



User manual
**Blood flow restriction
equipment**

About

This user manual will guide you to correctly use blood flow restriction equipment manufactured by Occlude. The Occlude equipment is developed and designed for blood flow restriction exercises only and any use of Occlude equipment must be in accordance with this user manual.

Occlude owns the copyright to this user manual and it cannot be copied or reproduced without written consent from Occlude.

Responsibility

Occlude is only responsible for the function and safety of the product if used in accordance with the guidelines in this user manual. If the user manual leads to any questions regarding the use of blood flow restriction equipment from Occlude, please contact Occlude prior to any use.

Violation of the guidelines in this user manual will cancel any responsibility of the manufacturer Occlude.

Product information

This user manual contains guidelines for the use of the following blood flow restriction equipment manufactured by Occlude:

- Blood flow restriction Occlude cuffs in size S, M, L and XL
- Occlude Sphygmomanometer

The products mentioned above are included in one or more parts in Occlude's product package, which consists of:

- Occlude Rehab+
- Occlude Rehab
- Occlude Athlete
- Occlude Single
- Occlude Sphygmomanometer

Warnings

A warning symbol **!** marks potential harm to persons and/or death if the relevant information in the user manual is not strictly adhered to.

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1.0 Blood flow restriction exercise

Blood flow restriction exercise (BFRE) is a well-researched and evidence-based training modality that induces significant muscular strength and hypertrophy while offering a very low load on the musculoskeletal system [4]. Thus BFRE is relevant for numeral rehabilitation settings and several patient cohorts who do not tolerate conventional heavy resistance training.

When BFRE is performed correctly the inflated cuff will partially restrict the arterial inflow and completely occlude the venous return from an extremity. During this condition a very low load of approx. 20-30% 1RM is sufficient to induce significant increases in muscular hypertrophy and strength.

Blood flow restriction exercise is exclusively [!] for use on arms and/or legs with the purpose of creating inadequate oxygen supply (hypoxia) to the working muscle [1, 2].

For further information on the physiological effects of blood flow restriction exercise, exercise prescriptions and practical use of the equipment please read section 6.0 "Guidance and Protocols for Blood Flow Restriction Exercise" and visit www.occludebfr.com.

2.0 Cuffs

The blood flow restriction cuffs from Occlude are registered as medical grade equipment and continuously undergo strict quality control. They consist of an internal air bladder, which is inflated by the sphygmomanometer. The external surface is made of highly resilient material to ensure an adequate level of durability. Picture 1 shows an Occlude cuff along with central cuff components: a male Velcro strap, a surface with female Velcro and metal ring to mount the cuff to an extremity, a male valve to connect the cuff and sphygmomanometer for air inflation.



Picture 1: Occlude cuff.

2.1 Sizes

Occlude cuffs for blood flow restriction exercise comes in four different sizes: small (S), medium (M), large (L) and extra large (XL). Sizes small and medium are designed for arms where as large and extra large are designed for legs. Every cuff covers a specific range of circumferences measured at the most proximal part of the limb and in a relaxed state:

- Small: 20-32 cm
- Medium: 31-44 cm
- Large: 45-61 cm
- Ekstra large: 60-74 cm

In the case two cuffs fits a limb we always recommend using the larger.

2.2 Colour codes

All Occlude cuffs are colour coded as follows:

- Green = size S
- Red = size M
- Grey = size L
- Blue = size XL

2.3 Mounting and fitting

Occlude cuffs are conical shaped to improve the fitting and comfort and to match the anatomical shape of arms and legs. When mounted and closed around a limb the valve should face down on the arm cuff and upward on the leg cuff in a standing neutral position. This is to ensure that the larger circumference of the cuff is always placed most proximal on the extremity.

Choose a matching cuff depending on extremity and circumference. Make sure the cuff is completely deflated prior to exercise. For optimal fit we recommend having tights or bare skin beneath the cuff. If necessary please use the supplied elastic bandages beneath the cuff to optimise friction and comfort. Mount the cuff as proximal as possible on the desired extremity. For optimal usage, the arm cuff should be mounted just beneath the armpit and the leg cuff should be mounted just beneath the Gluteus Maximus muscle.

