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A Review: Bracket Placement And Positioning

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Abstract
Good result in orthodontic treatment heavily depends on accuracy in bracket positioning and placement. Slight error can result in deviation of final outcome. Most commonly used criteria for bracket positioning are the localizing center of crown or the distance from incisal edge. In advancement of treatment quality other criteria are also put forward by some recent authors. Bracket positioning errors could result in undesirable tooth movements like, which could be minimized by different conventional to advance technology driven method including repositioning of brackets, using 3D printing for fabrication of transfer tray. Some clinician also advocated for transfer jigs and use of customized bracket placement charts.

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I. Introduction And Background

The preadjusted bracket system "straight wire" is the most widely used in orthodontic therapy today allows the teeth to be positioned into an occlusal contact with excellent mesiodistal inclinations (tips) and excellent faciolingual inclination (torque) [1]. The anticipated results of treatment are not achieved due to inaccurate bracket placement, variations in tooth structure, and variations in the maxillary/mandibular relationships, tissue rebound, and mechanical deficiencies of edgewise orthodontic appliances [2]. To facilitate efficient treatment reduction in the duration of the treatment Correct bracket placement and positioning plays an important role, it also eliminates efforts for additional wire bending in finishing stage. Both Direct and Indirect

Bracket Placement considers factors such as base adaptation, slot angulation, mesiodistal (rotational) and vertical position [3].

Two important criteria for guiding the placement of orthodontic brackets are center of the clinical crown (CC) and the distance from incisal edge (ME). In case of anterior teeth the ME method can be considered was more accurate in determining vertical position of brackets but it is less accurate for the upper first premolars. Due to large number of variation in the upper second premolars great difficulty could be encountered in vertical bracket placement. Vertical error could be minimized errors in the accuracy of bracket placement in the vertical dimension by using height gauges [4]. The center of the clinical crown is considered to be reproducible despite variation in individual tooth but anomalies in tooth length such as incisal wear and gingival architecture be accounted where gingival recontouring or direct bonding is planned.

II. Bracket Placement And Tooth Structure

Various recommendation was done from the position of the bracket where it fits better mechanically to at the center of the labial surface of the tooth and finally placement at the junction of the middle and the incisal thirds of the crown was recommended for anterior tooth [5]. Some recommended marginal ridges as guide for vertical positioning of brackets [6]. Recently, guidelines of the bracket uses (vertical tie wings) parallel to the long axis of the clinical crown and middle of its slot base is at the same height as the middle of the clinical crown [7].

Table 1: Recommended landmarks, definitions and clinical importance

Landmark	Definition	Clinical Importance
FACC	Facial Axis of Clinical Crown	Primary vertical reference line
FA Point	Midpoint of FACC	Ideal center for bracket placement
Gingival Margin	Cervical limit of crown	Used when measuring height from gingiva
Gingival Margin	Cervical limit of crown	Used when measuring height from gingiva

Maxillary incisors to facilitate slight bite opening, the brackets are placed on the maxillary incisors at 3.5 to 4.0 mm above the incisal edge, as measured from the center of the bracket slot.it is placed at the mesiodistal center of the crown, and the wings of the bracket should be parallel the long axis of the crown. In case of the lateral incisors it could be positioned 0.5 mm gingival to the incisal edges of the central incisors or at the same level [8].

