Original Research Article **Physiotherapy**

International Journal of Pharma and Bio Sciences

ISSN 0975-6299

CONCENTRIC VERSUS ECCENTRIC STRENGTH TRAINING IN ELBOW FLEXOR STRENGTHENING

T. James Panicker[1] J.Muthukumaran[2*]

[1] *T. James Panicker MPT I Year, Saveetha College of Physiotherapy, Saveetha University, Chennai India. E-mail ID: violetsred@gmail.com*
[2*] *J.Muthukumaran, Assistant Professor, Saveetha College of Physiotherapy, Saveetha University, Chennai India. E-mail ID: muthukumaran003@gmail.com*

ABSTRACT

Elbow Flexors weakness a relatively uncommon clinical diagnosis made by physical therapists. As a result, there is little evidence guiding clinical decisions regarding best practice or effective treatment options to restore individuals to their previous level of function. The Purpose of this study is to compare concentric and eccentric training and to determine which training is the best for Elbow Flexors strengthening and to include the same as the primary intervention in the rehabilitation of a patient with Elbow Flexors weakness. The Methodology examined ways to improve the strength of the elbow flexors by comparing between concentric and eccentric strength training. The population consisted of individuals of age group between 20 to 35 years. The subjects were allocated in two Groups, where one group received Eccentric training and the other group received Concentric training. The strength was measured using a standardized 1 RM protocol. The datas were statistically analyzed using descriptive and inferential statistics; mean and standard deviation were estimated using paired and independent t-tests. Paired t-test was used to compare data sets within the groups. Independent t-test was used to compare the data sets between the groups. Result from the statistical analysis made with Quantitative data, revealed statistically significant difference between the Groups – A & Group – B, also within the Group. From the results obtained it can be concluded that Eccentric Training is more effective in strengthening the Elbow Flexor than Concentric training.

KEYWORDS: **Strength training, concentric training, eccentric training, compare concentric and eccentric training**

*** J.Muthukumaran**
Assistant Professor, Saveetha College of Physiotherapy, Saveetha University, Chennai India. E-mail ID: muthukumaran003@gmail.com

Received on : 17-10-2016
Revised and Accepted on : 28-12-2016
DOI: http://dx.doi.org/10.22376/ijpbs.2017.8.1.b470-475

INTRODUCTION

Strength training is a type of physical exercise specializing in the use of resistance to induce muscular contraction which builds the strength, anaerobic endurance, and size of skeletal muscle. [1]The basic principles of strength training involve a manipulation of the number of repetitions (reps), sets, tempo, exercises and force to cause desired changes in strength, endurance or size by overloading of a group of muscles [2].In one common method, weight training uses the principle of progressive overload, in which the muscles are overloaded by attempting to lift at least as much weight as they are capable. They respond by growing larger and stronger. This procedure is repeated with progressively heavier weights as the practitioner gains strength and endurance [3].However, performing exercises at the absolute limit of one's strength (known as one rep max lifts) is considered too risky for all but the most experienced practitioners.. One repetition sets are not well suited to these aims. Practitioners therefore lift lighter (sub-maximal) weights, with more repetitions, to fatigue the muscle and all fibers within that muscle as required by the progressive overload principle.[4]When properly performed, strength training can provide significant functional benefits and improvement in overall health and well-being, including increased bone, muscle, tendon and ligament strength and toughness, improved joint function, reduced potential for injury, increased bone density, increased metabolism, improved cardiac function, and elevated HDL cholesterol [5]. Training commonly uses the technique of progressively increasing the force output of the muscle through incremental weight increases and uses a variety of exercises and types of equipment to target specific muscle groups [6]. Strength training is primarily an anaerobic activity, although some proponents have adapted it to provide the benefits of aerobic exercise through circuit training [7].Concentric Training is a type of Assuming mean level (SD) of the level of strength by the first training programme is 26.93 (3.19) and the mean level of strength by the second training programme is 22.67 (2.46) the sample size is estimated to be 10 persons each in the two group in order to obtain a significant difference for a 5% significant level.

Inclusion Criteria

1. Both genders aged between 20-35 years.
2. Participants with Training Age above one year.
3. Participants who were willing to give-up their current training for this study

Exclusion Criteria

1.Any concurrent condition which would be contraindicated to strength training such as high blood pressure.
2. Recent injuries to upper extremity.
3. Neurological symptoms in the upper limb.