Use the closing system by pulling the male Velcro strap through the metal ring and pull back to connect the male and female Velcro. The correct tightness will allow two fingers between the cuff and skin. Ensure that the two overlapping ends of the cuff cover each other. Pictures 2 and 3 illustrate correct mounting of an arm cuff and a leg cuff.



Picture 2: Correctly mounted arm cuff. The valve faces down.



Picture 3: Correctly mounted leg cuff. The valve faces upwards. (The valve is not seen in the picture).

3.0 Sphygmomanometer

Occlude's sphygmomanometer consists of a manual pump module, a pressure gauge, a screw valve, a rubber hose and a female coupling.



Picture 4: Occlude sphygmomanometer.

The manual pump module in the sphygmomanometer works by hand. Release and press the pump module until the desired pressure is achieved.

Pressure is measured in millimetres of Mercury (mmHg) and is read by the pointer's position on the display. The pressure can be measured only when the sphygmomanometer and cuff are connected.

The screw valve works to fine-tune the cuff pressure as well as deflating it after usage. Turning the valve clockwise will enclose the sphygmomanometer (picture 5) and turning the valve counter clockwise will deflate it (picture 6). Please make sure the screw valve is completely closed prior to inflating the cuff.



Picture 5: Occlude sphygmomanometer with a closed screw valve.



Picture 6: Occlude sphygmomanometer with an open screw valve.

3.1 Connecting the Sphygmomanometer to the Cuff

The cuff is ready for inflation after correct mounting. First attach the sphygmomanometer to the cuff by pressing down the female valve on top of the male valve. Please notice that it is only possible to attach the sphygmomanometer to the cuff when the shiny metal plate of the female coupling is pushed in (Picture 7-9).



Picture 7: Press the metal plate in so that the small metal split protrudes.



Picture 8: When the metal split protrudes, it can be mounted on the male valve.

3.2 Adjusting the Cuff Pressure

The screw valve must be closed before inflation is initiated. Inflating the cuff to the predetermined pressure must take place under complete muscle relaxation in the involved musculature. We recommend sitting upright on a chair in a relaxed position. The fitting of the cuff will always adjust after the initial inflation. This is due to fluid in the extremity being pressed away from under the cuff and the cuff finding a general snug fit. Consequently the pressure will typically decrease 5-15 mmHg. To prevent this from happening during the blood flow restriction exercise, we recommend performing 5-6 unloaded repetitions with the restricted extremity after initial inflation. Please check the pressure again and readjust. Disconnect the sphygmomanometer from the cuff and the exercise can begin.



Picture 9: Correct fitting of sphygmomanometer to cuff. The pressure can now be increased in the cuff.

3.3 Disconnecting the Sphygmomanometer

When the cuff is inflated to the desired pressure, disconnect the sphygmomanometer by pushing in the metal plate on the female coupling. The female coupling will automatically release and activate the male valve.

3.4 Post Blood Flow Restriction Exercise

After the completion of the blood flow restriction exercise, either deflate the cuff by connecting the sphygmomanometer as explained in 3.1 and opening the screw valve or press directly down on top of the white valve split on the male valve.

4.0 Maintenance

The cuffs are produced of high quality materials that withstand alcohol cleaning and we recommend doing this after each usage. The cuffs cannot tolerate machine washing. Further, please always deflate the cuffs after use.

4.1 Durability

Occlude guarantees a minimum of 100 exercise cycles for each cuff.

5.0 Safety instructions

Occlude recommends that blood flow restriction exercise should not be maintained for more than 10 minutes at a time [!]. Immediately stop your workout if you feel dizziness or physical discomfort [!].

