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Case Report

MH Setup Technique, A Manually Customized Bracket-Setup, applied in Fully-treated Class II molar-relationship case

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ABSTRACT

This paper presented a case that demonstrated the clinical capabilities of the MH technique in manually converting conventional brackets into fully customized brackets, without incurring additional costs for 3D bonding or complex lab apparatus. The first set of conventional MBT braces were bonded directly on the pretreatment casts using bracket gauge and panorex X-ray guidance. The pre-treatment casts were cut and, the teeth were set into wax rims using full engagement arch-wires. The first set of brackets was removed, and teeth were guided into perfect occlusion on the casts and fixed in that position. The second set of conventional MBT brackets was fit over full-engagement arch-wires and set over the teeth. The composite now acted as custom-made bases to compensate the difference between the brackets bases and the actual teeth positions. The arch-wires were removed, and the second set of brackets was transferred to the patient using vacuum-formed indirect transfer trays and the treatment was commenced. The final results were ideal with a total treatment time of one year in an extraction case, with only added cost of an extra set of brackets. The finishing phase was only one month with settling elastics without any need for brackets modifications, despite the class II full unit molar relationship. The case was followed for three years, and the results were very stable.

Keywords: MH setup; Kesling wax setup; indirect bonding; Custom-made brackets; Class II molar finishing.

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INTRODUCTION

One of the most crucial aspects that worried the clinician in the orthodontic instances was the occlusion and finishing. [1] Providing perfect occlusion was a dream and a privilege that set the smart from the low-ability doctor apart. [2] Primarily goals were the positioning of teeth into perfect alignment and the capacity to offer beautiful, but anatomically exact positions of teeth. [3, 4] Clinician had to go through several phases of finishing and settling to supply as much as he could for his patients, not mentioning all the occlusion rules. Either lack of competence or absence of exact fixed appliance prescriptions or positioning explained the causes for that. [5,6]

Prior to debonding, several strategies were proposed and implemented by the clinician to compare the desired occlusion and the actual results attained. [7] Kesling's setup was one of the earliest methods used to achieve ideal occlusion of the teeth. Kesling recommended meticulous cutting of casts, ensuring that the contact points are not trimmed, and resetting the teeth into their optimal placements using wax rims. [8] Starting from that optimal posture, the clinician used calculations to determine the necessary movements and assessed the expected final outcomes before to commencing the therapy. The method was designed primarily to facilitate the customization of lingual braces. It employed full engagement arch-wires to align the braces and accurately attach them onto the casts in order to produce indirect bonding trays for conventional braces with composite custom-made bases. [9]

The Kesling setup provided challenges in terms of technique sensitivity and complexity. Any minor mistake in positioning the teeth or failing to achieve the required 3D orientation will lead to far greater errors compared to direct bonding performed by clinicians using their visual abilities. A well-recognized fact is that any effective strategy is rendered ineffective if not implemented just to prevent any further procedures, mistakes, and complexities. [10,11]

An alternative approach involved using specialized laboratory equipment to align the brackets in three dimensions with the tooth surface, without requiring any deformation of the pretreatment castings. [12] The tool used was the orthodontic equivalent of the prosthodontic surveyor, supplemented with an extra compass that allowed the technician to accurately position each bracket with estimated angulation/inclination for exact attachment to the tooth. The efficacy and accuracy of the method were constrained to circumstances when a properly trained operator and exact technical equipment were accessible. Notwithstanding, it is crucial to acknowledge the costs linked to the laboratory tests and the practical difficulties in moving patients between clinics and laboratories, especially when the laboratories are situated in different countries. [13]

The modern 3D methods of scanning and manufacturing custom-made brackets to be bonded for a specific patient were the cutting edge in modern Orthodontics. The need of good, well calibrated and precise scanner was a must to start scanning a patient. Moreover, the company’s manufacturing braces started avoiding the use of any scanners except the ones they own. [14] Considering all the prior alternatives, the

authors were interested in integrating the objective of attaining optimal outcomes without introducing unjustifiable expenses into the treatment budget. To address the limitations of the original Kesling wax setup, the authors devised straightforward yet innovative and precise techniques that were accessible in any clinic. An inherent limitation of the Kesling arrangement was its lack of precision, which was addressed by employing traditionally boned braces that achieved the same level of accuracy as visual aids, gauges, and panorex X-rays. Subsequently, the initial set of braces was taken out and replaced with a new set, after making necessary adjustments to the location of the teeth, resulting in excellent yet cost-effective outcomes. [15,16]

The current case presentation provided a step by step approach of the MH technique from diagnosis till finishing and three years follow-ups after retention to better provide an explanation of the suggested methodology.

Case Summary: Figure (1), Table (1).

a.

b.

