

MODULE: SQUAT JUMP

BRIEF DESCRIPTION:

Squat jump is a vertical jump and among the most often used tests for maximal anaerobic power output of the lower extremities. It is a concentric muscle action which involves coordinated extension of the trunk, hip, knee and ankle. Based on the parameters derived from the ground reaction force (GRF) and flight time dynamics of this elementary movement pattern can be thoroughly studied.

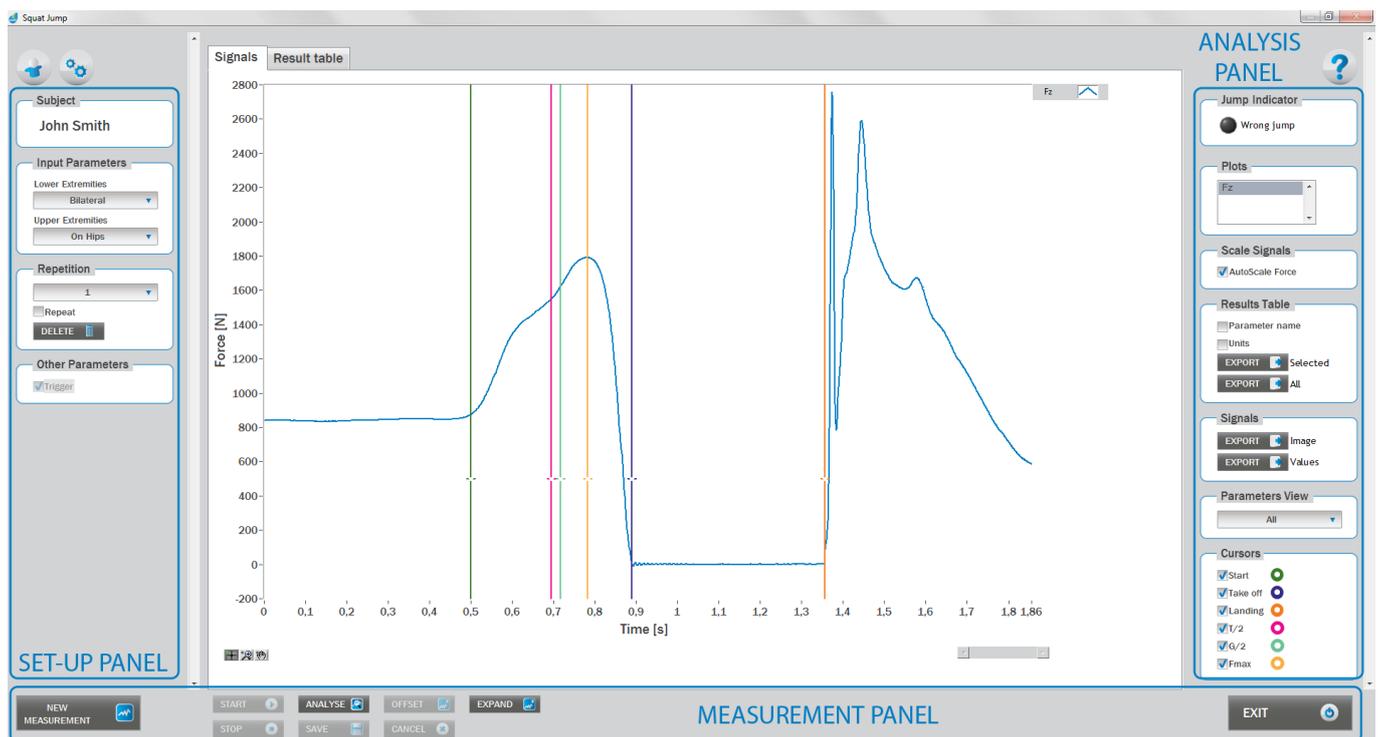
The initial position of the subject is usually a semi-squat (knee $\sim 90^\circ$ and trunk/hips in a flexed position). However, this position can sometimes be adjusted to the specific goals of the measurement. From the starting position the subject performs a vertical push off action as quickly and as explosively as possible in order to perform the highest possible jump in the shortest possible time; thereby using a concentric movement only. It is important to ensure that the subject does not perform any counter movement before the push off.



When the Squat Jump module opens, the existing measurements of the selected subject inside the current Visit are displayed and the user can review them (see section Analysis for details). If no measurements have yet been done for this subject, than only the option to start a new measurement is enabled. In order to begin a new measurement, click New Measurement button and select the Input Parameters to exactly define the measurement task.

