International Journal of Medical Science and Education
pISSN- 2348 4438 | eISSN-2349- 3208
Published by Association for Scientific and Medical Education (ASME)
Int.J.Med.Sci.Educ. January-February 2021; 8(2) : 17-23
Available Online at www.ijmse.com
www.ijmse.com
Review Article

A REVIEW OF VERTICAL CONTROL IN FIXED ORTHODONTICS

Dr. Garima Goyal[1], Dr. Ashish Gupta[2], Dr. Anushree Agrawal[3], Dr. Prateek Agarwal[4],

1. Assistant professor, Dept. of Orthodontics & Dentofacial Orthopaedics, Mahatma Gandhi Dental College & Hospital, Jaipur, 2. Consultant Cardiologist, Krishna Heart and General Hospital, Jaipur 3. Consultant Orthodontist, AMRI Hospital, Kolkata, 4. Associate Professor, Department of Oral And Maxillofacial Surgery, Mahatma Gandhi Dental College And Hospital, Jaipur

*Corresponding author – **Dr Garima Goyal**
Email id - doctorgarimagoyal@gmail.com

Received: 20/03/2021 ***Revised:07/05/2021*** ***Accepted: 24/05/2021***

ABSTRACT

In previous studies, various terms are described to define the excessive vertical facial height, dolichofacial pattern, including hyperdivergency and leptoprosopic pattern. The adequate control of the vertical dimension is reported to be essential for a successful anteroposterior correction. Extreme dextrorotation, high angle type, hyperdivergency, dolichofacial pattern, adenoid faces, idiopathic long face, total maxillary alveolar hyperplasia, and vertical maxillary excess all have excessive vertical growth of the maxilla as their common denominator. Thus, it had been very difficult to differentiate this vertical maxillary dysplasia is categorized as a traditional anteroposterior classification. Maxillary molars are stated to be the first 'bite openers' and mandibular incisors, are stated to be the first 'bite closers'. An increase within the vertical facial dimension results in more vertical displacement and that leads to rotation of the maxilla and mandible, which often results in prolonged treatment times, poor esthetic results, and compromised treatment objectives.

Keywords: vertical control, orthodontics, vertical maxillary dysplasia.

INTRODUCTION

In previous studies, various terms are described to define the excessive vertical facial height, dolichofacial pattern, including hyperdivergency and leptoprosopic pattern. The adequate control of the vertical dimension is reported to be essential for a successful anteroposterior correction **(1)**. Extreme dextrorotation, high angle type, hyperdivergency, dolichofacial pattern, adenoid faces, idiopathic long face, total maxillary alveolar hyperplasia, and vertical maxillary excess all have excessive vertical growth of the maxilla as their common denominator **(2)**. Thus, it had been very difficult to differentiate this vertical maxillary dysplasia is categorized as a traditional anteroposterior classification. Maxillary molars are stated to be the first 'bite openers' and mandibular incisors, are stated to be the first 'bite closers' **(3).** An increase within the vertical facial dimension results in more vertical displacement and that leads to rotation of the maxilla and mandible, which often results in prolonged treatment times, poor esthetic results, and compromised treatment objectives **(4).** The aim and objective of treatment of patients who had sufficient potential for growth should be to control and restrain the maxillary descent and to stop the eruption of the anterior teeth **(5).** However, when the severity of vertical deformity is more which leads to correction can't be obtained by camouflage or growth modification, in that case, the mixture of orthognathic surgery and orthodontics may provide the sole viable treatment

(6). The subsequent article provides a review on the control of vertical growth during the active fixed treatment.

Predictors of Vertical Growth

The numerous morphological characteristics related to hyperdivergent growth include the increased gonial angle, increased lower anterior facial height, decreased posterior facial height, and short mandibular ramus **(7).** Skieller et al found that mandibular morphology could also be wont to anticipate the direction of residual growth supported the sort of previous development **(8).** The morphological descriptors suggested by Bjork in their study by implants which include the form of the lower border of the mandible, the inclination of condylar head, inclination of the mandibular symphysis, the curvature of the mandibular canal, these all leads to the thickening of the cortical bone below the symphysis **(9)**.

