Kaatsu Training and its correlation with reduced risk of falling in the elderly population: Based on evidence.

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ABSTRACT

SAMPLE ABSTRACT:

Introduction. Vascular occlusion consists of training that involves decreasing blood flow to the muscles to be worked through the use of a blood pressure cuff or other device that restricts blood during exercise.To verify the influence of the use of Kaatsu Training in the relationship process with the reduction of the risk of falls in the elderly population. **Material and Method.** We reviewed periodic trials in Pubmed/Medline, Cochrane, Science Direct and PEDro databases published from 2017 to 2023.**Results:** The vascular occlusion method has been widely used, it acts by reducing blood flow in the muscle, thus restricting the return, especially the quadriceps is weak, strengthening it results in a decrease in the incidence and progression of the disease. Presenting beneficial effects, such as reduction of pain and discomfort, reduction of overload and joint stress, hypertrophy and functional capacity. **Conclusion:** Training with partial vascular occlusion may be a good alternative for gaining strength in the knee extensor musculature in elderly people who, due to pain, have low tolerance for high-load exercises for muscle strengthening.

Keywords: Occlusion, Elderly, Functional Capacity, Health, Training.

1. INTRODUCTION

Vascular occlusion consists of a training that involves decreasing the flow of blood to the muscles to be worked, through the use of a blood pressure cuff or other device that restricts blood during exercise. In this context, the Kaatsu training method emerged, which consists of resistance training with low intensity combined with partial vascular occlusion, aiming to reduce venous return causing the accumulation of blood in the blood vessels to induce muscle hypertrophy [1].

Severe falls in the elderly have received special attention in terms of epidemiological research and clinical practice, either because of their repercussions for individual and collective health or because of the challenges in proposing prevention and rehabilitation strategies. The demand for health services related to falls is a sign of severity, but there are few populationbased studies on this event [2].

Blood flow restriction training, also known as Kaatsu training, involves placing a pressure band on the proximal end of an end to limit blood flow from the distal muscle, resulting in increased muscle volume and strength. It has been shown that only 20 to 30% of 1 repetition maximal resistance training (1MR) can produce the same level of benefits as high-load training, so it is more suitable for rehabilitation treatment groups or older adult groups [3].

With vascular occlusion occurs a temporary hypoxia in the muscle, in addition to the production of metabolites such as lactate and H+ ions. These physiological changes generate a signal to the central nervous system, and as a consequence, in recovery occurs greater release of anabolic hormones. In addition, the reduced blood supply resulting from occlusion triggers an early fatigue of type I fibers, which causes a greater recruitment of fast-twitch fibers (type II) that have a greater hypertrophic response [4].

The increase in endurance and gain of muscle mass has a direct connection with muscle fatigue, the explanation for this occurrence is that compression in the shortened muscle generates tension on the capillaries, creating a restriction of blood flow, decreasing the rate of removal of metabolites. The specific mechanisms behind metabolic stress to cause hypertrophy are unclear, however, several studies have demonstrated significant increases in strength and hypertrophy of metabolic and blood training when evaluating vascular occlusion training compared to traditional high intensity training [1].

It is believed that vascular occlusion causes metabolic accumulation to occur, which consequently has an increase in growth factors and thus increases resistance, phosphorylation and muscle protein synthesis, in addition to promoting increased strength, as much as conventional resistance exercise with high loads. The load used is an important variable and the intensity of resistance training is quantified by the maximum weight that can be lifted in a single time, that is, 1 MR. Low-load exercises, 20 to 50 percent of 1 MR associated with partial vascular occlusion in healthy people had similar results compared to traditional high-load exercises, but with less anterior knee discomfort [5].

The skeletal muscle is highly plastic and can adapt to the demands imposed, when subjected to exercises with progression of resistance, large increases in muscle strength are noted, in relation to size are observed after a constancy of several weeks. When sufficient mechanical overload is induced, anabolic processes prevail over catabolic processes, which promote an increase in muscle protein synthesis and corresponding enlargement of muscle fibers. The size and contractility of muscle fibers are determined by the amount of myofilament proteins (myosin and actin) and any change in their quantity or contractility modifies the basic functionality of the muscle [5].