When the New Measurement button is selected for the first time after entering the Squat Jump module, the force plate is initialized. After the automatic initialization process is finished, the zero offset must be done (follow the instructions on the pop-up message). The plate must be unloaded during the entire initialization and zero offset procedure. This procedure is performed every time you enter the Squat Jump measurement module. Zero offset can be repeated any time manually by pressing the Offset button, otherwise the automatic zero offset is done every 30 minutes.

BASIC FUNCTIONS:



SET-UP PANEL:

SUBJECT

Name

The selected subject.

INPUT PARAMETERS

See [Selecting Input Parameters](#) section for details.

REPETITION

Repetition

Number of repetitions for the selected Input parameters.

Repeat

If checked, the selected repetition is replaced when the new measurement is performed.



Delete

Delete the selected repetition.

OTHER PARAMETERS:

Trigger

When trigger option is selected, software will automatically cut the signal before the »first cursor« (duration is defined with Start buffer parameter) and after the »last cursor« (duration is defined with Start buffer parameter). Start buffer and Stop buffer can be set in settings window. For details about setting the parameters refer to Settings Section.

ANALYSIS PANEL:

PLOTS

Plots

The list of all channels. The selected channels are shown on the graph.

SCALE

AutoScale Force

If checked, the vertical scale of the graph is adapted to the maximum and minimum value of all force signals.

RESULTS TABLE

In the Result Table panel, result parameters from Result table tab can be exported into clipboard, CSV or TXT format. Format of the file can be set in settings window under export section. For details about setting the parameters refer to Settings Section.

Parameter Name

Parameter name will be included.

Units

Units of the parameters will be included.

Export Selected

By clicking on Export Selected button only the parameters that are selected in the table will be included.

Export All

By clicking on Export All button all parameters from the table will be included.

SIGNALS

In the Signals panel, image or values (row data) of acquired signal can be exported. Image and values can be exported with different parameters, which can be set in Settings window under export section.

For details about setting the parameters refer to Settings Section.

Export Image

Export the image of signals (as visible on the graph on the Signals tab) into the clipboard. Image can be paste in any image editor.

Export Values

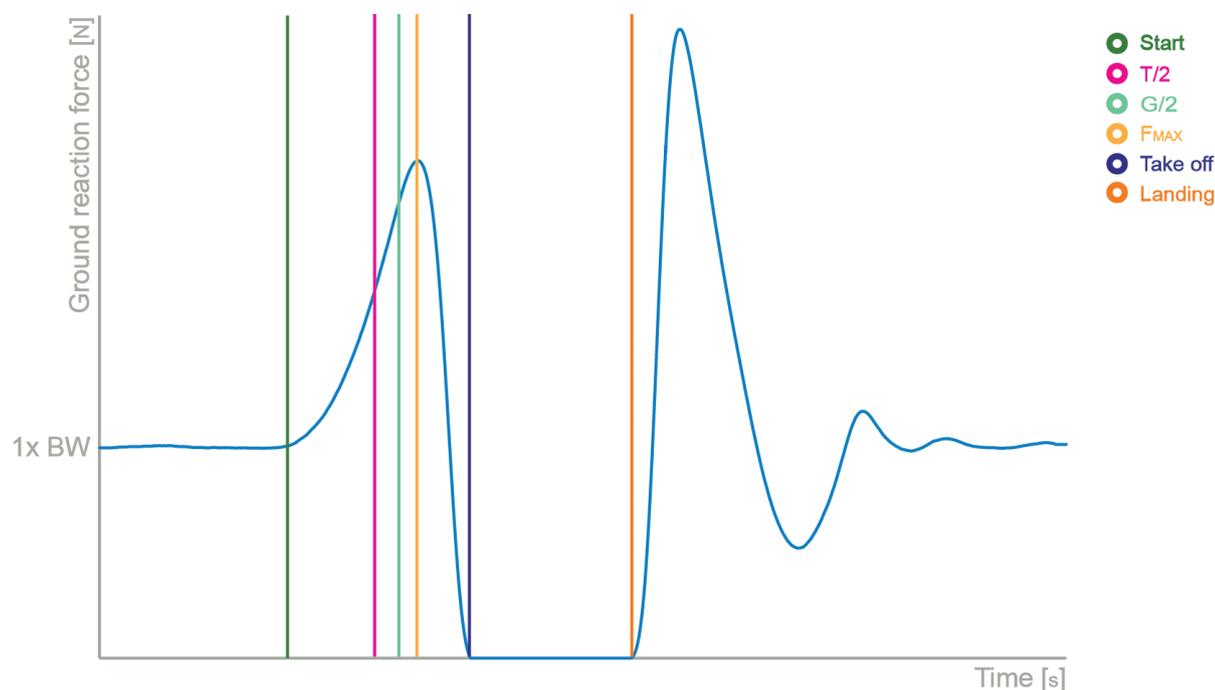
Export values (raw data) of signals (as visible on the graph on the Signals tab) into CSV or TXT format. Format of the file can be set in settings window under export section. For details about setting the parameters refer to Settings Section.

