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CLINICAL SECTION

Choosing a pre-adjusted orthodontic appliance prescription for anterior teeth

Eleanor Thickett
Royal Bournemouth Hospital, Bournemouth, UK

Nigel G. Taylor and Trevor Hodge
Royal Surrey County Hospital, Guildford, UK

A common orthodontic task is to correct anterior tooth position using brackets whose torque, tip and in-out are pre-adjusted. Bracket prescription greatly influences final aesthetics and function. Pre-adjusted orthodontic brackets have in-built prescriptions of torque, tip and in-out which are optimized for average cases. Refinement of tooth position can be achieved by archwire adjustment or archwire auxiliaries. Modifications to bracket position such as inversion can also help achieve individual tooth movements. Planning bracket position must be considered at the outset of treatment to achieve the maximum benefit. A number of clinical scenarios will be discussed including: a Class II division 1 malocclusion with lateral incisors palatally displaced, and another case with absent lateral incisors for space closure. Also, Class III malocclusions with consideration given to: canine angulation; a palatally displaced canine requiring labial movement; absent upper central incisors (space closure), and finally, a Class III case where incisor inclination requires consideration.

By using a typodont to illustrate some of the points, this article aims to (1) show how three pre-adjusted orthodontic bracket systems (Andrews, Roth and MBT) vary significantly in their ability to influence tooth position and appearance; (2) inform clinicians how modified bracket position can influence tooth position.

Key words: Bracket prescription, variations of bracket positioning

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Introduction

For all patients, the lower third of the face, and particularly the anterior teeth are vital for social communication and acceptance. Orthodontic treatment aims to position anterior teeth to achieve optimum aesthetics and function. Over the years clinicians have considered how bracket design can achieve this treatment objective.

At the beginning of the 1970s Andrews defined six keys or characteristics of a normal occlusion:[1]

- the molar relationship;
- the crown angulation;
- crown inclination;
- rotations;
- spaces;
- occlusal plane.

Andrews[1–3] described a pre-adjusted orthodontic bracket designed to control tooth movement in three dimensions, which required fewer bends introduced into the archwire to manipulate tooth position. The buccolingual crown thickness, crown angulation and crown inclination of individual teeth from 120 study models were measured, taken from patients who had never received orthodontic treatment. These values were averaged and their values incorporated into a bracket system designed to create the six keys to occlusion.[1]

From the models the average crown angulation (tip) and inclination (torque) values were calculated (see Table 1):

Andrews produced brackets for non-extraction and extraction cases. The S series were for non-extraction cases. His reasoning for this was that, in extraction cases, anti-rotation and anti-tip were to be incorporated into the bracket design. This was to eliminate the tip and rotation of the buccal surface towards the extraction site. Overcompensation of the tip allows for rebound of the tooth so that the net effect is to leave the tooth with the correct degree of tip. Further classification of the bracket types are listed below:

Address for correspondence: Miss E. Thickett, Orthodontic Department, Royal Bournemouth Hospital, Castle Lane East, Bournemouth, Dorset BH7 7DW, UK.
Email: ellie@ethickett.fsnet.co.uk

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- Class I cases with Angle's Class I molars;
- Class II cases with Angle's Class II molars, but with lower arch length problems (lower crowding/protrusion);
- Class II Classic cases with Class II molars with no lower arch length problems and lower anterior teeth in good relationship to the face.

This was further subdivided into 'types' depending on the amount of crowding in the lower arch:

- Type A: 7 mm of crowding
- Type B: 10 mm of crowding
- Type C: 14 mm of crowding

Roth[4] introduced further modifications in an attempt to reduce the number of bracket types required using Andrews' prescription. Roth introduced a prescription for a set of brackets that would be applicable to most cases, so reducing the bracket inventory was required. Roth found that a large percentage of his cases could be treated with a prescription selected from Andrews' Set C upper incisor brackets, Set S lower brackets, minimum translation brackets in the upper posterior buccal segments/lower canines, and maximum translation series brackets on the upper canines and lower posterior segments. This then became the Roth prescription. However, Roth also proposed increasing the tip for the canine brackets to facilitate canine guidance and added distal crown tip on the lower buccal segments because he felt his prescription would be more anchorage demanding. Finally, the Roth prescription, in addition to having more tip and torque in the anterior region, was also intended to increase upper molar torque to prevent the palatal cusps dropping.

