

Effectiveness of Flapless Piezocision on Maxillary En-Mass Retraction : A Randomised Control Trial

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ABSTRACT:

Introduction: This single-centered, parallel-groups trial aimed to evaluate the efficacy of flapless piezocision in accelerating en-masse retraction on maxilla.

Methods: Thirty two patients with Class I and Class II Division 1 malocclusion aged, 18-25 years, requiring maxillary first premolar extractions, were randomly distributed into 2 groups (n = 16 each): 1 group was treated using flapless piezocision (PCG), and the other group was control group (CG)treated with conventional en-masse retraction with anchorage based on miniscrews placed between maxillary second premolars and first molars bilaterally. Randomization was implemented with lottery method; allocation was concealed in sequentially numbered, opaque, sealed envelopes. The study was single-blinded (outcomes' assessor). The primary outcome was the duration of en-masse.

Results: When comparing pretreatment and progress records, there was significantly more retraction in the PCG than in the CG ($P \leq .001$). The amount of en-masse retraction was significantly greater in the PCG (mean = 4.6 ± 0.39 mm) than in the CG (mean = 2.46 ± 0.16 mm; $P \leq .001$). There was also more extraction space closure in the PCG than in the CG, as measured on the casts ($P \leq .001$). The rate of space closure per month was almost twice in the PCG than in the CG.

Conclusions: There was a significant difference between the two groups in terms of amount of retraction space closure. The en-masse retraction of maxillary anterior teeth in experimental group resulted in improvements of retraction of maxillary anterior teeth by almost twice of

what seen in control group. Within the limitations of this randomized clinical trial, it appears reasonable to conclude that en-masse retraction combined with flapless Piezocision is an effective treatment technique for accelerating tooth movement.

Keywords: Accelerated Orthodontics, Flapless Piezocision, Retraction

1. INTRODUCTION

Malocclusion is a common problem of the maxillofacial region and has a global distribution. [1]. It can negatively affect the quality of life of a person by compromising aesthetics and function. Patients with malocclusion can benefit from either removable or fixed orthodontic treatment, but treatment duration can range from months up to 2–3 years in case of comprehensive treatment [2] and is a matter of concern for the patient. Prolonged treatment time is one of the most important challenges in daily practice because of the multiple side effects of lengthy treatments, such as dental caries, periodontal diseases, and root resorption and decreased patient compliance (3) In cases presenting with crowding and/or bimaxillary protrusion, class II malocclusions, extraction of premolars is the main orthodontic treatment option; with this option spaces are either closed by en-masse retraction or two-step space closure. (4) In these cases, treatment time could extend up to 2 years, and even longer in some cases. Accelerated tooth movement is desirable to shorten patients' orthodontic treatment time [5,6]. Various mechanical/physical stimulations, such as Low-Level Laser therapy (LLLT) [7–10], vibration [11], and photobiomodulation [12] are used to accelerate orthodontic tooth movement. Surgical methods are also used to accelerate orthodontic tooth movement [13], e.g., corticotomy-assisted orthodontic treatment, which is highly invasive because it involves a large flap elevation and invasive bone surgery and may cause postoperative complications [14]. Dibart et al.[15] proposed a relative minimally invasive procedure called “piezocision,” in which a piezoelectric knife is used to decorticate the alveolar bone after gaining access through interdental vertical gingival

