CLINICAL STUDY WITH HUNOVA

Chronic ankle instability

hunova for evaluation and treatment of chronic ankle instability using performance index

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We present how we have used the "Performance index" as an assessment and training instrument for the evaluation and the optimization of physical performance of a basketball player suffering of chronic ankle instability. We decided to evaluate the athlete using a specific assessment program with an innovative robotic device to analyze balance components, reactivity to perturbations, lower limbs strength, ankle range of motion (ROM) and core stability with numerical parameters in order to find the player's functional deficits compared to high performing subjects' normality ranges. In this case report, we present the data of a basketball player who resulted impaired especially in several functional areas due to right ankle instability. After a focused training on hunova the subject's performance improved returning close to the normality ranges. The improvements we observed encouraged us to share this experience: in response to the robotic training program ankle range of motion and monopodalic balance improved in a significant way.

Introduction

Chronic ankle instability is a condition characterized by a constellation of symptoms, typically including pain, weakness and a feeling that the ankle episodically gives way. Anatomical lateral ankle ligament laxity and mechanical instability, peroneal muscle weakness and ankle proprioceptive deficits (manifested by decreased ability to perform single-leg stance) are the primary factors thought to cause and perpetuate symptoms.

Affected persons may have difficulty participating in sports, particularly high-demand sports that require quick starts and stops, cutting, and jumping such as basketball. The subject came to our rehabilitation facility asking our help to improve his condition. Our aim was to evaluate ankle condition using a multidimensional standardized battery test denominated Performance index. The Performance index is a multidimensional evaluation index used to analyze the total body physical condition of the subject performing the test and compare the overall performance with respect to normality ranges, consisting of the mean values of high performing athletes. This index is a performance evaluation that covers different functional areas and gives an indication of where the subject is in deficit (compared to top performers) and where the athlete needs to work to maximize physical performance. The index is calculated as a combination of the results of the assessments grouped into 7 functional areas: *Core, Squat, Bipodalic equilibrium, Monopodalic equilibrium, Ankle Strength, Ankle Range of Motion (ROM), Monopodalic Reactive Balance*. This subdivision makes it easy to identify the less performing functional areas and identify the treatment needed to increase the subject's performance. In particular, the overall performance, decomposed in the previous functional areas, is represented in the form of a 7-point radar graph as shown in Figure 1 a, c. For each area (tip of the graph) a colored dot is present which represents how the subject is positioned with respect to the normality of the top performers (distance from the average) in that functional category. The further away from the center, the better the performance in that specific area. If the dot is green, the performance in that area is excellent and does not