The variations proposed by McLaughlin, Bennett and Trevisi (MBT) aim to further improve the results of completed cases.[5,6] These clinicians suggested a reduction in the anterior tip found in the Andrews and Roth prescriptions to values much closer to Andrews' original data. The aim was to reduce the strain on molar anchorage and to avoid arch length increases that can occur in treatment. In addition, a reduction in tip of the canines has also been introduced in the MBT prescription to reduce the risk of cuspid and bicuspid roots coming in close proximity, and to allow the crowns to be placed in a slightly more upright position, thus reducing the anchorage demand. The tip on the upper posterior teeth is also reduced in the MBT system further reducing anchorage demands.

Variations in torque with the MBT system are recommendations based on the personal observations of its founders. Palatal root torque has been increased in the upper arch to account for the loss of torque that commonly occurs when using other pre-adjusted appliances during overjet reduction and space closure. This can occur as a result of excessive forces due to the 10° of slop of a 019 × 25-inch archwire in a 022 × 028-inch slot. Conversely, in the lower arch the labial root torque has been increased to prevent the tendency of the lower incisors to procline, which can occur during levelling of the curve of Spee and elimination of lower incisor crowding.[7]

Pre-adjusted brackets have been developed with different prescriptions designed to reduce or avoid the need for first, second and third order adjustments of the wire during treatment:

- *Incorporation of first order or in-out adjustment:* Variation of the base bracket thickness around the arch reduces the need for compensating in-out bends.
- *Incorporation of second order or tip adjustment:* Angulation of the bracket slot reduces the need for tip bends in the archwire.
- *Incorporation of third order or torque adjustment:* Bracket slots are inclined to compensate for the inclination of the facial surfaces of the tooth therefore reducing the need for torque in the archwire.

The angulation and torque values (second and third order bends) built into the bracket are often referred to as the appliance/bracket prescription. Prescriptions for Andrews, Roth, and MBT straight wire appliances systems are presented in Tables 2 and 3.

Table 1 Andrews prescription values for tip and torque.

Tip°							
Upper	3.59	8.04	8.4	2.7	2.8	5.7	0.4
Teeth	1	2	3	4	5	6	7
Lower	0.53	0.38	2.5	1.3	1.54	2.0	2.9
Torque°							
Upper	6.11	4.42	−7.3	−8.5	−8.9	−11.5	−8.1
Teeth	1	2	3	4	5	6	7
Lower	−1.71	−3.24	−12.7	−19.0	−23.6	−30.7	−36.0

Table 2 Tip values for the three bracket prescriptions (degrees).

Tip or second order								
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	Andrews	2	2	5	2	2	2	2
	Roth	2	2	7	−1	−1	−1	−1
	MBT	4	8	8	0	0	0	0

Aims

- To show how three pre-adjusted orthodontic bracket systems (Andrews, Roth and MBT) vary significantly in their ability to influence tooth position and appearance.
- To inform clinicians how modified bracket position can influence tooth position.

Bracket variations

Various suggestions have been made regarding bracket choice and positioning to optimize tooth position when teeth are absent or where an attempt is made to overcome a local problem of tooth position. The aim is to reduce the need for archwire adjustments or auxiliaries. Careful bracket selection and positioning simplifies the treatment of localized anomalies in the following situations:

- Class II division 1 malocclusion with lateral incisors palatally displaced;
- absent lateral incisor: space closure;
- Class III malocclusions: canine angulation;
- palatally displaced canine: labial movement;
- absent upper central incisors: space closure;
- Class III: incisor inclination.

Class II division 1 malocclusion with lateral incisors palatally displaced

In Class II division 1 malocclusions, the upper lateral incisors may be palatally displaced. Orthodontic treatment aims to align both crown and root; however, a standard lateral incisor bracket may provide insufficient labial root torque to position the lateral incisor root correctly. Labial root torque may be introduced into the archwire with torquing pliers (e.g. Rose torquing pliers) or by a single tooth torquing auxiliary.

Table 3 Torque values for the three bracket prescriptions (degrees).

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 1 Typical bracket set-up for upper anterior teeth. It is relevant to note that variability in tooth morphology influences the root positions of these anatomically correct typodont teeth. This is especially visible for the lateral incisors in this example

A simpler solution, however, is to invert the lateral bracket. At the start of treatment bracket inversion maintains the crown angulation, but boosts labial torque by reversing slot inclination. This approach may also increase patient comfort by gradual introduction of labiolingual torque. The effect of different bracket prescriptions will now be discussed.

