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Clear thinking about interproximal stripping

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Reducing the mesio-distal size of teeth by removing enamel in the process known as interproximal stripping is a way orthodontists can gain a modest amount of space in their treatment of crowding.

They have used this therapeutic procedure since the Eighties in the mandibular incisor region to correct relapse or to prevent it. But with the more recent near universal use of bonding to place brackets on teeth and thus eliminate full mouth banding, it has become possible to obtain space in a similar way in posterior sectors of the arch with the Air Rotor Stripping (A.R.S.) technique that Sheridan[2] described in1985.

Today interproximal stripping has become a viable alternative to the extraction of permanent teeth or arch expansion in cases of moderate 4 to 8 mm crowding, which makes it an attractive choice in the treatment of adults.

But, because it is an irreversible act, orthodontists should undertake a careful analysis before deciding to use it. This article will not only outline the special materials required for the removal of interproximal enamel but review the parameters that govern interproximal stripping according to the different protocols proposed by a variety of authors.

1 - CONDITIONS REQUIRED FOR USING INTERPROXIMAL STRIPPING

1 - 1 - Dental anatomy

Not all teeth are suitable for interproximal stripping. Orthodontists can use the Le Huche index[14] to help them determine the varying degrees of divergence in teeth with regard to their mesio-distal widths at the level of their contact points and the mesio-distal width of their roots at the level of the cemento-enamel junction.Thehigher the index the more that tooth can be considered to have a triangular shape and, according to Langlade[13], the more suitable it is for reduction of interproximal enamel on its mesial and distal surfaces (fig. 1 and 2). Before dentists undertake this procedure they must have a periapical X-ray film of the tooth in question. For teeth whose shape is

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Figure 1
The pronounced triangular shape of the lower left lateral incisor makes it an excellent candidate for removal of some of its mesial and distal enamel.

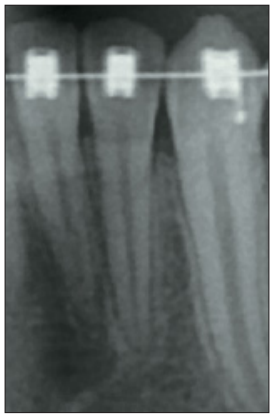


Figure 2
Periapical film of this tooth.

Figure 3
Intraoral view of Valentin's teeth showing the macrognathia of the upper left central.

Figure 4
Valentin's panoramic film. The Le Huche index figure for the upper left central is almost 0, which means it is not possible to reduce the mesio-distal diameter of this oversized tooth.

not triangular (fig. 3 and 4), the enamel's proximity to the root could be, if it were stripped, a cause of periodontal disease.

In addition, the tooth's enamel covering must be sufficiently thick to allow for safe removal of some of it. Studies by Hudson, Gillings, and Buonocore and Shillingburg and Grace in Fillion[8] have shown that:

– The enamel layer covering the crowns of maxillary and mandibular teeth is not quite 1 mm thick, but starting with the distal surface of the canine teeth the thickness is greater;

– Mesial enamel is slightly less thick than distal enamel;

– There is no correlation between the thickness of enamel and the size of the tooth.

1 - 2 - Oral Hygiene

Because stripping roughens the surface of the remaining enamel covering plaque accumulates more on affected teeth, according to Radlanski *et al.*[19]. Patients whose teeth were stripped need to keep their teeth scrupulously clean and have frequent prophylaxes. Accordingly, patients

with poor oral hygiene are poor candidates for interproximal stripping as they are, indeed, for orthodontic treatment itself.

2 - WHEN SHOULD STRIPPING BE DONE?

