

## Renforcement musculaire et Blood Flow Restriction en Kinésithérapie

**Durée de la formation présentiel :** 7 heures

**Pré-requis :** Diplôme d'Etat de Masseur-Kinésithérapeute ou équivalent

**Formateur :** Cyril Péna, Kinésithérapeute, Certificat de Thérapie Manuelle, Préparateur physique

**- Modalité d'évaluation et de suivi :** Formateur et stagiaires devront procéder à l'émargements de présence par demi-journée. Une attestation de formation sera fournie à chaque participant

**- Thème :** Prévention et prise en charge des pathologies neuro-musculoquelettiques : Renforcement musculaire et Blood flow restriction en kinésithérapie (BFR en kinésithérapie)

### **Description :**

Le renforcement musculaire représente une phase essentielle de la rééducation des pathologies musculosquelettiques. Il doit être à la fois optimal mais aussi adapté à l'état clinique des patients (hyarthrose, statu inflammatoire) et, ou des contraintes articulaires de part charges additionnelles utilisées. Depuis les quelques dernières années, de nombreux cliniciens et chercheurs ont mis en évidence des méthodes de renforcement plus efficaces comme le renforcement avec restriction de flux sanguin ("*Blood flow restriction*"). Ce type de renforcement permet des gains trophiques musculaires significatifs et rapides, cardio-respiratoires et de fonction chez des patients avec très peu de charges additionnelles et de contraintes articulaires. Ce type de renforcement est sécuritaire et recommandé par plusieurs études scientifiques et revues systématiques récentes. Cette formation a pour objectif d'aborder ce nouvel outil rééducatif pour la pratique Kinésithérapique

### **Objectifs :**

- Connaître les grands mécanismes physiologiques du renforcement musculaire et d'endurance cardio-respiratoire
- Connaître les indications et contre indications relative à l'utilisation du Blood Flow Restriction (restriction de flux sanguin)
- Être capable de mettre en place un protocole de renforcement musculaire et d'endurance cardio-respiratoire de restriction de flux sanguin adapté à chaque patient en fonction des données cliniques et de ses besoins
- Être capable de maîtriser les différents outils de pratique de la restriction de flux sanguin

### **Emploi du temps et programme**

8h30 – 9h00 : Présentations et aperçu du cours (Théorie)

9h00 – 10h00 : Introduction, Généralités, physiologie musculaire, Mécanismes physiologiques du renforcement musculaire et d'endurance cardio-respiratoire (Théorie)

10h00 – 10h30 : Définitions du BFR, Indications et contre indications relative à l'utilisation du BFR (Théorie)

10h30 – 10h45 : Pause

10h45 – 12h00 : Applications cliniques et protocole du BFR pour le renforcement musculaire du membre inférieur et supérieur (Théorie & Pratique)

12h00 – 12h30 : Résumé et applications clinique (Théorie)

12h30-13h30 : Repas

13h30 – 14h15 : Mécanismes physiologiques de l'endurance cardio respiratoire (Théorie)

14h15 – 15h30 : Session pratique de mise en pratique du BFR pour le travail cardio respiratoire (Théorie & Pratique)

15h30 – 15h45 : Pause

15h45 – 16h45 : Session pratique protocole BFR pour pathologies spécifiques (Théorie & Pratique)

16h45 – 17h30 : Conclusion (Théorie)

**Méthode utilisée :**

Cette formation se réalisera sous la forme HAS de pédagogie cognitive collective (présentielle) avec une répartition théorique/pratique à 40%/60% comportant :

- Une analyse des pratiques professionnelles (APP) sous forme de questionnaires (voir questionnaire électronique)
- Une acquisition de connaissances théoriques (synthèse de l'état de la science) sous forme de communications magistrales
- Les messages-clé synthétisés sur des documents écrits seront fournis permettant le transfert des acquis sur le terrain.
- Un dispositif de suivi par emails ou session de révision d'analyse et de modifications de pratique afin de mesurer les changements de pratique à la suite de la formation.

