Review Article

Torque in Orthodontics – A Review

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Abstract

The fundamental goal of orthodontic treatment nowadays is appropriate soft-tissue proportions and adaptations, with a functional occlusion as a secondary goal. The orthodontist must pay close attention to the three-dimensional orientations of the patient's teeth, including intra-arch and inter-arch dental relationships, to achieve both cosmetic and functional treatment goals. The orthodontist must completely comprehend the mechanism by which orthodontic appliances induce orthodontic tooth movement, as well as the constraints of the various appliances available, to achieve the goals of orthodontic therapy, including correct torque.

Keywords: Torque, Torque review, Torquing auxiliaries, Torque prescriptions.

Introduction

The American Board of Orthodontics[1] recommends that orthodontic treatment aim to achieve eight main criteria centered on dental and occlusal relationships: Ideal tooth alignment, ideal marginal ridge alignment, correct buccolingual inclination, adequate posterior occlusal contacts, correct anteroposterior occlusal relationships, ideal overjet, tight interproximal contacts, and correct root angulation. Obtaining sufficient buccolingual inclination, also known as inclination or torque, is a difficult task.

The orthodontist must completely comprehend the mechanism by which orthodontic appliances induce orthodontic tooth movement, as well as the constraints of the various appliances available, to achieve the goals of orthodontic therapy, including correct torque.

Torque is used in orthodontics to change the inclination of all teeth, notably the incisors. The amount of variation in the buccolingual inclination of the crowns is mostly determined by the wire torque stiffness, bracket design, wire/slot play, and ligation mode. Because there are so many different factors that might affect torqueing moments, it's difficult for a practicing professional to make an empirical clinical determination of the best torqueing approach.

When it comes to incisor torque values, there is a lot of difference across prescriptions.

Biomechanics of Torque

The concept of a force, or action applied to a body, is the first to be introduced. A force is a load applied to an object that causes the thing to move to a different location in space. A force can be thought of as a push or pull that tends to affect the velocity of an item. The center of resistance can also be defined by its relationship to the force: A force for which the line of action passes through the center of resistance producing a movement of pure translation. The tooth's Center of Resistance is found along the root of the tooth, with the exact location depending on a number of circumstances. The application of a force with a line of action to this location will tend to cause translation. When a force is applied at a distance from the Center of Resistance, it tends to rotate. The magnitude of the force multiplied by the distance between the force's Line of Action and the object's Center of Resistance is known as the Moment of the Force, which is the tendency of a body to rotate. Center of rotation is the point, around which body appears to rotate, determined from initial and final position. Two non-collinear forces of equal magnitude but opposite direction make constitute a pair. The Moment of a Couple is the magnitude of one of the forces multiplied by the perpendicular distance between the two forces, and it is equal to the magnitude of one of the forces multiplied by the perpendicular distance between the two forces.[2]

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Need For Torque

1. To maintain the health of the teeth and the surrounding structures
2. Normal angulations bring about better esthetics
3. Normal axial inclination provides successful correction of Class II molar relation
4. Proper reduction of bimaxillary protrusion
5. Proper alignment of extremely crowded teeth
6. Optimal correction of extreme deep bite which requires maximum anchorage consideration and maximum anterior crown tipping
7. Proper anterior guidance during mandible excursions and proper food deflection.

Torque Force

Torque is nothing more than the twisting of an edgewise wire. When the wire is engaged in the mechanism's brackets, it tries to untwist itself, creating torque force. The operator must understand that, due to the anatomic shape of the teeth, inserting an edgewise wire in the brackets of a totally banded arch without first applying adequate torque to the wire to make it passive within the brackets is difficult.

These facts lead the orthodontist to recognize two forms of torque:

- Passive torque, which has no effect or force on the tooth when engaged
- Active torque, which has a distinct action or force on the tooth when engaged.

The torque force is named for the action it has on the tooth crown.

- Lingual torque, which causes the crown of the tooth to tip lingually and the roots to tip labially or buccally, depending on the situation
- Labial or buccal torque, which causes the crown of the tooth to be tipped labially or buccally, depending on the situation, and the roots to be tipped lingually.

The other forms of torque are:

- Continuous torque recommended in the mandibular incisor region
- Progressive torque recommended in the posterior region.

Importance of Torque

Smile esthetics

Patients with appropriate incisor crown inclination are seen to be more beautiful than those who have significant inter-incisal angles at the end of orthodontic therapy. Rather than "non-extraction heroics" or needless lateral expansion and labial tipping of the maxillary dentition,[3] fullness of the smile should be achieved by adjusting the clinical crown torque of the maxillary canines and premolars to their most esthetic look in different face types.

