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Minimally Invasive Dentistry to Enhance the Esthetic and Function in a Class III Skeletal Case

Cosmetic dentistry has become an integral part of dental care (1,2). A systematic review by Samsonyanová and Broukal found that facial attractiveness is the main motivational factor among patients to seek orthodontic treatment (3). From a technical point of view, Sarver suggests that dentists view dentofacial esthetics in terms of macro (facial profile), mini (positioning of maxillary incisors) and micro esthetics (proportion and shape of anterior teeth and associated gingival tissues) (4).

Skeletal and dental classification of malocclusion helps in the management and treatment planning of dental problems as well (5). Each dental malocclusion class has skeletal, dentoalveolar and dental components. Each class of malocclusion has its own adaptation or maladaptation, influenced by genetics and epigenetics (6-9).

Treatment planning for a skeletal Class III malocclusion in adults presents many challenges, and orthognathic surgery may be part of the solution (10,11). Yet, there may be numerous potential complications associated with orthognathic surgery (12). The ultimate decision to treat a Class III skeletal relationship surgically or non-surgically depends on acceptance by the patient. According to Eslami et al., a Holdaway angle of 10.3 degrees and Wits appraisal of -5.8 mm can be used as a critical diagnostic parameter for determining surgical versus non-surgical treatment in borderline skeletal Class III cases (11). Zere et al. suggest that a -6.0 to -9.0 mm Wits appraisal will lead to a compromised orthodontic result (10).

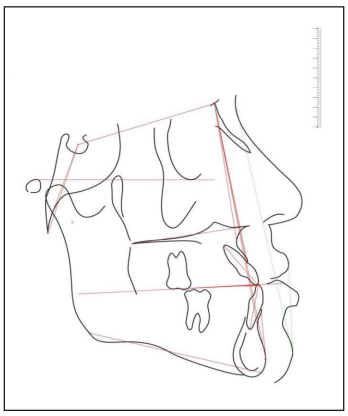
This article outlines the use of a minimally invasive and non-surgical treatment approach to enhance the esthetics and function in a Class III skeletal case

Case report

A 20-year-old male presented for an esthetic solution to multiple diastemas in the maxillary anterior (Figure 1). Data collection consisted of assessing medical and dental history, a clinical exam, extraoral and intraoral photos, maxillary and mandibular impressions, assessing maximum intercuspation position, and lateral cephalometric and panoramic radiographs.

The patient's medical and dental history did not present contraindications to dental treatment. Upon clinical examination, generalized spacing and Class III malocclusion with no functional shift and an asymptomatic TMJ were noted (Figure 1).

Figure 1.
Preclinical images.



Measurements	Patient	Norm	Clinical Deviation	Standard Deviation	Graph	Interpretation
BASAL - Cranial Base Form						
SN-Ba (deg)	125.4	131.0	-5.6	4.5		slightly decreased basicranial angulation – Type III
Saddle angle (deg)	127.3	123.0	4.3	5.0		within normal limits
SAGITTAL - Jaw Position						
SNA (deg)	81.3	82.0	-0.7	2.0		within normal limits
Facial Plane (deg)	83.3	80.0	3.3	3.5		within normal limits
Facial Convexity (deg)	-2.1	2.0	-4.1	2.5		slighty convex
Apical Base Position						
SNA (deg)	81.3	82.0	-0.7	2.0		within normal limits
SNB (deg)	82.9	80.0	2.9	2.0		mandible is slightly prognathic
ANB (deg)	-1.7	2.0	-3.7	1.5		moderate Class III relationship
SAGITTAL - Dento-Basal Relations						
NA/Pt (deg)	2.4	2.0	0.4	1.0		within normal limits
Mx 1 to Palatal Plane (deg)	120.4	110.0	10.4	6.0		upper incisor is slightly proclined
Mx 1/NA (mm)	6.6	4.0	2.6	2.0		upper incisor is in a slight anterior position
GoGn to CL (deg)	71.1	70.0	1.1	6.0		within normal limits
Mn 1/GoGn (deg)	87.1	93.0	-5.9	3.0		lower incisor is slightly retroclined
Mn 1/NB (mm)	4.2	4.0	0.2	2.0		within normal limits
Chin Button (mm)	0.9	4.0	-3.1	2.0		chin is slightly retruded
Chin Button at Maturity (mm)	0.9					no chin growth expected
VERTICAL - Jaw Position						
SN/Palatal Plane (deg)	8.3	8.0	0.3	3.0		within normal limits
GoGn/SN (deg)	31.1	32.0	-0.9	4.0		within normal limits
Palatal Plane/GoGn (deg)	22.7	25.0	-2.3	6.0		within normal limits
Dento-Basal Relations						
Palatal Plane/Occlusal Plane (deg)	5.9	10.0	-4.1	4.0		mandibular plane is slightly convergent to the occlusal plane
Mandibular Plane/Occlusal Plane (deg)	16.4	20.0	-3.6	5.0		within normal limits
Custom Factors						
Holdaway Angle (deg)	9.8	10.0	-0.2	3.0		within normal limits
WITS appraisal (mm)	-7.7	-1.0	-6.7	2.0		severe Class III relationship