Procedure

20 subjects were selected based on inclusion and exclusion criteria. Detailed procedure was explained in muscle contraction in which the muscles shorten while generating force. This occurs when the force generated by the muscle exceeds the load opposing its contraction [8].During a concentric contraction, a muscle is stimulated to contract according to the sliding filament mechanism. This occurs throughout the length of the muscle, generating force at the musculo-tendon junction, causing the muscle to shorten and changing the angle of the joint [9]. In relation to the elbow, a concentric contraction of the biceps would cause the arm to bend at the elbow (a biceps curl)[10].Eccentric Training is the lowering phase of an exercise [11]. For example, in a biceps curl the action of lowering the dumbbell back down from the lift is the eccentric phase of that exercise — as long as the dumbbell is lowered slowly rather than letting it drop.There are three distinct phases in the movement of muscles and tendons: isometric (no movement), concentric (contracting) and eccentric (Extracting). All three of these stages in muscles movements have an effect on muscle tissues and tendons (tendons are what attach the muscle to the bone) [12]. Eccentric training focuses on slowing down the elongation of the muscle process in order to challenge the muscles, which can lead to stronger muscles, faster muscle repair and increasing metabolic rate. Eccentric movement provides a braking mechanism for muscle and tendon groups that are experiencing concentric movement to protect joints from damage as the contraction is released[13].

METHOD

Study Design : Comparative study.
Study Setting : The Lord's Gym
Mathiazhagan Nagar,
Mannurpet,Chennai - 600050.
Sampling Technique : Randomization method.
Sample Size : 20.

Subject's language and from those who are interested; informed consent was obtained from all the participants. Pretest 1 Repetition Maximum (RM) weight values were determined for all subjects using a standardized 1 RM protocol. A warm-up of 10 sub maximal repetitions was performed, followed by a 3-minute rest period.Subjects in the training groups were trained for 3 days per week for 6 weeks (18 sessions). After 6 weeks of training, all subjects were subjected for 1RM.

One Repetition Maximum Calculation

Each subject's 1RM were determined by having them perform sequential one repetition bilateral arm curls with increasing resistance using the CYBEX ARM CURL MACHINE. Two minutes of rest was allowed before a new weight was introduced. The weights were increased until the subject is unable to lift the heavier load.maximum four trails were allowed and the final weight was considered as 1RM and used to determine the initial training intensity. Subjects were divided into Group A and Group B by random allocation method. GROUP A underwent ECCENTRIC TRAINING whereas GROUP B underwent CONCENTRIC TRAINING.

Resistance Training

Both the groups were trained using MODIFIED CYBEX ARM CURL MACHINE. Subjects were required to perform Biceps Curls. For Group A, resistance was applied only during the Eccentric Phase in which the load during the concentric phase is released manually. For Group B, resistance was applied during the Concentric Phase only in which the load during the eccentric phase is released manually. Subjects in both the group were trained with 60% of their 1RM. Once the subject is able to perform 100% of all the required repetitions at the lower weight, the resistance was again increased.

Outcome Measures

Each subject's1RM were determined by having them perform sequential one repetition bilateral arm curls with increasing resistance using the Modified Cybex Arm Curl Machine. 1RM was measured using 2.5% rule, here the participants was asked to do Arm curl with 50% of projected 1RM as many as they can and product of the given repetition and 2.5 were considered as weight to be added for next consequent trails till the 1RM was achieved.

Statistical Analysis

The data's were statistically analyzed using descriptive and inferential statistics; mean and standard deviation were estimated using paired and independent t-tests. Paired t-test is used to compare data sets within the groups. Independent t-test is used to compare the data sets between the groups.

RESULTS

From the statistical analysis made with Quantitative data, revealed statistically significant difference between the Groups – A & Group – B.