It is known that the term occlusion refers to the obstruction, closure or momentary purposeful blockage of a natural opening or passage of the organism. Thus, it can be understood that the Kaatsu method works with the restriction of venous return and decrease in arterial flow. As well as training with vascular occlusion, the increase in endurance and the gain of muscle mass to a direct link with the fatigue of the musculature and the accumulation of metabolites inside it [6].

The application of vascular occlusion with low resistance training increases plasma concentrations of growth hormone and also noradinepinephrine during exercise. The metabolic response generated by resistance exercise results in the hormonal anabolic release in a considerable way in the substrates of growth hormone and growth hormone through insulin can be local and systemic, all of these, induce the pathways of muscle hypertrophy [8].

During resistance exercise, α-motor neurons activate muscle fibers to generate force, dictating neural recruitment of muscles, tissue starts with the smallest motor units and progresses to larger motor units. Training with occlusion has been shown to be an effective alternative to promote these changes, where there are standardized protocols [8,9].

Despite the benefits of the method, when pressure is applied improperly, it can cause harm to the individual. When there is hemostasis or interruption of blood flow in the veins and

arteries along with ischemia, it can cause nerve damage, muscle damage, vein injuries, changes in clotting factors and capillary permeability [7].

It is necessary to pay attention not only to the positive results, which are considerably more significant according to the studies reviewed, but also to all the limitations presented by scholars opposed to the practice of the method, care and restrictions in the use of vascular occlusion as a training protocol. Because the physiological mechanisms that explain the efficiency of this type of training are not yet fully understood, but they seem to be dependent on metabolic and hormonal changes, production of free radicals, among others [7].

In this sense, the present study had the relevance of identifying in the scientific literature the considerations about the technique of partial vascular occlusion when submitted to the elderly population at risk of falling.

2. MATERIAL AND METHODS

This is bibliographic research carried out from the survey of articles in the online database of Google Scholar, Scientific Electronic Library Online (SciELO), Scopus bibliographic database, Virtual Health Library (VHL), Latin American and Caribbean Literature in Health Sciences (LILACS).

As inclusion criteria, free articles were used, published between 2017 and 2023, all published in indexed journals, in Portuguese and English; studies classified as experimentais and systematic research. As exclusion criteria were articles published in previous years, studies that did not fit the theme addressed and with paid access.

The data collection period was from April to May 2023. After selecting the material and reading the data, they were analyzed and discussed in order to offer a greater notion about Kaatsu Training and its correlation with the reduction of the risk of falls in the elderly population and its respective relevance.

Because it is not a study with human beings, the present study did not need to be submitted to the ethics and research committee, according to resolution 466/12.

3. RESULTS AND DISCUSSIONS

In the present study, 30 articles were found, of which 5 were selected for the study, according to the inclusion criteria determined. The following information was extracted from the articles: authors, year of publication, type of study, methodology and outcomes. The characteristics of the samples, used and the results of the studies are presented in Table 1.

Table 1. List of published articles and results obtained.

AUTHOR	YEAR	DESIGN OF THE STUDY	METHODOLOGY	DENOUEMENT

Teixeira[10]	2018	Literature Review	Perform a literature review topresentthe vascular occlusion, explainingthemainphysiologicalreactionsthatoccurduring training, establishing its modeofapplication, necessaryinstrumentsandalsobringopinionsofprofessionals in theareaonthesubject.	Throughthearticlesandmaterialsstudied, it wasevidentthattheapplicationofstrength training associatedwith vascular occlusionisverypromising. Reactionssuch as inductionofgrowthhormonesecretion, improvementofaerobicandanaerobic performance in athletes, reductionofbloodpressurewereobserved in thestudiesfoundand are just some ofthosethat make thismethodsopromising.
Lasevicius et al[11]	2018	DescriptiveSearches	The researchisof a descriptive, comparativeandalmost experimental methodological design, with a quantitativeandcross-sectional approach. Descriptiveresearchhas os its mainpurposethedescriptionofthecharacteristicsof a givenpopulationorphenomenon, orthe establishment ofrelationshipsbetweenvariablesandthequantitative approach ischaracterizedbythe use ofquantification, both in themodalitiesofinformationcollectionand in thetreatmentofthemthroughstatisticaltechniques.	The presentstudyconcludesthatthe total volume of training influencesmusclestrength in experiencedbodybuilders. Individualstrained in strength training withthehighestsignificant total training volume have a greaterincrease in significantmusclestrength for upperandlowerlimbs.
Maul et al[12]	2020	Literature Review	The studywasconductedthrough a literature review usingtheScielo, Virtual Health Library andPubMeddatabases in October 2020. The termsusedwere "OsteoarthritisoftheKnee", "Restrictionofbloodflow" and "Partial vascular occlusion".	Studieshaveshownthatexerciseswithbloodflowrestrictioncanbeindicated in thetreatmentofkneeosteoarthritis in placeof high-loadexercises, presenting beneficial effectssuch as reductionofpainanddiscomfort, reductionofoverloadand joint stress, hypertrophy, improvementofstrengthandfunctionalcapacity.