A ceci s'ajoute :

- La formation comprend des étapes magistrales et pratiques (réalisation des techniques).

Une évaluation de la formation en fin de formation par les participants ainsi qu'une évaluation par QCM des acquis en fin de formation

**Outils pédagogiques mobilisés :**

Un support de cours en français illustré détaillant la présentation power point sera fourni. Ce support de cours reprend les aspects théoriques, clinique et techniques du contenu de la formation. Le lieu de stage comprend un système de projection, d'un paper board, de tables d'examen, matériel et machines spécifiques de traitement. Un organisateur représentant l'organisme de formation sera présent tout au long de la formation pour assurer la partie logistique de la formation.

Un support de cours en français illustré détaillant la présentation power point sera fournie. Ce support de cours reprend les aspects théoriques, clinique et techniques du contenu de la formation. La formation comprend des travaux pratiques et des études de cas cliniques. Le lieu de stage comprend un système de projection, d'un paper board, de tables d'examen et d'outils de Blood Flow Restriction en Kinésithérapie

### **Bibliographie de la formation :**

- 1 Thomas AC, Wojtys EM, Brandon C, *et al.* Muscle atrophy contributes to quadriceps weakness after anterior cruciate ligament reconstruction. *J Sci Med Sport* 2016;19:7–11.
- 2 Petterson SC, Barrance P, Buchanan T, *et al.* Mechanisms underlying quadriceps weakness in knee osteoarthritis. *Med Sci Sports Exerc* 2008;40:422–7.
- 3 Palmieri-Smith RM, Thomas AC, Karvonen-Gutierrez C, *et al.* Isometric quadriceps strength in women with mild, moderate, and severe knee osteoarthritis. *Am J Phys Med Rehabil* 2010;89:541–8.
- 4 Papalia R, Zampogna B, Torre G, *et al.* Sarcopenia and its relationship with osteoarthritis: risk factor or direct consequence? *Musculoskelet Surg* 2014;98:9–14.
- 5 Vos T, Flaxman AD, Naghavi M, *et al.* Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2163–96.
- 6 Woolf AD, Pfleger B. Burden of major musculoskeletal conditions. *Bull World Health Organ* 2003;81:646–56.
- 7 Lang T, Streeper T, Cawthon P, *et al.* Sarcopenia: etiology, clinical consequences, intervention, and assessment. *Osteoporos Int* 2010;21:543–59.
- 8 Dinunno FA, Jones PP, Seals DR, *et al.* Limb blood flow and vascular conductance are reduced with age in healthy humans: relation to elevations in sympathetic nerve activity and declines in oxygen demand. *Circulation* 1999;100:164–70.
- 9 Blain H, Vuillemin A, Teissier A, *et al.* Influence of muscle strength and body weight and composition on regional bone mineral density in healthy women aged 60 years and over. *Gerontology* 2001;47:207–12.
- 10 Breen L, Phillips SM. Skeletal muscle protein metabolism in the elderly: interventions to counteract the 'anabolic resistance' of ageing. *Nutr Metab* 2011;8:68.
- 11 Segal NA, Torner JC, Felson D, *et al.* Effect of thigh strength on incident radiographic and symptomatic knee osteoarthritis in a longitudinal cohort. *Arthritis Rheum* 2009;61:1210–7.
- 12 Segal NA, Glass NA, Felson DT, *et al.* Effect of quadriceps strength and proprioception on risk for knee osteoarthritis. *Med Sci Sports Exerc* 2010;42:2081–8.
- 13 Amin S, Baker K, Niu J, *et al.* Quadriceps strength and the risk of cartilage loss and symptom progression in knee osteoarthritis. *Arthritis Rheum* 2009;60:189–98.
- 14 Narici MV, Reeves ND, Morse CI, *et al.* Muscular adaptations to resistance exercise in the elderly. *J Musculoskelet Neuronal Interact* 2004;4:161–4.
- 15 Garber CE, Blissmer B, Deschenes MR, *et al.* American College of Sports Medicine. American college of sports medicine position stand. quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Med Sci Sports Exerc* 2011;43:1334–59.
- 16 Ogasawara R, Loenneke JP, Thiebaud RS, *et al.* Low-load bench press training to fatigue results in muscle hypertrophy similar to high-load bench press training. *Int J Clin Med* 2013;04:114–21.
- 17 Schoenfeld BJ, Peterson MD, Ogborn D, *et al.* Effects of low- vs. high-load resistance training on muscle strength and hypertrophy in well-trained men. *J Strength Cond Res* 2015;29:2954–63.
- 18 Schoenfeld BJ, Wilson JM, Lowery RP, *et al.* Muscular adaptations in low- versus high-load resistance training: a meta-analysis. *Eur J Sport Sci* 2016;16:1–10.
- 19 Burgomaster KA, Moore DR, Schofield LM, *et al.* Resistance training with vascular occlusion: metabolic adaptations in human muscle. *Med Sci Sports Exerc* 2003;35:1203–8.