Why it's Necessary

Previous studies reported that controlling the vertical dentoalveolar development was however difficult, due to most of the orthodontic mechanotherapy may affect the vertical movements of teeth **(10).** Vertical movement of teeth was restricted therefore immediate effects were observed. Musculature affects even reported to have outsized results on the vertical movement control due to the weaker musculature permits lesser resistance to radiate along with lower facial height during the procedure **(11).** Proffit stated that three indicators will be wont to predict the tendency toward open bite. **(12)** These are:

1. The cranial base flexure angle is also known as saddle angle: an increased cranial base flexure angle predisposes to skeletal and dental open bite.

2. The orientation of the maxilla: down posteriorly and being up anteriorly.

3. A brief ramus height and obtuse gonial angle.

Various treatment mechanisms that extrude posterior teeth will lead to open the bite, lengthen the anterior vertical dimension and hinge the mandible back. Within the adult patient, extrusion of teeth within the posterior segment will cause a gap of the bite through backward rotation of the mandible, i.e., a rise in facial height and an overjet. Space closure might be involved protraction of the posterior teeth, which leads to the effect of extrusion, especially in the cases when significant tipping of molars is detected **(13)**. One frequently used method of space closure and interocclusal correction is that the use of sophistication II elastics. The observed adverse effects of the elastics are upper and lower molar anterior extrusion, along with the steepening of the occlusal plane **(13).**

Vertical Control During Fixed Orthodontic Therapy

Vertical Pull Chin Cup: The vertical chin cup had been reported in many studies as a supplementary device along with the intraoral fixed appliances. It consists of a head bonnet and a chin cup connected either by an elastic strap or elastics to get forces upwards in the vertical direction **(14).** Haass et al reported the utilization of a vertical pull chin cup alone in their study among Class I patients with severe vertical dysplasia and in conjunction with cervical gear when it was accompanied with anteroposteriorly. It reported that the vertical chin cup observed the anterior rotation of the mandible, with the emerging force vector directing through the anterior part of the mandibular corpus and up to 3cm from the outer canthus of the attention **(15).** Eren et al reported the consequences of vertical chin cap alone in their study and reported that a decrease within the mandibular angle, decrease within the lower posterior dentoalveolar height, posterior rotation of the maxilla, and a high incidence of overbite in open bite cases. The vertical control pat is requested to wear the chin cup 12hrs each day the forces used may be a minimum of 16 ounces on all sides and therefore the direction/ angle of pull is as forward as implicated **(16).**

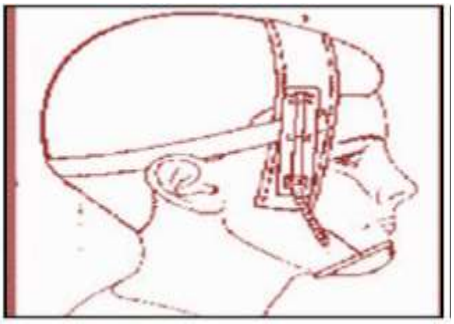

Fig. 1: Diagrammatic representation of vertical pull chin cup.

High Pull Headgear: High pull headgear is very recommended to regulate extrusive effects of treatment and to bring a positive change within the growth pattern. It has been reported that high pull headgear should be attached to the maxillary first molar along with a strap that crosses the highest point of the top **(17)**. The direction of the force applied to the molar varies with the planning of the

facebow but is typically designed to use an upward (intrusive) and backward (destabilizing) force. The force level is usually between 250 to 300 g per side. Various studies had reported that much higher force levels were approximately within the range of 9,000 to 1,200g **(18)**. However, all the procedures either with headgear or a chin-cup, applicated for growth modification, dental movement, and control of the vertical dimension, are only compliance. Firouz et al reported that prime pull headgear can result in relative restriction of forwarding and downward maxillary growth also as intrusion and distalization of the maxillary molars **(19)**.

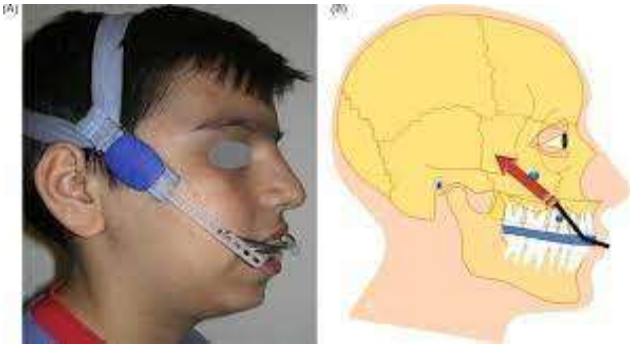

Fig. 2: Diagrammatic representation of High pull headgear.