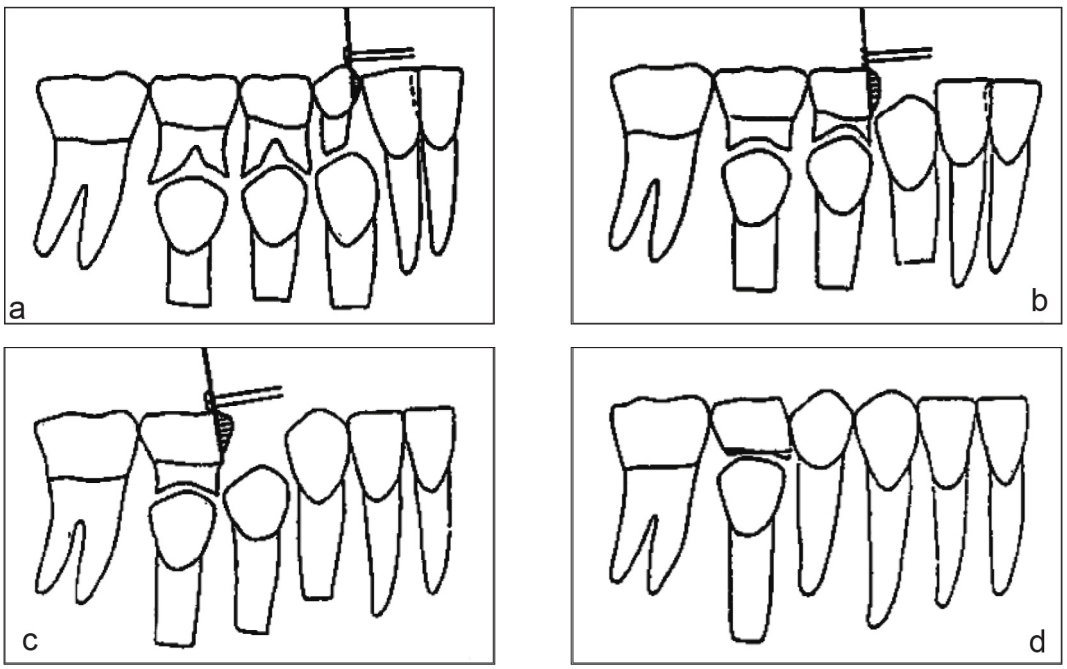
2 - 1 - Crowding/relapse of crowding

Arch length discrepancy is negative difference between the size of the dental arches (the available space) and the size of the teeth (the required space).

Orthodontists can utilize the interproximal stripping of selected temporary teeth to facilitate the eruption of partially blocked out teeth because the available space (diastema) is insufficient, according to Bassigny[1].

Van Der Linden[27] suggests that dentists can prevent crowding, or improve conditions for the alignment of anterior teeth by taking advantage of the leeway space in selective stripping of some temporary teeth (fig. 5).

But, primarily, orthodontists use stripping on permanent teeth.



Figures 5 a to d
Correcting crowding in the mixed dentition, as suggested by Van Der Linden:

a: the crown of the temporary canine is stripped mesially in order to create space for alignment of the anterior teeth;

b: the crown of the first temporary molar is stripped mesially to create conditions that will facilitate eruption of permanent canine into its correct position;

c: the mesial surface of the crown of the second temporary molar is stripped to ease eruption of the first bicuspid;

d: the width of the second temporary molar is more or less equal to the width of the second bicuspid.

Because, as Sheridan[22,23,24] points out, orthodontists can use stripping to correct crowding of 4 to 8 mm, it becomes an attractive modality to treat adults with moderate Class I malocclusions, moderate bimaxillary crowding, and at risk profiles. These situations may even include full arch crowding extending to posterior sectors.

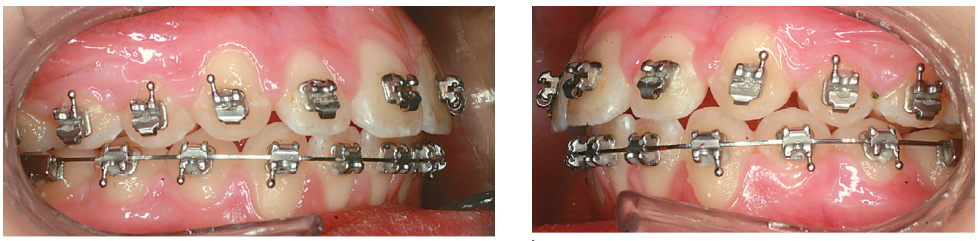
2 - 2 - Disharmony in size of upper and lower teeth