PARAMETERS VIEW

In the Parameters View panel, calculated parameters which are displayed in the result table can be set. By default, all and basic view are available. Basic view contains preset parameters and cannot be changed. Custom view can be defined, by clicking »Manage...« button.

To create a new view click on add button and enter the name of the view. Parameters included in the view are selected by checking the checkboxes next to them. To confirm the changes click save.

CURSORS:



Start

Indicates the start of the jump (start of the movement).

Take Off

Indicates the start of the flight phase.



Landing

Indicates the start of the landing.

T/2

Indicates the half of the time between the Start and Take Off event.

G/2

Indicates the time where half of the force impulse is reached. Force impulse is calculated between the Start and Take Off event.

Fmax

Indicates the maximum force between the Start and Take Off event.

JUMP INDICATORS:

Indicates the false movement at the start of the jump (if the eccentric movement is present). Maximal allowed eccentric movement is defined as the percent of body weight exceeded. The percent of body weight is defined with parameter Criteria which can be set under General settings in Settings window.

MEASUREMENT PANEL

New Measurement

Starts with a new measurement.

Start

Starts the measurement.

Stop

Stops the measurement.

Save

Saves the measurement.

Cancel

Cancel the last measurement.

Offset

Makes zero offset. Note that the force platform must be unloaded during the process.

Analyse

Performs the analysis.

Collapse

Collapses the graph and the side panels are shown.

Expand

Expands the graph and the side panels are hidden.

Exit

Closes the measurement module.

SELECTING INPUT PARAMETERS:

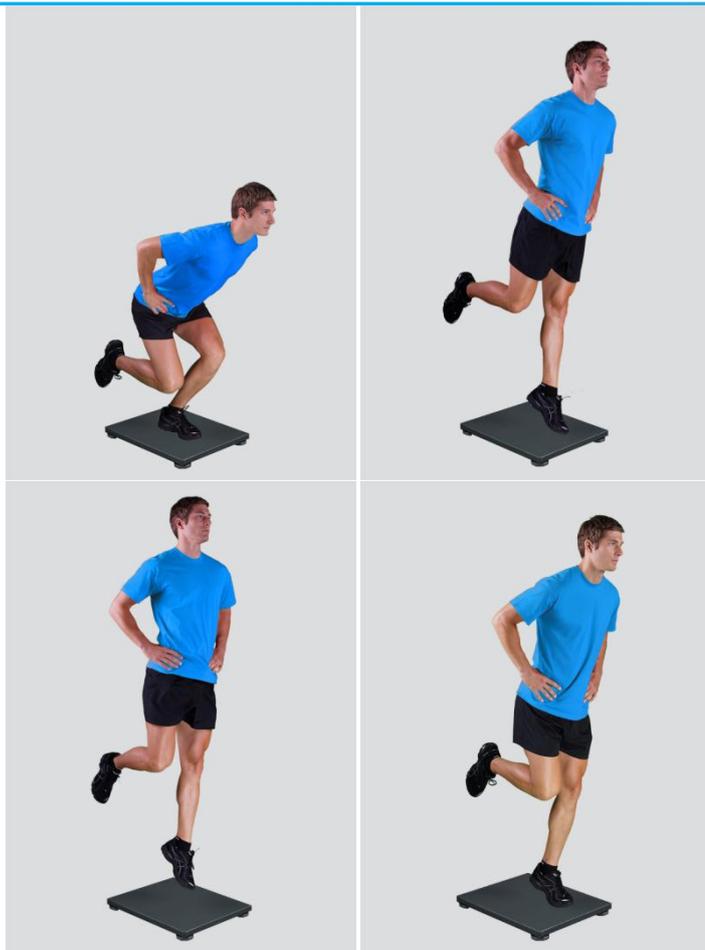
Before the measurement can start, the user has to choose some input parameters with which the measured motor task (jump) is specifically defined. These parameters are important for further analysis, comparisons and reporting. The jump`s characteristics are defined by the following parameters:

LOWER EXTREMITIES:**Bilateral**

The subject is standing in the centre of the plate with the feet placed parallel or with toes pointing slightly outward. Feet should be shoulder-width apart.