Stability

There is a strong argument and supporting data that the mandibular intercanine and, to a lesser degree, inter-molar transverse dimensions are somewhat immutable and constant (with a minor decline with age), and that any significant enlargement is doomed to relapse (unless, of course, this can be counteracted by lifetime retention). In contrast to inter-molar width, studies have shown that mandibular inter-canine width can survive just a minor increase (an average of 0.5 mm). The extension of the maxillary palatal suture is an obvious exception. Expanding the mandibular posterior teeth to have them relapse to a pre-treatment arch dimension and/or an inclination of about −25° to −30° does not make much sense.[4]

Function

To avoid impending functional interaction with the maxillary posterior teeth, the mandibular first molars are lingually inclined. This design directs masticated food inside toward the tongue rather than outward toward the cheeks, allowing for more effective chewing. The maxillary first molars (facial surface crowns) are also lingually inclined (−9) degrees, with the mandibular first molars inclined in a 3:1 ratio more than the maxillary first molars. This is because the mandible (and mandibular teeth) attack the maxillary teeth at an inward angle during trituration; as a result, the maxillary posterior teeth (crowns) have functionally adapted to accept forces at an inner angle and avoid occlusal interferences.[4]

Effect on teeth

In orthodontic treatment, appropriate buccolingual inclination of both posterior and anterior teeth is regarded vital for providing stability and a good occlusal connection. Andrew considers crown inclination (labio-lingual or buccolingual inclination) to be the third key to proper occlusion. The fullness of the lips is influenced by the post-treatment anteroposterior position of the mandibular incisors, which plays an important role in orthodontic treatment planning.

a. Anterior tooth torque: Because under torqued front teeth might prevent the anterior maxillary dentition from moving distally, torque of the maxillary incisors is especially important in maintaining an esthetic mouth line, correct anterior guiding, and a stable Class I relation.
b. Posterior teeth torque: Mandibular molar lingual crown torque increases progressively from the first to the third molar in the adult dentition. From the first to the third molar, the buccal crown torque of the maxillary molar increases.

Effect on apical bases

Torque aids the orthodontist in achieving a desired shift in points A and B, which in turn aids the orthodontist in achieving desired facial alterations in his patients. Many undesirable tooth motions will occur if the orthodontist does not comprehend torque, making orthodontic treatment more complicated and the treatment results less acceptable. The reduction of the disparity between the angles SNA and SNB is one of the most

commonly encountered issues. The anterior teeth must be moved to achieve this decrease. Without the right application of torque force, this movement will not be possible.[5]

Torque Requirements in Maxillary and Mandibular Arch Wire

Both the maxillary and mandibular anterior teeth should have lingual root torque for optimal axial inclinations. In the mandibular posterior teeth, the arch wire should have lingual crown torque, while canines do not require any torque to provide adequate occlusion.

Anterior torque

The essential criterion is that the wire must fill the bracket, which means that the wire's diagonal dimensions must exceed the occlusogingival width of the bracket slot to maintain twist activation. To provide lingual root torque to the maxillary anterior region, hold the pliers mesial to a V bend and bend the wire in the gingival direction.

Posterior torque

It can be one of two types.

- Continuous
- Progressive

Brodie began by emphasizing the need of progressive torque in achieving mass torque action in the buccal section. Otherwise, when the wire is inserted in the cuspid tooth's bracket, the bracket eliminates the torque action from the teeth distal to the cuspid tooth, and the wire remains passive in the brackets of each successive tooth until the cuspid tooth movement is complete.

Tissue Reactions to Torque

The pressure area is frequently near to the central region of the root during the early movement of the torque as the PDL is wider in the apical third than in the middle third. The apical surface of the root gradually begins to compress nearby periodontal fibers after loss of bone sections corresponding to the middle third, establishing a broader pressure area. For tooth movement to occur, high stress levels in the apical area necessitate considerable bone resorption. Undermining resorption, which causes a considerable decrease in movement, may occur as a result of this concentration of stresses.[6]

Root resorption and torque

Most examinations have established that root resorption is widespread after orthodontic treatment since Ketcham's first comprehensive study on the subject. The prevalence appears to be dependent on a number of factors, including the root resorption criterion employed, the type of appliance and forces used, the extent of tooth movement, the length of the active treatment period, and the patient's age. There appears to be no such thing as safe tooth mobility. Intrusion and torque are likely to be the most damaging to the involved tooth.