- 20 Takarada Y, Tsuruta T, Ishii N. Cooperative effects of exercise and occlusive stimuli on muscular function in low-intensity resistance exercise with moderate vascular occlusion. *Jpn J Physiol* 2004;54:585–92.
- 21 Abe T, Kawamoto K, Yasuda T, *et al.* Eight days KAATSU-resistance training improved sprint but not jump performance in collegiate male track and field athletes. *Int J KAATSU Train Res* 2005;1:19–23.
- 22 Loenneke JP, Kim D, Fahs CA, *et al.* Effects of exercise with and without different degrees of blood flow restriction on torque and muscle activation. *Muscle Nerve* 2015;51:713–21.
- 23 Takarada Y, Takazawa H, Sato Y, *et al.* Effects of resistance exercise combined with moderate vascular occlusion on muscular function in humans. *J Appl Physiol* 2000a;88:2097–106.
- 24 Loenneke JP, Wilson JM, Marín PJ, *et al.* Low intensity blood flow restriction training: a meta-analysis. *Eur J Appl Physiol* 2012a;112:1849–59.
- 25 Abe T, Fujita S, Nakajima T, *et al.* Effects of Low-intensity cycle training with restricted leg blood flow on thigh muscle volume and VO<sub>2</sub>max in young men. *J Sports Sci Med* 2010;9:452–8.
- 26 Ozaki H, Miyachi M, Nakajima T, *et al.* Effects of 10 weeks walk training with leg blood flow reduction on carotid arterial compliance and muscle size in the elderly adults. *Angiology* 2011;62:81–6.
- 27 Ozaki H, Sakamaki M, Yasuda T, *et al.* Increases in thigh muscle volume and strength by walk training with leg blood flow reduction in older participants. *J Gerontol* 2011b;66:275–263.
- 28 Pearson SJ, Hussain SR. A review on the mechanisms of blood-flow restriction resistance training-induced muscle hypertrophy. *Sports Med* 2015;45:187–200.
- 29 Takarada Y, Nakamura Y, Aruga S, *et al.* Rapid increase in plasma growth hormone after low-intensity resistance exercise with vascular occlusion. *J Appl Physiol* 2000b;88:61–5.
- 30 Reeves GV, Kraemer RR, Hollander DB, *et al.* Comparison of hormone responses following light resistance exercise with partial vascular occlusion and moderately difficult resistance exercise without occlusion. *J Appl Physiol* 2006;101:1616–22.
- 31 Loenneke JP, Fahs CA, Rossow LM, *et al.* The anabolic benefits of venous blood flow restriction training may be induced by muscle cell swelling. *Med Hypotheses* 2012b;78:151–4.
- 32 Kawada S, Ishii N. Skeletal muscle hypertrophy after chronic restriction of venous blood flow in rats. *Med Sci Sports Exerc* 2005;37:1144–50.
- 33 Pope ZK, Willardson JM, Schoenfeld BJ, *et al.* Exercise and blood flow restriction. *J Strength Cond Res* 2013;27:2914–26.
- 34 Fujita S, Abe T, Drummond MJ, *et al.* Blood flow restriction during low-intensity resistance exercise increases S6K1 phosphorylation and muscle protein synthesis. *J Appl Physiol* 2007;103:903–10.
- 35 Fry CS, Glynn EL, Drummond MJ, *et al.* Blood flow restriction exercise stimulates mTORC1 signaling and muscle protein synthesis in older men. *J Appl Physiol* 2010;108:1199–209.
- 36 Laurentino GC, Ugrinowitsch C, Roschel H, *et al.* Strength training with blood flow restriction diminishes myostatin gene expression. *Med Sci Sports Exerc* 2012;44:406–12.
- 37 Takarada Y, Sato Y, Ishii N. Effects of resistance exercise combined with vascular occlusion on muscle function in athletes. *Eur J Appl Physiol* 2002;86:308–14.
- 38 Yasuda T, Brechue WF, Fujita T, *et al.* Muscle activation during low-intensity muscle contractions with restricted blood flow. *J Sports Sci* 2009;27:479–89.
- 39 Yasuda T, Loenneke JP, Ogasawara R, *et al.* Influence of continuous or intermittent blood flow restriction on muscle activation during low-intensity multiple sets of resistance exercise. *Acta Physiol Hung* 2013;100:419–26.
- 40 Wernbom M, Augustsson J, Raastad T, *et al.* A low-load alternative to heavy resistance exercise? *Scand J Med Sci Sports* 2008;18:401–16.