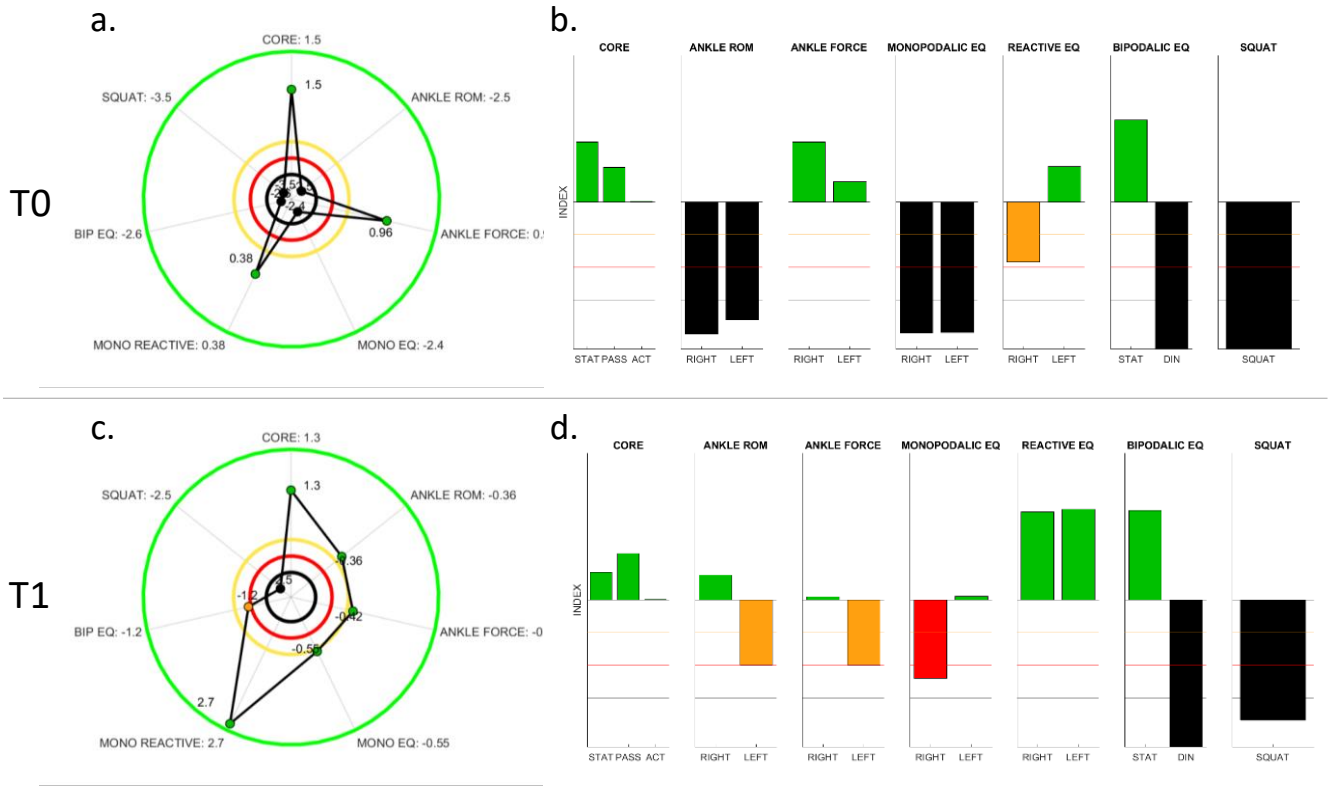

Figure 1: a: Performance Index at T0, initial assessment. Ankle range of motion, Monopodalic equilibrium, Bipodalic equilibrium and Squat resulted very out of range. b: The seven functional areas of the Performance Index at T0, initial assessment. Each functional area is separated in its main components or divided into left/right. Bilateral ankle ROM and bilateral monopodalic balance resulted highly impaired and became the training goals. Bipodalic equilibrium and squat were considered secondary training goals. c: The seven functional areas of the Performance Index at T1, final assessment. After the focused training, Ankle range of motion and monopodalic balance are green. Bipodalic equilibrium is orange, there was a small improvement on bipodalic balance even if working on the monopodalic one. d: Performance Index bar plots at T1, final assessment. Ankle ROM and monopodalic balance, our treatment functional areas goals, resulted not black anymore. The bigger improvement was found in the right ankle mobility and in reactive balance. Right stance monopodalic balance improved, but there is still room for improvement.

require specific training; if yellow the performance is good, if red is fair, if black is poor. For these last 3 colors hunova recommends a specific training different in difficulty depending on performance level. We have applied this tool to a case of chronic ankle instability to identify initial deficits and secondarily treat them with a specific training protocol. Data are collected from a 24 years old basketball player affected by chronic ankle instability at the beginning and at the end of a specific training.

Athlete

Male, 24 years old, professional basketball player (weight: 100kg; height: 186 cm). At the time of our first evaluation (early June 2019) the subject complained a feeling of right ankle instability, but still played in all the matches of the team.

Initial evaluation

Foot and Ankle Ability Measure (FAAM) sports sub-scale was conducted at the beginning and at the end of the treatment. The FAAM initial assessment individuated moderated difficulty in 1 task (starting and stopping quickly) and slight difficulty in 3 tasks (walking on uneven ground, land from a jump, rapid lateral shifts).

Manual muscle test was also performed at baseline. The bilateral muscular strength of all the lower limb major muscles scored the maximum. Muscular strength was not affected (also the performance index confirmed this hypothesis). Evaluation in form of Performance Index was performed at the beginning (T0 – June 2019) and at the end of the training period (T1 – July 2019) after a 1.5-month interval. The assessment required 30 minutes and consisted of the following robotic tests on hunova:

BIPODALIC STANCE

1. Balance test on static base
2. Balance test on elastic base (dynamic)
3. Squat assessment

SITTING

4. Five times sit to stand
5. Balance test on raised static seat
6. Balance on proprioceptive seat and combined passive base
7. Balance on proprioceptive seat and variable counter resistive base

MONOPODALIC STANCE

8. Balance test on static base (right foot)
9. Balance test on static base (left foot)
10. Reactive balance (right foot)
11. Reactive balance (left foot)

ANKLE (Right and Left)

