NAVICULAR-DROP TESTING is widely done to determine the amount of pronation an individual has at the ankle–foot complex. Pronation occurs at the subtalar joint of the ankle, which is composed of three talocalcaneal articulations and enables motion occurring in three planes simultaneously. Pronation is defined as a combination of eversion, abduction, and dorsiflexion. Navicular drop is a clinical measurement used to estimate pronation. It is defined as the distance between the height of the navicular with the subtalar joint in neutral (Figure 1) and weight bearing in a relaxed stance (Figure 2). The subtalar joint is in neutral position when the foot is neither supinated nor pronated.

In the procedure described by Brody, the technique used by most researchers for measuring navicular drop, the patient stands barefoot on a firm surface with the midline of the heel, lower half of the calf, and navicular marked. The standing foot is placed so that the subtalar joint is in neutral, which is when it is in a position of equal congruency. The examiner places a thumb just anterior and inferior to the medial malleolus and the index finger just in front of the anterior aspect of the fibula. Then the hindfoot and ankle are inverted and everted so the examiner can sense when the depressions felt by the finger and thumb are equal. This is the neutral position of the subtalar joint and the position of optimal function of the foot. An index card is placed on the inner side of the hindfoot, and the level of the navicular is marked on the card. Then the foot is allowed to relax with weight bearing, and the resulting lower position of the navicular is marked on the card. The difference between the height of the navicular with the subtalar joint in neutral and in weight bearing is the patient’s navicular drop.

In addition to the technique described by Brody, there are other methods that are more sensitive and precise, including electromagnetic tracking or video analysis and adjustable calipers such as the Vernier height gauge (Mitutoyo, Japan). Although the index card is the most economical, it has the most inherent error. A limitation of measuring navicular drop...
with a two-dimensional method is that it is an estimate of three-dimensional motion. Loudon et al. used the index card in their study and obtained an intrarater reliability of .87, which is considered good. Others, though, have shown poor reliability with the index card, such as Picciano et al., who obtained an intratester reliability of .61–.79 and an intertester reliability of .57.

Another tool is an electromagnetic tracking device or video analysis. The Metrecom (FARO Medical Technologies Inc., Lake Mary, FL) is an electromechanical, three-dimensional digitizer that measures the two positional points of the navicular in three-dimensional space and calculates the difference. It is reported to have a mean accuracy of 0.9 mm when digitizing a calibration device. Allen and Glasoe used it in their study relating navicular drop to ACL injuries and obtained an intrarater reliability of .90. Mueller et al. also used the Metrecom and found that the benefit was that movement could be measured in three planes. Their results indicated that most of the navicular’s movement occurred in the vertical direction, and they reported an intrarater reliability of .78–.83.

An adjustable caliper is cost effective and accurate—the Vernier height gauge has a resolution of 0.02 mm. The navicular is palpated and a mark is made under the navicular tuberosity to serve as a guideline for measuring the neutral and weight-bearing positions. Reliability using this device has been reported to be good. Gilmour and Burn reported interrater reliability as .77–.80 and intrarater reliability as .91 when measuring navicular drop.

Assessing navicular drop provides a quantitative measure of movement at the subtalar joint that can be used for bilateral comparison to determine whether an intervention, such as orthotics, would be effective. One consideration when calculating navicular drop is the definition of normal and abnormal scores. Table 1 lists interpretations from several studies of normal versus abnormal values. These data should be useful for your own clinical comparisons.

In conclusion, navicular drop can be assessed using a variety of tools that range in cost from virtually nothing (index card), to relatively inexpensive (height gauge), to expensive (electromagnetic-video analysis). Knowledge of normative values and proper technique lends another evaluation tool to practicing clinicians and researchers. Clinically, navicular drop is not hard to measure with an index card and can serve as a valuable part of ankle and foot evaluations to determine whether an athlete has a predisposing factor that could lead to injury.

### Table 1. Interpretations of Normal and Abnormal Navicular-Drop Values

<table>
<thead>
<tr>
<th>Author</th>
<th>Instrument</th>
<th>Normal Value</th>
<th>Abnormal Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen and Glasoe</td>
<td>Metrecom</td>
<td>6–9 mm</td>
<td>—</td>
</tr>
<tr>
<td>Brody</td>
<td>index card</td>
<td>10 mm</td>
<td>15 mm</td>
</tr>
<tr>
<td>Loudon et al</td>
<td>not specified</td>
<td>6 mm</td>
<td>&lt; 6 or &gt; 9 mm</td>
</tr>
<tr>
<td>Moul</td>
<td>index card</td>
<td>6–9 mm</td>
<td>—</td>
</tr>
<tr>
<td>Mueller et al</td>
<td>Metrecom</td>
<td>—</td>
<td>&gt; 10 mm</td>
</tr>
<tr>
<td>Snock</td>
<td>1-mm-lined paper</td>
<td>6.8 mm</td>
<td>15.1 mm</td>
</tr>
</tbody>
</table>

### References


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