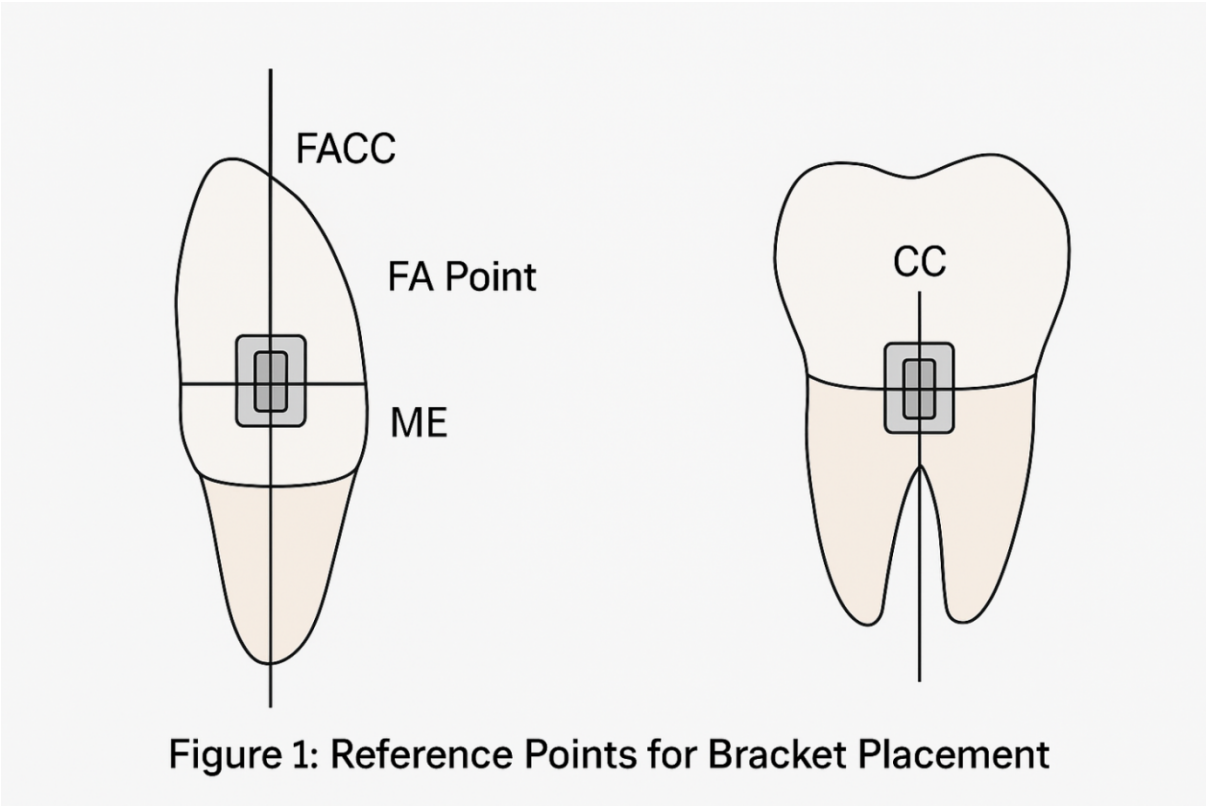


Figure 1: Reference Points for Bracket Placement

In Maxillary canines and premolars the bracket placement on maxillary canines is similar to that of the central incisors, in that the bracket. After determination of midline of the tooth by examining the buccal and lingual cusps, bracket is placed at the mesiodistal center of the buccal surface. In case of second premolar Placing the bracket in a should be placed more anterior in position on the buccal surface. It will result in slight distal rotation of the maxillary premolar [9,10].

In Mandibular incisors brackets are placed at the mesiodistal center of the crowns and toward the incisal edge. In patients having extreme deep bite position of bracket is a more gingivaly may lead to extrusion of teeth, which result in more complexity in overbite correction. In cases of extreme deep bite instances of excessive vertical overlap of the teeth, appliances should be placed on upper arch first. leveling and intrusive mechanics such as utility arch, anterior bite plate, "turbo-tails" can be used to open the bite anteriorly before placing bracket on lower arch [11].