As a result, there is no standard approach for reducing iatrogenic root resorption. The clinician must evaluate the anatomical environment as shown by radiographs with great attention. Following procedures must be based on these findings. As long as the movement is active, radiographic examinations must be performed at regular intervals.

Torque Angle's Impact on the Critical Contact Angle

Defined as angle at which clearance between arch wire and bracket first disappears. If the angulation between the archwire and the bracket slot is less than the critical contact angle, no binding or notching occurs; if this angle is equal to or greater than the critical contact angle, binding occurs.

The essential contact angle dropped as bracket width, torque angle, and wire size increased, according to the study's findings. It was found that as the torque angle was increased up to 7.24°, the critical contact angle decreased to zero, and further increases in the torque angle will lead to full expression of torque in the tooth for various arch wire and bracket slot combinations, such as.019–0.025" arch wire in a.022–0.028 inch slot. This means that the amount of torque applied to the archwire should be >7.24° if this archwire bracket combination is utilized to exert torque on a tooth.

Torque with Various Appliance Systems

- Removable Appliances
- Edgewise Appliance
- Begg Technique
- Pre-Adjusted Edgewise Appliance - Various Prescriptions
- Modern Begg Technique
- Lingual Technique
- Clear Plastic Appliances

Removable appliances

Many minor malocclusions can be treated using removable appliances; however, because removable equipment can only tip crowns, it has been impossible to torque roots, especially in cases when anterior teeth are spaced. Although removable appliances can effectively close voids in these circumstances, the anterior teeth still retain labial root prominence at the completion of therapy. A new procedure for root tipping anterior teeth with removable appliances was developed to eliminate this problem and the necessity for a fixed appliance to rectify it. For additional anchorage and to resist leverage in the anterior region, a removable appliance is made in the traditional fashion, with Adams clasps on first permanent molars and triangle clasps between first and second premolars.

Root movement has also been achieved with the use of removable appliances. Root movement can be accomplished with a variety of torqueing springs. Normally, they get their elasticity by twisting a section of wire, similar to how torque bars made of high tensile steels are employed in load vehicles'

suspension systems. The following are the components of a conventional torqueing spring:

1. Torque bars
2. Base plate to which it is firmly fixed
3. Apron spring for torqueing.

These springs are adaptable, simple to make, and simple to position and alter.

Watkin (1933) employed a box type attachment in his adaptation of the pin and tube device, while Friel and McKeag described a stainless steel box attachment (1938). The "McKeag Box" was the name given to this box.[7]

Edgewise appliance

During the first 30 years of the last century Dr. Edward H. Angle pioneered the edgewise mechanism, moving orthodontics from the conventional E. arch to the ribbon arch. The edgewise mechanism makes a unique addition to achieving orthodontic treatment goals by allowing complete control over the axial inclination of all teeth in all directions.[8]

To resolve the ambiguous wording, a discussion of passive torque is required. We must recognize that, due to the anatomic shape of the teeth, inserting an edgewise wire in the brackets of a completely banded arch without first applying adequate torque to the wire to make it passive within the brackets is difficult.[5]

An operator must have progressive lingual torque from the cuspid distal and labial torque in the incisal segment in the mandibular arch in order to construct a passive edgewise wire after leveling. Both the maxillary and mandibular arches have identical torque requirements. Lingual root torque should be present in both the maxillary and mandibular anterior teeth for optimal axial inclination. The arch wire should have lingual crown torque in the mandibular posterior teeth and buccal root torque in the maxillary posterior teeth to ensure proper occlusion. As a result, the torque bends in both arches are similar.

Torque technique

With rectangular wires, active torque must be handled with extreme caution. A definite approach should be created so that torque may be generated, increased or decreased as needed, with assurance that the required action has been achieved.

On the wire, each inter-proximal area is noted, including the inter-proximal area of the right cuspid and premolar. Place a slight "V-bend" at the inter-proximal area of the lateral incisor and cuspid as the next stage. It has the following functions:

1. To distinguish the anterior and posterior segments
2. To solder attachments
3. To give independent anterior and posterior root torque.

Torqueing individual teeth

Mark the inter-proximal spaces on each side of the tooth with the arch wire. Remove the passive arch wire and grip it with the groove in the No. 142 plier mesially to the mesial mark. Because a short segment of torqued wire cannot be held securely, it is difficult to seat with the fingers. Because torque bends frequently damage the plane of the arch, the arch wire is repositioned on the arch wire diagram and symmetry is re-established after each torque bend. After all bends in the arch wires have been established, both arch wires should be checked against the initial malocclusion model, and the arch form should be made to adhere to the type required for the specific case, with any modifications indicated by the proposed treatment.