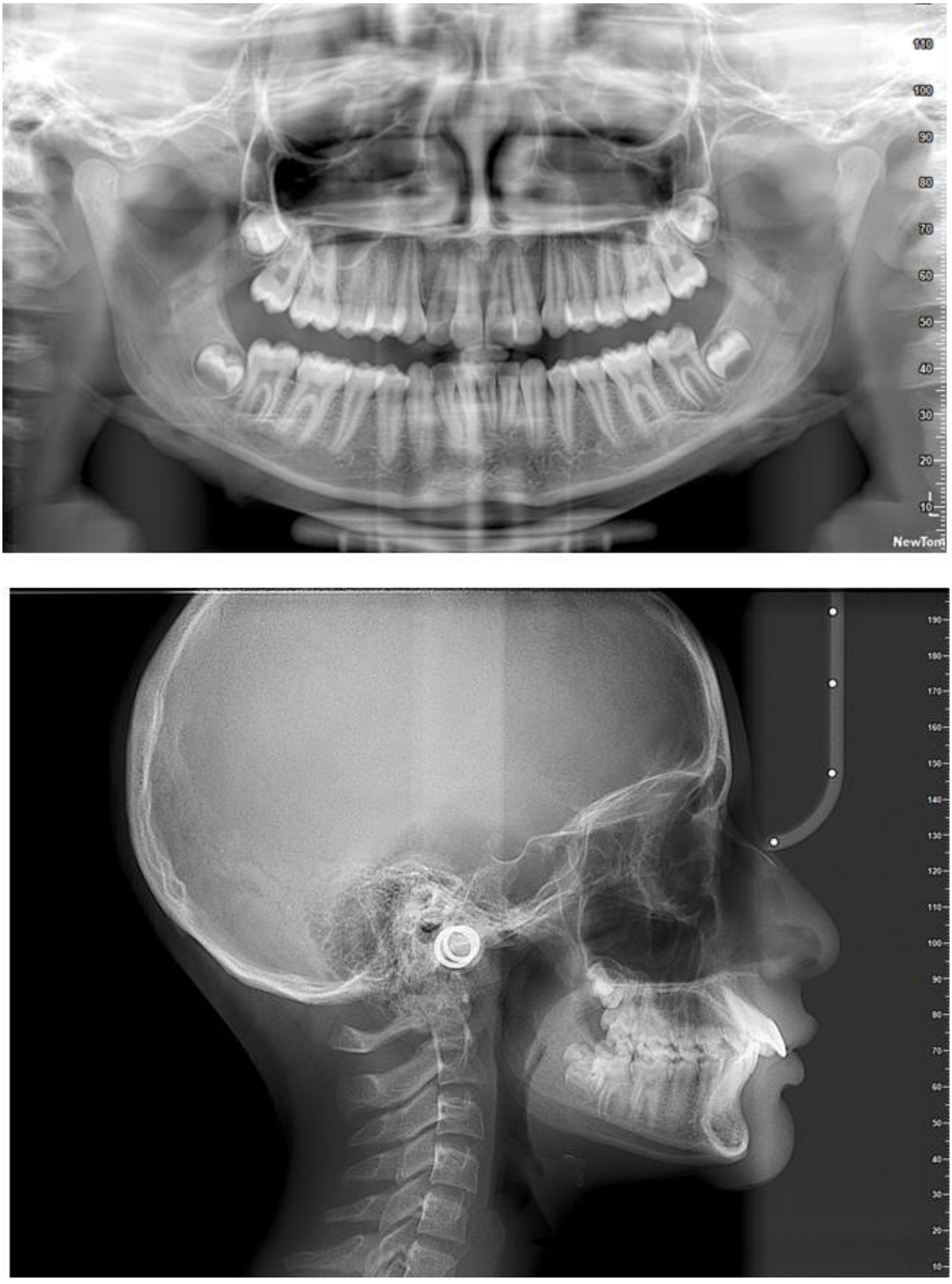


Figure 1: (a) Pre-treatment extra-oral and intra-oral photographs; (b) Pre-treatment panoramic and lateral cephalometric radiographs.

Table 1: Pre-Treatment Cephalometric Analysis.

Variable	Norms*	T1
SNA	81 +/- 3°	**84°**
SNB	78 +/- 3°	**80°**
ANB	3 +/- 2°	**4°**
MMPA	27 +/- 5°	**22°**
Face height ratio	55% +/- 2%	**53%**
SN to maxillary plane	8 +/- 3°	**8°**
Upper incisor to maxillary plane	109 +/- 6°	**126°**
Lower incisor to mandibular plane	93 +/- 6°	**98°**
Interincisal angle	135 +/- 10°	**112°**
Lower incisor to APo line	1 +/- 2mm	**1.5mm**
Upper lip to E line	-2 to -4 mm	**-2 mm**
Lower lip to E line	0 to -2 mm	**-2 mm**
Nasolabial angle	90°-110°	**90°**

*Kadhim HA, Azzawi AM, Uraibi AH, Hasan HS. Iraqi Adult Cephalometric Standards: An Analytical Approach. Asian Journal of Dental Sciences. 2020;3(1):9-20.