A disharmony between the size of the maxillary and the mandibular teeth can make it difficult for orthodontists to achieve satisfactory occlusal relationships in finishing treatment, causing residual overjets, canines not quite in Class I relationship, and midline deviations. In assessing this disharmony with the Bolton index[4] orthodontists can calculate the excess of tooth width of one arch over the other in terms of:

– The general, over-all ratio of the sum of the mesio-distal diameters of the twelve mandibular teeth (the third molars are not considered) with the sum of the mesio-distal diameters of the twelve maxillary teeth times 100. The normal figure is 91.3%.

– The anterior ratio of the sum of the mesio-distal diameters of the six anterior teeth with the sum of the diameters of the six maxillary anterior teeth times 100. The normal figure is 77.2%.

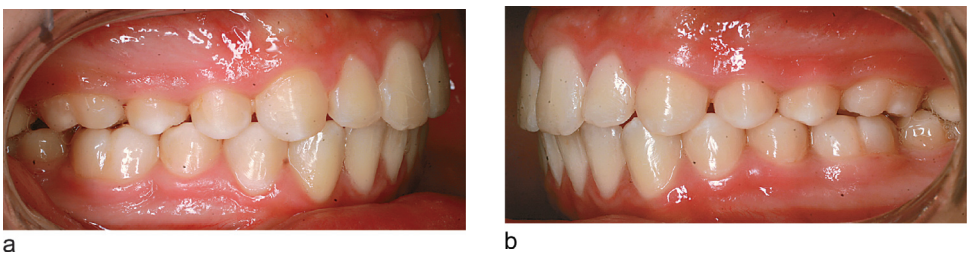
By comparing the measured percentage with the normal percentage the examiner can determine if the tooth disharmony results from an excess of tooth material in the mandible or in the maxilla. By selective stripping in the excess zone, the orthodontist will then be able to improve the occlusal relationships of



a b

Figures 6 a and b

A case treated to the finishing stage: note the residual overjet resulting from an excess of maxillary tooth material as recorded by the Bolton index.



a b

Figures 7 a and b

The same case after the orthodontist had adjusted the axial inclinations of the anterior teeth by appropriate torqueing, and, after band removal, had stripped the maxillary anteri-

the two arches. For example, at the close of treatment for a patient, whose Bolton index confirmed an excess of anterior maxillary tooth material, the buccal segments were in good occlusion but a residual overjet persisted. The orthodontist was prepared to perform distal stripping of the upper laterals and canines so the anteriors could be retracted (fig. 6 and 7). But he had to consider the possibility that excessive stripping could cause in imbalance in tooth substance so he undertook the procedure after careful analysis and with extreme prudence.

Another situation possibly calling for interproximal stripping is agenesis of premolars where the treatment plan calls for retaining a temporary with no successor. But that temporary tooth would have a wider mesiodistal diameter than the missing bicuspid and prevent the orthodontist from achieving a good Class I occlusion. The solution is to use interproximal stripping to reduce the temporary molar to the size of a bicuspid (fig. 8) if its anatomy is suitable for such a procedure.

2 - 3 - Esthetics for adults

By using interproximal stripping orthodontists can sometimes avoid having to extract teeth as an adjunct to their mechano-therapy. This is important because an important percentage of adult patients have at-risk profiles, that is a prominent nose with bi retrocheilia and progenia, a backward inclined upper lip but a bimaxillary protrusion. When such patients have a healthy periodontium and a moderate crowding of about 8 mm stripping becomes the method of choice for obtaining needed space for tooth alignment rather than extraction of premolars. Germeç and Taner[10] studied 26 puberty aged patients with Class I malocclusions characterized by a moderate arch length discrepancy of 5 mm and acceptable facial profiles. Orthodontists treated the13 patients of the first group with the extraction of four premolars and used no posterior anchorage. The other group of 13 patients was treated with stripping and no extractions. The authors found no skeletal differences between the two groups. But the upper and lower

Figure 8
Interproximal stripping is about to be performed on this temporary tooth to improve occlusion.