In the Andrews prescription a lateral incisor bracket with a 3° of torque when inverted delivers an inclination, which was increased by 6° (from –3 to 3° with the standard bracket prescription). Effective torque however, depends on the bracket prescription. Before bracket positions are modified the prescription of the brackets must be known. For instance, inverted Roth lateral incisor brackets produce a difference of 16° compared with 6° with Andrews prescription as normally positioned Roth lateral brackets have 8° of palatal root torque incorporated into their design. An MBT bracket inverted on a lateral incisor changes torque by 20° as 10° changes to −10°. Full bracket expression is unlikely with the archwire dimensions used in clinical practice. This may be further compounded by the slot size being larger than manufacturers' state.[7,8] The pure effects are best demonstrated on a typodont (Figures 1 and 2).

Absent lateral incisors: space closure

When maxillary lateral incisors are absent and space closure is planned, which bracket is best placed on the canine? The standard MBT canine bracket has 7° of labial root torque, which is appropriate for a canine in its usual position in the line of the arch. This is inappropriate, however, if this tooth is to replace a

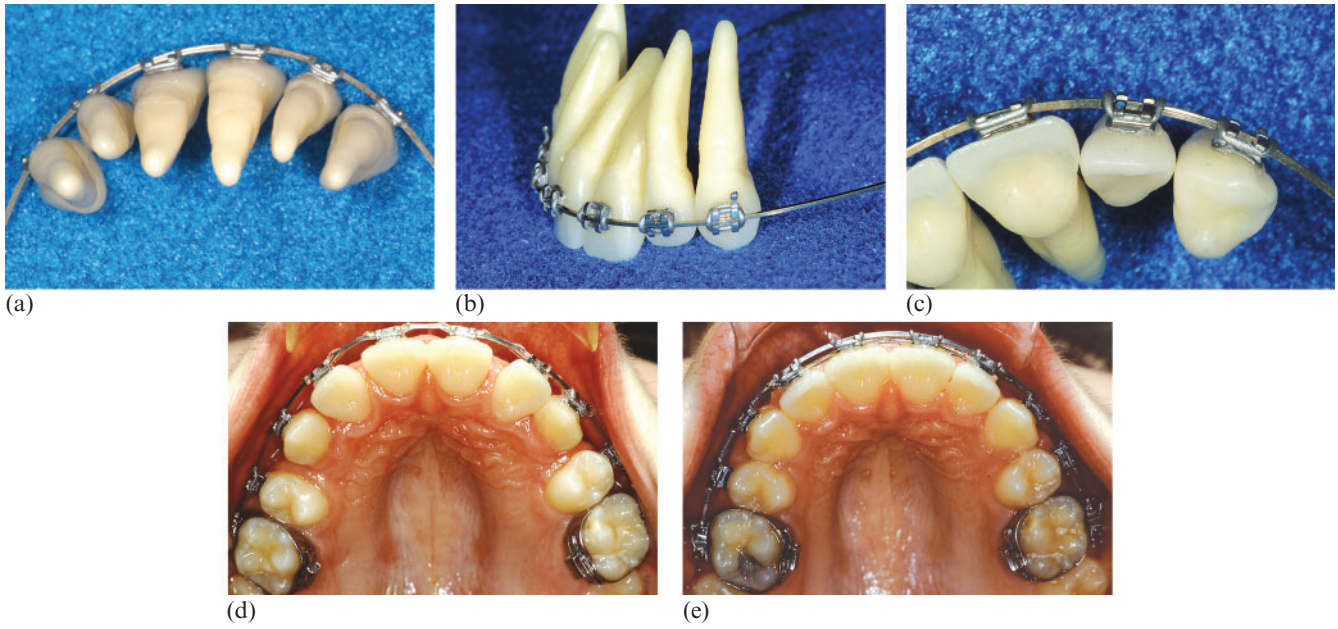


Figure 2 Inverted upper lateral incisor bracket applying additional root torque to an instanding left lateral incisor. The right-side bracket is placed in the normal position. Note the more labial position of the root apex when the bracket is inverted, reversing the torque. (a) Apical view. (b) Lateral view (c) Incisal view. (d) Clinical view start. (e) Clinical view finish

lateral incisor where palatal root torque is indicated, rather than labial torque. One suggestion is to place a lateral incisor bracket on the canine crown. However, the height of the bracket stem and the labiolingual thickness may be too great, and may position the tooth palatally in the line of the arch unless first order bends are also incorporated. Also there may be insufficient torque in view of the greater crown-root angle found in canines. Bracket fit creates a further problem as canine crown labial convexity is greater than that of the lateral incisor.

