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# Interproximal reduction using modified oscillating strips

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KEY WORDS *enamel reduction, interproximal reduction, oscillating strips, stripping*

*In interproximal reduction, to gain space in the maxilla and mandible, the use of mechanically oscillating systems, and in particular diamond-coated abrasive strips, such as Oscident Strips (Oscident, Bad Homburg vor der Höhe, Germany) or the Ortho-Strips system (Intensiv, Montagnola, Switzerland), has proven clinically successful. By modifying the working area of the oscillating diamond strips in the Ortho-Strips system and leaving a non-diamond grain–coated zone of 0.5 mm at the upper and lower margins, unwanted abrasion and cervical step formation can be prevented, thus significantly increasing safety when using this system.*

## Introduction

Crowding is one of the most common problems encountered in the orthodontic practice; thus, gaining space is of great importance. In addition to extraction therapy, several methods have been established to eliminate crowding or create space, such as maxillary or mandibular transverse expansion, proclination of the anterior teeth, and distalisation. Interproximal reduction (IPR), also known as approximal mesiodistal enamel reduction, interproximal stripping, interdental enamel reduction, interdental polishing or slenderising, has been proven to be an alternative method for gaining space. IPR is also used to correct tooth size discrepancies (Bolton analysis) and to recontour teeth[1,2].

## Historical review

In 1944, Ballard[3] advocated stripping in the mandibular anterior region to correct tooth size discrepancies. A few years later, Hudson[4] described the use of several metallic strips for stripping the contact points of mandibular incisors and canines. Peck and Peck[5] then recognised that there is a significant relationship between the shape of mandibular incisors and the occurrence of crowding in this region. Thus, well-aligned mandibular incisors have significantly lower mesiodistal/faciolingual indices than crowded incisors; as such, the authors recommended reproximation or stripping to correct tooth shape deviations[5].

In 1980, Tuverson[6] examined mesiodistal crown reduction of anterior teeth using abrasive garnet discs to correct mandibular length discrepancies, and found that this approach promoted stability and improved gingival conditions due to the larger contact surfaces. In the same year, Boese[7] found that reproximation performed precisely during orthodontic therapy can increase the long-term stability of the mandibular anterior segment. To maintain stability in patients with pronounced horizontal growth and signifi-

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**Table 1** Comparison of IPR methods

| Variable | Manual | Machine-rotating with grinders | Machine-rotating with discs | Mechanical oscillation on a 1/12 circular path | Machine linear oscillation | Ultrasonic oscillation |
|---|---|---|---|---|---|---|
| Motor drive | No | Yes, normal 'fast runner' | Yes, normal handpiece or contra-angle handpiece | Yes, special contra-angle handpiece | Yes, special contra-angle handpiece | Yes, ultrasonic handpiece |
| Damage to neighbouring tooth | No, due to one- or double-sided separating strip | Yes, hardly avoidable even with steel matrix | No, due to one- or double-sided separating strip | No, due to one- or double-sided honeycomb disc segment | No, due to one- or double-sided separating strip | No, due to one- or double-sided separating strip |
| Risk of notching | Low | High; the thinner the grinder, the higher the risk | High, due to the large and bulky cut protection | Low | Low | Low |
| Coarseness/fineness | Fine | Coarse, limited by minimum thickness of the grinder | Fine | Fine | Fine | Rather coarse, limited through minimum diameter of the sonic tip |
| Contourability of abrasion surface | High | High if there is a risk of notching and/or damage to neighbouring tooth | Low | Low | High | High |
| Speed of removal | Laborious | Very high | Very high | High | Very high | Moderate |
| Special features | Very good option to contour teeth | Cooling problems with very long grinders | Not recommended without cut protection, but this is hardly available | Requires an agile orthodontist and wide mouth opening from the patient | Very good option to contour teeth | Requires an agile orthodontist and wide mouth opening from the patient |

cant changes in the mandibular shape during treatment (especially in the anterior teeth), he proposed reproximation in combination with circumferential supracrestal fibrotomy (CSF) 4 to 9 years after treatment.

