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Anterior Crowding Treatment with Interproximal Enamel Reduction (IER) Technique of Orthodontics Treatment: Case Report

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Abstract: ***Introduction: Anterior crowding is the most common case in orthodontic patients. Several methods can be performed such as transverse arch expansion, anterior tooth proclination, teeth distalization in the arch, tooth extraction, or interproximal reduction on tooth enamel. Age, facial profiles, and number of crowding determine the treatment options. One of the most commonly known non-extraction techniques (Interproximal Enamel Reduction) is slicing. This technique is indicated for patients with mild to moderate crowding (4-8 mm), slicing is an alternative to tooth extraction. Case Report: A 13-year-old girl came to the Pediatric Hospital Installation at Dental and Oral Hospital (RSGM) of University Padjadjarancomplained about the composition of the front crowding, not neat, disrupt the appearance and reduce self-confidence. Discussion: This case report explains in stages the orthodontic treatment of mild crowding using the non-extraction techniques (Interproximal Enamel Reduction). Conclusion: The success of orthodontic treatment in correcting malocclusion, especially cases of crowding depends on many factorsof growth and development, namely genetic factors; prenatal and post-natal environment (biological, physical, psycho-social, family, customs, culture, nutritional factors); severity of the case, motivation and cooperative of the patient.***

Keywords: Crowding, Slicing, Orthodontic treatment, Growth & Development

1. Introduction

Crowding is the most common malocclusion, defined as differences in the relationship tooth size and jaw, resulting in rotating and overlapping teeth.[6] Based on the cause, crowding can be classified into primary, secondary, and tertiary crowding.[8,9] Primary crowding is caused by the mismatchedsize between primary teeth and permanent teeth, generally a genetic factor. Secondary crowding occurs in the posterior region due to the earlier extraction of the first molars. Tertiary crowdinghappens towards the end of the maximum peak of mandibular growth, which coincides with the eruption of the third molar.[9]

Management of Crowding

The need to repair crowding is to consider the aesthetic and functional needs. As facial and dental development continues throughout childhood and adolescence, early intervention can help develop normal occlusion and facial harmony.[8] The development of late mixed dentition period is a good time to start treatment on crowding. Early intervention requires the brain's ability to evaluate and identify per individual, plan and make decisions based on available information.[8]

Slicing

Interproximal enamel reduction technique or *slicing* is a clinical procedure that involves reduction, re-contouring, and protection of the proximal surface of tooth enamel. The purpose of this procedure is to obtain space in orthodontic treatment and provide a suitable shape to the teeth if needed [10,11]

Indicationof Slicing

Slicing is performed only in patients with low caries risk and good oral hygiene to avoid increased susceptibility to caries. The main indications of slicing are the lack of space in dental arch of 4-8 mm, the Bolton Index discrepancy, the ability to get space for tooth movement without the need for extraction, tootth shape changes, macrodontia, normalization of gingival contours and elimination ofgingiva black triangle, increased retention, stability after orthodontic treatment, and improvement of the Spee curve.[1]

Contraindications of Slicing

Slicing should not be performed for patients with high caries risk and poor oral hygiene to avoid the risk of developing caries. The main contraindications are if the crowding is more than 8 mm, active periodontal disease, enamel hypoplasia, cold hypersensitivity, and the presence of several restored teeth, rounded premolars, and teeth with large pulp chambers (primary teeth).[1, 5]

Method of Slicing

The important thing to know before performing slicing is how much enamel can be reduced, performed by projecting a line from the cervical line to the occlusal plane vertically because the dentine is projected on a straight line from the cervical line. Research shows that enamel is slightly thinner on the distal surface than mesial. Another way to measure enamel thickness is to use a specific measuring device (special gauge) which has a measurement accuracy of up to tenth of a millimeter (Figure 1.1).[1]

Figure 1.1: Examples of gauges for tooth enamel thickness

After determining the thickness of the interdental enamel of the tooth, the dentist can only determine how much email can be reduced.