Personal history: The case D.H. was a 16-year-old Iraqi female presented to the Orthodontic Clinic. Her chief complaint was "My upper teeth are sticking out."

Medical history: Medically, she was fit and well.

Dental history: She is a non-smoker and a regular attendant for prophylaxis.

Family history: This was irrelevant to the treatment.

Pathological findings:

- Multiple carious spots were evident in her posterior teeth.
- Areas of stains and calculus formations were obvious on both arches.

Skeletal findings:

- The patient was skeletally high normal class 1 Antro -posterior with ANB angle of 4 degrees.
- The maxilla was in normal antero-posterior relation to the scull base with SNA angle of 84 degrees.
- The mandible was in normal antero-posterior relation to the scull base with SNB angle of 80 degrees.
- The maxilla-mandibular plane angle MMP was of low normal range of 22 degrees.
- The maxilla itself to the skull base was normal with SN/MxP angle of 8 degrees.
- Lower anterior face height percentage in relation to total anterior facial height was in low normal with a ratio of 53%.

Dental findings:

- The patient presented with a full set of permanent dentitions with the wisdom teeth developing in the four quadrants.
- The upper and lower arches were moderately crowded.
- The incisor relation was of class II div. 1 with increased overjet (8mm) and normal overbite.
- The lower midline was of 2 mm to the right in relation to the facial midline, but the upper midline was coincident with the facial midline.
- The canine relationship was of class II ¾ unit on the right side and of class II ¼ unit on the left side.
- The molar relationship was of class II ¾ unit on the right side and class I on the left side.
- Both upper and lower incisors were proclined in relation to their skeletal bases. The upper incisor angle of 126 degrees to maxillary base and lower incisor of 98 degrees to the mandibular base.
- The interincisal angle was decreased as 112 degrees.
- The lower incisal edge to APo line was normal as 1.5 mm.

Extraoral soft tissue findings:

- The patient presented with a convex facial profile.
- decreased mandibular plane angle.
- Normal anterior face height.
- Upper lip was normal as -2 mm to Rickets E line.
- Lower lip was normal as -2 mm to Rickets E line.
- Nasolabial angle normal of 90 degrees.

Problem List:

1. Upper and lower arches were moderately crowded.
2. Incisor relation of class II div. 1 with increased overjet (8mm) was evident.
3. The lower midline was of 2 mm to the right in relation to the facial midline.
4. The canine relationship was of class II ¾ unit on the right side and of class II ¼ unit on the left side.
5. The molar relationship was of class II ¾ unit on the right side and class I on the left side.
6. Both upper and lower incisors were proclined in relation to their skeletal bases.
7. The interincisal angle was decreased as 112 degrees.

Aims and Objectives:

a) To relief the crowded arches.
b) To correct the Incisor relation into class I with normal overbite and overjet.
c) To correct the lower midline in relation to the facial midline.
d) To achieve class I canine relationship on the right and the left sides.
e) To attain stable molar relationship both sides.
f) To improve the interincisal angle.

Treatment planning:

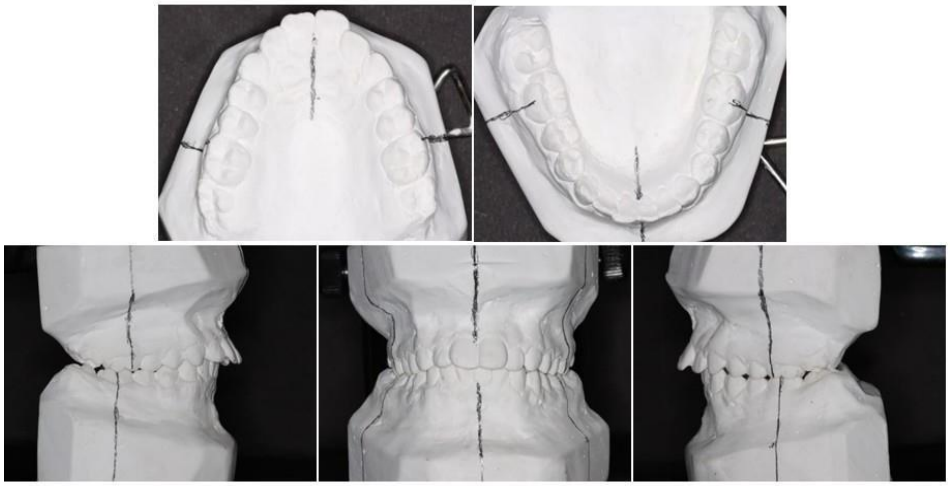
The plan was to extract upper first premolars to relief the crowded upper arch and correct the molars relationship into stable full-unit class II. The upper incisors would be retracted into class I relationship with ideal 2 mm overbite and overjet, controlling the torque to enhance the interincisal angle. The canines would be finished into class I relationship. The lower arch would be levelled and aligned to correct the lower midline in relation to the facial midline. Those aims were achieved using MBT prescription brackets of 0.018" x 0.025" slot dimensions (Dentaurum, Germany).