incisions. The accelerating effects of surgical methods are explained by the regional acceleratory phenomenon (RAP), which involves an increase in bone turnover depending on a localized surge in osteoclastic and osteoblastic activity in the alveolar bone after exposure to cortical injury and during active tooth movement (16) Abbas et al.[17] evaluated and compared the efficiency of corticotomy-assisted orthodontics and piezocision during canine retraction using sliding mechanics. They showed that piezocision was an efficient treatment modality with which to accelerate canine retraction. However, Tuncer et al [18] assessed en-masse retraction and space closure using sliding mechanics and found that there was no difference compared to the control group. The differences between these two studies could be attributed to the different models used and the tools used to assess the results. The recent systematic review by Khlef et al (19) indicated that there was a lack of scientific evidence on the effectiveness of flapless corticotomy performed by piezosurgery in accelerating the en-masse retraction of the maxillary 6 anterior teeth. Recent piezocision studies have yielded contradictory results. To date, several novel modalities have been reported to accelerate orthodontic tooth movement, including low-level laser therapy, pulsed electromagnetic fields, electrical currents, corticotomy, distraction osteogenesis, and mechanical vibration. However, pertinent results are inconclusive, and some are unreliable, which may bias clinicians' understandings and mislead clinical practice. Thus, an addition scientific data would be quite beneficial for clinicians.

2. AIMS & OBJECTIVES:

The aim of the present study was to evaluate the effectiveness of flapless

piezocision in clinical trial. The objectives of this clinical trial was to calculate and compare the rate and effectiveness of anterior retraction with use of conventional fixed orthodontic mechanotherapy in one quadrant vs use of piezocision

3. MATERIAL AND METHODS

Trial design, registration, and any changes after trial Commencement

This study was a single-centered, 2-arm parallel group randomized controlled clinical trial. It was registered at Ethical Committee board of institution There were no changes after trial commencement, with an allocation ratio of 1:1

Participants, eligibility criteria, and settings
Patients seeking orthodontic treatment at the outpatient clinic of the Department of Orthodontics of the Indira Gandhi Institute of Dental Sciences, SBVU Campus were screened for conformity with the following inclusion criteria: (1) Patients with bimaxillary protrusion, Angle's Class I/ Class II div I malocclusion with anterior crowding requiring extractions (2) Age between 18- 25 years (3) good oral hygiene and healthy gingiva (4) no history of orthodontic treatment; (5) no history of systemic diseases; and (6) no current intake of medication that could affect bone biology. The exclusion criteria were (1) Patients who did not provide oral and written consent to participation (2) Patients in active growth phase (3) Patients with gross skeletal and dentofacial deformities which require orthognathic surgery. All patients were given a detailed description of the procedures, and informed consent was obtained from those willing to participate in the study. Next, the patients were randomly assigned into the piezocision group (PG) and the control group (CG) using the random lottery technique. There were no changes to the methods after commencement of the trial.

Sample Size

A total of 32 participants completed the study, with 16 in the PCG and 16 in the CG. The sample size was calculated using

software called G*Power (version 3.1.9.2) with effect size $d = 0.208$, power (1 - β) set at 0.95, and $\alpha = 0.05$ (two-tailed). The primary outcomes were the amount of tooth retraction. The analysis showed that power was 0.97 for group differences to reach statistical significance at the .05 level. This analysis showed that the sample size did not compromise the statistical power and was sufficient on effect size observed on the basis of the mean between-group comparison. No precautions were made to increase the number of patients in case of dropouts.

Interventions

Patients were randomly assigned to either the PG or CG using the random lottery method. Envelopes containing treatment allocation cards were prepared, After shuffling, patients were asked to pick one of the opaque sealed envelopes from a container to allocate the treatment approach. The containers included envelopes with the word "PG," indicating the piezocision treatment group, and envelopes with the word "CG," indicating the control group. The eligible patients were informed in detail about the procedures of the study and were asked whether they wanted to participate in the study. Information sheets were distributed to all patients, and informed consent was obtained from all patients before recruitment. After obtaining pretreatment records, the miniscrews were inserted, each with a diameter of 1.8 mm and a length of 8 mm, Placement of miniscrews was performed by one expert investigator. Miniscrews were inserted between the maxillary second premolar and first molar under infiltration local anesthesia. All patients received MBT bracket prescription of 0.022-inch slots. Patients in the PG were referred for extraction of both maxillary first premolars and piezocision, and those in the CG were referred for extraction of both maxillary first premolars. Written consent was obtained. The patients were sensitised regarding the procedure details

of peizocision. The extraction of first premolars was performed for all patients at the beginning of the treatment, in order not to disturb the results of the applied corticotomy. Leveling and alignment were performed with the following archwires sequences: 0.014-in (NiTi), 0.016-in NiTi, 0.016 x 0.022-in NiTi, 0.017 x 0.025-in NiTi, 0.019 x 0.025-in NiTi, 0.019 x 0.025-in stainless steel (SS).² To ensure the completion of the leveling and alignment phase, the last SS archwire was left for 3 weeks before starting the retraction process.

