residents and an experienced orthopedic consultant. At this point, the interrater reliability was measured for all three angles. The procedure was then repeated one month later by the two orthopedic residents to
calculate the intra-observer reliability. All measurements were made using the digital SYNAPSE viewing and editing software (SYNAPSE PACS View Version 5.7.102, Bedford, UK).

Before pursuing the measurement process, the amount of zoom of the radiographs was fixed to 100% to avoid possible errors. The SCA was measured by drawing two lines, the first representing the second line of the BA, drawn from the calcaneal tuberosity towards the highest point of the posterior facet of the calcaneus. Whereas the second line resembles a modification of the second line of the CAG, it will be drawn tangential to the intraarticular posterior talar facet of the calcaneus; for accuracy purposes, this line was not extended to the tarsal sinus (Fig. 1). The BA [4] was measured by drawing two intersecting lines. The first line pointed from the highest point of the anterior calcaneal process towards the highest point of the posterior facet. The second line was set tangential to the upper edge of the calcaneal tuberosity. The CAG [10] was measured by delineating the downward and upward inclination of the upper surface of the os calcis (Fig. 2). All radiographs had been taken in the authors’ affiliated radiology department with the x-ray beam centered perpendicular mediolateral about 2,5 cm inferior to the prominence of the medial malleolus of the distal tibia while the patient lies in the lateral recumbent position. The lateral aspect of the knee and ankle joint was put in contact with the table resulting in the tibia lying parallel to the table as the injured foot was held in dorsiflexion.

The Intraclass correlation coefficient (ICC) was used to detect the intra- and interobserver reliability of all three angles in both groups. ICC of > 0.7 was interpreted as excellent, 0.4–0.7 as good, and < 0.4 as poor agreement.[2]

The ability of the SCA to evaluate the severity of the injury pattern preoperatively and assess the postoperative radiological outcome was tested through a paired t-test. An independent-samples t-test was used to prove the statistically significant difference of the SCA values in the control and preoperative groups. The Correlation between the values of the SCA and the severity of the injury pattern according to the Sanders classification was tested through the determination of the Pearson’s correlation coefficient. SPSS Software version 13.0 (Chicago, IL, USA) was used for the data analysis.

**Results**

The highest value of the SCA throughout the measurement process for all of the three testers in the control group was 139°, whereas the lowest value was 111°. The mean value of the SCA in the control group was 122.8°. Mean values for the BA and the CAG in the control group were 32.7° and 119.5° consecutively (Table 2). Regarding the preoperative group, mean values of the SCA, BA and CAG were 144.9°, 17.2° and 108.8° respectively. As for the postoperative group, the mean SCA value was 134°, whereas the mean values of the BA and CAG were 25.6° and 113° respectively (Table 2).
Table 1
Demographic data of both groups

<table>
<thead>
<tr>
<th></th>
<th>Control group (n = 50)</th>
<th>CF group (n = 40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>48 (29–94)</td>
<td>56 (38–92)</td>
</tr>
<tr>
<td>Gender (m/f)</td>
<td>30/20</td>
<td>28/12</td>
</tr>
<tr>
<td>Side (right/left)</td>
<td>29/21</td>
<td>18/22</td>
</tr>
</tbody>
</table>

Table 2
Measurements for all groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>Angles</th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>SCA</td>
<td>122.8</td>
<td>5.3</td>
<td>111</td>
<td>139</td>
</tr>
<tr>
<td></td>
<td>BA</td>
<td>32.7</td>
<td>4.4</td>
<td>22</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>CAG</td>
<td>119.5</td>
<td>7.4</td>
<td>94</td>
<td>138</td>
</tr>
<tr>
<td>Preoperative group</td>
<td>SCA</td>
<td>144.9</td>
<td>13.1</td>
<td>122</td>
<td>172</td>
</tr>
<tr>
<td></td>
<td>BA</td>
<td>17.2</td>
<td>8.5</td>
<td>1</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>CAG</td>
<td>108.8</td>
<td>24.6</td>
<td>38</td>
<td>143</td>
</tr>
<tr>
<td>Postoperative group</td>
<td>SCA</td>
<td>134</td>
<td>8.7</td>
<td>116</td>
<td>154</td>
</tr>
<tr>
<td></td>
<td>BA</td>
<td>25.6</td>
<td>7.9</td>
<td>10</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>CAG</td>
<td>113</td>
<td>23.9</td>
<td>42</td>
<td>144</td>
</tr>
</tbody>
</table>

Exhibited in (Figs. 3–5) frequency distribution curves for the values of the SCA, BA, and the CAG in all groups.

Figure .5

Frequency distribution curves demonstrating the values of the CAG in the control (A), preoperative (B), and postoperative groups (C).