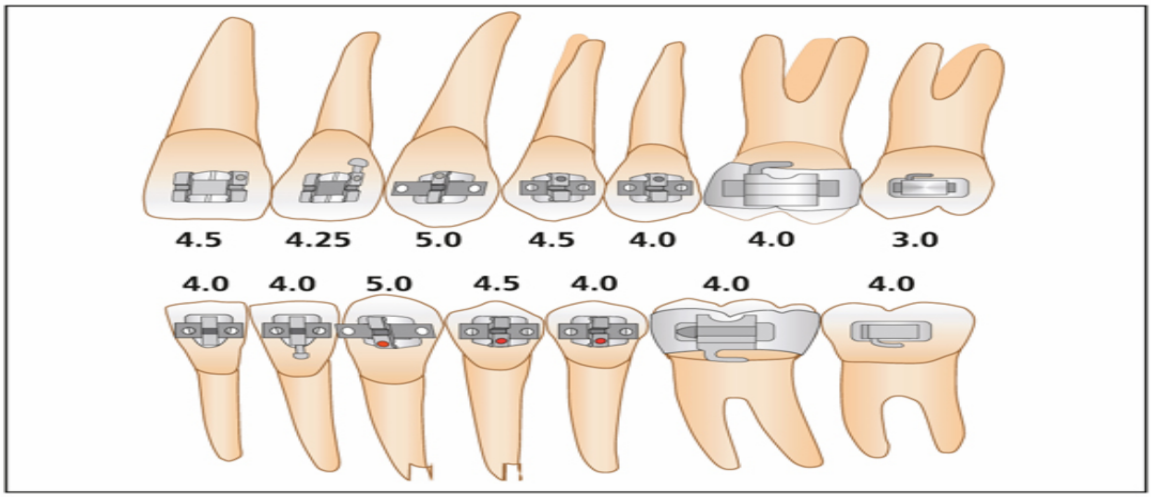
For Mandibular canines and premolars every effort should be made to place the brackets gingivally, especially in the region of the mandibular second premolar, so that the brackets are out of occlusion [12].

Table 2: Recommended Heights of respective tooth.

Tooth Type	**Recommended Height (mm)**	**Notes**
Maxillary Central Incisor	3.5–4.0	Slight bite opening
Maxillary Lateral Incisor	3.0–3.5	0.5 mm gingival to central
Maxillary Canine	4.5	Centered mesiodistally
Maxillary First Premolar	4.5	Slightly anterior placement
Mandibular Central/Lateral Incisor	3.0	Near incisal edge

Mandibular Canine	4.0	Gingival placement preferred
Mandibular Premolar	4.5	Out of occlusion

Figure 2: recommended heights.[19]



III. Common Specific Bracket Errors

Bracket positioning errors could be three dimensional: horizontal, axial and vertical which leads to undesirable tooth movements. Despite the use of gauges and bracket positioning charts , occurrence of errors is a common sight in practice [13].

If bracket not positioned parallel to long axis of the Maxillary central incisors, tooth angulation and associated rotational discrepancy might occur. In case of maxillary lateral incisors bracket placed too incisally can lead to intrusion and increased vertical step between incisal edges of adjacent maxillary central incisor and canine. Horizontal positioningof brackets in Maxillary canines can cause rotational discrepancy. In maxillary premolar occlusally placed bracket could result into intrusion of the tooth resulting in marginal ridge discrepancies between adjacent molar and poor buccal occlusion interdigitation. If Molar tube/band placed too gingival (particularly over-seating palatally) in Maxillary first molars, extrusion of the tooth resulting in marginal ridge discrepancies between adjacent premolar, poor buccal occlusion interdigitation and reduction in overbite.

Horizontal positioning of bracket in mandibular canines usually result in distal rotational discrepancy (mesio-lingual), which may complicate fixed retainer placement unless corrected. If mandibular premolars bracket placed too occlusally leads to intrusion of the tooth resulting in marginal ridge discrepancies between adjacent molar and poor buccal occlusion interdigitation. For Mandibular first molars if Molar tube/band placed too gingival extrusion of the tooth resulting in marginal ridge discrepancies between adjacent premolar and poor buccal occlusion interdigitation lingual crown inclination can also develop [14].