Figure 9
An unaesthetic black triangle can be seen between the central incisors of this patient before treatment began. It is related to the anatomy of the teeth that causes the contact point to lie too far occlusally and the roots to diverge.

lips of the extraction group were more retruded than the lips of the non-extraction group. Moreover, the treatment time for the stripping group was 8 months faster than it was for the extraction group.

Interproximal stripping is also indicated for the removal of interincisal black triangles (Zachrisson in Philippe[17]). They can be caused by a loss of bone or a contact point displaced occlusally and be accompanied by overly divergent roots (fig. 9),

To correct them, the orthodontist should move the contact point gingivally by reshaping the teeth with interproximal stripping. These triangles usually appear, in adult patients whose periodontal status is not strong enough to sustain prolonged orthodontic treatment or extended tooth movement.

So it is more important with this type of patient for orthodontists to bear in mind that included in the changes facial structures undergo with ageing are opening, according to Crétot[6], of the interincisal angle along with a senescent recession of the free borders of the lips reflecting their continual thinning.

3 - HOW SHOULD A STRIPPING PROCEDURE BE CARRIED OUT?

3 - 1 - Protocols

• How much enamel should be removed?

Beginning with the work of Hudson, Gillings and Buonocore, Shillingburg and Grace, and Demange and Francois[7] a number of authors have published tables giving the maximum amount of enamel that can safely removed so that iatrogenic damage is kept at as low a level as possible (tab. 1).

The table gives the quantity of enamel that should be removed from both surfaces of each tooth, except of the first molar, times four (mesial and distal of the right and left quadrants). Enamel is taken only from the mesial surface of the first molar. This table is applied to the mandibular arch. For the maxillary teeth the orthodontist uses it without change except for the incisors, where the figures for the centrals and laterals are reversed.

	1*	2*	3*	4*	5*	6**
1 mm	.15	.15				
2 mm	.20	.30				
2 mm	.25	.25				
2 mm	.15	.15	.20			
3 mm	.20	.25	.30			
3 mm	.15	.15	.20	.25		
4 mm	.15	.15	.20	.25		
5 mm	.20	.25	.35	.45		
5 mm	.15	.20	.25	.30	.35	
6 mm	.20	.20	.30	.40	.40	
7 mm	.20	.30	.35	.45	.45	
8 mm	.20	.30	.35	.45	.45	.50

***4 surfaces: mesial, distal, right and left**
****2 surfaces: mesial, right and left**

Table 1
Reduction of enamel as a function of the number of teeth, after Demange and Francois.

Fillion[9] published a table (tab. II) in this journal that presented the upper limits of enamel substance that can be removed. Using this guide, orthodontists can gain at most 8.6 mm of space in the mandible and

	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		

Table II

Upper limits of amount of enamel to be removed. After Fillion.

10.2 mm in the interproximal stripping of all the teeth from the mesial surface of one first molar to the mesial surface of the other. According to him, "*Orthodontists should assign priority in stripping to the posterior teeth, because any malfunction in stripping of the incisors might disfigure them.*"

These two tables, which are complementary, present only theoretical figures. The practitioner should not follow them blindly but, with the aid of periapical radiographs, carefully adapt the stripping to take the specific anatomic conformation and periodontal status of each tooth into consideration. Practitioners should measure the width of the teeth in every case before any interproximal stripping in order to know in advance how much enamel should be removed and then use calipers as they work to see how much they are actually removing.

• The fundamental principles of stripping

Sheridan[23] and Fillion[8,9] have proposed these guidelines:

– Do not strip any teeth before bonding attachments to them.

– Fully align rotated teeth before stripping them.

– Do not strip all the teeth in a single appointment.

– Separate the teeth, by putting separators in place on a previous appointment, before stripping them so as to improve access, as Sheridan[23] advises.

– Always strip from the posterior to the anterior to prevent any loss of the space being gained from slippage resulting from the .anterior component of force.

– Always protect adjacent soft tissue with cotton rolls and wooden wedges.