The SCA showed excellent intratester reliability and so did the BA and the CAG for the first tester. For the second tester, excellent intratester reliability was noted for the BA, SCA, and the CAG except for the postoperative group, as the ICC value for the CAG was 0.48 (Table 3). Similarly, excellent intertester reliability was noted for the BA and SCA, except for the control group for the SCA (ICC=0.69).
Table 3
Intratester reliability

<table>
<thead>
<tr>
<th>Groups</th>
<th>Tester I (95% confidence interval)</th>
<th>Tester II (95% confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SCA</td>
<td>BA</td>
</tr>
<tr>
<td>Control group</td>
<td>0.97</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>(0.71–0.99)</td>
<td>(-0.02–0.98)</td>
</tr>
<tr>
<td>Preoperative group</td>
<td>0.99</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>(0.99–0.99)</td>
<td>(0.98–0.99)</td>
</tr>
<tr>
<td>Postoperative group</td>
<td>0.99</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>(0.99–0.99)</td>
<td>(0.99–0.99)</td>
</tr>
</tbody>
</table>

Whereas poor intertester reliability for the CAG ensued after the calculation of the ICC (Table 4). However, the ICC for CAG in the control group was good (Table 4). The performance of the SCA assessing the severity of the injury preoperatively and evaluating the postoperative reduction of calcaneal fractures was tested through a paired t-test. The p-value was < 0.001. The independent-samples t-test between the SCA values of both the control and preoperative groups resulted in a p-value of < 0.001. The operative management of calcaneal fractures in the CF-group resulted in a decrease of the value of SCA by 8.3°.

Table 4
Intertester reliability

<table>
<thead>
<tr>
<th>Groups</th>
<th>SCA (95% confidence interval)</th>
<th>BA (95% confidence interval)</th>
<th>CAG (95% confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>0.69 (0.51–0.81)</td>
<td>0.94 (0.90–0.96)</td>
<td>0.59 (0.35–0.75)</td>
</tr>
<tr>
<td>Preoperative group</td>
<td>0.99 (0.99–0.99)</td>
<td>0.97 (0.95–0.98)</td>
<td>0.08 (-0.34–0.43)</td>
</tr>
<tr>
<td>Postoperative group</td>
<td>0.99 (0.98–0.99)</td>
<td>0.97 (0.94–0.98)</td>
<td>0.10 (-0.35–0.45)</td>
</tr>
</tbody>
</table>

Of all 40 Patients included in our study, 4 were operated on without preoperative CT-Scans. There were respectively 10 patients with injuries of Type II, Type III and Type IV of the Sanders classification. The remaining 6 patients were classified as Type I injury after the evaluation of CT-Scans.
Correlation between the values of the subtalar calcaneal angle (SCA) and the severity of the injury pattern according to the Sanders Classification.

The highest value of the SCA was 172° in a type II injury of the Sanders classification, whereas the lowest value was noted as 122° in a type I injury. The value of Pearson’s correlation coefficient was 0.324. Illustrated in (Figure 6) a scatter plot identifying the ascendance of the trend line pointing out the positive correlation between both variables.

Discussion

Being the most commonly injured bone of the tarsus, fractures of the calcaneum account for 75% of all foot fractures and about 1–2% of all fractures.[25] A displaced calcaneal fracture results in a reduction of the value of the BA,[4] whereas a more acute CAG is indicative of a fracture.[10] Several previous studies indicated the poor intra- and interobserver reliabilities of both the CAG and BA.[1, 18, 23] It was even recommended, that the latter should not be acknowledged as a sole reference for pre- and postoperative evaluation of calcaneal fractures.[18] Although Böhler himself indicated the importance of the tuber-joint angle in the diagnosis of calcaneal fractures[4], Knight et al. [15] implied that the BA is of limited use in that regard. To reach a more precise evaluation of displaced calcaneal fractures, the SCA was suggested as an accessory radiological marker to the BA and CAG.

In our current study, the BA showed excellent intratester reliability for both testers (Table 3) and excellent intertester reliability (Table 4). In their retrospective study, Labronici et al.[17] noted excellent intertester reliability of the BA with an ICC of 0.98. Retrospectively evaluating 248 lateral calcaneal radiographs, Šimunović et al. [33] also confirmed the excellent intertester reliability of the BA with an ICC value of 0.94. Analyzing 82 lateral calcaneal radiographs postoperatively, Bulut et al.[6] documented excellent intratester reliability (ICC = 0.83) but good intertester reliability (ICC = 0.46) of the BA. Otero et al.[23] reported excellent intra- and intertester reliabilities for the BA with ICC values of 0.98 and 0.83 respectively. The BA had excellent intertester reliability (ICC = 0.84) according to Knight et. al.[15] In agreement with these results, Ma et al.[20] also reported excellent intertester reliability of the BA (ICC = 0.91), while Barroco et al.[1] and Willmott et al.[35] reported good intertester reliability for the BA (Table 5).
The CAG showed poor intertester reliability in our study for both the pre- and postoperative groups and good intertester reliability for the control group (Table 4), yet excellent intratester reliability for both testers except for the postoperative group for the second tester (Table 3). Bulut et al.[6] reported good intertester reliability for the CAG (ICC = 0.66) and excellent intratester reliability (ICC = 0.85–0.92). Otero et al.[23] pointed out the poor intra- and intertester reliability of the CAG, while Knight et al.[15] and Barroco et al.[1] reported good interobserver reliability for the CAG (Table 5).

