Outline the significance of the pre-adjusted Edgewise appliance system and useful bracket variations in orthodontics

Dr MJ Rowland-Warmann **BSc BDS (Manc) MSc Aes.Med. (Lond) MJDF RCS (Eng)**

GDC: 178642

Word Count (excluding references): 1680

Module 4: Fundamentals of Orthodontic Treatment of Skeletal Problems in Preadolescence and Adolescence

Submission December 2017

Student ID BP0150715

Contents

Outline the significance of the pre-adjusted Edgewise appliance system and useful bracket variations (such as changing bracket position, orientation or location in the arch)

Introduction

Andrews introduced the pre-adjusted edgewise appliance in the 1970s and revolutionised orthodontics (Andrews, 1979). This replaced the edgewise appliance where all brackets were identical and there was great need for wire bending (Johnson, 2013). Andrews introduced tip through slot angulation and torque through slot inclination, along with "in-out" through bracket base variation (Thickett, Taylor, & Hodge, 2007).

Modern bracket prescriptions and their evolution

The inception of the pre-adjusted edgewise appliance was hailed as significant, reducing wire bending, allowing for the movement of groups of teeth and thus shorter treatment times, yet more consistent treatment outcomes (Thickett et al., 2007). This increased focus on precise bracket placement, and straight wires placed more strain on anchorage (Singh, 2017).

There have been many modifications in tip and torque in pre-adjusted edgewise since Andrews (Mittal, Thiruvenkatachari, Sandler, & Benson, 2015). MBT and Roth are the most commonly used today.

Andrews

The original straight wire appliance used siamese brackets placed on the facial axis of the clinical crown with heavy forces to control tooth movement in three dimensions (McLaughlin, Bennett, & Trevisi, 2002; Mohammadi & Moslemzadeh, 2011).

Prescription values took average values from 120 models (Andrews, 1972, 1979). Andrews' prescription had different sets for various malocclusions, degree of crowding and extraction/non-extraction cases (Singh, 2017), incorporating anti-rotation and anti-tip into extraction cases (Andrews, 1979). This resulted in a large number of bracket types.

Roth

To minimise he plethora of bracket types and necessary inventory, Roth devised one set of brackets applicable for most cases, combining Andrews' set C upper incisor, set S lower incisors , minimum translation upper posterior and lower canine brackets, and maximum translation upper canine and lower posterior (Thickett et al., 2007). He also increased tip to assist canine guidance, and distal crown tip to lower buccal segments as his prescription was more anchorage demanding. Furthermore, upper molar torque increased to prevent palatal cusp drop (McLaughlin et al., 2002; Singh, 2017; Thickett et al., 2007).

MBT

Devised by McLaughlin, Bennett and Trevisi in the 1990s, this prescription is based around a number of principles. Bracket versatility, light continuous forces, anchorage control, group movement of teeth and a single finishing wire are key elements of the MBT theory. Accurate bracket placement is significant, and bracket placement charts were devised (Figure 1) (McLaughlin et al., 2002).

Upper right														Upper left
Average for adults	2.0	3.0	4.0	4.5	5.0	4.5	5.0	5.0	4.5	5.0	4.5	4.0	3.0	2.0	Average for adults
	2.5	2.5	3.5	4.0	4.5	4.0	4.0	4.0	4.0	4.5	4.0	3.5	2.5	2.5	
Lower right															Lower left

Upper right														Upper left
Average for children	2.0	2.5	3.5	4.0	4.5	4.0	4.5	4.5	4.0	4.5	4.0	3.5	2.5	2.0	Average for children
	2.0	2.0	3.0	3.5	4.0	3.5	3.5	3.5	3.5	4.0	3.5	3.0	2.0	2.0	
Lower right															Lower left

Figure 1: MBT bracket placement charts; from (McLaughlin et al., 2002)

MBT reduced anterior tip compared with Roth and Andrews. Its aim was to reduce strain on molar anchorage and avoid in-treatment arch length increase (Thickett et al., 2007); undertorquing teeth requires space, so for every 5° of anterior inclination, 1mm of arch length is generated, resulting in lack of stability (Badawi, Toogood, Carey, Heo, & Major, 2008; Fleming, DiBiase, Sarri, & Lee, 2009). Increased palatal root torque counteracts torque loss during overjet reduction and space closure and labial root torque increased to limit lower incisor procline on levelling. Furthermore, canine tip was reduced to upright roots and prevent canine and premolar root proximity (Moesi, Dyer, & Benson, 2013; Thickett et al., 2007).