Table 3: Common errors, involved teeth and clinical effects

Error Type	**Tooth Involved**	**Clinical Effect**
Bracket too incisal	Maxillary lateral incisor	Intrusion, vertical step

Bracket too gingival	Maxillary first molar	Extrusion, marginal ridge discrepancy
Horizontal misplacement	Mandibular canine	Rotational discrepancy
Non-parallel to long axis	Maxillary central incisor	Axial angulation errors

IV. Solution Of Bracket Positioning Errors

Most clinicians are aware that clinically the (preadjusted) appliance does not eliminate wire bending. Variations in tooth structure and malocclusions affect the final bracket positions. Variations from the straight wire appliance averages must be compensated by bends placed in the arch wires. Resetting of Bracket positioning can be done as errors normally starts to seem once Initial alignment and leveling part was done. The orthodontist ought to as early as acknowledge and correct these errors in order that wire changes can be minimum in later stages. After initial bracket placement, there is a need to wait for completely express the bracket's prescription and position. If severe bracket-positioning error happens, then there's a requirement to reset the bracket with wire (.014 or .016-in nickel-titanium), some author suggest a .018 ×.018-in Sentalloy wire for a 0.018 slot appliance.

A reset evaluation includes both clinical and radiological evaluations. In most patients, a reset assessment can be performed within first 6 months of active treatment. Inspection of each tooth individually for bracket placement errors should be done, paying particular attention to base adjustments, marginal ridge height differences, crown rotation, and non-parallel roots. The information collected during the reset evaluation act as guide when the reset is planned. Resetting significantly improved the tooth-to-tooth relationship and made it easier to assess the relative position of brackets between adjacent teeth. It also greatly improves facial visibility of each tooth. The same .018 by .018 inch Sentalloy wire (GAC International) can use for the bracket recipe and the primary representation of the position. Use of lighter wires is suggested if one or more of the brackets have a lot of position changes [15].

V. Other Methods

Accuracy of bracket position using indirect bonding (IDB) describes a procedure in orthodontics in which attachments are bonded to patients' teeth with the help of a transfer device (thermoplastic and 3D-printed indirect bonding trays). At first, impressions were, scanned with an intraoral scanner and imported into the treatment and simulation software. The software-integrated Bonding module provides virtual attachments from a bracket library and automatically positioned them on the facial axis point of every tooth surface. Based on these reference models, Bonding Trays were designed for each dental arch. The IDB trays were then placed onto their corresponding arches in patient on the occlusal and vestibular surface to ensure a correct fit. each bonding unit was light cured and IDB trays were carefully removed [16].

CAD/CAM transfer jig systems, which is a transport and a two-piece appliance has a part that separates the bracket from the tooth, and finally joins the two parts together to form the bracket bond. To overcome the limitations of the two-body transmission, it is redesigned as one-body. Its contour conforms integrally to all labial structures of the bracket and the occlusal surface or incisal edge of the tooth. Given its design, one body system would be more accurate than two body in terms of placing the brackets in their planned positions [17].

Table 4: Recommended methods for bracket positioning

Technology	Function	Advantage	Reference
3D printed IDB trays	Transfers virtual bracket positions	High precision	von Glasenapp et al., 2022
CAD/CAM jigs	Single-body transfer	Accurate bracket-	Park et al., 2021

	tool	tooth fit	
FAQ.FIX® device	Mechanical positioning system	Reduces manual error	Mazzeo et al., 2013
Digital height gauges	Electronic measurement tool	Improves reproducibility	Armstrong et al., 2007

Customized bracket placement chart as positioning tool in straight wire techniques can be developed by using the height of the crown of each tooth and report it on the corresponding facial axis of the clinical crown(FACC) row. In case of incomplete eruption or coronal fracture, it may be useful to refer to the completely erupted and/or intact tooth (i.e., incisors). By Reporting the selected FA points for each tooth on FA row and patient overbite to adjust the placement. For the development of the Bracket Placement Clinical Chart, the operator can also use the MBT or criteria, measuring only the height of an upper central incisor to obtain the correct height of the other teeth.