A few years later, Sheridan[8,9] attracted attention when he described the use of the air-rotor stripping method in cases with mild to moderate crowding. To prevent or reduce gingival retraction or the formation of 'black triangles' in the anterior region post-treatment, Zachrisson[10] recommended mesiodistal enamel reduction, in addition to alteration of root angulation, to shift the contact points apically.

## Indications and contraindications

IPR is a clinical procedure routinely used in orthodontic treatment, and is of particular importance in aligner therapy[13,15,17,19,20] because the latter has clinical limitations or

it may not be possible to generate space for crowded teeth[17].

In addition to resolving mild or moderate maxillary or mandibular crowding, eliminating Bolton discrepancies and correcting the curve of Spee, IPR is used to modify tooth shape, manage poorly contoured fillings, prevent or reduce black triangles and normalise gingival contour, thus optimising aesthetics. It can also be used to reduce and eliminate incisor protrusion, improve posttreatment stability and prevent relapse[2,13-17].

IPR is considered contraindicated in cases of tooth hypersensitivity, and in microdont, rectangular and abnormally shaped teeth[16].

## Extent of IPR

The amount of IPR that can be performed without causing dental and periodontal risks is evaluated differently in the literature. Hudson[4] states that maximum possible space gain of 3.00 mm can be achieved for the mandibular anterior teeth (0.20 mm IPR for the central incisors, 0.25 mm for the lateral incisors and 0.30 mm for the canines). Tuverson[6] noted a harmless space gain of 4.0 mm by reducing the tooth structures in the mandibular anterior region (0.3 mm for the eight incisor surfaces and 0.4 mm for the four canine surfaces).

Fillion[11] limited the amount of IPR in the incisors to 0.3 mm in the maxilla and 0.2 mm in the mandible. If the lateral region is included to gain additional space, IPR should not exceed 0.6 mm for the maxillary and mandibular premolars and first molars. Stroud et al[12] state that in the mandibular posterior region, a 50% reduction of the original enamel coat of the premolars and first molars can result in space gain of 9.8 mm.

## IPR devices

Various systems for IPR, whether handpieces or machines, rotating or oscillating, have been introduced, clinically tested and improved over the years. Air-rotor stripping using fine tungsten carbide or diamond burs, use of manual diamond-coated strips, handpieces or contra-angle mounted diamond-coated discs and employment of hand-held or motor-driven abrasive metal strips are among the most common methods[2]. The individual IPR methods must be differentiated with regard to handling, efficacy in contouring of the abraded surface, speed of enamel removal and possible risks (Table 1)[17].

## Effects of IPR

IPR is associated with numerous advantages, but it also entails some disadvantages. For example, the resistance of the ground tooth is affected and its sensitivity is increased[1,25]. Scanning electron microscopy studies have shown that, depending on the procedure used, scores, grooves or notches remain, and these can be between 10 and 40 µm wide and deep[26-29]. If the surface is not sufficiently smoothed and polished after enamel removal, these scores, grooves and notches provide contact surfaces for plaque accumulation. Demineralisation and caries lesion formation are promoted[13,14,23,25,27,30]; however, no direct correlation between IPR and increased incidence of caries lesions has been proven[1,14]. Furthermore, unwanted ridges or steps in the interdental area may be produced during IPR and these can cause future cavities[23].

## Oscillating diamond strip system

Recently, mechanical oscillating abrasive strips have gained popularity[2,13,14,20,21], including Oscident Strips (Oscident, Bad Homburg vor der Höhe, Germany) and the Ortho-Strips system (Intensiv, Montagnola, Switzerland). Mechanical oscillating abrasive strips have been associated with reduced risk of soft tissue damage, achievement of more uniform enamel surfaces, reduced chair time, and more predictable results compared to manual strips[2,13,22-24].

In the present author's practice, a new modified and patented version of the Ortho-Strips system (Pat EP115201863.6) is used in combination with a contra-angle handpiece (WG69LT, Intensiv). The indications for use of this system are IPR when < 5.0 mm space is available in the maxilla or mandible, deviations in the sum of tooth widths, and management of unaesthetic interdental spaces (stocky tooth shapes, overcontoured restorations and/or gingival recession).