Corticotomy Intervention

After giving L.A, two vertical interproximal incisions (below interdental papilla) is given on the mesiobuccal and distobuccal side of maxillary canines using no: 15 blade. Vertical interproximal incisions were performed 5mm apical to mesial and distal interdental papilla of extraction site. Incision length was 10mm apically. With Piezocision knife, corticular alveolar incision with a depth of 3mm was performed. The piezocision procedure were performed by one expert investigator for all patients. The patients underwent the following postsurgical regimen: (1) taking antibiotic tablets (1000 mg Augmentin: 875 mg amoxicillin and 125 mg clavulanate potassium) 1 tablet twice a day for 1 week, (2) maintaining good oral hygiene, (3) putting ice packs on for the first 6-8 hours after corticotomy, (4) avoid smoking completely during the first week after corticotomy, (5) eating soft food in the first few days after corticotomy, and (6) taking 500 mg acetaminophen (Panadol) only if necessary. Nonsteroidal antiinflammatory drugs were forbidden in order to avoid overlapping with the regional acceleratory phenomenon (RAP). Two weeks later, En-masse retraction was initiated in both groups on a 0.019 x 0.025-inch stainless-steel arch wire using elastomeric e-chains (250 g of force, bilaterally) extended between the miniscrews and power arms soldered mesial to the canines bilaterally. A strain caliper (Dentaurum, Ispringen,

Germany) was used to measure and confirm the force used, and en-masse retraction was continued for a period of 4 months days after progress records, including photographs and orthodontic models were obtained. The treatment was continued for patients in both groups until the treatment objectives were achieved. Final records were then obtained, and the appropriate retention was provided. Pretreatment (T1) and progress (T2) orthodontic models were compared by a single blinded operator to evaluate the amount of space closure, using digital vernier calliper. To reduce measurement errors, the orthodontic models for subjects were randomly selected to be remeasured by the same investigator one month after the first measurement. Intra-examiner reliability of the measurements was assessed using the intraclass correlation coefficient.

Outcomes (primary) and any changes after trial commencement

The primary outcome was the duration of en-masse retraction in both the groups. It was calculated from the first day on which E-chains were applied until the period of 4 months. No changes to the study design were made after commencement.

Harms

No serious harms were observed in both groups.

Blinding

Blinding either the investigator performing the clinical procedures or patients was not possible; however, blinding was applied only for the outcome's assessor.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp. Normality of the data was analysed using Shapiro-Wilk test. Results on continuous measurements were presented on Mean $\pm$ SD. Inferential statistics like Paired t test was used to compare measurement within a group over a period of time. Independent t

test was used to compare change in measurement over a period of time between the groups. The significance of the level adopted was 5%.

4. RESULTS

There were no significant differences between the two groups for any initial measurements, supporting the fact that both groups were similar at the beginning of the study. When comparing pretreatment and progress records, there was significantly more retraction in the PCG than in the CG ($P \leq .001$). The amount of en-masse retraction was significantly greater in the PCG (mean = 4.6 ± 0.39 mm) (Table 1, Fig 1) than in the CG (mean = 2.46 ± 0.16 mm; $P \leq .001$). (Table 2, Fig 2) There was also more extraction space closure in the PCG than in the CG, as measured on the digital casts ($P \leq .001$). The rate of space closure per month was almost twice in the PCG than in the CG. (Table 3 and 4, Fig 3 and 4)

