

Interdisciplinary Management of Deep Bite Malocclusion with Excessive Curve of Spee and Severely Abraded Lower Incisors

Abstract

It is difficult to restore severely abraded lower incisors in adult patients with a deep bite, that is associated with an excessive curve of Spee in the lower arch and a reverse curve in the upper arch. Orthodontics is the first step in an effective interdisciplinary treatment plan. Intrusion of the incisors in both arches is required to level the plane of occlusion and correct the deep bite without increasing the vertical dimension of occlusion (VDO). Once the occlusion is aligned, the restorative dentist can restore the severely abraded lower incisors. Incisor extraction or extensive enamel stripping in the lower arch were treatment options for resolving the anterior tooth size discrepancy, which was expected to become more severe as the curve of Spee was leveled. Extraction of the lower right central incisor was the best option because it had a root fracture. The extraction space was closed and the anterior segment was aligned over the apical base of bone by intruding the incisors and leveling the curve of Spee. Anterior bite turbos (raisers) were placed on the maxillary central incisors to open the bite and intrude the lower incisors. Class II elastics were required for anterior-posterior correction of the buccal interdigitation. Pre-restorative orthodontic treatment optimally aligned the dentition for a more predictable esthetics and function for this 54 year old male patient. Correcting extruded lower incisors in older adults is particularly important because the lower anterior dentition is increasingly visible with age. This challenging malocclusion, with Discrepancy Index (DI) of 13, was treated to an excellent result, Cast-Radiograph Evaluation (CRE) of 10. (Int J Ortho Implantol 2015;37:4-16) .

Key words:

Deep bite, abraded incisors, lower incisor extraction, bite turbos, passive self-ligating brackets

History and Etiology

A 53-year-7-month-old male with a slight Class II relationship was concerned about poor esthetics and excessive abrasion of his lower incisors (Figs. 1-3). Interdisciplinary treatment was provided (Fig. 4-6), as documented by the pretreatment (Fig. 7), post-treatment (Fig. 8), and cephalometric radiographs (Fig. 9). The chief complaint was well managed by correcting the overbite and overjet (Fig. 10). The medical history was non-contributory. The treatment plan was based on the etiology as defined by a careful review of the history and presenting conditions. Interdisciplinary treatment was the patient's expectation because he had previously been informed that the abraded incisors could not be restored without orthodontics preparation. Root canal treatment had been performed on all of lower incisors, but the root of the lower right central incisor was fractured (Fig. 11), and the patient was scheduled for endodontic evaluation.

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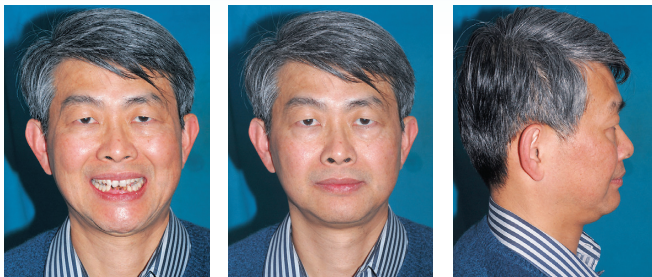


Fig. 1:

Pre-treatment facial photographs show an ideal profile with no facial asymmetry, but the lower anterior area is unesthetic when smiling.



Fig. 4:

Post-treatment facial photographs demonstrate the facial form was maintained, and the lower incisor area is more esthetic when smiling.



Fig. 2.

Pre-treatment intraoral photographs show severely compromised lower incisors.



Fig. 5:

Post-treatment intraoral photographs document optimal alignment and esthetics of the entire dentition. The only significant deficit is the lack of ideal gingival papillae between the lower incisors.

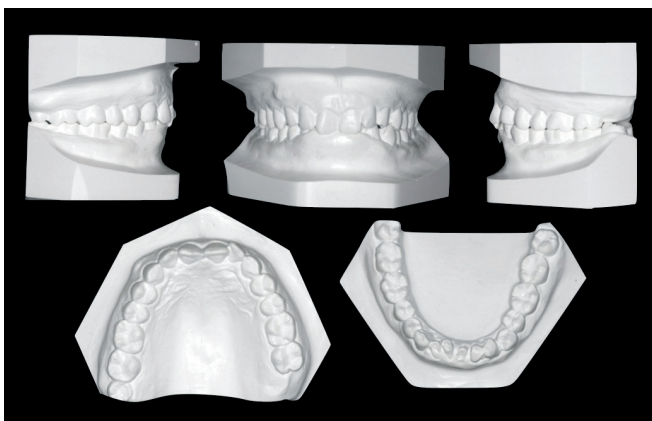


Fig. 3: Pre-treatment study models (casts)

