



# Star excursion balance test for assessment of dynamic instability of the ankle in patients after harvest of a fibular free flap: a two-centre study

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## Abstract

We aimed to show that the star excursion balance test can identify instability in the ankle of patients who have had harvest of a fibular free flap. We compared the reach distance of the operated leg against that of the non-operated leg in 26 patients who had had harvest of the flap over a period of three years from August 2009 at two different centres. The goal of the test is to reach as far as possible with one leg in eight directions while balancing on the other. We also assessed the overall function of the operated leg using the Foot and Ankle Disability Index (FADI) and the American Orthopaedic Foot and Ankle Score (AOFAS). The star excursion balance test is simple and cheap, and is quick and easy to do in the outpatient department.

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## Introduction

Use of the fibular free flap for composite bony reconstruction in the head and neck enables two teams to operate at the same time. Other advantages include a good stock of long cortical bone, and a long and reliable pedicle. The fibula is a dynamic component of the lower extremity that bears between 10% and 16% of the total load and transfer of load when walking. The integrity of the interosseous membrane keeps the tibia and fibula together and allows for the transfer of load from the ankle to the knee. Harvest of a fibular free flap interrupts the membrane and disrupts this important tibia-fibula unit.<sup>1</sup>

At least 6–7 cm of proximal and distal length of fibula must be left intact to avoid altering transfer of load at knee and ankle joint.<sup>2</sup>

Instability of the ankle is defined as an abnormal tendency of the joint to subluxate or dislocate with normal activity and stresses. Overall balance, which is normally maintained by adaptation at the hip, knee, and ankle, is disturbed when the position of a joint is not properly sensed, and this leads to a failure of coordinated movement. The maintenance of posture during quiet standing does not adequately test the ankle or enable deficits to be detected.

The star excursion balance test is a simple, dynamic, accurate, and functional assessment during which the patient has to maintain the centre of gravity without losing balance. The stance requires dorsiflexion of the ankle, flexion of the knee

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and hip, as well as adequate strength, proprioception, and neuromuscular control to do the reaches. Standing on a potentially unstable operated leg while reaching out the other in different directions tests the patient's stability to the limit, and indicates the dynamic postural stability of the ankle.<sup>3</sup>

## Patients and methods

In this retrospective two-centre study at Hull Royal Infirmary, UK, and Mahavir Jain Hospital, Bengaluru, India, we recruited all patients who had had fibular free flaps between 2009 and 2011 and who were free from disease. Their records showed no pre-existing musculoskeletal or neurological conditions. Bone had been harvested using a standard subfascial technique, and at least 7 cm of proximal and distal bone had been spared to maintain the stability of the joint.<sup>4,5</sup>

We collected data on age, height, and weight, the length of the limb from the anterior superior iliac spine to the tip of the medial malleolus, and the side of the donor leg (Table 1). Patients were asked to complete the American Orthopaedic Foot and Ankle Society (AOFAS) scale and the Foot and Ankle Disability Index (FADI) for the operated leg.

We used the star excursion balance test as described by Olmsted et al<sup>3</sup> to test the dynamic balance and stability of the ankle by measuring the reach distances in each of the eight directions. Before the test, each patient was given a verbal and visual demonstration and they did six trials in each of the 8 directions for each leg, as recommended by Gribble and Hertel.<sup>6</sup>

To prepare for the test, we used a protractor, tape, and tape measure to mark out a star-shaped grid on the hard rubber floor of a room in the outpatient clinic. Eight lines radiated out from the centre at 45° angles (Fig. 1), and these were named according to the direction of reach from the supporting leg: anterolateral (AL), anterior (A), anteromedial (AM), medial (M), posteromedial (PM), posterior (P), posterolateral (PL), and lateral (L).

Table 1  
Age, height, and length of leg.

Case No.	Age (years)	Height (cm)	Length of operated leg (cm)
1	38	173	87.5
2	54	173	88
3	60	160	81
4	80	170	86
5	55	152	79
6	74	183	102
7	59	173	92.5
8	69	191	102
9	60	173	93.5
10	43	173	99
11	50	165	84.5
12	39	170	87
13	68	180	94
14	28	157	78
15	46	168	84
16	19	173	86
17	53	188	100
18	27	173	90
19	61	173	91
20	45	173	90
21	27	157	80
22	60	168	82
23	40	157	76
24	25	152	76
25	60	168	80
26	45	173	76

We asked each patient to stand on one leg in the middle of the grid and to reach to the furthest point possible on the lines with the other leg as shown in Fig. 2.<sup>7</sup> They had to touch the line as lightly as possible to make sure that they steadied themselves by neuromuscular control of the supporting leg. The test was then repeated with the other leg. The examiner marked the touch point, measured the distance from the centre of the grid with a tape measure in centimeters, and recorded it. The trial had to be repeated if the patient made a heavy touch, rested the foot on the ground, lost balance, or could not return to the starting position in a controlled manner.

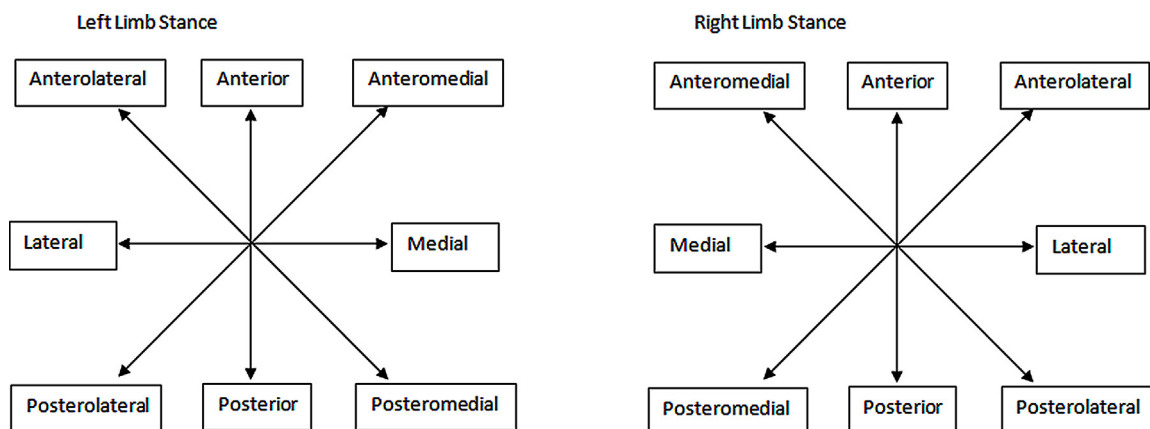


Fig. 1. Directions of reach for the star excursion balance test (reprinted with permission from Hertel J, Braham RA, Hale SA, Olmsted-Kramer LC. Simplifying the star excursion balance test: analyses of subjects with and without chronic ankle instability. *J Orthop Sports Phys Ther* 2006;36:131-137. <http://dx.doi.org/10.2519/jospt.2006.36.3.131>. ©Journal of Orthopaedic & Sports Physical Therapy®).

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