– Always reshape the stripped teeth to their proper form and restore the remaining enamel surface to its original smoothness, polishing being essential.

– Finally, according to Sheridan[24], prescribe a fluoride solution that patients can use to increase the potential for remineralization of the abraded enamel surfaces.

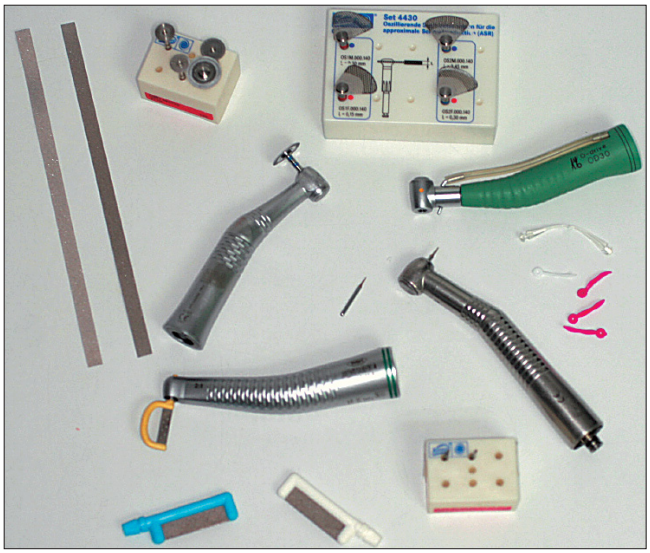


Figure 10
A view of all of the materials and tools employed in stripping.

3 - 2 - Materials needed (fig.10)

• Manual

The tool for stripping by hand is a thin metal strip covered on one or both sides with an abrasive material that is usually used alone but may be mounted with a handle. Its thickness varies from .15 to .4 mm. Sheridan[24] points out that hand stripping of the buccal teeth is laborious, impractical, relatively unproductive, time consuming, and likely to leave bits of the strip lodged between teeth.

• Rotary instruments

– Diamond discs

These discs are covered with standard or extra-fine diamond grains on one or both surfaces. Their thickness and their diameters may vary. Zachrisson[28,29] primarily employs these discs for stripping in accordance with the method proposed by Tuverson[26]. This is a four-handed technique that uses air cooling as a .1 mm thick diamond disc mounted on a blue ring contra angle removes enamel with separators aiding the process (fig.11). Next, the orthodontist uses round or triangular diamond burs (#8833, Komet) to round off any angularities left on the enamel surface. But Sheridan[24] asserts that it is dangerous to use a diamond disc on a high speed rotating instrument in close proximity to a patient's tongue, cheeks, and lips. But attaching a disc guard to the hand piece to guard against the possibility of cutting into soft tissues reduces visibility.

– Burs

To avoid these impediments Sheridan[22,23,24] recommends using special burs with "deactivated" points (IDEAL burs@) that won't create ridges in the proximal enamel (fig. 12). He prefers tungsten carbide burs for posterior and lateral sectors and diamond burs for anterior regions. Tungsten and diamond burs are, in addition, used for taking proximal bulk from amalgam and composite restorations.

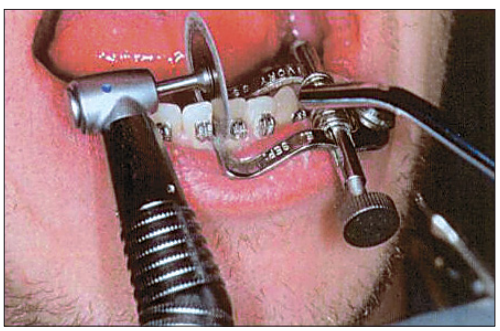
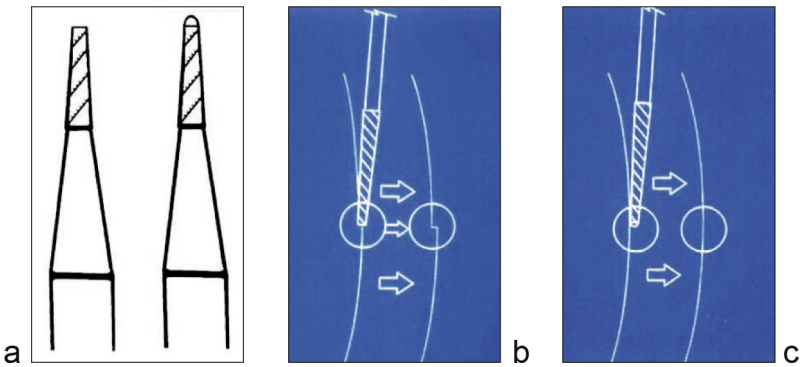