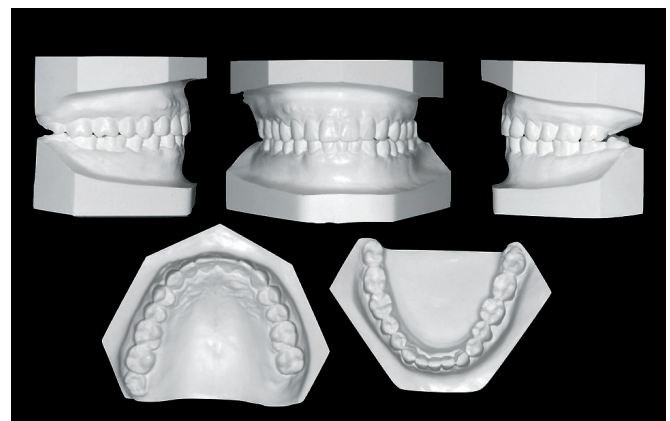
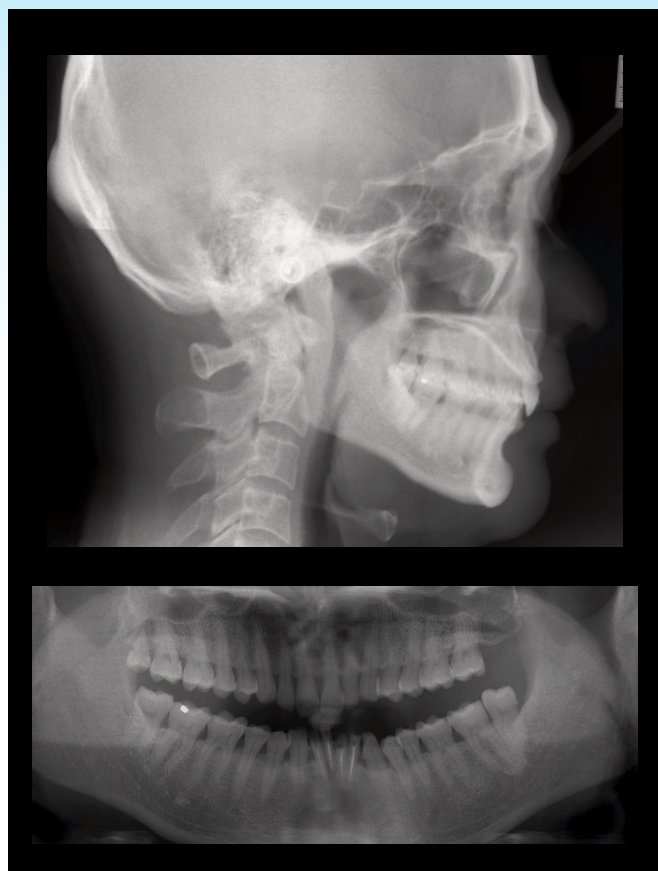
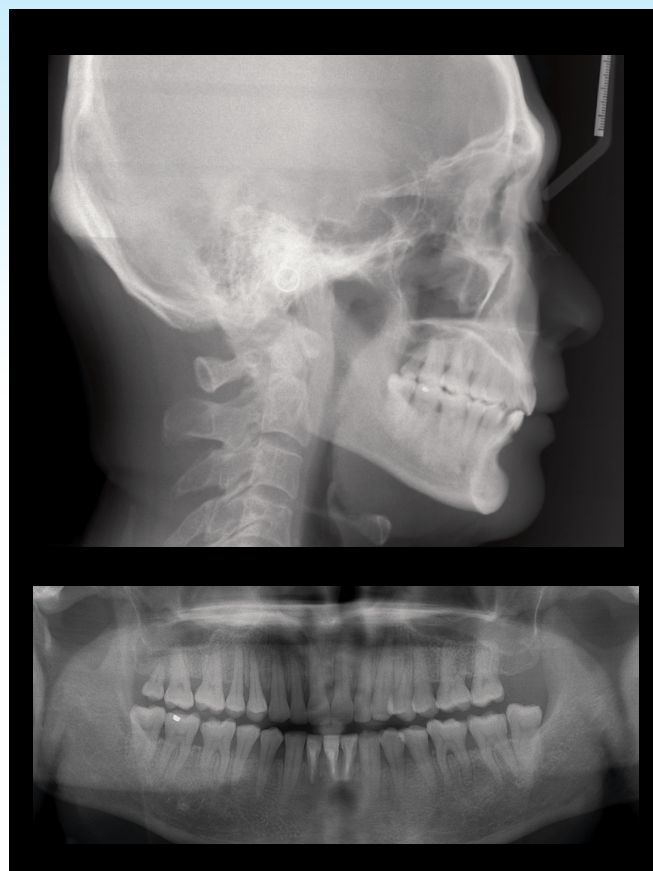