Vertical Adjustable Corrector: John P Devincenzo designed the VAC with one buccal bar, a trans arch stabilizing wire, and three skeletal implants during which two were placed within the zygomatic processes superior to the maxillary sinuses however one anterior was placed mesial or distal to the lateral incisor **(20).** The forces were applied with the assistance of a cord that is attached to rings of molar implants to the archwire between the primary and second molars. It generates an initial force of 300-450gms along with the posterior region and an initial force of 175-250g of force along with the premolar and anterior region. it had been observed that maxillary anterior teeth intruded at the acceleration of 1mm per month and molars were intruded at the acceleration of 0.6mm per month. It had been reported that a vertically adjustable corrector was routinely applied for the intrusion of the posterior and anterior side of retraction **(21).**

Active Vertical Corrector: it's an appliance consisting of repelling magnets placed in bite blocks that cover the posterior teeth. Dellinger et al reported in their study that vertical corrector was controlled by the constant type of intrusive forces under the magnetic flux which results in increased cellular activity with a high probability of microcurrent flow which acts as a positive tissue stimulator and along with it saliva acts as an electrolyte. Kalra et al reported in their study that an elongated mandibular length, upward and forward autorotation of the mandible, and intrusion of teeth were subjected to procedure with the utilization of fixed magnetic applicators **(22)**. Babre and Sinclair et al reported in their study that mandibular and maxillary molar autorotation and intrusion were corrected with the application of an active vertical corrector. B Melson et al reported in their study that the effects of bite block with and without application of repelling magnets among rhesus shows the histomorphological effects and characterized remodeling observed in both zygomatico-temporal sutures and pterygo-maxillary suture **(23).** Kuster and ingervall et al reported in their study that compared the utilization of spring-loaded bite blocks with repelling magnets. They concluded that meaningful improvement in an open bite of approximately 1.3mm within the spring-loaded group and approximately 3mm in the magnet group **(24).**

Mandibular Bite Block: it was reported that fixed composite bite blocks on the mandibular molars act as the effective natural modality of controlling the vertical height. Mc Namara et al reported in their study that no intrusion of the mandibular and maxillary teeth in their observation. However, the eruption of teeth was reported inhibited by the appliance. Altuna and woodside et al reported in their study that depression of maxillary molars by the mandibular bite blocks in their observation **(25).** This treatment approach is concluded to be effective by inhibiting the growth of the tall buccal dentoalveolar processes, hence it prevents down and backs rotation of the mandible. it's best before the cessation of growth of the jaws. It was reported that development was caused by mandibular anterior rotation resulting in molar intrusion and increased chances of anterior eruption **(26).**

Fig. 3: Diagrammatic representation of Mandibular Bite Block.

Vertical Holding Appliance: The vertical holding appliance was described by deberardinis et al reported in their study that stated modification of the transpalatal arch to regulate the vertical dimension among the high angle patients. The acrylic button situated on the modified vertical holding appliance was of a consistent dimension of 17mm and its thickness was situated midway between the premolars and maxillary first molars, 6mm distant from the palate to permit pressure from the tongue to act as an intrusive force as described by Chiba et al. Umemori et al recommended in their study that initial force of approximately 500gms while Kalra et al concluded in their study approximately 90gms/tooth for molar intrusion among growing children **(27).**

Fig. 4: Diagrammatic representation of Vertical Holding Appliance.

Low Mandibular Lip Bumper and Lingual Arch: Cetlin and Ten Hoeve et al reported in their study that advocated the utilization of a lip bumper for the event of the lower dental arch. They reported in their conclusion that if the lip bumper were positioned low in approximation the cheek and lip mucosa would be rested above the appliance, and this procedure would inhibit vertical mandibular molar and dentoalveolar development **(28).**

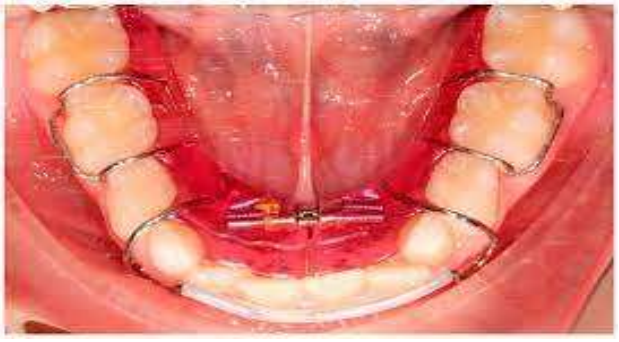

Fig. 5: Diagrammatic representation of Low Mandibular Lip Bumper and Lingual Arch.