Figure 1
The Cybex Arm Curl Machine

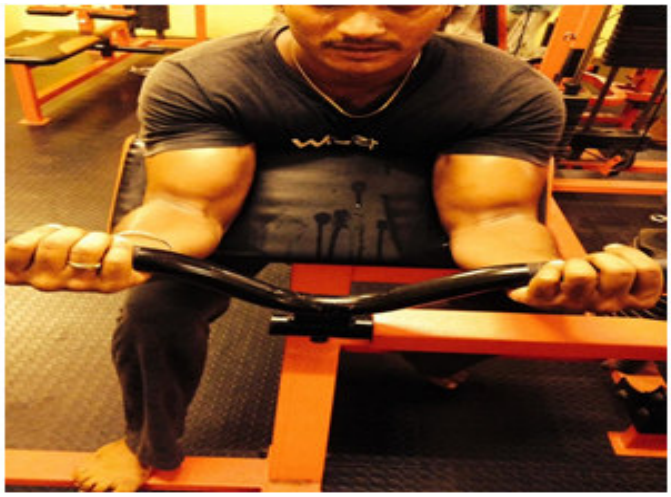

Figure 2
Subject Performing Eccentric Training

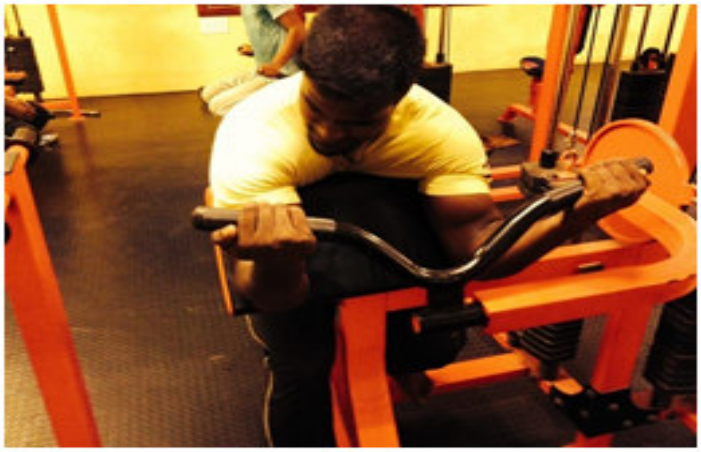

Figure 3
Subject Performing Concentric Training

Table 1
Comparison of Pre-Training & Post-Training Values of Group A

Group A	Mean	Standard Deviation	T-Value	P-Value
Pre-test eccentric	14.60	2.99		
Post-test eccentric	24.89	4.14	6.7082	0.0002

Table2
Comparison of Pre-Training & Post- Training Values of Group B

Group B	Mean	Standard Deviation	T-Value	P-Value
Pre-test **concentric**	14.20	2.39		
Post-test **concentric**	24.22	2.73	18.7617	0.0001

Table3
Comparison of Post-Training Values Between Group A & Group B

Groups	Mean	Standard Deviation	T-Value	P-Value
Group A	12.00	2.49		
Group B	9.78	1.56	2.2942	0.0348

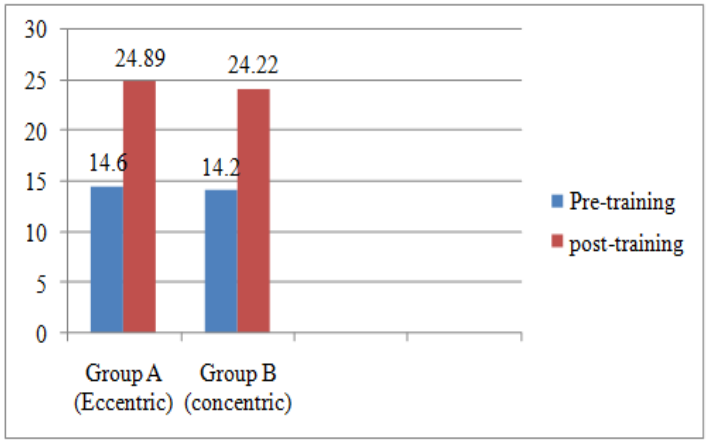

Figure 1
Comparison of Pre-Training And Post-TrainingValues Within The Groups A & B

