



การstrippingฟันด้วยแอร์โรเตอร์ในการรักษา ทางทันตกรรมจัดฟัน - บทความปริทัศน์

อุดม ทอชอุดมพร ทบ., MSc (Orthodontics), อ.บ.(ทันตกรรมจัดฟัน)

ภาควิชาทันตกรรมป้องกัน คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ อ.หาดใหญ่ จ.สงขลา 90112

บทคัดย่อ

การstrippingฟันด้วยแอร์โรเตอร์นับเป็นอีกทางเลือกหนึ่งของการรักษาทางทันตกรรมจัดฟันที่อาจทดแทนการถอนฟันหรือการขยายความโค้งของแนวขากรรไกร เทคนิคดังกล่าวเริ่มได้รับการเผยแพร่ในปี ค.ศ.1985 และได้ผ่านการปรับปรุงหลายครั้งเพื่อเพิ่มประสิทธิภาพและสะดวกต่อการปฏิบัติงาน ข้อดีของการstrippingฟันด้วยแอร์โรเตอร์ในผู้ป่วยที่มีฟันซ้อนเกในระดับเล็กน้อยถึงปานกลางคือช่วยหลีกเลี่ยงการถอนฟัน อีกทั้งไม่มีการเปลี่ยนแปลงมิติของความโค้งในแนวขากรรไกร อย่างไรก็ตาม ยังมีข้อดกถึงถึงผลเสียของการstrippingฟันด้วยแอร์โรเตอร์ เช่น การสูญเสียแร่ธาตุของผิวเคลือบฟันที่ถูกstripping ผลเสียต่ออวัยวะปริทันต์ เป็นต้น ทันตแพทย์จึงควรคำนึงถึงข้อควรระวังทุกครั้งที่จะให้การรักษาผู้ป่วยด้วยวิธีการนี้

(ว กัณฑ์ จุฬาฯ 2547;27:163-70)

คำสำคัญ: การstrippingฟันด้วยแอร์โรเตอร์

Introduction

Interproximal enamel stripping is a technique that could be applied to orthodontic treatment for various purposes. An article of Ballard¹ in 1944 was probably the first publication ever advocating the mesio-distal enamel reduction when a significant right-left imbalance of anterior tooth width existed. Since then, interproximal stripping has been regularly employed for the relief of lower anterior crowding²⁻⁶, correction of tooth size discrepancy⁷, enhancing post-treatment stability^{2, 8-11}, and cosmetic recontouring

of anomalous morphology teeth.^{3, 12, 13} Formerly, the means of the procedure used to be restricted to abrasive strips and abrasive disks. Also, only the enamel of the anterior teeth was allowed to be reduced due to the old style orthodontic banding systems in the posterior teeth. Nowadays, it is possible to reduce the interproximal enamel of all teeth that we should thank to the development of resin bonded orthodontic appliances. Later, a new technique of interproximal stripping, so called air-rotor stripping has been introduced^{14, 15} and has been widely utilized by

orthodontists worldwide as an alternative to extraction or expansion therapy. The purpose of this article is to review the background and benefits of air-rotor stripping, and to address the possible disadvantageous effects of the technique.

Background

Air-rotor stripping technique (ARS) was introduced by Sheridan¹⁴ in 1985. It is a technique to create space for aligning or retracting anterior teeth by the accumulative removal of interproximal enamel in the posterior teeth. The author¹⁴ was initially inspired by the theory of Begg¹⁶ who examined the Australian aboriginal population and stated that the loss of interproximal tooth substance is a natural functional process. Teeth become smaller occluso-lingually and mesio-distally with age. The lack of such loss in modern population may produce crowding phenomenon. Hence, interproximal stripping of all teeth would be a mimicking procedure of natural tooth wear which may maintain the normal function and stability of the dentition.

The author¹⁴ also gave Peck and Peck credit for their development of norms for mesio-distal/facio-lingual dimension ratio (MD/FL ratio) of the lower anterior teeth in well-aligned dental arches. They³ recommended that, in order to achieve good lower anterior alignment, lower incisors should be reshaped if the MD/FL ratio exceed the norms.