Figure 2.
Cephalometric analysis.

The patient's cephalometric radiograph demonstrated a Holdaway angle of 9.8 degrees, Wits appraisal of -7.7 mm and ANB of -1.7 degrees. Based on this, Eslami et al. (11) suggest surgery, while Zere et al. (10) note a compromised orthodontic result (10) (Figure 2).

Kois and Kois' (13) comprehensive risk tool was used to assess in four areas: periodontal, biomechanical, functional and esthetic. Based on the data, the patient presented with low periodontal risk with Stage 1, Grade A classification (14), low biomechanical risk, low to medium functional risk and high esthetic risk.

In addition to the patient's esthetic concerns, functional objectives were considered, including achieving an improved overjet and overbite, bilateral and equal simultaneous contacts on the posterior teeth, TMJ harmony with opening and closing muscles, and minimizing any undesirable effects on the airway. The 14 esthetic objectives outlined by Magne and Belser were also considered (15).

After discussion of treatment options, including risks, benefits and costs, with the patient's consent, the treatment plan consisted of retraction of mandibular anteriors, distribution of maxillary spacing to the ideal width to height ratio, gingival height balance, bilateral and simultaneous equal contacts on the posterior teeth, and porcelain veneers on the maxillary anterior and bicuspid teeth to fill in the anterior spacing and address the desired smile.

The initial phase of the treatment was conducted using clear aligners. Records were sent to Invisalign