The tip and torque values of Andrews, Roth and MBT are illustrated in Figures 2 and 3.

Torque or third order								
Upper	MBT	17	10	−7	−7	−7	−14	−14
	Roth	12	8	−2	−7	−7	−14	−14
	Andrews	7	3	−7	−7	−7	−9	−9
	TEETH	1	2	3	4	5	6	7
Lower	Andrews	−1	−1	−11	−17	−22	−30	−33
	Roth	−1	−1	−11	−17	−22	−30	−30
	MBT	−6	−6	−6	−12	−17	−20	−10

Figure 2: Andrews/Roth/MBT torque values; from (Thickett et al., 2007)

Upper	MBT	4	8	8	0	0	0	0
	Roth	5	9	13	0	0	0	0
	Andrews	5	9	11	2	2	5	5
Teeth		1	2	3	4	5	6	7
Lower	Andrew	2	2	5	2	2	2	2
	Roth	2	2	7	−1	−1	−1	−1
	MBT	0	0	3	2	2	0	0

Figure 3: Andrews/Roth/MBT tip values; from ("Erratum," 2014)

Bracket variations for different scenarios

As the prescription on an individual bracket is known, variations can be employed when there is a local tooth positioning problem or missing tooth by changing the orientation or using a bracket on a tooth other than the one for which it was intended (Singh, 2017; Thickett et al., 2007). Inversion results in a torque change but not tip. Swapping the right and left brackets changes the tip value without changing torque (Thickett et al., 2007).

Palatally placed lateral incisors

The lateral incisor bracket will not supply enough labial root torque. Inversion of the lateral incisor bracket reverses slot inclination, gradually introducing torque with the wire sequence, improving comfort over the use of torqueing pliers (Singh, 2017; Thickett et al., 2007)

Applied in practice, an an Andrews bracket has a 6° difference, Roth 16° and MBT 20° (Figure 4-6).

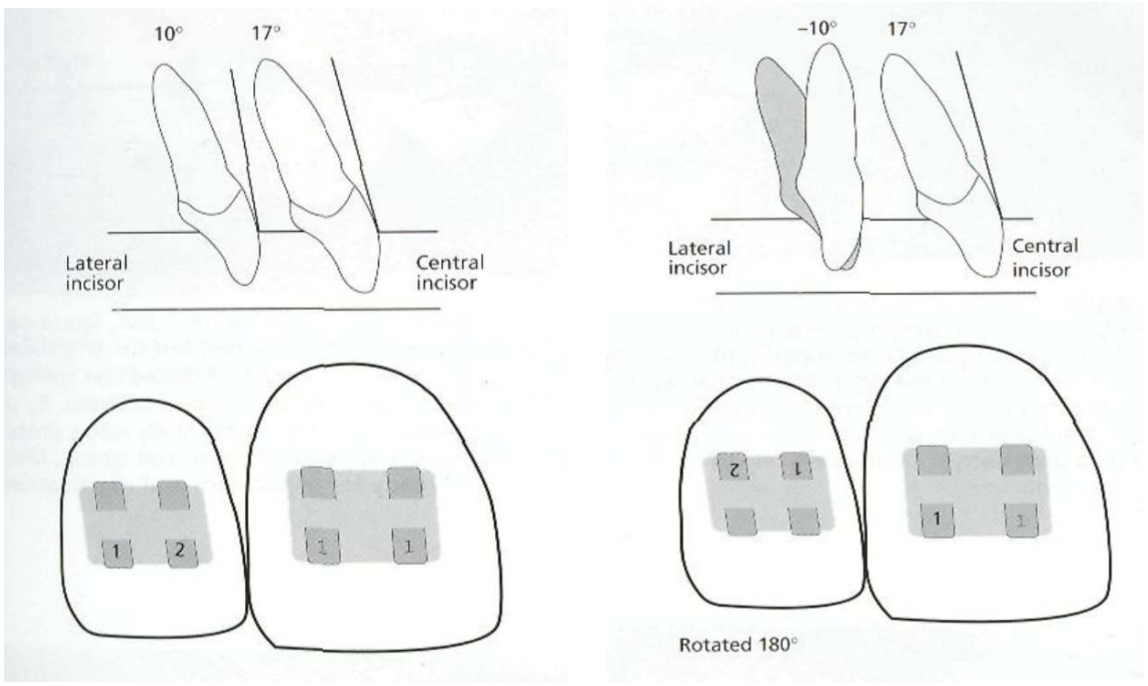

Figure 4 & 5: Management of palatally placed lateral incisors; from (McLaughlin et al., 2002)