Use Class II or Class III Elastics in High Angle Cases: it's been reported that attachment of sophistication II elastics to the lower second molars created a more horizontal vector of force (Thorow, 1970). Pearson (1997) et al reported in their study that no implication of elastics to the lower second molars. They reported in their study that elastic engagement is only necessary among short Class II elastics which can be attached from the upper first molar to a category II hook then to the distal of the lower premolar. Roth et al reported in their study that type one, two and three elastics of short Class on all sides could be applied from the medial side of the lower first molar to the medial side of the upper second premolar, and from the distal side of the lower second premolar to the medial side of upper first premolar, and from the distal side of the lower first premolar to upper canine **(29).**

Fig.6: Diagrammatic representation of Class II or Class III Elastics in High Angle Cases.

Extraction of teeth for vertical control: consistent with Pearson extraction of premolar results in a mesial drift of posterior teeth which causes closure of mandibular angle. Garlington and Logan et al reported in their study that enucleation of mandibular second premolars is conclusive in selected patients, to regulate the vertical growth. The inclusive criteria were mandibular angle greater than 38°, minimal lower arch discrepancy, increased lower anterior facial height, and hyperdivergent skeletal pattern. Yamaguchi and Nanda et al reported in their study that the changes in horizontal position and vertical position of the molars were hooked by the application of force and not on the non-extraction and extraction strategy. When extractions are a part of the treatment plan, it's important to regulate the vertical position of maxillary and mandibular molar teeth to avoid their vertical occlusal movement, which could avoid the outcome of closing rotation of the mandible, especially among adults **(30).**

Multiloop Edgewise Arch Wire: Kim et al reported in their study that popularized the multiloop edgewise archwire (MEAW) for correction of open bite malocclusion. The MEAW contains horizontal and vertical loops fabricated from a 16 x 22 ss wire in an L - shape fashion the vertical loops act as an opportunity among teeth, which lowers the load-deflection rate and provides the necessary horizontal control. The horizontal loops successively reduce the load deflection and further provide vertical control. Typical tip backbends approximately of 3-5degrees were given on each tooth. Elastics were applied between the loops which lie mesial side to opposing cuspids **(31).**

Fig. 7: Diagrammatic representation of Extraction of teeth for vertical control.

Fig. 8: Diagrammatic representation of Multiloop Edgewise Arch Wire.

Mini-implant Anchorage System: Recently, the utilization of implants as a source of absolute skeletal anchorage has been reported. Umemori et al reported in their study that if titanium miniplate were used to intrude the posterior teeth, it would reducing the vertical dimension among adults with open bites **(32).** The titanium mini plates were fixed to the buccal cortical bone around the apical regions of the lower first and second molar teeth and were wont to intrude the posterior teeth. The lower molars were intruded 3 to five ram, and therefore the open bite was significantly reduced with almost no vertical movement of anterior teeth. A lower lingual arch is applied to counteract the buccal moments resulted from molar intrusion when forces are countered from the buccal mucosa side **(33).**

Fig. 9: Diagrammatic representation of mini implant.

REFERENCES

1.Benedicto Ede N, Kairalla SA, Oliveira GMS, Junior LRM, Rosário HD, Paranhos LR. Determination of vertical characteristics with different cephalometric measurements. Eur J Dent. 2016;10(1):116-20. doi: 10.4103/1305-7456.175694, PMID 27011750. Available from: /pmc/articles/PMC4784141.

2.Zere E, Chaudhari PK, Sharan J, Dhingra K, Tiwari N. Developing Class III malocclusions: challenges and solutions. Clin Cosmet Investig Dent. 2018;10:99-116. doi: 10.2147/CCIDE.S134303, PMID 29950903. Available from: /pmc/articles/PMC6016584.

3.Arriola-Guillén LE, Castillo AA-D, Pérez-Vargas LF, Flores-Mir C. Influence of maxillary posterior discrepancy on upper molar vertical position and facial vertical dimensions in subjects with or without skeletal open bite. Eur J Orthod. 2016 Jun 16;38(3):251-8. Available from: /pmc/articles/PMC4914910.