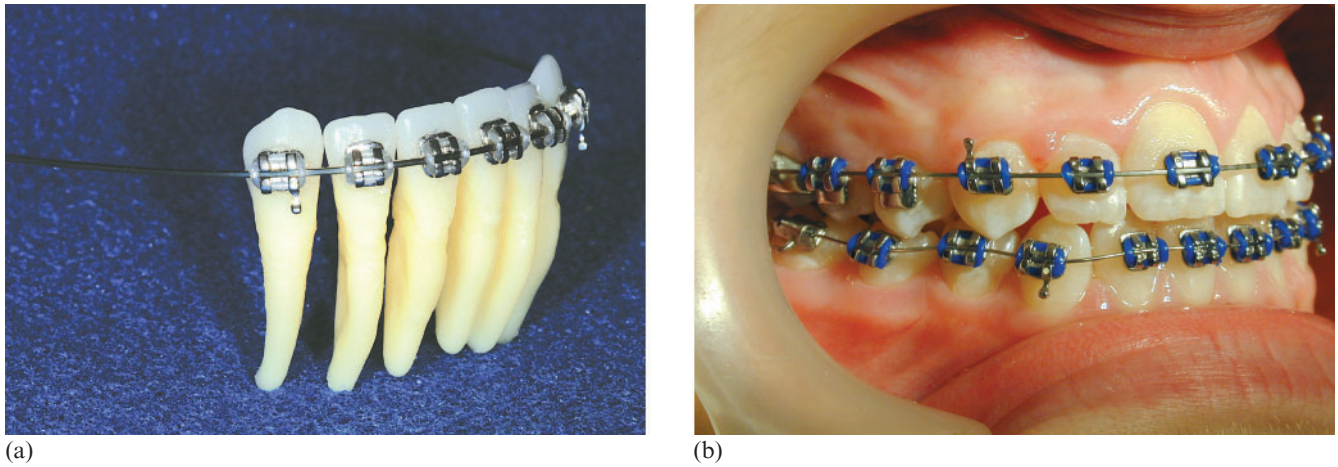
One solution is to place a lateral incisor bracket after recontouring of the canine to mimic the lateral incisor. Potential obstacles are the wide range of canine crown anatomies and unfavourable crown-root angulations.

An alternative is to invert the canine bracket on the canine tooth. This achieves a crown angulation of 11°, but 7° labial root torque becomes 7° of palatal root torque for both MBT and Andrews prescription, but slightly less for Roth brackets due to the prescription. The canine bracket is compound contoured to fit the crown surface; the bracket stem height is unchanged. Tip may be excessive where a canine is replacing a lateral incisor. Canine tip varies between different prescriptions (Table 1). In the MBT prescription, the tip value is identical for both the lateral incisor and the canine. In the Roth prescription there is a 4° difference and with the Andrews there is a difference of 2°. Therefore, a Roth bracket (with 13° of tip when inverted onto a canine replacing a lateral incisor) delivers 4° of additional tip beyond the norm for a lateral incisor (Figure 3).

Canine angulation in Class III cases

Orthodontic camouflage is carried out when a Class III malocclusion is treated by accepting the skeletal pattern; orthodontic appliances tilt the upper and lower incisors to compensate for the skeletal discrepancy. Camouflage effectively retroclines the lower labial segment. It has been suggested that contra-lateral canine brackets on the lower canines encourage the crowns to tip distally.

Figure 3 The effect of inverting canine brackets in case with absent lateral incisors and where the canines are to replace the absent teeth



(a) (b)

Figure 4 (a) Contra-lateral brackets placed upon the lower canines. The crowns are tipped distally. (b) Clinical photograph with lower canine brackets transposed to achieve dental camouflage in a Class III malocclusion

Dentoalveolar compensation is facilitated and anchorage requirements are reduced. Transposed MBT brackets attached to mandibular canines are shown in Figure 4. The outcome of bracket transposition will depend on the bracket prescription. In the Andrews prescription 5° tip becomes a 10° difference; with MBT 8° becomes a 16° difference.

Labial movement of a palatal canine

When a palatally displaced canine is moved labially, movement of the crown may occur in advance of the root leaving it unattractively tipped. Increased labial root torque overcomes this. One option is to invert the lower contra-lateral canine bracket onto the upper canine. The MBT prescription in this case would provide no benefit as the torque values are similar for the upper and lower canines. Roth and Andrews prescriptions, however, would provide a small benefit, as there is a difference of 9 and 4°, respectively. The additional labial root torque may, therefore, help to correct tooth position (Figure 5).

Absent upper central incisor: space closure

Following loss of an upper central incisor, space closure may involve moving the lateral incisor mesially. The lateral then abuts the adjacent central incisor. As the lateral moves mesially, its root should move further mesially than its crown; the mesial surface is then vertical. This permits the restorative phase to build up the distal surface with an optimal emergence profile. This avoids the problem of retention from a mesiogingival margin on the restoration. It has been suggested that it is useful to bond the contra-lateral central incisor bracket to tilt the tooth so its distal crown aspect approaches vertical.