**Unilateral-Left / Unilateral-Right**

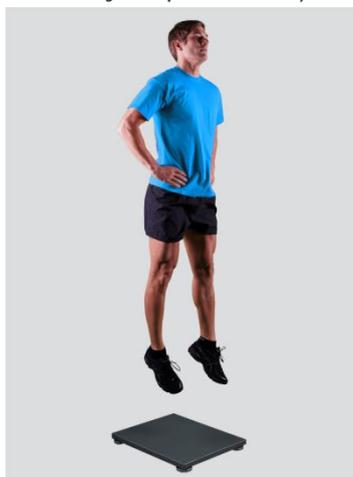
The subject is standing on a single leg (left or right) in the centre of the plate.



UPPER EXTREMITIES:

On Hips

The subject places his/her hands on his/her hips.



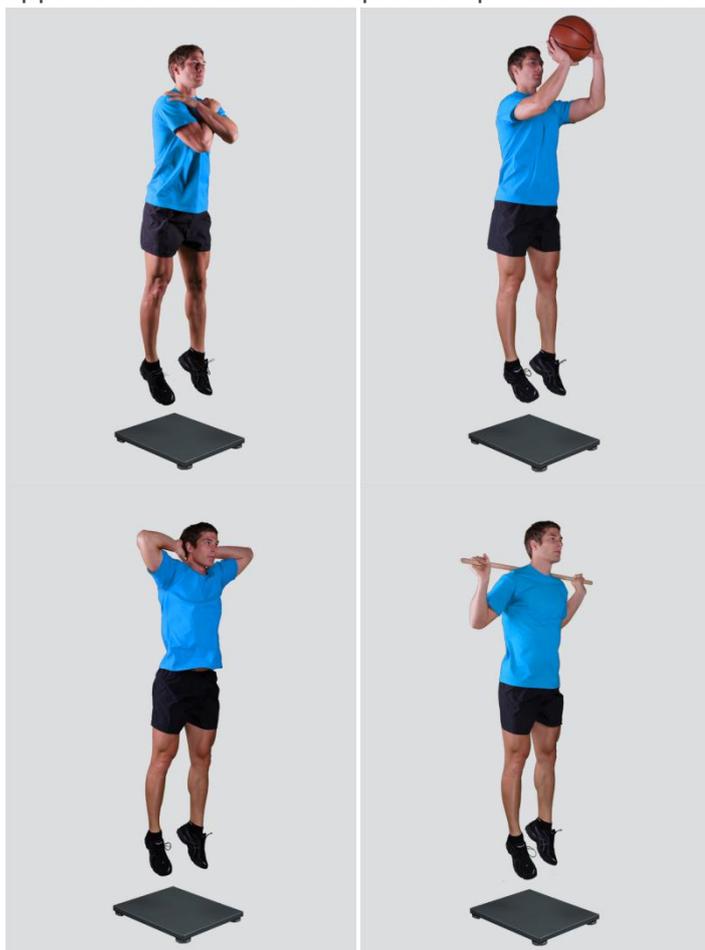
Free

Subjects are free to use their arms as they want. Specifically useful when observing how subjects differ in using arms as a biomechanical advantage.



Other user defined

In case of any other position of the upper extremities, the user can select this option and can define another function/placement of the upper extremities (see Settings Section for details). After doing so, the newly defined input parameter will from then on appear as an optional choice under the Upper extremities in the Squat Jump measurement module.



MEASUREMENT:

After selecting input parameters, the subject steps on the plate and acquires the required position. Ensure that the subject is standing in the centre of the plate as described above. After the subject



has acquired the required position and is ready to start the movement, click Start. At that time, the subject is free to start the jump and the software will automatically recognize the beginning and the end of the jump. For details about this automatic acquisition please see Settings Section.