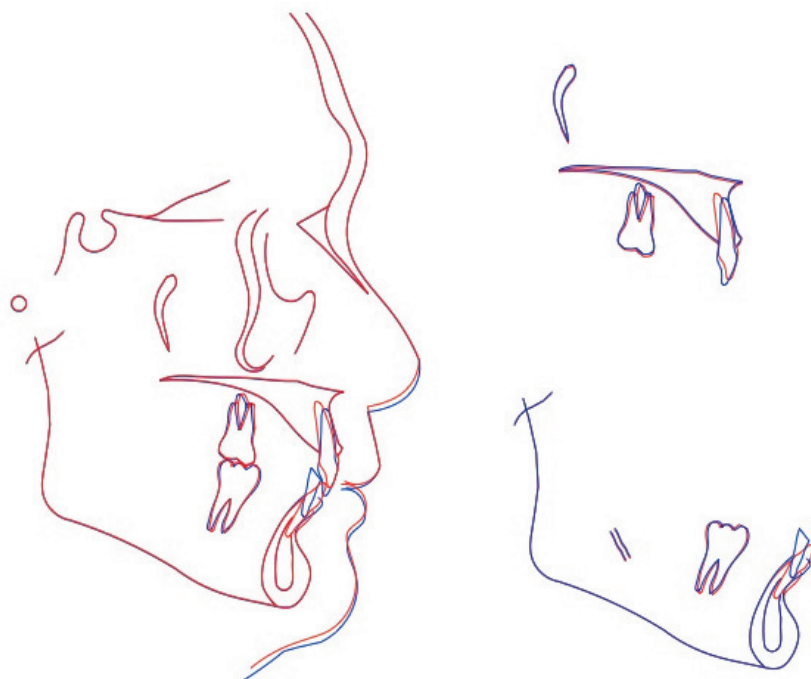
Fig. 6: Post-treatment study models (Casts)



■ **Fig. 7:**
Pre-treatment cephalometric and panoramic photographs



■ **Fig. 8:**
Post-treatment cephalometric and panoramic photographs



■ **Fig. 9:**
Tracings of the pre-treatment (blue) and post-treatment cephalometric films are superimposed on the stable skeletal structures of the anterior cranial base (left), maxilla (upper right) and mandible (lower right). Note that the dentition alignment was corrected without affecting the skeletal structures.

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	84.1°	84.5°	0.4°
SNB°	77.1°	77.3°	0.2°
ANB°	7.0°	7.2°	0.2°
SN-MP°	30.1°	30.6°	0.5°
FMA°	21.7°	22.1°	0.4°
DENTAL ANALYSIS			
U1 TO NA mm	-2.8 mm	-0.7mm	2.1 mm
U1 TO SN°	81.8°	95.9°	14.1°
L1 TO NB mm	1.4mm	7.3 mm	5.9 mm
L1 TO MP°	69.9°	102°	32.1°
U1 TO PP mm	31.3 mm	29.5 mm	-1.8 mm
U6 TO PP mm	24.3 mm	24.4 mm	0.1 mm
L1 TO MP mm	45.2 mm	40.8 mm	-4.4 mm
L6 TO MP mm	33.9 mm	34.1 mm	0.2 mm
FACIAL ANALYSIS			
E-LINE UL	-2.5 mm	-2.2 mm	0.3 mm
E-LINE LL	-3.7 mm	-2.9 mm	0.8 mm

■ Table 1: Cephalometric summary



■ Fig. 10:
Pre-treatment (left) compared to post-treatment (right)
overbite and overjet correction

Diagnosis

Skeletal:

- Skeletal Class II (SNA 84.1°, SNB 77.1°, ANB 7°)
- Average mandibular plane angle (SN-MP 30.1°, FMA 21.7°)

Dental:

- Slight Class II molar and cuspid relationship
- Overjet was 3.5-4 mm
- Overbite exceeded 100%
- 1.5 mm space deficiency in the upper arch
- 3 mm space deficiency in the lower arch
- Severely abraded lower incisors
- Upper right, lower right and lower left wisdom teeth were present.
- Upper and lower dental midlines were coincident with the facial midline
- Arch forms: *symmetrical tapering ovoid for both arches.*

Facial:

- Form and convexity was within normal limits (WNL)

The ABO Discrepancy Index (DI) was 14 as shown in the subsequent worksheet.