Commercially available torqueing mechanisms[9]

The Muir torqueing mechanism is made by Unitek Corporation and consists of loops on an archwire that become active when the arms extending posteriorly are joined.

Warren anterior torqueing springs are made by Rocky Mountain Dental Products Company and have separate loops that fit over a normal rectangular archwire and bear against the crowns of teeth close to the gingiva.[10]

A spur torqueing auxiliary wire with two or four spurs placed at varied distances is also available from TP Laboratories, Inc. Spurs are included into the series loops and bear against the crown surfaces of the teeth.

Problems with edgewise torque

By inserting an active rectangular wire into a rectangular bracket slot, edgewise mechanics torques teeth. The equal and opposite reciprocals are received by the directly neighboring teeth, which are often overlooked. As a result of both the desired tooth movement and the generally undesirable opposite movement of the adjacent teeth, the faciolingual disparity between adjacent teeth is reduced. To rotate all of the incisors in the same faciolingual direction, traditional progressive torque necessitates the placement of incremental archwire bends, all acting in the same direction, between contiguous teeth.

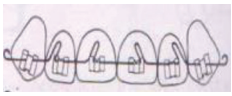
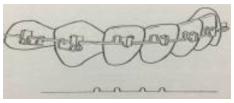
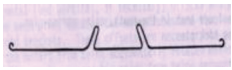
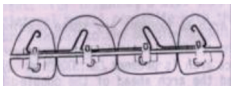
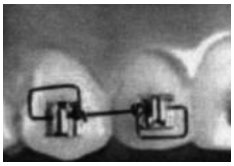
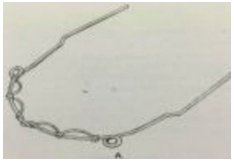
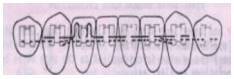
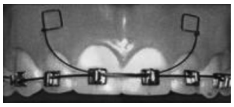
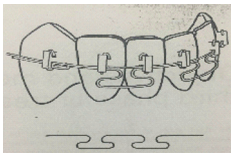
Torqued bracket slots

The slot is cut at a right angle to the base in the original and most basic edgewise bracket. To achieve proper crown-root inclinations, the rectangular archwire must be twisted or torqued. A somewhat empirical approach is used to add torque to a square or rectangular archwire. Manufacturers began offering brackets with torqued slots in the late 1950s or early 1960s. These brackets were created to avoid the requirement for providing torque to the upper archwire's anterior part.[11]

Begg Technique

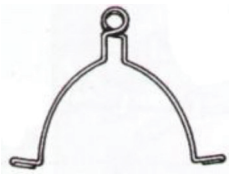
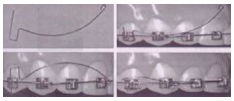
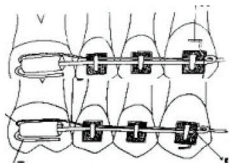
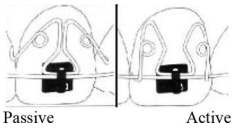
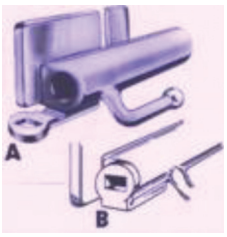
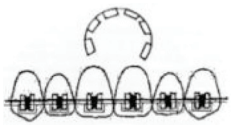
The "light wire differential force approach," also known as the "Begg technique," is based on the use of tooth moving force values that, in addition to providing a high level of control over tooth movement, are also the most physiologically acceptable to the tissues and move the teeth the fastest. The Begg approach has been separated into three treatment stages. The treatment can be separated into two phases: A crown tipping phase that covers the first two stages and a root tipping phase that covers the third stage. Most patients can tell whether or not they need to twist their incisor roots lingually by the conclusion of the second round of treatment (and sometimes even before that).

Torquing auxilaries[12]