Figure 6 shows a single absent central incisor using typodont teeth; Figure 7 shows both central incisors have been lost with both lateral incisors planned for mesial movement and restorative build up.

Incisor inclination in Class III malocclusions

When Class III malocclusions are treated orthodontically the upper incisors tend to be proclined as the malocclusion is camouflaged. Subtelny[9] and Catania[10] advocated the use of labial root torque and tying the archwire forward to advance 'A' point and boost anteroposterior arch length. The possibility exists to invert incisor brackets and use these to provide labial root torque, which may be useful in some selected cases.

Figure 5 Canine bracket inverted on the upper right canine

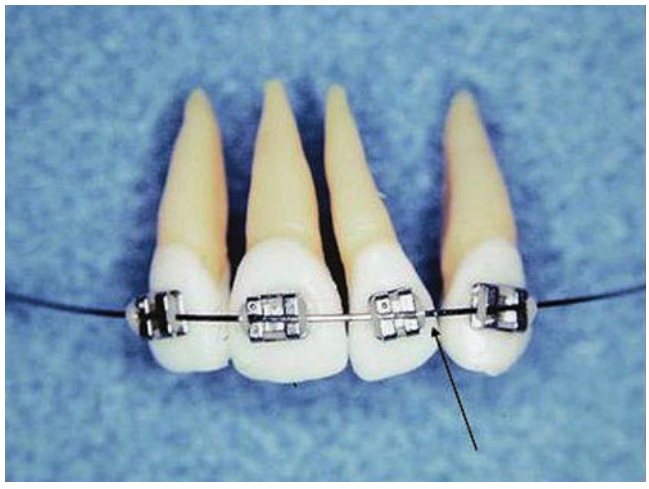


Figure 6 Contra-lateral central incisor bracket placed on the upper left lateral incisor. Note the exaggerated tip, which brings the mesial surfaces together and allows build up of the distal emergence profile

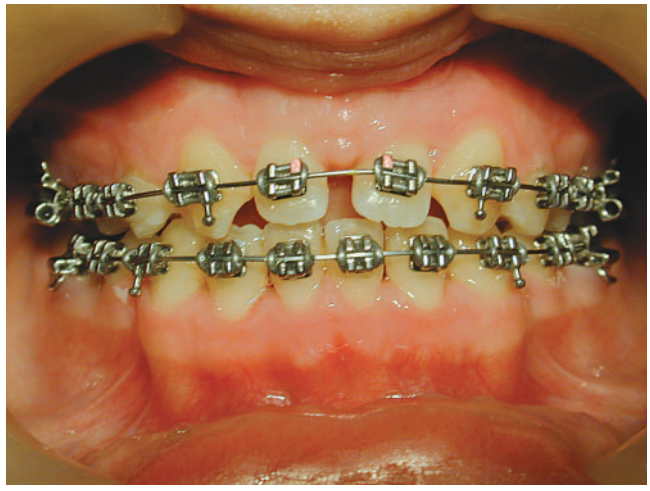


Figure 7 Clinical photograph with absent central incisors. Upper canine brackets are inverted to provide additional palatal root torque. The lateral incisor brackets are transposed to achieve improved root paralleling prior to mesial movement and restorative build-up

For the central incisors this would effectively change the torque values: Andrews 7 to -7° (a 14° change), Roth 12 to -12° (a change of 24°), and MBT 17 to -17° (a change of 34°).

Conclusion

Bracket choice is a fundamental part of treatment planning in orthodontics. A thorough knowledge of different bracket prescriptions is essential to achieve optimum tooth positioning in the most efficient way. Ideally, our inventory will offer a range of bracket prescriptions, such as the systems discussed here—Andrews, Roth and MBT—but this may be unrealistic from the point of view of cost and storage requirements. A bracket's in-built prescriptions of torque, tip and in-out need review both at treatment outset, and as teeth respond to orthodontic forces. Modifications to bracket position and prescription can maximize the potential from the pre-adjusted appliance:

- bracket inversion;
- placement of the contralateral bracket on the tooth;
- use of alternative bracket systems—Andrews versus Roth versus MBT.

It is important for those users of a single prescription that they are aware of those changes that may offer benefits and those that do not. In addition, there is no substitute for careful evaluation of tooth positioning in the final stages of treatment and the appropriate finishing bends to be placed in the archwires to achieve optimum detailing.

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