In his first publication, Sheridan¹⁴ recommended the original stripping technique as follows: a 0.20" brass wire is placed in the interproximal space to prevent damaging the papilla during stripping, it also acts as a guide for the bur and prevents ledging the interproximal enamel walls. Then, enamel removal is accomplished by means of a 699L tapered crosscut

fissure carbide bur with a lateral approach (buccal or lingual) to the interproximal area. A tungsten carbide bur is more advantageous than a diamond bur in the way that the cutting particles on the tip of the diamond bur are quickly worn and it could create frictional heat leading to pain and pulpal damage. The reduced enamel walls are then finished with carbide finishing burs, finishing diamonds, polishing disks, or hand-held finishing strips. Lastly, topical fluoride solution is applied to prevent the formation of secondary caries. Although there have been no studies indicated how much enamel could be exactly reduced, the author quoted the previous research of Peck and Peck³ on the thickness of enamel who postulated that 50% of interproximal enamel can be safely removed and the study of Shillingbourg and Grace¹⁷ that as many as 8.9 mm of space can be yielded if the procedure is applied to all teeth in the arch.

In the same publication, the author presented a modified procedure using a bur to reduce the enamel on the lingual and labial surfaces until the contact area becomes knife-edge shape. This remaining enamel is then removed with a hand-held metal abrasive strip. The procedure has been claimed to be useful for the stripping of lower anterior teeth where only small amounts of enamel are to be removed.

Later on, Sheridan and his co-workers have continuously improved the air-rotor stripping technique. In 1987, Sheridan¹⁵ introduced a revision of his original air-rotor stripping technique that the posterior teeth should be aligned and the contact points should be opened prior to the reduction procedure. The most distal interproximal contact is separated by means of a thick separator or an open-coil spring. The contact points are then sequentially stripped from posterior to anterior and teeth are moved distally into the created

spaces like beads on a string. Sheridan and Ledoux¹⁸, in 1989, recommended the application of sealant resin to the mechanically stripped surface in order to smooth the roughness on the proximal enamel. They found according to the SME observation that the adherence of the sealant material to the proximal enamel was similar to those observed on the occlusal surfaces of enamel. The sealed surfaces appeared to be as smooth as untreated enamel. The authors inferred that the technique could possibly increase caries resistance. Recently, Ballard and Sheridan¹⁹ proposed the use of a removable plastic device so-called Essix appliance as an anterior anchor to counteract the anterior vector of force produced by the open-coil spring during the air-rotor stripping procedure.

Besides the contribution of Sheridan, other authors have advocated the modification of the air-rotor stripping technique for the improvement of efficiency and the ease of use. Jarvis²⁰ stated that the lateral approach in buccal or lingual direction during stripping is difficult and may unintentionally create notching on the cutting surface. He recommended an occlusal approach by using an air-rotor and a tungsten carbide bur, followed by a series of finishing disk (Sof-lex®). He claimed that the occlusal approach is easier and less likely to harm the tooth than the lateral approach. Joseph et al²¹ proposed a combined mechanochemical technique by applying 37% phosphoric acid in conjunction with a finishing strip after the routine mechanical stripping. The authors claimed that the microabrasive chemical stripping created a relative smooth enamel surface and encouraged the remineralization potential. However, it has been debated that such combined technique resulted in etched, but impenetrable surface that is susceptible to decalcification despite the application of

fluoridating solutions.²² However, a later investigation by Rossouw and Tortorella²³ supported the effectiveness of the use of low concentration acid in conjunction with mechanical procedure. A late research by Piacentini and Sfondrini²² on the efficiency of various enamel polishing methods after air-rotor stripping at SEM level advocated the use of a 8-straight blade tungsten carbide bur followed by Sof-lex® disks. They claimed that the method produced smoother enamel surfaces than intact enamel.

The benefits and drawbacks

It has been well accepted that air-rotor stripping can be used as an alternative to extraction or expansion treatment in mild or moderate (4-8 mm) crowding patients.^{13-15, 19-21, 23-31} The technique is able to reduce the difficulties in extraction cases and the instability of over-expansion in non-extraction cases because it allows transverse arch dimension and anterior inclinations to be maintained.³¹ In addition, air-rotor stripping has been reported to significantly reduce treatment time.³² The technique can also be applied to the elimination of tooth-size discrepancies and the enhancement of stability.^{8, 9, 33}

Although air-rotor stripping technique has been recognized for its advantages, clinicians should not utilize the technique without any cautions since the adverse effects of air-rotor stripping on the enamel and the periodontal tissue have been occasionally reported. However, some other studies have not found the drawbacks of the technique. The following part of the review will discuss the controversies of the possible deleterious effects of air-rotor stripping.