5. DISCUSSION

Main findings in the context of the existing evidence, interpretation

En-masse retraction involved the retraction of anterior teeth with fixed orthodontic appliance with 0.022-inch slot brackets and tubes. A 4-month period after piezocision was observed, since it was reported [16] to be the optimal time for the maximum effect of the regional acceleratory phenomenon in terms of tooth movement acceleration. Upadhyay et al [20,21] found that the average time of en-masse retraction was 8.61, 9.2, and 9.4 months in previous studies. According to Uribe et al, [22] the majority of orthodontists considered a reduction of 20%-40% in treatment duration to be attractive for using alternative techniques to promote the rate of orthodontic tooth movement. The results obtained by Tuncer et al [23] are contradictory with our study, however, the en-masse retraction duration was similar in both groups with no significant difference between them ($P \leq 0.96$). This finding could

be explained by the minimal amount of bony injury that was performed only from the buccal side with cortical alveolar incisions equal to 3 mm in length, whereas in the current study, the cortical alveolar incisions were made with a length of 10 mm and a depth of 3 mm. This disagreement can also be attributed to several factors, such as the study of Tuncer et al., in which extraction was performed 4 months before commencing piezocision and en-masse retraction, extraction was performed simultaneously with piezocision in the current study. The piezotome was used to remove the bone from the extraction socket distal to the canine root on the buccal side of the socket. This was reported [24] to be important in order to decrease resistance to tooth movement in a distal direction. In addition, the arch wire used in the Tuncer et al. study during sliding was 0.016 x 0.022-inch stainless steel, which could have allowed more tipping of the teeth during retraction, which also required more time to resolve, where-as in the current study we used 19x25-inch stainless steel for retraction. Thicker wires would decrease this tendency; however, they would increase the coefficient of friction. Thus, in an attempt to minimize tipping during retraction, power arms were used in our study. The findings of our study in agreement with those of two previous studies [25,26] that showed enhanced en-masse tooth movement after performance of corticotomy and that reported that tooth movement velocity with corticotomy was almost two times faster than with conventional en-masse retraction. The miniscrews provided an absolute posterior anchorage and allowed for the occurrence of a slight distal movement of the maxillary first molars in both groups with no significant difference between them ($P \leq 0.96$). This result might be due to the transmission of the retraction force to the posterior teeth through the interdental contact points formed between the maxillary canine and second premolar. Davoody et al. [27] reported significant

molar tipping to the distal when miniscrews were utilized in en-masse retraction of incisors. Performing en-masse retraction by applying horizontal force parallel to the archwire at the height of 8-10 mm would cause primarily a bodily movement associated with a slight controlled palatal tipping. This result may have happened because of the path of the applied force axis closest to the center of resistance of maxillary anterior teeth. This finding also indicated that both the flapless piezocision did not adversely affect the incisors' inclination during en-masse retraction. In addition, the piezicision techniques would reduce the en-masse retraction duration, which might reduce the incidence of EARR, which can be attributed to the increased osteoclastic activity, and decreased bone density associated with RAP which in return would decrease the probability of hyalinization necrosis and root resorption. The evaluation of root resorption was not the aim of this study. With literature studies, the decrease in bone density would reduce a possible accumulation of excessive pressure in the periodontal ligament and subsequent occurrence of root resorption. However, there is no consensus between the studies and more investigation is necessary [28,29].

Limitations

The focus of this study was oriented toward the retraction with respect to the maxilla only, and there should be an evaluation of the responses in the mandible as well. In addition, there is a need to evaluate the periodontal tissues after corticotomy. The levels of perception of pain and discomfort should also be investigated in future research. In the current analysis, there was no differentiation between males' and females' acceleration rates. Blinding was neither applied to the investigator nor the patients during the trial. Finally, long-term complications such as teeth vitality were not evaluated in this trial.