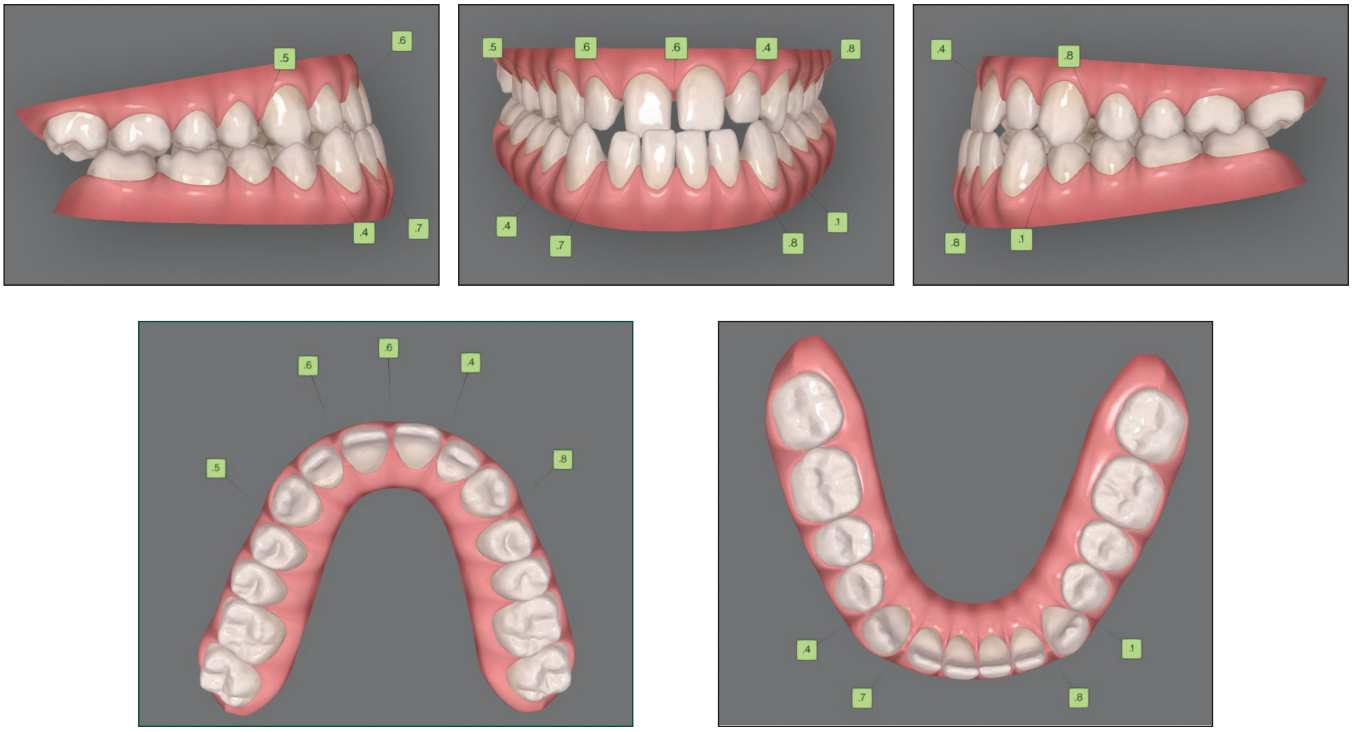


Figure 3.
Initial Invisalign (Aligntech) treatment planning records.

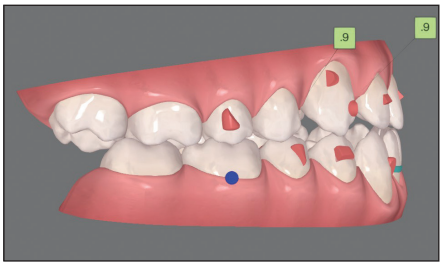


Figure 4.
Clear aligner treatment.

Figure 5.
Unplanned molar intrusion leads to posterior open bite.

Figure 6.
Addressing posterior open bite and the lack of mandibular anterior intrusion were overcome with a fixed partial appliance with TADs.

(Align Technology) for treatment planning (Figure 3), and treatment was initiated (Figure 4).

According to a retrospective study of 58 patients by Talens-Cogollos et al. (16), unplanned molar intrusion of close to 1.0 mm after clear aligner therapy was present in approximately 74 per cent of their sample. Such molar intrusion can increase the overbite and decrease the overjet (17). There was unplanned molar intrusion and a lack of mandibular anterior intrusion in this case, which led to a posterior open bite (Figure 5). The posterior open bite and the lack of mandibular anterior intrusion were overcome by use of a fixed partial appliance with TADs (Ormco) (18) (Figure 6).

Once the teeth were in position, a temporary mockup to check for space distribution, overjet/overbite, gingival height, occlusion, phonetics and to seek patient feedback was done (Figure 7) (19). There was a slight midline discrepancy and tooth size concern clinically, but it was not deemed as an esthetic concern by the patient (20).