12. Ankle ROM sagittal plane
13. Ankle ROM frontal plane
14. Isometric test (-10°; pushing in plantar flexion)
15. Isokinetic test (150°/s, flexion and extension)
16. Isokinetic test (90°/s, flexion and extension)
17. Isokinetic test (60°/s, flexion and extension)

Treatment

Training was focused on the 2 functional areas which resulted inferior in performance respect to the rest and highly correlated with chronic ankle instability condition: ankle ROM and monopodalic equilibrium. Each functional area had a dedicated training macroarea suggested by the device. The combination of the two macroareas created the training session. 8 personalized hunova training sessions with variation of difficulty depending on the athlete's performance were prescribed together with conventional training on the field and in the gym. The proposed exercises had an increasing progressive difficulty for each training session.

Each training session on hunova lasted 1 hour, twice a week. Sessions were focused on:

1. improving ankle range of motion (right and left);
2. increasing ankle proprioception with control exercises (tracking / drawing) with and without resistance (especially right ankle);
3. improving monopodalic balance and postural control (right and left single stance);
4. working on right monopodalic reaction times.

Results

Initial evaluation

The results of the initial assessment (T0) are reported in Figure 1a in a radar plot representing the functional areas scores that make up the performance index. Each area has a score in the form of a colored dot. The green and the yellow line delimit the area of the graph within which the data will assume the green color. A yellow or red dot means that the score is out of range within a certain amount in the specific functional area. Black means that the value is very far from the normality range. The athlete's ankle range of motion, monopodalic balance, bipodalic balance and squat functional categories scores emerged extremely outside the normality range calculated evaluating the performance of top performers. Ankle ROM is very limited in respect to the values scored by other athletes. Balance in single leg stance is particularly affected. In Figure 1b, each functional area is separated in its main components or divided into left and right sides. As in the radar chart, the bars take on the color of the area in which they end. Each bar starts from the average value of normality (grey line in the middle of the graph) and indicates how the subject is positioned with respect to this value (distance from the average). Core, ankle force and static bipodalic balance functional areas are not affected (green columns). The athlete resulted impaired in both right and left ankle range of motion, monopodalic equilibrium bilaterally, while reactive equilibrium is slightly impaired on the right side. Bipodalic balance in dynamic conditions and squat are colored in black too, but were not considered as training goals.

Final evaluation

Following the focused training the athlete repeated the performance evaluation test and the clinical scale.

The FAAM final assessment individuated moderated difficulty in 1 task (start and stop quickly) and slight difficulty in 1 task (walking on uneven ground). Landing from a jump and rapid lateral shifts have improved and are now performed without difficulty nor pain.

In Figure 1c, the results from the Performance Index at T1 are represented. Ankle ROM and monopodalic balance functional areas improve and are now inside the normality range (green color). Thanks to this improvement, the overall performance index score improved from 57% to 74.3%. Squat and bipodalic balance in dynamic conditions are still abnormal (orange and black) but were not part of our treatment goals. Hopefully, we will continue the training in the future to improve also those functional areas. Ankle ROM resulted out of range bilaterally at T0. Ankle ROM functional area bars in Figure 1d passed from black to orange (left ankle) and green (right ankle): increasing the range of motion training goal on hunova was successful. The specific training has increased right ankle mobility to values higher that top performers' ones. Left monopodalic equilibrium bar is green, the right stance one passed from black to red. Right stance reactive balance improved and is now better than the mean of the normality range.

Conclusions

Performance index is a very powerful solution to evaluate performance and optimize it. In this case, we have studied how chronic ankle instability affected the basketball player's physical performance in order to optimize it. Specific training programs have been suggested from the device for the athlete based on which functional areas were considered mostly impaired after the first execution of the test. In comparison with top performers, the athlete resulted with minor performance scores in ankle range of motion and single leg stance balance due to his painful and instability condition. The athlete performed focused sessions on hunova, training on these two areas twice a week in addition to traditional training. When the player repeated the test, the performance index was much higher (74.3%), and the 2 functional areas resulted globally into normality ranges. In addition, the FAAM score improved: Landing from a jump and rapid lateral shifts movements are now performed without difficulty nor pain. Furthermore, the athlete performed much better during the season, but the most important evidence is that he felt more confident on relying on the right ankle while playing basketball. We are very happy about the performance index because it helps us to identify functional deficits that affect physical performance. After the identification, this instrument gives us also the training solutions.

The performance index is an easy and valid instrument to use in all sports related injuries for all type of athletes that have been or are injured.