Radlanski et al³⁴ investigated stripped enamel surfaces at SEM level twelve weeks prior to extraction and reported that furrows of 10-30 microns in depth

and width resulting from the stripping procedure could favor the accumulation of plaque, and that it was impossible to remove plaque from these furrows with dental floss. The authors also stated that, despite the use of fine and ultrafine strips, the stripped enamel surfaces were unable to be polished. As a consequence, it led to an increased risk of dental caries. However, in later research, Radlanski et al³⁵ reversed their previous conclusion by reporting the low incidence of caries in stripped enamel at SEM level at one year follow up. The finding was in agreement with that of Crain and Sheridan²⁷ who compared 151 stripped enamel surfaces with 517 untreated surfaces by means of bite-wing radiographs at the duration of two to five years after stripping. They did not find any statistically significant association between proximal stripping and caries susceptibility. However, it must be noted that bite-wing radiographs have been shown to be highly unreliable as caries progression may cross more than half of the proximal enamel thickness before it is detected with clinical radiographs.³⁶

Twesme et al²⁹ stated from their *in vitro* study that stripped enamel surfaces may be more susceptible to the demineralization comparing with intact surfaces. However, their experimental design did not mimic the real intra-oral environment where there is a balancing activity of demineralization and remineralization. An experiment on the permeability of abraded enamel³⁷ showed that, initially, the abraded enamel was demineralized rapidly. Nonetheless, salivary buffers neutralized the enamel surfaces within minutes, and remineralization subsequently begun within one hour. The rapid rate of intra-oral remineralization exhibited a mechanism for the protection of the enamel against demineralization. The authors explained that mechanical stripping of the enamel surface not only

removed the inert enamel surface, but it also created surface porosity resulting in an increased surface area for interacting with remineralizing agents. El-Mangoury et al²⁸ also found a similar result. They performed a SEM investigation on proximally stripped enamel of the premolars that had been recommended for extraction for orthodontic purpose and concluded that interproximal stripping did not increase the risk of dental caries and there would be a spontaneous remineralization within 9 months after stripping.

It has been assumed that the compressing of interradicular soft tissues and bone could induce periodontal problems.^{38, 39} The statement was based on the belief that an adequate space between the teeth at the level of crestal bone is necessary for continuing the gingival health. Closing the stripped spaces could reduce the amount of transseptal bone between teeth and predispose these areas to periodontal disease.³⁹⁻⁴¹ It may become more difficult to scale or to floss the reproximated contact points.²⁰ However, Sheridan²⁶ argued that the closure of stripped space did not differ from the routine closure of a naturally occurring space. In fact, gingival tissue could adapt itself easily, and interdental bone is the most adaptive bone in the body.^{42, 43} A number of later studies⁴⁴⁻⁴⁷ also did not find the association between interradicular width and the prevalence of periodontal destruction. Moreover, some studies^{6, 8, 15, 48} even showed patients whose gingival tissues were significantly improved after correction of dental malalignment by selective stripping. Presumably, it may be postulated that the compression of the alveolar bone when the stripped spaces are closed has no link with the risk of periodontal disease.

Some other complications associated with reproximating posterior teeth, which have been

previously reported, are impaired function (food impaction and poor marginal contacts) resulting from an imprecise or careless approach to reduction⁴⁹, sensitivity to extreme temperatures due to over-reduction of the enamel², tooth discoloration from which the pulp irritation is sufficient to cause extensive secondary dentine deposits²⁰, and the placement of subgingival contact areas on the stripped teeth.⁵⁰

Clinical considerations

It is apparent that there have been diverse opinions as to whether air-rotor stripping is injurious to the enamel and periodontal tissues. Clinicians must take precautions to ensure that the negative effects of air-rotor stripping are eliminated. The followings are some recommended considerations.

1. Air-rotor stripping is not a substitute for extraction. Extraction is still necessary for severe crowding. Stripping may be more appropriate for the resolving of mild to moderate crowding in Class I arch length discrepancies and minor Class II patients whose growth have already ceased.²⁶ Should there be more than one treatment options, the final decision must be made on the dentist-patient agreement basis.

2. Evaluate the caries potential (DMF scores) and periodontal condition of each patient before the stripping procedure.²⁹ Stripping can be accomplished only after a careful assessment of the quantity of enamel that can be safely removed and it is contraindicated in patients who have poor oral hygiene or periodontal problems.²²

3. Inform every patient that the stripped surfaces may be more susceptible to demineralization and plaque accumulation.²⁹

4. Up to one half that the enamel thickness could be removed when stripping interproximally.¹⁴ However, since the ability to predict proximal enamel widths is still poor, it would be prudent to take radiographic records prior to stripping.²⁹

5. The amount of enamel reduction should be precisely related to the amount of space needed.¹⁵ For example, if 5 mm of crowding exists, then 5 mm of interproximal enamel should be removed.