Alternative treatments:

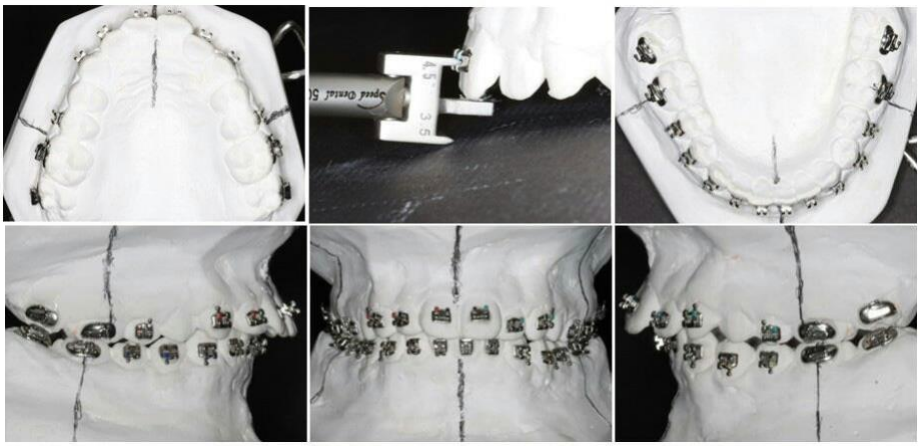
The alternative treatment plan was to extract all four first premolars or upper 1st premolars and lower 2nd premolars and retract both upper and lower segments with class II mechanics to finish the case into class I incisor and molar relationships. The authors refused these plans because of the normal lip protrusion in relation to the Esthetic lines.

MH setup:

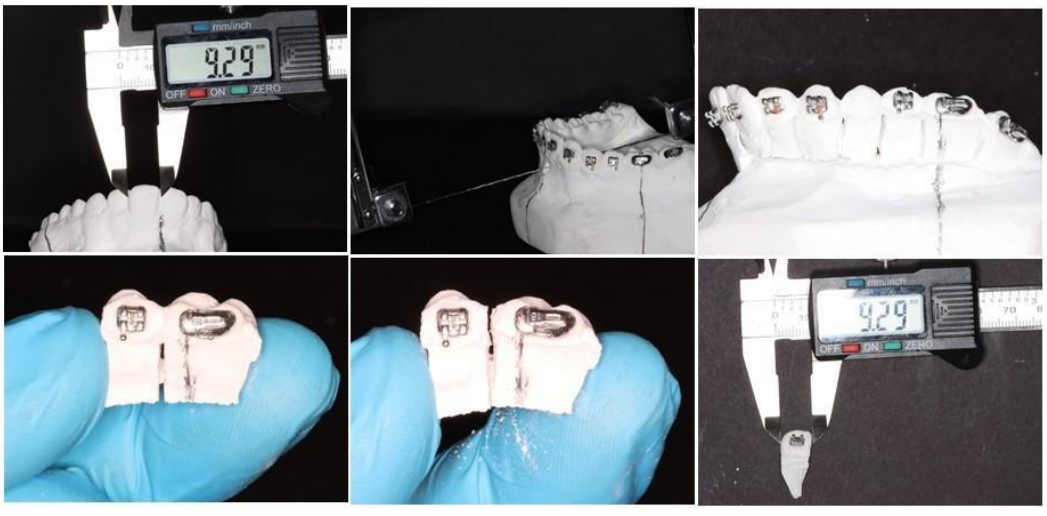
a.



b.



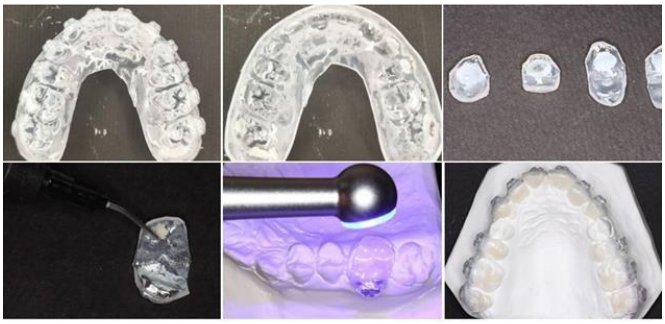
c.



d.

e.

f.



g.

h.

Figure 2: (a) Casts mounting and markings; (b) Initial bonding of the setup casts; (c): Sectioning casts and separating the teeth; (d) Initial wax setup steps; (e) Refining the occlusion and settling teeth together and stabilizing teeth for the following steps; (f) Final Bonding of the setup casts; (g) Initial and final layers of transfer tray; (h) Bonding intraorally and final appearance of the bonded case.

1. **Measurements and standardization:**

Teeth on casts were measured through their contact points and the measurements were registered on the patient's sheet. Figure (2, a).