Fillion *et al.* recommended not to reduce more than 0.3 mm of enamel in the maxillary incisor, 0.6 mm in the maxillary posterior teeth, 0.2 mm in the mandibular incisor, and 0.6 mm on the mesial surface of the posterior mandible. Chudasama and Sheridan[6] stated that interdental enamel is thinner in the maxillary lateral incisors and lower central and lateral incisors, so that only 0.5 mm can be reduced from this contact point. Sheridan and Ledoux stated that 6.4 mm of space can be obtained by *slicing* eight interproximal surfaces of premolars and molar teeth. Stroud *et al.* assume that it is possible to reach 9.8 mm by applying the same procedure.[1]

Slicing Procedures

Before performing slicing, all the teeth in the arch must be leveled and aligned, because after leveling and aligning, we can easily assess whether the correct occlusion can be achieved or not. After being aligned, separator must be used to obtain space between teeth which will increase visibility and access to the point of contact. All teeth should not be sliced on one and the same visit. *Slicing* must be performed with handpiece which emits water or air conditioning.[1]

When choosing instrumentation for the procedure of slicing, it is important to determine which instrumentation and soft tissue protector should be used. General interproximal reduction instrumentation of teeth consists of manual and rotary techniques. The most clinically accepted slicing techniques include:[1]

1) Air-rotor stripping (ARS) technique with fine tungsten-carbide or diamond coated strip bur
2) Bur disk diamond on handpiece or contra-angle
3) Abrasive metal strips for hand usage or machine.

Figure 1.2: Abrasive metal strip that is used by hand

The advantage of abrasive metal strips is that it provides optimal visibility and provides easy access to erode and finishing.

Figure 1.3: Interproximal enamel reduction with diamond disk

Figure 1.4: Air-rotor stripping[12]

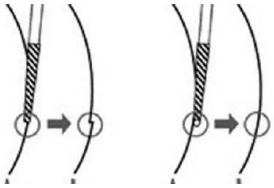


Figure 1.5: Bur with non-cutting /stroking tip[1]

Figure 1.6: Various types of bur water rotor stripping (STAR^{TM})[12]

Figure 1.7: Ortho-strips and the handles

2. Case Report

A 13-year-old girl came to the Pediatric Hospital Installation at Dental and Oral Hospital (RSGM) of Padjadjaran University complained about the composition of the front crowding, not neat, disrupt the appearance and reduce self-confidence, so she wanted to tidy them up. The general condition of the patient was good, there was no history of systemic disease, congenital abnormalities, regular drug administration, and dental trauma. Extra oral examination found no abnormalities, right and left mesofacial and symmetrical facial types, convex facial profiles, positive lip seal, and no temporomandibular joint disorder (Figure 2.1). The patient had a balanced head and shoulder position, and symmetrical posture (Figure 2.2)

Intra-oral examination showed good oral hygiene, no dental caries, tongue and normal labial and lingual frenulum. Panoramic radiographs showed patches on teeth 36 and 46. Teeth 18, 28, 38 and 48 had not erupted, and partial eruptions in teeth 37, 47. The shape of the normal condyle, the right and left condylus height is unbalanced (the left condyle is 1 mm higher than the right condyle) and there are no complaints in the Temporo Mandibular Junction (TMJ) joint (Figure 2.3). Cephalometric analysis used was: Steiner's analysis for the assessment of skeletal, dental, and

soft tissue. In this case, it was stated that the patient had a skeletal class I (orthognathic) relationship, a protrusive maxillary dental abnormality and a retrusive menton (Table 2.1). Down's analysis was used to take into account the facial and dental relationships of the patients and compare them with normal facial and dental morphology. Down's analysis in this case showed a normal skeletal relationship with the orthognathic facial type, dental abnormalities showed protrusive maxillary and mandibular incisors and labioversion (Table 2.2).