- 41 Segal NA, Williams GN, Davis MC, *et al.* Efficacy of blood flow restricted, low-load resistance training in women with risk factors for symptomatic knee osteoarthritis. *PM&R* 2015;7:376–84.
- 42 Ohta H, Kurosawa H, Ikeda H, *et al.* Low-load resistance muscular training with moderate restriction of blood flow after anterior cruciate ligament reconstruction. *Acta Orthop Scand* 2003;74:62–8.
- 43 Loenneke JP, Fahs CA, Rossow LM, *et al.* Effects of cuff width on arterial occlusion: implications for blood flow restricted exercise. *Eur J Appl Physiol* 2012c;112:2903–12.
- 44 Scott BR, Loenneke JP, Slattery KM, *et al.* Exercise with blood flow restriction: an updated evidence-based approach for enhanced muscular development. *Sports Med* 2015;45:148–50.
- 45 Moher D, Shamseer L, Clarke M, *et al.* PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev* 2015;4:1–9.
- 46 Higgins JPT, Altman DG. Assessing risk of bias in included studies. In: Higgins JPT, Green S, eds. *Cochrane handbook for systematic reviews of interventions*. Version 5.0.1. Oxford: The Cochrane Collaboration, 2008:187–235.
- 47 Higgins JPT, Green S. *Cochrane handbook for systematic reviews of interventions*. Chichester: Wiley Blackwell, 2008.
- 48 Smart NA, Waldron M, Ismail H, *et al.* Validation of a new tool for the assessment of study quality and reporting in exercise training studies: TESTEX. *Int J Evid Based Healthc* 2015;13:9–18.
- 49 Segal N, Davis MD, Mikesky AE. Efficacy of blood flow-restricted low-load resistance training for quadriceps strengthening in men at risk of symptomatic knee osteoarthritis. *Geriatr Orthop Surg Rehabil* 2015b;6:160–7.
- 50 Bryk FF, Dos Reis AC, Fingerhut D, *et al.* Exercises with partial vascular occlusion in patients with knee osteoarthritis: a randomized clinical trial. *Knee Surg Sports Traumatol Arthrosc* 2016;24:1580–6.
- 51 Takarada Y, Takazawa H, Ishii N. Applications of vascular occlusion diminish disuse atrophy of knee extensor muscles. *Med Sci Sports Exerc* 2000c;32:2035–9.
- 52 Iversen E, Røstad V, Larmo A. Intermittent blood flow restriction does not reduce atrophy following anterior cruciate ligament reconstruction. *J Sport Health Sci* 2016;5:115–8.
- 53 Mattar MA, Gualano B, Perandini LA, *et al.* Safety and possible effects of low-intensity resistance training associated with partial blood flow restriction in polymyositis and dermatomyositis. *Arthritis Res Ther* 2014;16:473.
- 54 Yokokawa Y, Hongo M, Urayama H, *et al.* Effects of low-intensity resistance exercise with vascular occlusion on physical function in healthy elderly people. *Biosci Trends* 2008;2:117–23.
- 55 Karabulut M, Abe T, Sato Y, *et al.* The effects of low-intensity resistance training with vascular restriction on leg muscle strength in older men. *Eur J Appl Physiol* 2010;108:147–55.
- 56 Abe T, Sakamaki M, Fujita S, *et al.* Effects of low-intensity walk training with restricted leg blood flow on muscle strength and aerobic capacity in older adults. *J Geriatr Phys Ther* 2010;33:34–40.
- 57 Patterson SD, Ferguson RA. Enhancing strength and postocclusive calf blood flow in older people with training with blood-flow restriction. *J Aging Phys Act* 2011;19:201–13.
- 58 Iida H, Nakajima T, Kurano M, *et al.* Effects of walking with blood flow restriction on limb venous compliance in elderly subjects. *Clin Physiol Funct Imaging* 2011;31:472–6.
- 59 Karabulut M, Sherk VD, Bembem DA, *et al.* Inflammation marker, damage marker and anabolic hormone responses to resistance training with vascular restriction in older males. *Clin Physiol Funct Imaging* 2013;33:393–9.
- 60 Thiebaud RS, Loenneke JP, Fahs CA, *et al.* The effects of elastic band resistance training combined with blood flow restriction on strength, total bone-free lean body mass and muscle thickness in postmenopausal women. *Clin Physiol Funct Imaging* 2013;33:344–52.