6. CONCLUSION

There was a significant difference between the two groups in terms of amount of retraction space closure. The en-masse retraction of maxillary anterior teeth in experimental group resulted in improvements of retraction of maxillary anterior teeth by almost twice of what seen in control group. Within the limitations of this randomized clinical trial, it appears reasonable to conclude that en-masse retraction combined with flapless Piezocision is an effective treatment technique for accelerating tooth movement.

7. REFERENCES

1. Alhammadi MS, Halboub E, Fayed MS, Labib A, El-Saaidi C. Global distribution of malocclusion traits: A systematic review. *Dental Press J Orthod.* 2018; 23(6):40 e1–e10. Epub 2019/01/24. <https://doi.org/10.1590/2177-6709.23.6.40.e1-10.onl> PMID: 30672991; PubMed Central PMCID: PMC6340198.
2. Mavreas D, Athanasiou AE. Factors affecting the duration of orthodontic treatment: a systematic review. *Eur J Orthod.* 2008; 30(4):386–95. Epub 2008/08/06. <https://doi.org/10.1093/ejo/cjn018> PMID: 18678758.
3. Graber TM, Vanarsdall RL. *Orthodontics: Current Principles and Techniques.* St Louis CV Mosby; 1994.
4. Felemban NH, Al-Sulaimani FF, Murshid ZA, Hassan AH. En masse retraction versus two-step retraction of anterior teeth in extraction treatment of bimaxillary protrusion. *J Orthod Sci.* 2013;2:28–37.
5. Buschang PH, Campbell PM, Ruso S. Accelerating tooth movement with corticotomies: is it possible and desirable? *Semin Orthod* 2012;18:286–294.

6. Pilon JJ, Kuijpers-Jagtman AM, Maltha JC. Magnitude of orthodontic forces and rate of bodily tooth movement. An experimental study. *Am J Orthod Dentofacial Orthop*. 1996; 110:16–23.
7. Ge MK, He WL, Chen J, Wen C, Yin X, Hu ZA, Liu ZP, Zou SJ (2015) Efficacy of low-level laser therapy for accelerating tooth movement during orthodontic treatment: a systematic review and meta-analysis. *Lasers Med Sci* 30:1609–1618
8. Youssef M, Ashkar S, Hamade E, Gutknecht N, Lampert F, Mir M (2008) The effect of low-level laser therapy during orthodontic movement: a preliminary study. *Lasers Med Sci* 23:27–335.
9. AlSayed Hasan MMA, Sultan K, Hamadah O (2017) Low-level laser therapy effectiveness in accelerating orthodontic tooth movement: a randomized controlled clinical trial. *Angle Orthod* 87:499–5046.
10. Doshi-Mehta G, Bhad-Patil WA (2012) Efficacy of low-intensity laser therapy in reducing treatment time and orthodontic pain: a clinical investigation. *Am J Orthod Dentofacial Orthop* 141:289–297
11. Leethanakul C, Suamphan S, Jitpukdeebodindra S, Thongudomporn U, Charoemratrote C (2015) Vibratory stimulation increases interleukin-1 beta secretion during orthodontic tooth movement. *Angle Orthod* 86:74–80
12. Ekizer A, Türker G, Uysal T, Güray E, Taşdemir Z (2016) Light emitting diode mediated photobiomodulation therapy improves orthodontic tooth movement and miniscrew stability: a randomized controlled clinical trial. *Lasers Surg Med* 48:936–943
13. Kim SJ, Park YG, Kang SG (2009) Effects of corticision on paradental remodeling in orthodontic tooth movement. *Angle Orthod* 79:284–291
14. Dibart S, Yee C, Surmenian J, Sebaoun JD, Baloul S, Goguet-Surmenian E, Kantarci A (2014) Tissue response during piezocisionassisted tooth movement: a histological study in rats. *Eur J Orthod* 36:457–464
15. Dibart S, Sebaoun JD, Surmenian J. Piezocision: A minimally invasive, periodontally accelerated orthodontic tooth movement procedure. *Compend Contin Educ Dent*. 2009;30:342–344, 346, 348–350.
16. Frost H (1983) The regional acceleratory phenomenon: a review. *Henry Ford Hosp Med J* 31:3–9
17. Abbas NH, Sabet NE, Hassan IT. Evaluation of corticotomyfacilitated orthodontics and piezocision in rapid canine retraction. *Am J Orthod Dentofacial Orthop*. 2016;149:473–480.
18. Tuncer N'I, Arman-Ozcırpıcı A, Oduncuoglu BF, Gocmen JS, Kantarci A. Efficiency of piezosurgery technique in miniscrew supported en-masse retraction: a single-centre, randomized controlled trial. *Eur J Orthod*. 2017;39:586–594.
19. Khlef HN, Hajeer MY, Ajaj MA, Heshmeh O. En-masse retraction of upper anterior teeth in adult patients with maxillary or bimaxillary dentoalveolar protrusion: a systematic review and meta-analysis. *J Contemp Dent Pract* 2019;20:113–27.
20. Upadhyay M, Yadav S, Patil S. Mini-implant anchorage for enmasse retraction of maxillary anterior teeth: a clinical