With the successful evaluation and acceptance by the patient, the teeth were prepared minimally (on enamel only) for porcelain veneers on teeth 15 to 25 (Figure 8). The esthetic and longevity success of porcelain veneer depends on understanding the limitation of the procedure. The bond to enamel is highly successful but the bond to dentine is questionable (21). Incisal reduction

Figure 7.
Temporary mockup to check for space distribution, overjet/overbite, gingival height, occlusion, phonetics, and patient satisfaction.

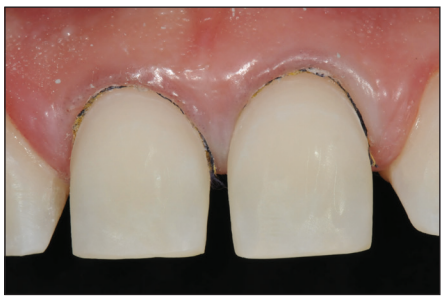


Figure 8.
Veneer preparation.

Figure 9.
Final restorations.

with palatal chamfer preparation allows for esthetic and functional control (22). Guidance must be shallow to allow for chewing function without damaging the anterior restorations (23). The porcelain veneers used in this case were e.max (Ivoclar), fabricated by Innovative Dental Laboratories, Toronto.

Initial evaluation of restorations consisted of establishing the maxillary occlusal plane and midline to the horizon, and assessment of the 14 esthetic objectives (15). The tooth surface was then air abraded (PrepStart) with 27-micron aluminum oxide at 40 psi, followed by 32 per cent phosphoric acid-etch (BISCO) and placement of Multi-Purpose bond (3M). The porcelain veneers were pre-etched in the lab. After the try-in, the surface was treated with a silanizing agent, Monobond Plus (Ivoclar), and dried; Multi-Purpose bond (3M) was applied and Variolink LC (Ivoclar) was used for cementation. After placement, the surface was cured for three seconds for the initial set. Excess cement was removed, glycerin was added to the margin and light-cured according to the manufacturer's protocol.

To check for proper placement of the veneers inter-proximally and to facilitate cleaning of excess cement, placement started with the two central incisors, followed by the two laterals sequentially, and so forth.

The occlusion was checked with an articulating paper of 200 microns (Bausch), followed by eight microns (Bausch) to achieve a posterior balanced occlusion and eliminate any contacts in the chewing envelope except for centric stops. The final cemented restorations are shown in Figure 9.

Conclusion

When people seek cosmetic dentistry, they are not aware of the challenges associated with the treatment. Each component — skeletal, dentoalveolar and dental — must be assessed to fully appreciate the nature of any esthetic deficits and thus direct treatment goals to address those deficits. After data collection, the treatment plan must start with the end in mind. Consideration should be directed at the macro, mini and micro

Figure 10.
Pre and post treatment.

esthetics (4), balanced occlusion, guidance compatible with the chewing envelope, and the airway. Post-treatment, in this case the periodontal risk did not increase, the biomechanical risk remained low as all preparations were in the enamel, the functional risk was reduced with a balanced bite and, more importantly, the dentofacial risk was lowered (Figure 10). OD