- 61 Yasuda T, Fukumura K, Uchida Y, *et al.* Effects of low-load, elastic band resistance training combined with blood flow restriction on muscle size and arterial stiffness in older adults. *J Gerontol A Biol Sci Med Sci* 2015;70:950–8.
- 62 Vechin FC, Libardi CA, Conceição MS, *et al.* Comparisons between low-intensity resistance training with blood flow restriction and high-intensity resistance training on quadriceps muscle mass and strength in elderly. *J Strength Cond Res* 2015;29:1071–6.
- 63 Libardi CA, Chacon-Mikahil MP, Cavaglieri CR, *et al.* Effect of concurrent training with blood flow restriction in the elderly. *Int J Sports Med* 2015;36:395–9.
- 64 Shimizu R, Hotta K, Yamamoto S, *et al.* Low-intensity resistance training with blood flow restriction improves vascular endothelial function and peripheral blood circulation in healthy elderly people. *Eur J Appl Physiol* 2016;116:749–57.
- 65 Coe R, . It's the effect size, stupid. What effect size is and why is it important. . Exeter, UK:British Educational Research Association 2002; 12–14.
- 66 Karabulut M, Bembem DA, Sherk VD, *et al.* Effects of high-intensity resistance training and low-intensity resistance training with vascular restriction on bone markers in older men. *Eur J Appl Physiol* 2011;111:1659–67.
- 67 Waclawovsky G, Lehnen AM. Hemodynamics of aerobic and resistance blood flow restriction exercise in young and older adults. *Eur J Appl Physiol* 2016;116:859–60.
- 68 Fitzgibbons PG, Digiovanni C, Hares S, *et al.* Safe tourniquet use: a review of the evidence. *J Am Acad Orthop Surg* 2012;20:310–9.
- 69 Manini TM, Clark BC. Blood flow restricted exercise and skeletal muscle health. *Exerc Sport Sci Rev* 2009;37:78–85.
- 70 Pope ZK, Willardson JM, Schoenfeld BJ. Exercise and blood flow restriction. *J Strength Cond Res* 2013;27:2914–26.
- 71 Loenneke JP, Wilson JM, Wilson GJ, *et al.* Potential safety issues with blood flow restriction training. *Scand J Med Sci Sports* 2011;21:510–8.
- 72 Nakajima T, Kurano M, Iida H, *et al.* Use and safety of KAATSU training: results of a national survey. *Int J KAATSU Train Res* 2006;2:5–13.
- 73 Iversen E, Røstad V. Low-load ischemic exercise-induced rhabdomyolysis. *Clin J Sport Med* 2010;20:218–9.
- 74 Tabata S, Suzuki Y, Azuma K, *et al.* Rhabdomyolysis after performing blood flow restriction training: a case report. *J Strength Cond Res* 2016;30:2064–8.
- 75 Umbel JD, Hoffman RL, Dearth DJ, *et al.* Delayed-onset muscle soreness induced by low-load blood flow-restricted exercise. *Eur J Appl Physiol* 2009;107:687–95.
- 76 Allison RC, Bedsole DL. The other medical causes of rhabdomyolysis. *Am J Med Sci* 2003;326:79–88.
- 77 Heitkamp HC. Training with blood flow restriction. Mechanisms, gain in strength and safety. *J Sports Med Phys Fitness* 2015;55:446–56.
- 78 Jessee MB, Buckner SL, Mouser JG, *et al.* Letter to the editor: Applying the blood flow restriction pressure: the elephant in the room. *Am J Physiol Heart Circ Physiol* 2016;310:H132–3.
- 79 AORN Recommended Practices Committee. Recommended practices for the use of the pneumatic tourniquet in the perioperative practice setting. *AORN J* 2007;86:640–55.
- 80 McEwen JA, Inkpen K. Tourniquet safety: preventing skin injuries. *Surgical Technol* 2002;34:6–15.
- 81 Counts BR, Dankel SJ, Barnett BE, *et al.* Influence of relative blood flow restriction pressure on muscle activation and muscle adaptation. *Muscle Nerve* 2016;53:438–45.