S. No.	AUXILIARY	SYSTEM/AUTHOR	IMAGE	PURPOSE
1.	4 spurs	Beggs – stage III/Dr. P. R. Beggs		Used to palatally torque the roots of the maxillary central and lateral incisors.
2.	Brandt type 4 spurs	Beggs – stage III/Dr. P. R. Beggs		Torque the mandibular central and lateral incisor roots labially.
3.	2 spurs (van der Heydt auxiliary)	Beggs – stage III/Dr. P. R. Beggs		Used for torqueing the mandibular central incisors roots labially.
4.	Short 4 spurs	Beggs – stage III/Dr. P. R. Beggs		Used for torqueing the maxillary central and lateral incisors roots palatally without engaging cuspid bracket.
5.	Reciprocal	Beggs – stage III/Dr. P. R. Beggs		Used when the central incisors roots are to be torqued palatally and the lateral incisor roots are to be torqued labially.
6.	One to one	Beggs – stage III/Dr. P. R. Beggs		Indicated when two adjacent teeth require root torque in opposite directions.
7.	SPEC	Beggs – stage III/Dr. P. R. Beggs		Indicated when two adjacent teeth require root torque in opposite directions.
8.	Udder type	Beggs – stage III/Dr. P. R. Beggs		If the mandibular anterior teeth are becoming overly proclined, this procedure is recommended.
9.	Rat trap (Pre wound)	Beggs – stage III/Dr. P. R. Beggs		Torque the maxillary anterior roots palatally.
10.	Individual	Beggs – stage III/Dr. P. R. Beggs		When a single tooth's root needs to be torqued.
11.	Jenner	Dr. P.R. Beggs/ Beggs Stage I or II		To correct the prominent roots of maxillary or mandibular canines
12.	Buccal root torquing auxiliary	Beggs Stage III/Dr. P. R. Beggs		To provide buccal root torque to molars
13.	Vertical	Beggs Stage III/Dr. P. R. Beggs[13]		To provide lingual root torque to mandibular anterior teeth.

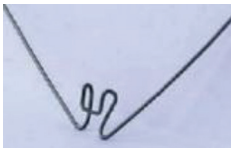
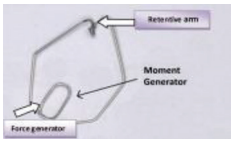
(Contd...)

Torquing auxilaries[12] *(Continued)*

S. No.	AUXILIARY	SYSTEM/AUTHOR	IMAGE	PURPOSE
14.	Kitchton	Beggs/Dr. John Kitchton		To apply palatal root torque to either the two maxillary central incisors (2 auxiliary teeth) or both sides of the maxillary central and lateral incisors [4 teeth auxiliary])
15.	Warren spring	PEA/Rocky Mountain Orthodontics		Used most commonly to apply lingual root torque, mainly to maxillary central Incisors.
16.	Universal Torqueing Spring	PEA/Dr. Jack Perlow		It can be used on extraction and non- extraction cases, on upper and lower teeth, on centrals or laterals, for labial or lingual torque.
17.	Single root	Dr. P. C. Kesling/Tip Edge		To deliver root torque to a single tooth
18.	Reverse	Franciskus Tan		It's especially good at producing a canine eminence when there's a lot of labial canine root movement. It also provides a labial root torque in palatally impacted canines.
19.	Individual Tooth Auxiliary	Dr. Anthony J. O'meara	 Passive Active	For providing palatal root torque to individual tooth.
20.	Torqueing Flaps	Tip Egde		During anterior tooth retraction, buccolingual torque management is important.
21.	Side Winder Spring	Tip Edge		For mesiodistal root movement of individual tooth
22.	Mollenhauer's Aligning Auxiliary	PEA/Dr. B. Mollenhauer		To deliver palatal root torque in anterior teeth
23.	Torqueing Bar	Tip Edge		For torqueing of maxillary incisors in late Stage III

(Contd...)

Torquing auxilaries[12] *(Continued)*

S. No.	AUXILIARY	SYSTEM/AUTHOR	IMAGE	PURPOSE
24.	Goodman torqueing Springs	PEA/Ortho Arch company		Applied labial or lingual root torque to upper or lower incisors, cuspids, or bicuspids to reduce treatment duration and prevent relapse.
25.	Simple individual Tooth Torqueing (SITT)	Dr. Jose Jacob		Torqueing of individual teeth
26.	Single tooth torqueing auxiliary	Dr. Benoy Mathews		Torqueing of partially blocked out teeth.

Pre-adjusted edgewise

One of the most essential and potent factors in the edgewise arch mechanism is edgewise wire torque. However, because it is the least discussed, it is frequently misunderstood. Each rectangular arch wire has to be twisted in the original edgewise manner. Failure to put third order bends causes the anterior teeth to become overly upright, while the buccal and lingual cusps of the molars become depressed and elevated, respectively. Placing the torque in the bracket means cutting the bracket slot into the bracket at an angle, allowing a flat rectangular archwire to be inserted into the bracket slots without the twist bends (Straight Wire).