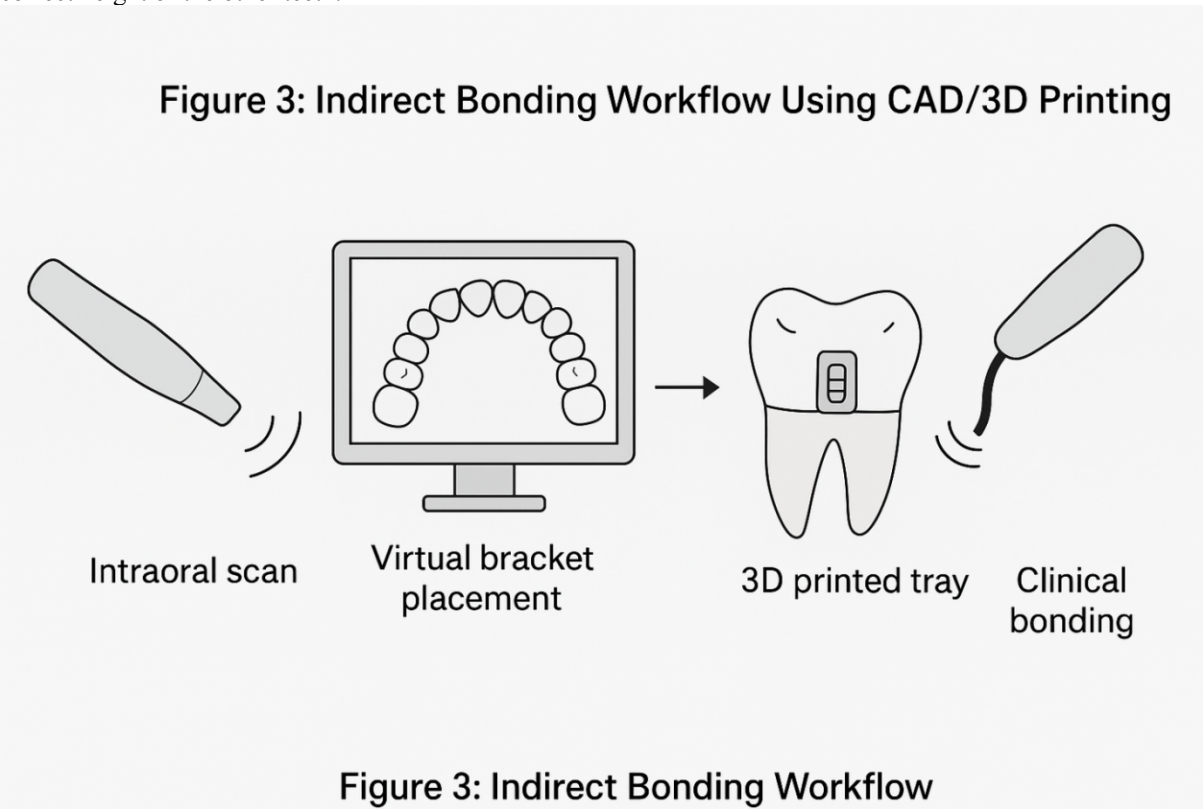


Figure 3: Indirect Bonding Workflow

Table 5: Direct and indirect bonding.

Parameter	**Direct Bonding**	**Indirect Bonding (3D/CAD)**
Accuracy	Operator dependent	High (CAD precision)
Chairside Time	Longer	Shorter
Equipment Required	Minimal	3D printer/scanner

Cost	Lower	Higher
Reproducibility	Moderate	Excellent

VI. Conclusion

Correct bracket positioning and placement is the main key to get desired final outcome of orthodontic treatment. Slight error in bracket positioning could deviate the result of treatment. To minimized these errors various method are done by orthodontist from indirect bonding to using technological advancement in designing special bracket transfer tools

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