Avoid cutting the interdental tissues

7. Always measure and record the accumulated space.²⁶

8. Finish proximal walls as smooth as possible and contour the teeth to resemble its original morphology to prevent wide contacts that might be restricted the space of the gingival papillae.^{13, 26}

9. The application of topical fluoride, especially fluoride varnish, is strongly recommended.¹³

Summary

Air-rotor stripping is an effective alternative to expansion or extraction treatment in mild to moderate space of deficiency cases. Despite its well-accepted advantages, clinicians must carefully evaluate the enamel to be removed and cautiously perform the procedure so that the best possible finishing of the enamel surfaces are accomplished and the biologic requirements of the oral cavity are met.

References

1. Ballard ML. Asymmetry in tooth size, a factor in the etiology, diagnosis, and treatment of malocclusion. *Angle Orthod* 1944;14:67.
2. Paskow H. Self-alignment following interproximal stripping. *Am J Orthod* 1970;58:240-49.
3. Peck S, Peck, H. Orthodontic aspects of dental anthropology. *Angle Orthod* 1975;45:95-102.
4. Boese LR. Fiberotomy and reproximation without lower retention 9 years in retrospect : Part I. *Angle Orthod* 1980;50:88-97.
5. Boese LR. Fiberotomy and reproximation without lower retention 9 years in retrospect : part II. *Angle Orthod* 1980;50(169-178).
6. Tuverson DL. Anterior interocclusal relations, Part 1. *Am J Orthod* 1980;78:361-70.
7. Bolton WA. Disharmony in tooth size and its relation to the analysis and treatment of malocclusion. *Angle Orthod* 1958;28:113-30.
8. Betteridge MA. The effects of interdental stripping on the labial segments evaluated one year out of retention. *Br J Orthod* 1981;8:193-97.
9. Burkland G. Technique clinic : Improving mandibular incisor stability. *J Clin Orthod* 1977;11:143.
10. Barrer HG. Protecting the integrity of mandibular incisor position through keystone procedure and spring retainer appliance. *J Clin Orthod* 1975;9:486-94.
11. Ihlow D, Kubein-Meesenburg, D., Hunze, J., Dathe, H., Planert, J., Schwestka-Polly, R., Nagerl, H. Curvature morphology of the mandibular dentition and the development of concave-convex vertical stripping instruments. *J Orofac Orthop* 2002;63:274-82.
12. Dahlberg AA. A wing-like appearance of upper incisors among American Indians. *J Dent Res* 1959;38:203-4.
13. Harfin JF. Interproximal stripping for the treatment of adult crowding. *J Clin Orthod* 2000;34:424-33.
14. Sheridan JJ. Air-rotor stripping. *J Clin Orthod* 1985;19:4359.
15. Sheridan JJ. Air-rotor stripping update. *J Clin Orthod* 1987;21:781-88.
16. Begg PR. Stone age man's dentition. *Am J Orthod* 1954;40:298-312.
17. Shillingbourg HT, Grace, C.S. Thickness of enamel and dentin. *J So Calif Dent Assoc* 1973;41:33-52.
18. Sheridan JJ L, P.M. Air-rotor stripping and proximal sealants - a SEM evaluation. *J Clin Orthod* 1989;23:790-4.
19. Ballard R, Sheridan, J.J. Air-rotor stripping with the Essix anterior anchor. *J Clin Orthod* 1996;30:371-73.
20. Jarvis RG. Interproximal reduction in the molar/ premolar region : the new approach. *Aust Orthod J* 1990;11:236-40.
21. Joseph VP, Rossouw, P.E., Basson, N.J. Orthodontic microabrasive reproximation. *Am J Orthod Dentofac Orthop* 1992;102:352-9.
22. Piacentini C, Sfondrini, G. A scanning electron microscopy comparison of enamel polishing methods after air-rotor stripping. *Am J Orthod Dentofac Orthop* 1996;109:57-63.
23. Rossouw PE, Tortorella, A. A pilot investigation of enamel reduction procedures. *J Can Dent Assoc* 2003;69:384-8.
24. Sheridan JJ, Ledoux, P.M. Air-rotor stripping and proximal sealants - a SEM evaluation. *J Clin Orthod* 1989;23:790-4.
25. Sheridan JJ, Hastings, J. Air-rotor stripping and lower incisor extraction treatment. *J Clin Orthod* 1992;26:18-22.
26. Sheridan JJ. The physiologic rationale for air-rotor stripping. *J Clin Orthod* 1997;31:609-12.
27. Crain G, Sheridan, J.J. Susceptibility to caries and periodontal disease after posterior air-rotor stripping. *J Clin Orthod* 1990;24:84-85.
28. El-Mangoury NH, Moussa, M.M., Mostafa, Y.A., Girgis, A.S. In-vivo remineralization after air-rotor stripping. *J Clin Orthod* 1991;25:75-78.
29. Twesme DA, Firestone, A.R., Heaven, T.J., Fred, F.F., Jacobson, A. Air-rotor stripping and enamel demineralization in vitro. *Am J Orthod Dentofac Orthop* 1994;105:142-52.
30. Valinoti JR. Interproximal stripping. *Am J Orthod* 1974;66:577-8.
31. Zhong M, Jost-Brinkmann, P., Zellmann, M., Zellmann, S., Radlanski, R.J. Clinical evaluation of a new technique