Lima et al[13]	2018	Randomized Clinical Trial	The studywasconducted in thehuman performance laboratoryof a privatecollege in themunicipalityof Vitória da Conquista, in the Southwest regionof Bahia, targetingindividualsaged between 18 and 40 years, excludingtheinterference ofaging in the gradual lossofmusclemassandstr ength, the sample wascomposedof male individuals.	It canbeconcludedthattheRestrictedEf fectofbloodflowis more effectivethan High IntensityResistance Training, gains in musclestrengthandhypertrophy. It isrecommendedto use theRestrictedEffectofbloodflow in clinicalpractice, as anadditionalpossibility for potentiation in strengthgainsandincreasedperimetr y.
Tameirão[14]	2020	Literary Review	Thisis a review in theelectronicdatabases: PEDro, Pubmedand Cochrane Library. The Search strategyinvolvedarticles in PortugueseandEnglish. Use As aninclusioncriterion, studiespublishedbetwee n 2009 and 2019 thatreportedthemusclest rengtheningassociatedw ithpartial vascular occlusion, usingloadslower (30%1-MR), comparedtotraditionalre sistancestrengthening, loads of 70%1-MR.	Wecanconcludefromthis review thatlowintensitymuscle training associatedwithpartial vascular occlusionisaneffectivestrategytopro videincreases in strengthandmusclehypertrophy similar totraditionalresistance training. In addition, it is a viablestrategy for musculoskeletalrehabilitation, since it canbeapplied in variousclinicalscenarios, wheretraditionalresistance training is a limitation.

Camargos, et al[15]	2017	Systematized Review	Fromeacharticle, informationregardingthe objectives, methodology, sample andconclusionwasselected. Then, for the final presentationoftheresults, thearticlesweredividedaccordingtotheirobjectives, throughthetechniqueofcontentanalysis, beingcategorized as: perceptionofeffort, discomfortand/orpain; hemodynamicvariations; indirectmarkersofmuscle damage; hypertrophyandmusclestrength; and hormonal changes	Vascular occlusionhasbeendemonstrated as animportanttechniquetopromotethe developmentofmusclemassandstrength. There are fewpublicationsonthemainrisks, safe parameterstoworkwithandspecificclinicalpopulations. In addition, it isnoticed, regardingtheapplicationtechnique, thatthereis no consensus onthepressureintensityused, thecorrectworkloadandthenumberofsets andrepetitions.
Barros et al[16]	2020	Field Research	The populationconsistedofelderlyindividualsagedbetween 60 and 69 years, female. The researchpresents a quantitative approach withexploratory, analyticalanddescriptive objective, the experimental procedural techniquewasusedthroughfieldresearchwith experimental group, with data collectionatdifferent times throughout a resistance training session.	Weconcludethatthe use ofResistance Training with Vascular Occlusion in theevaluatedgrouppresentedsatisfactory responses, beingabletoworkwith a loadlowerthanthetraditionalmethod, whichmaybe beneficial in some situations, especially for thegroupofhypertensiveelderly.

*****1 RM: 1 Maximum repetition.

According to Teixeira [10] the method of vascular occlusion has been widely used, acts by reducing blood flow in the muscle and thus restricting venous return, this method has been shown to be effective in populations ranging from athletes, healthy

adults to older adults, to increase muscle hypertrophy, with gains similar to traditional resistance exercises, but with less intensity, generating less discomfort, being a great ally in the initial part of musculoskeletal rehabilitation.