The paired t-test to evaluate the performance of the SCA in the pre- and postoperative radiographs of the CF-group showed a p-value of < 0.001. The independent-samples t-test to test the significant difference between the SCA values of both the control and preoperative groups also resulted in a p-value of < 0.001. These results deny the null hypothesis and assert the significant difference of the SCA values for both the control and postoperative groups in relation to the preoperative group. The SCA showed excellent intratester reliability for both testers (Table 3). The intertester reliability of the SCA was good for the control group and excellent for both the pre- and postoperative groups (Table 4). The variance in the experience level of the observers is another point that essentially adds credibility and reliability to our study. The abovelist results corroborate our hypothesis, that the SCA is valuable for pre- and postoperative evaluation of calcaneal fractures that mainly involve the posterior facet. The normal value of the SCA was set between 111°-139° pursuant to the lowest and highest values in the control group.

<table>
<thead>
<tr>
<th>Study</th>
<th>Intertester-ICC BA</th>
<th>Intratester-ICC BA</th>
<th>Intertester-ICC CAG</th>
<th>Intratester-ICC CAG</th>
<th>Number of radiographs</th>
<th>Number of testers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labronici et al.[17]</td>
<td>0.98</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>31</td>
<td>2</td>
</tr>
<tr>
<td>Šimunović et al.[33]</td>
<td>0.94</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>248</td>
<td>3</td>
</tr>
<tr>
<td>Bulut et al.[6]</td>
<td>0.46</td>
<td>0.82–0.83</td>
<td>0.66</td>
<td>0.85–0.92</td>
<td>82</td>
<td>2</td>
</tr>
<tr>
<td>Otero et al.[23]</td>
<td>0.83</td>
<td>0.83–0.98</td>
<td>0.28</td>
<td>0.16–0.67</td>
<td>34</td>
<td>4</td>
</tr>
<tr>
<td>Knight et al.[15]</td>
<td>0.84</td>
<td>-</td>
<td>0.52</td>
<td>-</td>
<td>130</td>
<td>5</td>
</tr>
<tr>
<td>Barroco et al.[1]</td>
<td>0.74</td>
<td>-</td>
<td>0.40</td>
<td>-</td>
<td>97</td>
<td>6</td>
</tr>
<tr>
<td>Willmott et al.[35]</td>
<td>0.72</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>127</td>
<td>2</td>
</tr>
<tr>
<td>Ma et al.[20]</td>
<td>0.91</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>143</td>
<td>6</td>
</tr>
</tbody>
</table>
throughout the measurement process for all the three testers. Flattening of the SCA could either result from loss of the calcaneal height in cases of displaced intraarticular calcaneal fractures, it could also be seen in consequence of extraarticular avulsion fractures of the calcaneal tuberosity. However, other rare conditions such as the Haglund deformity could affect the measurement process, leading likewise to further flattening of the - obtuse – SCA. Operative reduction of calcaneal fractures in the CF-group resulted in correction of the SCA by 8.3° and the BA by 7.7°. Whereas the CAG was further flattened by 4.2°.

Analyzing the distribution of the values shown in (Figs. 3–5), both the SCA and BA showed the so-called bell curve with a standard normal distribution in all groups. The distribution curves of the CAG showed an unconditional and negatively skewed distribution for all groups. This asymmetrical distribution shows that more values of the CAG are concentrated on the right side of the distribution graphs and indicates that there is a wide gap between the measurements of all three testers for the CAG. The low intra- and interobserver reliability of the CAG \[1, 15\] could be explained by the considerable difficulty to determine the necessary anatomical landmarks of the os calcis for this angle, explicitly the posterior and anterior talar facets, especially in cases of displaced intraarticular fractures.\[23\] Diversely, the BA connects three dots, which makes it easily applicable on all radiographs.

The Sanders classification \[28\] is based on the number of fracture lines entering the posterior facet of the calcaneus interpreted in the coronal sections of CT-Scans. In the same perspective, the SCA was suggested to evaluate calcaneal fractures mainly involving the posterior facet. The value of the Pearson’s correlation coefficient testing the correlation between the values of the SCA in the CF-group and the severity of the injury pattern according to the Sanders classification was 0,324, which indicates a positive but rather nonlinear correlation between the values of the SCA and the severity of injury pattern in consonance with the Sanders classification. Based on their retrospective study in which the data of 697 patients were included, Mitchell et al.\[21\] concluded that there was a strong association between the BA and the Sanders classification. With respect to the distinctly lower sample size, we also proved the positive correlation between the Sanders classification and the values of the SCA (Fig. 6). Unequivocally, higher values of the SCA are associated with lower values of the BA and vice versa.