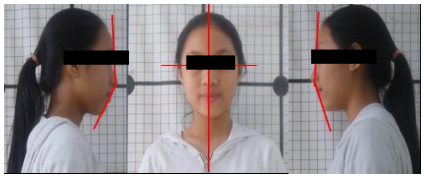


Figure 2.1: Patient's extra oral appearance

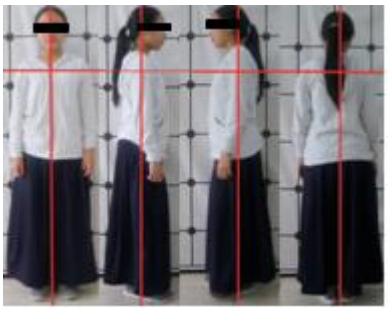


Figure 2.2: Patient's body profile

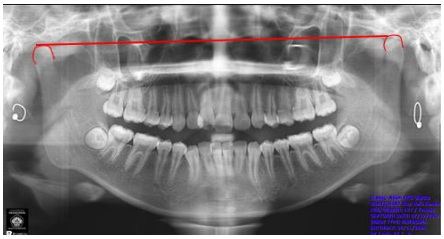


Figure 2.3: Image of panoramic radiographs

Figure 2.4: Image of Cephalometric radiographs

Wits analysis was used as a complement to skeletal analysis, which in this case showed a class I skeletal relationship (Table 2.3). Model analysis was performed from the sagittal direction to see the anteroposterior canine and molar relationship and determine the Angle classification, in this case it could be classified as Class I Angle, and see the shape of the maxillary and mandibular dental arches. This case occurred in the period of permanent teeth, so that the ALD (Arch Length Discrepancy) calculation, Pont, and Howes methods were used.

Analysis of Arch Length Discrepancy (ALD) in the maxilla showed an estimation of differences in dental arches and arches of the jaw with a lack of 0.5 mm space, whereas in the mandible there was a 1 mm room shortage (Table 2.4).

Table 2.1: Steiners Analysis

	Result	Conclusion
<S N A	91^0	Prognation
< S N B	87^0	Prognation
<A N B	4^0	Skeletal Class I
<1- NA	24^0	Normal
<1-NA (mm)	4 mm	Normal
<1-NB	24^0	Normal
1-NB (mm)	9 mm	Proposition
<1-1	126^0	Protrusion
Pg-NB (mm)	1 mm	Menton Retrusion
<GoGn-SN	22^0	Normal
<Bid Occ-SN	28^0	Normal

Table 2.2: Down's Analysis

Skeletal	Result	Conclusion
<Facial N-Pg	93^0	Normal
<Konveksitas	10^0	Normal
<AB plane	-5^0	Normal
<FHP-Mandibular plane	28^0	Normal
Y/Y axis	64^0	Normal

Dental	Result	Conclusion
<occlusal plane	14^0	Normal
<1-1	126^0	Protrusion
<1 RB- Mandibular plane	103^0	Labioversion
<1 RB- Occlusal plane	70^0	abnormal
1-AP plane	6 mm	Protrusion

Table 2.3: Wits Analysis

A-Occl-B	Result	Conclusion
AO-BO	1 mm	Skeletal Class I

Table 2.4: Analysis of Arch Length Discrepancy

Upper arch length	= 107, mm
Dental arch length of RA / Number of Mesiodistal 16-26	= 108 mm
Difference	= -0.5 mm
Lower arch length	= 95.5 mm
Dental arch length of RB / number of mesiodistal widths 36-46	= 96.5 mm
Difference	= -1 mm

The Howes Index was used to determine whether the apical base is sufficient to load the patient's teeth. The Howes index showed a value of 44.4%, meaning that it is necessary to extract teeth or expand, and a difference of 2 mm between the arch width of the tooth and the arch of the jaw showed that it is safe to expand.

The Pont index was used to determine the ideal arch width based on the mesiodistal width of the crown of the four maxillary incisors (12, 11, 21, 22).

Diagnosis was made through a whole series of examinations and skeletal class 1 classification and diagnosis of Class 1 of type 1 and 2 Angle malocclusions with upper jaw crowding (11 labioversions, 12 palatoversions, 41 mesolipyoversion, 42 stopalatoversion, 7 mm overjet, and 4 mm overbite, median line shift to the

right as much as 1 mm, and the convex profile and the absence of interference with the temporomandibular joint. The etiology of this case is the presence of persistent teeth, an imbalance in the growth and development of the teeth and the upper and lower jaw arches.

3. Case Management, Figures, and Tables.

Diagnosis was made through a whole series of examinations and skeletal class 1 classification and diagnosis of Class 1 of type 1 and 2 Angle malocclusions with upper jaw crowding (11 ambiversions, 12 palatoversions, 41 mesolipyoversion, 42 stopalatoversion, 7 mm overjet, and 4 mm overbite, median line shift to the right as much as 1 mm, and the convex profile and the absence of interference with the temporomandibular joint. The etiology of this case is the persistence of teeth, imbalance in growth, development of teeth and arches of the upper and lower jaws.