- cephalometric study. *Am J Orthod Dentofacial Orthop* 2008;134:803-10. 25.
21. Upadhyay M, Yadav S, Nagaraj K, Nanda R. Dentoskeletal and soft tissue effects of mini-implants in Class II Division 1 patients. *Angle Orthod* 2009;79:240-7.
 22. Uribe F, Padala S, Allareddy V, Nanda R. Patients', parents' and orthodontists' perceptions of the need for and costs of additional procedures to reduce treatment time. *Am J Orthod Dentofacial Orthop* 2014;145(Suppl 4):S65-73.
 23. Tuncer NI, Arman-Özçirpici A, Oduncuoglu BF, Göçmen JS, Kantarci A. Efficiency of piezosurgery technique in miniscrew supported en-masse retraction: a single-centre, randomized controlled trial. *Eur J Orthod* 2017;39:586-94.
 24. Liou EJ, Huang CS. Rapid canine retraction through distraction of the periodontal ligament. *Am J Orthod Dentofacial Orthop*. 1998;114:372–382.
 25. Bhattacharya P, Bhattacharya H, Anjum A, et al. Assessment of corticotomy facilitated tooth movement and changes in alveolar bone thickness-A CT scan study. *J Clin Diagn Res*. 2014;8:ZC26.
 26. Sakthi SV, Vikraman B, Shobana VR, Iyer SK, Krishnaswamy NR. Corticotomy assisted retraction: an outcome assessment. *Indian J Dent Res*. 2014;25:748–754
 27. Davoody AR, Posada L, Utreja A, et al. A prospective comparative study between differential moments and miniscrews in anchorage control. *Eur Orthod*. 2012;35:568–576.
 28. Patterson BM, Dalci O, Papadopoulou AK, Madukuri S, Mahon J, Petocz P, Spahr A, Darendeliler MA. Effect of piezocision on root resorption associated with orthodontic force: a microcomputed tomography study. *Am J Orthod Dentofacial Orthop*. 2017;151(1):53–62. doi: 10.1016/j.ajodo.2016.06.032.
 29. Figueiredo DS, Houara RG, Pinto LM, Diniz AR, Araújo VE, Thabane L, Soares RV, Oliveira DD. Effects of piezocision in orthodontic tooth movement: a systematic review of comparative studies. *J Clin Exp Dent*. 2019;11(11):e1078–e1092. doi: 10.4317/jced.56328.