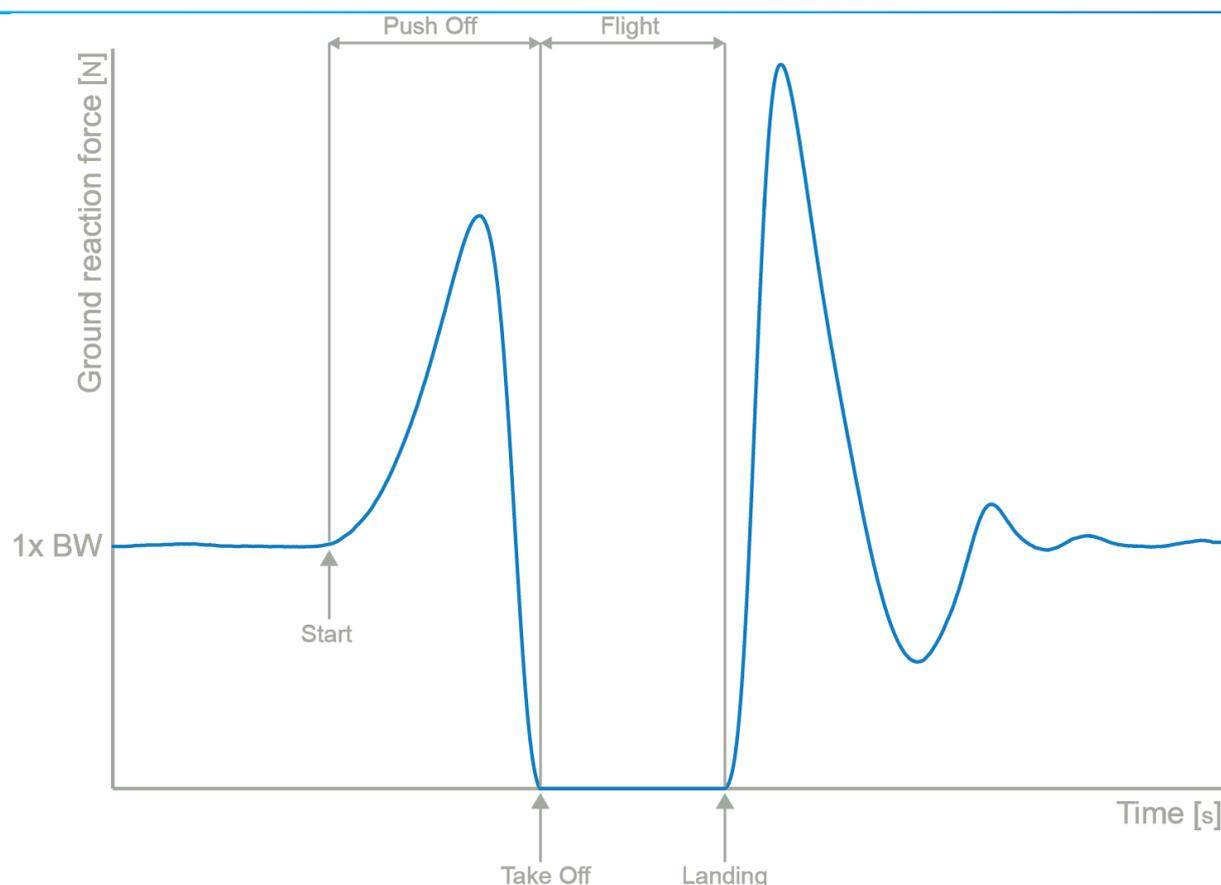
If you want to start a new measurement, click the New Measurement button and repeat the procedure. Before doing so, you can change the Input Parameters; if not, the Input Parameters of the previous measurements will be used. If you want to repeat a certain measurement, click on the drop down menu, select the repetition you want to replace and check the box Repeat. Then click Start and a pop-up window will ask you if you really want to repeat the measurement. Click OK if you want to repeat.

ANALYSIS:

Analysis enables you to check the signal(s) of the ground reaction force and the calculated parameters. Under the Signal tab you can see the signal and markers which are placed automatically. You can move all markers if they were placed incorrectly. Under the Results Table tab you can see all the calculated parameters numerically, while the visualisation of the results comparisons can be done under the Results Graphs tab. These two tabs enable you to make quick comparisons of the values of the parameters among different repetitions and/or among different sub-versions of the test. If you want to confirm the measurement, click Save. If you would like to export the calculated parameters use Export function in Result Table panel.