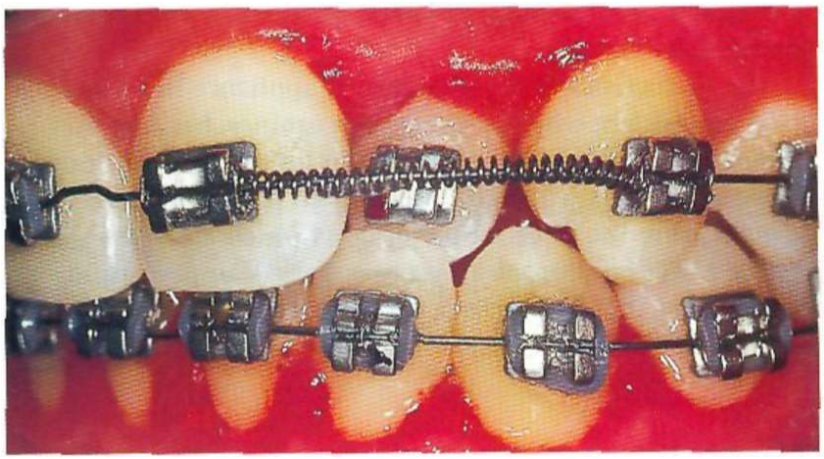

Figure 6: clinical presentation of bracket for palatal lateral incisors; from (McLaughlin et al., 2002)

Absent lateral incisors

The canine bracket is unsuitable when replacing a lateral, as it gives grater labial root torque when palatal root torque is required for lateral incisors – the crown anatomies of the two teeth are vastly different. A lateral bracket would position the tooth palatally and the fit is poor; a further option would be to recontour the canine, then place the bracket, although this may result in poor tooth angulation. A simple measure is inversion of the canine bracket, maintaining the bracket fit and in-out (Figure 7). MBT and Andrews gives palatal root torque changes by 14 degrees; tip values for laterals and canines in MBT are identical, with Roth there is a small difference (McLaughlin et al., 2002; Thickett et al., 2007).

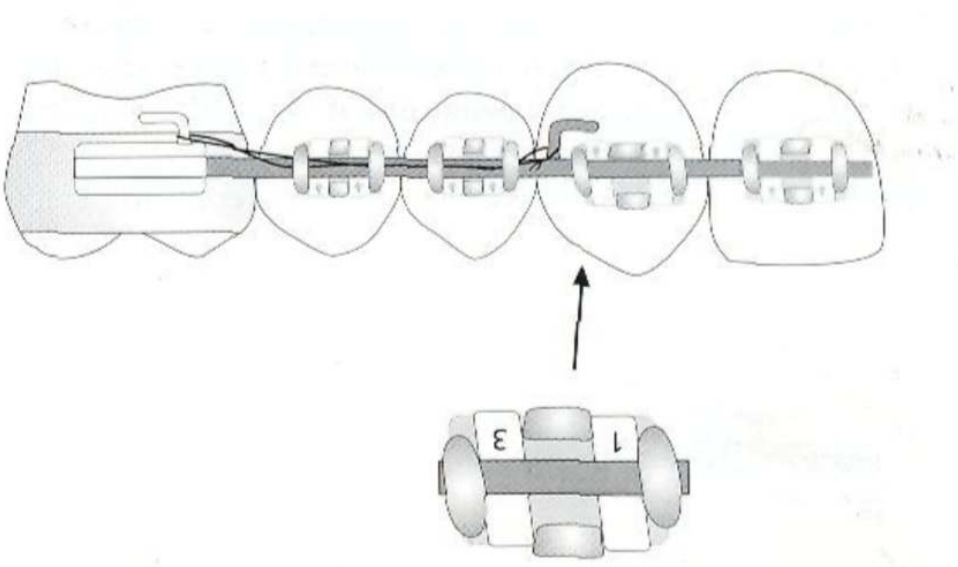

Figure 7: Positioning canine bracket for absent lateral incisor; from (McLaughlin et al., 2002)

Class 3 canine angulation

When camouflaging, the underlying malocclusion is accepted and incisors are compensated. To angle lower canines favourably, the contralateral canine brackets can be switched to encourage distal tip and reduce anchorage requirements (Figure 8) (Singh, 2017; Thickett et al., 2007). Some clinicians prefer using the correct bracket, angulating it for crown tip to

leave the power arm available but this may cause a poor fit to the tooth (Arun & Kallur, 2008).