5.1 Arterial Occlusion Pressure (AOP)

Occlude recommends the method of individually based working pressure through the determination of arterial occlusion pressure (AOP)[4,13]. AOP is defined as the pressure needed for a complete occlusion of the arterial inflow to an extremity and can be determined with the use of an ultrasonic or handheld Doppler. This method is widely recommended in the scientific literature to maximise the safety of blood flow restriction exercise. Knowledge and skill acquisition of this method can be obtained in one of Occlude's many evidence-based courses. Occlude encourages all who are new to blood flow restriction exercise to participate in such workshops.

In general using a working pressure of 40-50 % of AOP in a sitting position is recommended. This is in accordance with the scientific literature as this will lead to both an optimal training adaptation and minimal discomfort [3]. In the case individually determined AOP isn't possible Occlude's internal tests have determined that 80 mmHg in armcuffs and 90 mmHg in leg cuffs will suit the majority of the population. Please note that these pressures are indicative [!].

5.2 Duration of Blood Flow Restriction Exercise

In line with leading researchers in blood flow restriction exercise; Occlude recommends that the occlusion time during blood flow restriction exercise should be kept below 10 minutes [!]. After a maximum of 10 minutes under blood flow restriction the cuff should be deflated or released. A pause of minimum 5 minutes is recommended before exercise of the same extremity can be repeated. During the maximal 10 minutes of blood flow restriction exercise, both agonist and antagonist muscles (Example: hamstring and quadriceps) can be exercised. Further in-depth knowledge of different exercise protocols is presented in 6.1.2. Occlude recommends that a maximal of 2-3 exercises under blood flow restriction per muscle group is performed within the same session.

5.3 Special Patient Cohorts

Occlude recommends consulting a physiotherapist or general practitioner before initiating blood flow restriction in special patient cohorts [!]. Special patient cohorts include persons with a history or current diagnosis of:

- Cardiovascular diseases
- Untreated hypertension
- Heart palpitations (heart flutter)
- Thrombosis (blood clots)
- Illnesses related to the blood's ability to coagulate

6.0 Guidance and Protocols for Blood Flow Restriction Exercise

Occlude recommends that the use of blood flow restriction exercise is organised with support from a physiotherapist or health care professional. In the following section a list of protocols from the scientific literature is presented. For further information and scientific knowledge please visit www.occludebfr.com.

6.1.1 Weekly Exercise Frequency

The recommended weekly frequency of blood flow restriction exercise should always be based on the individual's training history and physical level. A meta-analysis of the current scientific studies that use blood flow restriction exercise as a rehabilitating modality showed a positive effect of exercise frequency of 2 to 7 times a week [4]. As a rule of thumb an untrained individual can easily benefit from the lower part of this frequency (2-4 times/week), whereas well-trained individuals will aim for the higher frequency (3-7 times/week). The choice of exercise protocol also impacts the recommended weekly exercise frequency. In specific cases, feel free to contact Occlude for further guidance.

6.1.2 Introduction Protocol

Blood flow restriction exercise can lead to discomfort while exercising and soreness after the first sessions. However, studies have demonstrated a significant reduction in both discomfort and soreness after the first 6 sessions [5]. Occlude recommends that users and/or health care professionals take this knowledge into consideration when initiating blood flow restriction exercise with new users.

No studies to date have investigated the effect of a run-in phase on compliance to or feasibility of blood flow restriction exercise. Nevertheless, to accommodate the large reduction in soreness and discomfort during the first 6 sessions and to minimize the risk of side effects, Occlude recommends increasing the training volume throughout the first 6 sessions. The standard protocol in studies

investigating the effect of blood flow restriction exercise is the “30-15-15-15 repetition protocol” (see 6.1.3). Based on the “30-15-15-15”-protocol Occlude suggests the following run-in phase:

1. session:	20-10-10 repetitions (40 reps. in total) with 90 seconds rest in between
2. session:	20-10-10-10 repetitions (50 reps. in total) with 60 seconds rest in between
3. session:	25-10-10-10 repetitions (55 reps. in total) with 60 seconds rest in between
4. session:	25-12-12-12 repetitions (61 reps. in total) with 60 seconds rest in between
5. session:	30-12-12-12 repetitions (66 reps. in total) with 60 seconds rest in between
6. session:	30-15-15-15 repetitions (75 reps. in total) with 60 seconds rest in between

Thus 20-10-10 consists of 20 repetitions in the first set, 10 repetitions in the second set and 10 repetitions in the third set.