All the parameters calculated for analysis are commonly used in biomechanics, kinesiology and rehabilitation¹⁻⁴. Parameters are calculated from the ground reaction force and flight time. For more information regarding the parameters see the references below.

For some modules additional analysis routines are available as separate products. See section About the Product for more information.



CALCULATED PARAMETERS:

GENERAL

Jump Height from Take Off V [m]

The height of the jump calculated from the Take Off velocity as calculated from the force impulse.

Jump Height from Flight T [m]

The height of the jump calculated from the Flight Time.

Start interval relative F [%BW]

Average force in the 1st 50 ms of the Push Off divided by the body weight (50 ms is a default value and can be changed under the Settings section).

Start interval relative P [W/kg]

Average power in the 1st 50 ms of the Push Off divided by the body weight (50 ms is a default value and can be changed under the Settings section).

Start interval A [m/s²]

Average acceleration in the 1st 50ms of the Push Off (50 ms is a default value and can be changed under the Settings section).



Start interval V [m/s]

Average velocity in the 1st 50ms of the Push Off (50 ms is a default value and can be changed under the Settings section).

Relative maximal F [%BW]

Maximal force during the jump (i.e. Push Off) divided by the body weight.

Relative maximal F in the 1st half of Push Off [%BW]

Maximal force between the Start and the half of the Push Off divided by the body weight.

Relative maximal F in the 2nd half of Push Off [%BW]

Maximal force between the half of the Push Off and the Take Off divided by the body weight.

Relative maximal P [W/kg]

Maximal power during the Push Off divided by the body weight.

Relative E [J/kg]

Energy during the Push Off divided by the body weight.

A [m/s²]

Average acceleration during the jump.

A in the 1st half of Push Off [m/s²]

Average acceleration between the Start and the half of the Push Off.

A in the 2nd half of Push Off [m/s²]

Average acceleration between the half of the Push Off and the Take Off.

Vertical Take Off V [m/s]

Velocity of the vertical movement at the Take Off.

TIME PARAMETERS

Push Off T [s]

Time interval between the Start and the Take Off.

Flight T [s]

Time interval between the Take Off and the Landing.

T of the 1st half of FI [s]

Time interval between the Start and the half of the total force impulse.

T of the 2nd half of FI [s]

Time interval between the half of the total force impulse and the Take Off.

T to maximal F [s]

Time interval between the Start and the maximal force.

T from maximal F to Take Off [s]

Time interval between the maximal force and the Take Off.



FORCE IMPULSE PARAMETERS

Total FI [Ns]

Force impulse (i.e. integral of a force with respect to time) between the Start and the Take Off.

Total FI from Flight T [Ns]

Total force impulse calculated from the Flight Time.

FI in the 1st half of Push Off [Ns]

Force impulse (i.e. integral of a force with respect to time) between the Start and the half of the Push Off.

FI in the 2nd half of Push Off [Ns]

Force impulse (i.e. integral of a force with respect to time) between the half of the Push Off and the Take Off.

Ratio between FI in both halves of Push Off [%]

Ratio of the force impulse (i.e. integral of a force with respect to time) between the Start and the half of the Push Off and the force impulse between the half of the Push Off and the Take Off.

FI between Start and maximal F [Ns]

Force impulse (i.e. integral of a force with respect to time) between the Start and the maximal force.

FI between maximal F and Take Off [Ns]

Force impulse (i.e. integral of a force with respect to time) between the maximal force and the Take Off.

Ratio of FI before and after maximal F [%]

Ratio between the force impulse (i.e. integral of a force with respect to time) between the Start and the maximal force and the force impulse between the maximal force and the Take Off.

REFERENCES:

1. Cormie, P., Deane, R. & McBride, J.M. Methodological concerns for determining power output in the jump squat. *J Strength Cond Res* 21, 424-430 (2007).
2. Fukashiro, S. & Komi, P.V. Joint moment and mechanical power flow of the lower limb during vertical jump. *Int J Sports Med* 8, 15-21 (1987).
3. McLellan, C.P., Lovell, D.I. & Gass, G.C. The role of rate of force development on vertical jump performance. *J Strength Cond Res* 25, 379-385 (2011).
4. Walsh, M.S., Ford, K.R., Bangen, K.J., Myer, G.D. & Hewett, T.E. The validation of a portable force plate for measuring force-time data during jumping and Landing tasks. *J Strength Cond Res* 20, 730-734 (2006).