Figure 11
Zachrisson's protocol: a fourhanded method utilizing a disc and a separator (from JCO).



Figures 12 a to c
a: difference between a conventional bur and one with a "deactivated" point;
b: removing enamel with a standard bur may a ridge that will interfere with space closure;
c: enamel reduction with a "deactivated" bur (IDEAL burs®) (from JCO).

- Special kits

– KaVo *O-drive* oscillating contra-angle combined with Komet O-Stripper discs

This is a segmented 60° oscillating diamond disc. Its pivot angle is 30°. It can be fixed in the contra-angle at the desired angulation, which facilitates access to the site and improves visibility and can safely be manipulated without a risk of its cutting into soft tissue. It therefore gives the practitioner the capability of working with all the precision afforded by a rotating disc but without any its undesirable features. Orthodontists can assure patients of its safe design by passing it over one of their fingers before introducing it into the mouth. The discs have variable thicknesses of .15 mm, .30 mm, and .45 mm. They operate from the occlusal to the cervical area of the tooth under a cooling water jet. The operator can sense its passage through the contact point.

But if the contact point is tight the patient will feel "vibrations" and the practitioner will have to hold the contra-angle firmly or, perhaps, prepare for its use by first improving access with a manual stripper.

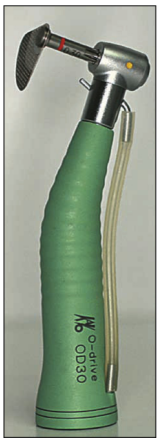
– The Orthofile system (SDC) (fig. 14)

This system uses mini-stripping bands mounted on special contra-angles that oscillate from buccal to lingual. Their thickness varies from 15 um to 150 um. The maximal amount of enamel that can be removed per tooth is .3 to .5 mm. With this system there is no risk of cutting into soft tissue but patients still feel "vibration."

These special kits make it possible for orthodontists to remove interproximal enamel precisely without making patients uncomfortable and in a relatively short time.

- Polishing

This important step in enamel stripping restores correct anatomical form to the tooth and removes roughness from the interproximal surfaces... Polishing itself can remove some substance from the enamel surface that should not be allowed go



a

b

Figures 13 a and b
a: O-drive contra-angle (Kavol) and O-Stripper (Komet);
b: teeth that have been reduced with this system.

Figure 14
The SDC Orthofile system.

beyond the established limits. To prevent this from happening some different possibilities are available to the practitioner.

Sheridan[23,24] uses medium diamond burs to redesign the contour of the teeth. Zachrisson[28,29] and Sheridan[23,24] use a disc to improve the condition of the interproximal surfaces. And a study by Rossouw and Tortorella[20] has shown that adding an application of phosphoric acid to the mechanical polishing improves the result. So Sheridan[24] advises practitioners that after stripping with discs they finish by polishing interproximally with a flexible strip dipped in a 37% solution of phosphoric acid (fig. 15). Then the area should be rinsed thoroughly.

Figure 15
Polishing interproximally with a strip soaked in phosphoric acid (from JCO).

Filion[8] says that orthodontists can polish the interproximal areas of incisors canines either with strips or with polishing discs. But for premolars and molars he prefers tungsten carbide burs.

4. ADVANTAGES/DISADVANTAGES OF STRIPPING

4 - 1 - Advantages

- Need for extractions is is eliminated and the possible undesirable consequences of extractions are avoided.
- Less tooth movement is required.
- Treatment time is shortened.
- Increases probability of stable results.

