

Knowledge and Awareness of Bi Dimensional/ 2 Dimensional / Dual Dimensional Orthodontic Archwires amongst Dentists- A Questionnaire Study

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Abstract:- The perfect control of tooth movement requires the application of a system of specific forces appropriately supported by accessories such as orthodontic archwires. The mechanical basis of orthodontic treatment consists of the assumption that accumulated elastic energy can be transformed into mechanical work by the movement of teeth. During the overjet reduction a distally directed force retracts anterior teeth by sliding an archwire through brackets and tubes in the buccal segments. Significant resistance to movement may arise due to frictional forces generated. Round wires slide well, but the torque control is a significant problem. Rectangular wires produce effective torque expression but pose a challenge to free sliding due to factors like friction and force used to overcome friction, etc. To utilize the properties of both wires, the wire should be bi-dimensional. Dual-dimensional wire is one such wire with different dimensions in the anterior and posterior sections. Henceforth the primary aim of this study was to evaluate by a questionnaire about the knowledge and awareness of Bi dimensional archwires among the dentists

wire contact force.⁴ Space closure is one of the most challenging processes in Orthodontics. Tooth extraction, molar distalization, expansion of dental arches, interproximal reduction, among other things, have been part of the orthodontic armamentarium to correct malocclusion and allow dental space gain with which the orthodontist should deal. The ability to close spaces, especially those resulting from tooth extraction, is an essential skill required during orthodontic treatment. Space closure mechanics without knowledge can result in failure to achieve an ideal occlusion. Current knowledge in biomechanics, allied with the development of new material and techniques, made significant upgrading possible in space closure, which has simplified mechanics.⁵ Studies on friction reveal that the effective force must increase two folds to overcome the frictional resistance, resulting in a hazardous overload of the anchorage units. To reduce friction clinically, some practitioners prefer the round wires, or they reduce the rectangular wires in the buccal segments to a more rounded cross-section to minimize binding. It would be ideal to have the characteristics of both rectangular and round wires in an archwire. Dual dimensional wires do not require any manipulation, such as twisting or welding, to produce a bi-dimensional effect.

I. INTRODUCTION

Archwires are designed to move the teeth with light and continuous forces. Such forces may reduce the potential for patient discomfort, tissue hyalinization and undermining resorption.¹

It is important that frictional forces should be eliminated or minimized when orthodontic tooth movement is being planned. Mesiodistal tooth movement can be accomplished by free body movement or by guidance of a tooth along an arch wire.² Friction is the resistance to motion when one object moves tangentially against another. For one object to slide against the other, the force application must overcome the frictional force; higher frictional resistance requires greater orthodontic forces.³ The presence of friction in many fixed orthodontic appliance is undeniable and is recognized by the clinician. In the presence of appliance friction, tooth movement apparently occurs as a sequence of very short steps or jumps rather than as a smooth, continuous motion. Resistance to displacement will be substantially influenced by the normal (perpendicular) component of the bracket-to-

II. MATERIALS AND METHODS

The present study was a cross- sectional questionnaire-based survey conducted among BDS graduates, post graduates and orthodontists from December 2020 to January 2021.

A 12 -item questionnaire was included in the study to evaluate the knowledge of utilization of 2 dimensional archwires in regular practice for increased compliance and easier retraction. The questionnaire was in English language and open ended and self-administered. The Ethical approval was obtained from the Ethical committee KVG dental college Sullia, Dakshina Kannada. Soft copy of questionnaire was delivered through Whatsapp and Whatsapp groups to maximum possible number of orthodontists, BDS graduates including PG residents. A total of 283 responses were included in the study.

➤ *Sample size calculation:*

Using the formula,

$$n = \frac{(Z_{1-\alpha/2})^2 (SD)^2}{(d)^2}$$

where,
 SD = Standard Deviation- 0.42

$Z_{1-\alpha/2} = 1.96$ AT 95% confidence interval
 d = Absolute error or precision- 0.05,
 Substituting the values we get
n = 283

Following were the components of the questionnaire

1. Your designation
 - a. MDS Orthodontics
 - b. MDS any other branch
 - c. PG student Orthodontics
 - d. PG student any other branch
 - e. BDS
2. Years of practice
 - a. 0-5
 - b. 5-10
 - c. 10 and above
3. Have you ever heard of two dimensional wires
 - a. Yes
 - b. No
4. Have you ever used a 2 dimensional wire?
 - a. Yes
 - b. No
5. Which stage in a fixed mechanotherapy do we use Bi dimensional arch wires?
 - a. Levelling and alignment
 - b. Retraction
 - c. Finishing and settling
6. Do you think they are more effective than conventional rectangular wires?
 - a. Yes
 - b. No
7. What are the types of 2D wires that u know of
 - a. 0.021*0.021*0.18 Stainless steel
 - b. 0.022*0.18 anterior segment 0.018*0.22 posterior segment - Stainless steel
 - c. 0.021*0.021*0.18 Ni Ti
 - d. 0.021*0.18 anterior segment 0.018 posterior segment - Stainless steel
8. What do you think is the reason for the efficiency of 2D wires?
 - a. Manufacturing process involved
 - b. Method of usage in the clinic
 - c. Reduced friction between bracket slot and archwire
 - d. Physical properties of constituents used