Considering the calcaneus one of the main weight-bearing bones of the human body, some authors came to the conclusion, that different calcaneal angles may vary due to variations in the structure of the os calcis and bearing capacity.\[32\] Many other factors could affect the measurement process of different calcaneal angles such as the obliquity of the lateral view which is in many cases challenging because of the pain some patients are suffering directly after the trauma and the subsequent soft tissue swelling. In such cases, the proficiency level of the radiology technician plays also an important role. Addressing one of these issues, De Boer et al. \[3\] discussed the influence of the obliquity of the radiographs on the measurement of both the BA and the CAG. A significant increase in the value of the BA was noted in their study during dorsiflexion or external rotation of the foot, while the value of the CAG increased during plantar flexion and logically decreased following dorsiflexion. However, the CAG was not affected by rotational movements of the foot.
The main limitation of the study is the small sample size of both the control and CF-groups, since the vast majority of patients who presented in our traumatology department with pain over the heel bone or were even diagnosed with calcaneal fractures underwent x-ray examinations in the form of lateral ankle or foot views.

The gender distribution in the study was male-dominated with m/f ratio of 58/32. In that regard, former studies indicated that the values of different calcaneal angles do vary significantly according to gender and age.\[19, 31]\ The mean age of the patients included in our study was 48 yrs. in the control group and 56 yrs. in the CF-group (Table 1). No lateral calcaneal radiographs of children were included in our study. However, some authors pointed out the morphological changes of the os calcis in children due to the ossification, which makes the measurement of calcaneal angles in children incomprehensible.\[30]\ Conceding that a study with a greater sample and more observers could yield a different result to that of the present one, we emphasize the necessity to conduct further studies in the future to evaluate the performance of the SCA.

**Conclusion**

In conclusion, the subtalar calcaneal angle (SCA) is proved to be as reliable as the Böhler angle (BA) and more reliable than the critical angle of Gissane (CAG) when evaluating calcaneal fractures involving the posterior facet. The positive correlation between the SCA and severity of injury pattern according to Sanders classification may offer a clue regarding the prognosis of different injury patterns. In the authors’ opinion, the SCA is not to replace the BA, but both angles should rather be applied simultaneously with the purpose of accomplishing a more accurate assessment of calcaneal fractures.

**Declarations**

**Financial Disclosure:**

The authors received no financial support for the research, authorship and publication of this article.

**Conflict of Interest:**

The authors declare that there is no conflict of interest.

This study was approved by the Lörrach Hospital Institutional Review Board.

**Ethical Statement**

Hereby, I Abdelkader Shekhbihi, M.D. consciously assure that for the manuscript “The Subtalar Calcaneal Angle; A Novel Angle for Evaluation of Displaced Calcaneal Fractures.” the following is fulfilled:

1) This material is the authors’ own original work, which has not been previously published elsewhere.
2) The paper is not currently being considered for publication elsewhere.

3) The paper reflects the authors' own research and analysis in a truthful and complete manner.

4) The paper properly credits the meaningful contributions of co-authors and co-researchers.

5) The results are appropriately placed in the context of prior and existing research.

6) All sources used are properly disclosed (correct citation). Literally copying of text must be indicated as such by using quotation marks and giving proper reference.

7) All authors have been personally and actively involved in substantial work leading to the paper, and will take public responsibility for its content.

8) This study was approved by the Lörrach Hospital Institutional Review Board.

I agree with the above statements and declare that this submission follows the policies of the European Journal of Trauma and Emergency Surgery as outlined in the Guide for Authors and in the Ethical Statement.

References


**Figures**
Figure 1

The Subtalar Calcaneal Angle (SCA).
Figure 2

The measurement technique of the SCA (A,B), the BA (C,D), and the CAG (E,F) on the same pre- and postoperative lateral calcaneal radiographs of a 65 YO male patient who sustained a calcaneal fracture of joint-depression type (left side).

Figure 3

Frequency distribution curves demonstrating the values of the SCA in the control (A), preoperative (B), and postoperative groups (C).
Figure 4

Frequency distribution curves demonstrating the values of the BA in the control (A), preoperative (B), and postoperative groups (C).

Figure 5

Frequency distribution curves demonstrating the values of the CAG in the control (A), preoperative (B), and postoperative groups (C).
Figure 6

Correlation between the values of the subtalar calcaneal angle (SCA) and the severity of the injury pattern according to the Sanders Classification.