Straight wire appliance[14]

Straight wire appliance is the only fully programmed appliance. Most treatment procedures used with any edgewise appliance can be used with a fully programmed appliance, but with less wire bending. Tooth position is referenced from the crown's facial axis not from the tooth's or Crown's long axis. Treatment mechanics in orthodontics is determined by four elements: Bracket selection, bracket positioning, archwire selection, and force levels

The Roth prescription[15]

Andrews invented the straight wire appliance, which has all of the components for a perfect result incorporated into the brackets and a unique bracket for each tooth. Roth highlighted his experiences with the Andrews Standard bracket arrangement, the disadvantage of non-angulated brackets, and torque in the base versus torque in the bracket face in his 5-year clinical study of the Andrews Straight Wire Appliance. In 1979, Roth invented a bracket system that adjusted the Andrews standard setup brackets' tip, torque, rotations, and in and out movements. The goal of the Roth concept was to offer overcorrected tooth position before the removal of the appliance, allowing the teeth to function normally in the majority of situations.

The new torqued appliance[16]

New Torqued Appliance was built by Creekmore (1973) incorporating torques and other features into the brackets for 90% of treatment, leaving 10% for adjustments in archwire required for individual cases.

Vari simplex discipline[17]

By R. G. "Wick" Alexander 1983."Vari" refers to the variety of bracket (edgewise) types used. Simplex" relates to the KISS principle (keep it simple, sir) Archwire fabrication is simplified with first, second, and third order bends placed in bracket instead of archwire. Simpler archwire afford fewer archwire changes and facilitate easier ligation and activation. Multi loop arch wires are rarely used, because they are time consuming, create food traps and often impinge over gingival tissue. Soldered hooks to the archwire avoided; as they are time consuming and can reduce wire effectiveness. Temporary ligature hooks or permanent ball hooks placed on bracket for elastic attachment. Discipline reflects the idea that orthodontist must be very knowledgeable in edgewise mechanics and must play an active role in the application of the appliance to the individual patient.

Ricketts bio progressive therapy[18]

This system has evolved from edgewise tipping introduced by Robert M Ricketts in 1920. Pre-angulated brackets: An orthodontic bracket having its slot inclined with respect to the plane, of the archwire, permitting control of the Mesio-distal (second order) angulation of the tooth, by engaging a straight wire. Pre-torqued bracket: An orthodontic bracket having its slot rotated with respect to its base (and the plane of the archwire), so that it permits control of the labio-lingual (third order) inclination of the tooth by engaging a straight rectangular archwire of suitable cross sectional dimensions. Roth was built into upper incisors and all four canines with Standard Bioprogressive setup. Originally the torqueing of the lower Buccal segment and setup bends in the arch for the premolars and molars were regulated into arch wires many clinicians still enjoy this setup because a series of preformed arches were designed which when placed into the inventory, could be applied in the individual situation.

MBT™ bracket system[19]

To complement their treatment philosophy and eliminate the perceived deficiencies of the original Straight Wire Appliance (SWA), McLaughlin and Bennett collaborated with Trevisi to redesign the SWA bracket system. When constructing the third generation of pre-adjusted brackets, the MBT system, they reexamined Andrews' initial findings and took into account additional research input from Japanese sources. Because the pre-adjusted appliance method is inefficient in providing torque because to the narrow area of torque application, it is necessary to add extra torque to the critical incisor and molar brackets to meet clinical goals with minimal wire bending.

Modern Begg technique

Thompson's[20] combination anchorage technique is intended to increase the orthodontist's treatment effectiveness. Dual-flex wires eliminate the utilization of loops in Phase I bite-opening alignment and retraction mechanics by combining arch wires such as Dual Flex 1 and 2. These are multi-segment wires with a posterior section of round 0.016-inch stainless steel and an anterior section of round 0.016-inch nickel-titanium (Titanal). A Dual Flex 2[21] wire can be employed in cases when considerable anterior resistance is required to prevent lingual movement of anterior teeth. From canine to canine, this wire has a circular 0.018-inch stainless steel posterior segment and a 0.016-inch * 0.022-inch nickel-titanium anterior segment.

Torque at the base versus Torque at the face

Torque in the base, according to Andrews, is a requirement for a fully programmed appliance that gives satisfactory results without arch wire bends, assuming the brackets are properly set. The LA point, the base point, and the slot point were all on the same horizontal plane when the brackets were designed. An acute angle at the occlusal aspect of the bracket base and an obtuse (>90) angle at the gingival aspect of the bracket base are used to achieve this. The slot axis will no longer correspond with the base point and FA point, indicating that brackets with torque in the face do not meet the tight specifications set out by the straight wire appliance. Modern bracket systems employ computer-aided design to enable greater design flexibility, not only in terms of slot placement in the brackets, but also in terms of bracket strength and features such as tie-wing depth and labio-lingual profile. With no variation in slot location, the brackets can be finished with all torque-in-base (full size and clear) or a combination of torque-in-base and torque-in-face (mid-size).