At the first visit, initial examination of the history, physical examination, posture, extra oral, intra-oral (Figure 3.1), dental health education,and printing the maxilla and lower jaw as a study model (Figure 3.2), then panoramic and cephalometric x-rays were performed.

Preliminary treatment begun with *scaling* and prophylaxis with Preventive Resin Restorative(PRR) of teeth 16, 26, 36, 46 and providing maxillaryfluorinetypical administration. Orthodontic phase with bracketing in the maxilla, after buccal tube is installed in teeth 16 and 26. Bonding bracketon the teeth 15, 14, 13, 11, 21, 22, 23, 24, 25, slicing in the mesial and distal teeth 16, 15, 14, 13 (Figure 3.3) was used to open a room between teeth 11 and 13, and levelingandalignment starting with NiTi wire sizes ranging from 0.12; 0.14; 0.16; 0.18, usage of Stainless Steel (SS) wire0.14; 0.16 then ligature wire from teeth 15 to 25 and elastic rubber to correct interdigitation, ending using wire recta 0.18 x 0.22. The orthodontic phase in the lower jaw was placed in buccal tube in teeth 36 and 46, followed by bonding bracket in teeth 35, 34, 33, 31, 41, 43, 44, and 45, slicing in the mesial and distal teeth 36, 35, 34, 33, 46, 45, 44, 43; leveling and alignment starting with NiTi wire sizes ranging from 0.12; 0.14; 0.16; 0.18, usage Stainless Steel (SS) wire0.14; 0.16 then ligature wire from teeth 35 to 45 and elastic grade 2 rubber to correct interdigitation, ended bywire recta 0.18 x 0.22 use.

Figure 3.1: Intra-oral features before treatment: Appearance (A**)** Anterior; (B) Right lateral; **(C)** Left lateral (D) occlusal maxilla (E) occlusal lower jaw

Figure 3.2: Analysis of patient's model before treatment seen from direction: (A) Anterior; (B) Right lateral; (C) Left lateral

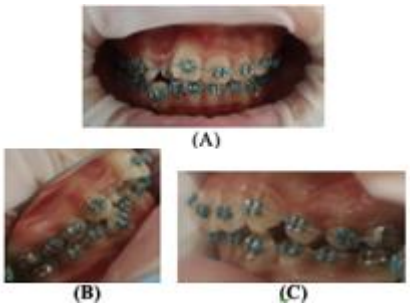


Figure 3.3: The initial stage of patient's orthodontic phase of (A) Anterior; (B) Right lateral; (C) Left lateral

Figure 3.4: The initial stage of the patient's orthodontic phase seen from the occlusal of (A) Upper jaw; (B) Lower jaw

Figure 3.5: Final stages of slicing in distal and mesial teeth 13

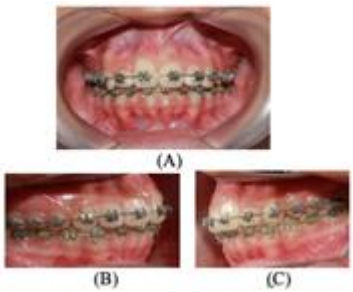


Figure 3.6: Stages during patient orthodontic treatment of (A) Anterior; (B) Right lateral; (C) Left lateral

Figure 3.7: Stages during patient orthodontic treatment seen from occlusal: (A) maxilla; **(**B**)** Lower jaw

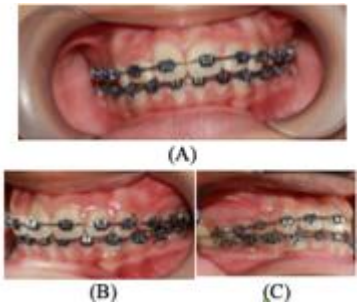


Figure 3.8: Final stages of patient orthodontic treatment of (A) Anterior; (B) Right lateral; (C) Left Lateral

Figure 3.9: Final stages of patient's orthodontic treatment seen from occlusal: (A) Upper jaw; (B) Lower jaw

Slicing was performed at 0.125 mm for every 16 to 13 teeth as many as 4 maxillary posterior teeth, so that a space of 0.5 mm was obtained. Slicing started from the distal 16 teeth first, then followed to mesial 13, and the lower jaw slicing was performed at 0.125 mm in each tooth 36 to 46 as many as 8 posterior teeth in the lower jaw, so that a space of 1 mm was obtained. Slicing started from distal teeth 36 to mesial 33 and distal teeth 46 to mesial 43, so that a room of 1 mm was obtained, for several visits (Figure 3.9). Slicing from one tooth to another was performed after a shift of teeth covered the gap caused by previous slicing. After slicing, teeth were applied with topical fluoride. Patients were instructed to maintain their diet and oral hygiene, as well as routine control every 3 weeks to the dentist.