**Figs 1a-b** Simplified insertion and avoidance of cervical step formation due to the non-coated zone at the upper and lower margins of the abrasive strip.

The Ortho-Strips system for opening the interdental space, enamel contouring and polishing was developed in 1996 by Intensiv in collaboration with Drs Hubertus van Waes and Thomas Matter at the University of Zurich, Switzerland. Its abrasive strips are diamond-coated on one or both sides, with different grains. In the new modified Central version, four grain sizes are available for IPR and contouring: 60 µm (brown) for reducing approximal enamel, 40 µm (red) for contouring, 25 µm (white) for finishing and 15 µm (yellow) for polishing the treated surfaces. By bending the arch slightly, the adaptable metal strips allow it to be adjusted to the tooth contour. The optimal contact pressure of 1.0 to 2.5 N is achieved when the strip bends approximately 1.0 to 1.5 mm. To ensure easier insertion of the strips between the interdental contact points in an oral to buccal direction and avoid unwanted abrasion and cervical step formation, a 0.5-mm non-diamond grain–coated zone was left at the upper and lower margins of the strips in the modified version (Figs 1a and b).

## Therapeutic procedure

The applied contra-angle handpiece transforms the circular movement performed by the motor into a linear movement. The fine calibration of the micromotor (up to 40,000 rpm) to move the reciprocating contra-angle (transmission ratio 2:1, maximum stroke rate 20,000 per minute) enables the interdental space to be opened quickly under light and spray with the Ortho-Strips Opener (Intensiv; 8 µm [orange] with saw) at the lower margin of the strip. In particular, there is no risk of tilting or jamming, which can lead to unwanted notches.

If desired, the teeth can be separated in advance using elastics. A surface anaesthetic (e.g., Ultracare, Ultradent Products, South Jordan, UT, USA) is applied for analgesation of the interdental papillae. The interdental space is opened using the Ortho-Strips Opener in the medium speed range, and good support is recommended. The contouring strip (40 µm, red) is used for simultaneous IPR and contouring of the approximal spaces. This is done for forced IPR under spray cooling using a high speed range and for contouring using a medium speed range with the micromotor. The finishing strip (25 µm, white) is used for finishing and contouring the tooth surface, and the pre-polishing strip (15 µm, yellow) for subsequent polishing, also under spray cooling in a medium speed range. Then, polishing is carried out through rubber cup polishing, flossing and use of CleanPolish paste (Kerr Dental), before fluoridating with Tiefenfluorid (Humanchemie, Alfeld, Germany).

## Case report

A 14-year-old girl attended the practice requesting correction of her maxillary anterior teeth. The maxillary central incisors demonstrated mild crowding, and also exhibited particularly pronounced mesial enamel bulges, such that a black triangle was to be expected even after correction of crowding (Fig 2a). It was necessary to consider which approach could be applied in this case. In consultation with the patient and her parents, aligner treatment was selected.




**Figs 2a-c** **(a)** Initial clinical situation, **(b)** after IPR and polishing, and **(c)** after insertion of two silicone rings over the maxillary central incisors to close the gap.

**Fig 3** Clinical situation at the follow-up appointment 24 hours later.

**Fig 4** Clinical situation after a further 24 hours. The insertion of a silicone ring in the maxilla from the left to right lateral incisor enabled the remaining gaps to be closed completely.

The required space was to be generated by IPR, the extent of which was determined using a gauge (Intensiv).