Slot inclination - In partially programmed appliances, inclinations are limited to the face of the bracket, as opposed to fully programmed appliances, which have the inclination built into the base of the bracket. Torque values are placed in the bracket slot face, but the slot point is not located on the crown's mid transverse plane. In contrast, the inclined bases of completely programmed brackets locate the slot point on the crown's mid-transverse plane, allowing the required torque to be fully expressed.[22]

Tip edge

This is done at the end of the therapy process. Nickel titanium torque bars are used to torque the roots of maxillary incisors. These are curved ribbon arch sections with a torque of 30° and dimensions of 0.022–0.018 inch. Because they are located right beneath the arch wire, these auxiliaries are completely undetectable when in use. Torque bars are used on the maxillary central incisors with special Deep Groove Brackets. These have Edgewise arch wire slots that have been pre-adjusted and are cast into the bottom of Tip Edge arch wire slots. In Stages One and Two, a cap is used to fill the Deep Groove; this is removed at the start of Stage Three, and a Torque bar is ligated firmly lingual to the circular base arch wire. Specific root torqueing auxiliary is used to torque individual teeth. These brackets are frequently used with Ceramic Tip Edge brackets that lack the Deep groove function.[23]

Self-ligating brackets

In general, self-ligating brackets fall into one of two design groups, active or passive, depending on how the slot is closed. Badawi *et al*.[24] looked at how 0.019 × 0.025-in stainless steel archwires connected to two active self-ligating brackets and two passive self-ligating brackets affected third-order moments. They came to the conclusion that active self-ligating brackets offer better torque control because the active clip drives the wire into the bracket slot. Active self-ligating brackets have less archwire bracket slop than passive self-ligating brackets. The passive self-ligating brackets produced smaller moments at low torsion angles and higher moments at high torsion angles, which made them unsuitable for clinical usage. Active self-ligating brackets offer a broader clinically useful range of torque activation and higher expression of torque at clinically usable torsion angles (0–35°) when compared to

Torque prescription	Tooth	Central incisor	Lateral incisor	Canine	1st premolar	2nd premolar	1st molar	2nd molar
The Roth prescription	Maxilla	12°	8°	−2°	−7°	−7°	−14°	−14°
	Mandible	−1°	−1°	−11°	−17°	−22°	−30°	−30°
The Vari-simplex discipline	Maxilla	14°	7°	−3°	−7°	−7°	−10°	−10°
	Mandible	−5°	−5°	−7°	−11°	−17°	−22°	−27°
The Bio-progressive system	Maxilla	22°	14°	7°	−7°	−7°	−10°	−10°
	Mandible	−1°	−1°	−7°	−11°	−17°	−27°	−27°
MBT™ bracket system	Maxilla	17°	10°	−7°, 0°, +7°	−7°	−7°	−14°	−14°
	Mandible	−6°	−6°	−6°, 0°, +6°	−12°	−17°	−20°	−10°

passive self-ligating brackets. Thomali *et al*. compared the torque expression of active and passive self-ligating brackets, concluding that the torque expression of the two brackets differed only little. When the engagement angle and slot size were both increased, the torque expression rose as well.[25]

Lingual technique[26,27]

With a lingual appliance, correct torque control is extremely challenging due to decreased arch radius, decreased interbracket distance, complicated lingual geometry, highly variable tooth morphology, and limited access and vision.

Because slight changes in labiolingual long axis inclinations of the incisors would show up as apparent height disparities, early torque control becomes more crucial with lingual brackets.

The Torque and Angulation Reference Guide (TARG) instrumentation is designed to transfer bracket prescriptions from the more reliable labial surfaces of each tooth to the lingual at a given bracket height, effectively allowing the laboratory technician to set customized torque and angulations for each individual prescription without sectioning the model. A Class II, division 2 case, for example, is marked on the prescription as requiring greater torque in the maxillary anteriors. The technician then uses the TARG to "dials" the recommended torque, positioning the lingual bracket at a higher torque angle than the averaged bracket values. The advance adhesive is then used to compensate for the lingual bracket base's fit. The torque of the maxillary and mandibular anterior teeth demands additional attention. The first is to utilize a torqueing auxiliary, similar to those used in traditional Begg mechanotherapy, where force is applied to the tooth at the incisal edge.