- 82 Fujita T, Brechue WF, Kurita K, *et al.* Increased muscle volume and strength following six days of low-intensity resistance training with restricted muscle blood flow. *Int J KAATSU Train Res* 2008;4:1–8.
- 83 Loenneke JP, Abe T, Wilson JM, *et al.* Blood flow restriction: an evidence based progressive model (review). *Acta Physiol Hung* 2012d;99:235–50.
- 84 Kubota A, Sakuraba K, Sawaki K, *et al.* Prevention of disuse muscular weakness by restriction of blood flow. *Med Sci Sports Exerc* 2008;40:529–34.
- 85 Kubota A, Sakuraba K, Koh S, *et al.* Blood flow restriction by low compressive force prevents disuse muscular weakness. *J Sci Med Sport* 2011;14:95–9.
- 86 Van der Spuy L. Complications of the arterial tourniquet. *South Afr J Anaesth Analg* 2012;18:14–18.
- 87 Kalogeris T, Bao Y, Korthuis RJ. Mitochondrial reactive oxygen species: a double edged sword in ischemia/reperfusion vs preconditioning. *Redox Biol* 2014;2:702–14.
- 88 Loenneke JP, Balapur A, Thrower AD, *et al.* The perceptual responses to occluded exercise. *Int J Sports Med* 2011;32:181–4.
- 89 Staunton CA, May AK, Brandner CR, *et al.* Haemodynamics of aerobic and resistance blood flow restriction exercise in young and older adults. *Eur J Appl Physiol* 2015;115:2293–302.
- 90 Hollander DB, Reeves GV, Clavier JD, *et al.* Partial occlusion during resistance exercise alters effort sense and pain. *J Strength Cond Res* 2010;24:235–43.
- 91 Martín-Hernández J, Ruiz-Aguado J, Herrero JA, *et al.* Adaptation of perceptual responses to low load blood flow restriction training. *J Strength Cond Res* 2016:1.
- 92 Lejkowski PM, Pajaczkowski JA. Utilization of vascular restriction training in post- surgical knee rehabilitation: a case report and introduction to an under-reported training technique. *J Can Chiropr Assoc* 2011;55:280–7.