- for interdental enamel reduction. *J Orofac Orthop* 2000;61:432-9.
32. Winter WW. The artistry of tooth reshaping for beauty and to gain space. *Lancet J* 1990;3:1-4.
 33. Zachrisson BU. On excellence in finishing, Part 2. *J Clin Orthod* 1986;20:536-56.
 34. Radlanski RJ, Jager, A.,Schwestka, R., Bertzbach, F. Plaque accumulations caused by interdental stripping. *Am J Orthod Dentofac Orthop* 1988;94:416-20.
 35. Radlanski RJ, Jager, A., Zimmer, B. Morphology of interdentally stripped enamel one year after treatment. *J Clin Orthod* 1989;23:748-50.
 36. Gwinnett AJ. A comparison of proximal carious lesions as seen by clinical radiography, contact microradiography, and light microscopy. *J Am Dent Assoc* 1971;83:1078-80.
 37. Brudevold F, Tehrani A., Bakhos Y. Intraoral mineralization of abraded dental enamel. *J Dent Res* 1982;61:456-9.
 38. Pritchard JF. The effect of bicuspid extraction orthodontics on the periodontium. *J Periodontol* 1975;46:534-42.
 39. Kessler M. Interrelationships between orthodontics and periodontics. *Am J Orthod* 1976;70:154-72.
 40. Klassman B, Zucker, H.W. Treatment of a periodontal defect resulting from improper tooth alignment and local factors. *J Periodontol* 1969;40:401-10.
 41. Hatasaka HH. A radiographic study of roots in extraction sites. *Angle Orthod* 1976;46:64-68.
 42. Midgett RJ, Shaye, R., Fruge, J.F. The effect of altered bone metabolism on orthodontic tooth movement. *Am J Orthod* 1981;80:256-60.
 43. Melcher A. On the repair potential of periodontal tissue. *J Periodontol* 1976;47:256-61.
 44. Heins PJ, Thomas, R.G., Newton, J.W. The relationship of interradicular width and alveolar bone loss. *J Periodontol* 1988;59:73-79.
 45. Tal H. Relationship between the interproximal distance of roots and the prevalence of intrabony pockets. *J Periodontol* 1984;55:604-07.
 46. Artun J, Kokich, V.G., Osterberg, S.K. Long-term effect of root proximity on periodontal health after orthodontic treatment. *Am J Orthod* 1987;65:948-51.
 47. Heins PJ, Wieder, S.M. A histologic study of the width and nature of inter-radicular spaces in human adult premolars and molars. *J Dent Res* 1986;65:948-51.
 48. Boese LR. Increased stability of orthodontically rotated teeth following gingivectomy in *Macaca nemestrina*. *Am J Orthod* 1969;56:273-90.
 49. Jarvis RG. Interproximal reduction : A restorative adjunct to orthodontic procedures: Part I. *Aust Prosth J* 1989a;3:51-56.
 50. Takei HH. The interdental space. *Dent Clin North Am* 1980;24:167-76.

Air-rotor stripping in orthodontic treatment - a literature review

Udom Thongudomporn DDS, MSc (Orthodontics), Diplomate (Thai Board of Orthodontics)

Department of Preventive Dentistry Faculty of Dentistry, Prince of Songkla University

Hatyai, Songkhla 90112

Abstract

Air-rotor stripping was first introduced as an alternative to extraction or expansion therapy in orthodontic treatment in 1985. Since then, the technique has been variously modified for the improvement of its efficiency and the ease of use. Air-rotor stripping has been claimed to be advantageous for the relief of mild to moderate crowding without sacrificing premolars or violating the original arch dimension. However, the opinions on the drawback of the procedure, such as demineralization of the stripped enamel, periodontal complication, and so on, have been varied. It is suggested that clinicians should take precautions whenever the technique is clinically applied.

(CU Dent J 2004; 27:163-70)

Key words: *air-rotor stripping; interproximal stripping; enamel reduction; orthodontic treatment*