4 - 2 - Disadvantages

- It is irreversible.

5 - CONSEQUENCES OF STRIPPING

5 - 1 - Stability

Some authors[3,26] believe that interproximal stripping increases the stability of results because it broadens contact areas between teeth.

Up until the 1980s orthodontists used stripping primarily to correct relapse of incisal crowding after orthodontic treatment. The indices devised by Peck and Peck[16]. Indicate the ideal form of lower incisors that would not be likely to lead to or provoke crowding. One might think, accordingly, that incisors that did not conform to this high morphological standard could be reshaped in such a way they would assume a certain normality that would preclude relapse. However, the work of Puneky *et al.*[18] shows that there is no correlation between the shape of lower incisors and Little's irregularity index[15]. Interproximal stripping should not be employed for the purpose of creating an ideally shaped tooth in view of the not infrequent finding of perfectly aligned teeth despite their unfavorable Peck and Peck index rating.

It wasn't until 1985 that Sheridan[21] demonstrated that stripping could be performed not just on anterior teeth but that it could also be utilized in the posterior sectors of the arch. This made stripping a feasible alternative to extraction of permanent teeth in borderline cases. It has become a reliable tool for orthodontists to employ in helping them to avoid increasing the intercanine distance or tilting lower incisors too far labially. So it seems to offer a promise of more stable results, although no one has as yet confirmed this assertion with statistical evidence.

5 - 2 - The periodontium

One might think that reducing interproximal enamel and thereby diminishing the space between teeth would increase the incidence of periodontal disease. However, several studies[11,25] have shown that the narrower the interproximal bone is the better it resists periodontal disease. Other studies[2,3,5] have demonstrated the good periodontal heath of patients who have received interproximal stripping during the course of orthodontic treatment. Fillion[8,9] concluded that "the removal of interproximal enamel has no negative effect on the periodontium and it might, in fact, have the beneficial effect, under certain conditions, of improving the resistance of bone to disease." This is even more true because stripping tends to remove plaque, which is usually a primary factor in causing periodontal disease.

5 - 3 - Dental caries

Interproximal stripping leaves grooves and creases in the enamel surface. According to Filion[8] the abrasive strip is the most harmful tool because it creates the deepest grooves. It roughens the enamel, thus leaving it, according to Radianskky *et al.*,[19] more susceptible to the accumulation of plaque. So polishing, that smoothes out these rough edges as much as possible becomes a crucial

step. But because this, too, removes some enamel, should orthodontists take away a little less enamel in stripping so that exquisite polishing can take away a little more?

To answer the question of the possible noxious effects of stripping, Jarjoura *et al*[12]. examined 40 patients, all under the age of six, clinically and radiologically after a practitioner had performed interproximal stripping on their teeth. They found no increase in caries or any other harmful effects of stripping in this group. Naturally the authors concluded that stripping did not increase the risk of development of caries. They also found that the application of topical fluoride on stripped surfaces for patients already using fluoride toothpaste conferred no supplementary benefits.

Zachrisson *et al*.[28] studied the dental health of 61 patients 10 years after they had their mandibular incisors stripped according to the protocol we previously described.

They used clinical and radiological examinations to look for the presence of caries, bleeding after probing, pocket depth, and gingival recession. They measured extent of relapse, and width/thickness ratio on models, comparing the figures taken from end of treatment casts and those taken 10 years later. Problems of caries and periodontal disease had not increased, nor had the distance between roots decreased. Thus, according to their protocol, interproximal stripping of enamel did not cause any iatrogenic damage.

6 - CONCLUSION

Localized or extended throughout the arch, removal of tooth structure through interproximal stripping has become a standard part of the orthodontic therapeutic arsenal. Using it, orthodontists can avoid extractions, correct arch length discrepancies, and improve occlusal relationships. However, orthodontists should conduct this procedure with extreme care and with respect for dental physiology. It is essential for them to follow a rigorous protocol and to equip themselves with instruments with which they can quantify the amount of enamel removed. To put it another way, they must be prudent because the procedure is irreversible.

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