4. Discussion

According to Bishara (2001), knowledge of growth and development is very important in dentistry. It is because development is the basis for understanding and developing clinical skills, by studying and understanding the process of growth and development. A dentist will be able to distinguish normal variations caused by abnormal or pathological processes in patients, so that later they can make appropriate treatment plans for their patients. One case of malocclusion that is frequently occured is crowding. [21]

Crowdingmay interfere with social relations because it affects aesthetic and emotional factors so that this can be the main reason for patients choosing an orthodontic treatment. The selection of appropriate treatment plan depends on which factors affecting the occurrence of thecrowding. Extraction is a commonprocedure performed to correct crowding. Extraction decisions should be made not only by considering the number of crowding but also the final effect of orthodontic treatment of tooth shift on the soft tissue on the face surface. Orthodontic treatment that is not accompanied by extraction measures has become a growing field of science today and will reduce the potential for trauma in patients and the risk of other adverse complications that cannot be restored to their original state (irreversible), besides non-extraction actions also provide fairly good value and benefits.[17]

One reason for taking non-extraction procedure is relatively small risk of complications compared to treatment with extraction. However, if direct extraction procedureis performed without other considerations, the process can no longer be changed.[17]

Reduction of mesio-distal size of the dentition with enamel removal in interproximal or known as slicing is a non-tooth extraction procedure that can improve crowding.[1,4] This procedure is taken to obtain not too much amount of space and is an alternative action of tooth extraction or dental arch expansion that can be performed in patients with healthy periodontal tissue and have moderate cases of teeth which are 4-8 mm.[1,4,10]

According to Frindel,[4]slicing is also indicated to eliminate interincisal black triangles caused by bone loss or improper contact points during occlusion which can also be followed by divergent roots. This black triangle is usually formed in patients with weaker periodic tissue to support long-term orthodontic treatment, which is a fairly long period of tooth shift.

Fillion[18] included a table that shows the number of enamels that can be taken with slicing. By using this guide, the dentist can obtain a maximum of 8.6 mm of space in the mandible and 10.2 mm on slicing the interproximal of all teeth starts from the mesial surface of the first molar to the mesial surface of the first molar opposite.

Table 4.1: Tooth enamel limit that can be sliced[18]

	CENTRAL		LATERAL		CANINE		FIRST PREMOLAR		SECOND PREMOLAR		FIRST MOLAR		TOTAL PER ARCH
	M	D	M	D	M	D	M	D	M	D	M	D	
UPPER ARCH	0,3	0,3	0,3	0,3	0,3	0,6	0,6	0,6	0,6	0,6	0,6		10,2
REDUCTION OF TOOTH SURFACE	0,6		0,6		0,6		1,2		1,2		1,2		
LOWER ARCH	0,2	0,2	0,2	0,2	0,2	0,2	0,6	0,6	0,6	0,6	0,6		8,6
REDUCTION OF TOOTH SURFACE	0,4		0,4		0,4		0,9		1,2		1,2		

Slicing always performed at the first place on the posterior teeth and the last in the anterior teeth to prevent loss of space caused by loss of theanterior component of force.[4,18]

The success of a treatment plan in correcting malocclusion, especially in cases of crowding depends on many factors, the treatment performed by a dentist is not only limited to eliminating the causes of pain, but also to correct the morphological aberrations and complex functions of dentofacial. It could be due to irregularities in growth and development from pre-natal to adulthood. The growth and development of each individual varies, this is affected by several factors, including: [21,22,23]

a) Genetic factors

Genetic factors are the basis in achieving the final results of the growth process in children.