2. **Bonding the first set of brackets:**

   a. The casts of the patient were bonded with brackets of MBT prescription with 0.018" x 0.025" slot dimensions (Dentaurum, Germany) using ideal measurements with the gauge as follows:
   b. Upper centrals and all premolars at 4.5 mm.
   c. Upper lateral incisors and lower incisors together with the first molars were bonded at 4 mm.
   d. All canines were bonded at 5 mm.
   e. All second molars were bonded at 3.5 mm. Figure (2, b).

3. **Sectioning the casts:**

   a. Teeth on casts were cut using a very fine saw
   b. Starting from a transverse horizontal cut at the gingival level and then proceeding with fine vertical cuts till the papillae crest.
   c. The saw never allowed passing beyond the papillae crest, to avoid trimming the contact points. Figure (2, b).
   d. Using fine finger pressure, teeth were separated through crack propagation, which was a known phenomenon of gypsum products. Figure (2, c).

4. **Measurements and standardization:**

After separation, teeth were measured again through contact points to make sure that no loss of width happened. Figure (2, c).

5. **Setting teeth into wax rims:**

   a. A stainless steel (St.Sl.) archwire of 0.018" x 0.025" dimensions (Dentaurum, Germany) was used to mount teeth on it in a precise way allowing for the best positioning. Figure (2, c).
   b. Using the archwire, teeth were mounted into wax rims fixed on gypsum bases.
   c. A cell-phone application software (Level-Tool Bud-Android) was used with a glass slab fit over the teeth to allow for precise orientation with zero pitch, yaw, and roll. Figure (2, d).

6. Refining the occlusion:

a. After fitting both arches into the wax rims, the brackets and wires were removed.
b. Occlusion was adjusted by individual teeth pressure to provide an excellent result. Figure (2, e)
c. A layer of gypsum was painted on the wax rims to fix the teeth in the adjusted positions. Figure (2, e).

7. Bonding the second set of brackets:

a. A fresh set of MBT brackets with a 0.022" slot size (Dentaurum, Germany) was mounted on a pair of full engagement 0.021.5" X 0.025" (St. Sl.) archwires, (Dentaurum, Germany) coordinated to the adjusted teeth occlusion. Figure (2, f)
b. The use of slot 0.022" X 0.025" allowed better sliding mechanics in that particular extraction case.
c. Orthodontic bonding composite was applied to the brackets and they were fit onto the teeth and cured. The composite was acting now as custom-made bases for the new brackets. Figure (2, f).

8. Formation of vacuum indirect bonding transfer trays:

a. Arch wires were removed and a soft vacuum-formed sheet of 1 mm thickness was pressed over the casts to guard the brackets from getting dislodged by the next hard vacuum formed tray.
b. The sheet was cut into individual teeth segments and refitted over a replica of the original patient's casts using a small portion of flowable composite from the palatal and lingual surfaces, then cured. Figure (2, g).
c. Another vacuum-formed sheet of a hard material of 1 mm thickness was pressed on top of the previous soft vacuum sheet, to act as a transfer tray. Figure (2, g).

9. Bonding the case using indirect technique:

a. The composite on the brackets was etched for 1 minute to activate the surface layer for bonding and remove any debris then washed and dried.
b. The patient's teeth were etched for 20 minutes, washed, and dried.
c. A bonding agent was applied to the brackets and natural teeth.
d. A very small amount of orthodontic composite was applied to the brackets and the vacuum sheets were pressed onto the teeth and cured for 40 seconds for each tooth. Figure (2, h).
e. The vacuum sheets were peeled away from the arches and teeth.
f. Excess composite flashes were removed with finishing burs and the case was ready for treatment. Figure (2, h).

Wires sequences and sliding mechanics:

1. After teeth extraction, the teeth were leveled and aligned with sequential NiTi (Dentaurum, Germany) archwires reaching 0.019" X 0.025" sizes.
2. Retraction of the upper anterior segment:
    a. En-mass retraction was performed using sliding mechanics on 0.019" X 0.025" Stainless Steel (St. Sl.) arch wires (Dentaurum, Germany)
    b. Stainless Steel hooks were soldered distal to the upper canines and retraction using power chains on both sides from the wire hooks till the hooks on the first molar tubes was applied.
3. The final assessment:
    a. After space closure attained, a check on the occlusion clinically using visual inspection and on casts revealed the need for vertical elastics to settle the occlusion
    b. Settling commenced on 0.016" Stainless Steel archwires (Dentaurum, Germany) for one month. Figure (3).
    c. The case was ready for debonding and retention.

Figure 3: Spaces Closure And Settling.

Retention Protocol

The lower fixed retainer was bonded on the anterior segment. On the other hand, a 1.5 mm thickness hard vacuum-formed sheet was used on the upper arch, figure (4).

Figure 4: Retention Protocol.

Treatment Duration And Results

a.

b.