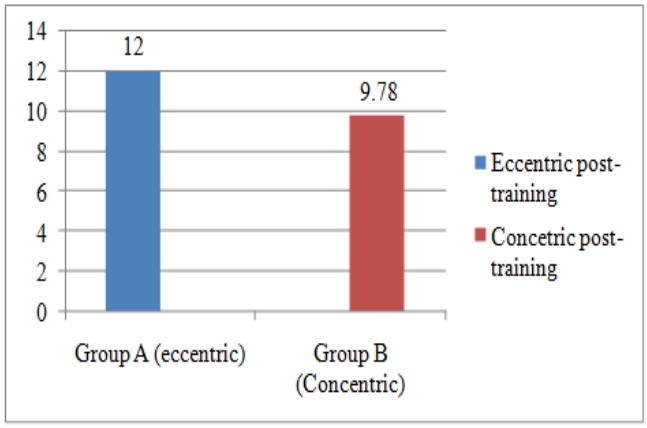

Figure 2
Comparison of Post-Training Values Between Group A & Group B

DISCUSSION

The data comparative study suggest that Eccentric resistance training exercises may be superior to Concentric resistance training exercise in strengthening the Elbow flexor muscles. Thomas W 1998 proposed that Eccentric training focuses on slowing down the elongation of the muscle process in order to challenge the muscles, which will lead to stronger muscles, faster muscle repair and increasing metabolic rate. Bubbico 2010 proposed that in controlled release reversals of such concentric motions, the eccentric movement stretches the muscle with opposing force that is stronger than the muscle force. With more cross bridges remaining attached there is greater strength development in the muscle. LaStayo 2010 stated in his study that a significant increase of 6% in muscle mass was found with eccentric training. They carried out an eccentric training program of 11 weeks with elderly subjects. Given the results they found, they concluded that neither damage, nor inflammation, appeared to be prerequisites to induce anabolic responses resulting in muscle growth in elderly individuals.In this study both the Eccentric Group as well as the Concentric Group received training for 3 days per week for 6 weeks (18 sessions).The results of this study add support to the hypothesized effects of Eccentric Training. In this study, the post-training Mean for Eccentric training group One RM was 12.00 whereas the post-training Mean for Concentric training group One RM was 9.78. It should be noted that the statistical analysis showed high significant result in Eccentric trained Group than in concentric trained group. From the obtained results of this study Concentric Versus Eccentric Strength Training in Elbow Flexor Strengthening, it can be concluded that Eccentric Training is more effective in strengthening the Elbow Flexor than Concentric training.

CONCLUSION

From the obtained results of this study Concentric Versus Eccentric Strength Training in Elbow Flexor Strengthening, it can be concluded that Eccentric Training is more effective in strengthening the Elbow Flexor than Concentric training

FUTURE RECOMMENDATION

This study can be bone longer duration and both concentric and eccentric exercise protocols can compare with complex training movements or exercises.

ACKNOWLEDGEMENT

Firstly I thank my Lord almighty and my Mother for helping me and guiding me from the beginning till the end of this study. I would also like to thank Mr. Ashok, proprietor of 'The Lords gym' who helped me by providing the equipments needed. I am using this opportunity to express my gratitude to everyone who supported me throughout the course of this project. I am thankful for their aspiring guidance, invaluably constructive criticism and friendly advice during the project work. I am sincerely grateful to them for sharing their truthful and illuminating views on a number of issues related to the project.

CONFLICT OF INTEREST

Conflict of interest declared none.

REFERENCES

1. Higbie EJ, et al, Effects of concentric and eccentric training on muscle strength, cross-sectional area, and neural activation 1996 Nov; 81. PMID:8941543
2. Kilka, et al, High-Intensity Circuit Training Using Body Weight: Maximum Results with Minimal Investment. ACSM'S Health & Fitness Journal 2013 may.
3. McArdle WD , et al. Exercise physiology energy, nutrition and performance. 5th ed. Philadelphia, PA: Lippincott Williams &Wilkin 2001.
4. Feigenbaum, M.S.; Pollock, M.L. "Strength