b) Environmental factors

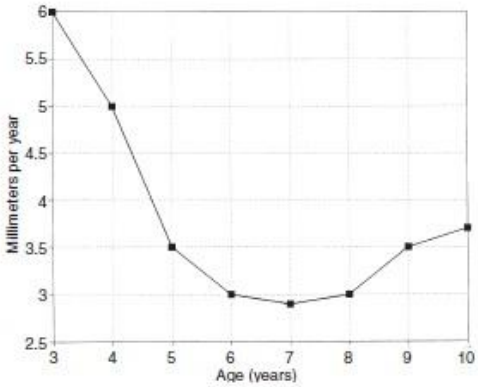
1. Prenatal environment, which includes maternal nutrition during pregnancy, the presence of toxins or chemicals, radiation, stress, embryonic anoxia, immunity, infection, and others.
2. Postnatal environment, including:

Biological factors, namely race (ethnicity), gender, age, nutrition, health care, vulnerabilityto diseases, chronic diseases, metabolic functions, hormones. Generally, the highest growth rate is during childhood and increases again during adolescence. Below is a curve that describes the speed of growth according to age and sex.

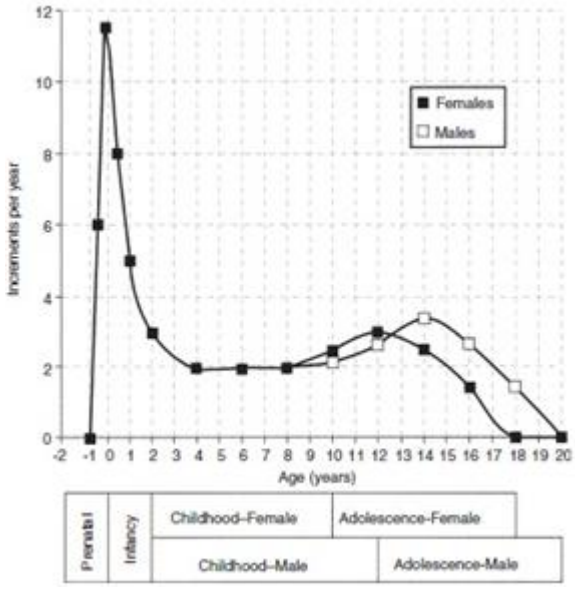
Physical factors, namely, weather (season, geographical conditions), home condition, sanitation, radiation.

Psycho-social factors, namely stimulation, motivation, family, school, stress, love and affection, quality of interaction berween children and parents. Family factors and customs, including work / family income, parent's education, number of siblings, gender in the family, household stability, personality of the parent, customs, norms, religion, etc.

Cultural factors



Curve 1: Incremental (Speed) Growth According to Age[22]



Curve 2: Incremental Growth Describes Differences in Men and Women Growth Stage[22]

c) Nutrition

Growing with malnutrition can affect the body size, chemicals in the body, and the quality and texture of some tissues (for example, teeth and bones). Malnutrition can also delay both growth and growth acceleration. Adequate intake of nutritious food is very important for the growth of each individual. Tooth growth is prioritized for bone growth, and bone grows better than soft tissue such as muscle and fat.[22]

In this case report, besides being affected by growth and development including sex and age of the patients who are in the period of growth spurt,i.e. 12-13 years old for women, the success or failure of the treatment is also affected by the level of crowding. The milder the case, the more it will greatly affect the success of treatment, because a simple orthodontic treatment method or technique can be taken, i.e.non-extraction using interproximal enamel reduction (slicing) technique. In addition, the patient's internal factors such as genetic factors and race as well as having both parents withcrowding history, and inter-tribal marriages, habits and dietary patterns of patients from childhood, motivation, cooperation and patient compliance in undergoing control, parental support and the family are also very influential in the success of the treatment performed, in addition to the support of methods and quality of the material and the appropriate orthodontic treatment techniques and plans chosen by the dentist who treats the patient.

5. Conclusion

1) The success of orthodontic treatment plan in correcting malocclusion, especially cases of crowding depends on many factors that affect growth and development, namely genetic factors; prenatal and post-natal environment (biological, physical, psycho-social, family, customs, culture, nutritional factors); severity of the case as well as motivation and cooperation of the patient.
2) Interproximal enamel reduction or *slicing* technique is a part of non-extraction orthodontic treatment plan that can be chosen to obtain a room in treatment of mild*crowding* case. Currently, the reduction of interproximal enamel has become an alternative to extraction of permanent teeth.
3) Slicing allows sufficient space for crowdingteeth to shift to the arch properly. This case shows an orthodontic mechanism that is consistent with the gradual slicing procedure that will provide quality aesthetic and dental occlusion stability in patients.

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