4.Sevillano MGC, Diaz GJF, Menezes de LM, Nunes LKF, Miguel JAM, Quintão CCA. Management of the vertical dimension in the camouflage treatment of an adult skeletal Class III malocclusion. Case Rep Dent. 2020;2020:8854588. doi: 10.1155/2020/8854588, PMID 32850154. Available from: /pmc/articles/PMC7441420.

5.Schendel SA, Carlotti AE. Variations of total vertical maxillary excess. J Oral Maxillofac Surg. 1985;43(8):590-6. doi: 10.1016/0278-2391(85)90126-0.

6.Qamar Y, Tariq M, Verma SK, Mohan J, Amir A. Vertical control in fixed orthodontics- A review. IP Indian J Orthod Dentofac Res. 2020;4(1):9-12. doi: 10.18231/2455-6785.2018.0003.

7.Krarup S, Darvann TA, Larsen P, Marsh JL, Kreiborg S. Three-dimensional analysis of mandibular growth and tooth eruption. J Anat. 2005;207(5):669-82. doi: 10.1111/j.1469-7580.2005.00479.x, PMID 16313399. Available from: /pmc/articles/PMC1571566.

8.Skieller V, Björk A, Linde-Hansen T. Prediction of mandibular growth rotation evaluated from a longitudinal implant sample. Am J Orthod. 1984;86(5):359-70. doi: 10.1016/S0002-9416(84)90028-9.

9.Bj RK A, Skieller V. Normal and abnormal growth of the mandible. A synthesis of longitudinal cephalometric implant studies over a period of 25 years. Eur J Orthod. 1983 Feb;5(1):1-46. doi: 10.1093/ejo/5.1.1.

10.Miles TS, Flavel SC, Nordstrom MA. Control of human mandibular posture during locomotion. J Physiol. 2004 Jan 1;554(1):216-26. doi: 10.1113/jphysiol.2003.050443, PMID 14678503. Available from: /pmc/articles/PMC1664734.

11.Mangla R, Singh N, Dua V, Padmanabhan P, Khanna M. Evaluation of mandibular morphology in different facial types. Contemp Clin Dent. 2011;2(3):200-6. doi: 10.4103/0976-237X.86458, PMID 22090764. Available from: /pmc/articles/PMC3214527.

12. Proffit WR, Mason RM. Myofunctional therapy for tonguethrusting: background and recommendations. J Am Dent Assoc. 1975;90(2):403-11. doi: 10.14219/jada.archive.1975.0075, PMID 1053783.

13.Brown DT, Gaudet EL, Phillips C. Changes in vertical tooth position and face height related to long term anterior repositioning splint therapy. Cranio®. 1994;12(1):19-22. doi: 10.1080/08869634.1994.11677988.

14.Burstone CR. B. Deep overbite correction by intrusion. Am J Orthod. 1977;72(1):1-22. doi: 10.1016/0002-9416(77)90121-X.

15.Mousoulea S, Tsolakis I, Ferdianakis E, Tsolakis AI. The effect of chin-cup therapy in Class III malocclusion: A systematic review. Open Dent J. 2016 Dec 14;10(1):664-79. doi: 10.2174/1874210601610010664, PMID 28077971. Available from: /pmc/articles/PMC5204060.

16.Abdelnaby YL, Nassar EA. N. Chin cup effects using two different force magnitudes in the management of Class III malocclusions. Angle Orthod. 2010 Sep;80(5):957-62. doi: 10.2319/022210-110.1.

17.Bilbo EE, Marshall SD, Southard KA, Allareddy V, Holton N, Thames AM, Otsby MS, Southard TE. Long-term skeletal effects of high-pull headgear followed by fixed appliances for the treatment of Class II malocclusions. Angle Orthod. 2018 Sep 1;88(5):530-7. doi: 10.2319/091517-620.1.

18.Li C, Sfogliano L, Jiang W, Lee H, Zheng Z, Chung C-H, et al. Total maxillary arch distalization by using headgear in an adult patient::reconsidering. Angle Orthod. 2021 Mar 1;91(2):267-78. doi: 10.2319/010320-857.1. Available from: /pmc/articles/PMC8028481.

19.Firouz M, Zernik J, Nanda R. Dental and orthopedic effects of high-pull headgear in treatment of Class II, division 1 malocclusion. Am J Orthod Dentofac Orthop. 1992;102(3):197-205. doi: 10.1016/S0889-5406(05)81053-4.