The usage of a torqued ribbon arch is the second option. The mandibular anterior teeth receive 45° of torque, while the maxillary anterior teeth receive 30°. When the ribbon arch passes through the cuspid-bicuspid inset, it will naturally transition to roughly 90° for the buccal portions. Rectangular wire made of beta titanium, stainless steel, or Elgiloy may also be effective. According to Hocevar, the ribbon arch is efficient for torqueing maxillary anterior teeth, and it has the added benefit of being gentler in the buccolingual directions, which is a significant benefit in lingual orthodontic therapy.

Clear plastic appliances

For those adults who want to move their teeth, clear plastic tooth shifting appliances are a great solution or responsible teens who are hesitant to wear fixed appliances, will follow the clinician's instructions, and whose primary complaint is mild to moderate alignment issues. Essix tooth movement is a biomechanical system that employs a thin, robust, and virtually invisible removable plastic prosthesis. The Essix device is regularly modified by the doctor to achieve treatment goals and, where necessary, to make in-course modifications. The Essix tooth movement mechanics give the doctor the freedom to apply force to the crown surface wherever it is most effective. Unlike an edgewise bracket, which only allows force to be applied to the bracket slot, an Essix device allows force to be applied to any part of any given surface. The type of tooth movement is determined by this force.

Essix[28]

Because the distance between opposing moments is restricted only by the length of the clinical crown measured in millimeters rather than the width of a rectangular bracket slot measured in thousandths of an inch, Essix-induced torque is more efficient than edgewise torque.

Variations in Torque Expression

Despite the plethora of empirical and scientific data demonstrating the importance of appropriate torque, there is significant variation in anterior dental torque values among varied prescriptions. Thus, the maxillary central incisor torque in pre-adjusted appliances varies from 12° in the Roth prescription to 22° in the Bio-progressive prescription, representing a difference of nearly 100% of the prescribed value. Manufacturing methods, material qualities, and biologic factors are the most common causes of torque variation.[29] Morina *et al*. evaluated the ability of traditional brackets and self-ligating brackets to generate the moment angle needed to produce torque. Ceramic brackets had the best torque maintenance, followed by typical metal brackets, self-ligating active brackets, and self-ligating passive brackets.[30]

Torque and Sliding Friction

Torque will not have a significant influence on mesiodistal sliding friction until it surpasses the wire-slot combination's third-order clearance angle. According to reports, a fully drawn, 0.019 × 0.025-inch wire in a 0.022-inch open slot has a third-order clearance of about 10°. The presence of occlusogingival normal forces between wire and slot, components of the torsional couple formed, causes an increase in friction beyond 10° of torque.

Moore *et al*. studied friction in two distinct brackets with pre-determined faciolingual tip and torque. When torque was applied, they saw a considerable increase in friction.[31] Sims *et al*. also measured the friction created by wires sliding through bracket slots that were set to input precise torque values. They discovered that when tension was applied, a self-ligating bracket consistently exhibited less resistance to sliding than two traditionally ligated brackets.[32]

According to Chung *et al*., friction in passive self-ligating systems is lower than in active self-ligating systems for modest torque angles. Differences in frictional resistances between crown attachment sets often decrease as torque increases approaching the third-order clearance angle. With this clearance removed, changes in frictional resistance may depend less on the type of ligation and more on the ligating mechanism's basic design.[33]

Torque Considerations in Adults

Using typical edgewise arches for routine torque are not always the best option. The lingual and labial cortical plates in the front region of adult teeth are typically thin and dense; if teeth are not moved gently, the apices of the teeth may be pressed against the dense alveolar bone, shortening the root as a result of resorption. The center of resistance varies with alveolar bone height, which is a crucial point to remember. Adults with alveolar bone loss will have distinct tooth mobility than teens.

In adults, a narrow arch is preferred for torque movement. If the force is applied for a long time, light wire torque might cause root resorption.

The greatest technological option for preventing root resorption is to use light torqueing forces that act intermittently over a short distance.

Conclusion

Many operators consider torque to be a forbidden and harmful force, but it is not difficult to achieve with correct understanding and a systematic, technical approach. The operator's skill to effectively regulate torque will make the difference between an artistically treated case with all of the aesthetic beauty desired in the finished denture and a tooth-straightening accomplishment with very few of these desirable attributes. Torque concerns can influence the outcome of the therapy as well as the stability of the achieved result in a variety of ways, as shown in the preceding discussion. When using any of the various treatment philosophies and appliance systems currently available to orthodontists, great caution is required when it comes to torque management.

Torque control should be maintained throughout the treatment so that teeth can be moved to their final positions as soon as the brackets are in place and the first archwires are linked in. As a result, there is a progressive progression towards completion, with less work necessary at the end.

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