Treatment Objectives

After a thorough examination and discussion with this patient, 5 treatment objectives were established to satisfy his concerns:

1. Level and align both upper and lower arches.
2. Improve the esthetics of the lower incisors.
3. Reduce the anterior overbite and establish normal overjet and overbite.
4. Maintain the stable posterior occlusion.
5. Close the lower right central incisor space and restore the other three lower incisors.

Maxilla (*all three planes*):

- A – P: *Maintain*
- Vertical: *Maintain*
- Transverse: *Maintain*

Mandible (*all three planes*):

- A – P: *Maintain*
- Vertical: *Maintain*
- Transverse: *Maintain*

Maxillary Dentition:

- A – P: *Maintain*
- Vertical: *Maintain*
- Transverse: *Maintain*

Mandibular Dentition:

- A – P: *Increase incisal axial inclinations*
- Vertical: *Maintain*
- Transverse: *Maintain*

Facial Esthetics:

- Maintain the patient's good profile.

Treatment Plan

Extraction of the fractured lower right central incisor and correction of the endodontic treatment for the other three incisors. Flatten the lower curve of Spee by intruding the incisors. Provide adequate space for lower incisor restoration with the upper midline coincident with the center of the lower left central incisor. The slight Class II occlusion was acceptable.

Appliances and Treatment Progress

After the lower right central incisor was extracted, endodontic treatment was completed on the other incisors.

A .022" slot Damon Q® bracket system (*Ormco, Glendora, CA*) was bonded on the upper arch using standard torque brackets on the incisors, which were replaced with high torque brackets 10 months later. Upper incisor intrusion and anterior tipping was accomplished with an elastic occlusal to the brackets from canine to canine, and power chains were used to correct rotations (*Fig. 12*). Two months later, the overjet had been increased and enough space was provided for lower incisor restorations (*Figs. 13 and 14*).

In the 8th month of treatment, low torque brackets were bonded up-side down on the lower incisors and high torque brackets were bonded on the lower canines, to provide labial crown torque in the anterior segment. Glass ionomer cement (*GIC*) bite raisers (*turbos*) were bonded on the occlusal surfaces of both upper first premolars. Class II elastics were used to move the lower dentition forward and open the bite (*Figs. 15 and 16*). The initial archwires were .013" CuNiTi on both arches.

In the 14th month of treatment, coordination of the arches was accomplished with elastics applied from: 1. the upper right cuspid and first premolar to a lingual button on the lower right first premolar, and 2. the upper left cuspid and first premolar to a lingual button on the lower left first bicuspid. The anterior component of elastics traction moved the lower first premolars anteriorly. An open coil spring was inserted between the lower premolars bilaterally (Fig. 17).

In the 21st month of treatment, two bite turbos were bonded on the lingual surfaces of the maxillary central incisors to open the bite and provide intrusive force on the three lower incisors as well as the upper central incisors (Fig. 18).

In the 25th month of treatment, repositioning of brackets was performed to detail alignment, tooth angulation and occlusal contacts (Fig. 19). After five months of detailing, fixed appliances were removed 30 months of treatment.



■ Fig. 11:

Periapical X-ray films of the lower incisors document the treatment sequence. Left is pre-treatment showing the compromised lower incisors. Center is after extraction of the central incisor, and composite build-up of the other incisors. Right is at the end of treatment.



■ Fig. 12:

Two months (2M) into treatment (54yr 1m), an intercuspid elastic coursing under the brackets had a significant intrusive component on the central incisors. Simultaneously, individual elastic chains were applied from the first molars bilaterally, to rotate the central incisors mesial-out.



■ Fig. 13:

After four months (4M) of treatment (54yr 3m), the overjet was increased, overbite was shallower, and a diastema opened between the central incisors.



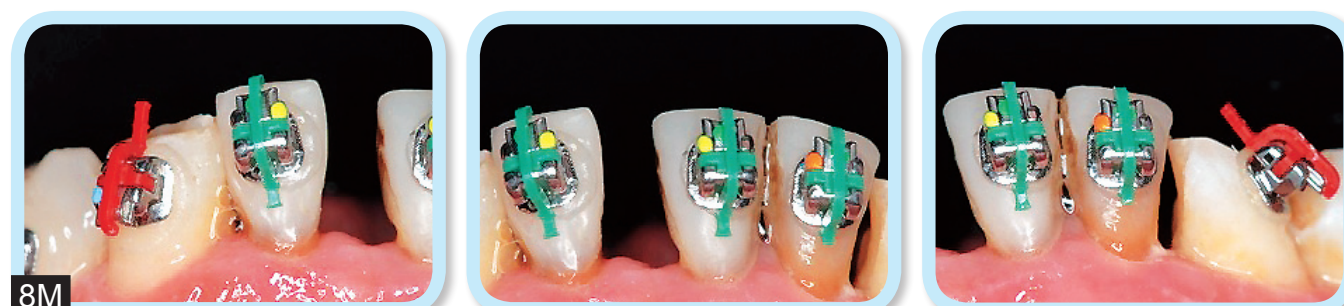
■ Fig. 14:

In the sixth month (6M) of treatment (54y5m), adequate space was achieved for lower incisor composite resin build-up.