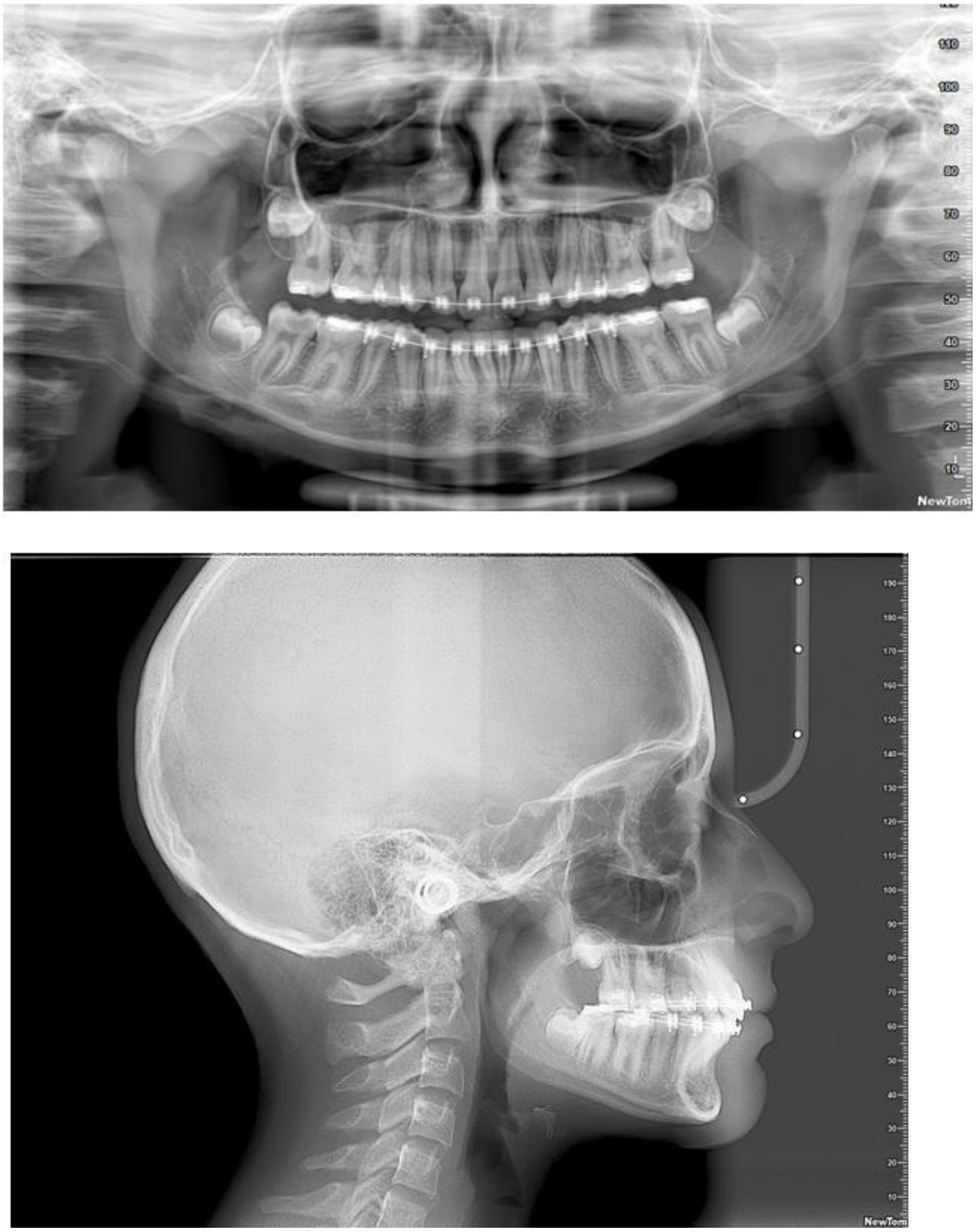
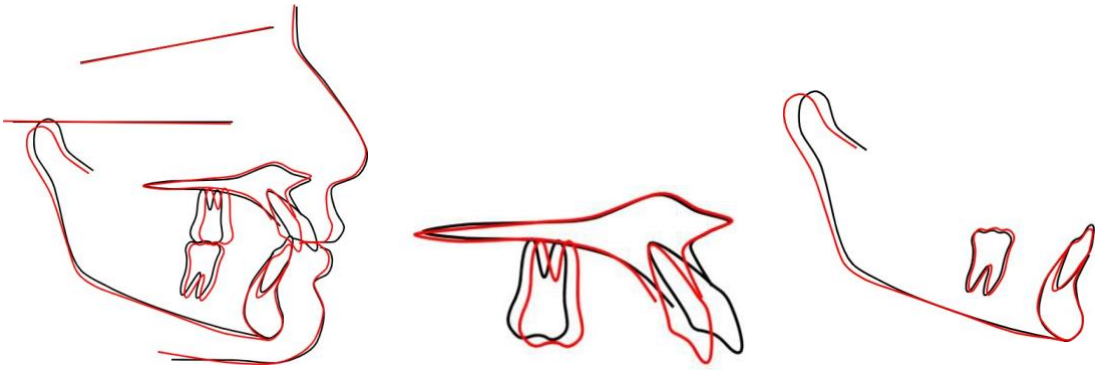


Figure 5: (a) Post-treatment extra-oral and intra-oral photographs; (b) Post-treatment panoramic and lateral cephalometric radiographs.