Figure 8: contralateral canine bracket for class 3; from (Thickett et al., 2007)

Labial movement of palatal canine

Palatal canine movement results in crown movement without the root, causing unattractive tip. In order to increase labial root torque, the lower contra-lateral canine bracket can be inverted to the upper. This is relevant in Roth where there is 9° change; in MBT there are similar torque values (Thickett et al., 2007).

Canine gingival recession

In cases where the gingivae has receded or the canine is very prominent, inverting the bracket gives palatal root torque, which can help reduce further recession (McLaughlin et al., 2002).

Absent upper central incisor

In order to facilitate restorative treatment, the preferential mesial root movement over the crown should occur. Bonding the contralateral central incisor bracket to tilt the tooth allows this (Figure 9) (Thickett et al., 2007); however, some clinicians prefer centring the

lateral incisor in the space for restorative purposes claiming this improves force transmission through the root (Arun & Kallur, 2008)

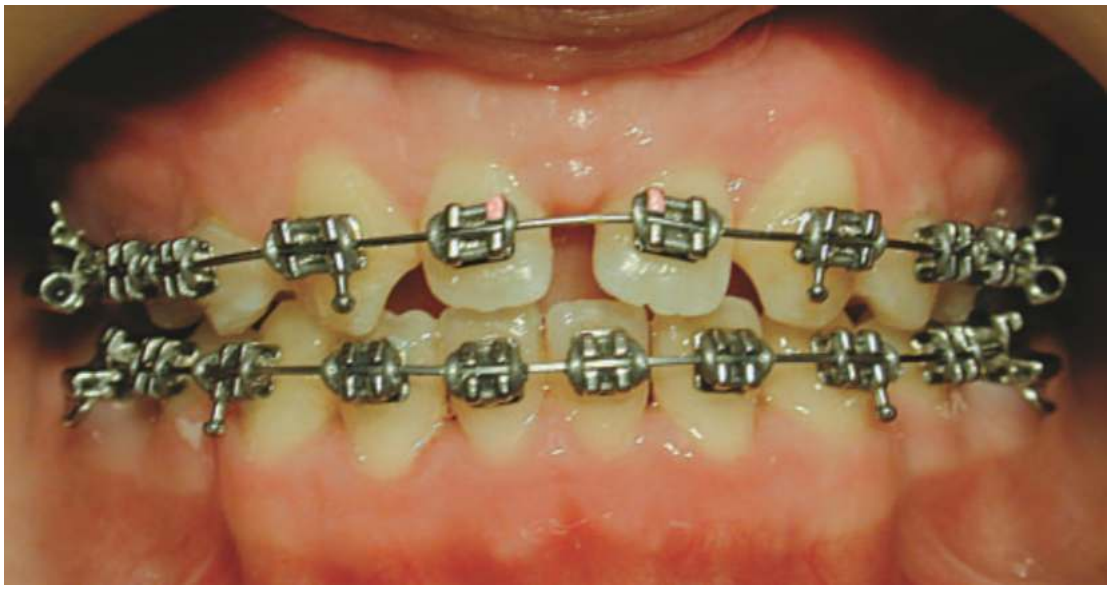

Figure 9: management of missing central incisor; from (Thickett et al., 2007)

Incisors in class 3

In class 3 cases, there is a need for upper incisor proclination. It is possible to invert incisor brackets for labial root torque, MBT giving the greatest change at 34° (Thickett et al., 2007) although there are concerns that this amount of torque risks root resorption (Arun & Kallur, 2008).

Upper premolar substituting canine

In cases where the canine is absent or replacing the lateral incisor, placement of the bracket more distally on the premolar moves the palatal cusp out of the way (Singh, 2017). Smoothing the palatal cusp of the first premolar may be required to further hide it or improve occlusal interference.

Case finishing

In order to achieve good finishing and occlusion in MBT prescription, lower second molar tubes can be used on the contralateral upper first and second molars to result in zero tip

and zero rotation, resulting in mesio-palatal rotation of upper molars, as shown in figure 10 (McLaughlin et al., 2002).