9. Do you think we can modify the conventional rectangular wire into a 2dimensional wire?
 - a. Yes
 - b. No
10. What are the reasons for not using 2 Dimensional wires on a regular basis?
 - a. Anchorage Loss
 - b. Increased Expenditures
 - c. Increased duration of treatment
 - d. Lack of awareness and availability
11. Does the usage of 2 dimensional wires affect the treatment duration
 - a. Increases
 - b. Decreases
 - c. Doesn't affect the treatment duration
12. Do u think 2 dimensional wires should be used on a regular basis in orthodontic practice?
 - a. Yes
 - b. No

III. RESULTS

Out of the 283 responses obtained, 142 were Post Graduates in orthodontics, 67 were BDS graduates and 27 of them were PG students in other branches and 47 were MDS Graduates in other branches. In terms with the years of practice, 172 of them had an experience of 0-5 years, 69 of them had an experience of 5-10 years and 42 of them had an experience of 10 years or more. 230 of the responders had never heard about this class of wires whereas 271 of them had never used it before. When asked about which stage the wire was used in fixed mechanotherapy, 142 of the responders thought they could use it for levelling and alignment, 51 of them considered that it could to be used for the phase of retraction whereas 90 of them thought they might be used for finishing and settling. 51 of the dentists thought it would be more effective than conventional whereas 59 of them thought it wouldn't.

When asked about the reason for the efficiency of the dual dimension wires, 80 of them answered that it was because of the manufacturing process, 85 of them thought it's because of the methodology of usage, 71 of them thought it's because of the decreased friction between the archwire and the bracket slot and 47 of them believed it to be because if the physical constituents. 64 of them thought that we could modify the regular stainless steel archwire into a bi dimensional wire whereas 66 of them believed we couldn't do that. When asked about the minimal usage of the dual dimensional wires in regular practice, 85 of them thought it is because of the loss of anchorage, 72 of them thought it's because of increased expenditure, 50 of them answered that it's because of increased duration of treatment and 76 of them responded by assuming that it is because of the lack of awareness. When asked whether bi dimensional wires must be used in regular practice, 67 of them thought they should be and 52 of them thought it cannot be. 132 of them thought it

might increase the duration of treatment and 85 of them thought it would reduce the treatment duration.

IV. DISCUSSION

Laboratory studies simulating the retraction of teeth along round archwires have shown that as archwire sizes increase relative to constant bracket slot size, thus reducing the clearance between the archwire and the bracket slot, frictional resistance increases as wires decrease in size relative to bracket slot size, creating more clearance between the archwires and the bracket slots, there will be considerably more tipping, which will also increase frictional resistance as binding occurs between the bracket slot and the archwire. The rectangular wires produce more frictional resistance during sliding mechanics because of the wider area in contact with the brackets slot which create, with the round wires, contact lines instead of contact points, and also for the higher bending stiffness of rectangular wires. This can be the explanation why an undersized archwire can be considered more useful to optimize sliding mechanics with lighter forces, without compromising the arch width and avoiding bowing effect. Moreover, if undesired tipping is present at the end of the protraction phase, it can be easily corrected during the finishing phase.⁶

Dual dimensional/2 Dimensional/ Bi dimensional archwires are one amongst the latest modifications amongst the stainless steel orthodontic archwires used during the phase of retraction. The presence of different geometrical cross section in a single wires, significantly reduces the friction between the slot and the wires especially when used along with the posterior teeth. The usage of these wires is extremely minimal in regular orthodontic practice in India. The reasons might be-

- Increased costs of the material
- Lack of production by the manufacturers in India
- Lack of awareness of the usage amongst the clinicians
- Inadequate research and development

Several archwire manufacturers of Canada and USA have proposed the usage of the Bi dimensional wires in the place of conventional archwires for enhanced treatment results. SPEED System Orthodontics, Cambridge Ontario, Canada is one amongst them.

V. CONCLUSIONS

- In the age of low-friction systems and mini-implants, dual-dimensional wires can be used as an alternative to rectangular wires during retraction if mini-implants are used for direct anchorage.
- Though several modifications of archwires are being used, Bi dimensional stainless steel wires are barely in use in regular clinical practice
- There has to be proper research for the creating awareness, development and marketing of bi dimensional archwires among the orthodontists in India so that more convenient treatment plan is formulated

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