(a) **(b)** **(c)**

Figure 6: Cephalometric superimpositions (a) total face superimposition; (b) Maxillary superimposition; (c) Mandibular superimposition.

Figure 7: Three years follow up.

The total treatment time was twelve months in total. The incisors were finished into class I with ideal overbite and overjet as measured on the lateral cephalometric film and the post treatment casts, also, the canines were into class I perfect relationship and the molars were into full unit class II relationship, as shown in figure (5, 6), Table (2). Moreover, the result was stable after three years of follow-up. Figure (7). The finishing quality was assessed on the post treatment casts using ABO standards with the following steps, as shown in (table 3). [17]

Table 2: Post-Treatment Cephalometric Analysis.

Variable	Norms*	T1	T2	Difference
SNA	81 +/- 3°	**84°**	**84°**	**0°**
SNB	78 +/- 3°	**80°**	**80°**	**0°**
ANB	3 +/- 2°	**4°**	**4.5°**	**0.5°**
MMPA	27 +/- 5°	**22°**	**23°**	**1°**
Face height ratio	55% +/- 2%	**53%**	**54%**	**1%**
SN to maxillary plane	8 +/- 3°	**8°**	**8°**	**0°**
Upper incisor to maxillary plane	109 +/- 6°	**126°**	**117°**	**-9°**
Lower incisor to mandibular plane	93 +/- 6°	**98°**	**103°**	**5°**
Interincisal angle	135 +/- 10°	**112°**	**116°**	**4°**
Lower incisor to APo line	1 +/- 2mm	**1.5 mm**	**2 mm**	**0.5 mm**
Upper lip to E line	-2 to -4 mm	**-2 mm**	**-4 mm**	**-2 mm**
Lower lip to E line	0 to -2 mm	**-2 mm**	**-2 mm**	**0 mm**
Nasolabial angle	90°-110°	**90°**	**100°**	**10°**

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Table 3: Discrepancy Index (DI) Calculation.

TOTAL D.I. SCORE 25

For mm measures, round up to the next full mm.
Examiners will verify measurements in each category.

OVERJET

≥ 0 to < 1 mm (edge-to-edge)	= 1 pt
≥ 1 to ≤ 3 mm	= 0 pts
> 3 to ≤ 5 mm	= 2 pts
> 5 to ≤ 7 mm	= 3 pts
> 7 to ≤ 9 mm	= 4 pts
> 9 mm	= 5 pts
Negative Overjet (x-bite): 1 pt per mm per tooth	= ___pts
Total	4

OVERBITE

> 1 to ≤ 3 mm	= 0 pts
> 3 to ≤ 5 mm	= 2 pts
> 5 to ≤ 7 mm	= 3 pts
Impinging (100%)	= 5 pts
Total	2

ANTERIOR OPEN BITE

0 mm (edge-to-edge), 1 pt per tooth	=____pts
then 1 pt per mm per tooth	=____pts
Total	0

LATERAL OPEN BITE

≥ 0.5 mm, 2 pts per mm per tooth	
Total	0

CROWDING (only one arch)

≥ 0 to ≤1 mm	= 0 pts
> 1 to ≤ 3 mm	= 1 pts
> 3 to ≤ 5 mm	= 2 pts
> 5 to ≤ 7 mm	= 4 pts
> 7 mm	= 7 pts
Total	2

OCCLUSAL RELATIONSHIP

Class I to End On	= 0 pts	
End-to-End Class II or III	= 2 pts per side	____pts
Full Class II or III	= 4 pts per side	____pts
Beyond Class II or III	= 1 pt per mm additional	____pts
Total	6	

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LINGUAL POSTERIOR X-BITE

> 0 mm, 1 pt per tooth	Total 0

BUCCAL POSTERIOR X-BITE

> 0 mm, 2 pts per tooth	Total 0

CEPHALOMETRICS (See Instructions)

ANB ≥ 6° or ≤ -2°	@4pts	= 4
Each full degree > 6°	___x 1 pt	= ___
Each full degree < -2°	___x 1 pt	= ___
SN-MP		
≥ 38°	@2pts	= ___
Each full degree > 38°	___x 2 pts	= ___
≤ 26°	@1pt	= 3
Each full degree < 26°	___x 1 pt	= ___
$\bar{1}$ to MP ≥ 99°	@1pt	= 1
Each full degree > 99°	___x 1 pt	= ___
Total		8

OTHER (See Instructions)