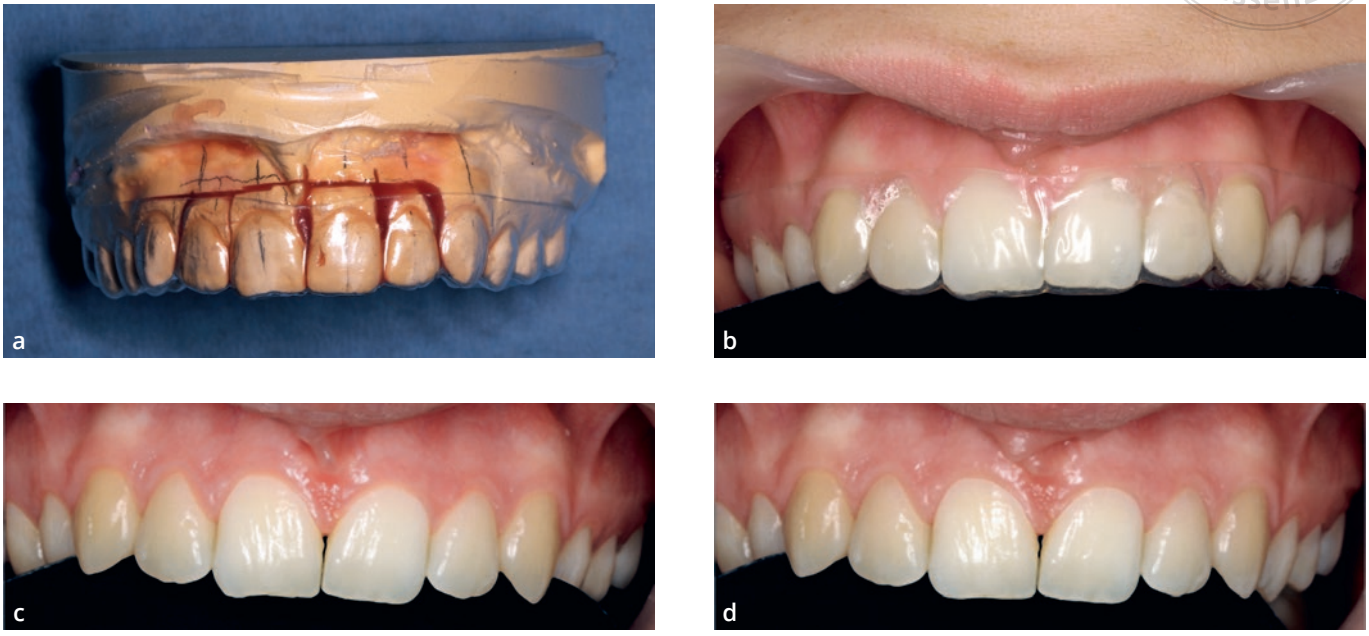
The contouring strip was used to remove the mesial enamel bulges and to contour the approximal spaces accordingly (Fig 2b). After IPR, the finishing strip and pre-polishing strips (white and yellow) were used for polishing. Finally, fluoridation was performed with Tiefenfluorid according to the manufacturer's instructions. To close the space, two silicone rings were placed over the maxillary central incisors and secured against slipping off using composite points (Beautifil Flow, Shofu, Kyoto, Japan) (Fig 2c).

At the follow-up appointment 24 hours later, most of the gap had already been closed (Fig 3). To optimise the contact surfaces between the central and lateral incisors, a silicone ring was inserted in the maxilla from the left to the right lateral incisor. A further 24 hours later, all the gaps were completely closed (Fig 4).

To correct the slightly tilted maxillary left central incisor, an aligner (silicone on the inside, acrylic on the outside) was made using a mini wax-up (Fig 5a). For the next 12 days, the patient wore the aligner for 22 hours a day (Fig 5b). Theoretically, it would also have been possible to perform angulation control with the aid of an attachment; however, this measure was not taken. Figure 5c shows the result after the total 2 weeks of treatment. The incisal edge of the maxillary right central incisor was slightly corrected using a polishing strip (Shofu) (Fig 5d). A fixed retainer (Leone, Florence, Italy) was bonded in the maxilla from the left to the right lateral incisor for retention.