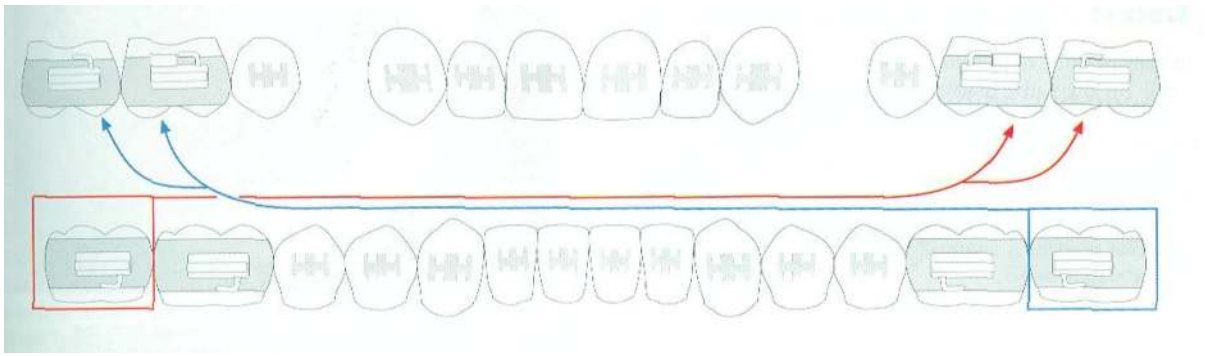

Figure 10: case finishing molars, from (McLaughlin et al., 2002)

Does the prescription matter?

Moesi et al and Mittal et al demonstrated that there was no difference in subjective aesthetic judgement or anterior tooth angulation between MBT and Roth bracket prescriptions, and small changes in the prescription do not make clinically detectable results (Kattner & Schneider, 1993; Mittal et al., 2015; Moesi et al., 2013).

The concept of torsional (slot) play must be addressed. The engagement angle between the bracket and wire is variable, so small changes in brackets may not fully express as the working wire only engages the bracket at few points and full prescription expression may never occur (Figure 11) (Archambault et al., 2010).

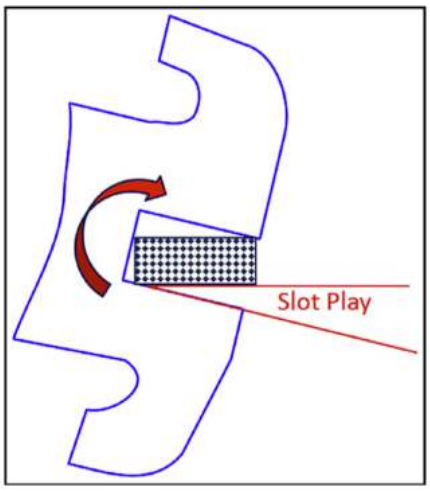

Figure 11: the concept of torsional play; from (Johnson, 2013)

Prescription expression is dependent on the working archwire and the variation in engagement. Figure 12 shows increasing the thickness of archwires in different bracket slots decreases torsional play; a change in archwire is a similar difference to the prescription difference in degrees between Roth and MBT (Archambault et al., 2010; Badawi et al., 2008; Moesi et al., 2013). Using a wire sequence that gradually expresses the prescription and finishing cases in the thickest wire possible is therefore essential (Badawi et al., 2008; Moesi et al., 2013). Errors in prescription can also stem from improper machining (Cash, Good, Curtis, & McDonald, 2004). In an attempt to express more of the desired values, high torque prescriptions have been advocated (Gioka & Eliades, 2004).

Nominal wire size	*0.018 slot*	*0.022 slot*
0.014 × 0.025	12.0	24.4
0.016 × 0.016	11.6	Spin
0.016 × 0.022	7.8	21.7
0.016 × 0.025	6.7	18.1
0.017 × 0.017	6.5	28.5
0.017 × 0.022	4.8	18.0
0.017 × 0.025	4.2	15.1
0.0175 × 0.0175	4.3	23.4
0.018 × 0.018	2.4	19.5
0.018 × 0.025	1.7	12.5
0.019 × 0.025	X	9.5
0.020 × 0.020	X	8.9
0.021 × 0.016	X	7.1
0.021 × 0.021	X	5.1
0.021 × 0.025	X	4.2
0.022 × 0.018	X	2.4
0.022 × 0.025	X	1.7

Calculation assumptions: wires undersized by 0.0002 in; slots oversized by 0.0005 in; wire corner radius = .0004 in.