■ Fig. 15:

In the eighth month (8M) of treatment (54y7m), the lower arch was bonded, bite turbos were placed on the maxillary first premolars, and light, short Class II elastics were applied.



■ Fig. 16:

In the eighth month (8M) of treatment (54y7m), low torque brackets were bonded up-side down on lower incisors and high torque brackets were bonded on lower canines.

Results Achieved

The patient was treated to an acceptable result as documented in Figs. 4-6. Cephalometric and panoramic radiographs document the pre-treatment conditions and post-treatment results (Figs. 7 and 8). Superimposition of cephalometric tracings document the pretreatment condition (53y7m, T1) relative to after treatment (56y6m, T2) are shown in Fig. 9. A summary of cephalometric measurements is provided in Table 1. The ABO Cast-Radiograph evaluation (CRE) score was 10 as shown in the subsequent worksheet.



■ Fig. 17:

At seventeen months (17M) of treatment (55y4m), a .019x.025" SS archwire was used on the upper arch to enhance anchorage. Open coil springs were inserted between the premolars bilaterally, and Class II elastics were used to protract the lower dentition.



■ Fig. 18:

At twenty-one months (21M) of treatment (55y8m), glass ionomer bite turbos were bonded on the lingual surfaces of maxillary central incisors, providing intrusive force on the lower incisors as well upper central incisors.



■ Fig. 19:

In the twenty-fifth month (25M) of treatment (56y), finishing and detailing is accomplished with bracket repositioning.

Maxilla (all three planes):

- A – P: *Maintained*
- Vertical: *Maintained*
- Transverse: *Maintained*

Mandible (all three planes):

- A – P: *Maintained*
- Vertical: *Maintained*
- Transverse: *Maintained*

Maxillary Dentition:

- A – P: *Upper incisors proclined (increased axial inclination)*
- Vertical: *Upper incisors intruded 1.8 mm*
- Transverse: *Maintained*

Mandibular Dentition:

- A – P: *Lower incisors proclined ~32°*
- Vertical: *Lower anteriors intruded 4.4 mm*
- Transverse: *Maintained*

Facial Esthetics: Maintained

Bolton's tooth-size discrepancy analysis: The anterior Bolton's ratio at the end of treatment was 71.8% (30.5 mm/ 42.5 mm)

Retention

Upper and lower Hawley retainers were delivered. The patient was instructed to wear them full time for the first 6 months and at night time only thereafter. The patient was also instructed in proper home hygiene and maintenance of the retainers.

Final Evaluation of Treatment

In general, both upper and lower arches were well-

aligned, but the original slight Class II canine molar relationships were maintained (Figs. 5 and 6). In spite of there being over 100% deep overbite initially, both the overjet (4 to 2 mm) and the openbite (100 to 45%) decreased significantly by the end of treatment. The Cast-Radiograph Evaluation (CRE) score was excellent (10 points), with most of the points associated with problems in alignment / rotations, marginal ridge discrepancies, and lack of occlusal contacts. The CRE and IBOI pink & white scores are listed at the end of this report.

In the beginning of the treatment, an intra-arch elastic from canine to canine provided an intrusive component on the upper incisors to improve overjet, bite opening and axial inclination. This combination alignment improvements resulted in adequate space for lower incisor restoration and bracket bonding.

A relatively rigid archwire was used in the upper arch (.019x.025" SS) to improve the axial inclination (*torque*) of the upper incisors. It also stabilized the maxillary arch as an anchorage unit for protracting the lower dentition with Class II elastics.

A technically difficult aspect of the treatment was deepbite correction and mandibular anterior space closure. It was easily achieved by using high torque brackets on the lower anterior teeth, and applying Class II elastics to protract the lower dentition. In addition, the incisor bite turbos produced incisor intrusion and bite opening.