REFERENCES

1. Tin-Oo MM, Saddik N, Hassan N. Factors influencing patient satisfaction with dental appearance and treatments they desire to improve aesthetics. *BMC Oral Health.* 2011 Feb;11(6).
2. Samarodnitzky-Naveh GR, Geiger SB, Levin L. Patient's satisfaction with dental esthetics. *JADA.* 2007 Jun;138(6):805-8.
3. Samsonyanová L, Broukal Z. A systematic review of individual motivational factors in orthodontic treatment: facial attractiveness as the main motivational factor in orthodontic treatment. *International Journal of Dentistry.* 2014 May 20;938274.
4. Sarver DM. Dentofacial esthetics: from macro to micro. Chicago, IL: *Quintessence Publishing Company, Incorporated;* 2020. 502 p.
5. Mageet AO. Classification of skeletal and dental malocclusion: revisited. *Stomatology Edu Journal.* 2016 Jan;3(3-4):205-11.
6. Moreno Uribe LM, Miller SF. Genetics of the dentofacial variation in human malocclusion. *Orthodontics & Craniofacial Research.* 2015 Apr;18:91-9.
7. Cakan DG, Ulkur F, Taner TU. The genetic basis of facial skeletal characteristics and its relation with orthodontics. *European Journal of Dentistry.* 2012 Jul;6(03):340-5.
8. Huh A, Horton MJ, Cuenco KT, Raoul G, Rowlerson AM, Ferri J, Sciote JJ. Epigenetic influence of KAT6B and HDAC4 in the development of skeletal malocclusion. *American Journal of Orthodontics and Dentofacial Orthopedics.* 2013 Oct 1;144(4):568-76.
9. Zabrina S, Ramadhanti, Jazaldi F, Gultom FP, Auerkari EI. Genetic and epigenetic aspects of class III malocclusion with mandibular prognathism phenotypes. *In AIP Conference Proceedings.* 2021 Mar 23;2344(1):050010.
10. Zere E, Chaudhari PK, Sharan J, Dhingra K, Tiwari N. Developing Class III malocclusions: challenges and solutions. *Clinical, Cosmetic and Investigational Dentistry.* 2018;10:99.
11. Eslami S, Faber J, Fateh A, Sheikholaemmeh F, Grassia V, Jamilian A. Treatment decision in adult patients with class III malocclusion: surgery versus orthodontics. *Progress in Orthodontics.* 2018 Dec;19(1):1-6.
12. Kim YK. Complications associated with orthognathic surgery. *Journal of the Korean Association of Oral and Maxillofacial Surgeons.* 2017 Feb;43(1):3-15.

13. Kois DE, Kois JC. Comprehensive risk-based diagnostically driven treatment planning: developing sequentially generated treatment. *Dental Clinics.* 2015 Jul 1;59(3):593-608.
14. Klinger A. Periodontal classification revisited: the classification system in the test of time. *Compendium.* 2022 Mar;43(3).
15. Magne P, Belser U. Bonded porcelain restorations in the anterior dentition. A biomimetic approach. In Carol Stream, IL: *Quintessence*. 2002.
16. Talens-Cogollos L, Vela-Hernández A, Peiró-Guijarro MA, García-Sanz V, Montiel-Company JM, Gandía-Franco JL, Bellot-Arcís C, Paredes-Gallardo V. Unplanned molar intrusion after Invisalign treatment. *American Journal of Orthodontics and Dentofacial Orthopedics.* 2022 Mar 16;162(4):451-58.
17. Rebibo M, Darmouni L, Jouvin J, Orthlieb JD. Vertical dimension of occlusion: the keys to decision. *International Journal of Stomatology & Occlusion Medicine.* 2009 Sep;2(3):147-59.
18. Kravitz ND, Kusnoto B, Tsay TP, Hohit WF. The use of temporary anchorage devices for molar intrusion. *JADA*. 2007 Feb;138(1):56-64.
19. Dragusha R, Ibraimi D. Mock-up: an aid in the different steps in aesthetic dental treatment. *European Scientific Journal.* 2016 Feb 1;12(6).
20. Kokich Jr VO, Asuman Kiyak H, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. *Journal of Esthetic and Restorative Dentistry.* 1999 Nov;11(6):311-24.
21. Carvalho RM, Manso AP, Geraldeli S, Tay FR, Pashley DH. Durability of bonds and clinical success of adhesive restorations. *Dental Materials.* 2012 Jan 1;28(1):72-86.
22. Jankar AS, Kale Y, Kangane S, Ambekar A, Sinha M, Chaware S. Comparative evaluation of fracture resistance of ceramic veneer with three different incisal design preparations: an in-vitro study. *Journal of International Oral Health: JIOH.* 2014 Feb;6(1):48.
23. Cranham JC. Anterior guidance: myth or mandatory. *Inside Dentistry.* 2015;11:94-101.

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