Figure 12: change in wire size versus slop; from (Johnson, 2013)

Conclusion

Clinicians must understand prescriptions to achieve ideal tooth position. Even with pre-adjusted appliances, achieving all six keys of occlusion is still difficult (Davies, Gray, Sandler, & O'Brien, 2001; Kattner & Schneider, 1993). There is a need for a bracket inventory to include a variety of prescriptions and the knowledge to apply them in different scenarios for individual patient needs. Whilst the pre-adjusted appliance is economical and efficient, and has no doubt revolutionised orthodontic treatment, it relies heavily on accuracy of bracket placement, and no single prescription totally eliminates wire bending. The outcome of orthodontic treatment, however, does not rely on the prescription alone (Kattner & Schneider, 1993; Lotzof, Fine, & Cisneros, 1996; Thickett et al., 2007).

References

Andrews, L. F. (1972). The six keys to normal occlusion. *Am J Orthod, 62*, 296-309.

Andrews, L. F. (1979). The straight-wire appliance. *Br J Orthod, 6*, 125-143.

Archambault, A., Lacoursiere, R., Badawi, H., Major, P. W., Carey, J., & Flores-Mir, C. (2010). Torque expression in stainless steel orthodontic brackets. A systematic review. *Angle Orthod, 80*(1), 201-210. doi:10.2319/080508-352.1

Arun, A. V., & Kallur, R. (2008). Choosing a pre-adjusted orthodontic appliance prescription for anterior teeth. *J Orthod, 35*(1), 59; author reply 59-60. doi:10.1179/146531207225022446

10.1179/jor.35.1.59

Badawi, H. M., Toogood, R. W., Carey, J. P., Heo, G., & Major, P. W. (2008). Torque expression of self-ligating brackets. *Am J Orthod Dentofacial Orthop, 133*(5), 721-728. doi:10.1016/j.ajodo.2006.01.051

Cash, A. C., Good, S. A., Curtis, R. V., & McDonald, F. (2004). An evaluation of slot size in orthodontic brackets - are standards as expected? *Angle Orthod, 74*(4), 450-453.

Davies, S. J., Gray, R. M. J., Sandler, P. J., & O'Brien, K. (2001). Orthodontics and occlusion. *Br Dent J, 191*(10), 539-549.

Erratum. (2014). *Journal of Orthodontics, 36*(1), 70-70. doi:10.1179/jor.2009.1.70

Fleming, P. S., DiBiase, A. T., Sarri, G., & Lee, R. T. (2009). Comparison of mandibular arch changes during alignment and leveling with 2 preadjusted edgewise appliances. *Am J Orthod Dentofacial Orthop, 136*(3), 340-347. doi:10.1016/j.ajodo.2007.08.030

Gioka, C., & Eliades, T. (2004). Materials-induced variation in the torque expression of preadjusted appliances. *American Journal of Orthodontics and Dentofacial Orthopedics, 125*(3), 323-328. doi:10.1016/j.ajodo.2003.02.007

Johnson, E. (2013). Selecting custom torque prescriptions for the straight-wire appliance. *Am J Orthod Dentofacial Orthop, 143*(4 Suppl), S161-167. doi:10.1016/j.ajodo.2012.09.003

Kattner, P. F., & Schneider, B. J. (1993). Comparison of roth appliance and standard edgewise appliance treatment results. *Am J Orthod Dentofac Orthop, 103*(1), 24-32.

Lotzof, L. P., Fine, H. A., & Cisneros, G. J. (1996). Canine retraction: A comparison of two preadjusted bracket systems. *Am J Orthod Dentofac Orthop, 110*, 191-196.

McLaughlin, R. P., Bennett, J. C., & Trevisi, H. J. (2002). Systemised Orthodontic Treatment Mechanics. *Mosby*.

Mittal, M., Thiruvenkatachari, B., Sandler, P. J., & Benson, P. E. (2015). A three-dimensional comparison of torque achieved with a preadjusted edgewise appliance using a Roth or MBT prescription. *Angle Orthod, 85*(2), 292-297. doi:10.2319/122313-941

Moesi, B., Dyer, F., & Benson, P. E. (2013). Roth versus MBT: does bracket prescription have an effect on the subjective outcome of pre-adjusted edgewise treatment? *Eur J Orthod, 35*(2), 236-243.

Mohammadi, A., & Moslemzadeh, S. H. (2011). Comparison of the accuracy of bracket placement with height bracket positioning gauge and boone gauge. *J Dent Res Dent Clin Dent Pros, 5*(4), 111-118.

Singh, P. (2017). Fixed appliances and bracket prescriptions. *BPP Lecture, May 2017*.

Thickett, E., Taylor, N. G., & Hodge, T. (2007). Choosing a pre-adjusted orthodontic appliance prescription for anterior teeth. *J Orthod, 34*(2), 95-100. doi:10.1179/146531207225021996