Lasevicius et al [11] says that individuals with osteoarthrosis of the knee, where mainly the quadriceps is weak and the strengthening of it results in a decrease in incidence and progression of the disease, this is just one example among so many others, because physiotherapy is based on kinesiotherapy, making it the main tool in all types of treatments, regardless of the injury to be treated.

According to Maul et al [12] showed that exercises with blood flow restriction can be indicated in the treatment of knee osteoarthritis instead of high-load exercises, presenting beneficial effects, such as reduction of pain and discomfort, reduction of overload and joint stress, hypertrophy, improvement of strength and functional capacity. And when performed correctly it has been shown to be a safe alternative compared to exercises without restriction, making it necessary further studies to verify the appropriate intervention period for these patients.

Traditional rehabilitation efforts typically result in an incomplete return to the function the individual wishes to perform. With this, the use of rehabilitation together with vascular occlusion will allow a recovery in less time, increased muscle strength and improved functionality, considering that tissues require time for proper healing before loads are safely imposed. The traditional practice of rehabilitation focuses on early mobilization, progressive increase in strength, improvement of range of motion during exercises, and no application or strict regulation of deleterious mechanical stress on tissue that is still in the process of healing [13].

In this context, loads below this recommendation are not able to develop muscle strength and hypertrophy. However, resistance training performed at high intensity is often contraindicated for some clinical populations (e.g., acute injury, postoperative period, some chronic diseases, etc.). Such patients may be unable to withstand the high mechanical stress during muscle strengthening exercises, without generating overload and joint pain [14].

However, this trend has been conquering many appreciators around the world, for presenting little harm, efficient for the development of physical capacities, and for fulfilling, like no other physical activity, the role of body modeling. This practice is a great strategy when it comes to improving the quality of life, given that any individual can practice it and enjoy its benefits, as long as the training program is appropriate and consistent with the goal and need of the practitioner. At the same time that the method with occlusion is referred to as capable of providing muscle hypertrophy, studies demonstrate that, in this training, there is a greater risk for the development of venous thromboses, congestive heart failure and hematological diseases [15].

There is still no consensus on the pressure applied to the cuff, because there are differences in each equipment used, such as the different cuff widths, so they suggest that the pressure is between 40 and 80% of the arterial occlusion pressure, however a literature review showed that the most used pressures vary between 110 and 160 mmHg. Not forgetting that this training should be done with the

accompaniment of a health professional trained to monitor the exercises, so that there are no problems arising from the use of vascular occlusion [16].

4. CONCLUSION

Training with partial vascular occlusion can be a good alternative for the strength gain of the knee extensor muscles in the elderly, due to pain, have low tolerance to exercises with high load for muscle strengthening. This is because the technique makes it possible to obtain strength gain with low loads in association with the Kaatsu Training method.

With joint limitations and muscle weakening in the elderly, there are limitations and high rates of fall in this part of the population. The present study focused on verifying the influence of vascular occlusion training on reducing the risk of falls in the elderly. Several factors were found during the review that led to a higher risk and among them, significantly, muscle weakness.

With Kaatsu Training it is possible to increase lean mass and stimulate hypertrophy, helping to increase muscle strength and consequently balance. The relationship between training with vascular occlusion and the decrease in the risk of falls has a great positive influence and can improve quality of life.

Considering the positive effect of the present training, it is suggested that further research be carried out in order to deepen the training specifically in the elderly who are part of the groups with the highest incidence of falls and fear of falling.

REFERENCES

1. Moraes FS, Sartor IJ. The Effect of Resistance Training Using Vascular Occlusion in Knee Rehabilitation. Ano 2019.

2. Hughes L, Paton B, Rosenblatt B, Gissane C, Patterson SD. Blood flow restriction training in clinical musculoskeletal rehabilitation: a systematic review and meta-analysis. Br J Sports Med. 2017;51(13):1003-11. doi: 10.1136/bjsports-2016-097071

3. Viana VM, Luciano TF, Farias JM. Training with Vascular OcclusionPromotesPhysiologicalandPerceivedExertionChanges Similar toConventionalStrength Training. BrazilianJournalofPrescriptionandExercisePhysiology RBP F E X.