Supernumerary teeth	___x 1 pt	= 0
Ankylosis of permanent teeth	___x 2 pts	= 0
Anomalous morphology	___x 2 pts	= 0
Impaction (except 3rd molars)	___x 2 pts	= 0
Midline discrepancy (≥3 mm)	@ 2 pts	= 3
Missing teeth (except 3rd molars)	___x 1 pt	= 0
Missing teeth, congenital	___x 2 pts	= 0
Spacing (4 or more, per arch)	___x 2 pts	= 0
Spacing (mx cent diastema ≥ 2 mm)	@ 2 pts	= 0
Tooth transposition	___x 2 pts	= 0
Skeletal asymmetry(nonsurgical tx)	@ 3 pts	= 0
Addl. treatment complexities	___x 2 pts	= 0

Identify:

Total Other 3

DISCUSSION

In the present day, it is widely acknowledged by clinicians that the implementation of customized brackets and 3D computed positioning has significantly reduced the final stage to just two months, leading to substantial improvements in occlusion outcomes. [18] Conversely, the costs associated with producing bespoke brackets and implementing 3D processes increased the costs to thrice or even more in certain instances. The expenses were duly recorded on the patient's invoices or the insurance schemes. [19] Adopting the traditional techniques, the Kesling wax setup proved to be one of the most effective and ingenious approaches for obtaining a comprehensive understanding of the expected treatment plans. One of the drawbacks of the Kesling wax setup was its inherent difficulty in execution and the accompanying time consumption. Furthermore, the occurrence of faults and mistakes involved in setting teeth into optimal placements was common. The consequences would be disastrous if one were to employ the Kesling setup and, for whatever reason, set teeth with mistakes and constructed the plan and brackets positions based on such settings. [20] Indirect bonding techniques were developed to offer simpler yet more precise means of attaching appliances to castings within a 360-degree viewing range, therefore enhancing accuracy and performance. [21] Yet those techniques did not solve the other problem of trying to fill all people with the same size of shoes. The trials to bond the same appliance with the same prescription to every person with different sizes and shapes of teeth and expecting to reach the same ideal goals were naïve. [22] Combining the Kesling wax setup with a modified facilitated approach for accuracy with the introduction of custom bases for the brackets with composite resin, would combine the benefits and reach the proper goals. [23]

The use of prescription brackets with full archwires on teeth helped to set them into wax rims, providing accurate individual positioning and excellent arch form. [24] Even with that, one could view that the results were not ideal, even with applying all the rules and using indirect bonding. Then removal of the brackets and wires with refinements and adjustments on the wax rims saved the same hassle that would have appeared in the patient’s mouth. [25] The use of full engagement archwire on the second set of brackets allowed the composite to fill any gaps between bases and teeth surfaces, provided a custom-made brackets effect, and delivered the ideal desired positions with the stock brackets in hand. [26,27]

The indirect bonding and the use of vacuum-formed sheets facilitated the transfer of the brackets from the casts to the patient’s mouth with minimal chair-side time. The time spent in the lab even if was long, facilitated and decreased the chair-side timing for the case which facilitated the process, patients' comfort, and decreased contamination and failures. [28,29]

After the treatment was completed, only one month of settling was needed to gain the ideal results. The occlusions of full unit class II molars and class III molars were particularly difficult to achieve. The tubes of the upper molars had 5 to 10 degrees of rotations to facilitate good occlusion into the class I relationship. [30,31] On the other hand, finishing into class II or III molars, it was always advisable to use the lower second molars tubes on the upper first molars to provide zero-degree rotation to be able to finish into good interdigitations. [32] Even with that, any clever clinician would mention that it was always a nightmare to

finish, even with lower second molar tubes. Having a look at the provided case, one could realize that the molars were in perfect interdigitation although the relationship was class II molars and the tubes used were upper molars tubes. That was in fact due to the application of custom-made bases of composites that transferred the ideally set relationship to the ideally fit brackets over their fully engaged archwires. [33, 34]

In summary, the MH setup technique was perfect to treat and solve the case into ideal occlusion with minimal expenses and treatment time. Combining the foundation of the Kesling wax setup with clever and accurate modifications into indirect bonding and custom-made brackets with minimal expenses was perfect for everyday use.

CONCLUSIONS

- MH setup aided the finishing phase with good indication on the accuracy of the bonding and bracket positioning.
- The occlusion finished into class II molar using MH setup, did not require other finishing steps as toe-in or toe-out bends to acquire good molar interdigitation.
- MH setup used more laboratory steps than conventional indirect bonding techniques but avoided wire bending finishing steps.
- The MH setup technique could be replaced by special lab apparatuses and applying digital 3D methods, but the cost was to be elevated a lot.

DECLARATION OF PATIENT'S CONSENT:

The authors declare that they got all the necessary consents from the patient for treatment and publishing.

FINANCIAL SUPPORT AND SPONSORSHIP:

Nil.

CONFLICTS OF INTEREST:

There are no conflicts of interest

ACKNOWLEDGMENTS:

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