TABLES:

Table No.1: Comparison of measurement within Experimental Group

	N	Mean	SD	P value
Baseline	16	6.22	0.22	0.001*
4months	16	1.62	0.47	
Baseline- 4 months	16	4.60	0.39	

Table No.2: Comparison of measurement within Control Group

	N	Mean	SD	P value
Baseline	16	6.15	0.19	0.001*
4months	16	3.68	0.18	
Baseline- 4 months	16	2.46	0.16	

Table No.3: Comparison of change in measurement from Baseline to 4 months in Experimental & Control Group

Groups	N	Mean	SD	P value
Experimental	16	4.60	0.39	0.001*
Control	16	2.46	0.15	

FIGURES:

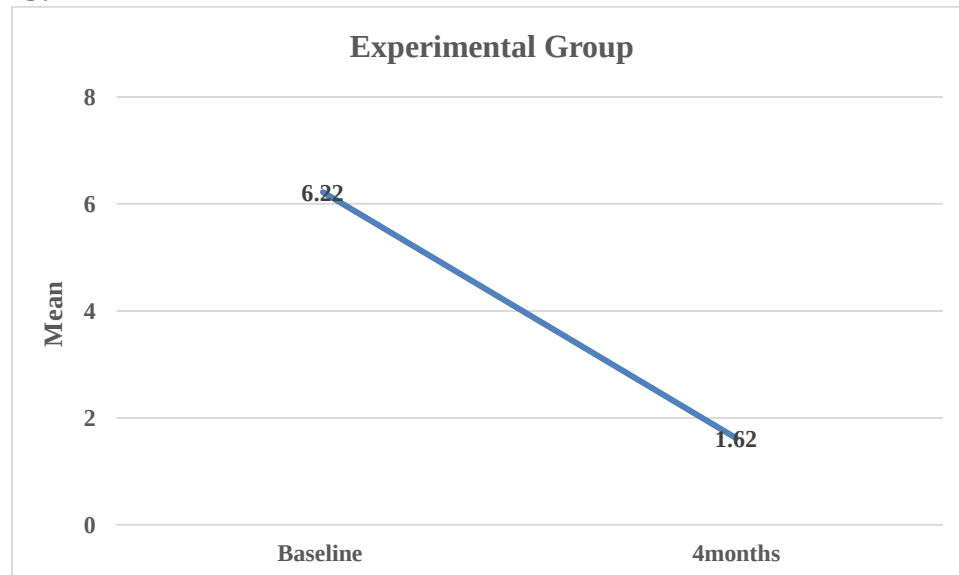


Fig.1

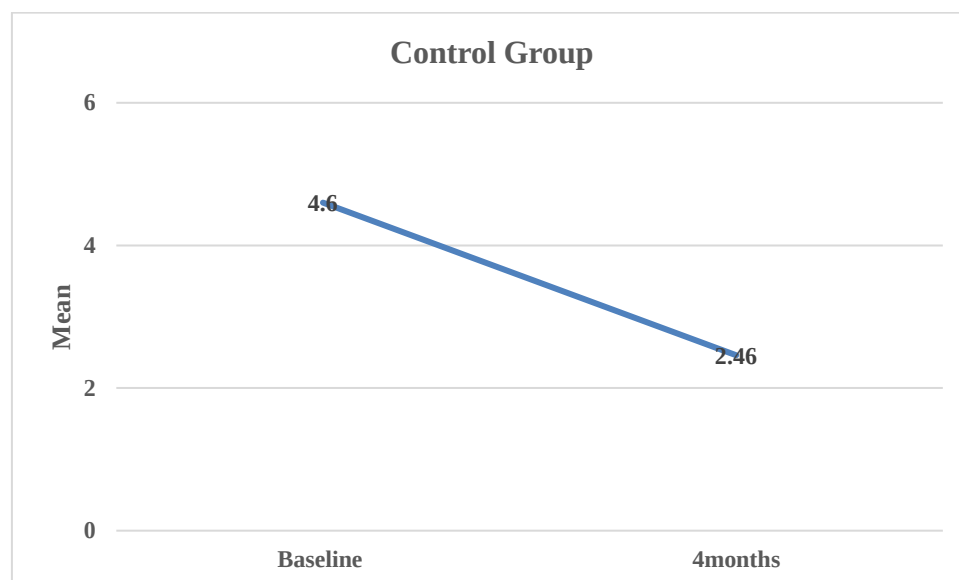


Fig.2

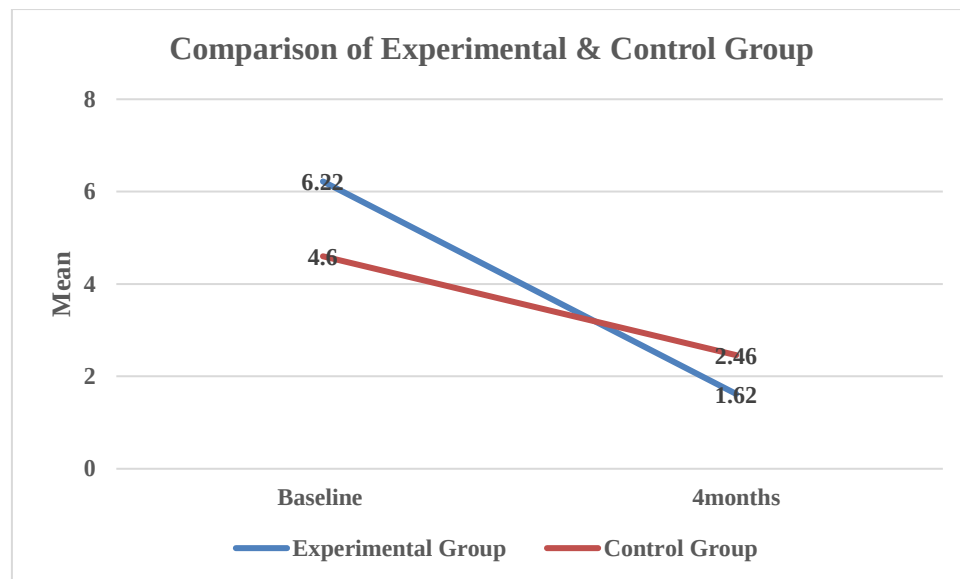
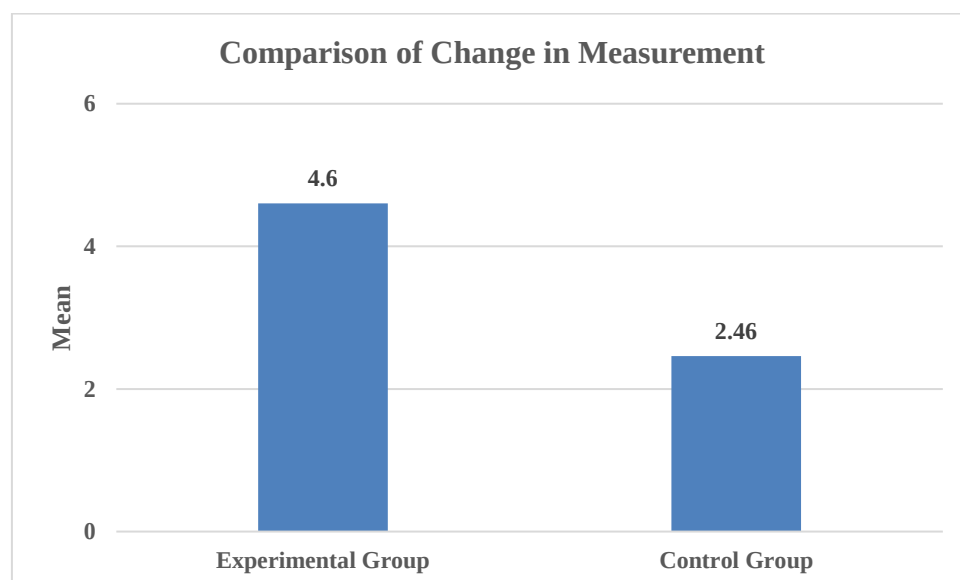


Fig.3

GRAPHS:

Graph 1