Training. Rationale for Current Guidelines for Adult Fitness Programs". *Physician and Sports medicine* 1997 ISSN 0091-3847
5. Rhea MR, Phillips WT, Burkett LN, *et al.* "A comparison of linear and daily undulating periodized programs with equated volume and intensity for local muscular endurance 2003.
6. JayaseelanDJ , et al. Eccentric training for the rehabilitation of a high level wrestler with distal biceps weakness: a case report 2007 PMCID: PMC3414073.
7. Kisner C, Colby LA. Kisner. Therapeutic exercise: Foundations and techniques. 5th ed.
8. M. Roig, K et al, The effects of eccentric versus concentric resistance training on muscle strength and mass in healthy adults: a systematic review with meta-analysis 2008.
9. Thomas W. et al, ATC Concentric Versus Enhanced Eccentric Hamstring Strength Training: Clinical Implications 1998.
10. Brooks, G.A.; Fahey, T.D. & White, T.P. Exercise Physiology: Human Bioenergetics and Its Applications. Mayfield Publishing Co 1996. ISBN 0-07-255642-0
11. Burkett LN. Causative factors in hamstring strains. Med Sci Sports. 1970 spring; 2(1):39–42.
12. Yamamoto T. Relationship between hamstring strains and leg muscle strength. A follow-up study of collegiate track and field athletes. J Sports Med Phys Fitness. 1993 Jun;33(2):194–199
13. Jonhagen S, Németh G, Eriksson E. Hamstring injuries in sprinters. The role of concentric and eccentric hamstring muscle strength and flexibility. Am J Sports Med. 1994 Mar-Apr; 22(2):262–266.
14. Zarins B, Ciullo JV. ACute muscle and tendon injuries in athletes. Clin Sports Med. 1983 Mar; 2(1):167–182.
15. Gibala MJ, MacDougall JD, Tarnopolsky MA, Stauber WT, Elorriaga A. Changes in human skeletal muscle ultra structure and force production after acute resistance exercise. J Appl Physiology (1985) 1995 Feb; 78(2):702–708.
16. Housh TJ, Housh DJ, Weir JP, Weir LL. Effects of eccentric-only resistance training and detraining. Int J Sports Med. 1996 Feb; 17(2):14
17. Asmussen E. Positive and negative muscular work. Acta Physiology Scand. 1953; 28(4):364–382.
18. Rodgers KL, Berger RA. Motor-unit involvement and tension during maximum, voluntary concentric, eccentric, and isometric contractions of the elbow flexors. Med Sci Sports. 1974 Winter; 6(4):253–259.
19. Pahud P, Ravussin E, Acheson KJ, Jequier E. Energy expenditure during oxygen deficit of sub maximal concentric and eccentric exercise. J Appl Physiology Respire Environ Exercise Physiol. 1980 Jul; 49(1):16–21.
20. Komi PV, Buskirk ER. Effect of eccentric and concentric muscle conditioning on tension and electrical activity of human muscle. Ergonomics. 1972 Jul; 15(4):417–434.
21. Ellenbecker TS, Davies GJ, Rowinski MJ. Concentric versus eccentric isokinetic strengthening of the rotator cuff. Objective data versus functional test. Am J Sports Med. 1988 Jan-Feb; 16(1):64–69.
22. Johnson BL, Adamczyk JW, Tennoe KO, Stromme SB. A comparison of concentric and eccentric muscle training. Med Sci Sports. 1976 Spring; 8(1):35–38.
23. Mannheimer JS. A comparison of strength gain between concentric and eccentric contractions. Physical Therapy. 1969 Nov; 49(11):1201–1207.
24. Pavone E, Moffat M. Isometric torque of the quadriceps femoris after concentric, eccentric and isometric training. Arch Phys Med Rehab. 1985 Mar; 66(3):168–170.
25. Garrett WE., Jr Muscle strain injuries: clinical and basic aspects. Med Sci Sports Exercise. 1990 Aug; 22(4):436–443.
26. Fitzgerald GK, Rothstein JM, Mayhew TP, Lamb RL. Exercise-induced muscle soreness after concentric and eccentric isokinetic contractions. Physical Therapy. 1991 Jul; 71(7):505–513. 28. Hortobágyi T, Katch FI. Role of concentric force in limiting improvement in muscular strength. J Appl Physiology (1985) 1990 Feb; 68(2):650– 658.
27. Hortobágyi T, Katch FI. Role of concentric force in limiting improvement in muscular strength. J Appl Physiology (1985) 1990 Feb; 68(2):650– 658.
28. Braith RW, Graves JE, Pollock ML, Leggett SL, Carpenter DM, Colvin AB. Comparison of 2 vs 3 days/week of variable resistance training during 10- and 18-week programs. Int J Sports Med. 1989 Dec; 10(6):450–454.
29. Newham DJ, Jones DA, Clarkson PM. Repeated high-force eccentric exercise: effects on muscle pain and damage. J Appl Physiology (1985) 1987 Oct; 63(4):1381–1386.