20.Flanagan D. Bite force and dental implant treatment: a short review. Med Devices (Auckl). 2017 Jun 27;10:141-8. doi: 10.2147/MDER.S130314, PMID 28721107. Available from: /pmc/articles/PMC5501108.

21.Gowd MS, Shankar T, Ranjan R, Singh A. Prosthetic consideration in implant-supported prosthesis: a review of literature. J Int Soc Prev Commun Dent. 2017 Jun 1;7(Suppl 1);Suppl 1:S1-7. doi: 10.4103/jispcd.JISPCD_149_17, PMID 28713760. Available from: /pmc/articles/PMC5502545.

22.Melsen B, McNamara JA, Hoenie DC. The effect of bite-blocks with and without repelling magnets studied histomorphometrically in the rhesus monkey (Macaca mulatta). Am J Orthod Dentofac Orthop. 1995;108(5):500-9. doi: 10.1016/S0889-5406(95)70050-1.

23.Yang Y, Raine A, Colletti P, Toga AW, Narr KL. Abnormal structural correlates of response perseveration in individuals with psychopathy. J

Neuropsychiatr Clin Neurosci. 2011;23(1):107-10. doi: 10.1176/appi.neuropsych.23.1.107.

24.van Galen GP, Liesker H, de Haan A. Effects of a vertical keyboard design on typing performance, user comfort and muscle tension. Appl Ergon. 2007;38(1):99-107. doi: 10.1016/j.apergo.2005.09.005.

25.Alsafadi AS, Alabdullah MM, Saltaji H, Abdo A, Youssef M. Effect of molar intrusion with temporary anchorage devices in patients with anterior open bite: a systematic review. Prog Orthod. 2016;17(1):9. doi: 10.1186/s40510-016-0122-4, PMID 26980200. Available from: /pmc/articles/PMC4803715.

26.Iwasa A, Horiuchi S, Kinouchi N, Izawa T, Hiasa M, Kawai N, et al. Skeletal anchorage for intrusion of bimaxillary molars in a patient with skeletal open bite and temporomandibular disorders. J Orthod Sci. 2017;6(4):152-8. doi: 10.4103/jos.JOS_63_17, PMID 29119097. Available from: /pmc/articles/PMC5655966.

27.Kjær I. Mechanism of human tooth eruption: review article including a new theory for future studies on the eruption process. Scientifica (Cairo). 2014;3:189-209. Available from: /pmc/articles/PMC3944225.

28.Ingervall B. UT. No effect of lip bumper therapy on the pressure from the lower lip on the lower incisors. Eur J Orthod. 1998;20(5):525-34. doi: 10.1093/ejo/20.5.525.

29.Valarelli FP, Carniel R, Cotrin-Silva PP, Patel MP, Cançado RH, Freitas KMS, et al. Treatment of a Class II malocclusion with deep overbite in an adult patient using intermaxillary elastics and Spee curve controlling with reverse and accentuated archwires. Contemp Clin Dent. 2017 Oct 1;8(4):672-8. doi: 10.4103/ccd.ccd_625_17, PMID 29326527. Available from: /pmc/articles/PMC5754997.

30.Hannam AG, McMillan AS. Internal organization in the human jaw muscles. Crit Rev Oral Biol Med. 1994;5(1):55-89. doi: 10.1177/10454411940050010301, PMID 7999950.

31.Kim YH, Han UK, Lim DD, Serraon MLP. Stability of anterior open bite correction with multiloop edgewise archwire therapy: A cephalometric follow-up study. Am J Orthod Dentofac Orthop. 2000;118(1):43-54. doi: 10.1067/mod.2000.104830.

32.Sherwood KH, Burch JG, Thompson WJ. Closing anterior open bites by intruding molars with titanium miniplate anchorage. Am J Orthod Dentofacial Orthop. 2002;122(6):593-600. doi: 10.1067/mod.2002.128641, PMID 12490869.

33.Kim YH, Han UK, Lim DD, Serraon MLP. Stability of anterior openbite correction with multiloop edgewise archwire therapy: A cephalometric follow-up study. Am J Orthod Dentofacial Orthop. 2000;118(1):43-54. doi: 10.1067/mod.2000.104830, PMID 10893472.

How to cite this article: Goyal G., Gupta A., Agrawal A, Agarwal P . A review of vertical control in fixed orthodontics., Int.J.Med.Sci.Educ 2021;8(2):17-23