## Discussion

The effectiveness of the Ortho-Strips system has been studied several times in the literature. Keck[24] investigated the amount of enamel removal achieved and the roughness of the approximal enamel surfaces after application of the Ortho-Strips system, and concluded that 50 to 70 µm enamel can be removed within 10 seconds, regardless of the contact pressure and the selected grain size. Cumula-




**Figs 5a-d** **(a)** Mini wax-up for the fabrication of an aligner to correct the maxillary left central incisor. **(b)** Aligner in situ. **(c)** Final clinical situation after the full 2 weeks of treatment. **(d)** To optimise the aesthetic appearance, the incisal edge of the maxillary right central incisor was corrected.

tive stripping of the enamel surfaces proved to be more efficient than continuous stripping, which the author attributes to a cleaning effect of the strip during setting down[24]. The roughness values achieved after application of the fine strips (40, 25, 15 and 8 µm) were < 1 µm. The roughness of a stripped enamel surface can be levelled within 5 seconds by using a strip finer than the one used previously[24].

Danesh et al[25] compared five different methods for IPR with regard to the surface roughness produced after application of the available polishing methods. The use of coarse abrasive strips or burs resulted in irregular surfaces that could not be smoothed effectively even by subsequent polishing, whereas the best results were achieved with the automatically oscillating systems Ortho-Strips, Profin LTB-75 (Dentatus, Spånga, Sweden) and O-Drive D30 (KaVo Dental, Biberach, Germany); the smoothest surfaces were achieved when Ortho-Strips and Profin LTB-75 were used for polishing[25]. Thus, the authors considered the use of oscillating systems to be advantageous.

In a comparative study, Gazzani et al[13] concluded that mechanically oscillating diamond strips demonstrate greater efficiency in IPR and require less chair time compared to manual strips. They also found that the mechanical IPR system (Ortho-Strips) tested in the study created more regular enamel surfaces compared to the manual strips (Steelcarbo strips, Horico, Berlin, Germany) tested in parallel[13].

In a recent study, Danesh et al[31] assessed and compared the quality of enamel surfaces after IPR using four different systems. They also investigated the relationship between depth of acid penetration and enamel surface quality, as well as the importance of remineralisation. Manual IPR using abrasive metal strips and use of the oscillating Ortho-Strips system resulted in smoother interproximal enamel surfaces and a lower acid penetration depth than IPR using oscillating segmental discs and a Safe-Tipped Bur Kit (Dentsply Sirona, Charlotte, NC, USA).

## Summary

In IPR, to gain space in the maxilla and mandible, the use of mechanically oscillating systems, and in particular diamond-coated abrasive strips, such as Oscident strips or the Ortho-Strips system, has proven clinically successful. By modifying the working area of the oscillating diamond strips in the Ortho-Strips System and leaving a non-diamond grain–coated zone of 0.5 mm at the upper and lower

margins, unwanted abrasion and cervical step formation can be prevented, thus significantly increasing safety when using this system.

## Declaration

The author declares that there are no conflicts of interest relating to this study.