Discussion

Restoration of the lower incisors was essential for improving the patient's dental esthetics,¹ but restoring the crown form of severely abraded

incisors is challenging.² Excessive occlusal shear, due to the deepbite and/or parafunction, produced the progressive attrition. Continual eruption of the incisors was also a factor because the lower incisors had no centric stop in occlusion. If the tooth wear was generalized bruxism, it may have affected the vertical dimension of the occlusion, thereby requiring an opening of the bite before providing definitive restorations. However, if the tooth wear is limited to the mandibular anterior teeth, orthodontic intrusion provides enough space for appropriate restoration without altering the patient's vertical dimension of occlusion.^{3,4,5}

Bite turbos (*raisers*) are very useful early in treatment for opening a deep overbite, to leveling the curve of Spee and prevent interference with lower brackets.^{6,7} Advantages for bite turbos are: 1. no patient cooperation is required, 2. full-time alteration of occlusion, and 3. they are easy to bond and remove. Bite turbos bonded on the lingual surface of upper incisors are particularly useful for deepbite correction in Class I and II malocclusions with a moderate overjet. They can be constructed with glass ionomer cement, composite resins or self-curing acrylic resins. For adults, bite turbos provide an intrusive force resulting in upper and lower incisor intrusion, usually without significant extrusion of the posterior teeth, because the mandibular plane angle is unchanged.

Lower incisor extraction is a valuable option for some patients.^{8,9,10,11} The space gained can help correct a tooth size discrepancy, relieve lower anterior crowding, as well as assist in retraction of lower incisors and correction of anterior crossbite.^{12,13,14} The lower right central incisor was extracted for the present patient because its root was fractured. The space was utilized for lower anterior intrusion and deepbite correction. However, extracting one

incisor resulted in a tooth size requiring a restorative increase in the width of the other three incisors. The Bolton's ratio was 71.8% when the treatment was finished, compared with the normal mean value of 77.2%. Consequently, there was excessive upper incisor tooth width which resulted in a deeper overbite than normal at the end of treatment.

Restoration of lower incisors was essential prior to bonding brackets on their labial surfaces. Mandibular incisors are difficult to partially restore with conventional anterior crown forms, so composite build up was utilized to adequately restore the worn incisors without resorting to full-crown restorations.^{15,16,17} The severely abraded incisors had previously received root canal therapy, so fiber posts were inserted in the upper root to reinforce the restored crown structure.

Porcelain crowns were contraindicated because: 1. too much reduction of tooth structure is required, 2. when incisors are reduced in diameter they are susceptible to fracture, and 3. porcelain is abrasive to opposing teeth. Thus composite build-up was a much better option than porcelain, even though the restorations were a little darker than ideal. The latter was not a problem because the patient did not show much of the lower incisors when smiling. After almost 2 years of follow up, the composite restorations have held up very well, and no attrition has been noted.

Conclusion

As patients age, the upper lip lengthens and it is more difficult to display the maxillary incisors when smiling. So the mandibular anterior teeth are increasingly more visible during speaking, smiling and sometimes even at rest. For the present

patient, restoration of the lower incisors was crucial to improving dental esthetics. Adjunctive orthodontic treatment assisted the restorative dentist in restoring the severely-worn, over-erupted lower incisors by intruding the lower and upper anterior teeth without changing the patient's vertical dimension. The lower right central incisor was extracted due to root fracture and its space was utilized to compensate for the decrease in arch length when the curve of Spee was corrected. With proper planning and careful clinical management, lower incisor extraction significantly contributes to the resolution of deepbite, crowded malocclusions with a deep curve of Spee. The pursuit of excellence in orthodontic treatment results requires optimal esthetics, function and stability.

Acknowledgements

Thanks to Dr. Jeng-Feng Hwang for his excellent composite restoration of the lower broken incisors without further reduction of the compromised tooth structure.

Thanks to Dr. Tien Chun Kuo for her excellent endodontic retreatment of the compromised lower incisor.