6.1.3 “30-15-15-15”-Protocol

In most studies investigating the effect of blood flow restriction exercise a standard protocol of 30-15-15-15 repetitions separated by 30-60 seconds rest and with an intensity of 20-30% of 1 repetition maximum (1RM) is used. This typically leads to a total training duration of 6 to 8 minutes and a total of 75 repetitions. In the case a 1RM cannot be predetermined, Occlude recommends increasing the load if more than 15 repetitions in the last set can be performed and if the health conditions of the user allows it. Make sure to keep the cuff on and inflated during the rest period.

As a variation to this protocol the 30-60 seconds inactive rest between sets could be replaced by an exercise for the antagonist muscle group. For instance, if a knee extensor exercise is chosen as the primary lift, a knee flexion exercise can be performed in-between instead of inactive rest. This protocol is sometimes rated with a higher level of perceived exertion, but is simultaneously very effective in optimizing a training effect in a short amount of time.

6.1.4 Working to Concentric Failure Protocol

Working to concentric failure is more strenuous than the 30-15-15-15-protocol because every set is performed to concentric failure. This protocol usually consists of 3-5 sets separated by 30-60 seconds rest with approximately 30 % of 1 RM. Please remember to keep the cuff on and inflated in-between sets. Try to target 30-35 repetitions in the 1st set, 20-25 repetitions in the 2nd, 15-20 repetitions in the 3rd and 10-15 repetitions in the 4th.

When utilizing this protocol it is typically necessary to lower the resistance throughout sets 1 to 4 to reach the target number of repetitions. Occlude does not recommend this protocol for new users, but it can be the optimal choice for the trained user or athlete who targets maximum muscle hypertrophy, as seen in power lifters [6].

6.1.5 Protocols for Immobilized Users

Blood flow restriction exercise is a useful modality in an immobilized rehabilitation phase or in early-phase post surgery where bodyweight support/walking/cycling is unwanted. Blood flow restriction exercise without external resistance can attenuate muscle loss, (atrophy) and disuse weakness [8] in periods with a low activity level, bed rest or immobilization [7]. The typical protocol is performed twice a day and consists of 5x 5 minutes with blood flow restriction separated by 3 minutes of rest with the cuff deflated. This protocol has been used on ACL-patients in early-phase post knee surgery. When progression is viable we recommend continuing to a protocol with muscular contraction as these are significantly more effective in maintaining and/or increasing muscle mass.

A BFRE protocol can further be combined with unloaded isometric contractions or neuromuscular electrical stimulation (NMES) in the early rehabilitation phase or in instances where the body has a very low tolerance to load [9, 10]. By doing so, it is possible to combine blood flow restriction exercise with muscle activating exercise, thus optimizing the protection of muscle mass and function. Occlude recommends that this evaluation should always be done by a physiotherapist or health care professional [!].

6.1.6 Treadmill Protocols

Blood flow restriction exercise can be combined with walking and/or cycling in rehabilitation periods [11, 12]. Occlude recommends 2x8 minutes exercise on a cycle ergometer or a treadmill separated by 5 minutes of rest with the cuff deflated. Adjust the resistance, inclination or cadence to reach an adequate level of fatigue during this protocol.

6.1.7 Cool-down Protocol

After completion of a blood flow restriction protocol Occlude recommends a cool-down protocol for a quick and easy recovery. Perform 1-2 sets of 15-20 repetitions with low resistance and without blood flow restriction. We recommend using the same exercise as used in the blood flow restriction protocol.

7.0 Reference list

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8.0 Contact

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