4. Clarkson, Matthew J., May, Anthony K, Warmington, Stuart A. Isthererationale for thecuffpressuresprescribed for bloodflowrestrictionexercise? A systematic review. ScandinavianJournalOf Medicine & Science In Sports, [S.L.], v. 30, n. 8, p. 1318-1336, 27 abr. 2020. Wiley. http://dx.doi.org/10.1111/sms.13676.

5. Costa GPN, Moreira VP, Reis AC, Leite SN, Lodovichi SS. EffectsofPartial Vascular OcclusiononMuscleStrengthGain. Physiotherapist, University Center oftheEducational Foundation of Guaxupé - (UNIFEG). Physiotherapist, Master'sDegree in RehabilitationSciencesfrom Universidade Nove de Julho - (UNINOVE). Ano 2017 – Brasil.

6. Farias GS, Azevedo MVGT. Effectof Vascular Occlusion for StrengthGainandQuadricepsMuscleHypertrophy: Systematic Review. UNILUS –

UndergraduateCourse in PhysicalTherapy – graduatingfromthe 5th year – Santos, SP Year 2020 – Brasil.

7. Patterson SD, Hughes L, Warmington S, ET AL. Blood Flow RestrictionExercise: ConsiderationsofMethodology, Application, andSafety. Front Physiol. 2019. doi:10.3389/fphys.2019.00533

8. Guimarães BM, Alves RR, Lopes LCC. Applicabilityof vascular occlusion training toincreasehypertrophyandmusclestrength: a review study. InternationalJournalof Movement Science andRehabilitation, v. 2, n. 1, p. 4-15, 2020.

9. Lixandrão ME, Ugrinowitsch C, Berton R, ET AL. Magnitude ofMuscleStrengthand Mass AdaptationsBetween High-LoadResistance Training Versus Low-LoadResistance Training Associated withBlood-Flow Restriction: A Systematic Review and Meta-Analysis. Sports Med. 2018. doi:10.1007/s40279-017-0795-Y.

10. Teixeira, CLS. Strength Training with Vascular Occlusion. São Paulo: Editora Lura, p.1-88, 2018.

11. Lasevicius T, Ugrinowitsch C, Schoenfeld BJ, Roschel H, Tavares LD, De Souza EO, Laurentino G, Tricoli V. Effectsofdifferentintensitiesofresistance training withequated volume loadonmusclestrengthandhypertrophy. Eur J Sport Sci. 2018 Jul;18(6):772-780. doi: 10.1080/17461391.2018.1450898. Epub 2018 Mar 22. PMID: 2956497.

12. Maul, SEV, et al. EffectsofExercisewithBlood Flow Restriction in IndividualswithKneeOsteoarthritis. In: Proceedingsofthe II Congress ofOrthopedicsand Manual Therapyand III Sergipe SymposiumonOrthopedicPhysicalTherapyand Manual: Physiotherapeuticcare in chronicpain. Annals... Lizard (SE) Online, 2020. Available in: <https//www.even3.com.br/anais/2cotema/303570.

13. Lima IS, et al. EffectofBlood Flow Restriction Training Versus High-IntensityResistance Training ontheStrengthofSedentaryIndividuals: A RandomizedControlled Clinical Trial. R. bras. Ci. e Mov 2020;28(2):157-162.

14. Tameirão LC. MuscleStrengthening Associated withPartial Vascular Occlusionand Its Applicability in MusculoskeletalRehabilitation – 2020. Journalof Health oftheValleys. ISSN: 2674-8584 V.1 - N.2 – 2020.

15. Camargos, Gustavo Leite, et al. "Physical training with vascular occlusion: a systematized review." ScientificJournal UNIFAGOC-Health 1.2 (2017): 59-68.

16. Barros, DLM de, Ribeiro, TE, Santana, MHDS, & Santana, F. (2020). Resistance training with vascular occlusionandadaptive responses in controlledhypertensiveelderly / Resistance training with vascular occlusionandadaptive responses in controlledhypertensiveelderly. BrazilianJournalofDevelopment, 6 (7), 49431–49440. https://doi.org/10.34117/bjdv6n7-550.