References

1. Wylie WL. Discussion of "The Lower Incisor-Its Influence on Treatment and Esthetics." *American J of Orthod* 1959 Jan;45(1):50-54.
2. Kokich VG, Spear F, Mathews D. Mandibular Incisor Intrusion: An Adjunct to Restoring Short, Abraded Anterior Teeth. *Inside Dentistry* [serial online] 2008 Apr;4(4). Available from: URL: <http://www.dentalaegis.com/id/2008/04/restorative-dentistry/mandibular-incisor-intrusion-an-adjunct-to-restoring-short-abraded-anterior-teeth>.
3. Spear F, Kokich VG, Mathews D. Interdisciplinary management of anterior dental esthetics. *J Am Dent Assoc* 2006;137:160-169.
4. Kokich VG, Spear F. Guidelines for treating the orthodontic-restorative patient. *Semin Orthod* 1997;3:3-20.
5. Kokich VO Jr. Treatment of a Class I malocclusion with a carious mandibular incisor and no Bolton discrepancy. *Am J Orthod Dentofacial Orthop* 2000 Jul;118(1):107-13.
6. Philippe J. Treatment of deep bite with bonded biteplanes. *J Clin Orthod* 1996;30:396-400.
7. Jackson S, Sandler PJ. Fixed biteplanes for treatment of deep bite. *J Clin Orthod* 1996;30:283-7.
8. Nakane Matsumoto MA, Lourenço Romano F, Lima Ferreira JT, Tanaka S, Morizono EN. Lower incisor extraction in orthodontic treatment. *Am J Orthod* 1977 Nov;72(5):560-7.
9. Canut JA. Mandibular incisor extraction: indications and long-term evaluation. *Eur J Orthod* 1996 Oct;18(5):485-9.
10. Klein DJ. The mandibular central incisor, an extraction option. *Am J Orthod Dentofacial Orthop* 1997 Mar;111(3):253-9.
11. Kokich VG, Shapiro PA. Lower incisor extraction in orthodontic treatment. Four clinical reports. *Angle Orthod* 1984 Apr;54(2):139-53.
12. Bolton WA. Disharmony in tooth size and its relation to the analysis and treatment of malocclusion. *Angle Orthod* 1958 Jul;28(3):113-30.
13. Little RM, Riedel RA, Artun J. An evaluation of changes in mandibular anterior alignment from 10 to 20 years postretention. *Am J Orthod Dentofacial Orthop* 1988 May;93(5):423-8.
14. Riedel RA, Little RM, Bui TD. Mandibular incisor extraction: postretention evaluation of stability and relapse. *Angle Orthod* 1992;62(2):103-16.
15. Redman CD, Hemmings KW, Good JA. The survival and clinical performance of resin-based composite restorations used to treat localised anterior tooth wear. *Br Dent J* 2003;194(10):566-72.
16. Hemmings KW, Darbar UR, Vaughan S. Tooth wear treated with direct composite restorations at an increased vertical dimension: results at 30 months. *J Prosthet Dent* 2000;83(3):287-93.
17. Gow AM, Hemmings KW. The treatment of localised anterior tooth wear with indirect Artglass restorations at an increased occlusal vertical dimension. Results after two years. *Eur J Prosthodont Restor Dent* 2002;10(3):101-5.



Discrepancy Index Worksheet

TOTAL D.I. SCORE 13

OVERJET

0 mm. (edge-to-edge) =
1 – 3 mm. = 0 pts.
3.1 – 5 mm. = 2 pts.
5.1 – 7 mm. = 3 pts.
7.1 – 9 mm. = 4 pts.
> 9 mm. = 5 pts.

Negative OJ (x-bite) 1 pt. per mm. per tooth =

Total = 0

OVERBITE

0 – 3 mm. = 0 pts.
3.1 – 5 mm. = 2 pts.
5.1 – 7 mm. = 3 pts.
Impinging (100%) = 5 pts.

Total = 5

ANTERIOR OPEN BITE

0 mm. (edge-to-edge), 1 pt. per tooth
then 1 pt. per additional full mm. per tooth

Total = 0

LATERAL OPEN BITE

2 pts. per mm. per tooth

Total = 0

CROWDING (only one arch)

1 – 3 mm. = 1 pt.
3.1 – 5 mm. = 2 pts.
5.1 – 7 mm. = 4 pts.
> 7 mm. = 7 pts.

Total = 1

OCCLUSION

Class I to end on = 0 pts.
End on 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. pts.
additional

Total = 0

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB $\geq 6^\circ$ or $\leq -2^\circ$ 0 = 4 pts.

Each degree $< -2^\circ$ x 1 pt. =

Each degree $> 6^\circ$ 1 x 1 pt. = 1

SN-MP

$\geq 38^\circ$ = 2 pts.

Each degree $> 38^\circ$ x 2 pts. =

$\leq 26^\circ$ = 1 pt.

Each degree $< 26^\circ$ x 1 pt. =

1 to MP $\geq 99^\circ$ = 1 pt.