## References


1. Koretsi V, Chatzigianni A, Sidiropoulou S. Enamel roughness and incidence of caries after interproximal enamel reduction: A systematic review. Orthod Craniofac Res 2014;17:1–13.
2. Lapenaite E, Lopatiene K. Interproximal enamel reduction as a part of orthodontic treatment. Stomatologija 2014;16:19–24.
3. Ballard ML. Asymmetry in tooth size: A factor in the etiology, diagnosis, and treatment of malocclusion. Angle Orthod 1944;14:67–71.
4. Hudson AL. A study of the effects of mesiodistal reduction of mandibular anterior teeth. Am J Orthod 1956;42:615–624.
5. Peck H, Peck S. An index for assessing tooth shape deviations as applied to the mandibular incisors. Am J Orthod 1972;61:384–401.
6. Tuverson DL. Anterior interocclusal relations. Part I. Am J Orthod 1980;78:361–370.
7. Boese LR. Fiberotomy and reproximation without lower retention, nine years in retrospect: Part II. Angle Orthod 1980;50:88–97.
8. Sheridan JJ. Air-rotor stripping. J Clin Orthod 1985;19:43–59.
9. Sheridan JJ. Air-rotor stripping update. J Clin Orthod 1987;21:781–788.
10. Zachrisson BU. Interdental papilla reconstruction in adult orthodontics. World J Orthod 2004;5:67–73.
11. Fillion D. Teil 2: Vor- und Nachteile der approximalen Schmelzreduktion. Inf Orthod Kieferorthop 1995;27:64–90.
12. Stroud JL, English J, Buschang PH. Enamel thickness of the posterior dentition: Its implications for nonextraction treatment. Angle Orthod 1998;68:141–146.
13. Gazzani F, Lione R, Pavoni C, Mampieri G, Cozza P. Comparison of the abrasive properties of two different systems for interproximal enamel reduction: Oscillating versus manual strips. BMC Oral Health 2019;19:1–7.
14. Baumgartner S, Iliadi A, Eliades T, Eliades G. An in vitro study on the effect of an oscillating stripping method on enamel roughness. Prog Orthod 2015;16:1–6.
15. Livas C, Jongsma AC, Ren Y. Enamel reduction techniques in orthodontics: A literature review. Open Dent J 2013;7:146–151.
16. Haubrich J. Praxistipp: Approximale Schmelzreduktion mit dem Ortho-Strips-System. Kieferorthopädie 2007;21:99–102.
17. Goldbecher H, Goldbecher C. Approximale Schmelzreduktion (ASR) – Routine in der Kieferorthopädie? Kieferorthopädie Nachrichten (Kompendium "Ästhetik") 2015;54–56.
18. De Felice ME, Nucci L, Fiori A, Flores-Mir C, Perillo L, Grassia V. Accuracy of interproximal enamel reduction during clear aligner treatment. Prog Orthod 2020;21:1–7.
19. Mendoza BS, Martín GH, Jiménez CC. Finishing with clear aligner appliances: A systematic review. J Aligner Orthod 2018;2:171–182.
20. La Valle M, Iaracitano B, Basilico M. Use of aligners to treat buccal bone loss. J Aligner Orthod 2020;4:311–330.
21. Lione R, Gazzani F, Pavoni C, Guarino S, Tagliaferri V, Cozza P. In vitro and in vivo evaluation of diamond-coated strips. Angle Orthod 2017;87:455–459.
22. Zingler S, Sommer A, Sen S, Saure D, Langer J, Guillon O, Lux CJ: Efficiency of powered systems for interproximal enamel reduction (IER) and enamel roughness before and after polishing–An in vitro study. Clin Oral Investig 2016;20:933–942.
23. Lombardo L, Guarneri MP, D'Amico P, et al. Orthofile®: A new approach for mechanical interproximal reduction: A scanning electron microscopic enamel evaluation. J Orofac Orthop 2014;75:203–212.
24. Keck BA. Schmelzabtrag und Rauhigkeit approximaler Schmelzflächen nach der Bearbeitung mit dem Ortho-Strips System. Zürich: Med Diss, 2000.
25. Danesh G, Hellak A, Lippold C, Ziebura T, Schafer E. Enamel surfaces following interproximal reduction with different methods. Angle Orthod 2007;77:1004–1010.
26. Hein C, Jost-Brinkmann PG, Schillai G. The enamel surface quality after interproximal stripping—a scanning electron microscopic assessment of different polishing procedures [in German]. Fortschr Kieferorthop 1990;51:327–335.
27. Radlanski RJ, Jäger A, Schwestka R, Bertzbach F. Plaque accumulations caused by interdental stripping. Am J Orthod 1988;94:416–420.
28. Radlanski RJ, Jäger A, Zimmer B, Bertzbach F. Rasterelektronenmikroskopische Untersuchung zur klinischen Anwendung des interdentalen Strippens. Fortschr Kieferorthop 1990;51:117–122.
29. Radlansk, RJ, Jäger A, Zimmer B, Schwestka R, Bertzbach F. Ergebnisse rasterelektronenmikroskopischer Untersuchungen zum interdentalen Strippen in vitro. Fortschr Kieferorthop 1989;50:276–284.
30. Hellak AF, Riepe EM, Seubert A, Korbmacher-Steiner HM. Enamel demineralization after different methods of interproximal polishing. Clin Oral Investig 2015;19:1965–1972.
31. Danesh G, Podstawa PKK, Schwartz CE, Kirschneck C, Bizhang M, Arnold WH. Depth of acid penetration and enamel surface roughness associated with different methods of interproximal enamel reduction. PLoS One 2020;15:e0229595.