Each degree $> 99^\circ$ x 1 pt. =

Total = 1

OTHER (See Instructions)

Supernumerary teeth x 1 pt. =
Ankylosis of perm. teeth x 2 pts. =
Anomalous morphology x 2 pts. =
Impaction (except 3rd molars) x 2 pts. =
Midline discrepancy (≥ 3 mm) @ 2 pts. =
Missing teeth (except 3rd molars) x 1 pts. =
Missing teeth, congenital x 2 pts. =
Spacing (4 or more, per arch) x 2 pts. =
Spacing (Mx cent. diastema ≥ 2 mm) @ 2 pts. =
Tooth transposition x 2 pts. =
Skeletal asymmetry (nonsurgical tx) @ 3 pts. =
Addl. treatment complexities 3 x 2 pts. = 6

Identify: Lower one incisor extraction was planned in such an adult deepbite case.

Total = 6

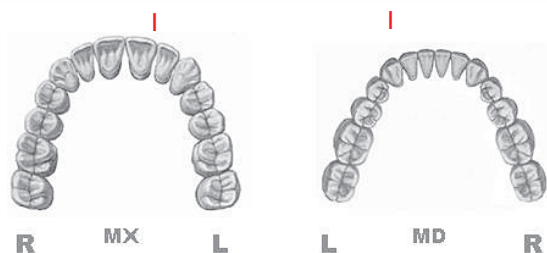
Cast-Radiograph Evaluation

Total CRE Score

10

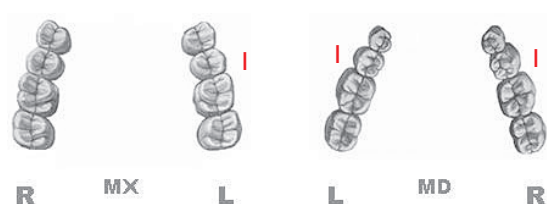
Alignment/Rotations

2



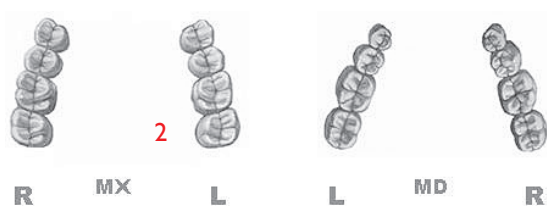
Marginal Ridges

3



Buccolingual Inclination

2



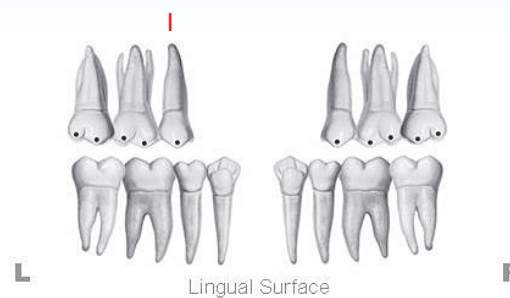
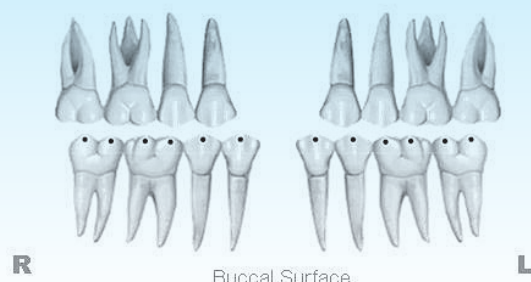
Overjet

0



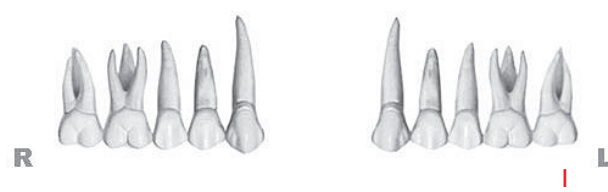
Occlusal Contacts

1



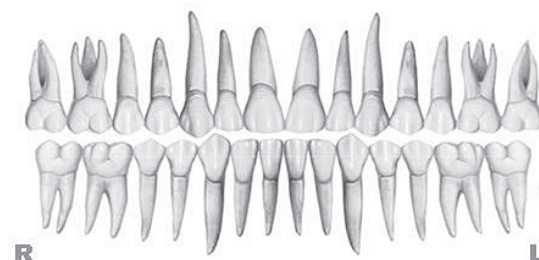
Occlusal Relationships

1



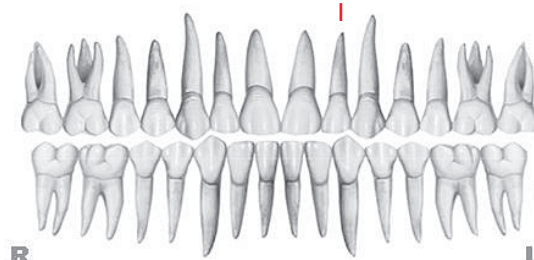
Interproximal Contacts

0



Root Angulation

1



INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.